Social Implications of Big Data and Fog Computing

Jeremy Horne

mindsurgeon@hotmail.com

ABSTRACT

In the last half century we have gone from storing data on 5-1/4 inch floppy diskettes to cloud and now fog computing. But one should ask why so much data is being collected. Part of the answer is simple in light of scientific projects but why is there so much data on us? Then, we ask about its "interface" through fog computing. Such questions prompt this chapter on the philosophy of big data and fog computing. After some background on definitions, origins and contemporary applications, the main discussion begins with thinking about modern data collection, management, and applications from a complexity standpoint. Big data is turned into knowledge but knowledge is extrapolated from the past and used to manage the future. Yet it is questionable whether humans have the capacity to manage contemporary technological and social complexity evidenced by our world in crisis and possibly on the brink of extinction. Such calls for a new way of studying societies from a scientific point of view. We are at the center of the observation from which big data emerge and are manipulated, the overall human project being not only to create an artificial brain with an attendant mind but a society that might be able to survive what "natural" humans cannot.

INTRODUCTION

Fog computing is another link in the chain of information storage extending back from storing data in a handwritten manner to adding machines, vacuum tubes, and floppy diskettes. One creates the information, stores it, and then distributes it. It is easy to confabulate the motivation for its instrumentation, the "why" of the foundation (big data) with how we get it (storage and distribution methods). Two aspects characterize information: its growth and centralization. Fog computing has enabled its distribution not only to computers to billions of devices in a network we know of as the "Internet of things" (IoT), ranging from printers and phones to "smart appliances", like refrigerators and personal security systems. In essence, anything that can house a computer chip is a candidate for this network. Accordingly, the scope of information has increased. In keeping with maintaining clarity between the storage of information and its rationale with its distribution, we will first look at big data in depth and its implication and then consider its mode of distribution (fog computing) in a similar light. A prefatory note about the origin of the present article is in order.

You are reading "Social Implications of Big Data and Fog Computing", which is a re-write and updating of "Visualizing Big Data from a Philosophical Perspective" that appeared in the 2018 *Handbook of Research on Big Data Storage and Visualization Techniques* (Segall and Cook, 2018, Chapt. 28, pp. 809-852). Most of the discussion was not simply of techniques but about the thinking underscoring why big data should be generated at all. Inasmuch as the current paper was invited, it can be assumed that someone "up there" thought that asking the "why" is important. The present article goes further and fits the "why" into a larger framework of how we regard societies and the challenges they are facing in an ever increasing complex environment. As to the visualization, there are just as many ways of displaying data as there are projects and methods for creating it, as will be seen below.

Most of the technical aspects of the original work have not changed, and I will leave it to others to banter back and forth on all that updated “techie stuff”. One can only imagine the further technological development that can and often has occurred during the last one or two years in which many of the sources used for researching the first article appeared. Too, the visualization aspect will be not be emphasized here, because one only need read the original article for that information. Typing in “big data visualization” and related phrases will produce hundreds, if not thousands of images, each with its own purpose and technique. This is a trivial exercise without much intellectual content. What has been lacking in all these discussions about big data is similar to what was lacking and as expressed by J. Robert Oppenheimer in the development of the atomic bomb – the social implications of the technology.

There has been another addition to the previous article in the technological aspect, however, that does strengthen the sociological observations: the further development – fog computing - that is closely analogous to a neurophysiology and the argument made in the previous article. As in societies being at least analogously organic, there is a corresponding aspect of organicity in the technology, and that is beginning to assume literally a life of its own. But, we are getting ahead of ourselves a bit.

It is likely that each one of us has encountered some aspect of big data, it often being a buzz word. With fog computing as soon as one picks up a cell phone, works on a computer, or even opens the refrigerator door s/he in effect is one of the tentacles of a gigantic organism with emergent properties that we do not seem able to predict or control. Whenever we interact with a government agency, go to school, shop or use a computer, data is collected with or without our consent. As recent as 20 May 2018 controversy is swirling about Facebook’s allowing its guard to be down so that the British company Cambridge Analytica could acquire through the popular social media outlet Facebook and mine its data to promote Donald Trump’s U.S. presidential campaign. Insofar as privacy is concerned, if the information is in cyberspace, then logically it is accessible, the only secret in existence being the deodorant. The trail from the origins of data as representations of information ages ago to its present uses and abuses is long. While we marvel at the technology, it is critical to understand why the technology was created in the first place.

There is data (big or otherwise) and then there is its use and fog computing distribution. One should fathom the implications of the first to appreciate what happens with the latter. Otherwise stated and amplified, what applies to the first applies also to the second.

This article will touch on some of the technical aspects of big data and fog computing, what is collected (as in National Security Agency's bulk data collection programme), and the limits of collecting large quantities of data. Overall, if something can be measured, data can be collected be it the length of every spider's leg, width of every tree or weight of every grain of sand. Yet, there is no dearth of facts but without organization and context there is little or no meaning. An overarching consideration is whether it should be collected at all.

Reactions to technology often are like this where people learn of the cleverness being developed, the “wow”, “awesome”, and glitz of the gadgets. Big data is no exception as in the wide eyed reaction to being told of huge data storage capacities and now the ability of persons to access that data directly or through their Internet of things (IOT) devices with fog computing. Older generations accustomed to paper based card catalog systems in libraries especially are taken aback in learning the big data of the whole of the Library of Congress in the very near future (and even now with 20 ten terabyte (TB) hard drives) can be sitting on their desk at home or on their laptop.

Facts are meaningless in themselves and they need to be connected to each other. Even if a person relates the facts to each other still there is no final coherence unless there is a framework for that coherence, i.e., a theme. There are two basic ways of remembering a situation: rote and as a series of connected events or motif. Describing the beautiful setting of the Grand Canyon including the ecology, geological history and so forth is further impressed upon us by introducing something closer and to which we can translate as a relevant experience the way someone like ourselves interacted with that environment as a story. So, one tells of a story of someone in the Grand Canyon invoking the description of all the things the narrator would like for the audience to remember - the environment, history and so forth. This is the way knowledge was passed down throughout prehistoric times by tales, proverbs, myths and other oral communications (Eliade, 1954). Here, a story is told about the development of big data, that story being analogous to a parable conveying meaning of the assemblage of descriptions about that big data.

Contemporary events may seem to be enveloping us, the proverbial tail wagging the dog. One needs to point only to global warming, exploding populations, mounting political and religious violence, and economic failures. There are luminaries who doubt the capacity of this species even to survive the next 100 years (Firth, 2015; Rees, 2008; Sheldrick, 2014; Carey, 2014). We read of events daily often noting the facts but failing to apprehend the context.

To provide meaning, one has to know what gives rise to the data in the first place including the rationale for it, how it is collected and how it is processed. Science gives the rationale for technology, theory does it for practice and overall the "why" is necessary for the "what" of anything. Besides the ways we think, the "why" of thinking is the subject of philosophy. We are also looking for an explanatory model of events that is consistent. There are immediate purposes for collecting data such as for doing scientific experiments and financial transactions but one should start wondering about the reasons large volumes of data are collected on persons. Science exists because one wants to control the future but this is done by understanding the past and such involves measurement and attendant data collection followed by analysis. Big data on us often is collected systematically and a case can be made that it is done for the same reason. Fog computing details how penetrating that data can be.

In many cases it seems that science and the technology emanating from it have been sufficient to solve problems where antibiotics in medicine, phones and computers in communications and automobiles in transportation are obvious examples. In each of these areas we can identify big data sets. There are huge research projects like the Dark Energy Survey which uses a 570 megapixel camera and the 4-meter Blanco telescope at the Cerro Tololo Inter-American Observatory in Chile (Wikipedia, 2018h). Genome sequencing, modeling chemical interactions, analysis of social systems and ecological studies are others. Meteorological agencies are attempting to capture meaning through thermodynamic models of weather systems. Then, there is big data captured in sociological analysis. Searching "sources of big data" and similar phrases on the Internet will produce hundreds of websites and images displaying various projects collecting, analyzing and displaying big data.

The capacity to collect data for all intents and purposes is limitless but its organization, analysis and application are the barriers to its utility. Humans have limitations to perform acts as in memorizing and seeing great distances and have devised tools like computers and telescopes to assist. So it is with intellectual limitations, creating devices like computers to compensate. Big data may be thought of as a tool, the organization as the way of using it. Whether humans have the native abilities (read "intelligence") to manage the complexity is debatable, a factor contributing to the explanation of why so much research is being done in Artificial Intelligence, particularly with the announcement of the Decade of the Brain (Brain Project, 2015). With its 10 billion synapses (Synapses, 2015; Herculano-Houzel, 2012), the brain and associated consciousness arguably are greatest challenges to those collecting and managing big data. Yet, in considering that we live in a society, one asks about society being an entity of its own a human unto itself. Not only must the human brain encounter challenges of an increasingly complex world but we as a species are in the same situation. Think about this while reading the following philosophical account of big data. Consider that the ultimate visualization of big data is looking at ourselves in the mirror. We will first look at "big data" first and its implications, and then we will examine its distribution and use with fog computing.

BACKGROUND OF BIG DATA AND FOG COMPUTING

What Is/Are Data?

A systematic way of understanding the concept being conveyed by a word is to analyze the meaning of the word itself. Origins and context are a good starting point. The etymology of data is:

1640s, plural of datum from Latin datum "(thing) given," neuter past participle of dare "to give" (see date (n.1)). Meaning "transmittable and storable computer information" first recorded 1946. Data processing is from 1954. (Data Etymology, 2018)

As a definition, there are these examples as the public first encounters the term:

Noun

1. A plural of datum.

2. (Used with a plural verb) individual facts, statistics or items of information:

These data represent the results of our analyses. Data are entered by terminal for immediate processing by the computer.

3. (Used with a singular verb) a body of facts; information:

Additional data is available from the president of the firm. (Data Dictionary dot com, 2018)

1**:** factual information (as measurements or statistics) used as a basis for reasoning, discussion or calculation <the *data* is plentiful and easily available — H. A. Gleason, Jr.> <comprehensive *data* on economic growth have been published — N. H. Jacoby>

2**:** information output by a sensing device or organ that includes both useful and irrelevant or redundant information and must be processed to be meaningful

3: information in numerical form that can be digitally transmitted or processed (Data Dictionary Webster, 2018)

Facts and statistics collected together for reference or analysis. See also datum. (Data Dictionary Oxford, 2018.)

From the basic definition of data and its etymology, one can make some immediate observations.

1. a single piece of information, as a fact, statistic or code; an item of data.

(Datum Dictionary dot com, 2015)

Webster's says, “noun plural but singular or plural in construction, data often attributive “ (Datum Dictionary Webster, 2015). There is “A piece of information. See also data.” (Datum Dictionary Oxford, 2015)

One should note that the technical term is “datum”, the singular of data if one is to adhere to the Latin correctly. We will refer to “data” but what is said here applies to the singular “datum”. Words common to these are fact, information and statistics. However, as we will see in a moment, the three are not synonyms for what initially is collected but results. One could take a photograph of anything and call that “data”. However, we are the ones who give it meaning such as in a fact, information or statistic. The meow of a cat, the ripples on a pond, the smell of a rose, the feel of a porcupine's quill, and the taste of a chocolate bar all are data. The five senses feed to us the reflections of the phenomena of our environment in what we may call “big data.”

The term “big data”, itself, seems to assume a childlike perspective, a first grade word, “big” being juxtaposed to a much more complex term “data” (as opposed, let's say, to complex data or large information bases). It’s coming into use only recently and in a specialized context might suggest that the term is a proper noun, i.e., the first letter of the two words is capitalized. However, common use – lower case “b” and “d” - says otherwise thus giving guidance here (Uncapitalized, Big Data, 2015). Hence, we will refer to “big data”.

It helps to place a datum in its context using a common complexity model, i.e., data, information, knowledge and wisdom (DIKW). This DIKW sets forth:

- Data – mere phenomena;
- Information – Phenomena that are processed as being intelligible or not;

- Knowledge – Information that is evaluated as to quality or integrity;
- Wisdom – Knowledge that is drawn upon to create ideas not found in the knowledge alone (DIKW Pyramid, 2018).

Figure 1. Data-Information-Knowledge-Wisdom Pyramid (Ibid.)

Data by itself is phenomena, bits being expressed as zeros and ones in the computer world. Whether it has meaning or not is the job of the information scientist winnowing out whether there is randomness (unpredictability) or patterns. That information is run through an accountability filter, the result being from epistemology (justified belief or knowledge). Synthesizing from that knowledge gives us wisdom. The subject of this chapter is multiples of datum but is it information? Data is to be processed because often what is encountered is unintelligible. Consider:

0001, 0010, 0011, 0100, 0101

and

0111010101010010 .

Both are data. There are two ways of looking at whether it makes sense. A mathematician or competent computer scientist will recognize the first sequence as binary or base two counting. The second sequence has no discernible pattern. That the first is intelligible as a pattern means that there is information. The second not having any pattern means there is no recognizable information. However, the other way of "making sense out of nonsense" is reversed, in attempting to translate the binary into words. The first does not translate into text, as it is not divisible by eight. The second does translate into "uR". In other words, whether data has meaning or not can be perspectival; it depends upon one's intent, point of view, and so forth. (As an aside, determining if something has content given a perspective – as in seeing the "uR" instead of nonsense – is meta as opposed to object level. One is talking about something rather than directly using it. For example, one may talk in English about the Spanish "mesa" as meaning "table", rather than simply saying in Spanish "poner esto sobre la mesa" – put this on the table.) While there may be information because of meaning does not say there is knowledge.

The collection of data may be by recording information electronically or even by hand. (For example, a person knowing about the census realizes that at least some of the data is collected the old fashioned way by physically writing down answers.) How to interpret the data comes under "information" - making sense of it. Whether it has any value refers to knowledge and this is largely dependent upon organization and subsequent validation.

The Origin of Data Collection

It is thought that Protagoras (c. 490 c. 420 BCE) said "Man [humans] is the measure of all things" (Wikipedia, 2018n), be it a qualitative description of phenomena or a quantitative measurement. Data collection can be as simple as making a tally mark on a stone, as was done in the Upper Paleolithic period of human development (Wikipedia, 2016) between 10,000 and 50,000 years ago. The 30,000 year-old paintings in the southern French Chauvet-Pont-d'Arc Cave (Wikipedia, 2018d) are data. Any recorded description involves data.

Measurement involves a language that conveys a concept of comparison. Comparison rests upon a fundamental law: something exists because of what it is not, a law of dialectics. One may picture her/himself in a room where everything is of the same shade and texture. There would be no way of discerning one object from another. If the lighting is changed, let us say as a single light bulb being the source of illumination, shadows will appear, each object now contrasted with the other by the shadowing. This simple discernment is comparison. Measurement can yield both the discernment and its magnitude of difference.

Data is about description, description is about comparison and comparison is about measurement. Otherwise stated, measurement, in its most basic form is about empiricism or understanding through the senses or in modern parlance, "sense data". These data are collected through sensors, our bodies having the most immediate sensors: tongue (taste), skin (tactile), eyes (sight), nose (olfactory) and ears (sound). Humans construct devices to extend the abilities of the natural sensors. Fog computing, itself, is a manifestation of how ubiquitous these sensors are.

Perhaps the simplest form of an artificial sensor is the sun dial or even a stick in the ground reflecting the position of the sun in its periodic traversing of the Earth's sky. The specific length of a shadow indicates time of day. The shadow is a piece of data, the information being that the shadow is so many centimeters long, the knowledge being that it is five o'clock in the afternoon. All of these sensors, natural and artificial, collect data, that data being processed to determine if it makes sense or contains information. Whether that information has any value requires higher cognitive faculties to evaluate it, memory, ability to compare and so forth.

To understand the world, we have come to rely on empiricism that which is gained through the senses. Science applications have yielded sensor technology where data about every motion and energy emittance can be sent to us for our devices to process. The explicit way of generating detail was verbalized by Rene Descartes (1596-1650), the modern originator of the analytical method. Descartes said, "...we cannot conceive body unless as divisible … body is by nature always divisible... (Descartes, 1641)". He set the stage for modern deduction theory and analysis thus highlighting the philosophy of the Age of Reason or Rationalism. It is subdivision, after all, that is the origin of big data.

Current Sources of Big Data and Rationale for Generating it.

Big data results from measuring complex phenomena. Broad categories are exemplified by:

- Fluid dynamic processes (weather, bodies of water, behavior of gases);

- Nuclear processes (Large Hadron Collider, simulation of nuclear explosions);
- Social interactions (economic, political, educational, sociological);
- Biological descriptions (Human Genome Project, Artificial Intelligence).

In essence, if one wants to produce data, simply subdivide the phenomena or synthesize by relating two or more pieces. Observing phenomena and collecting information on it is guided by basic parameters as in:

- The nature of pattern and randomness;
- what to look for;
- how to look for it;
- What to do with it.

The "techie stuff" concerning big data

Characteristics of big data often are listed as:

- Volume - How much of it there is;
- Variety - How much difference there is in what is collected;
- Velocity - How fast the data is coming in and processed;
- Variability - How consistent is the characteristic of the data coming in;
- Veracity - Refers to the quality of the data received;
- Complexity - The number of sources as well as the type of data received (Big Data Characteristics, 2015; Kalbandi, 2015).

"Volume" is discussed here in terms of storage. "Velocity" refers to processing speed, a topic covered here after storage. "Variety", "variability", and "complexity" correspond to organizational issues. "Veracity" is discussed in terms of the data-information-knowledge-wisdom (DIKW) hierarchy discussed above.

Four parameters may be considered as limiting big data: how much potential data there is to be collected, the storage of it, the processing speed and the management (organization, interpretation and application) of it. We now treat each of these in turn.

Collecting data is no problem, as the plethora of sensors (Tae-il, 2013) indicates, as well as our capabilities of Cartesian analysis (Descartes, 1641). Any object can be subdivided to Planck scale, 1.6 x 10^{-35} meters. At this quantum level particles "flick in and out of existence" (Hawking, 2018). To illustrate the possibility of representing every aspect of our universe, one may consider Bostrom's (2003, pp. 243-255) idea that we may be inside of a matrix, part of a computer program. Such would require modeling and managing 1080 bits corresponding to the number of particles in the universe according to one physicist (Heile, 2015) and the same as the Eddington number of protons (Wikipedia, 2018i). This quantity of data far exceeds any current ability to store it, let alone process it, although quantum computing (Wikipedia, 2018o; Khodjasteh, 2013) may provide solutions in the future. Also, it may be possible to approximate a description of the universe by representing groups of these particles. Here, it is the quality of representation and subsequent organization of data that would be the determinant in successful management. Further,

> A simulation that is undetectable by science (for instance, both astronomers and quantum physicists) would have to be very large and detailed, it would be very hard to justify its vast costs (it's easy to compute what is the physical volume of computer memory required to try to simulate a unit volume of substance-Avogadro constant is still very large in comparison to the volume of computer memory: The most powerful supercomputer in the world (in June 2015) has "only" circa 1015 bytes of memory, compared with circa 6 x 1023 - particles contained only in 12 grams of unit matter and such supercomputers nowadays still have the weight of hundreds of tons.). (Webb, 2014)

To place data storage in perspective, consider that the whole document set of the U.S. Library of Congress can be stored in 200 terabytes (TB) (Johnston, 2012). Shantanu Gupta, director of Connected Intelligent Solutions at Intel is reported as saying that:

- On YouTube, 72 hours of video are uploaded per minute, translating to a terabyte every four minutes;
- 500 terabytes of new data per day are ingested in Facebook databases;
- The CERN Large Hadron Collider generates 1 petabyte per second.
- The proposed Square Kilometer Array telescope will generate an Exabyte of data per day;
- Sensors from a Boeing jet engine create 20 terabytes of data every hour.
- (Higgenbottom, 2012)

To relate data storage quantities to each other, consider the following:

Table 1. Multiples of bytes

MULTIPLES OF BYTES					
Decimal			Binary		
Value		Metric	Value	IEC*	JDEC+
1000	kb	kilobyte	1024 KiB	kiloibyte	KB kilobyte
1000^2	MB	megabyte	1024^2 MiB	megaibyte	MB megabyte
1000^3	GB	gigabyte	1024^3 GiB	gigaibyte	GB gigabyte
1000^4	TB	terabyte	1024^4 TiB	teraibyte	ENIAC – *circa* 1948 (U.S. Army photo)
1000^5	PB	petabyte	1024^5 PiB	petaibyte	
1000^6	EB	exabyte	1024^6 EiB	exaibyte	
1000^7	ZB	zetabyte	1024^7 ZiB	zetaibyte	
1000^8	YB	yottabyte	1024^8 YiB	yottaibyte	
* International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) - https://en.wikipedia.org/wiki/ISO/IEC_80000 + The Joint Electron Device Engineering Council - https://en.wikipedia.org/wiki/JEDEC_memory_standards#Unit_prefixes_for_semiconductor_storage_capacity					

In 2010, it was estimated that storing a yottabyte on terabyte size disk drives would need one million city block size data-centers as large as the states of Delaware and Rhode Island combined (Diaz, 2010). However, the writer does not specify how tall the buildings would have to be and as will be seen shortly, the capacity of disk drives keeps growing. Too, Quantum Computing may drastically enlarge the ability to store data currently kept in separate spaces all in one place (Khodjasteh, 2013).

