In the Beginning was Variety

The algorithm used in this exercise is different from other computerised evolutionary algorithms in that it starts with just one primordial organism. **Once the algorithm is initiated there is no further operator intervention**. The algorithm allows reproduction, mutation, competition and invasion by enemies. Competition is between randomly selected pairs of organisms, with the loser being eliminated and the winner making an extra copy of itself. The exact rules will be outlined in the narrative. The initial population consists of 3-gene organisms in the range 951-999.

The primordial first self-replicator appears:

969

Its only characteristic is that it can make inaccurate copies of itself:

969, 979, 982, 971, 978, 963, 966

It continues to fill-up the space available:

969, 979, 982, 971, 978, 963, 966, 950, 994, 954, 967, 965, 968, 985, 976, 992, 984, 997, 956, 962, 963, 985, 999, 981, 973, 993, 963, 970, 964, 996, 983, 965, 965, 956, 983, 991, 977, 965, 968, 963, 971, 969, 997, 950, 950, 971, 998, 979, 997, 969, 974, 996, 997, 989, 957, 983, 977, 976, 952, 979, 951, 986, 951, 996

There is only room for 4096 organisms in this niche and the first section of the whole (full) population now looks like this:

969, 979, 982, 971, 978, 963, 966, 950, 994, 954, 967, 965, 968, 985, 976, 992, 984, 997, 956, 962, 963, 985, 999, 981, 973, 993, 963, 970, 964, 996, 983, 965, 965, 956, 983, 991, 977, 965, 968, 963, 971, 969, 997, 950, 950, 971, 998, 979, 997, 969, 974, 996, 997, 989, 957, 983, 977, 976, 952, 979, 951, 986, 951, 996, 978, 996, 967, 976, 952, 957, 983, 963, 971, 987, 954, 968, 960, 985, 999, 972, 984, 978, 983, 986, 999, 954, 997, 979, 964, 993, 950, 956, 950, 966, 966, 950, 967, 964, 979, 970, 970, 982, 987, 985, 984, 960, 990, 972, 958, 990, 979, 952, 997, 994, 989, 961, 950, 977, 957, 964, 964, 974, 966, 985, 976, 973, 978, 960, 959, 952, 992, 995, 996, 968, 975, 972, 994, 984, 978, 982, 961, 981, 994, 950, 960, 978, 989, 995, 971, 982, 987, 984, 991, 983, 957, 985, 975, 980, 999, 993, 993, 989, 966, 974, 987, 984, 964, 984, 953, 974, 999, 964, 994, 998, 986, 988, 956, 975, 974, 987, 962, 979, 992, 968, 969, 961, 964, 995, 956, 998, 973, 992, 968, 988, 985, 999, 962, 950, 965, 974, 997, 974, 980, 966, 991, 997, 955, 989, 951, 985, 994, 957, 997, 981, 969, 953, 979, 973, 997, 983, 984, 964, 978, 975, 975, 952, 969, 968, 976, 984, 979, 987, 969, 961, 987, 993, 986, 975, 974, 985, 958, 988, 993, 979, 992, 999, 990, 988, 992, 963, 991, 993, 966, 974, 993, 994, 965, 964, 978, 956, 956, 978, 969, 980, 989, 967, 991, 950, 974, 976, 973, 978, 960, 997, 981, 969, 951, 999, 965, 958, 969, 951, 987………..

With the niche now full, continued reproduction results in competition between the organisms for survival. Competition takes the form of fights to the death between randomly chosen pairs, with the winner initially chosen at random. The inevitable emergence of organisms with both a survival advantage and improved copying fidelity leads to groups of individual varieties now being discernible. A few million fights to the death leads to a decreasing number of different organisms and a section of the 4096 population now looks like this:

