Digital Immortality:

Theory and Protocol for Indirect Mind Uploading

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**Abstract**. Future superintelligent AI will be able to reconstruct a model of the personality of a person who lived in the past based on informational traces. This could be regarded as some form of immortality if this AI also solves the problem of personal identity in a copy-friendly way. A person who is currently alive could invest now in passive self-recording and active self-description to facilitate such reconstruction. In this article, we analyze informational-theoretical relationships between the human mind, its traces, and its future model; based on this analysis, we suggest the instruments to most cost-effectively collect quality data about a person for future resurrection. These guidelines form a “digital immortality protocol”. Digital immortality is plan C for achieving immortality, after plan A, life extension, and plan B, cryonics.

**Keywords**: Digital immortality – superintelligence – effective altruism – life extension – mind uploading.

**Highlights**:

* Future superintelligent AI will be able to simulate past people.
* To help AI improve its simulations, we can collect data about a living person now.
* Passive data collection is constant recording.
* Active data collection is running tests and recording self-description.
* The best way to collect information is to create art, as it is unique, valuable, and predictive.

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# 1. Introduction

The term “digital immortality” is used with two different meanings*: 1) direct brain uploading* via brain scanning, which produces an uploaded and presumably eternal copy of the mind (Wiley, 2014); and 2) *indirect brain uploading*, that is, reconstruction of the personality based on its footprints by future AI, also known as “person capture” or “cyberimmortality”. Direct uploading is currently impossible, and many people now living will not survive until its appearance. In this article, the term “digital immortality” (DI) will be used only in the second meaning:

*Digital immortality is collecting information about a person with the expectation that this information will be used by future superintelligent AI to resurrect the person in the most accurate way possible.*

Another way to put the same idea into words is the [Terasem movement’s](http://www.terasemmovementfoundation.com/) suggestion that the “conscious analog of a person may be created by combining sufficiently detailed data about the person (a ‘mindfile’) using future consciousness software (‘mindware’)” (Terasem, 2014). Terasem suggests 2 services for “personality capture”: [www.lifenaut.com](https://www.lifenaut.com/), and another site, [CyBeRev.org](https://cyberev.org/), which offers slightly different functionality.

The idea of digital immortality has been explored by several authors. Bainbridge suggested running an array of tests and recording emotional reaction for “personal capture” (Bainbridge, 2004). Goertzel wrote about the role of AI in future resurrection of personality (Goertzel, 2007). Microsoft created a computer program to collect digital immortality data (Gemmell, Bell, & Lueder, 2006), and published an article outlining ideas related to its use (Bell & Gray, 2000), but Microsoft later closed the project and kept the code proprietary because of the legal complexity of transferring its ownership. Kurzweil collected data about his father, including boxes of his fathers’ letters, hoping for his future resurrection. He hopes to create an “avatar”, or a “virtual computer replica” in the future. Kurzweil said, "That [will be] a replica, but I can actually make a strong case that it would be more like my father than my father would be, were he to live" (Berman, 2011).

Recently, several projects have appeared which suggest using social media data to create a chat-bot based on the digital footprint of the deceased person. In one, a son worked together with his dying father on his chat-bot (Vlahos, 2017). The *Eternemy* startup suggests help in data collection (Schilling, 2016). The *2045 movement* and *Humai* have more complex agendas, which combine different approaches (it appears activity on these projects has slowed down as of early 2018). Even funeral agency *Fenix* now suggests interactive chats with the dead, which are expected to evolve into full blown avatars (Alestig, 2018). *Memori* connects person’s memories with physical objects. <http://getmemori.com/en/about.html> *Digital Immortality* *Now* (Volpicelli, 2016) is concentrated not on providing services, but on consulting in DI.

The idea of the informational uploading of a person via non-technological means can be traced back as far as Saint Augustine, who wrote his *Confessions* in the 4th century (Augustine, 398 AD). But the real beginning of the honest and conscious creation of the model of self was *Confessions* by Rousseau, written in the 18th century, which starts with the following words: “I have resolved on an enterprise which has no precedent and which, once complete, will have no imitator. My purpose is to display to my kind a portrait in every way true to nature, and the man I shall portray will be myself” (Rousseau, 1782). After Rousseau, the genre of autobiography flourished, but it was not recognized as an actual instrument for achieving immortality. Berdyaev wrote the book “Self-Knowledge: An Essay in Autobiography” (Berdyaev, 1950), which is not only biography with facts and emotions, but full of generalizations of personal traits, which also become declarations. As a result, proper self-description became a transformative technique, similar to “recapitulation”, as described by Castaneda (1993). The longest-ever written diary has 35 million words (180 MB), kept by R.Shields (Martin, 2007). He wrote an entry every 5 minutes for decades, thereby collecting a lot of information about himself.

Surely, personal writings were recognized as some form of immortality, as seen in “Exegi monumentum”, a poem by Horace (Horace, 23 BC), a philosopher also regarded as world first autobiographer. But as Woody Allen famously said: “I don't want to achieve immortality through my work. I want to achieve it through not dying” (W. Allen, 1993). Despite its limitations, a written text has ability to influence the reader, who creates an internal model of the characters described. In the case of autobiography, it is a model of the text’s author, and thus she can “install” her personality in the other human’s brain. However, this “viral” form of text-based immortality was never recognized, and is of limited importance now, as powerful AI will soon appear and provide a more effective method of resurrection.

This article suggests that passive recording is not enough; active information-extraction efforts are needed to quickly and cost-effectively collect and focus on the most important information about a person. Based on the idea of information renormalization by importance and predictive power, it seems possible to collect enough data to enable digital immortality in reasonable time, and with reasonable effort and costs.

The article consists of two parts: theory and practice. If you want to start preparing for personal digital immortality immediately, skip to the practical part.

# *THEORY*

# 2. Why is digital immortality needed?

The first answer is that people are still dying and not much can be done about it. Once we accept the premise that human lives and minds are valuable, there is a moral imperative to protect, extend, and/or preserve them if possible.

Only a few people are signed up for cryonics, and for many it is expensive and logistically difficult or impossible (as cryonic is legal only in US). Cryonics could also fail due to legal, organizational, or financial problems. Digital immortality, on the other hand, could provide a cheap and affordable option for potentially indefinite life extension for almost everybody.

As in the case of cryonics, fighting aging, and many other important issues, the main problem of DI is not technological, but psychological: people don’t want it. The main reasons—besides the fact that many have never even heard of the idea—is the problem of personal identity: the thought that the model of their personality will not be the same person is a “showstopper” for the idea of DI (Bainbridge, 2006).

Copying of the digital minds opens possibility for indefinite life extension (Eubanks, 2008), as copying outperform any survival strategy longterm.

# 3. Informational identity

## 3.1 Two types of personal identity: observational and informational

The analysis of the problem of personal identity will be limited here, as it is known to derail discussion about mind uploading. Several publications claim that the identity problem will make mind uploading difficult (Swan & Howard, 2012), and most people share this view.

According to Parfit, there are two types of the personal identity (Parfit, 1984):

* “qualitative identity” which we will call *informational identity* in this article, is the measure of similarity between two minds (Parfit’s term is not self-obvious).
* “numerical identity” which we will call *observer identity* for clarity, answers the question: will my copy (in the next moment of time) be me or not?

In short, belief in the observer identity implies that informational identity is not enough for “real” identity, and some form of *non-informational identity carrier* is needed, which could be either “soul” or “continuity of consciousness”. These things are currently unmeasurable, so their existence is purely based on belief for now; in other words, we can’t measure observer identity.

In this article, the “conservative approach” to personal identity will be used; that is, the idea that one should try to preserve as much identity as possible. It is assumed that in the future scientists will better understand the nature of the identity, and when superintelligent AI appears, it will be able to solve the problem.

Thus, we are postponing the solution of the problem of the observational identity into the future. Maybe observational identity is just an illusion, maybe it is real, but future AI will find ways to capture and transfer it. For example, if the observer identity is connected with continuity of consciousness which is related to causal connection between mind states, then preservation of causal connections between me-now and a future copy could be used to extract not only information, but also “causal connection”. Future AI may find a way to use causal connections with the past to extract “continuity”. But to preserve causal connection, we need to preserve some form of information about the person, so we again return to digital immortality.

Human personal identity is not the same as identity of minds in general and is a social construct (Bamford & Danaher, 2017). The author has explored the problem of personal identity in detail in (Turchin, 2016).

## 3.2 Criteria for informational identity

The following criteria may be used for informational identity in the case of the constantly changing human mind:

*Strict criterion:* the copy is the same person if *the difference between the copy and the original is less than the typical changes that a human being experiences sleeping through one night.*

Human memory decays exponentially (Murre & Dros, 2015), but different types of memories decay at different speeds. One night’s loss may be roughly estimated as losing 0.1 per cent of all personal data, but more research is needed. It is absurd to require a higher level of informational identity as it will be lost in several hours because of the natural rate of forgetting. The strict criterion translates into ~99.9 per cent behavioral similarity. We later will discuss how it could be measured. If one rejects the strict criterion, one must assume that each person is another person next day, which is theoretically correct but practically absurd. (The relative importance of different facts will be discussed later in the section about predictive power of facts in the section 4.10.)

*Mild criterion*: If a person becomes sick, and later recovers, she is still regarded as the same person, despite the fact that she may lose some of her memories and skills. Here, the copy will be regarded as the same person in the mild sense if *the difference is equal to forgetting the last year of experienc*es—which, due to the exponential rate of memory decay, may mean losing more than half of her memories.

Plus, the mild criterion means that the person will be recognized as the same by his social circle (Rothblatt, 2012)—and by himself, if she will be able to somehow have a view of her internal mental states. The fact that humans are able to recognize themselves from inside is based on observation that sometimes they fail to recognize their identity, mostly in cases of some dissociative disorders. This inability to recognize oneself is based on discrepancy between image of self and actual observations, but in case of DI we can’t be sure that “image of self” was preserved accurately. Thus, to ensure identity via self-recognition we need to imagine the situation where currently living person could have a look on internal experiences of his model, and either recognized as her or not. This experiment is counterfactual, as we can’t actually provide access of past person to her future model, however, future AI could predict result of the experiment. For example, if I wake up in the body of the opposite sex, it is easy to predict that I will recognize that something is wrong with me.

This ability to “self-recognize” and be recognized by others is based on the retention of the core “indexical and identification information”. In the human case, this core includes memories about the person’s name, native language, family members, living address—in other words, everything that is typically used to recognize the person. The core could be rather small and will be discussed later—here, we just assume that *the core is the socially accepted set of memories used to identify the person (as well as the ways how I internally identify myself)*. In the mild case criterion, the core should be mostly intact, but still could have some errors, as it rather typical for human to forget even some important details about themselves.

Rothblatt (Rothblatt, 2012) suggested as a criterion examination of the copy by a group of psychologists, an analogy to the Turing test. Our criterion is even stricter as it suggests counterfactual possibility of internal self-testing, that is, will I regard myself as me, even in the presence of some small changes.

## 3.3 Should computer be conscious?

It seems that idea of digital immortality is based on the assumption that a computer can have consciousness—but this assumption is not required. Digital data about the dead person will be analyzed by the superintelligent AI, but it could put the resulting model not on the digital carrier, but inside another biological brain artificially grown from biological neurons, if AI finds that biological neurons are necessary for subjective experiences. Other solutions will may be found to preserve consciousness in a computer, potentially involving the use of quantum computers or as-yet unknown devices.