A further perspective on yottabyte storage capacity is:

> With recently demonstrated technology using DNA computing for storage, one yottabyte of capacity would require a volume between 0.003 and 1 cubic meter depending on number of redundant backup copies desired and the storage density: "Our genetic code packs billions of gigabytes into a single gram". DNA is much less mature technology than microSDXC cards (for this application) and accompanied by uncertain costs but this suggests potential information density. (Yottabyte, 2018)

Here and elsewhere in this article are descriptions of technological capacities, such as the size of storage devices, figures which have been increasing as advances are made. Accordingly, little attempt has been made to obtain new figures since the publication of the previous article, as it is those figures not only are sufficient to make the point of the arguments but are now even more reinforced by those advancements.

As of this writing (March 2018), for a desktop personal computer (PC) one can purchase across the counter in retail consumer outlets a four Terabyte (TB) hard disk drive (HDD) for under $100. In September 2014, a desktop PC 10 TB HDD appeared (Hard Drive Capacity, 2015). In 2018 the capacity had increased to 12 TB and for under $800. One TB thumb, or flash drives were available at the end of 2015 (Thumb Drive Capacity, 2015). While the prices started out high, as with the current lower storage capacity ones, price drops could be expected, given the downward trend in prices in other technologies. This all says nothing about solid state drives with vastly reduced access times. These are desktops and laptops that the ordinary consumer can purchase. Data storage does not seem to be much of a problem. What, then, about processing speed?

A four-time winner, Tianhe-2, a supercomputer developed by China's National University of Defense Technology, once more took home the title as the world's fastest computer with a performance of 33.86 petaflops (quadrillions of calculations per second) on the Linpack benchmark. To reach that remarkable number, Tianhe-2 uses over 3 million Intel Xeon E5-2692v2 12C cores running at 2.2GHz. It's not the speed of the processor you see in modern-day supercomputers that's important; it's how you get all those processors to work in concert with each other. In addition, its main processors are backed up by Intel Xeon Phi 31S1P coprocessors. (Tianhe, 2015)

Then, "President Obama has signed an executive order calling for the US to build the world's fastest computer by 2025 (Baraniuk, 2015). The supercomputer would be 20 times quicker than the current leading machine which is in China (Supercomputers, 2015).

In terms of cloud storage, the sky is the limit. One only needs the hardware and connectivity. With many free email services being given, 15 gigabytes of storage is routine. Then, there are dozens of data storage services such as Dropbox, Trend Micro, and Google (Wikipedia, 2018e; Wikipedia, 2018f). Of course there are pros and cons of such methods, but data storage capacity itself is not an issue, at least for home use and most scientific projects.

Organization of the data is the bottleneck. However, organization is somewhat simplified if one knows the purpose for which the data is sought. Once an organizational scheme is identified, then the sophisticated and often abstract aspects can be presented visually. That a "picture is worth a thousand words" works quite well if that picture is that of the purpose.

Visualizing Big Data and a Research Excursion in pattern Recognition

Pictorializing big data is for our benefit. A picture is worth a thousand words. The display of the data itself or a picture representing it may give us some insight into the data's meaning that verbal descriptions may not be able to do. For examples, one need do an Internet search for "big data visualization" and similar phrases, selecting "images for" to see the myriads of ways of presenting big data displays. There are just as many images as there are algorithms to generate them, given an Internet search under "Visualization of big data" and similar phrases represented by the examples above. Many times visualization techniques are just as much of an art as they are a technical methodology. One visual presentation of what otherwise would be incomprehensible in formulas and words may not make any sense to one person but may be enlightening to another.

How might the data be visualized? It has been said that, as in statistics, there are two basic forms of presentation: to the specialist in the area and to the public. There are processed and unprocessed data where less refinement is required for the specialist. In each area of inquiry, different project teams may collect and process data with different methods.

Particularly relevant to this discussion is open data where:

> Thanks to open data we now have services such as App&Town: an application that acts as a guide from your point of departure to your destination using Barcelona's metropolitan transport services. The app offers the best routes and indicates where the nearest stop or station is as well as advising when you have to get on or off; or how about CityBikes, which provides information

about the city's Biking system. As a useful aid for the health sector mention should be made of SOS info: an application that shows information about the user (allergies, illnesses, emergency contact details, etc.) and the location of the nearest emergency services. (Spelling in original) (Ibid., 2015)

An additional method of visualizing data is with context diagrams showing the interrelation of components in a system (Wikipedia, 2018g). These often convey a crisp and clear meaning about what the data means as opposed to tables of data about voters wanting something from their representatives or figures showing what happens inside the system (as in traffic patterns, revenue, numbers of students per school, etc.).

Now, we get to the deep structure of data and begin our trip of pattern recognition.

It needs to be stated at the outset that bivalency is used to designate the on and off switch conditions in computer architectures. No inherent meaning exists in the way computer scientists design these architectures or the machine language software they manage. Nor is there any particular significance in the zeros and ones in themselves as any symbol could be used to represent the on and off conditions. The bivalent logic that computers use to generate data of any size is a language of a basic order in the universe (Horne, 1997). Here, the logic is specifically applied to how the concept of magnitude is regarded, in this case a base two counting, most commonly expressed by the zeros and ones. Sets of zeros and ones are arranged according to rules or instruction sets, each computer chip architecture having a different way of configuring these. Machine code instruction sets are unique to each processor or processor family, the instructions themselves being physical designs of bit arrangements that represent machine commands. This means that the instruction set belongs to a particular processor class but using generally the same type of architecture (Machine Code, 2018) rather than from any natural ordering, as in binary counting.

With any digitized phenomenon, including large bodies of data, recursion might be used as a method for detecting patterns not otherwise revealed by mathematical analysis or visualization. The Wuensche and Wolfram designs above result from repeatedly and randomly concatenating binary operators, a type of recursion. Recursion here means that the outputs of a binary formula are fed back in as inputs until the function reappears as an output (Horne, 2006).

There is a natural binary space that emerges from fundamental dyadic computations of base two (Horne, 2006). Contained in a display of zeros and ones, as above, are sets of four representing binary functions where p and q are placeholders for the permutation of zeros and ones, shown in Table 1.

Table 2. Table of Functional Completeness (Horne, 2006)

p	**q**	**f_0**	**f_1**	**f_2**	**f_3**	**f_4**	**f_5**	**f_6**	**f_7**	**f_8**	**f_9**	**f_{10}**	**f_{11}**	**f_{12}**	**f_{13}**	**f_{14}**	**f_{15}**
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

A logician, mathematician, and computer science student will recognize that this table shows a binary counting from left to right, reading the columns downwards: 0000, 0001, 0010, etc., functions f0, f1, f2, f3, onward to the right. Any display of zeros and ones will contain complete or partial sets of functions from the TOLS as in (using the arbitrarily selected color code):

0001001010100111010100

1110100101011101010100

010101000110101111100010 10...

… rendered in terms of functions as:

f1f2f10f7f5000

f14f9f5f13f50

f5f4f6f11f14f210....

Not only is each of these functions recursive, but any function over any other two functions, f*(fn,fp) is recursive as well because there can be only a maximum of 16 iterations (only 16 unique functions) on any branch before there is a repetition of one of the previous (Horne, 2006). Otherwise stated, even if there are 16 unique outputs on a branch, there is repetition on the 17 iteration, i.e., no function can have more than sixteen iterations. This is reflected by a three-dimensional hypercube displaying all 4096 dyadic relations (Horne, 2012). Of 16 panels, there is, for example, f_{13} - ⊃, p contains q, p ⊃ q, – defines deduction shown by Table2.

Table 3. Panel 13, f_{13}, p⊃ q (Horne, 2012)

f_{13}	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
f_0	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}
f_1	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}
f_2	f_{13}	f_{13}	f_{15}	f_{15}	f_{13}	f_{13}	f_{15}	f_{15}	f_{13}	f_{13}	f_{15}	f_{15}	f_{13}	f_{13}	f_{15}	f_{15}
f_3	f_{12}	f_{13}	f_{14}	f_{15}	f_{12}	f_{13}	f_{14}	f_{15}	f_{12}	f_{13}	f_{14}	f_{15}	f_{12}	f_{13}	f_{14}	f_{15}
f_4	f_{11}	f_{11}	f_{11}	f_{11}	f_{15}	f_{15}	f_{15}	f_{15}	f_{11}	f_{11}	f_{11}	f_{11}	f_{15}	f_{15}	f_{15}	f_{15}
f_5	f_{10}	f_{11}	f_{10}	f_{11}	f_{14}	f_{15}	f_{14}	f_{15}	f_{10}	f_{11}	f_{10}	f_{11}	f_{14}	f_{15}	f_{14}	f_{15}
f_6	f_9	f_9	f_{11}	f_{11}	f_{13}	f_{13}	f_{15}	f_{15}	f_9	f_9	f_{11}	f_{11}	f_{13}	f_{13}	f_{15}	f_{15}
f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
f_8	f_7	f_7	f_7	f_7	f_7	f_7	f_7	f_7	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}	f_{15}
f_9	f_6	f_7	f_6	f_7	f_6	f_7	f_6	f_7	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}	f_{14}	f_{15}
f_{10}	f_5	f_5	f_7	f_7	f_5	f_5	f_7	f_7	f_{13}	f_{13}	f_{15}	f_{15}	f_{13}	f_{13}	f_{15}	f_{15}
f_{11}	f_4	f_5	f_6	f_7	f_4	f_5	f_6	f_7	f_{12}	f_{13}	f_{14}	f_{15}	f_{12}	f_{13}	f_{14}	f_{15}
f_{12}	f_3	f_3	f_3	f_3	f_7	f_7	f_7	f_7	f_{11}	f_{11}	f_{11}	f_{11}	f_{15}	f_{15}	f_{15}	f_{15}
f_{13}	f_2	f_3	f_2	f_3	f_6	f_7	f_6	f_7	f_{10}	f_{11}	f_{10}	f_{11}	f_{14}	f_{15}	f_{14}	f_{15}
f_{14}	f_1	f_1	f_3	f_3	f_5	f_5	f_7	f_7	f_9	f_9	f_{11}	f_{11}	f_{13}	f_{13}	f_{15}	f_{15}
f_{15}	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}

The recursion method is shown in Table 3 with the diagram for Function 9 in Figure 7.

Table 4. Recursion method (Horne, 2006)

For the p side:	For the q side:
F*(fp, fq) = fa	F*(fp, fq) = fa
F*(fa, fq) = fb	F*(fp, fa) = fb
BaraniukF*(fb, fq) = fc	F*(fp, fb) = fc
….	….
	Max F*(fp, fq [illegible] 16) before there is repetition

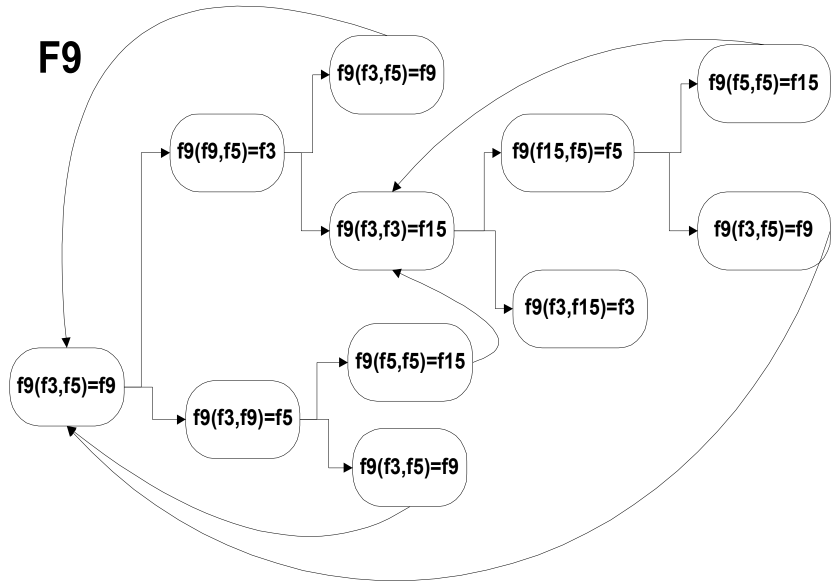


Figure 2. . Recursion diagram for f_9

We said that just because there does not appear artistically to be a pattern, it doesn't mean that there is not one as the example above illustrates. In terms of visualization, reducing binary strings to functions may assist in detecting patterns. For example, we have the traditional truth table rendering of (p & q) ’ [(r = s) v (p ’ r)] in Table 4.

Table 5. Traditional truth table (partial) (Horne, 2012)

p	**q**	**r**	**s**	**(p**	**&**	**q)**	**→**	**[(r**	**≡**	**s)**	**v**	**(p**	**→**	**r)]**
0	0	0	0	0	0	0	1	0	1	0	1	0	1	0
0	0	0	1	0	0	0	1	0	0	1	1	0	1	0
0	0	1	0	0	0	0	1	1	0	0	1	0	1	1
0	0	1	1	0	0	0	1	1	1	1	1	0	1	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1	1	0	0	1	1	1	1	0	1	0	1	1	0	0
1	1	0	1	1	1	1	0	0	0	1	0	1	0	0
1	1	1	0	1	1	1	1	1	0	0	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

This is reduced to a table of functions (Table 5), making it easier to discern regularities.

Table 6. Truth table in terms of functions (Horne, 2012)

					1		3		1		2		1	
p	q	r	s	(p	&	q)	→	[(r	≡	s)	v	(p	→	r)]
					f_1				f_9		f_7		f_{13}	
f_0	f_0	f_3	f_5	f_0	f_0	f_0	f_{15}	f_3	f_9	f_5	f_{15}	f_0	f_{15}	f_3
f_0	f_{15}	f_3	f_5	f_0	f_0	f_{15}	f_{15}	f_3	f_9	f_5	f_{15}	f_0	f_{15}	f_3
f_{15}	f_0	f_3	f_5	f_{15}	f_0	f_0	f_{15}	f_3	f_9	f_5	f_{11}	f_{15}	f_3	f_3
f_{15}	f_{15}	f_3	f_5	f_{15}	f_{15}	f_{15}	f_{11}	f_3	f_9	f_5	f_{11}	f_{15}	f_3	f_3

In Table 6, without the distraction of the detail of the 0s and 1s, one may discern repetitions of functions. Again, the configurations do not <u>necessarily</u> convey any deeper meaning than that there is a regularity. One, however, should ask what "generates it" and moreover, "why", beyond the simple fact a formula exists. That is, what generates the formula?

Latent or unexpected arrangements and processes may exist inside data displays. What results is "emergence", something that cannot be explained by the properties of the individuals used to create the results (Emergence, 2018). All digitized data is in its most basic form bits (zeros and ones). Usually, data storage is according to predefined categories used to collect it. The more vague and coarsely grained the categories, however, the less context and often the less value. Displays of large data sets as zeros and ones may reveal patterns whereas other forms of analysis may not. This works in at least two ways, the first being the existence of patterns in a binary display but no known ordering (or categorization of data) principle and the second where the ordering principle is not known but there results a pattern which then tells the person that principle.

For example, there is a pattern, a regularity, in the following images in Figure 5 and Figure 6, generated by randomly concatenating dyadic binary formula but no meaning is obvious beyond that, the issue being that apparent randomness can spawn order.

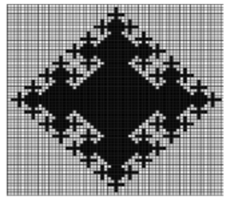


Figure 3. Regularity in cellular automata (Wolfram, 2002)

…and

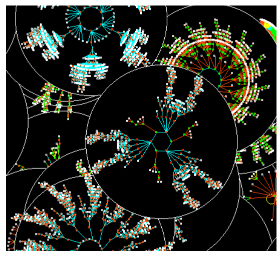


Figure 4. Pattern from concatenating dyadic formula randomly (Wuensche, 1993)

These patterns of Wuensche (1993) and Wolfram (2002) may not represent or convey any meaning by themselves as in a display of machine code (Wikipedia, 2018k) of zeros and ones. Rather, the art results from a naturalness. East Asian philosophies have mandalas and koans, objects and expressions upon which persons can meditate to gain meaning and perhaps these images may be included. Overcoming randomness is through pattern recognition and such allows us (or so we think) to manage the future. As has just been seen, though, regularity does not compel us to repeat it, only to know that an order exists. Above, the regularity in the visualization seems to challenge the supposed randomness used to generate the images. Tautologically, knowledge of order is foundational to answering why it exists.

The second example of discerning a pattern in a binary display and extrapolating the algorithm is exploratory research representative of visualization that may explain data ordering where initial analysis may not. In a more purposeful fashion, most modern computers generating and managing big data use machine language, an example of which is:

01101100 01100101 01100011 01110100 01110010 01101111 01101110 01101001 01100011 00100000
01101101 01100101 01100100 01101001 01100001 00100000 01110100 01101000 01100101 01110010
01100101 00100000 01100011 01100001 01101110 00100000 01100010 01100101 00100000 01110110
01100101 01110010 01111001 00100000 01101100 01101001 01110100 01110100 01101100 01100101
00100000 01110000 01110010 01101001 01110110 01100001 01100011 01111001 00100000 01100001
01101110 01111001 01110111 01100001 01111001 00101110

To a person unfamiliar with binary code, this display would be meaningless, but its meaning is translated as, "With an electronic media there can be very little privacy anyway" (Binary Translator, 2018).

On the heels of this statement two aspects need to be considered about what is found inside data, other than the ostensible information they may convey. First is a pattern inside the zeros and ones that may emerge despite attempts to mask their ostensible messages. The second is to illustrate that wherever there are zeros and ones there is the opportunity to introduce other information, as in malware.

What is fog computing?