………………996, 996, 981, 963, 977, 996, 996, 963, 963, 981, 963, 977, 963, 963, 963, 981, 974, 963, 996, 996, 977, 963, 963, 981, 996, 963, 996, 977, 963, 963, 963, 996, 996, 981, 981, 996, 963, 981, 977, 963, 963, 981, 963, 996, 996, 963, 977, 996, 981, 977, 977, 963, 996, 996, 963, 963, 974, 963, 996, 977, 963, 996, 963, 963, 963, 963, 963, 996, 963, 977, 963, 981, 977, 996, 963, 996, 981, 981, 963, 963, 996, 996, 963, 963, 996, 963, 963, 963, 996, 963, 981, 977, 996, 981, 977, 977, 996, 996, 963, 963, 963, 963, 963, 974, 963, 996, 963, 963, 996, 963, 963, 963, 996, 963, 977, 996, 996, 996, 963, 963, 963, 981, 974, 974, 996, 963, 977, 977, 963, 981, 981, 977, 981, 963, 977, 963, 963, 996, 996, 996, 996, 996, 963, 996, 977, 963, 963, 996, 963, 963, 996, 974, 981, 974, 977, 963, 963, 977, 996, 996, 977, 996, 981, 981, 996, 974, 963, 963, 974, 963, 996, 981, 977, 963, 963, 981, 977, 963, 963, 996, 996, 963, 963, 963, 981, 996, 963, 963, 977, 963, 963, 963, 963, 963, 996, 981, 963, 996, 963, 977, 981, 977, 996, 963, 996, 963, 981, 981, 996, 963, 977, 974, 963, 996, 963, 996, 963, 963, 963, 974, 963, 963, 981, 996, 963, 996, 996, 977, 963, 981, 963, 963, 996, 977, 963, 996, 963, 963, 974, 981, 963, 996, 963, 963, 963, 963, 963, 977, 974, 996, 963, 977, 977, 963, 963, 963, 977, 996, 977, 977, 963, 963, 977, 977, 963, 996, 977, 963, 963, 981, 963, 963, 977, 977, 963, 963, 963, 963, 996, 963, 977, 996, 963, 963, 996, 963, 974, 963, 963, 977, 996, 963, 963, 963, 963, 996, 963, 996, 977, 996, 981, 996, 996, 977, 977, 996, 963, 977, 963, 996, 963, 963, 963, 977, 963, 977, 996, 963, 963, 977, 963, 963, 963, 963, 996, 963, 996, 977, 963, 981, 981, 977, 996, 977, 996, 981, 963, 996, 963, 977, 963, 996, 981, 963, 977, 963, 996, 996, 996, 963, 981, 963, 963, 963, 963, 981, 963, 996, 996, 963, 963, 996, 963, 996, 963, 996, 977, 977, 977, 996, 963, 977, 963, 996, 963, 996, 977, 981, 963, 963, 963, 996, 963, 977, 963, 996, 996, 977, 963, 963, 963, 963, 963, 977, 963, 963, 963, 963, 996, 963, 996, 963, 996, 974, 963, 977, 981, 963, 974, 977, 996, 996, 974, 963, 996, 963, 963, 963, 996, 963, 963, 996, 963, 996, 963, 963, 963, 977, 963, 963, 977, 981, 996, 963, 963, 963, 963, 996, 977, 996, 977, 981, 981, 996, 963, 963, 963, 996, 963, 963, 981, 996, 963, 996, 974, 963, 996, 963, 981, 963, 963, 963, 963, 996, 974, 996, 996, 963, 996, 996, 963, 981, 977, 963, 963, 963, 963, 963, 963, 963, 981, 977, 963, 996, 977, 981, 977, 963, 981, 996, 963, 963, 977, 963, 996, 977, 977, 963, 981, 963, 996, 996, 963, 974, 963, 963, 963, 963, 963, 981, 963, 977, 996, 996, 963, 996, 963, 963, 963, 996, 977, 977, 996, 963, 977, 963, 963, 963, 963, 981, 996, 996, 963, 963, 963, 977, 981, 996, 963, 963, 963, 963, 963, 977, 981, 981, 963, 963, 981, 963, 963, 977, 963, 963, 963, 963, 963, 963, 996, 981, 963, 974, 963, 963, 996, 996, 963, 981, 963, 963, 996, 963, 996, 963, 977, 963, 963, 963, 963, 963, 963, 963, 963, 977, 977, 981, 963, 963, 963, 963, 963, 963, 963, 981, 963, 963, 996, 977, 996, 963, 974, 981, 963, 963, 963, 977, 996, 996, 963, 977, 963, 963, 963, 963, 963, 963, 977, 977, 981, 963, 963, 963, 996, 963, 963, 963, 996, 974, 963, 996, 963, 963, 974, 996, 963, 977, 981, 963, 996, 996, 963, 963, 981, 977, 963, 996, 963, 963, 977, 996, 977, 963, 963, 977, 963, 963, 963, 963, 963, 963, 996, 977, 963, 977, 963, 996, ……………

The four best survivors are named j, k, m and n.

j= 974,   k= 981,   m= 996,   n= 963

In the absence of mutation if this process were to continue then the whole population would eventually consist of just one type of organism. In other words they would all be clones and the first enemy to appear that could overcome this organism would drive the entire population into extinction. There is competition between species for survival and some species would gain an advantage if they favoured any organisms which could mount a defence against their enemies. What was once a copying error system of crude reproduction is now moulded into a variety-maintaining system where at least some of the population can make a successful defence against dangerous interlopers.

The survivors j, k, m and n can be viewed as the organisms best suited to their environment, or the organisms best equipped to fight off rivals or the organisms that were just plain lucky!

Let us assume that these four were best equipped to fight off four newly-arrived interlopers. The interlopers, like the initial population, consist of three genes and are 110, 111, 112, and 113. Each of these four interlopers can defeat any of the 950-999 population except that j can defeat 110, k can defeat 111, m can defeat 112 and n can defeat 113.

The competition continues as before with random pairs teaming up for a battle to the death. The winner replaces the loser with a copy of itself.

As mentioned above, to avoid the fate of a population of clones, all the organisms 951-999 can now mutate occasionally. A system of regularly-occurring mutations is an adaptation from what was initially a series of copying errors. These mutations could result in j, k, m or n losing their lethality or any other member of the 951-999 population gaining lethality by mutating to j, k, m or n.