In other words, the possibility of a non-classical nature for the human mind does not prevent the viability of digital immortality as a resurrection technology. If “soul” exists, it could “return” to a sufficiently advanced replica.

## 3.4. Theory about the possibility of eternal preservation of information

Everything which exists in our universe is decaying because of entropy. However, information can be copied; the nature of information is that it is easy to copy. To ensure eternal preservation, the rate of copying should be higher than the rate of decay, including the fact that any copying has a non-zero probability of errors. This error rate can be infinitely small by some preservation mechanisms like control sums.

In the past, when only a few copies of manuscripts existed, and copying was expensive, the question of how many copies should be preserved was not trivial. A mathematical model showed that creating one copy every year is enough to outperform the decay process [ref].

## 3.5. Transformational resurrection

One way to stop thinking about “identity obstacle” is to assume that the resurrected person will not be you but will instead be someone who is closer to you than your child. She will be a person with same DNA, same set of memories, and same values, but improved: younger, healthier and open to adapt to the new world.

As mentioned, Kurzweil suggested, and has said that he can prove, that his reconstructed father will be more his father than his father was at any moment of his life; that is, the upload will be a quintessence of what his father was (Berman, 2011). Such proof may lie in the fact that most of the time, humans react automatically to stimuli, and don’t always remember things which they regard as important to them. Thus, constructing a “better me”, which is close to me in my best moments of life—but even better—is possible by simultaneously combining all of the traits which were my best traits at different moments in my life.

There could be many future time-lines, which suffice to satisfy the informational identity criterion, but only some of them present a “best me”. It is human nature to want to improve and to change one’s own personality. Thus, the creation of an idealized image of self will be not only the fixation of current hidden desires, but an act of creation of a “better me”, including instructions for the future AI of how I should be improved.

The paradoxical part of resurrection is that, despite the fact a resurrected person should be as close as possible to the original for the purpose of identity preservation, most saved data should be immediately discarded as the person adapts to the changed world around them. Resurrection is always a transformation. If we know in advance which data may be discarded without being read, we may choose to not invest in its preservation.

## 3.6 Loss of time in DI

It is obvious that DI will not provide a full accounting of the last several days of the person. There are several reasons for this. Firstly, active uploading periods—that is, the most concentrated periods of uploading, are at relatively infrequent intervals, like every several years. Constant passive recording provides a narrower update than these infrequent full uploads. Secondly, last days are full of memories which would be forgotten, if death does not occur. In addition, when a person is seriously ill, there is often no time to invest in proper recording. She may experience very transformative changes in the last moments of life which will not be recorded.

As a result, after resurrection, a person may feel as if she has some form of amnesia about her last time period. It is rather typical for humans to have some form of amnesia after a serious illness, especially coma, and such memory loss is not considered to have changed their “identity”.

This also means that only our mild criterion of informational identity is applicable to DI, that is, one year of distance. How much you remember about what you felt and planned last year? Are you regarding yourself one year ago as you?

## 3.7. Different personalities in the different periods of time

A person is always changing, sometimes more slowly and sometimes more quickly. Stable periods could be called temporal personalities, which have a rather stable set of traits, like dominating values, emotions, job, friends, home—which could be easily distinguished from those of another period. Such periods are established as social roles, like first grader, sophomore, mother of toddler, professor, a person who is grieving loss.

As personalities within these periods are more or less stable, it is not important in which moment of this period a person is recreated. The clear beginning of a new period means that an update of the digital immortality data is needed.

## 3.8. Immortality-for-me and immortality-for-other

The *observer identity* is important from my point of view, and its preservation can be called *immortality-for-me*. If we are interested in the eternal existence of someone else, like a loved one, this is the problem of *immortality-for-other*. In the first case, we are more interested in continuity of existence, and in the second case, the most important is stability of behavior and the ability of peers to recognize it as “the same person”.

This difference may affect data collecting strategies when a person is collecting data about himself or about another person. For example, if we return a dead poet to life, we may expect that he will continue to write high-class verse. But from his point of view, it may be more important to study world history, learn the fate of his relatives, and drink in a bar.

Preserving identity doesn’t mean future behavior will be predictable; there could be many different future timelines with the same initial identity.

## 3.9. Preserving identity as a decision under uncertainty problem

The nature of the human personal identity is currently unsolved.

Let’s imagine the following thought experiment: you are expecting capital punishment via hanging, but the night before you get a message: there is 1 per cent chance to escape the prison, but to do so, a very strange set of actions are required. Should you agree? The answer seems to be YES! both from an emotional and a rational point of view.

The situation is similar for digital immortality. It is uncertain if DI will work, but it seems reasonable to try if there is nothing to lose. However, in real life there are opportunity costs, as explored in the next subsection

## 3.10. Digital immortality as plan C, after life extension and cryonics

There are other options for a contemporary person at the beginning of the 21st century to reach immortality, including life extension until the creation of AI (plan A) and cryonics (plan B) (Turchin, 2015). They seem to have a higher chance of success for most young people, as they could survive until immortality or earn money to pay for cryonics. However, for older and poor people, these two options are less available, and they must go directly to plan C: digital immortality. Plan D in this context is “quantum immortality” (Turchin, 2018).

The idea of a multilevel defense suggests that as the future is very uncertain, different approaches may be tried simultaneously, with investments distributed proportional to their expected effects. A multilevel defense suggests that a person should invest in the three most promising plans, life extension, cryonics, and digital immortality. As the returns on investment diminish for each plan in turn, it seems reasonable to turn to the second most effective plan after investment in the first.

## 3.11. Necessary conditions for DI and its probability of success

There are two necessary conditions for the digital immortality:

1) Human personal identity is (a) “copy-friendly” and (b) “noise stable”.

2) In the future, (a) superintelligent (b) benevolent (c) AI will appear and (d) it will choose to resurrect past people.

These two main conditions consist of 6 mutually independent sub-conditions of unknown truth. If we apply to them theory of logical uncertainty (Kosoy, 2017) and Bayesian logic, we can give them a prior probability of 0.5 each. For digital immortality to be possible, all six conditions must to be true, which has a 1:64 chance, or 1.56 per cent. To get the actual probability of success we need to add probability that the data will be correctly collected and will survive until AI.

Yudkowsky (Yudkowsky, 2016) wrote that this style of reasoning creates underestimation (illustrated by the cases of cryonics and the election of Trump) probably because it excludes the optimizing agent’s “will to win”, which could outperform chance by deliberately concentrating on the weak points of such chains.

Anyway, a 1 per cent of success with DI seems to be a well-reasoned estimation, and personally the author thinks that the chances are even higher.

## 3.12. Overcoming the showstopper effect of the identity problem

The practice shows that most people spend all their available resources not on digital immortality but on musing about the identity problem; people are mostly inclined solutions that are not “copy-friendly”. This tendency may result from the fact that human identity is powerful socio-biological adaptation. Humans are also do not adapted to be in a state of logical uncertainty about complex philosophical problems: they choose to believe.

To overcome the problem, it seems reasonable to add the digital immortality practice to several other similar ideas:

* creating external effective memory (Memex)
* creating a personal assistant-avatar, trained on personal behavior
* preserving family history

## 3.13. Overcoming the fear of the “unfriendly resurrection”

Some people expressed fear that unfriendly AI will resurrect them based on the digital immortality and based on that expressed intent not to be digitally resurrected. But by doing so, they prevented any benevolent AI from creating their digital replicas, but non-benevolent AIs will proceed anyway. So your replicas will find yourself only in hands of UFAI (no matter how improbable UFAI is). And there is non-zero probability that you are not original anyway, but already a replica, so - with some circularity caveat - you just ensured that you are in hands of UFAI.

The same way by refusing to invest in the creation of high-quality replicas, you increase the share of bad quality replicas.

This by agreeing in DI, you increase probability that friendly AI will resurrect you.

# 4. The theory of reverse reconstruction of the human mind

## 4.1 Reconstruction based on traces as an inverse problem

Imagine a function f(t) which outputs string of numbers (f1, f2 … ft). The problem of digital immortality can be formalized as reconstruction of f(t) based on given string of (f1, f2 … ft).

There are two ways to reconstruct the function:

1. Reconstruction of the actual function f(t).
2. Reconstruction of the function f2(t), which outputs the same string of numbers.

If f(t) is a simple function and the string is long, full reconstruction of the function is possible. For example, if we have the string (1, 4, 9, 16, 25) we can conclude that f = x2.

For full reconstruction (1), three conditions must be met:

1. The description of the function f(t) is shorter than the output string.
2. The function f(t) is the simplest function, unique in term of algorithmic complexity that can produce the output F (Ming & Vitányi, 1990).
3. The computational complexity of its reconstruction can be achieved with existing computers.

It is rather obvious that these conditions can’t be realized for the human mind. We can consider the human brain as a very larger neural net, with 100 trillion synapses, and consider that at least 1 kb of data is needed to describe each one. If each description includes information about two connected neurons, the type of synapse and its weight, this is equal to 1017 bits of data, or approximately 1016 bytes.

(Strictly speaking, many different functions could have the same output on part of its inputs – but in human case I just don’t know which one of such similar in beginning functions I am. For example, I don’t know how I will react on 1-million-dollar prize, and there are many future timelines this different reaction which still will be me. In other words, I am indexically uncertain about who I actually am. See also thought experiment about smoking lesion.)

The life-long informational output of the human being is the total sum of signals which the brain sends through its motor functions, which could be roughly estimated as 1 kB a second (and probably less), mostly relating to speech and posture. In that case, the total life output of the brain is 35 GB/year, or 2 terabytes for 70 years = 2 × 10Е12 bytes, that is, 5000 times less than the total amount of data in the brain.

This analysis probably ends the idea of full connectome reconstruction based on behavioral patterns. However, constant changes in the human brain, like learning, pruning and neuronal death do not affect human personal identity, and thus much less information is actually needed.

More on inverse problems: <https://en.wikipedia.org/wiki/Inverse_problem>

## 4.2 Reconstruction of function output based on its previous behavior

But there is another type or reconstruction, this is, reconstruction of the output F, which is more applicable for the human minds. There are three reasons for it:

1. *We can’t observe our connectome,* but only its behavior, even from within. If we ignore here the problem of the nature of the qualia, I will not be able to recognize that a part of my mind was replaced by another system with the same functions. For example, if part of my visual cortex is replaced by another part that can recognize the same objects in the same way, I will not be aware of the difference.
2. *Human minds constantly lose neurons* and their connections without significant loss of socially accepted identity or functionality. An adult brain typically loses 1 per cent of it cortical mass every year, not equal to the loss of 1 per cent of neurons, but neuronal loss is probably the on same order of magnitude. Humans lose a lot of information about the previous day during sleep each night.
3. *Human behavior has a large random component*, with both hardwired non-individual and simple parts (reflexes). The individual, non-random part of human behavior is relatively small.

This means that reconstruction of output F for the human mind could be done with large error, R, which consists of a part connected to the natural human tendency to forget, R1, and a part connected with intrinsic randomness of the human behavior, R2.