This author loves standardization, and the U.S. National Institute of Standards and technology (NIST) is working on a definition, as expressed in its August 2017 "The NIST Definition of Fog Computing" (NIST, 2017, p. 2):

> Fog computing is a horizontal, physical or virtual resource paradigm that resides between smart end-devices and traditional cloud or data centers. This paradigm supports vertically-isolated, latency-sensitive applications by providing ubiquitous, scalable, layered, federated, and distributed computing, storage, and network connectivity.

Let us compare NIST's diagram of fog computing to human anatomy.

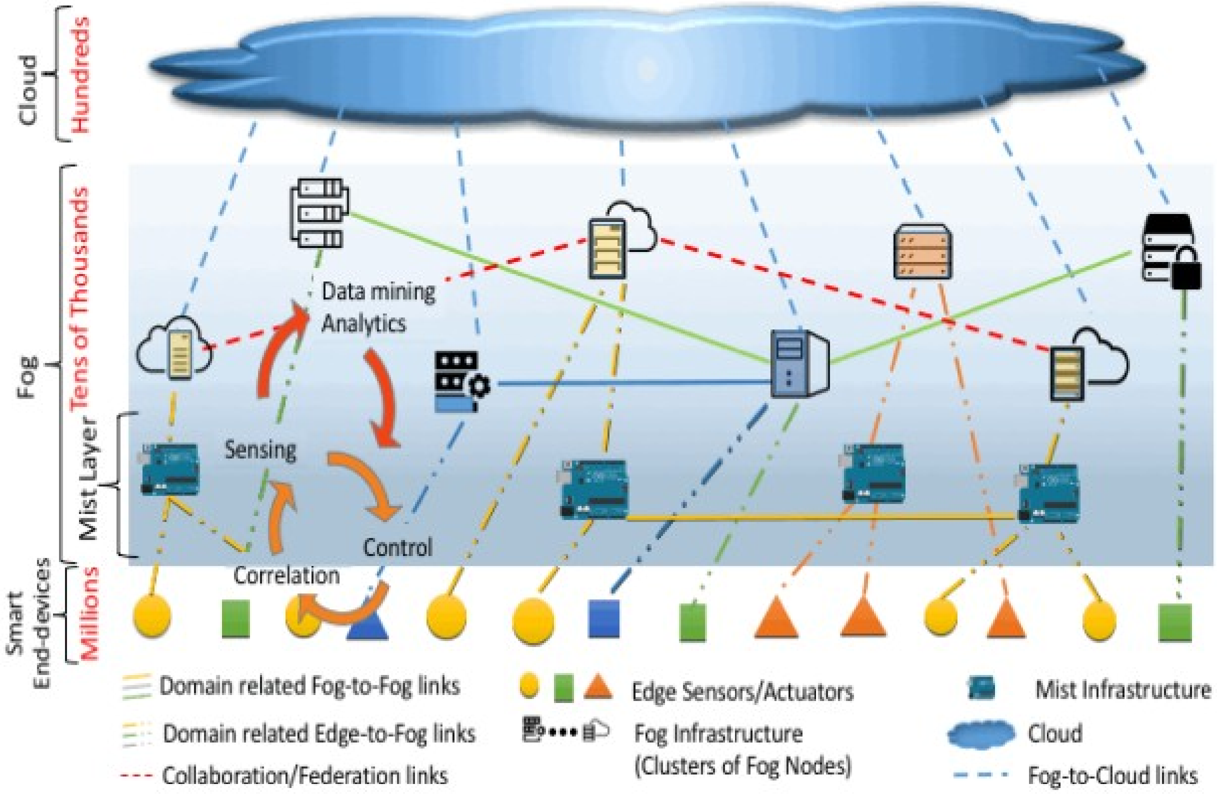
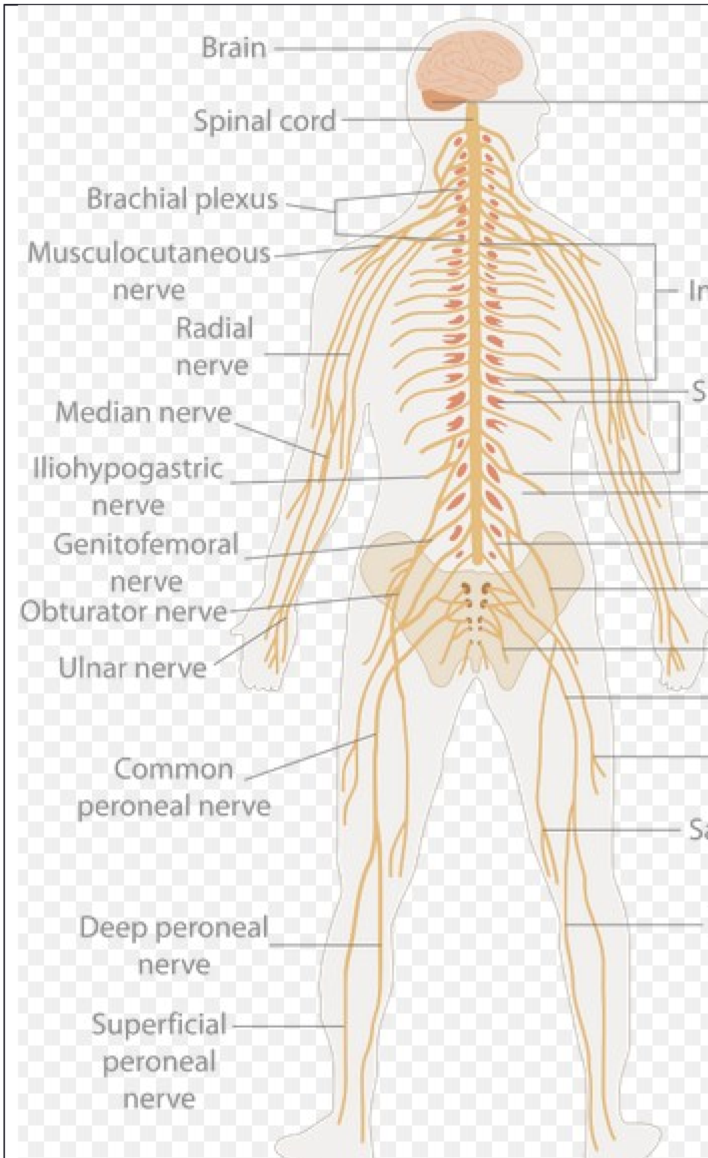
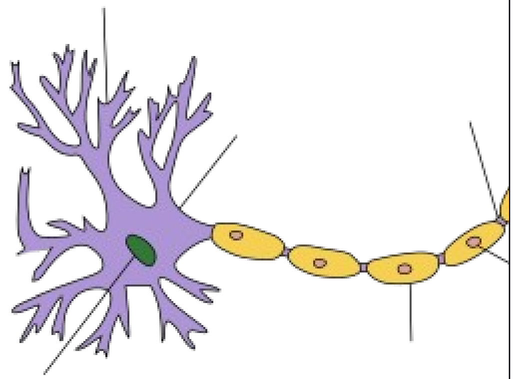


Figure 5. Cloud computing configuration (NIST, 2007, p. 8)

The cloud might be considered the human body, with the "fog" underneath it the various organs, and the "smart-end-devices" the neurons. Here, the NIST diagram might be a misleading, as big data can and usually is stored in computers, with the devices feeding in an receiving big data. There seems to be a transformation, where big data is being shifted to the cloud, with the computers being its manipulators. Of course, the "elephant in the room" question is where the big data is being stored in the BIST model, other than the "cloud". Of course, the answer is in computers, albeit especially configured.

Still the hierarchy of number applies, there being many more neurons than nerves, and many more nerves than organs, and so forth. The overall discussion does not change, in that there are what analogously are data reception, transmission, and manipulation devices (cell phones, IoT, etc.) and a passage from these to a central area (cloud, huge data banks, etc.), the whole configuration effectively acting not unlike a huge organism that potentially could develop a life of its own.

We will see all of this in a social context later, but for now the comparison should be obvious, with all the attendant implications of self-organization, as the discussion about Wolfram, Wuensche, and emergence above indicated. Cloud computing might be regarded as a brain in the Internet overall, or at least that part of the Internet brain responsible for memory..

	
TE-Nervous system diagram (Own Work, 2010)	**Neuron (Quasar Jarosz, 2009)**

THE IMPORTANCE OF BIG DATA AND FOG COMPUTING

Big data concerns us for several reasons. The quantity of phenomena is so large that it makes the job of organizing, interpreting, and controlling it enormous, our frustrations often being reported in terms of "too much information" (TMI) or "information glut". One's ability to process it is complicated further if there is more potentially extraneous data. Then the "fingers" of control with fog computing ultimately manipulated by those generating and applying big data are more ubiquitous than ever, the end-users of data weighing convenience against privacy.

There are many relatively neutral projects where huge amounts of data result but to which there is little direct relation to us as in data from surveying the universe. Closer to us, there is information more of a personal concern. Each time one makes a purchase, data is collected, mainly the details about the transaction amount, date, store and item purchased. Beyond that there are other data about the person making the transaction, web data collection forms being a primary example. We are asked about who is making the purchase, why, income, age, sex and so forth. Marketers and advertisers particularly are interested in a buyer's profile for repeat business. Universities collect data on students and faculty and government do on the citizens/subjects in order to manage them.

The importance of what is to be identified comes first. Then, is how to collect it. The quality of collection is next. Organization is next. Then, we need to interpret whether collected data is information or not, as in the DUIKW pyramid discussed previously. These areas may overlap as in identifying the pieces before organizing them. We now come to the eye of the storm, humanity, itself. The philosophy underpinning big data can be discussed as concerning that apart from us as in scientific studies or what persons collect when we, ourselves, are observed. There are individuals and there is the society in which they live; big data exist for both. Philosophy is about asking "why".

Two aspects emerge. The first is about how we relate not only to big data, itself, but how we relate to those who are using it. Besides the privacy issues are social policy analysis and application in achieving ends which may not be agreeable to us, increased complexity of cataloguing use and access, and security. The second aspect is about the organic character of big data and how its development and evolution may track the development evolution of societies. Society may have a collective brain with its memory, so the collection of big data can be regarded as a memory to be accessed and used by artificial intelligence or consciousness. First, though, let us look at what is being collected now as big data and then we can discuss the future in terms of societal development.

The Social Source of Data

Data results from a record keeping, the purpose of which is to understand how to manage the future based on the past. This method is an outgrowth of the millennial-old playing of games but in a more formalized manner. For example, assessing a person's throwing capability by itself may not have much value but there is more meaning when viewed as the person having to compete with warriors with different capabilities. The data is a record of that person's capability. The individual is viewed in a systemic context, the society benefiting from a positive battle outcome. Further on down, the nature of social systems will be discussed, but for now a system is viewed as a collection of elements related by having a common purpose and interacting with an environment so as to be able to survive or adapt.

From various projects emerge big data but one should ask what produces the projects. Big data often is associated either with just itself as in an often inchoate mass of bits to be processed into information and organized or big data is associated with large-scale undertakings such as designing medicines or analyzing thermodynamics, but these do not simply happen. Organizations initiate them; more precisely, persons individually or collectively with motivations having enough influence in the organizations initiate them. In attempting to describe the future behavior of a society researchers will describe it with a model, much in the same manner a toy airplane "describe" a real one.

Researchers instantiate a model with various hypothetical factors and events to observe possible outcomes. As an example, one speaks of ecological systems. A particular one, as that in any country, is a model. The climate, vegetation, fauna and so forth are identified as elements. One then gives these variables a special condition, as there being a specific type of animal, tree or crop and studies their interactions in a simulation. Another example is that of a city where aspects such as traffic flow, electrical power management and communications management in themselves require big data sets. However, each of these is a subsystem within the framework of a larger one, the city. Here, all the data is collected, processed, interpreted, and disseminated within the larger context of a large dynamic system (the city), analogous to an organism composed of numerous subsystems all working together, a key word here being "organism". The simulation occurs by inserting specific examples of vehicles in a traffic flow, number of megawatts of power being supplied and how many phone calls are being made at a specific time.

One often cannot predict from big data sets precisely what will happen. This means that an outcome cannot be explained by what the pieces are doing or their properties individually. This is called "emergence" (Vintiadis , 2018). In essence a collection of entities with a purpose (a system) seems to assume an activity or life of its own. Such is what appears to be "organic behavior" in big data in the form of the Internet.

Networked computers are subject to compromise when there are one or more deleterious factors involved, malware (Wikipedia, 2018L) being the prime example. Over the years a medical or organic model has been used to address the problem as the "virus" and "anti-virus" terminology illustrates. So too the Internet has assumed a character that can be considered "organic" as a search for "Internet as organism" will show. In a way similar to how big data being generated in drug trials (simulated and real), a simulation may show what effect a specific piece of malware would have on the Internet at a specific time.

A simple Gedanken, or thought, exercise will place data collection about us in perspective. If there is a phenomenon, it can be detected either naturally or with some aid as in a sensor. This is no less true for ourselves in every organ, cell, movement or behavior as we above with the cellular-scale sensors that can be integrated with body tissue (Tae-il, 2013). One can subdivide to the quantum level and organisms including *Homo sapiens sapiens* (the correct and technical name for human beings) are not exempt. There are numerous projects that collect and manage big data and these in themselves are feats that impress technophiles but a larger picture emerges when they are seen as articulating as an organic whole. Who would care, were it not for the controversies over data collection and privacy, most of which focus on one's privilege to protect identity and prevent control by others? We are our own commanders, and the more someone else knows about us the greater potential they have to rob our identities, extort us and even replicate us making the individual superfluous.

Again, we need to be asking throughout, what drives big data? It is not simply about describing an individual in her/his entirety even the brain and consciousness. There are large data sets generated by easily identifiable projects, but, overall, we have that background question about the coalescence of large data sets. It may be argued successfully that the full power of the State rests upon the ability to collect, manage, and analyze data and the ability to exert its power (ultimately in a physical manner). We will discuss more formally later the nature and role of the State.

One should notice this discussion has progressed from talking about big data emanating from systems without human involvement, such as thermodynamic systems, quantum-cosmological phenomena (CERN [originally Conseil Européen pour la Recherche Nucléaire]), the Sloan Digital Survey) and ecological research to systems in which humanity plays an increasingly involved role or ones it has created outright as in the uninhabited autonomous systems (UAS), brain research, and human genome projects. It is humans - the creator and observer - to whom data and its management are important, and surely big data is created in these arenas, arguably the largest data sets of all.

Outside the development by governments are non-governmental big data projects that are just as sophisticated in replicating human behavior. Aside from the above references to artificial intelligence and non-hydrocarbon replication of the human brain are modeling and simulation projects of society, itself and for which research data can be obtained. Two prominent examples are *Simulated Society* (SimSoc), started in 1966 and the recent *Second Life* created in 2003. A visitation to these sites (easily accessible by an Internet search with these terms) will illustrate how far we have gone in creating an electronic world in which persons can interact to such a realistic extent that they will go so far as real world trading in currency (as in Linden Dollars for Second Life) and artifacts used in the simulation. We are on the edge of technological advancement not only in the realm of virtual reality but venturing into three-dimensional virtual worlds, where human consciousness could not only be altered but permanently affected and possibly merged into a larger world. In these social simulations it is instructive to observe not only the extent of big data generated but how the virtual and real world might cross over into each other by data manipulation.

Let us look at several examples of how big data is collected on our mentation (intelligence, emotions, psyche, behavior, mind, consciousness, etc.), our daily activities, and various social interactions with respect to the military.

Big Data about Ourselves and Psyche

To understand the conceptual framework for assessing the scope, purpose and ultimate meaning of big data as applied to our personal lives, we need to discuss its context, both historical and current. A central goal of modern scientific endeavor is to extrapolate from the past so as to be able to project to the future so as to be able to manage it. The more we know about objects and processes in our environment, the greater potential we have for managing the future. Immediate concerns over data collection on ourselves focus on privacy but a larger context shapes long term outcomes of other having data on us. Here, each piece of datum is mapped on to an aspect of our lives. Precisely why would anyone want to do this?

Aside from the everyday data collection at supermarkets by various governments, educational institutions and corporations, we have seen data collection on ourselves in a detailed way but another concerns the way we interact with society.

Perhaps it is natural for a person to react in some way - often by surprise and wonderment - when particular attention is paid, as when someone is taking a picture unexpectedly. Answering a few questions in an initial social exchange is to be expected. "Where are you from? What do you do?", etc. However, in this initial and casual exchange, anxiety heightens the more interrogation proceeds. In exchanges with organizations, a certain amount of data is anticipated to be collected, but again, the more that is collected the greater concern there is about motivation.

In the government area, official business is recorded from the military, driver's licenses, taxes and so forth. For schools, there is student data that can be in detail ranging from name and address to psychological profiles and detailed financial information.

With each encounter with a person or organization arises an opportunity for measurements to be taken of every aspect. Stand back, observe these and other sources of data, and consider collecting all of this data under one roof, thus allowing storage of a complete description of a person's past, present and probable future. So far, we have seen examples of projects that each unto themselves can generate big data, but there is one project beyond that encompassing all of the above and more. Each of us has both a physical and mental health collected by doctors and hospitals and big data reflects this. Going beyond a doctor's visit, physiological data now can be collected at the cellular level, where micron-sized sensors can be integrated with tissue (Tae-il, 2013), these sensors also being a part of fog computing.

In the not so distant future, the health of each any every cell hypothetically might be monitored in a manner analogous to how numerous intelligent communications devices report on their own health (how data is collected, managed and applied) such as smart phones. Fog computing is designed to manage this level of data collection and management granularity. We are on a curious road of complexity that may lead us in unanticipated directions. Thermodynamic and other physical systems present degrees of uncertainties and ranges of possible configurations and behavior that tax even the most advanced of contemporary supercomputers (Tianhe, 2015). Yet, the most complex of all is our brain and associated consciousness.

What follows is not an argument that the research described can be accomplished successfully but that we need to pay attention to what is driving it. The former may be fiction but the latter is fact. In the past decade, a number of projects have arisen to replicate the human brain, some of them being Blue Brain, Riken Brain Science Institute work and SyNAPSE (Blue Brain, 2015; Riken, 2015; IBM SYNAPSE, 2015; Human Brain Project, 2013). Ray Kurzweil (2015), leader of the Singularity Movement (Singularity, 2015) and Artificial Intelligence advocate categorically states that success along these lines is a distinct possibility. An appreciation for the scope and depth of research on replicating human mentation ("consciousness", intelligence, memory, etc.) may be gained by reflecting on a sample of available literature on the subject in “Steps toward Memory Preservation v1.6” (2018). Reading the bibliography is an eye-opening research exercise.

A description of physiology is easy compared to that of consciousness associated with the human brain (Toward a Science of Consciousness, 2018). The psychological domain has not been precise until more recently when diagnostic and treatment models became more medically oriented. Today, getting diagnosed and treated more often than not starts with a psychiatrist, a medical doctor specializing in the managing of mental problems. For many years the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) has been used to identify persons with abnormal deleterious mental conditions or disorders (DSM, 2015). However, it is clear that a person emerging from a psychiatrist's office with an evaluation based on the DSM of being mentally healthy can and does engage in violent behavior. That is, nothing in the application of DSM criteria guarantees these people will or will not act violently. One reason is that there is no clearly defined validation mechanism for the DSM. Human behavior until recently has been described primarily by a subjective evaluation of behaviorists relying on observing how a person acts and her/his reports of interactions with the environment. There is no set of clearly defined and uniformly applied metrics to observable conditions; diagnosis is behaviorally based. The DSM is merely a checklist of phenomena to be recorded and judged from professional training and experience. Even though the American Psychiatric Association is transitioning the DSM to the United Nations World Health Organization's International Classification of Diseases (ICD) (ICD, 2015) and even though it may be a more detailed description of a disorder, the same remarks about the DSM apply to it as well.

