

Discussion Summary: The evolutionary origin of complex features.

- The paper uses Avida software to conduct experiments on digital organisms in order to understand the evolutionary origins of complex features.
- The most complex function was found to be EQU, which was the main focus feature of the experiments done.
- Exact genealogy was traced without any missing links.
- The most complex function, EQU, evolved only after the evolution of several useful simpler functions which acted as a sort of stepping stones.
- Overlap of genetic networks underlying the simple function expression and their frequent loss as side-effects of mutations yielding more complex features; indicate that the simpler functions served as the building blocks for the more complex features.
- Complex features generally evolve by modifying existing structures and functions which was first proposed by Darwin.
- Complex features never evolved if the simpler functions weren't rewarded.
- There is no fixed path to the evolution of complex function. There are potentially a very large number of paths.
- Although complex feature first appeared as the immediate result of only one or two mutations, its function invariably depended on many instructions that had previously evolved to perform other functions along the way, such that their removal would result in the loss of the new feature. This was verified by replacing the generated instructions with blanks.
- Competition was spatial and also reward based.
 - The space was of 60 X 60 cells.
 - When an organism replicated, it replaced an organism in one of its surrounding cell, maintaining a constant population size.

- o When the organism successfully evolved a function, it was rewarded according to the complexity of the function which was pre-decided.
 - o The reward for a particular function was only once and that too the first time.
 - o SIP (single-instruction processing) units were the energy currency for the system. A single instruction execution required 1 SIP unit.
 - o If an organism was out of SIP, it would remain there until it was replaced by a newborn.
 - o Genome is the sequence of instructions which wraps around.
 - o Genome is responsible for generation of phenotype.
 - o Asexual organisms have been modeled.
- Digital organisms undergo same processes of reproduction, mutation, inheritance, competition, pleiotropy and epistasis that allow evolution, competition and adaptation by natural selection in organic forms.
- Digital organisms provide opportunities to address important issues in evolutionary biology.