Reconstruction of function output with a given error size is a well-explored topic in machine learning. It is probable that the human mind works in the same way, as it is also a neural net. The mind learns to predict the next moments of observed experiences; current artificial neural nets are also remarkable in predicting sequences (Karpathy, 2015) It is assumed that things which I never experienced are not part of me.

The task of behavior prediction is simplified since the behavior of most humans is rather stereotypical. But some of the most important human actions are uniquely individual, like writing original verse or generating creative insights. But if we look deeper, they are not as unique as they seem in the beginning but are part of the larger trained behavior; we see just the tip of the iceberg, and do not see hundreds of failed attempts.

## 4.3. Reordering of facts based on their predictive level

We will assume for now that output F consists of the sum of independent facts or behaviors. In reality, they are connected, but future AI will be able to unravel them, so we can think of them as functionally independent.

In that case, the total behavior could be presented as sum of small behaviors. For example, I sleep 8 hours, like to eat an egg on breakfast, read a spam email at 12h 11min 37sec. All these traits have different predictive value about my future behavior.

Now, my total past behavior F = sum (F1, F2, F3) and it could be extrapolated to my future behavior, F’. But different f has different predictive values. The fact that I slept 8 hours strongly predicts that will sleep around the same time the next day. The fact that I likes egg predicts that I will probably eat egg again, and the fact of reading the spam email all doesn’t predict anything (but my typical reaction to it may be predictive).

Thus, different facts about my past have different predictive value and we could renormalize their order so the most predictive facts are first: F (f(P1), f(P2… f(Pn), where Pn is the predictive power of each fact, and Pn > Pn + 1. The way we measure the predictive power of a fact is not important for now, but it is correlated to the time of the future behavior it predicts.

From the point of view of digital immortality, it is clear that we should collect the most predictive facts first. We will discuss which facts are actually predictive and how to extract them later in the section 5.

## 4.4. Common, unique, and random facts

Another way to classify facts is their level of individuality or “uniqueness”. The output F consists of 3 types of elements:

1. *Common facts*. These are traits which are shared by all humans or everybody from my social group, so there is no need to preserve them. Every human has parents, has two eyes, has reflexes, etc. Not surprisingly, common facts are typically the most predictive. The absence of some common fact may be unique information, for example, if a person has only one eye.
2. *Unique facts*. These facts describe traits of the person which differentiate him from other people.
3. *Ransom facts*. These are facts which have very small predictive power, like news read, the shape of the nail on my left thumb.

From the point of view of digital immortality, we should record all unique facts first, as they are most predictive of unique behavior.

## 4.5 Valuable facts

There are also unique and predictive facts which are trivial and don’t provide any information about individuality of a person. For example, my alarm clock rings at 12:01 PM every day. It is unique and predictive, as the next day it will go off at the same time again, but there is almost no difference about my personality if it is at 12:02 PM every day. The value of the fact is almost zero from my point of view as well as my typical peers (AI may extract some predictions from it, but I don’t regard this fact as important trait of my individuality).

In the other direction, the fact, that I prefer Vermeer over Rafael is an important fact about my self-determination, but its predictive power is lower, as I do not encounter the work of these artists every day.

## 4.6 Combining all types of facts

Based on all that was said in this section, we may conclude that for the successful future reconstruction we need facts about the person which satisfy three conditions. They must

1. Have predictive power
2. Be unique
3. Have subjective and objective value.

These conditions will help us to design tests which collect the most useful data quickly and cheaply, and also helps with data compression, which is important for storage.

All 3 types of properties should be present in fact for it to be important for the digital immortality, as we could imagine situations where only one of the properties is present, and the fact is not suitable for DI:

- *Predictive but not unique fact*: number of fingers

- *Unique but not valuable fact*: the shape of the nail on the little finger

- Predictive and *valuable, but not unique fact*: pin-code from the bank card

## 4.7 The size of human mind

According to the study "How Much Do People Remember?" (Landauer, 1986), the volume of the conscious human memory is about 109 bits, or 125 MB, and the average memory creation speed is 2 bits per second. These estimates were obtained by a set of experiments which asked groups of people to memorize words, images, and included subsequent playback at different intervals. (Crevier, 1993) provided an estimate of total human memory of 2.5 GB in the book "The tumultuous history of the search for AI".

The inspiration for the hero of the film “Rain Man", Kim Peek, was a savant with phenomenal memory. He knew 12,000 books by heart (N. Allen, 2009), which roughly corresponds to 6 gigabytes of information. Thus, even a memory savant can’t have a memory much over the range of several gigabytes.

The size of the Oxford English Dictionary text is 540 MB, corresponding to 310 000 entries. Most native speakers know fewer words. However, we could use this size estimate for this part of memory.

Thus, different estimates of the size of human conscious memory fall between 0.1–6 GB. Based on the size of the Dictionary, even unconscious memory is not much larger. In the following, we will use estimation of 1 GB of target data, what needs to be collected about a human to enable DI. But not every gigabyte equally counts!

Those parts of memory that are more difficult to access are larger, but of less importance, and as a result, we can assume that these two tendencies compensate for each other. Obviously, this estimate immediately raises questions about the role of 100 billion neurons in the human brain and the 1000 synapses of each, which give absolutely different estimates of information in the brain, on the order of 1016, or a billion times greater than our estimation of conscious memory.

If you believe that your personality is a powerful supercomputer, try to memorize the number 105578932879 and repeat it in 5 minutes. DI treats the personality as a program, and the brain as its carrier. Thus, there is no direct connection between the amount of information in the brain, and the amount of information in the mind. Similarly, there is no connection between the number of atoms in the flash drive and the number of letters in a document stored in it.

But if we consider that estimate of 1 GB of memory includes a lot of junk data, like non-unique, non-personal, random, or never-used memories, it seems that extracting of around 10 MB of data could be enough to extract most of unique, valuable and predictable information. We will call these “essential memories”. The amount of data contained in these essential memories is still very large, on the order of 5 times more than “War and Peace”.

## 4.8 Principle uploading speed limit and technical feasibility of digital immortality

The main problem of extracting information from the brain is that a person can consciously give out a very small amount of information, in contrast to the speed of visual perception, which is up to 1 MB/s in the optic nerve (Jonas, Schmidt, Müller-Bergh, Schlötzer-Schrehardt, & Naumann, 1992). For example, a person can, in principle, write 20 pages a day by hand or on a computer (about 40 kB), if he devotes all his time to that purpose and is not at the same time a professional secretary. Such writing is equal to an uploading speed of 14 MB a year, and 1 GB will be uploaded in 70 years. The holder of the Guinness World Record for the most prolific writer, C. Tellado, has written 4000 novels, which may be equal to 1.6 GB, assuming normal novel size (Thetimsonline, 2010). But most prolific professional writers wrote less than the 1 GB of total human memory. Isaac Asimov published 7.5 million words across 108 books, equal to only 45 MB, by the age of 49 (Nichols, 1969) and wrote even more after. Prolific AI safety writer E.Yudkowsky’s “Sequences” are 1 million words (ciphergoth, 2011).

The quickest way of uploading information is as speech, which is typically equal to 1 page every 2 minutes. A person speaking for several hours in a row could maybe read 100 pages, but for most, such speech would be unnatural and exhausting.

In general, we can assume that a person can hardly afford to spend more than 100 consecutive days of clean time on self-description—after all, one must also live. Otherwise, a description of one’s life will consist of a description of the description process. Thus, the maximum size of autobiographic information is not much than 10 000 pages, or around 10 megabytes, which is 100 times less than our full estimation of conscious memory, but should be enough, based on the “essential memories” concept.

Other instruments, like background data recording and DNA tests, could help to ensure that needed data is collected.

## 4.9 Uploaded data as a hash of the “mind function”

In previous sections, we have generally ignored the fact that collected data need to be deciphered to be converted into predictive functions. If we have excess data, such deciphering is not needed: we could just train a neural net or use other types of machine learning to extrapolate from the data. Current neural nets are using similar methods to learn to drive the cars: they are fed hundreds of thousands of hours of data and then become able to predict correct driver behavior without knowing rules.

But in many cases the output of human behavior causally corresponds to human traits but does not actually present the traits. Sometimes this may be just because it is a non-verbal skill, or because a person has some secret motives or unconscious desires. The situation in some sense is similar to the generation of a so-called cryptographic hash function (Preneel, 1994): this is a computationally complex transformation of input data which allow outsiders to identify, but not reconstruct, the original data.

In the same way, personal handwriting style can identify human’s unique handwriting skill, but we don’t have any idea how actually reconstruct the skill—and because of this feature, handwriting is a method for identification.

These factors combine to explain why we think that only superintelligent AI will be able to reconstruct human personal traits based on collected information. The computational complexity of such reconstruction may be extremely high and may require running quantum computers or world simulations, which will be discussed later.

We could also deliberately put the human mind, which we want to record, in situations where it generates such hashes:

1. *Filter situation*. The mind works as a filter of known data, for example, drawing a still life. In that case, distortions of the input works to reveal unique features of the mind, like its digital signature.
2. *Free generation situations*. Such situations may include free drawing based on imagination and automatic writing.

## 4.10 Combining the declining predictive power of facts with our identity threshold

In section 2, we stated our ideal: the ability to predict 99.9 percent of behavior, plus a full indexical core. If a person’s behavior is not evolving very quickly (as it seems true for most adults), that would mean that we need to record 99.9 percent of previous behavior to achieve that level of future prediction.

And by saying “behavior”, we should include here “internal behavior”, that is, thoughts, dreams, and hidden emotions.

The task of recording so much information seems to be complex, but our idea of “renormalization of facts”, and the idea of the half-life time of memory survival, provide an opportunity to record much less. Because of the declining predictive power of facts, recording the first N facts will be enough to predict future behavior to the needed threshold of 99.9 accuracy.

To estimate the value of N, we need some model of how the predictive power of facts declines, and also an assumption that we know how to find and extract predictive facts ahead of other facts. If predictive power declines exponentially, we would not need to record many facts; however, it seems that it declines slowly for most human beings. See fig. 1 for a representation of the estimated relationship between the predictive power of different types of facts.

The main question is how we can predict which facts are predictive, so they could be extracted first. One idea is that human behavior is cyclic, with cycles during the day and week, and if we record several such cycles, we will be able to predict the next cycle, as wells as the typical level of deviation between cycles.

Another idea is that the most predictive facts are those that already affected my past. If that is the case, something I remember often is more predictive, and if I never remember a fact which I know, it is less predictive. Thus, predictive facts take more time in the past.

The third idea is that humans are in some sense “holographic”, that is, smaller parts of their behavior resemble larger parts, and everything done by an individual seems to be done in their personal style. Some popular psychologists suggest that if you want to know how a person is during sex, look how the person eats—and this idea illustrates coherence of the personal style in different activities (Roberts-Grey, 2015).

Training datasets and environments also have strong predictive power. For example, learning the person’s native neighbourhood could help to predict types of behavior, like jokes, she may like. Similar environmental factors may include her musical playlists and composition and habits of friend circle (even now “shadow profile could be created about a person who never signed up on the Facebook (SpiderOak, 2016)).

Internal “feeling of self”—sometimes presented as a core of personal identity—could be learned from examining a person’s posture as it is presented via contraction of some muscles. Another part of “feeling of self” is the internal image of oneself, and it can be extracted by self-image drawings or transformative games.