In 2008, the U.S. National Institutes of Mental Health (NIMH) initiated its Research Domain Criteria (RDoC) project to arrive at diagnosing mental conditions based on an integrated approach including neuroimaging and genetics (RODC, 2018). In NIMH’s word:

> RDoC is a research framework for new ways of studying mental disorders. It integrates many levels of information (from genomics to self-report) to better understand basic dimensions of functioning underlying the full range of human behavior from normal to abnormal. The RDoC framework consists of a matrix where the rows represent specified functional constructs (concepts representing a specified functional dimension of behavior) characterized in aggregate by the genes, molecules, circuits, etc. used to measure it. Constructs are in turn grouped into higher-level domains of functioning, reflecting contemporary knowledge about major systems of emotion, cognition, motivation and social behavior. (Ibid., 2018)

Cognitive neuroscience is a rapidly developing field in which various parts of the brain are found to be responsible for specific behaviors (Brain Behavior, 2015; Wimmer, 2012; Gazzaniga et al, 2009; Kanai, 2011; Dawes and Fowler, 2009; Miller, 2012; Cope, 2014). To replicate the human mind requires at least an accurate and complete description of it as in the Research Domain Criteria project and the BRAIN Initiative (Brain Initiative, 2015). Neuroimaging is here and data collection underpins it. What to do with it shapes what data will be collected and how it is organized. Data collected on us now and of which we have concern about privacy is that reflecting our behaviors. Information on how one acts now can be significant in predicting how the person will act in the future.

There has been advanced a more formidable rationale for wanting to know how a person may act especially in light of increased worldwide terrorism and crime. The Broad Agency Announcement (BAA) BAA 11-65 calls for “New approaches for understanding and predicting the behavior of individuals and groups especially those that elucidate the neurobiological basis of behavior and decision making and the neurobiology of moral judgment, development, and action.” Factors motivating the DARPA search include (as stated in BAA 11-65) the need to understand:

- Attitude and habit formation particularly when uniquely influenced by or highly plastic in response to virtual interactions;
- Measuring human propensity to engage in violence against out-group members;
- Mechanisms important to mobilization into violent social movements and groups;

- Pathologies resulting in warfighter accidents, misjudgments and maladaptive behavior. (Broad Agency Announcement 11-65, 2015)

The BAA 11-65 was a first step in researching how that behavior might be preempted. Ultimately, the contract was awarded to Fast Mathematical Algorithms & Hardware.

> FMA&H will enable scalability to massive data of their basic analytic database processing system therefore addressing all components of their system. The scalability of their system will be tested and measured on several databases. The first tests will be on hyperspectral imagery where each pixel is a point in 256 dimensions and we have several megapixels. An outcome of the organization is an image segmentation coupled with a related spectral feature sets, integrated with the data morphology, to be achieved automatically with the data viewed as a generic database of size 10 (power of 6) X 256. Other tests will be performed and evaluated for efficiency on massive genetic databases as well as document elections (BAA 11-65 Award, 2015).

Ethical systems are predicated upon what their creators consider what should and should not be done in society. These "shoulds" and "oughts" are translated into the day-by-day standards of behavior, the moral code. Usually, ethical systems are predicated upon value systems or an ethos. These systems may be regarded from either the creator's perspective or the one expected to abide by the system. This consideration is even starker in discussing the ethics of social control. Attempts have been made to produce automated human behavior evaluation software such as Effects Based Assessment Support System (EBASS, 2015) and SENTURION (2015).

That the U.S. Taxpayers are funding research on how they may be controlled, evidenced by BAA W911NF-17-S-0002 (2017), where the Army Contracting Command of the Army Research Laboratory (ARL) is calling for research to

> …to support Strategic Land Power Dominance for the Army of 2030 and beyond. … Proposals are expected to be for cutting-edge innovative research that could produce discoveries that would have a significant impact on enabling new and improve d Army operational capabilities and related technologies. (Ibid., p. 1)…The Social and Cognitive Networks programs …supports projects that contribute substantive knowledge to theories about human behavior and interaction and make methodological advancements in modeling and analyzing social network structures (Ibid., p. 54) … Integrated Intelligence, Theory of Mind, and Collective Intelligence (ibid., p55) … identifying and modeling the coevolutionary multiscale dynamics of human neural, cognitive, physical and social systems. (Ibid., p. 60) … develop new theories to understand the dynamic interrelationships between individual/group cognition, decision-making and the role that these influences play on interactions with large and small social systems" (Ibid., p.61).

The U.S. intelligence apparatus has been busy, as well in focusing on the biological aspects of human behavior. Under the Officer of the Director of National Intelligence is The Intelligence Advanced Research Projects Activity (IARPA), inviting researchers to participate in programs, such as:

- **MICrONS** seeks to revolutionize machine learning by reverse-engineering the algorithms of the brain
- The focus of the **ICArUS** Program is to understand and model how humans engage in the sensemaking process, both during optimal and suboptimal (biased) performance. Of particular interest are cognitive biases related to attention, memory, and decision making.
- The goal of the KRNS Program is to develop and rigorously evaluate theories that explain how the human brain represents conceptual knowledge. In part the evaluation will rest on how well concepts can be interpreted from neural activity patterns using algorithms derived from the theories. In addition to new theories and algorithms, **KRNS** seeks the development of innovative protocols for evoking and measuring concept-related neural activity using

neural imaging methods such as (but not limited to) functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG).

- The **MOSAIC** program seeks innovative approaches to unobtrusive, passive, and persistent measurement to predict an individual's job performance.
- IARPA's **Janus** program aims to dramatically improve the current performance of face recognition tools by fusing the rich spatial, temporal, and contextual information available from the multiple views captured by today's "media in the wild".
- The **HFC** program seeks proposals for research to develop and test hybrid geopolitical forecasting systems. These systems will integrate human and machine forecasting components to create maximally accurate, flexible, and scalable forecasting capabilities.

(IARPA Research Programs, 2018)

The RDOC by the NIMH, BAAs, IARPA, and ethical behavior assessment programmes might be considered a primary investigatory phase of describing how the brain functions. It is said that describing a problem is half the solution. This would be the ultimate of control but control requiring enormous ability to collect data. The technological aspects pale in comparison to the ethical issues. While major scientists encourage research into artificial consciousness, they have warnings.

Each of the above projects – both non-governmental and governmental – is an example of reaction where the investigators respond to how persons and their minds behave. It remains how one can forestall behavior by creating the mind itself.

In January 2015, Nick Bostrom joined the late Stephen Hawking, Max Tegmark, Elon Musk, Lord Martin Rees, Jaan Tallinn among others in signing the Future of Life Institute's open letter warning of the potential dangers associated with artificial intelligence. The signatories "...believe that research on how to make AI systems robust and beneficial is both important and timely and that there are concrete research directions that can be pursued today" (AI Warning, 2015).

There are two directions in collecting data on neuroimaging: individual brains and collective ones. Sociologists like Gustav Le Bon (1896) continued the tradition in arguing that groups of individuals have a collective psyche, one not being the same as an individual. In a true Cartesian approach (Descartes, 1641), one attempts to understand the whole by breaking it down into its constituent parts. If society is an organism, then, we begin by identifying its components: members within it. As the method goes, by understanding how the individuals work, conclusions may be drawn about the whole in an inductive or probabilistic fashion.

Big Data Collected by the NSA on US

Two main US surveillance institutions are the National Security Agency (NSA) and the Department of Defense. Other spy agencies exist, such as the Central Intelligence Agency and Federal Bureau of Investigation, but it can be assumed that if information sharing is not seamless across the full spectrum of the US surveillance network, efforts are ongoing to make this happen (National Infrastructure Advisory Council, 2012). Indeed, a special website dubbed "Intel.gov" refers to "…a multi-agency community" (U.S. Intelligence Community, 2018). The controversial Cybersecurity Information Sharing Act of 2015, S.754 (S.754, 2015, pp. 31-34 2015), was signed into law by U.S. President Obama on 18 December 2015. Companies no longer have to make anonymous data they give to the U.S. Government concerning "cyber threat indicators", which the critics argue are not described in the legislation. If one wants to get somewhat facetious, they could argue that since every major computer operating system has vulnerabilities (National Vulnerability Database, 2015), then there is a "cyber threat indicator" every time someone gets on a computer. Whatever we communicate over the Internet may be deemed a "threat indicator" with all information being monitored by a federal agency. The U.S. Department of Homeland Security says, "Protecting the country from ever-evolving, transnational threats requires a strengthened homeland security enterprise that shares information across traditional organizational boundaries" (U.S.

Department of Homeland Security - If, 2018) . It is intriguing to note that the DHS phrase "If you see something, say something" is formally registered trademark (®) with the U.S. Patent and Trademark Office (U.S. Department of Homeland Security – Information, 2018). How can anyone miss the parallel between dictatorial spy agencies like the Gestapo and Stalin's NKVD encouraging citizens spying on each other?

Representative of the potential if not the actuality of governments collecting data on their populations is the U.S. National Security Agency (NSA) Utah Data Center (formally called "Intelligence Community Comprehensive National Cybersecurity Initiative Data Center") at Camp Williams near Bluffdale, Utah, between Utah Lake and Great Salt Lake. When one searches for "Utah Data Center" a web page entitled "Domestic Surveillance Directorate" appears with a mock-up but realistic insignia to the left (Utah Data Center, 2018), the astute observer of history being reminded of the vast repositories on information kept by the Gestapo, KGB and Stazi.

A number of verifiable facts are presented, peppered with links to some official U.S. Government website, as well as a major link entitled, "IC off the Record" (2018) with its banner headline, "Truth is coming and cannot be stopped". To the left of "Utah Data Center" page are numerous links to legitimate sources, such as news releases, descriptions, articles, and so forth. At the very bottom of this very official-looking page is

> This is a **parody** of nsa.gov and has not been approved, endorsed, or authorized by the National Security Agency or by any other U.S. Government agency. Much of this content was derived from news media, privacy groups, and government websites. Links to these sites are posted on the left-sidebars of each page.

However, the imitation is more real than one might think ostensibly. What is not a joke is The U.S. Army Corps of Engineers "project specifics":

- 65 Mega Watts Technical Load to the Raised Floor
- Average load density: 650 watts/square feet (sf)
- Maximum load density: 1600 watts/sf
- 100,000 sf of Raised Floor in 4 Data Halls
- Tier III Data Center Standard, Concurrently Maintainable
- Flexible Cooling to Data Hall IT Rooms: Water and Air
- Air: 250 watts/sf
- Water: 1600 watts/sf
- Clean Agent Fire Suppression for Data Halls
- Redundant Utilities, 100% Generator & UPS Backup
- Mechanical & Electrical Support Structures
- 2 Substations
- Goal LEED Silver, Other Green Technologies Stressed
- Water usage at full load is approx 1.7 million gal/day
- Thermal energy storage tanks
- 3 days of fuel storage
- Piping distribution will be primary and secondary
- Secondary pumps will be on UPS
- Cooling towers shall be Cooling Technology Institute
- (CTI) certified or built

(Ferguson, Lange, and Capenos, 2009, pp. 10-11)

"Tier III" is a classification created by The Uptime Institute, and recognized as a computer industry standard. It means "Concurrently Maintainable data center has redundant capacity components and multiple independent distribution paths serving the critical environment. For the electrical power backbone and mechanical distribution path, only one distribution path is required to serve the critical environment at any time" (Uptime Institute, 2018, p. 6, Section 2.3).

	Tier I	Tier II	Tier III	Tier IV
Minimum Capacity Components to Support the IT Load	N	N+1	N+1	N After any Failure
Distribution Paths - Electrical Power Backbone	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Critical Power Distribution	1	1	2 Simultaneously Active	2 Simultaneously Active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling	No	No	No	Yes

Figure 6. Tier requirements summary (Ibid., p. 9)

Some other actual facts about the very real Utah Data Center are its:

- Million and a half square feet overall "about a third larger than the U.S. Capitol and the House and Senate office buildings" ()
- Yottabyte capacity storage (one thousand trillion gigabytes of data)
- $1.2 billion cost
- 200 acres
- 900,000 square feet of technical support and administrative space.**" (**Building size, of course, is not the only factor in considering data storage capabilities; it is what can be placed inside. What is important concerns the ability to store massive amounts of data in such a small space. To illustrate, an average 15 x 15 foot room eight feet high is 259,200 cubic inches, each inch representing the size of a thumb drive. Above was described some of the latest advances in technology, where there now are two terabyte thumb drives. At this point, one can allow the imagination to do the rest in wondering how much data can fit in to a few hundred rooms of this size given what was said above about data storage capabilities. To conceptualize proportions, the NSA Utah Data Center mission critical area may contain 444 of these 15 x 15 foot rooms (100,000 square feet/225). (UTC data, 2018)

One can perseverate on the Utah Data Center indeed existing and be amazed over the physical construction, but the question is "why", outside the propagandistic reasons of "national security", etc. To uncritically believe NSA's 2013 press release:

> Many unfounded allegations have been made about the planned activities of the Utah Data Center. One of the biggest misconceptions about NSA is that we are unlawfully listening in on, or reading emails of, U.S. citizens. This is simply not the case."(Reuters Staff, 2013)

would be the height of naiveté, in light of the ongoing provisions of the Patriot Act, DHS, and what the Electronic Frontier Foundation has to say, all of which can be learned through the Internet and by what has been said to this point.

One also should reflect on the scope of the "Officer of *the* Director of National Intelligence (emphasis in original)(DNI, 2018). This is left as a research exercise.

As somewhat of a sidebar, to read the original Fed Biz Opps (Federal Business Opportunities) solicitation W912DR-10-R-0015 one accessing the listings even to read the contents of the solicitations and awardees has to be a registered contractor (Fed Biz Opps, 2018).

Big data collected by the military

Aside from the vast empire of the Department of Homeland Security lies the U.S. Department of Defense (DoD). We have discussed its Broad Agency Announcements calling for research on human behavior, but it also has been focusing on modeling and simulation (MSCO, 2015), or automated war, an outgrowth of which is Network-Central Systems, referred to commonly as "Net-Centric Warfare" (Wikipedia, 2018m). As an affirmation of what already has been said about systems and modeling and simulation as the generator of big data sets, the following is presented from the U.S. DoD Modeling and Simulation Coordination Office, *Modeling and Simulation Body of Knowledge* (MSBOK, 2015):

> A system is a collection of components organized to accomplish a specific function or set of functions. System types are: (1) units; (2) weapons; (3) platforms; (4) sensors; (5) life support and (6) Command, Control, Communications, Computers and Intelligence (C4I). Systems are further categorized by operating environment which is divided into five areas: (1) individual; (2) air; (3) sea; (4) space and (5) ground. (Ibid., p. 6)
>
> A model is a physical, mathematical or otherwise logical representation of a system, entity, phenomenon or process. (Ibid., 2015, p. 6)
>
> Human representation refers to the use of a computer-based model within a simulation that mimics either the action of a single human or the collective action of a team of humans. Human behavior representation can model any of the complicated facets of human behavior including ability to reason, ability to change the environment, reaction to comfort and discomfort, susceptibility to injury and illness, emotional responses, communication with others, ability to sense the environment and physical capabilities and limitations. (Ibid., p. 6)

A substantial rationale for identifying systems, creating models of them and testing them through simulations is to obviate the large costs of creating and seeing how they work in real life. The DoD's reasoning also is that, "The need for taking people out of dull, dirty and dangerous missions is a primary motivator for UAST [Uninhabited Autonomous Systems Test]" (UAST, 2015, p. 5). With UAST in mind, we now are ready to consider the larger context of big data, also focusing on the word "intelligence" in all of its forms – natural, artificial, and the very words like "intelligence gathering", "Director of National Intelligence", and out of its office, "Intelligence Advanced Research Projects Activity" (IARPA, 2018).

The Relationship Between Big Data and Societies

To summarize our discussion to this point, one wants ultimately to get knowledge about their environment. Beforehand, data needs to be collected and made sense of by converting it to information. Such information needs to be evaluated as to quality to produce knowledge. Then, the information is vetted and accessed *vis a vis* the repositories to the recipients with fog computing. In order to do any of this, one needs an organizational framework that comes through analysis or subdivision of the environment into constituent parts that are interactive, processing the environment and producing outputs which in turn feed back into the environment and its participants all in the form of what formally is regarded as a system. A system operates in an environment such as medical, social or educational. A particular system is a model. To study how a model acts, one identifies hypothetical situations or examples and observes how the model behaves, i.e., simulates a situation.

All of this is a formal way of generating big data. Yet, we have been discussing big data as an object – its size, who collects it, and even why it might be collected. NSA collects data to "...monitor, strengthen and protect the nation." IARPA collects it to understand human behavior better and possibly control it. Modeling and simulation projects (SimSoc and Second Life) allow people to live out their fantasies in a virtual world, and government projects want to see what happens when variables are manipulated so as to at least think about prescriptions for societies.

So, back to the fact that prompted this discussion about systems in the first place, one should be reminded about the nature of the entity that would want to do this. We can put the gamers aside and focus on those thinking about real-world uses and applications, i.e., governments. Governments are focal points for social decision-making, and it can be argued that societies, themselves are organisms. This next section traces the development and nature of modern societies, those same societies that are generating big data, that data reflecting more about the nature of the society generating it. Rather than having been more passive up to this point – social institutions collecting and using big data – that big data is part of a larger scope involving the very nature of these societies and what they do. More explicitly and in finding a common denominator of big data collection, that collection centers about the nature of thinking, mind, intelligence, consciousness, and so forth and finding ways of directing, shaping, or even re-creating it.

Following is a model for discussing the "why" of data in context. In essence big data is analogous to a memory and in the computer world that data is stored electronically. However, so goes the organization of society, so follows technological structure. One may think of a snake skin or animal armor; as the creature grows, so does its outer surface. Hence, we should examine the societal analog of memory and data storage, but to do so we need to identify the locus. In the organism, it is in the neurological structure, the more complicated loci being the brain.

Parallel to the emerging structure of data generation, storage, and distribution is the organization of society. Such organization is not only mechanical but is dynamic, as the parts of a body have their mechanical aspects, but each being an integral part of the whole corpus that embodies them. However to study these entities requires an approach, a discipline, better situated than the current political or social sciences.

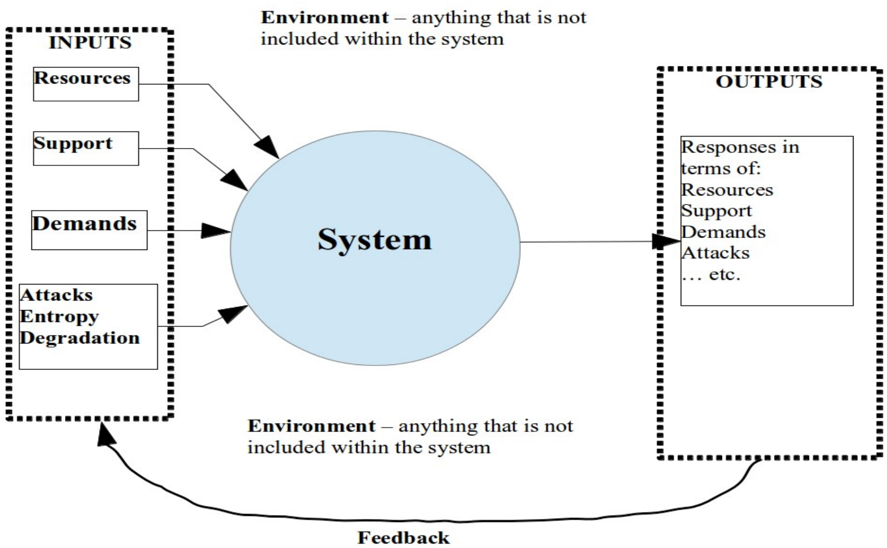
What is this to be a science about? It is not enough to say "a study of power", "politics", or "societies". What is about these things that would warrant the word "science"? Extrapolating from the past to project to the future as the foundation of science is not done very well by those purporting to be social or political scientists. This section sets forth a framework for making sense of how big data relates to a science of societies. Treating societies as organisms – dynamic entities – will help us better answer questions like "How could an institution such as the NSA, come about, despite the long history and tradition of mistrusting 'the government'?". Data is collected not as a recreation but for a specific and usually scientific purpose: discerning patterns from the past and present so as to be able to predict and manage the future. The NSA data is about us and the society and unless we see its collection in the context of the political, the society, it won't make much sense. It is time for those studying social and political science to realize this in a modern way. Let's start by looking at the foundation of societies, focusing upon their being special dynamic systems, in particular, organic ones.