The algorithm does not start until the niche is fully populated and j, k, m and n become prominent. One generation of the algorithm conducts the following actions:

1 organism from the 951-999 population is chosen at random for mutation

8 randomly chosen pairs fight to the death

Every 400 generations one new interloper (110, 111, 112 or 113) takes on one of the 951-999 population chosen at random for a fight to the death and if successful will replace that organism and will join the population alongside any other successful interlopers

A more sophisticated algorithm could demonstrate that rates of mutation and other variable parameters were selectable characteristics.

What is the outcome of this interaction between reproduction, mutation, invasion and competition?

After 30,000 generations a section of the population looks like this.

………………963, 987, 113, 994, 988, 112, 963, 111, 962, 110, 963, 997, 112, 967, 113, 981, 110, 963, 974, 111, 963, 974, 110, 974, 966, 112, 113, 996, 112, 970, 983, 974, 974, 112, 962, 113, 113, 981, 963, 996, 980, 112, 986, 113, 969, 981, 978, 957, 996, 993, 113, 978, 981, 112, 952, 974, 996, 963, 981, 974, 963, 963, 979, 952, 956, 986, 975, 996, 973, 111, 113, 962, 974, 981, 963, 112, 111, 996, 974, 974, 996, 963, 974, 957, 113, 958, 974, 113, 963, 112, 112, 113, 113, 111, 987, 963, 112, 113, 963, 974, 110, 113, 973, 110, 989, 988, 110, 974, 954, 995, 999, 981, 974, 112, 963, 983, 963, 954, 984, 955, 992, 963, 981, 973, 111, 112, 110, 981, 974, 972, 111, 974, 957, 963, 111, 959, 974, 112, 110, 994, 974, 974, 113, 996, 110, 996, 954, 977, 974, 996, 980, 974, 974, 974, 966, 988, 981, 994, 981, 981, 967, 996, 980, 963, 985, 953, 112, 974, 981, 981, 112, 113, 950, 974, 989, 981, 111, 963, 974, 112, 981, 996, 112, 112, 113, 974, 974, 981, 993, 974, 110, 981, 996, 112, 996, 986, 964, 111, 963, 111, 996, 981, 969, 111, 971, 112, 975, 970, 974, 974, 974, 963, 974, 963, 996, 995, 963, 113, 996, 113, 110, 998, 113, 112, 110, 110, 112, 974, 954, 994, 955, 111, 996, 111, 974, 111, 950, 956, 972, 981, 996, 974, 958, 113, 974, 967, 110, 991, 962, 963, 974, 974, 985, 976, 996, 974, 962, 981, 111, 974, 968, 963, 974, 998, 963, 970, 112, 974, 112, 974, 111, 974, 996, 996, 981, 974, 110, 963, 952, 952, 981, 112, 960, 974, 996, 967, 112, 963, 996, 113, 987, 111, 974, 996, 963, 113, 110, 111, 950, 996, 953, 974, 112, 981, 113, 112, 113, 963, 959, 974, 112, 963, 981, 111, 981, 981, 110, 974, 981, 110, 974, 110, 996, 956, 999, 112, 974, 996, 991, 113, 974, 974, 113, 974, 996, 974, 974, 979, 994, 113, 984, 960, 994, 961, 981, 974, 981, 974, 113, 996, 974, 111, 974, 974, 113, 113, 981, 970, 974, 113, 981, 112, 996, 974, 963, 974, 974, 971, 980, 962, 994, 113, 997, 113, 950, 963, 112, 993, 111, 981, 111, 996, 113, 112, 974, 111, 110, 996, 996, 992, 996, 990, 974, 981, 996, 996, 996, 111, 965, 112, 112, 952, 974, 112, 974, 112, 996, 974, 963, 974, 110, 112, 112, 968, 111, 963, 112, 963, 974, 981, 982, 983, 981, 963, 968, 957, 968, 985, 970, 955, 112, 112, 113, 963, 965, 112, 992, 963, 974, 993, 963, 974, 954, 970, 992, 974, 112, 963, 981, 976, 953, 110, 960, 963, 996, 974, 981, 967, 992, 963, 992, 113, 999, 996, 981, 974, 112, 974, 981, 996, 978, 974, 112, 979, 963, 981, ……………

So, there we have it. The organisms that now occupy the niche consist of a sustainable balance between the original population and the four invading types. The four useful defenders j (974), k (981), m (996), and n (963) are retained in high numbers. The initial inaccurate copying of the primordial self-replicators has morphed into a variety-maintenance system. This is an example of variety being maintained because of the variety of enemies encountered.

The evolution of cooperation between individual cells eventually leads to multicellularity. This cooperation, coupled with the above explained maintenance of variety at the level of the individual cell, will lead to unique, never-before-seen combinations of cells. These novel multicellular organisms with their unique characteristics are the potential source of increasing complexity.