*Fig. 1. Predictive level of facts. Unique facts, which are needed for DI, form a rather narrow strip between common and random facts; inside this strip, the curve declines almost linearly and doesn’t change much*.

## 4.11 Individual variance of predictability

It is not easy to estimate in advance the speed of decline of the power of predictive facts for typical human beings. It will require extensive psychological research, and it will surely vary between individuals; it is much more difficult to predict Einstein then to predict Mr. Smith. It seems that younger individuals with higher intelligence are less predictable, and older and less-intelligent people are less predictable.

However, a person, who underwent long “individualization” in the Jungian sense, for example, a self-taught artist, or an original thinker, may have many more individual traits than a younger person who is primarily shaped by his education and environment.

Older people (not affected by memory decline connected with aging) are carriers of large amounts of unique information.

## 4.12 Predictive facts as limits in the space of possible minds

It is wrong to think about predictive facts as simple behavioral patterns which future AI will mindlessly replicate. This idea affects current creators of chat-bots of the deceased people, who try to hard-code replies in the style “if X then Y”. Such replication would not be a real person and will invoke negative feelings from the public who will feel that it is a fake. Such replicates will be damaging to the idea of digital immortality.

Another view of predictive facts is how they “slice” the set of all possible minds (Yampolskiy, 2014). If we know that a person was born a woman, it automatically slices the set almost in half. The best predictive facts are those that maximally slice uncertainty in the set of all possible minds. We could know now that some facts are very strong, but we can’t predict how exactly they will affect the behavior. For such a prediction, we need superintelligent AI; without it, our prediction will be wrong.

# 5. Cost-effective extraction of the best predictive facts

## 5.1 The problem of the cost-effective extraction

Reasons DI is needed (section 2), criteria for informational identity (section 3), and the informational theory behind DI (section 4) have been explored. From this basis, an important question can be formulated:

*What is the most cost-effective way to extract the best predictive information about a human being?*

The question is important from the practical point of view. There is no reason to try DI if it can’t be done in a cost-effective manner. Cost-effectiveness here is relative to two factors:

1. Limited resources. A person can’t spend all her money and time on constant recording of everything, as she needs time to live her life and invest in other life-extension opportunities.
2. Different prices of predictive facts. Even constant recording could be done wrong if an important source of predictive facts is lost.

To solve this problem, existing sources of information about typical human beings will be examined in this section, and different extraction strategies analysed in the the next.

## 5.2 Human behavior

The most obvious source of information about a person is her behavior, which consists of:

* Symbolic behavior, mostly in use of language via speech and writing
* Actions, which include moving, dancing, working
* Expression of emotions, e.g. changes of facial expression

Here human "internal behavior” also should be added, which can’t be accessed directly but could be reached using different advance technologies or self-reporting:

* Thoughts (stream of consciousness)
* Internal mental images
* Emotions
* Dreams

## 5.3 DNA data

Another important source of personal information is human DNA. We know that twins are very similar in many aspects, because they share the same DNA. Any human cell has a full copy of a person’s DNA; thus, preserving even a small amount of tissue could provide us with an enormous amount of predictive information.

The size of human genome is 700 MB, but the individual variance is around 3 million changes, requiring about 125 MB to record, as for each change both the type and its location must be recorded (Robinson, 2014).

However, the expression pattern of DNA (phenotype) is individual, and changes with age. This depends on epigenetic factors, including methylation and which of the two copies of a gene is dominant. Some tissues probably could also preserve methylation patterns, but they may be different in different parts of the body. The pattern of gene expression diverges during cells differentiation (Ochab-Marcinek & Tabaka, 2010).

There are other factors that affect gene expression. For example, gene expression is more complex in women, as they have two copies of the X chromosome, and one of them is inactivated early in life, which happens randomly in different cells (Learn.Genetics, 2018). This produces different body coloring in cat clones, as color gene is on X chromosome. Some people are chimeric (Praderio, 2017), and have cells from two different twins which merged in womb on early stages.

Preserving tissue samples provide more information than just DNA. Even now, archeologists are able to reconstruct what a person ate and where she travelled based on the isotopic composition of bones. Tissues samples include microbiome, viruses, and even could have pieces of other people’s DNA, if it is from surface skin. Hormone level, toxins and maybe even RNA from brain (it was recently discovered that some neurons express capsids containing RNA (NIH, 2018)) also probably could be found in the tissue samples. The best tissue sample is full-body cryopreservation; many providers of cryonics also provide facilities to preserve tissue samples.

Hair is not a very good sample source, as special enzymes damage its DNA. One of the simplest solutions is blood and epithelial skin cells samples from inside the cheek, collected by cotton swabs. Dry blood is also relatively well preserved.

## 5.4 Digital footprint

Internet usage is very a distinctive part of human behavior. Humans currently spend a lot of time on the internet, and large amounts of this activity is recorded. Facebook records all news you have seen, not to mention information about which articles you liked. Your browser cache keeps track of all sites you visit. Most people openly share enormous amounts of information on social networks, and even if you don’t have an account, you will appear on the accounts of other people. There are rumors that some devices are constantly recording you, and voice assistants like Amazon’s Alexa probably do this.

This information costs money, as it provides marketing opportunities and AI-training possibilities that motivate companies to preserve it. However, the ways humans express themselves on the internet are socially restricted and affected by fashions. For example, there is a current fashion to post photos of one’s meals on Instagram. Such fashions make information less individual. There are also topics about which people will not post, as they may be illegal, compromising, or just embarrassing.

## 5.5 Relatives’ memories and expectations

Other people have a lot of memories about us, as well as expectations about our behavior. While this information is surely biased, in some cases it could be the only source of information about a person. These sources will be especially useful in case of immortality-for-other, as in that case the criterion and the source of information is the same; thus it is possible for a reconstruction to completely comply with expectations.

## 5.6 Security camera recordings

A lot of data is preserved by commercial and governmental security organizations. Video is the best external source information about a person, as it is most informationally coherent and informationally rich. It provides action, speech, and emotional clues, as well as context.

## 5.7 Personal belongings and archives

The environment a person creates carries the imprint of his personality. It also shapes his line of thoughts, and may carry small pieces of DNA among other forensic information. Handwritten archives, bills, photos from childhood also are large potential sources of data. All of these features provide valuable clues for DI.

## 5.8 Medical brain data

The idea of DI is based in the understanding brain uploading is currently impossible. However, because of developing technologies, new ways of getting data from inside the brain are becoming possible. There are two main currently available instruments:

1) Multi-channel EEG. The best systems currently provide 128 channels of data with high resolution. Simple wearable systems are available, like Muse, which has 4 channels.

2) Functional tomography. fMRT is expensive and potentially risky procedure which currently not available for DI goals.

Both instruments have already been used to reconstruct data from the brain. EEG has been used to reconstruct hands movements (Kim, Biessmann, & Lee, 2014). Deep learning based on EEG data was used to reconstruct visual images (Shen, Horikawa, Majima, & Kamitani, 2017). EEG was used to reconstruct words from a brain and it is expected that in 5 years it could be used to record thoughts on a smartphone (Jonston, 2017).

Electrodes attached to the throat will probably allow reading of small changes in muscular tension resulting from the internal thought stream—but this data will still require machine learning to reconstruct the real words that are being said. Some research on the topic was done by I.Trapesnikov (personal communication). This technology creates the opportunity to build a wearable device which constantly records one’s thoughts, data which will provide a large boost for digital immortality.

## 5.9 The subconscious—should it be regarded as part of the personality?

There are some processes in the brain which surely are not parts of our personality, like the activity of glia. Some unconscious processes may affect the self, but they are almost external to the personality; they could appear in dreams, like Freudian complexes. The situation is even more complex in the case of multiple personality disorder.

## 5.10 Human social graphs and the need for collective digital immortality

As humans are extremely social and mirror each other behavior, reconstruction of one’s social connections provides a lot of knowledge about an individual.

Collective digital immortality means that a person will be resurrected not alone, but inside his social circle.

## 5.11 Unexpected reactions

Another question is: should parts of myself, like my reactions to stimuli I have never experienced, like certain type of pain, be considered part of my personality? Probably, that we could safely ignore them.

## 5.12 Intersection of different data sources

It seems rather obvious that combining data sources will offer better prediction, in much the same way two spotlights from different directions are able to better highlight a dark area.

## 5.13 Sources of human individuality

There are three main sources of human individuality, that is, the uniqueness of a person, in the reductionist world model:

1) Initial conditions, i.e. DNA.

2) Training dataset, summed up as total education.

3) Random processes in the brain, which stack one on the another and create individuality.

If future AI has data on all sources of individuality, it will be able reconstruct this individuality. However, some part of individuality is “inborn”, like the property of 27 = 33. This individual property of the number 27 doesn’t depend on the way in which 27 is reached, e.g. 26 + 1 = 27 or 81÷3 = 27.

# 6. Main strategies of DI: passive and active uploading

## 6.1 DI as an acausal deal with future superintelligence

DI implies some form of partner relationship with future superintelligence, which is counterfactual. Different forms of such deals have been explored (Turchin, 2017b). We don’t know if superintelligence will appear, and we can’t know its final goals and capabilities. However, we could influence its goals by changing the ways in which we create AI.

Anyway, we assume that future superintelligence will have enormous computational capacity and also will have a goal to return dead people to life, in line of thoughts of cosmist Fedorov (Fedorov, 1903). Thus, in planning for DI we are collaborating with future AI, and we should try to help it get the information which will be most useful for the future reconstruction of people. We should also try to create such AI in the future and take steps to ensure that it will be benevolent and interested in the resurrection of the dead.

But the task has significant intrinsic uncertainty, as we don’t know how much information is needed or which information will be available from other sources that we can’t even imagine now. Some examples we can predict are global archeology and quantum archeology, resurrection simulations, and trade between multiverse branches, which will be discussed later.

By choosing a strategy for data collection, we make some assumptions about the abilities, and indeed, existence, of future AI:

1. *Superintelligence (SI) will appear*.
2. *SI will want to resurrect humans* with human-benevolent goals, not for strange experiments but to help people.
3. *SI will be not omniscient*; omniscient SI would make data collection unnecessary.
4. *SI will able to solve any equations* with unique decipherability; thus, we must collect data but will not need to decipher it).
5. *SI will appear relatively soon—*in the 21th century—and will have access to all current common human knowledge, so we don’t need to preserve non-unique information.

## 6.2 Main strategies of DI: data-driven, experiments and self-description

There are several main strategies for personality capture:

1. *Data driven*. Here it is assumed that an enormous amount of data is all that is needed, and future AI will able extract from it all the answers it will need. The main problem of this approach is its “behaviorist” philosophical basis, that is, it completely ignores personal subjectivity, will, and the ability to have secrets. Important predictive facts could be easily lost.
2. *Self-description based.* This is based on the idea of Rousseau, that a person is an inside observer of her own psychological processes, who can consciously conduct experiments on herself, determine the validity and predictive power of data, extract needed files, and even edit her own personality. The core method here is to write a complete and detailed autobiography.