How Societies are Organized

Late in the 1960s and mid-1970s, cybernetics was applied to social phenomena as systems analysis. Organizational behavior is predicated upon the dynamics of structures as systems. A system is a collection of elements in which each element bears a relationship to the other and the collection of elements has a purpose (Buckley, 1968, p. 430; Callaos, 1994, p. 3). In perspective, on a larger scale, examining the behavior of a collection of systems and systems of systems is in the realm of complexity studies and at this level big data becomes explosive. The explicit rationale for the systems analysis method as opposed to any others is that it follows directly from basic logic which is inherently a bootstrapping method. Logical proof allows one to posit assumptions within a set of definitions, rules and so forth and draw conclusions. Otherwise put, various elements are arranged according to a scheme-a system-where there are defined inputs, outputs and various processes. The theoretical underpinnings of a system applied to a particular set of circumstances produces a model, that model being tested with instantiations with simulation.

As Social Contract philosophers (e.g.: Hobbes and Rousseau) discussed societies as organisms starting in the 17th century, modern systems analysis identifies social components collected into functioning entities living in environments, intaking, outputting, and processing factors, either maintaining themselves or adapting (Buckley, 1968; Wikipedia, 2018r). For example, we may consider a general systems as a framework into which data can be related, i.e., a form of data visualization, a context diagram, Figure 7.

Figure 7. A context diagram of a generalized system



[Courtesy of the author, Jeremy Horne – drawn especially for this chapter]

The system takes demands and supports as inputs and processes the outputs as decisions and actions, which are processed by the environment and fed back to the system. Outputs, decisions and actions of authorities (Buckley, 1968, p. 434) are consequences of the behavior of system members. How the system processes inputs is a function of its ability to adapt. A political system must be able to allocate values and be able to have members accept those allocations of values. Stress and tolerance for it determines system viability. A cybernetic approach to systems theory in political science refers to an organism (system) having a behavior, a condition requiring consciousness, mind and psychology. Indeed, the expression "body politic" alludes to this. The word "corporation", a basic social unit, is about the "corpus", or body. It may be argued that, while there is no *homunculus* (as in an entity coordinating or being the center of consciousness), there is a center of organization, i.e., decision-making bodies, as in the three branches of government – legislative – executive – judicial (analogous to the brain of a body), where each of the other system's constituents (as in the electorate) have no sense of the organism's overall motion, direction or organizational-level consciousness. Such would explain why that long tradition of individualism and mistrust of government does not translate into coherent widespread opposition to institutions like the NSA. Somewhat analogous is a muscle exhibiting pain upon exercise directed by the brain, but the muscle, itself, is powerless to countermand the directive, except by breaking down.

A key feature of systems as observed by Ross Ashby (1954) is that most are dynamic because they have to be adaptive to survive. How does an ecosystem fare with the arctic as a model simulated by polar bears affected by climate change? Note that one may change the granularity of analysis by studying the population of polar bears as the system modeled by their being in a specific location and this model being simulated with a particular month. There is minimally a primitive organicity or organic character to a system, each part of the system articulating in concert with another to achieve the overall aim of survivability, adaptability or improvement.

The Nature of Organicity

All organic things are systems, but not all systems are organic. It is the "organic" aspect of societies that helps us place big data in better perspective. Yet, the question is begged: "what is organic?" An organism is seen as a dynamic entity that depends for its existence on parts that interact with each other and cannot exist independently of that entity. Note that "organicity" (having the characteristics of an organism) has to do nothing with the material out of which an organism may be made, be it a hydrocarbon or not. “Organic” rests upon the concept of what “life” means, and this question by no means has been finally resolved. However, and for our purposes and pulled from myriads of sources the following commonly are listed as criteria:

- Life has complex patterns.
- A living thing has metabolism (processing inputs as food to provide sustenance to sustain itself)
- Something living can interact dynamically with the environment
- Killable
- Able to maintain itself (or even adapt) despite environmental changes or even modify the environment.
- All the parts depend upon each other for their existence.
- The entity is able to reproduce itself.

Searching for Erwin Schrödinger, Carl Sagan, John Casti, and Alan Turing, among others, will enrichen the discussion, this being left as a research exercise. By no means is there any universal agreement about clear-cut lines between what life is and what it is not (Trovonov, 2012; Weber, 2018). Now, let’s couple systems and organicity to discuss the highest form of social evolution: the State.

The State and its Models

Plato thought in his Republic that the society is an organism carefully describing how each part should be qualified and function.

> However, in founding the city we are not looking to the exceptional happiness of any one group among us but as far as possible, that of the city as a whole. (Plato, 420b, 1968) Have we any greater evil for a city than what splits it and makes it many instead of one? Or a greater good than what binds it together and makes it one? (Republic 462A, 1968)

Thomas Hobbes' Leviathan (a Biblical sea monster) writes in the Introduction of ”Nature (the art whereby God hath made and governs the world),” and from this of societies not only being organic but artificial:

> Nature (the art whereby God hath made and governs the world) is by the art of man, as in many other things, so in this also imitated, that it can make an Artificial Animal. ... Art goes yet further, imitating that Rationall and most excellent works of Nature, Man. For by Art is created that great LEVIATHAN called a COMMON-WEALTH, or STATE, (in latine CIVITAS) which is but an Artificiall Man; though of greater stature and strength than the Naturall, for whose protection and defence it was intended; and in which the Sovereignty is an Artificiall Soul as giving life and motion to the whole body; The Magistrates and other Officers of Judicature and Execution, artificiall Joynts; & …. (Hobbes, 1651, Introduction; spelling and emphasis in the original)

Rousseau thought of human societies being organic as well:

> At once, in place of the individual personality of each contracting party, this act of association creates a moral and collective body composed of as many members as the assembly contains votes and receiving from this act its unity, its common identity, its life and its will. This public person, so formed by the union of all other persons, formerly took the name of city,1 and now takes that of Republic or body politic; it is called by its members State when passive, Sovereign when active and Power when compared with others like itself. Those who are associated in it take collectively the name of people and severally are called citizens, as sharing in the sovereign power and subjects as being under the laws of the State. (Rousseau, 1761, p. 44)

Perhaps by far the greatest development of a coherent idea of the State was Georg Wilhelm Friedrich Hegel (Hegel, G.W.F., 1833/1896/2001) in his *Grundlinien der Philosophie des Rechts, (Philosophy of Right)* (“§” references are section numbers locatable in any edition).

> The state is the realized ethical idea or ethical spirit. It is the will which manifests itself, makes itself clear and visible, substantiates itself. It is the will which thinks and knows itself, and carries out what it knows, and in so far as it knows. (§257, p. 128)
>
> [The State has] a higher authority, in regard to which the laws and interests of the family and community are subject and dependent. On the other side, however, the state is the indwelling end of these things, and is strong in its union of the universal end with the particular interests of individuals. Thus, just so far as people have duties to fulfil towards it, they have also rights" (§261)
>
> ...Political disposition is given definite content by the different phases of the organism of the state. This organism is the development of the idea into its differences, which are objectively actualized. These differences are the different functions, affairs, and activities of state. By means of them the universal uninterruptedly produces itself, by a process which is a necessary one, since these various offices proceed from the nature of the conception, …(§ 269 , p. 136)

After Hegel and then Darwin, the Victorian period, represented by Herbert Spencer descrying the social state (Spencer, 1896, p. 608, et. seq.) and Émile Durkheim (Durkheim, 18982, p. 123), as in his reference to social organism, and "For what else essentially constitutes the body social if it is not the social space) (Ibid., p. 203)", brought forward more the view of society as organic and evolving with a collective consciousness, just like one of Darwin's organisms (Organic Theory of the State, 2015).

Most relevant is Durkheim's (1858 – 1917) (1893/1984, p. 77) saying:

> All the functions of society are social, just as all the functions of an organism are organic (Ibid., p. 81).
>
> [C]o-operative relationships do not carry with them any other form of sanctions. Indeed, special tasks, by their very nature, are exempt from the effects of the collective consciousness. This is because if something is to be the object of shared sentiments, the first condition is that it should be shared, that is, present in every consciousness, and that each individual may be able to conceive of it from a single, identical viewpoint (Ibid., p. 82).
>
> In the end this law plays a part analogous in society to that of the nervous system in the organism. That system, in effect, has the task of regulating the various bodily functions in such a way that they work harmoniously together. Thus it expresses in a very natural way the degree of concentration that the organism has reached as a result of the physiological division of labour.
>
> Yet if from this comparison it is legitimate to induce, with some degree of probability, that economic functions are not of a kind to be placed under the immediate influence of the s**ocial 'brain',** it does not follow that they can be isolated from all regulatory influence. (Ibid., p. 164) (emphasis added).

We will return to the "social brain" later, but suffice it to say that these smatterings of writing about society being more coherent than a loose assemblage of entities and at least analogously a living being illustrate more profound thinking than most politicos realize. Suffice it to say, we rarely see any philosophy of society like this in mainstream public debate. It is a worthy research exercise and learning experience to read these (and many more) thinkers who proposed that societies are organic. Phrases like "society as organism", "superorganism", "organic societies" and related phrases will open up a new world to those accustomed to the prevalent thinking that social arrangement are just mechanical ones. For example, regarding society as an organism implies that human being are integrated and interdependent, the more harmonious the greater chance of survival and growth.   Indeed, the organizational model of governments and economic units is the corporation. A recent U.S. Supreme Court ruling (Citizens United vs. Federal Election Commission, 2015) concluded what had been assumed under this model, corporations are persons, complete organic units. Sociological data collection, like that in other systems areas, concerns describing organic entities and their components including us.

Characteristic of the social organism

Whether this direction towards a central authority collecting so much detailed data on us has a nefarious purpose is not immediately material. The effort is coherent and the effect of the coalescence of these events/factors shaping that collection may result in the same as if it were intentional. For argumentation's sake and to make this controversial (a nature of philosophical inquiry) discussion more dynamic, one may consider what the most elite of policy makers potentially may think about, an argument in behalf of the Devil. Such a discussion technique follows an accepted scientific methodology of attempting to disprove the null hypothesis (Popper, 1959) or that in logic of the indirect proof, the common denominator of each being the attempt to develop a contradiction. What might policy makers contemplating social control from an elitist perspective – hypothetical or intentional-consider in their collection of big data and its management? Let us look at what they are facing and why the organic model makes the most sense in identifying and solving social problems.

Challenges to the State as Organism

Set before societies is unreservedly an existential challenge to which traditional responses most likely will not be adequate. Much has been written about increasing adverse complexity brought about by exploding populations, global warming, environmental degradation, and greater technology (Homer-Dixon, 2007; Tainter, 2003). Because of these as major factors, coupled with others, scientists are now discussing the "Sixth Great Extinction", the question of whether *homo sapiens sapiens* will even be around as a subspecies in a hundred or so years. A cursory search under "sixth great extinction", or "Holocene extinction" will display hundreds of entries, many of them peer-reviewed scientific articles on the subject; these are recommended reading (eg: Ceballos, 2015). Organizations like the World Wildlife Fund, Post-Carbon Institute, The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and National Geographic Society have numerous pieces on the subject, those being retrievable by a simple search in their websites. So goes the species, so goes its organization(s).

This species cannot wait for the wheels of participatory decision making with all its infighting to meet the challenge (Kintisch, 2015). It is incumbent on anyone valuing the continuation of this human species and its environment to research the Sixth Great Extinction and think how a social consciousness resting upon the bedrock of big data might address. That there does not exist the State is reflected by governments meaningfully and totally assuming ownership of problems that are existential in nature. Let us focus on some. This discussion is needed to help provide a larger context within which big data is collected and used, each problem having its own data set. The nature of the society in which we live is a major determinant of that collection of data, its applications, and how we relate to that use.

Even with populations exhibiting passion for their fellow members of this species, indifference, tolerance of events, desensitization and gradualism (Lifton, 1986) allow mass suffering and death. There is a growing burnout of social caregivers that contributes to social paralysis in front of danger (Pace, 2014).

Given that so many people are getting on line with very affordable computers and intelligent communications devices, security has become such a highly complex issue that there may not be any real protection but only management of an attack that is seen as inevitable. Protective measures are chimeras not unlike whack a mole. As soon as one barrier is erected, the monster is inside the compound again. This problem is exacerbated because people not only have access to the computer but they are increasingly dependent upon its integrity in their daily lives. Millions of persons use antiquated software that was deficient to begin with and they do not do basic maintenance mainly because of being ignorant (Microsoft, 2015). Society, itself - education, commerce, government, etc. - also depend upon that integrity for basic functioning.

That computer security is a growing threat to communications stability (Computer Security, 2018; U.S. Cert, 2018; Sans, 2018; CERT, 2015; Wikipedia, 2018L; SC Magazine, 2018), may be symptomatic of a larger problem of how a growing population responds to material (read "economic") challenges. A prison guard knows all too well what an inmate can do with limited resources in fabricating contraband (Contraband, 2018). We now are witnessing what a population can do unfettered and with the same sociopathic mentality. While the one percent of the U.S. Population being sociopathic (NIMH-sociopathy, 2018) seems to be a low figure, it translates into 3.2 million persons (U.S. Census, 2015). This says nothing of at least 11 million others under severe mental duress (NIMH Results, 2018).

Given this mentality and a question of whether a large part of the population lacking ethics (Cattermole, 2010; Jordan, 2015; Ceballos, 2015; National Geographic, 2006) or intelligence (as in the IQ bell curve), we see more extremist movements and gangs that seem to be capable of meeting the consequences of alienation (Weber, 1992). It may be argued persuasively that the lack of employment, recreational facilities, social organizations or other institutions that traditionally have socialized individuals has been a main contributing factor to the social entropy (DeAngelis, 2009). Increasing millions are under psychological duress (NIMH Results, 2018) as the 353 incidents of multiple shootings (alone) would seem to indicate (Multiple Shootings, 2018).

More controversially is the question whether this subspecies has the intelligence and will enough to manage the onrushing complexity so as to save itself from extinction. Allowing the average to make critical decisions could be fatal. Considering this means critically regarding perhaps the most cherished myths of modern times, that of "democracy".

Despite all the talk about "democracy" and its being the rationale for so many modern wars, the backdrop of Plato and Aristotle has persisted throughout time. Plato in his *Republic* and Aristotle in *Politics* argued throughout that a participatory society (referring then explicitly to democracy) cannot last without a substantial educated middle class. One might add that the electorate needs to be ethical and be willing to participate in decision making. The classic argument is that the uneducated poor will easily be swayed by demagogues, be more prone to settle problems through violence (not having the capacity to think critically), and be susceptible to financial rewards in return for support. Persons not having a basic knowledge (Alsop, 2014), of even the geography where the contemporary affairs occur (let alone the affairs, themselves) will not be able to select their representatives intelligently. A knowledge of basic world events aside, more egregious is that one in four of Americans thinks the Sun goes around the Earth and only half realize that antibiotics are ineffective against viruses (National Science Foundation, 2014). It may be asked, "How can leaders and policy makers be selected intelligently those who will be faced with complexities far exceeding knowledge equal to that of an eighth grade student?" Recent world events seem to illustrate that social upheavals against dictatorships rarely culminate in participatory governments, the Middle East after the so-called Arab Spring being a case in point. There is enough "big data" to substantiate the thesis that violent approaches to problem solving are positively correlated with ignorance and low critical thinking skills. However, one must be intelligent to be educated and use those skills.

While substantial literature exists on multiple intelligences (Wikipedia, 2018t; Gardner, 1993; Gardner, 2004), one may ask whether the average person (average IQ) can understand today's complexities let alone manage them successfully (IQ, 2018). A persistent argument exists (Wikipedia, 2018b) that if society is composed largely of persons of average or lower than average intelligence, as reflected in a popular book, *The Bell Curve*, policy should be made only by intellectual elites (Hernstein, 1994). It is beyond the scope of this chapter to delve into the IQ debate but suffice it to say, reams of peer-reviewed literature have appeared on the subject as an Internet search under "IQ" and similar terms will indicate. There is ongoing argumentation about whether there has been a peak in the percentage of persons attaining quality education. In 1983, The Carnegie-Mellon Institute issued *A Nation at Risk* (National Commission, 1983), describing a National security risk existing because of the generally poor educational attainment of the US population. In the middle of the second decade of the 21st century, matters have not changed significantly. According to the U.S. Department of Education in 2013 – 30 years later-only 39% of high school students were academically prepared for college in mathematics and 38% in reading (DOE Statistics, 2013). If data from organizations like the Literacy Project Foundation are credible, concern is raised about 50% of U.S. Citizens being functionally illiterate, i.e., reading below the eighth grade. (Literacy Project Foundation, 2018). Even being able to read at a minimal level does not even begin to address serious issues like evaluating information for its quality (including identifying good sources of information), let alone critically thinking about it. The National Science Foundation surveys referenced above result partially from illiteracy but a question remains why persistently so many persons are illiterate let alone knowledgeable in basic facts.

Such deficiencies have major policy implications on an international scale, where ignorant voters select policy makers with the power ultimately to press buttons on nuclear weapons systems. It may be argued that the pattern of world events has not changed since ancient times with the exception of the capacity to destroy being greater and radically more complex technology being able to magnify human error especially beginning with World War One and now with vast nuclear weapons stockpiles. Societies have become enormously complex with even the best and brightest seemingly making questionable judgments (atomic bomb, bioweapons, and fossil fuels).

These may all be factors besetting the average and below average person, but as systems become even more complex, one may ask about the increasing portion of the more intelligent being drawn into this group, Dr. Theodore Kaczynski, the Unibomber, being case in point. At some point, even those with an above 150 IQ (or whatever standards are used to gauge intelligence, multiple and qualitatively different IQs included) may be incapacitated in managing social complexity. In an extreme case, one only need look at the *Einsatzgruppen* (Nazi death squads), where "Of the 25 *Einsatzgruppen* and *Einsatzkommando* leaders, 15 of them bore the title of PhD, most of them doctors of jurisprudence or philosophy. (*Einsatzgruppen*, 2006)". One asks the same of the Nazi doctors (Lifton, 1986).

Again, the above argumentation may not be necessarily sound, let alone valid, but one needs to consider it as a possible motivation for why data is being collected as BAA-1165 and the various intelligence websites illustrate. If the population cannot control itself even to the point of protecting its own environment, the question is raised, who will? For the present one may refer to the technocratic movement as a response to these problems (Technocracy, 2018), especially in considering such big data laden projects as those of NSA, NIMH, the BAAs and brain modeling.

What are the implications of fog computing?

