Emergence of Intelligence
Nature-inspired computation and optimization

EC + DL + ML ≅ AI + AL (Artificial Intelligence + Artificial life)

In our laboratory, we study computation and systems with the keywords of evolution and emergence.

- Why are the peacock’s feathers so incredibly beautiful?
- Why did the giraffe’s neck become so long?
- If a worker bee cannot have any offspring of its own, why does it work so hard to serve the queen bee?

We see that biological organisms are solving certain types of optimization problems through the process of evolution. It is the objective of the evolutionary method to exploit this concept to establish an effective computing system (an evolutionary system).

EC is integrated with ML and is widely applied not only in engineering optimization but also in financial engineering, art and design. Evolutionary reinforcement learning has been applied to robotics and game AI.

These methods aim to integrate engineering and life sciences, and to realize the main concepts of life phenomena, such as ‘symbiosis’ and ‘diversity.’ In addition, it will lead to the elucidation of the phenomena of ‘emergence’ and ‘complex systems’ for artificial life.

- Game AI:
  - (left, Ms. Packman) Evolved luring behaviors by means of GR
  - (right, Super Mario) Evolved Mario can solve a difficult stage effectively.

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Neuro-Darwinism
- NN, DQN, LSTM, CNN, RBM

Deep neuro-evolution
- X-ray based detection system for dangerous objects by means of deep neuro-evolution

Evolutionary robotics:
- Cooperative transportation by humanoid robots

Music composition by means of Interactive EC

Evoart portrait collection