Self-description is the highest level of uploading, and raw data collection about the brain is the lowest. Somewhere in between lie experimental testing and other ideas:

1. *Experiments and tests*. A subject runs a series of tests on her own brain in order to extract data via some technological setup. A fictional example of it could be seen in the movie *Transcendence* (Pfister, 2014), where main character was saying associations to words he heard while EEG signals were recorded. The evolution of this approach will probably evolve into real uploading
2. *Side-loading*. In this case, a model of the person is created simultaneously with data collection and calibrated based on human output. The model is based on some “human matrix”, that is, a model of the human brain without any individual traits. This approach is not currently widely available, but it is possible; in one case, a son created a father-chatbot and calibrated it with his father while his father was still alive (Vlahos, 2017). This idea has also appeared in the novel *Zendegi* (Egan, 2011).
3. *Personal assistant evolving into “exocortex”* and later into a digital copy of the owner. The major benefit of this approach is that it could be commercialized right now, and people are already investing in some digital helpers, like Evernote. The computer has already replaced our memory as the main instrument to preserve photos.

## 6.3 Not a black box, but a black torus

One way to describe DI is by analogy to a black box of which one wanted to create a copy. The copier doesn’t know what is inside the box, but she could record input and outputs signals. Thus, she could create a table of input and outputs, and when the table is sufficiently large, she will be able to predict the output with increasingly higher probability. To collect the data, she needs to put the black box in many maximally different situations.

However, the black box metaphor is an oversimplification, because inside the “black box” there is a conscious observer, a person who can observe her mental processes from inside. She could run experiments, address and extract memories, and make conclusions about the nature of psychological process she observes. She also has some accumulated experience about herself which she could present in the form declarations of personal traits.

Such a situation, a “black box” with an observer inside in it, could be called a “black torus”.

## 6.4 Combining strategies

The main way to combine strategies is use them at different times, though techniques should be consistent over time. Passive data collection could happen constantly in a background mode. Active data collection could combine different methods of self-description and self-experiment, but happen during discrete intense sessions.

After initial data collection, marginal backups are needed every so often, as personality changes. I estimate that major data uploading needs to happen approximately every 10 years, especially given that completely new uploading technologies typically appear during such a period, and also because of substantial personality changes may occur on such timescales. Shorter, less-intensive sessions are needed every year, which could coincide with proper data backup from hard drives.

Background data collection should happen all the time, and include speech recording, preservation of digital archives, informational photo and video collection, as well as preservation of random papers (like bills and tickets).

# 7. Digital immortality and art

Works of art meet the requirements of *predictive power, uniqueness* and *value* described above for DI. Every person has a unique art style, first of all, in drawing, in the same way everyone has a unique style of handwriting.

Art is typically a part of the best and most valuable things a person does. We love our friends for the stories they tell, the food they cook, the pictures they draw—and the way they react on us.

The artistic style of a person has predictive power over what she will create next. Style evolves with the creation of new art objects. Style is something like as a personal “hash function” or signature. A full and correct copy will create objects in the same style.

Creation of complex art requires coordination of all brain systems, so the complexity of the output corresponds to the complexity of the human mind. Many human actions don’t have such complexity—they are automatic, like walking, and a person does them mindlessly, devoting to them only part of their brain activity. The information traces of such actions have small algorithmic complexity and they are not footprints of the whole mind.

The world is constantly collecting more and more data about people using the Internet and video surveillance, and is investing in the storage of these data. But this is only passive information, and there is little of the essential and individual in it. Academic art education also kills individuality of style.

Contemporary humans are affected by powerful streams of data via mass media, which produce standardization of human minds, killing individual traces. The mechanism of it is “unconscious learning”. Naïve or outsider artists of the past, like Darger, lived in hermetic worlds where they had time to evolve their personal style, training on their own personal output.

Different types of art could be used as instruments to get special types of information. Spontaneous drawing presents content from the subconscious. Self-portrait is a presentation of person’s idea of Self. Drawing from nature acts as an information filter, and so we learn what kind of filter it is.

But what is art? It is not only drawing: singing, a story about life, dancing, theater, cooking—any complex unique activity acts as an imprint of personality. Moreover, different modes of artistic expression give different angles on the human’s personality, so it should not be limited to just one genre.

Art objects do naturally last better. Pictures can exist for hundreds of years and their value is recognized, so they are not likely to be intentionally destroyed. Novels can be copied.

If a neural network is maximally amplifying random noise, it could reveal the type of data on which it was trained. This is how Google’s “dreaming” networks work, and it provides insight into image generation in the human mind (Keshavan & Sudarshan, 2017). Human dreams are also revealing when considering the human subconscious. The same way, similar data could be extracted via spontaneous drawing—or on crystal-ball gazing, where random noise is amplified.

See my presentation: “DI and art” <https://www.slideshare.net/avturchin/ss-80472635> (Turchin, 2017a)

# 8. Post-mortem DI

Even if a person has died, it doesn’t mean that we have to stop fighting for his life. We could try cryonic method of plastination—that is, brain preservation with the goal of the future resurrection. But even if the brain was not preserved, it is not the end. A lot of data could be collected about the person, as has been done about some famous people by their biographers. I and some other researchers in digital immortality have collected data about their dead friends and relatives.

Information held by external carriers decays after a person’s death, so it should be collected as soon as possible, within the first months and years after death.

There are several main sources of data for post-mortem digital immortality:

1) DNA samples

2) Interviews with friends and relatives

3) Personal archives + hard drives + data on obsolete carriers + other people’s archives

4) Belongings and home.

5) Internet archives, including browser cash, websites and social network accounts.

Often surprisingly small amounts of data remain despite availability of videorecording and other data-gathering systems in the modern world.

# 9. Integration potential of DI

DI could be combined with several other powerful instruments, technologies and projects, enriching their potential and lowering prices.

## 9.1 Growth of technologies

The exponential growth of information technologies makes DI simpler with every year. We can collect more data, we have new instruments to examine the brain, and a lot of data is now collected automatically by the internet, banks, and security agencies. Every person now is better-recorded than most people were in the 20th century, except some celebrities or authors of autobiography.

Technological acceleration also provides new methods of data storage, but the situation here is not as good. A lot of data is lost on dead drives or to abandoned or unpaid accounts. It may have a better chance of survival if it were printed on paper. However, some effective solutions exist, like The Internet Archive, eternal M-disks, torrents, and blockchains.

The growth of information technology also implies that superintelligent AI could appear relatively soon, within several decades of the present day, and could recreate us, as well as collect data from currently untapped sources.

## 9.2 DI + cryonics

Cryonics is another instrument that can be used to reach future technological resurrection (Best, 2008). Surely, a lot of data from the brain will be lost if cryopreservation procedures are not perfect. Most likely, frozen—or more correctly, vitrified, preserved in a cold, glass-like state instead of crystallized by normal freezing—brains will be a source of data for future AI.

Such data could have holes, and digital immorality data could be used to fill in gaps and check the quality of the resurrection procedure.

Cryonic preservation of other people and even animals may be useful my personal digital immortality, as they have memories about me. Some people may have eidetic memory, which is almost like video, even if they can’t access it consciously.

A cryocompany may be used for the preservation of discs carrying data as well as cryopreservation of tissue samples.

## 9.3 DI + direct mind uploading

Constant development of the technologies that enable digital immortality will eventually merge with mind uploading technologies. Better ways to extract information from the brain via brain implants, neural dust, etc., will give a huge boost to digital immortality before full uploading is possible.

Some intermediate forms between DI and mind uploading will probably appear, like brain implants and personal assistants.

## 9.4 DI + exocortex

Creation of the exocortex, that is, a brain implant and other systems which collectively increase the intellectual potential of a person, will allow collection of large amount of data about the individual.

## 9.5 DI + quantum immortality

So-called “quantum immortality” is one particular case of “multiverse immortality” (Turchin, 2018), the idea that in a multiverse, all possible minds exist, and there will be always my next observer-moment, moment T+1 for any T. In particular, the situation of quantum immortality arises if the many-worlds interpretation of quantum mechanics is true; in that case, in any situation where I can die or survive, there is a possible future time-line where I survive.

But the problem is that it is not good per se, as most likely I will survive in some “bad immortality” time-line, for example, eternal aging without ability to die.

However, if digital immortality exists in the world, there is the possibility that my next observer-moment will be recreated by digital immortality, and the probability of this is much higher than the future of eternal aging.

Some lost data may be filled via quantum randomness generator (Almond, 2006). In a many-worlds multiverse, all needed data for the person’s resurrection will appear in some timeline. It will not result in the “measure” decline despite widespread belief, as the same experiment will be done by AIs in other worlds with other instances of “me”, so the total sum of measure will not change.

## 9.6 DI + Alzheimer

With aging, humans lose many personal traits which have value to them. Dementia, a common disorder of aging, causes patients to lose memories rapidly; however, even healthy people tend to lose memories. Thus, digital immortality could be useful even during the natural lifespan. We could use it personally or with help of future AI to return important memories, to return to being our “actual self”, not the bleak shadow which we become due to aging.

## 9.7 Resurrectional simulations

It is rather probable that the future AI will make large ancestral simulations (Bostrom, 2003). It could do it for different reasons, some of them rather technical, like modeling the conditions in which it appeared.

But it could also do one simulation of the past to resurrect all people who have ever lived. In that case, it will use all data not to model just one person, but to model all of human history. Such a model may be the most powerful instrument to extract useful predictions from available evidence. Some people who lived in the recent past will be modeled almost exactly, as there are a lot of data about them and thus uncertainty is small. But uncertainty will increase with distance in the past.

After a person lives his whole life in the resurrectional simulation, he will die in it, but appear in some form of “afterlife”; there all his personal data will be integrated in a whole and perfect personality. Surely, the best strategy how to resurrect people is in hands of the superintelligence.

There is a possibility that we already live in such a resurrectional simulation.

## 9.8. DI as psychotherapy

Many forms of therapy create a lot of data, and by practicing DI, the patient in therapy could also solve some of his problems and obtain a better knowledge of himself. Art therapy is an established field of psychotherapy. Another direction is self-analysis in Freudian terms (Horney, 1942). Automotive writing also could be used as an instrument for psychological problem solving, similar to Stone’s voice dialogue (Stone & Stone, 2011).

Thus, it may be useful to record data during psychotherapy (which is often not recorded or is later deleted).

## 9.9 Speed of personal changes and DI

The older a person is, the more slowly she normally changes. Quicker changes mean that DI data become obsolete more quickly. The changes between ages 10 and 15 are enormous, but in most cases the changes between 50 and 55 are rather small. However, there are people who evolve all their lives or experience a transformative experience at a later age—though their number is small. It is much more difficult to change personal traits at older ages, and long-term memories are more difficult to form. At the later stages of aging the changes becomes quicker again.

## 9.10 DI and family history

Genealogy is one of the most popular hobbies in Western countries. Collecting data about old family members may contribute to two goals: proper digital immortality and creation of better family histories, which will be available now.

## 9.11 Social aspects of DI

It looks like DI is largely a solitary activity, but many social activities could help:

* Create a startup
* Do it with friends, both for motivation and to polish the protocol
* Hire a biographer
* Become a famous person, so people will be naturally interested to collect and preserve data about you.
* Take actions which have a bigger footprint in the internet. Try to correctly present your views.
* Don’t lie and don’t keep secrets. It could damage your perspective of DI. To do so, don’t pursue a career which requires a lot of lying about your personality (like a con artist).
* Help others to collect their data. It will train you in DI techniques, and you will also be recorded when you ask questions. Another bonus is that the people around you will be correctly resurrected with you.
* Take chances to act uniquely and record it. Agree to give public presentations and interviews.
* Promote the idea of DI—more people collecting DI data increases the chances that effective technologies will appear and that future AI will include DI-based resurrection in its agenda.