It was mentioned that data can and often is acquired from sensors, perhaps the most personal example being those placed inside of a pill-sized object and the whole assembly being swallowed in order to report on what is happening inside the digestive tract. Typing in "microsensors", "miniature sensors", "radio frequency sensors", and similar phrases should prompt the imagination in envisioning how detailed data collection might be (Minin, I., 2011). On the outside, radio frequency (RF) tags can be affixed to just about any object, with that object being tracked. RF tags now are being embedded in the skin for various purposes. It is not a question, then, of whether objects can be tracked and data collected on them. Where does that data go, who manipulates it, who manages it, and why? A number of situations were alluded to above, which can be the core of lively debate, but what of the future?

What applies to cloud also applies to fog, as the latter merely is the interface between humans and big data. One may think of peripheral nerves and appendages in the form of drones, IoT devices, phones, etc. We saw how the The National Institute of Standards and Tchnology (NIST, 2017) fog computing diagram resembles neuroarchitecture. Hence, we can see in a society as organism model big data as memory, the "social brain" using it, and fog computing as a way of individual cells receiving and sending via the social brain big data.

If societies can be regarded either literally or analogously as organisms and computer technology in the form of data collection and management and artificial mentation parallel the organism in themselves assuming an organic character, we now see ourselves as at least technologically in the completion stage, where fog computing providing that last segment of detail to enable complete manipulation of the technological organism reflecting the society. As the organism takes on its emergent characteristics, so does the technological ensemble.

Towards a solution

If perceived deficiencies of the average individual and the societies in which they live are some of the motivations driving social control, what, then, is to be modeled? The above discussion on simulated societies may offer a starting point in that modeling and simulating human interactions in what amounts to a social laboratory can reveal roads to possible solutions. It has been said that principles of organization underpin the utility of large data sets.

Collecting data and identifying it as information about physiography, thermodynamic interactions in the atmosphere and precipitation levels are in the context of a larger framework of meteorology, each area of investigation articulating with another to describe a system. Data sets reflecting a description of DNA, diseases and the make-up of organisms are within the context or framework of promoting the health of those organisms as systems. For humans living together on this planet, it is the society that has been regarded as an organic system having a health. A reading of the literature of organic thinkers, Hegel and Durkheim in particular, will present a viable way of diagnosing and treating social and political problems. Durkheim's "social brain" is foundational.

For thousands of years humans have created tools to do what they could not alone. Simple machines (levers, wheels, inclined planes and so forth) are combined into complex ones. From the science that provides the understanding of our world comes the technology to manage it. Computers are tools to memorize, compute and analyze. Now, we have a society confronted with problems threatening species survival that even the best and brightest individually or collectively may not be able to solve, as Homer-Dixon and Tainter (discussed above) have alluded. To this point we have described a repository of information (data storage), methods of collecting that data, and some of the uses to which it might be put. The next step is connecting the myriads of parts of society – its members and technology to that repository and its manipulators. A clue is with cybernetics and scientists becoming involved their "scientific study of control and communication in the animal and the machine." as stated by Norbert Weiner (1948). But, first, we need a science of society and its subdomnain, politics.

The New Social and Political Science

Social and political use of big data generally re issues normally under the purview of sociology and political science, but they remain only as issues, rather than being viewed in a wider context of the nature of the society, itself, that society assuming a particular character that can help explain the larger role that big data is playing in our lives.

Political science has been thought to be a misnomer since time the term was presented formally in 1752 by David Hume, who wrote that:

> … politics may be reduced to a science So great is the force of laws and of particular forms of government and so little dependence have they on the humors and tempers of men, that consequences almost as general and certain may sometimes be deduced from them as any which the mathematical sciences afford us. (Hume, 1742)

Aristotle has been credited as the founder of political science (Aristotle and Political Science, 2015), and Aristotle's teacher, Plato, wrote extensively about the thinking behind and outcome of social behavior in the form of constitutions. However, the words "political science" do not appear in any of Plato's or Aristotle's works. The study of peoples' (demos) institutions polis (city) as a result of human behavior (ethics) was not regarded so much as a science as a philosophy or a way of thinking. More precisely politics was about how power is acquired, distributed and used, power being the ability to make another do one's will (What is Political Science, 2015). One of, if not the modern founder of the systemic studies of politics under the rubric "political science" was Henry Baxter Adams in 1880 in establishing the "Johns Hopkins Studies in Historical and Political Science" (Adams, 2015).

Years of debate ensued about how much of a science was there of politics. After all, science could be listed in their order of exactitude and value in predicting: math, physics, chemistry, biology, psychology and the so-called social sciences including political science (Political Science History, 2015). For the most part any technical rigor to the field has been in collecting and analyzing data from survey research, but because these surveys are behaviorist-oriented, with those surveyed being highly ephemeral in their views, precision might be regarded to that on par with predicting the outcome of a horse race. The recent attempts to prohibit the U.S. National Science Foundation from funding political science as in the failed Coburn Amendment SA 2631 (2015) illustrate this.

What may be giving force to a more legitimate study of societies as a science is a model that has been developing for millennia, one of the State being an organism, where diagnosis and treatment of problems would be analogous to medicine a thematic approach, more coherent that the cacophony of what exists now. Overlain on this is a focus on identifying the “social brain”, asking the pertinent question of whether its collective mentation is sufficient to meet future challenges, especially the Sixth Great Extinction. Heightened big data capacities, as well as more sophisticated management are at issue. It may be added, too, that political philosophy is conspicuously absent in political and social science departments, the preference being for mechanical descriptions and piecemeal Band-Aid type remedies for problems.

Political science (and social science) to be a science must follow scientific methods, but in contemporary times, with an increasingly interdependent and diverse world, it needs to be interdisciplinary. This is to say that political and social science students need to address not only what they are studying now but other fields, like biology (focus on organicity), artificial intelligence, neuroanatomy, and perhaps most important philosophy (consciousness studies, logic, and ethics) if this discipline is to have any thematic unity and coherences oriented to organic societies and social brain..

FUTURE DEVELOPMENTS AND RESEARCH

What might the ultimate meaning of big data be? We have seen “data points” above that indicate future technological development, the primary areas being in data storage capacity and processing speeds both addressed by quantum computing. To gain some perspective on how rapid technology can evolve, look at ENIAC, the vacuum tube-based computer sponsored by the U.S. Army in 1943, where in a large room the 30-ton machine of thirty separate units relied on forced-air cooling used 19,000 vacuum tubes, 1,500 relays and hundreds of thousands of resistors, capacitors, and inductors, and required about 200 kilowatts of electrical power. It was a complex operation for it to do square roots and long division (Weik, 1961). It is almost impossible to comprehend what may happen in the next 70 or so years given our moving ever so closer to replicating the human brain.

Yet, one should track development of big data where there is the greatest complexity in organization and management as well as in the areas of social control. In answer to the problems of democracy, referring back to Plato and Aristotle, policy makers may be thinking about developing tools to accomplish what humans alone cannot do among other things getting humans to live peacefully with each other. Big data is all about complexity both concerning the project for which it is collected and the big data itself in terms of collection methods, organization, interpretation and management. Somewhat of a paradox is emerging in that the level of complexity either natural (before any human intervention) or of humans' own making- far outstrips the ability of humans to deal with it. It was stated that the ability to replicate the universe is questionable at best. At some juncture, there is a crossover point, where after so many Cartesian subdivisions, the emerging complexity simply from a big data standpoint may be impossible to record, let alone be managed. We are out-analyzing ourselves, as it were. What emerges very likely will be something unpredicted.

We have seen how the discussion about big data started from a rather simple description of large individual systems, such as those involved in weather modeling, could be seen in larger contexts, leading into data about modeling the human brain and perhaps consciousness, itself, culminating in modeling all of society, inductively described by what happens with individuals. For this last, consideration is given to developing the ultimate tool, Durkheim's social brain, but that brain being human-made. This is a logical outcome of transhumanism (to be researched) and Kurzweil (2018), where, starting from simple prosthetics humans gradually are transformed into non-hydrocarbon beings.

There can be a science of societies and politics if there is an interdisciplinary program, not only consisting of historical and descriptive accounts of societies and politics but of scientific research methods, biology (as in focusing on what life is), neuroimaging, artificial intelligence, and above all, philosophy to impart the whole realm of study with meaning. At its foundation are social groupings as organisms, each organism having a "brain", each brain as a repository of "big data", with various "programs to manage it, but overall with a "high-road" ethos as the motivation for sustaining the organism.

Given the discussion about whether Earth can support this species in the future and much more long-range, the ultimate demise of the universe, thinking has emerged about reproducing humans digitally, the complete elimination of hydrocarbon-based life, big data far beyond creating an artificial brain. This digital immortality was proposed by Frank Tipler in his 1994 work *The Physics of Immortality* (Tipler, 1994). It may be pseudoscience or not but as with science fiction inspiring real technological development, this Ph.D. Physicist's work might have the same effect (Digital Immortality, 2018). Indeed, fog computing now is giving us those peripheral nerves which allow us to complete that mapping from hydrocarbon-based systems through non-hydrocarbon-based ones and one to full digitization of humanity. In any case, it is a bellwether of thinking about how to manage seemingly irresolvable complex problems. Ray Kurzweil (Kurzweil, 2015), referred to above as a leader of the singularity movement, sees such a day coming. As defined,

> The technological singularity is a hypothetical event related to the advent of artificial general intelligence (also known as "strong AI"). Such a computer, computer network or robot would theoretically be capable of recursive self-improvement (redesigning itself) or of designing and building computers or robots better than itself. Repetitions of this cycle would likely result in a runaway effect an intelligence explosion (Chalmers, 2010; Loosemore, 2011) where smart machines design successive generations of increasingly powerful machines, creating intelligence far exceeding human intellectual capacity and control. Because the capabilities of such a superintelligence may be impossible for a human to comprehend, the technological singularity is the point beyond which events may become unpredictable or even unfathomable to human intelligence. (Wikipedia, 2018s)

By regarding society as a natural organism, one looks at the evolution of computer networks and artificial intelligence with all that big data, processing ability, and fog computing to incorporate everything having a chip and those holding that object that may equal or even exceed present "natural" capabilities.

The concept is not new if one remembers Alan Turing and John Von Neumann. In a more sophisticated form John Glad (Glad, 2008) argues that we can shape our own evolution in a cyborg fashion. We have come full circle to our creating ourselves just as Von Neumann with his Universal Constructor (Universal Constructor, 2015) and Turing (Turing, 1950) suggested. A "minor" problem exists - bias. Turing stated,

> ...a machine undoubtedly can be its own subject matter. It may be used to help in making up its own programmes, or to predict the effect of alterations in its own structure. By observing the results of its own behaviour it can modify its own programmes so as to achieve some purpose more effectively. These are possibilities of the near future, rather than Utopian dreams. (Turing, 1950)

For argument's sake, let us say that the outcome of the ultimate big data project-the creation of a mind equivalent to ourselves-is feasible (and, again, we are not arguing that it ever can be successful, only that persons are working as though it could be). Clearly, the observer has become a participant, i.e., second order cybernetics and recursion (Wikipedia, 2018q). That artificial mind would be seeing us through ourselves, a case of reflexivity, a topic that has generated its own and very large body of literature

(Wikipedia, 2018p). Immediately, we are confronted with emergent systems immanent with human bias. A data visualization as a context diagram may appear as in Figure 8.

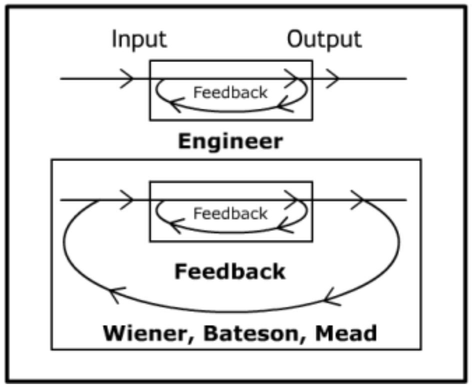


Figure 8. Second order cybernetics feedback loop (Côté, 1976)

If one is to posit that the culmination of big data with fog computing will be in the form of reproducing ourselves as in the artificial brain, one should be free to discuss some consequences having to do with human bias and the differences between an organic and a non-hydrocarbon-based way of doing things. Such is even truer about replicating society as a being unto itself. Too, the question is not so much as whether it is possible to do all of this down the road but the thinking in that direction and the implications of these attitudes.

In emergence, one needs to address autopoiesis or self-creation (Wikipedia, 2018a). After all, modeling a social brain is what we are doing. In the same discussion about the seeds of creation being within ourselves, one must also address in a dialectic fashion, autodestruction analogous to a death gene (Prescott, 2012). What if, in emergence, as in systems acting on their own (Singer, 2009), this tendency becomes predominant? The U.S. Department of Defense surely has these concerns as illustrated in one of its Broad Agency Announcements:

> This new and expanding challenge to the test community is being driven by rapidly accelerating technology developments in cognition, control, autonomy, sensors, computing, software and communications resulting in the development of advanced unmanned military-technical capabilities being deployed at an ever expanding pace. This is consequently straining the verification and validation methods as they are practiced today (BAA UAST-0002, p. 13).

Another consideration is that of entropy. It is said that the Universe is tending towards a heat death where all energy will be equally dispersed (Wikipedia, 2018j). Entropy also results when information emanates from chaos (as in the singularity that was the origin of the Universe) produced what we have today and will continue to produce until its heat death end. We have as Boltzmann entropy, the equalization of particles giving an evenness. Information entropy is regarded as the ability to predict (Shannon, 1948; Chaitin, 2001). It is uniformity that allows the experimental scientific method (Whewell, 1847), but is not uniformity randomness? Yet, this is a uniformity of process but it would appear that entropy in this sense already has occurred. In all the scientific development it becomes hypothetically possible to predict the future. Given what we have just said, we will be approaching a maximum entropy, in essence, a condition being, as the Universe is tending, one of maximum information dispersal. It will be a maximum Cartesianism as it were to test our ability to identify every element. Information entropy then may be that autodestruction. Our quest for “knowledge” is that autodestructive process with big data the barometer.

CONCLUSION

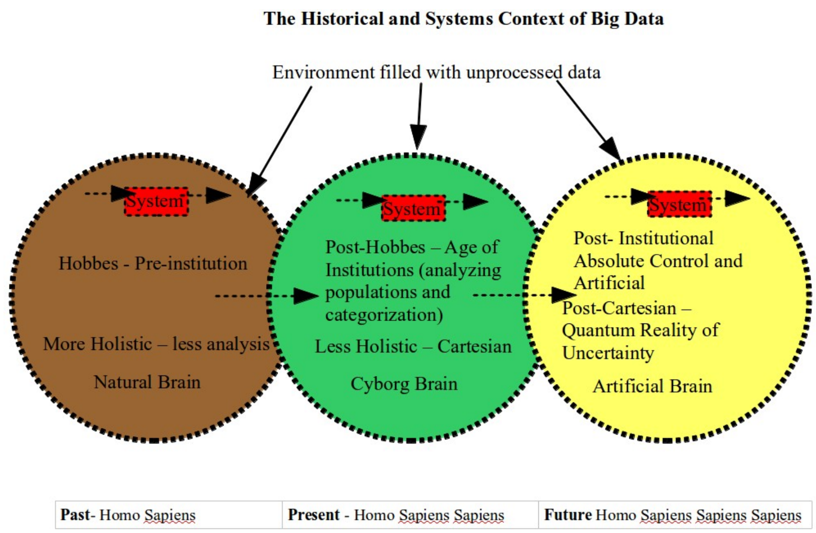
Data exists every time we measure something or tell someone about something. There may be too much of it for our own good. Ostensibly, it seems we can manage it by inventing storage and distribution technologies. However, "big" elides to "unmanageable" when there are insufficient organization and analysis methods. It is at this juncture where the conversation about "big data" goes from describing the technological wonderment to the more serious one of not only the organization but the purpose of big data. This brings in more profound considerations of philosophy (metaphysics, ethos, etc.). If we cannot manage the answers to this question, the technological aspects of management become minuscule even comical. Think of society as a child building a house of cards of big data and poking around it with fog computing.

Large projects, exemplified by genome sequencing, weather modeling, or quantum research in particle accelerators are simple in comparison to modeling global combat, the complexities of the human brain, or society as a conscious organism. Such complexity raises the question of humans' ability to manage it. It may be the case that in a situation similar to humans needing jack for the car they can't alone lift. Humans need a tool to help think of solutions for problems they cannot solve with their natural brains. It is in this context we can have our discussion of big data, especially in light of our discussion on the U.S. intelligence network and agencies, the National Institute of Mental Health's Research Across Domains (RDOC, 2015), the various artificial brain projects, and the Broad Agency Announcement calls for identification and detention of mentally disordered persons as potential terrorists (Broad Agency Announcement 11-65, 2015). One asks about the concept of Durkheim's "social brain", extending digital immortality (Tipler, 1994) to society as a whole, especially if this species is asking whether it will survive.

The more data accumulated the more we have measured our world and presumably the more we have understood it. Knowledge acquisition overall has as its main objective the enhancement of our ability to predict (and control) our future. The question immediately relevant in this paper is who acquires that data and who manages it? Without a science of society and politics, the anarchy of big data will continue, the trend leading where most anarchistic endeavors have in the past, to destruction and iron-fisted oppressive rule.

These broader considerations of "big data" and fog computing make it all the more imperative to conduct research not simply into the technological aspects of the subject but more importantly the reasons for it. So, in the end, the reader is left with a visualization of data within the larger framework of what has been described here linearly as:

Figure 9. Our context diagram



[Courtesy of the author, Jeremy Horne – drawn especially for this chapter]

From this, one only hopes that there will be a simulation of a second order cybernetic model that will at least preserve this species and its environment. Let's look into that mirror again and reflect on all of what has been said here.

0⊃0⊃1⊃?⊂1⊂0⊂0

REFERENCES

Use this reference list: https://wikivisually.com/wiki/Utah_Data_Center#cite_note-reuters1-4 APA format

A note on Wikipedia: This chapter is only a seed for further thinking about big data. Numerous citations of Wikipedia appear, not because they necessarily are peer-reviewed sources (though many articles are) but because they provide a general overview of the topic and moreover lists of further readings upon which the content is based. In addition, this information is what the general public often encounters (and only this one). One should refer to the content and references as any competent scholar would and see, for the most part, that most importantly, the Wikipedia presents a useful starting point for research.

In terms of other references, they are not meant to be complete but only what the author of this chapter thinks are representations of typical evidence supporting the arguments. A number of works for which there are no downloadable versions can be purchased on line through various booksellers. Many can be read on line via places like Gutenberg Project or https://archive.org/ ..

Note: All of the following links were retrieved 28 March 2018.