## 9.12 Age-related strategies for DI

For a young person, we are mostly interested in what she can be, but for an older one we are more interested in what she was, as she loses many valuable traits because of aging. This implies a different focus of interest of DI, the younger person. We may be interested in her creative style and in the direction of evolution of this style, which could be called “style of style”, while her memories are of less importance; she may forget most of them soon anyway. For older people, we are mostly interested in well-established skills, habits, and memories.

This is all connected with the notion that the personal identity of a human being is a complex socio-biological adaptation, which consists of several mutually supporting parts, and evolves with age.

# 10. Digital immortality as a cause of effective altruism

Surprisingly few people have ever been interested in digital immortality, probably less than 1000 worldwide as of 2018. Terasem reported 500 subscribers to their services; in Russia, I personally knows around 10 people who practice data recording for DI. These numbers are even smaller than number of people interested in cryonics, which has several thousand subscribers. However, DI is the cheapest way to immortality. Anyone who owns a computer and could afford to spend around 1 month on the project, could collect significant amount of data about his personality, which significantly increase the fidelity of his future reconstruction. DI could even be done without a computer, using paper and pen.

Reconstruction by an AI means one will be effectively immortal. Thus, DI is the cheapest way to save people from death. It could be estimated that preliminary data collection may cost around 1000 USD per person, mostly in form of the time. Advanced forms of DI data collection could be more expensive, as they include EEG, functional tomography, and an interview team, but may still be cheaper than high-end cryonics (see our similar take on fighting aging as a cause for effective altruism (Turchin, Denkenberger, Milova, Egorova, & Batin, 2017)).

Preservation of information about other people will help to reconstruct an individual’s possible reactions to them. Thus, collective digital immortality is the best option, as it provides mutual help in the reconstruction of each person. It also makes all procedures cheaper and increase the probability that reconstruction will happen.

# 11. Theory behind different recording technologies

In section 5, I analyzed different data sources. Here, I will look at some existing data-extraction technologies and analyze the effectiveness, shortcomings, and the best practices for the implementation of each.

## 11.1 Association tables

In the movie *Transcendence* (2014), the main character plays with free association. However, in experiments with Trapeznikov, we found that such experiments are mentally exhausting and put one in a trance-like state. In addition, most replies are not unique.

Another method is to draw all associations as a small mindmap around the central word.

## 11.2 Encyclopedia of things

Many ideas in the human mind are just mental images of unique things, like “my table” or “my cats”. To upload a person, an encyclopedia of such unique things is need. So, one may create a list of all types of most frequent unique objects, and then create descriptions of them, consisting of text and drawings. Drawings and handwritten text are a good way to capture personal style. During a self-description experiment in 1990, I found that he had around of 1000 unique objects, after which he was exhausted.

## 11.3 Encyclopedia of people

In the same way, an encyclopedia of friends could be created. A typical person has around 150 close friends, plus some historical people, like classmates, who still appear in our thoughts and dreams.

## 11.4 Declaration of personal properties

Everyone has an image of oneself, which include some ideas about personal properties. These ideas are often wrong, as they affected by different biases. However, self-image is part of the personality and informational identity core, and all such ideas about the self should be recorded. They are also based on long-term observation of one’s own behavior and carry an imprint of one’s values.

Berdyaev self-analysis (Berdyaev, 1950) is full of declarations of such personal traits. In some moment, the declaration of traits becomes the act not of self-description, but of self-constructing, as it presents the image of the idealized “me”, and even could change the self in the desired direction.

## 11.5 Automative writing of stream of consciousness

Self-description becomes easy after “installing” several skills, like remembering to start a recorder during interesting conversations. Another important skill is the ability to record one’s own thought stream in the style of automatic writing. Just sit at the table and record everything you have in mind, maybe using handwriting as it creates lower internal censorship. At the beginning, you will not know what to write, but later, you will adapt to record your thought stream.

Another important skill for DI is reflective thinking, which is the polar opposite of automatic writing, as it is the ability to think about what you think and trace small changes of emotions, the logic of one’s own thoughts, and physical conditions. In some sense, it is close to meditation.

## 11.6 Recording childhood memories

Childhood memories may be important part of the personal identity, as first mentioned by (Maeterlinck, 1907); otherwise godlike future selves will have no individuality. However, most geniuses have more individuality than simple men, so the growth of abilities does not produce a decrease in individuality.

Recording childhood memories is important, as according to many psychological theories such memories affect personality formation and serve as “psychological DNA”. I suggest recording of all memories until some age, like 10 years. However, human memory is variable, and some people remember themselves from different ages. The most traumatic and important memories probably should be recorded first as they have the large effect on the formation of individuality.

A person has an understanding what things which has happened with him are the most important, and these memories should be recorded first.

## 11.7 Video interview

For a video interview, several important conditions are needed. The first is a good interviewer. The problem is that many people have a ready-made life story which they could repeat but which is lacks important facets: it is just a social presentation of honorable and acceptable facts. A good interviewer can coax a person to open up and to go deeper in his soul, to make him answer spontaneously. Thus, it may be reasonable to hire an experienced professional interviewer. Another option is to use non-standard questions.

Another condition is high recording quality. HD video is needed to capture facial microexpressions, and at least 2 cameras are needed to get two different planes, full body and facial. Light should not be LED-based, to avoid blinks. Another camera should be behind the interviewed person to capture body language.

From my with Trapeznikov experience, preparing a proper setup for recording (with EEG) take up to 3 hours, and recording can’t be longer than 1 hour, as after that time both interviewer and subject are exhausted. High quality audio is needed, and killing background noises is one of the most useful things here. Using wearable mics and a ZOOM recorder is helpful.

Another option is relaxed videorecording on a phone, which could be much longer and doesn’t make people tense. But the cellular connection should be turned off, to avoid the chance a random call could kill the video, as in some phones it will be not preserved.

## 11.8 Professional police and psychological checklist

A lot of personality tests and questionnaires already exist. Police have exhaustive questionnaires about all personal traits, like “who were your friends in 5th grade”.

You can provide a lot of information about yourself by liking claims with which you are agree on Reddit.

## 11.9 Dream diary + drawings

Recording of dreams may provide useful insights into the opaque world of the personal unconscious. However, most text about dreams is very uninformative, as the structure of the dream is broken after awakening. Thus, it may be more productive to draw pictures about dreams and try to comment extensively about what you felt and thought during the dream. Japanese scientists have used MRI for dream reconstruction, EEG may provide better clues in the future (Anwar, 2011; Robertson, 2013).

## 11.10 EEG + spontaneous art

EEG gives some information about the brain, but currently we can only partially decipher it. Japanese scientists presented some form of mindreading via EEG in 2017, and expect that a smartphone app able to read thought stream will appear in 2022 (Jonston, 2017). EEG is already used in thought identification research (Nemrodov, Niemeier, Patel, & Nestor, 2018).

We hope that future AI will able to extract much more information from our EEG data. But we need to not just record EEG data, but all other activities of the person at the same time, so we will have audio and video clues for context. As we said before, creating art is the most complex and valuable thing a person can do for DI purposes, so it seems reasonable to try to record EEG while a person is making art. The most suitable form of art for such experiments are drawings.

## 11.11 Scanning of paper archive

All paper archives should be scanned, but not destroyed, as paper could survive longer than many digital carriers. It may be photographed and the photography or scanning process may be recorded on video, where some comments will be provided about the contents of the papers, like “this is a photo of my grandfather”. The papers will be triggers for some reactions; it is better to this together with a partner as it will be fun and naturally create opportunities for conversation. Doing it alone may be sad: archives are often full of past memory triggers.

## 11.12 Spontaneous theatre

Spontaneous theatre, also known as improv classes, may help to quickly put a person in many very different positions and demonstrate different types of reactions. Dialog and other forms of psychodrama are also similar to spontaneous theatre.

If a person is doing the same activity during every DI recording session, its informational content will diminish. Changes of activity will provide new spotlight positions to discover new personality traits.

It should be noted that if a person is a professional in some skill, his performance of this skill may be less informative about his personality, like art in case of a trained artist.

## 11.13 Lists

It may be useful starting point to create several lists of facts about oneself:

Movie I’ve seen + I liked + I hate

Books

Friends

Places I visited: cities, countries

My love

My secrets

My illnesses

My bad days

“Ask reddit” may be a source of unexpected questions.

My cars, my pets, my bags, etc

## 11.14 Guided visualization and active imagination

Jungian “active imagination” (Jung, 1925) is a form of guided visualization which uses open questions to maximally stimulate a person’s imagination and provide access to the content of the subconscious. Some people easily enter the trance state and see very bright pictures full of interesting subjects. See my book in Russian about active imagination (Turchin, 2007).

Active imagination may be combined with other recording techniques like EEG and video recording.

## 11.15 Idealized world: a novel

One of the important parts of the human identity is the set of personal values, but values are complex and not easy to extract. One way to capture such values is to write a novel with an image of ideal world, where a person would want to live. It will help to capture a core of the person’s identity.

Also, a novel is one of the most complex form of art, which mirrors the all sides of the personality. It may be supplemented with drawings, music, maps. Other forms of art are narrower and have less “algorithmic complexity”. A novel represents not just a set of boring facts, but the best of what I have in my personality—the best of me, which I want to present to the future.

Self-description is a transformative practice where our individuality not only fixated, but appear, and where we create an image of the future idealized self.

It is a part of human nature to want to improve and to change one’s own personality. Thus, creating an idealized image of the self will be not only the fixation of my current hidden desires, but an act of creation of a “better me” and instruction to the future AI of how I should be improved.

## 11.16 Bainbridge yes-no tool

Bainbridge created a questionary consisting of tens of thousands of yes-no questions that could help to extract a lot of data quickly (Bainbridge, 2006).

## 11.17 Terasem sites

According to Rothblatt (Rothblatt, 2012), both sites of the Terasem project have different functionality, and provide different ways of uploading information. Below is a description of the tests available on both sites, which may provide inspiration for uploading different data. Some interested ideas from their list not mentioned above:

Structured Religious Views

Structured Morality Views

Structured Political Views

Reactions to Stock Photos

Biometrics

Favorite Rankings of Music

Literature, Films, Things Places, People & Food Hated Rankings of Music

Literature, Films, Things Places, People & Food Free-Form Journal Entries

Historical Contextualizing

Chatbot Training

Gratitude Test

Free-Form Favoriting

Life Geo-Tagging

Social Network Maps

Temporal Sequencing

Website Linking

## 11.18 Uploading sessions

Peak performance is needed for DI, as performance at this level will provide the most unique and valuable information. So, it is important to record episodes of personal peak performance, like public speeches or telling a story to friends.

DI also should be practiced in sessions, especially if you do it with a partner.

## 11.19 “One my day” and videocommenting

In the LiveJournal there is a community, “one my day”, where people take photos during the course of one typical day of their life and provide comments with each photo. They typically take around 100 photos from morning to evening (LiveJournal, 2018).

A more advanced form of such lifelogging would be one-day videocommenting. This involves carrying a constantly recording camera all day and providing audio comments about all your thoughts, things you see, and typical behavioral patterns.

There are several commercial wearable video recorders, like GoPro, but they have short battery life span and create large videofiles. It is better to use a different device, like a police-style bodycam, which is worn on the chest and designed to provide around 10 hours of recording, or a secondary smartphone, which one could wear in the chest pocket of a shirt—camera-out. Unfortunately, smartphones tend to overheat. Wearable head-cameras are also typically heavy and strain the neck, or have small batteries. They also could be illegal in some countries (including Russia) if they look like “spy hardware”. Also, head video cameras are typically look ugly or weird and may affect the social perception of the person who carries them. Solutions such as Google Glass may not be so bad.

Police bodycam showed provide longest battery life and *lowest* minimal resolution for effective data compression; one example is the [BC-1, at a price around 250 USD](http://www.body-cam.ru/) with 12 hours of battery life

## 11.20 Audio dictation

For some people, it may be easier to record longer stories as audio (or video), rather than writing them. Dreams could also be simpler to record in audio form. Some people speak loudly with themselves, or even speak in dreams. Recording your personal life story and dreams, recording phone calls, and dictating stories from your life when you have free time will all provide valuable data for DI.

The following instruments will be useful:

• Wearable voice recorder

• Phone app for recording conversations

• Voice-activated digital audio recorder

## 11.21 Testing the mind as an information filter

This is a test how the mind changes the information which pass through it, which may probably may reveal some internal mechanisms. The main methods for such a test are:

* Drawing from nature and from memory
* Retelling stories or movies

## 11.22 Environmental data collection from photos

We may expect that in our age of Google Street View everything about outside is already recorded. However, taking informational photos about important places may be still useful.

Take photos of

• Other people, places, events, personal things, body parts.

• Apartment, furniture and item arrangements.

• Important places from personal history.

## 11.23 Keylogging

Most of activity in current world is spent not with humans but with computers. Advanced keylogging may be needed to fully collect information on such interactions. It should include not only the key pressed, but timing, screen capture, and accelerometer data.

On main computer

• Spy program: Keylogger, screen capture, mouse tracking

• Geo-tracking

• Archive chats from social networks

• Archive browser history and cache

## 11.24 Memoirs

There are many ways of recording personal information from memory:

• Diaries

• 1000 facts about me

• Collect memories by topic

• Automatic writing

• Write down history of your life

• Write childhood memories

• Describe your body scars and how you got them

• Write everything which you prefer would not be known to others or could be misinterpreted as evidence of your wrong doings

• Ask your parents and other people who remember you about stories when you were young and was a child. Maybe they have their own photo, video materials or diaries about you.

• Write a fictional story based on personal events.

## 11.25 Diaries and memory dumps

There are several types of possible diaries. One could consist of rather short description of what a person was doing each day. Another involves in-depth psychological analysis of thoughts, dreams and emotional states. Diaries should ideally be written everyday but making entries every week or month is also possible.

A memory dump is concentrated uploading of accumulated knowledge at its peak to free one’s brain. It most likely will take a form of an article or memo, which helps to bring structure to some experiences. This article may be seen as an example of such uploading of conclusions, as I spent around 30 years of thinking on the topic.

## 11.26 Drawings

Drawing is an instrument to output images from the brain, and probably only one currently available instrument. Some drawing could be done very quickly, on the order of 1 minute, to present basic details of an image. Drawings are also very individual in style, and are unique and valuable objects of art.

Collect

• Drawings of important things, places and people.

• Drawings of inner representations of abstract ideas.

• Art-therapy and automatic drawings.

• Drawings of the real world.

• Drawings of dreams.

## 11.27 Ask other people what they think and remember about you

Internal censorship prevents a person from having an objective self-image. The genre of memoir is often oriented on editing the past and presenting the “correct” version of the events to descendants and landing a final blow on enemies. A lot of memoirs often consist of descriptions of other peoples’ actions. These features all lower the predictive value of memoirs.

But if one interviews other people about oneself, maybe not directly, to escape “friendly censorship” due to the fear of inflicting embarrassment, the subject could collect a completely different view of her own personality.

## 11.28 Futuristic and untapped sources of information

There are several ideas in DI which, as far as I know, have never been used, but may be used in the future as legal and technological changes allow:

1. *Use of psychedelic drugs* to induce more active self-presentation. It could be LSD, memory enhancing drugs like galantamine or some truth serum. Stimulators will allow a person to speak more and to reach deeper levels of unconsciousness. Dissociative drugs could help to remove barriers of internal censorship and a person could tell much more about herself—the most popular such drug is alcohol. Stimulators could help to work more and produce larger output. Some chemicals (e.g. dopenzil) are said to be able to induce hypergraphia.

2. *Computerized testing*. A computer quickly demonstrates some stimuli like images and records reactions via EEG. Approximately the same could be done if a person watches a movie while carrying an EEG monitor. Use of tomography during uploading sessions not currently known.

3. *Invasive digital immortality*. Some brain implants will appear long before direct brain uploading is possible. Musk’s NeuraLink (Templeton, 2017) will be used for medical applications before it will be used for augmentation and uploading. Such implants will produce a lot of raw data about processes in the mind and will likely appear in the late 2020s (Chen, 2017). Implants could also send testing signals in the brain and record the outputs of some brain regions. That is, it will treat some brain regions as small black boxes and record their input-output pattern.

4. *Life extension*. An older person could still have some data about her past even if she seems to forget it—maybe she just can’t access it. If she lives longer—but not long enough to survive to actual immortality—she could survive until better recording and data extraction technologies. The same is true about other people who have personal memories of a deceased person—they could survive long enough that a large amount of data will be extracted about the people who they remember, like parents and grandparents who died long before other types of preservation appeared.

5. *Use of quantum or other currently unknown sources of information*. Some forms of quantum entanglement may help provide data for DI (Jones, 2017).

6. *Global archeology*. Future AI may be able to analyses all specks of dust on the earth’s surface and extract enormous information about the past.

7. *Use of optogenetics for better reading brain data*. Even getting a lot of data from the brain is not equal to proper direct uploading. Future scientists could see every spike of each neuron, but still will not know synaptic weights, which should be recalculated based on the observed spikes.

8. *Preserving raw tomography data*. Tomography is known be computationally complex and even NP-hard (Brunetti, Del Lungo, & Gerard, 2001). There is a hypothetical possibility to record tomography data about the brain now, but it cannot currently be deciphered, as it is computationally intractable for current computers. Such recording would preserve it until superintelligent AI is able to decipher it.

# PRACTICE

If you need super-simple version of the protocol, you need to do the following 4 things:

1) **DNA**. Collect own DNA, may be by sending it to 23andMe.
2) **Memoir**. Write down the history of your life with drawings.
3) **Lifelogging**. Practice video and audio recording of important conversations

4) **Archives**. Archive all the data from Facebook and scan archives.

## 12.1 Choosing a personal uploading strategy

The main starting point for the DI is to make a decision about beginning of a personal DI project and determine how much time and money one should spend on it.

The efforts should be divided almost equally between data collection and long-term data preservation. Data preservation is difficult, and it would be a pity to lose the data you collected.

I recommend starting with a period of active uploading and later turn to passive recording. However, if one doesn’t have the time for active uploading now, installing some recording software will be good first step.

The main principle here is to tap cheapest and most predicting information sources first.

• Make a decision about starting DI

• Time and resource allocation

• Choose available resources

• Plan your data collection methods for DI

• Choose the most informative methods first, but also try several methods to get different viewpoints on your personality

• Quickly upload the first version of your DI information

## 12.2 Steps of data collection

The advice below may seem obvious, but they are result of trials and errors of a group of people over several years. Below is a personal uploading plan, which is broken into “days”, though each task may actually require more than a single day.

### Day 1: Collecting existing data

1. Create a Dropbox or Google cloud account at least 1 TB, which provide *temporary* storage of your data (Temporary, because if a person dies, she will stop paying, and the data will be deleted. Google is a better option, as they may preserve the data for their own needs and it is likely that superintelligence will arise from Google.)

2. Copy all already existing electronic archives, including photo, documents, and video to this temporary storage.

3. Extract personal data from social networks. Facebook allows you to download all data you have ever created on their platform as one file. Extract archives from your email services, like GMail.

4. Install audio and video recording software on your PC. For Mac, the best programs are Evocam and Simple recorder. Evocam records video in 1-hour fragments from the built-in camera with good compression. Simple recorder records audio by clicking one small button.

5. Take care that you video files are compressed. Evocam can compress video to as file sizes as small as 100 MB for 1 hour. GoPro cameras can create several gigabytes per hour; large video sizes will complicate management of archive copies.

6. Use your smartphone as a recorder during conversation. Use of a standalone recorder is aggressive, and a smartphone is better for recording management and naming. Ask other participant of the conversation to record it, while explaining that you are not going to use or even transcribe the recording, but are creating recordings for the sake of digital immortality.

7. Start writing you autobiography. It should be long, emotion-centered and honest, not just a collection of facts.

8. Make photo and video recordings of your home environment. You may comment the video.

9. Start writing a diary.

10. Order a 23andMe test. 23andMe is Google-affiliated; surely Google will preserve your data. SNIP tests are not exactly the same as full genome reading, but Google will keep your biological materials.

### Day 2. Self-description

People are different, and prescribing one way of self-description for all will create unnecessary unification, where individuality will be lost. So, day 2 is better spent in reflection to determine which ways of self-expression are most appropriate for you. You may try different approaches, to see where information is running freely from you and clearly presents some unique insights. The more unique way of self-expression you will find, the better it will fix your uniqueness.

You may benefit from finding partner in self-description, but another option is take a vacation and spend it analyzing yourself.

### Day 3. Running psychological tests

There are many personality tests, you may choose the one you like and record all your data. It is better to take the test with large number of questions.

Running Rorschach tests also helpful.

The third type of tests is police tests which they use to collect data about a person.

### Day 4. Recording of the stream of consciousness

Just start writing down whatever thought is coming into your head. It is important to record every thought without censorship. If you will be able to write down a lot, like more than a hundred pages, even contemporary simulating systems like GPT-2 could simulate your internal stream of consciousness.

Note that recording the stream of consciousness is not exactly the same as pure automatic writing where you just open floodgates of your unconsciousness and could write completely unexpected texts. In recording the stream of consciousness (SC) you should put attention of what is actually going in your mind in your everyday life, like “I have to call my friend, there is my pet?”

Anyway, there is no way to do it wrong, as any your mistakes will be representation of your personality.

An alternative to writing is audiorecording of the thoughts, but it could be sometimes emotionally distressful, as it will be like confession, and it is known to trigger emotions.

### Day 5. Visiting friends and recording interviews with them

Other people have a lot of ideas about you and they also remember things which you prefer to forget. You may ask other people to tell what they remember about you, and surely you will be surprised. Just not forget to record this on audio with their permission.

### Day 6. Experiments with EEG monitoring

Currently it become possible to reconstruct internal thought stream based on EEG data using neural nets. Thus, recording such data may help in the future to reconstruct what you actually think. There are two options to record EEG – buy a commercial system like Muse or Open BCI with 32 channels, which may cost around 1000 USD and some knowledge in connecting wires etc.

Or just hire a medical professional for some medical tests, which may cost less in some countries. In Russia, one could get EEG at home starting from 150 USD.