_____ (2018). Steps toward Memory Preservation v1.6. https://docs.google.com/document/d/184MAffoiRo70JrYqG9GIcleBZRPoH1iqSAaJP3fJ97I/edit#heading=h.34vw9iiczx8a

Abdollahian, M., Baranick, M., Efird, B., & Kugler, J. (2006). *Senturion - A Predictive Political Simulation Model*. Retrieved on 28 December 2015 from www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA454175 , https://docs.google.com/viewer?url=http://www.ndu.edu/CTNSP/docUploaded/DTP%252032%2520Senturion.pdf and http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA448132

Adams (2017). *Henry Baxter Adams*. https://en.wikipedia.org/wiki/Herbert_Baxter_Adams

Azevedo, F. A., Carvalho, L. R., Grinberg, L. T., Farfel, J. M., Ferretti, R.E., Leite, R.E., Jacob, F.W., Lent, R., & Herculano-Houzel, S. (2009). Equal numbers of neuronal and nonneuronal cells make the human brain an isometrically scaled-up primate brain. *The Journal of Comparative Neurology, 513 (5),* 532-541. http://www.ncbi.nlm.nih.gov/pubmed/19226510

AI Warning (2018). *Nick Bostrom*. https://en.wikipedia.org/wiki/Nick_Bostrom

Alsop, H. (2014). *Americans surveyed: Misunderstood, misrepresented or ignorant? The Telegraph*. http://www.telegraph.co.uk/news/worldnews/northamerica/usa/10640690/Americans-surveyed-misunderstood-misrepresented-or-ignorant.html

Ashby, R. (1954). *Design for a brain*. New York: Wiley. https://ia801406.us.archive.org/3/items/designforbrain00ashb/designforbrain00ashb.pdf

BAA 11-65 Award (2015). *Defense Sciences Research and Technology*, FedBizOpps.Gov. https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=31cf5a859cfa2764da7e1b8d54a79d1c&_cview=0

Baraniuk, C. (2015). *Supercomputers: Obama orders world's fastest computer*. Technology Reporter, BBC News, Technology. http://www.bbc.com/news/technology-33718311

Barcelona Smart City (2015). http://smartcity.bcn.cat/es/

Binary Translator (2018). Q-Bit. http://www.qbit.it/lab/bintext.php?text=&enc=Encode+text+to+binary+code

Blue Brain (2018). *The Blue Brain Project – A Swiss Brain Initiative*. http://bluebrain.epfl.ch/

Brain Project (2000). *Project on the Decade of the Brain*. http://www.loc.gov/loc/brain/

Broad Agency Announcement 11-65 (2015). *Defense Sciences Research and Technology, DARPA-BAA-11-65*. https://www.fbo.gov/index?

s=opportunity&mode=form&id=31cf5a859cfa2764da7e1b8d54a79d1c&tab=core&_cview=1

BAA W911NF-17-S-0002 (2017). Broad Agency Announcement BAA - W911NF-17-S-0002 – 20017 https://www.arl.army.mil/www/pages/8/W911NF-17-S-0002.pdf

Buckley, W. (Ed.) (1968). *Modern systems research for the behavioral scientist*. Chicago: Aldine Publishing Company. http://philpapers.org/rec/BUCMSR and https://en.wikipedia.org/wiki/Walter_F._Buckley

Callaos, N. (1995) Metodologia Sistemica De Sistemas: Concepto y aplicaciones-libre. Caracas, VE: Universidad Simon Bolivar http://159.90.80.55/tesis/000077222.pdf (sporadic, as this is from Venezuela)

Carey, B. (2014). Stanford biologist warns of early stages of Earth's 6th mass extinction event. *Stanford News Service*. http://news.stanford.edu/pr/2014/pr-sixth-mass-extinction-072414.html

Cattermole, T. (2010). *Why we aren't as ethical as we think we are*. http://www.gizmag.com/we-arent-as-ethical-as-we-think-we-are/14572/

Ceballos, G., Ehrlich, P. R., Barnosky, A. D., Garcia, A., Pringle, R. M., & Palmer, T. M. (2015). Accelerated modern human induced species losses: Entering the sixth mass extinction et al. *Science Advances, AAAS, 1(5)*. http://advances.sciencemag.org/content/1/5/e1400253

CERT (2018). *Computer Emergency Response Team – Software Engineering Institute*, Carnegie-Mellon University. http://www.cert.org/

Chaitin, G. (2001). *Exploring Randomness. Theoretical interlude---What is randomness? My definitions.* London: Springer-Verlag. https://d-nb.info/960010319/04

Chalmers, D. J. (2010). The singularity: A philosophical analysis. *Journal of Consciousness Studies, 17,* 7-65. http://consc.net/papers/singularity.pdf

Chalmers, D. J. (2013). *The Matrix as metaphysics*. Oxford, United Kingdom: Oxford University Press. http://consc.net/papers/matrix.html

Citizens United vs. Federal Election Commission (2010). *Appeal from the United States District Court for the District of Columbia No. 08–205.* Argued March 24, 2009—Reargued September 9, 2009—Decided January 21, 2010. http://www.supremecourt.gov/opinions/09pdf/08-205.pdf

Congress.Gov (2015). *Coburn Amendment S. Amdt. 2631 to H.R. 2847*. Retrieved on 28 December 2015 from https://www.congress.gov/amendment/111th-congress/senate-amendment/2631

Computer Security (2015). *SANS.* www.sans.org

Contraband (2015). *Contraband images. Google Images*. https://www.google.com.mx/search?q=inmate+contraband&client=ubuntu&hs=Si7&channel=fs&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwiw0d-9oajJAhXXm4gKHa6FAq0QsAQIKA&biw=1272&bih=856

Cope, L. M., Ermer, E., Gaudet, L. M., Steele, V. R., Eckhardt, A.L., Arbabshirani, M.R., Caldwell, M.F., Calhoun, V.D., & Kiehl, K.A. (2014). Abnormal brain structure in youth who commit homicide. *Neuroimage Clin. 10(4),* 800-7. http://www.sciencedirect.com/science/article/pii/S2213158214000588

Côté, M. (1976). Redrawn from Co Evolution Quarterly and Cybernetics Society Conference brochure. *CoEvolutionary Quarterly*, June (10), 32-44. https://commons.wikimedia.org/wiki/File:SOCyberntics.png

Data Dictionary dot com (2015). http://dictionary.reference.com/browse/data

Data Dictionary Oxford (2015). *Data.* http://www.oxforddictionaries.com/us/definition/american_english/data

Data Dictionary Webster (2015). http://www.merriam-webster.com/dictionary/data

Data Etymology. http://www.etymonline.com/index.php?term=data

Datum Dictionary dot com (2015). Datum. http://dictionary.reference.com/browse/datum

Datum Dictionary Oxford (2015). Datum. http://www.oxforddictionaries.com/us/definition/american_english/datum

Datum Dictionary Webster (2015). Datum. www.merriam-webster.com/dictionary/datum

Dawes, C.T. & Fowler, J. H. (2009). Partisanship, voting, and the dopamine d2 receptor gene. *The Journal of Politics, 71(3)*, 1157–1171. http://jhfowler.ucsd.edu/partisanship_voting_and_drd2.pdf

DeAngelis, T. (2009). Understanding terrorism. Monitor on Psychology, 40(10), 60. *American Psychological Association*. http://www.apa.org/monitor/2009/11/terrorism.aspx

Descartes, R. (1641). Meditations on first philosophy. *The Internet Encyclopedia of Philosophy*. http://infomotions.com/etexts/philosophy/1600-1699/descartes-meditations-746.htm

Diaz, J. (2010). *The one hundred trillion dollars hard drive*. Gizmodo Media Group. Retrieved on 28 December 2015 from http://gizmodo.com/5557676/how-much-money-would-a-yottabyte-hard-drive-cost

Digital Immortality (2018). *Digital Immortality*. https://en.wikipedia.org/wiki/Digital_immortality

DIKW Pyramid (2018). *Data, Information, Knowledge, Wisdom Pyramid*. https://en.wikipedia.org/wiki/DIKW_Pyramid

DNI (2018). Office of the Director of National Intelligence. https://www.dni.gov/index.php

DOE Statistics (2013). *Department of Education Statistics- Nation's Report Card*. http://nces.ed.gov/programs/coe/indicator_cnb.asp and http://www.nationsreportcard.gov/reading_math_g12_2013/#/preparedness

DSM (2015). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5).* http://www.dsm5.org/Pages/Default.aspx

Durkheim, E. (1982). *Rules of sociological method*. New York: Macmillan. https://monoskop.org/images/1/1e/Durkheim_Emile_The_Rules_of_Sociological_Method_1982.pdf

Morel, O.T., Wong, M.E.Y., Goerger, S. R., Kwinn, M.J., & Dodge, R.C. (2006). *Effects Based Assessment Support System* (EBASS). http://www.dtic.mil/dtic/tr/fulltext/u2/a448132.pdf

Einsatzgruppen (2006). Einsatzgruppen http://www.deathcamps.org/occupation/einsatzgruppen.html

Eliade, M. (1954). *Cosmos and history (The Myth of the Eternal Return).* New York: Harper Torchbooks. http://users.uoa.gr/~cdokou/MythLitMA/Eliade-EternalReturn.pdf

Fed Biz Opps (2018). https://www.fbo.gov/?s=main&mode=list&tab=register&subtab=step1https://www.fbo.gov/index?s=opportunity&mode=form&id=5d3bb678bf9be78bda8397d61f027a5c&tab=core&tabmode=list&= ; https://www.fbo.gov/index?s=opportunity&mode=form&id=633411ff6e764cdffd3df8732b8a9cd6&tab=core&_cview=1

Ferguson, S., Lange, T., and Capenos, C. (2009). *Utah Data Center (UDC)*. U.S. Army Corps of Engineers, 13 November 2009 presentation, Salt Lake City, UT. https://info.publicintelligence.net/UtahDataCenter.pdf

Firth, N. (2010). Human race 'will be extinct within 100 years', claims leading scientist. *Daily Mail.* http://www.dailymail.co.uk/sciencetech/article-1287643/Human-race-extinct-100-years-population-explosion.html

Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (Ed.) (2009). *Cognitive Neuroscience: The Biology of the Mind,* 4th Edition. New York: Norton Publishing. https://www.amazon.com/Cognitive-Neuroscience-Biology-Mind-4th/dp/0393913481

Gardner, H. (1993). *Frames of mind: the theory of multiple intelligences*. New York: Basic Books. http://www.tecweb.org/styles/gardner.html ; https://en.wikipedia.org/wiki/Theory_of_multiple_intelligences https://howardgardner.com/papers/

Gardner, H. (2004). A multiplicity of intelligences: In tribute to Professor Luigi Vignolo. https://llk.media.mit.edu/courses/readings/gardner-multiple-intelligences.pdf

Glad, J. (2008). *The future of human evolution*. Schuylkill Haven, PA: Hermitage Publishers. http://www.whatwemaybe.org/txt/txt0000/Glad.John.2008.FHE.Meisenberg-abridgement.r004.en.pdf

Hawking, S. (2015). *Into a Black Hole, Stephen Hawing's Page*. http://www.hawking.org.uk/ and http://www.hawking.org.uk/into-a-black-hole.html

Hegel, G.W.F. (1833/1896/2001).. *Philosophy of Right*, S.W. Dyde, Trans. Ontario: Batoche Books, Ltd. https://socserv2.socsci.mcmaster.ca/econ/ugcm/3ll3/hegel/right.pdf

Heile, F. (2015). Is the total number of particles in the universe stable over long periods of time? *The Blog Quora*. http://www.huffingtonpost.com/quora/is-the-total-number-of-pa_b_4987369.html

Herculano-Houzel, S. (2012). The remarkable, yet not extraordinary, human brain as a scaled-up primate brain and its associated cost. *Proceedings of the National Academy of Sciences, 109 (1),* 10661-8. http://www.ncbi.nlm.nih.gov/pubmed/22723358

Herrnstein, R. J. & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life.* New York: Free Press. https://en.wikipedia.org/wiki/The_Bell_Curve

Higginbotham, S. (2012). As data gets bigger, what comes after a yottabyte? Examiner.com. https://gigaom.com/2012/10/30/as-data-gets-bigger-what-comes-after-a-yottabyte/

Hobbes (1651). *Leviathan or the matter, forme, & power of a common-wealth ecclesiastical and civill*. London: Andrew Crooke. http://www.gutenberg.org/files/3207/3207.txt

Homer-Dixon, T.F. (2007). *The Upside of Down*: Catastrophe, Creativity, and the Renewal of Civilization. New York: Knopf.

Horne J. (1997). Logic as the language of innate order in consciousness. *Informatica, 21 (4),* 675-682. http://www.vxm.com/link.LogicLanguage.html

Horne, J. (2006). Recursion of binary space as a foundation of repeatable programs. *Journal of Systemics, Cybernetics and Informatics, 4(5)*, 73-77. http://www.iiisci.org/journal/CV$/sci/pdfs/P277173.pdf

Horne, J. (2012). A new three dimensional bivalent hypercube. *Neuroquantology, 10(1),* 20-30. http://www.neuroquantology.com/index.php/journal/article/view/361

Human Brain Project (2013). *Human Brain Project*. https://www.humanbrainproject.eu/

Hume, D. (2015). *Essays moral, political and literary 1742, 1752.* The Founders' Constitution, 1, Chapt.11, Document 3. Chicago: The University of Chicago Press. http://press-pubs.uchicago.edu/founders/documents/v1ch11s3.html

IARPA (2018) Intelligence Advanced Research Projects Activity. https://www.iarpa.gov/

IARPA Research Programs (2018). https://www.iarpa.gov/index.php/research-programs

IBM SYNAPSE (2015). *IBM -Systems of Neuromorphic Adaptive Plastic Scalable Electronics (SyNAPSE)*. https://www.darpa.mil/program/systems-of-neuromorphic-adaptive-plastic-scalable-electronics

ICD-10 Version: 2016 (2016). http://www.who.int/classifications/icd/en/ and http://apps.who.int/classifications/icd10/browse/2016/en

IC off the Record (2018). https://nsa.gov1.info/dni/2018/index.html

Ionescu, D. (2013). Thumb Drive Capacity. Kingston’s 1 TB thumb drive packs massive storage capacity in tiny package. *PCWorld from IDG*. http://www.pcworld.com/article/2024220/kingstons-1tb-thumb-drive-packs-massive-storage-capacity-in-tiny-package.html

Johnson, K. A. & Becker, J. A. (2015). *The whole brain Atlas*. Harvard Medical School. Cambridge, MA. Retrieved on 28 December 2015 from http://www.med.harvard.edu/aanlib/home.html

Jordan, R. (2015). Stanford researcher declares that the sixth mass extinction is here. *Stanford News*, June 19. http://news.stanford.edu/news/2015/june/mass-extinction-ehrlich-061915.html

Kalbandi, I. & Anuradha J. (2015). A brief introduction on big data 5Vs characteristics and Hadoop technology. *Procedia Computer Science*, *48* (2015), 319-324. http://www.sciencedirect.com/science/article/pii/S1877050915006973

Kanai, R., Feilden, T., Firth, C., & Rees, G. (2011). Political Orientations Are Correlated with Brain Structure in Young Adults. *Current Biology*, *21*, 677-680. http://www.cell.com/current-biology/fulltext/S0960-9822(11)00289-2

Khodjasteh, K., Sastravan, J., Hayes, D., Green, T. J., Biercuk, M.J., & Viola, L. (2013). Designing a practical high-fidelity long-time quantum memory. Nature Communications, 4(2045). http://www.nature.com/ncomms/2013/130619/ncomms3045/full/ncomms3045.html

Kintisch, K. (2015). Climate crossroads. *Science AAAS*, 350(6264), 1016-1017. https://www.ncbi.nlm.nih.gov/pubmed/26612930

Kurzweil, R. (2018). *Ray Kurzweil: Future predictions*. http://en.wikipedia.org/wiki/Ray_Kurzweil#Future_predictions

Le Bon, G. (1896). *The crowd, A Study of the Popular Mind*. Kitchener, Ontario: Batoche Books. http://socserv.socsci.mcmaster.ca/~econ/ugcm/3ll3/lebon/Crowds.pdf

Lifton, R. J. (1986). *The Nazi doctor*s. New York: Basic Books. https://www.scribd.com/doc/200776030/Robert-Jay-Lifton-The-Nazi-Doctors

Literacy Project Foundation (2018). *Literacy by the Numbers*. http://literacyprojectfoundation.org/community/statistics/

Loosemore, R. & Goertzel, B. (2011). *Why an intelligence explosion is probable*. Humanity Media. http://hplusmagazine.com/2011/03/07/why-an-intelligence-explosion-is-probable /

Mearian, L. (2014). WD leapfrogs Seagate with world's highest capacity 10TB helium drive, new flash drives. *Computer World from IDG*. http://www.computerworld.com/article/2604311/computer-hardware/wd-leapfrogs-seagate-with-world-s-highest-capacity-10tb-helium-drive-new-flash-drives.html

Microsoft (2015). *Are you protected from online threats?* http://mscorp.blob.core.windows.net/mscorpmedia/2013/04/7536.Microsoft_5F00_SIR_5F00_infographic_5F00_long.png

Miller, G. (2012). Investigating the psychopathic mind. Science, *AAAS, 321*(5894), 1284-1286. http://www.sciencemag.org/content/321/5894/1284

Minin, I. (2011). Microsensors. London: InTech. SBN 978-953-307-170-1 https://www.intechopen.com/books/microsensors

Mondal, S. (2015). *Organic theory of the state*. http://socialscienc.blogspot.com/2015/02/organic-theory-of-state.html

MSBOK (2015). *Modeling and simulation body of knowledge*. http://www.msco.mil/documents/_25_MSBOK20101022DistA.pdf

MSCO (2015). *Modeling and Simulation Coordination Office*. http://www.msco.mil/

Gun Violence Archive (2018). Multiple shootings. (References at bottom of page for each shooting). http://www.gunviolencearchive.org/

National Commission (1983). *A nation at risk: The imperative for educational reform.* National Commission on Excellence in Education. https://www.edreform.com/wp-content/uploads/2013/02/A_Nation_At_Risk_1983.pdf

National Geographic (2006). *National Geographic-Roper Public Affairs 2006 geographic literacy study*.

The National Geographic Education Foundation - National Geographic Society. https://media.nationalgeographic.org/assets/file/Roper-Poll-2006-Highlights.pdf

National Infrastructure Advisory Council (2012). *Intelligence Information Sharing: Final Report and Recommendations*. Washington, D.C. https://www.dhs.gov/xlibrary/assets/niac/niac-intelligence-information-sharing-final-report-01102012.pdf

National Science Foundation (2014). *Science and engineering indicators 2014*, Chapter 7 Science and technology: Public attitudes and understanding. (pp. 7-23). http://www.nsf.gov/statistics/seind14/content/chapter-7/chapter-7.pdf

National Vulnerability Database (2018). *Computer Security Resource Center*, National Institute of Standards and Technology. https://web.nvd.nist.gov/view/vuln/search

Neuman, S. (2014). 1 in 4 Americans thinks the sun goes around the earth, survey says. The Two-way: *Breaking news from NPR*. http://www.npr.org/sections/thetwo-way/2014/02/14/277058739/1-in-4-americans-think-the-sun-goes-around-the-earth-survey-says

NIMH-sociopathy (2018). *Antisocial Personality Disorder*. http://www.nimh.nih.gov/health/statistics/prevalence/antisocial-personality-disorder.shtml

NIST (2017). The NIST Definition of Fog Computing. NIST Special Publication 800-191 (Draft). Gaithersburg, MD: National Institute of Standards and Technology. https://csrc.nist.gov/CSRC/media/Publications/sp/800-191/draft/documents/sp800-191-draft.pdf

Ollman, B. (2017). *What is Political Science? What should it be*? https://www.nyu.edu/projects/ollman/docs/what_poly_sci.php

Own Work (2010). Nervous System Diagram. https://commons.wikimedia.org/wiki/File:TE-Nervous_system_diagram.svg

Pace, P. R. (2014). Compassion fatigue a growing concern. *NASW News*. National Association of Social Workers, *59*(1). http://www.socialworkblog.org/nasw-news-article/2014/01/self-care-in-social-work-compassion-fatigue-a-growing-concern/

Popper, K. R. (1959). *The Logic of Scientific Discovery*. New York: Basic Books. A translation by the author with the assistance of Julius Freed and Jan Freed of Der Logik der Forschung, Vienna: J. Springer, 1935. http://strangebeautiful.com/other-texts/popper-logic-scientific-discovery.pdf

Prescott, B. (2012). *Gene helps predict time of death*. News. Harvard Medical School. http://hms.harvard.edu/news/gene-helps-predict-time-death-11-26-12

Quasar Jarosz (2009). Neuron Hand-tuned. https://commons.wikimedia.org/wiki/File:Neuron_Hand-tuned.svg

RDOC (2018). *Research Domain Criteria*. National Institute of Mental Health (NIMH). National Institutes of Health (NIH). Bethesda, MD: US. https://www.nimh.nih.gov/research-priorities/rdoc/index.shtml ; and https://en.wikipedia.org/wiki/Research_Domain_Criteria

Rees, M. (2008). *Sir Martin Rees: Earth in its final century?* https://www.youtube.com/watch?v=3qF26MbYgOA

Reuters Staff (2013). U.S. agency denies data center to monitor citizens' emails. https://www.reuters.com/article/us-usa-security-nsa/u-s-agency-denies-data-center-to-monitor-citizens-emails-idUSBRE93E11O20130416

Riken (2015). *Riken Brain Science Institute (RBSI)*. Japan. http://www.brain.riken.jp/en/

Rousseau, J. J. & Cole, G. D. H. (Ed.) (1761). *The Social Contract and Discourses*. London and Toronto: J.M. Dent and Sons. http://oll.libertyfund.org/titles/638

S.754 (2015). *Division N-Cybersecurity Act of 2015*. https://www.congress.gov/114/bills/s754/BILLS-114s754es.pdf and https://www.eff.org/files/2015/12/16/cisa_omnibus_pages_from_cprt-114-hprt-ru00-

sahr2029-amnt1final_1-2.pdf

Sans (2018). *SANS Institute*. www.sans.org

Sans Newsletter (2015). SANS. *NewsBites*, 17(098). https://www.sans.org/newsletters/newsbites

SC Magazine (2018). *SC Magazine*. https://www.scmagazine.com/

Segall, R.S. and Cook, J.S. (2018). *Handbook of Research on Big Data Storage and Visualization Techniques.* Hershey, PA.: IGI-Global. https://www.igi-global.com/book/handbook-research-big-data-storage/179829

Shannon, C.E. (1948). A Mathematical Theory of Communication. *The Bell System Technical Journal, 27(*623-656), 379-423. http://math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf

Sheldrick, G. (2014). '100 years left' scientists warn of TRIGGER to mass biological event WIPING OUT humans. *Express News*. http://www.express.co.uk/news/nature/493422/End-of-the-World-scientists-warn-biological-extinction-event-in-100-years

Singer, P. W. (2009). *Wired for war: The robotics revolution and conflict in the 21st century*. New York: Penguin. http://wiredforwar.pwsinger.com/

Spencer, H. (Ed.) (1897). *The principles of sociology*. New York: D. Appleton and Company. https://ia902305.us.archive.org/22/items/prinsocial01spenuoft/prinsocial01spenuoft.pdf

Tae-il, K., McCall, J.G., Jung, Y.H., Huang, X., Siuda, E. R., Li, Y., Song, J., Song, Y.M., Pao, H.A., Kim, R. H., Lu, C., Lee, S. D., Song, I.S., Shin, G., Al-Hasani, R., Kim, S., Tan, M.P., Huang, Y., Omenetto, F.G., Rogers, J.A., & Bruchas, M.R. (2013). Injectable, cellular-scale optoelectronics with applications for wireless optogenetics. *Science, AAAS*, 340(6129), 211-216. https://www.ncbi.nlm.nih.gov/pubmed/23580530 and http://rogers.matse.illinois.edu/files/2013/injectable.pdf

Tainter, J. A. (2003). *The collapse of complex societies*. New York & Cambridge, UK. *https://books.google.com.mx/books?id=M4H-02d9oE0C&printsec=frontcover&dq=%22collapse+of+complex+societies%22&hl=en&ei=1fCTTu7XG6TjiALbtMjjBA&sa=X&oi=book_result&ct=result&redir_esc=y#v=onepage&q&f=false*

Technocracy Inc. (2018). *Technocracy.* https://en.wikipedia.org/wiki/Technocracy ; Official Site: http://www.technocracyinc.org/

Theaetetus, P. (1921). *Plato in twelve volumes*, (Vol. 12.) translated by Harold N. Fowler. Cambridge, MA: Harvard University Press. http://www.perseus.tufts.edu/hopper/text?doc=urn:cts:greekLit:tlg0059.tlg006.perseus-eng1:152a

Tianhee (2015). *Six Clicks: The six fastest computers in the world.* http://www.zdnet.com/pictures/six-clicks-the-six-fastest-computers-in-the-world/

Tice, P. (2015). *NIMH Results from the 2014 national survey on drug use and health: Mental health detailed tables*. Serious psychological distress (SPD). Table 1.17a. (p. 195). http://www.samhsa.gov/data/sites/default/files/NSDUH-MHDetTabs2014/NSDUH-MHDetTabs2014.pdf

Tipler, F. J. (1994). *The Physics of Immortality*. New York: Macmillan. https://en.wikipedia.org/wiki/Frank_J._Tipler

Toward a Science of Consciousness (2018). *The Science of Consciousness*. http://consciousness.arizona.edu

Turing, A. M. (1950). Computing machinery and intelligence. *Mind*, 59 (236), 433-460. https://www.csee.umbc.edu/courses/471/papers/turing.pdf

Trifonov, E. N. (2012). Opinion: What is life? The Scientist, 16 February 2012. https://www.the-scientist.com/?articles.view/articleNo/31730/title/Opinion--What-Is-Life-/

UAST - Unmanned Autonomous Systems Technology BAA UAST-0002 (2015). https://www.fbo.gov/index?s=opportunity&mode=form&id=dbb918ff38f72d71f8f6165890a7e86a&tab=core&_cview=1

Uncapitalized Big Data (2018). http://www.sas.com/en_us/insights/big-data/what-is-big-data.html , https://en.wikipedia.org/wiki/Big_data, http://www.ibm.com/big-data/us/en/ , http://www.webopedia.com/TERM/B/big_data.html , https://www.oracle.com/big-data/index.html , and http://www.cisco.com/c/en/us/solutions/data-center-virtualization/big-data/index.html

Uptime Institute (2018). Data Center Site Infrastructure Tier Standard: Topology. https://uptimeinstitute.com/uptime_assets/4f5c1d5a03c7c51036ee73b524e0769fa6790d12bf01f52e2198a4e0cc7b6888-00001D.pdf

U.S.-Cert (2015). *U.S. Computer Emergency Readiness Team*. https://www.us-cert.gov/

U.S. Census Bureau (2018). *US and World Population Clock*. http://www.census.gov/popclock/

Utah Data Center (2018). *Domestic Surveillance Directorate*. https://nsa.gov1.info/utah-data-center/

U.S. Department of Homeland Security - If (2018). If you see something, say something. https://www.dhs.gov/see-something-say-something

U.S. Department of Homeland Security - Information (2018). Information Sharing. https://www.dhs.gov/topic/information-sharing

U.S. Intelligence Community (2018). We are the Intelligence Community. https://www.intelligence.gov/how-the-ic-works#our-organizations

UTC Data (2018). http://www.nextgov.com/cybersecurity/2010/09/army-awards-12-billion-contract-for-nsa-data-center-in-utah/47647/; http://facilitiesmagazine.com/utah/buildings/nsa-utah-data-center; https://en.wikipedia.org/wiki/Utah_Data_Center ; https://wikivisually.com/wiki/Utah_Data_Center; https://www.extremetech.com/electronics/242123-kingston-announces-worlds-largest-capacity-2tb-flash-drive; https://www.stripes.com/news/us/hints-surface-that-nsa-building-massive-pervasive-surveillance-capability-1.228664 ; https://www.wired.com/2012/03/ff_nsadatacenter/all/ ; http://www.dailymail.co.uk/news/article-2309906/Is-NSA-building-1-2billion-data-center-spy-Americans-Utah-desert-facility-monitor-emails-U-S-citizens.html

Vintiadis, E. (2018). Emergence. Internet Encyclopedia of Philosophy. https://www.iep.utm.edu/emergenc/ and https://en.wikipedia.org/wiki/Emergence

Von Newmann Universal Constructor (2017). Von Newmann Universal Constructor. https://en.wikipedia.org/wiki/Self-replicating_machine and https://en.wikipedia.org/wiki/Von_Neumann_universal_constructor

Webb, J. (2014). Met Office to build £97m supercomputer. Jonathan Webb Science reporter, *BBC News*. http://www.bbc.com/news/science-environment-29789208

Weber, B. (2018). Life. *The Stanford Encyclopedia of Philosophy* (Summer 2018 Edition), Edward N. Zalta (ed.), forthcoming URL = <https://plato.stanford.edu/archives/sum2018/entries/life/>

Weber, M. (1992). *The Protestant ethic and the spirit of capitalism*. London: Routledge. https://archive.org/details/protestantethics00webe

Weik, M.H. (1961). The ENIAC story. Aberdeen Proving Ground, MD: Ordnance Ballistic Research Laboratories. *The Journal of the American Ordinance Association*. http://ftp.arl.mil/mike/comphist/eniac-story.html

Whewell, W. (1847). *The philosophy of the inductive sciences*. London: John W. Parker. https://archive.org/details/philosophyofindu01whewrich

Wiener, N. (1948). *Cybernetics, or control and communication in the animal and the machine*. Cambridge: MIT Press. http://uberty.org/wp-content/uploads/2015/07/Norbert_Wiener_Cybernetics.pdf

Wikipedia (2018). *Prehistoric Numerals*. https://en.wikipedia.org/wiki/Prehistoric_numerals

Wikipedia (2018a). *Autopoiesis*. https://en.wikipedia.org/wiki/Autopoiesis

Wikipedia (2018b). *Bell Curve.* https://en.wikipedia.org/wiki/The_Bell_Curve

Wikipedia (2018c). *Big Data Characteristics.* https://en.wikipedia.org/wiki/Big_data#Characteristics

Wikipedia (2018d). *Chauvet Cave.* https://en.wikipedia.org/wiki/Chauvet_Cave

Wikipedia (2018e). *Cloud Storage*. https://en.wikipedia.org/wiki/Cloud_storage

Wikipedia (2018f). *Comparison of Backup Services*. https://en.wikipedia.org/wiki/Comparison_of_online_backup_services

Wikipedia (2018g). *Context Diagram*. https://en.wikipedia.org/wiki/System_context_diagram

Wikipedia (2018h). *Dark Energy*. https://en.wikipedia.org/wiki/Dark_energy

Wikipedia (2018i). *Eddington Number*. https://en.wikipedia.org/wiki/Eddington_number

Wikipedia (2018j). *Heat Death of the Universe*. https://en.wikipedia.org/wiki/Heat_death_of_the_universe#Origins_of_the_idea

Wikipedia (2018k). Machine Code. https://en.wikipedia.org/wiki/Machine_code

Wikipedia (2018l). *Malware*. https://en.wikipedia.org/wiki/Malware

Wikipedia (2018m). *Net-Centric*. https://en.wikipedia.org/wiki/Network-centric_warfare

Wikipedia (2018n). *Protagoras*. https://en.wikipedia.org/wiki/Protagoras

Wikipedia (2018o). *Quantum Computing*. https://en.wikipedia.org/wiki/Quantum_computing

Wikipedia (2018p). *Reflexivity (social theory).* https://en.wikipedia.org/wiki/Reflexivity_%28social_theory%29

Wikipedia (2018q). *Second Order Cybernetics*. https://en.wikipedia.org/wiki/Second-order_cybernetics

Wikipedia (2018r). *Systems Analysis*. https://en.wikipedia.org/wiki/Systems_analysis

Wikipedia (2018s). *Technological Singularity*. https://en.wikipedia.org/wiki/Technological_singularity

Wikipedia (2018t). *Theory of Multiple Intelligences*. https://en.wikipedia.org/wiki/Theory_of_multiple_intelligences

Wimmer, G.E. & Shohamy, D. (2012). Preference by association: How memory mechanisms in the hippocampus bias decisions. Science, *AAAS, 338* (6104), 270-273. http://www.sciencemag.org/content/338/6104/270.abstract

Wolfram, S. (2002). *A New Kind of Science*. Wolfram, Champaign, IL: Wolfram Media, Champaign, IL. http://www.wolframscience.com/nksonline/toc.html

Wuensche, A. (1993). Tools for researching Cellular Automata, Random Boolean Networks, multi-value Discrete Dynamical Networks, and beyond. Discrete Dynamics Lab (DDLab). http://www.ddlab.com/

Yottabyte (2018). *Creative Commons*. https://en.wikipedia.org/wiki/Yottabyte

ADDITIONAL READING

Big Data Visualization Images (2015). Big Data Visualization Images. https://www.google.com/search?site=&tbm=isch&source=hp&biw=1366&bih=662&q=big+data+visualization+images&oq=big+data+visualization+images&gs_l=img.3...1835.11629.0.11803 .

Chalmers, D. (2013). *The matrix as metaphysics.* Oxford, UK: Oxford University Press. http://consc.net/papers/matrix.html

Crowder, J.A. & Freis, S. (2013). Artificial psychology: The psychology of AI. *Journal of Systemics, Cybernetics and Informatics (JSCI)*, *11*(8), 64-67. http://www.iiisci.org/journal/CV$/sci/pdfs/iZA532FA.pdf

DIKW Pyramid (2018). DIKW Pyramid. https://en.wikipedia.org/wiki/DIKW_pyramid Image: https://kvaes.files.wordpress.com/2013/05/20130531-182549.jpg

Di Norcia, V. (2002). Technological complexity and ethical control. *IEEE Xplore Digital Library*, *21*(1), 33-39. http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=993599&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F44%2F21433%2F00993599.pdf%3Farnumber%3D993599

Easton, D. (1957). An approach to political systems. *World Politics, 9(3)*, 383-400. http://online.sfsu.edu/sguo/Renmin/June2_system/Political%20System_Easton.pdf and http://online.sfsu.edu/sguo/Renmin/June2_system/Political%20System_Easton.pdf

Kafatos, M. & Nadeau, R. (1990). *The conscious nniverse*. New York: Springer-Verlag. http://journalofcosmology.com/Consciousness140.html

Keeley, T. (2008). Giving devices the ability to exercise reason. *The Journal on Systemics, Cybernetics and Informatics (JSCI) 6(5),* 69-74. http://www.iiisci.org/Journal/CV$/sci/pdfs/I413DM.pdf

Koch, C. (2013).The end of the beginning for the brain. *Science, 339* (6121), 759-760. http://www.sciencemag.org/content/339/6121/759.summary

Kurzweil, R. (2018). *How to create a mind: The secret of human thought revealed*. Retrieved on 28 December 2015 from http://en.wikipedia.org/wiki/How_to_Create_a_Mind and https://en.wikipedia.org/wiki/Ray_Kurzweil

Leibnitz, P. M. (1703). *Explication de larithmetique binaire*. https://hal.archives-ouvertes.fr/ads-00104781/document

Lloyd, S. (2013). The Universe as Quantum Computer. Chapter for A Computable Universe: Understanding and exploring Nature as computation, H. Zenil ed., World Scientific, Singapore, 2012,16. https://arxiv.org/pdf/1312.4455.pdf

The Matrix (2018). The Matrix. http://en.wikipedia.org/wiki/The_Matrix

Misner, C. W., Thorne, K. S. & Wheeler, J.A. (1973). *Gravitation.* San Francisco: W.H. Freeman and Company. https://en.wikipedia.org/wiki/Gravitation_%28book%29 and https://www.pdf-archive.com/2016/03/21/gravitation-misner-thorne-wheeler/gravitation-misner-thorne-wheeler.pdf

Open Fog Consortium (2018). Open Fog Consortium. https://www.openfogconsortium.org/

Paranuk, H. V. (2013). Review of Weuenche, A. and Lesser, M. The Global Dynamics of Cellular Automata: An Atlas of Basin of Attraction Fields of One-Dimensional Cellular Automata. *Journal of Artificial Intelligence and Social Simulation*. http://jasss.soc.surrey.ac.uk/4/4/reviews/wuensche.html

Schmid, A. (2005). What is the Truth of Simulation? *Journal of Artificial Societies and Social Simulation, 8(4).* http://jasss.soc.surrey.ac.uk/8/4/5.html

Stafford, M. (2014). “Poli Sci Victory, For Now”, *Inside Higher Ed*. January 24. https://www.insidehighered.com/news/2014/01/24/wake-coburn-amendment-repeal-social-science-groups-plot-path-forward

Union of Concerned Scientists (2015). *Union for a healthy planet and safer world*. Cambridge, MA: US. http://www.ucsusa.org/

Veal, L. (2015). Siberia’s melting permafrost fuels climate change. AlJazeera, *Environment News.* http://www.aljazeera.com/indepth/features/2015/11/siberia-melting-permafrost-fuels-climate-change-151122124853964.html

Wikipedia (2018a). *Global warming*. http://en.wikipedia.org/wiki/Global_warming

Wikipedia (2018b). *Swarm intelligence*. http://en.wikipedia.org/wiki/Swarm_intelligence
Wikipedia (2018c). Transhumanism. http://en.wikipedia.org/wiki/Transhumanism

KEY TERMS AND DEFINITIONS

Broad Agency Announcement (BAA): A BAA is a solicitation to the general public for one of its members or organizations to provide under contract, in the words of the U.S. Code of Federal Regulations, 48 CFR 35.016(a), "scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding."

Cloud Storage: A repository of data on a remote storage medium often distributed through multiple servers accessible through the Internet and owned and managed by a provider.

Cellular Automaton: A grid of any number of dimensions composed of regularly-sized spaces or cells each of which may be in an active or inactive state, the whole assemblage of which assumes distinct conditions or goal states and through each unit of time each cell's condition being dependent upon the condition of one or more other cells.

Complexity Theory: Thinking underscoring the identification of simplicity or difficulty required in understanding the construction, analysis or resolution of a problem particularly related to systems.

Deduction: In an argument, if the premises are found to be true, the conclusion follows with certainty; the conclusion is found entirely within the set of premises; a closed system.

Dyadic Binary Formula: A composition of terms in a two-variable or base-2, system with a set of operators according to rules establishing how to compose an expression. Examples: $p \rightarrow q$, Rxy & Pyx, A + B (where “A” and “B” are the only two variables); 00111 * 10010

Emergence: Unexpected phenomena appearing (and often having a regularity or pattern) from a collection of apparently unrelated elements and where the elements themselves do not have the characteristics of the phenomena and that phenomena itself is not contained deductively within the elements (See “deduction”).

Induction: In an argument, the conclusions follow only probabilistically from the premises. The scope of the conclusions is larger than the set of premises individually or collectively.

Quantum Computing: A computer architecture relying on the physics of quantum mechanics where the units or qubits of transmitting data may be in a multiple set of states simultaneously and where the transmission of data requires the “collapse” of one or more the qubits to a definite state.

Recursion: In its simplest sense: repeatability. For example, when the outputs or results of a formula are fed back into the formula as inputs, the outputs will reappear. In the computer world, an overall solution requires the solution of its smaller constituents. One statement can generate any number of objects, meaning a specific program can describe limitless computations. A computer program reflects recursion by having a function call itself inside a program.

Reductionism (Cartesianism): Subdivision of a whole into parts normally meaning that the whole can be described by the sum of those parts.

Second Order Cybernetics: The introduction of the observer or creator of a situation as a part of what is being observed.

Visualization Technique: Simply and broadly stated, a method of pictorializing or generating images of a symbolized: such as verbal or numerical - description.