### Day 7. Creating art

Art is a unique signature of one’s personality. Different people may have inclination to different types of art, like singing, dancing or poetry. However, I recommend drawings as they could be done quick, they are rather unique in style and they could convey a lot of semantic information, which can’t be represented in words. Drawing with some text comments are especially useful. A person could make hundred simple drawings a day, which could present his childhood memories, dreams, friends etc.

Moreover, I recommend to make EEG and video recording while drawing. Such complex data collecting will provide many views on the same internal process.

Another thing you could do is the practice of active imagination with a partner and record resulting data.

### Day 8. Creating an idealized image of self

Not all data in your brain is actually you, and you may choose what you want to preserve in better form. The best way to do it is to create idealized version of yourself and the world where you would like to live in some form of fiction. It may be a novel or a series of drawings.

## 12.3 Privacy notice

If you want to be resurrected with high fidelity, you should not keep secrets from the future AI. But contemporary people could hold an advantage over you if they know your stupid jokes, financial misconduct, love affairs, etc. So, your data should be protected by strong passwords and encryption, but the strength of the password should not be infinite, or future AI will not able to decipher it.

Sensitive information may be additionally edited, so it can’t be used as legal evidence of misconduct (think about replacing bad words with one letter abbreviations).

## 12.4 Legal notice

Recording of other people is illegal without their consent in most jurisdictions. To record a conversation, you should ask other people for their agreement, which is typically easy to get from friends, especially if you promise never to publish or use the information.

Some people wear constant video recording glasses for the goals of DI, similar to Google Glass. This may annoy people but be of little use for DI, as it mostly records other people, not you. Recording your voice is the most valuable thing when in public.

At you home, you may record everything but may have to put out signs that recording is taking place. You may also wear a t-shirt with sign about recording, but its legal power is small.

# 13. Requirements for digital immortality software

If you have read all of this article, you may find yourself confused, as there a lot of detailed instructions to be taken into account to collect data for DI properly. If you are not a professional, who wants to devote your entire life to DI, you may find it difficult to choose what you should do next. There are several solutions:

1) Use a simplified uploading protocol with just several steps.

2) Seek the professional help of a person who is trained in DI (no such people exist now)

3) Use a computer program that will guide you through the process and automatically save data.

Such a computer program does not currently exist, but we can list requirements for it. It should consist of several parts:

1) **Recorder**. This audio and video recorder starts automatically when it hears the voice or see a person. This part is needed for passive DI. It also includes a keylogger and automatically copies the browser-cache.

2) **Tester**. This part asks question and prompts the user to upload his personal history. It may run psychological tests and schedule uploading sessions. It must allow addition of new parts, like new tests.

3) **Saver**. It automatically sorts, compresses, and encrypts data and saves it different clouds.

4) **Search** and speech recognition. This is an optional function, but it could help to convert collected data into active external memory, similar to ideas of Bell (Bell & Gray, 2000).

5) **Personal assistant**. This is also optional but is a second step toward creation of an exocortex. The system is trained on the data, can predict replies, work as extended working memory, find links during conversation, etc.

Such software should probably have both PC and mobile versions.

# 14. Data preservation strategies

Most electronic data lives only several years. Hard drives die, DVDs decay, and subscriptions to data storage services expire. But we want to be sure that all our data will reach future AI, which could require safe storage for at least decades, and maybe even centuries. Long-term data preservation could be achieved if the data is sufficiently “copyable” (Eubanks, 2008).

Main principles:

1) Create several independent different copies of all data

2) Use different approaches to data preservation

3) Create smaller “data-bombs” for longer storage.

4) Eternal storage must be free of charge and not depend on the decisions or fortunes of business.

Practical solutions:

1) Use Google

2) Use the Internet Archive

3) M-discs.

4) Space storage

You may need to invest in a powerful computer for photo and video compression and for constant copying of data between HDD, massive RAID, optical disks, and cloud services.

You also should be cautious about small startups which suggest they will collect and store your data for you. Only internet giants or well-established foundations have the necessary level of survivability to preserve data for decades, and copying is everything.

## Home hard drives archives

8-12 TB disks existed in 2018 for 200-300 USD partly for video surveillance goals, and even 60 TB solid state disks were presented, but they are very expensive. In addition, the typical failure rate of a consumer hard drive is 0.8 in case of extensive use because of wearing of mechanical parts, and excluding wearing (which is small for archival drives) it 0.9 in the first year and then 0.01 per year (Anthony et al., 2013). The most risk of home drives comes from falling, as this often happens with movable external drives and it could damage their internal mechanics (however, damaged drives should be still preserved, as future AI surely will be able extract data from them). The most reliable disks are Hitachi according to, which had only 1 per cent annual failure rate compared to 9 per cent for Western Digital (Lilly, n.d.) Surely, RAID massive inside a stationary computer is better than external HD.

The progress in hard-drives was slow in 2010s and was not able to cover growing size of personal information. Copying 1 TB over USB 3.0 will take at least 3 hours. Cheap external drives are also fragile, suffering damage or data loss from even small falls. With a price of around [250 USD](https://www.amazon.com/HGST-HUH728080ALE600-SATA-7-2K-128M/dp/B00Q1IZJD8/ref%3Dpd_sim_147_1?_encoding=UTF8&pd_rd_i=B00Q1IZJD8&pd_rd_r=2EV50JK1FPPZ1JRT4HCD&pd_rd_w=y8wtB&pd_rd_wg=ixpne&psc=1&refRID=2EV50JK1FPPZ1JRT4HCD) for 8 TB of internal Hitachi drive, and the need of several reserve copies of all data as well as a computer, the total price of storing a 10 TB archive could easily be around ~ 1000 USD. Most reliable cloud services are limited to 1 TB (as of 2018) or require more expensive “business accounts” for larger capacities, and are requiring yearly payment for maintaining. Another option, preserving data on durable M-disks, requires manual chunking as the biggest such disks are 100 GB. In addition, tape archives are expensive for individual users. In view of these difficulties, data copying is no longer easy, and the situation becomes similar to the historical issues around preserving manuscripts.

More about home data storage technology: <https://lifehacker.com/5660551/your-best-solutions-for-massive-multi-terabyte-storage>

## 14.1 Data structure

All the data you will collect will basically consist of two main parts: the most valuable information, consisting of handwritten text and audio, and the most size-consuming information, which is mainly photos from the holidays and GoPro video output. The first category will have a size of gigabytes, and the second will be several terabytes. Much data in the second category will be almost useless, but as we don’t know which part that is, we should preserve it all. As I discussed in section 3.4, management of such large data sizes is difficult.

Correct marking of the data structure will make its management much simpler. First, data should be in folders which clearly name the type of data and its year of creation. This will make updating and searching the archive much simpler. The correct data structure will also help the user remember to regularly copy all needed data types. However, double-copying of some data is inevitable.

All data should not be in one compressed archive, as a single error could make whole archive unreadable. However, even damaged HD could be repaired by AI in the future, and should be preserved.

While video is the most informative source of data, is predictive power fades quickly after the first few hours of personal recordings, so only a small part of it should be in HD; later videos may be kept in lower resolution.

Example data structure:

(My documents, 2017)

(My biography and digital immortality texts, 2017)

(My evernote, 2017)

(My audiorecorder, 2017)

(My videos, 2017)

(My photos from phone, 2017)

(My photos from Canon, 2017)

(My Evocam videos, 2017)

(My keylogger data, 2017)

(My emails, 2017)

(My facebook, 2017)

(My browser’s cache, 2017)

(EEG, 2017)

(Medical data, 2017)

(Downloads, 2017)

(My paper archive scan, 2006)

(WhatsApp, SMS, and other chat archives)

(Geo-tracking data)

## 14.2 Cheap small “data-bombs” for eternal preservation

As we said above, data consists of two parts: a small valuable part and a very large less-valuable part. You can currently preserve several gigabytes almost indefinitely in the internet (assuming no global catastrophes). Google provides up to 15 GB of space on Google Drive for free.

We call a a small piece of information which is easy to copy and which we could secretly put somewhere, expecting that in the future it will preserved for free almost eternally, a *data-bomb.* It is based on the principle that is cheaper to copy massive amounts of information verbatim than to clean them.

There are many internet sites which allow free posting of user content, like *Scribd*. The biggest amount of video information can be posted on *YouTube—*but take care not to post private information and to lock the videos. Google cache and the Internet Archive (*Wayback Machine*) will make copies of data you post on the web automatically and for free.

## 14.2 Underground preservation

The main problem of long-term preservation is that we do not know when superintelligent AI will appear. Maybe it will arrive in 10 years and will send its robot to our home to collect our disks and archives. Maybe there will be nuclear war, the Internet will collapse, and civilization will be built from scratch 200 years from now, with superintelligence appearing in 300 years. Maybe aliens will find our archives 100 million years from now.

This means that we should try very different ways of data preservation suitable for different future scenarios. One of such ways is to put data in the secret place on “eternal disks”. The only “eternal disks” available for ordinary users are *M-disks* (a type of Blu-ray disk), which has an expected survival time of 1000 years (MDISC, 2017). They can be recoded on an ordinary Blu-ray recorder and have sizes of up to 100 GB and a price of only a few USD each. Thus, to preserve several terabytes of data one needs at least several dozen disks.

These disks should be put in a box which *hard, hermetic and rust-proof*. A pressure cooker is an ideal choice, but in the face of recent terrorist attacks, buying multiple pressure cookers could be viewed with suspicion. Another option is a hermetic plastic box inside an aluminum pan, with cement used to fill the space between the inner and outer boxes. Professional stainless-steel boxes for time-capsules exist but are more expensive and may attract more attention from potential grave-diggers. This time-capsule provides oxygen removal, stainless steel and costs 70 USD <https://www.futurepkg.com/personal-7-x-9-arnold-time-capsule-standard>.

Don’t forget to add biological samples to the box, and perhaps some papers as well. You could bury it on your own property, but it is better do it secretly, as some people may think that the box contains valuables. You may use your plot at the cemetery, but first check how long you will own it. You may ask your friends to preserve it or put in the basement. Like most time-capsules, it could be built into the wall or foundation of a house. You may register your time-capsule with the International Time Capsule Society (<https://en.wikipedia.org/wiki/International_Time_Capsule_Society>).

There are several services which offer “digital time capsules”, (e.g. <https://www.lifestimecapsule.com/>), but it is not clear if such digital capsules will still exist several decades from now, especially if you stop paying the services. Non-traditional and non-digital carriers like microfilms may be a better choice (Normand, Gschwind, & Fornaro, 2007), (McKee & Panov, 2011).

The Arch Mission is planning to protect personal data in space (Wolfram, 2018) and it may accept personal archives in the next 10 years, so if your data is included, the next civilization on Earth will able to resurrect you (Turchin & Denkenberger, 2018).

# Conclusion

Digital immortality, also known as indirect mind uploading, is an almost untapped possibility for radical life extension. It is relatively cheap, and the main barriers to its adoption are philosophical: we don’t know the nature of personal identity, the power of the future AI, and the amount of data needed to maintain informational identity. This creates logical uncertainty about the possibility of DI, which thus should be regarded as only Plan C for achieving immortality, where Plan A is life extension until AI creation, plan B is cryonics, and plan D is quantum immortality. Combined, these plans provide a reasonable chance for radical life extension for 21st century people, in the absence of global catastrophe.

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