

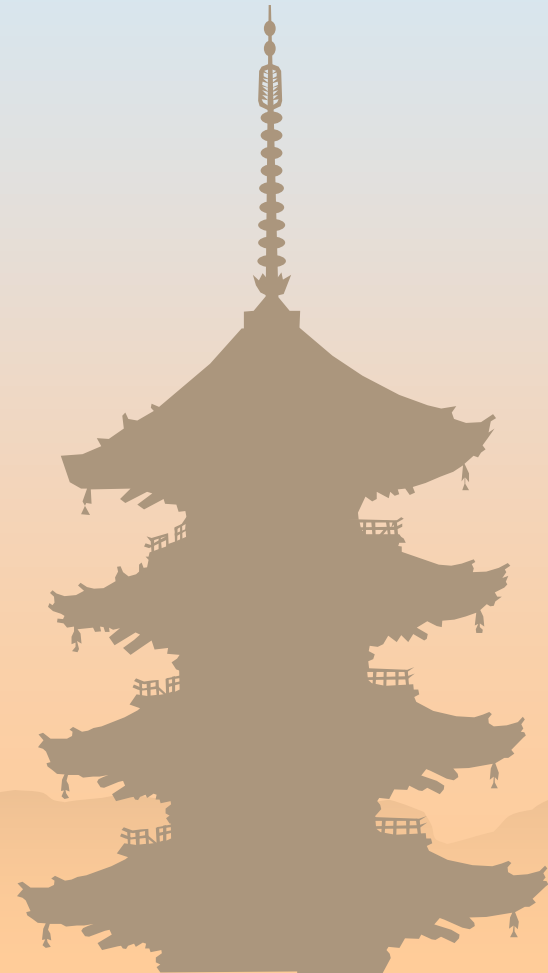
A Primitive Emotion and Its Cooperative Function Simulated in Neural Networks

Towards a Theory of Emotions
as Cognitive Functions

S. Nagataki, M. Shibata, et al.

nagataki@lets.chukyo-u.ac.jp

mshibata@kenroku.kanazawa-u.ac.jp



Purpose

- ❁ Clarifying what functional-causal roles emotions play and how they relate to other cognitive mechanisms
 - 1 Focusing on a primitive emotion performing a cooperative function
 - 2 Simulating that function as acquired in the evolutionary process



Working Hypotheses

1 Multi-dimensionality of emotions

Emotions evolutionarily have got multiple layers operating differently in a variety of cognitive tasks.

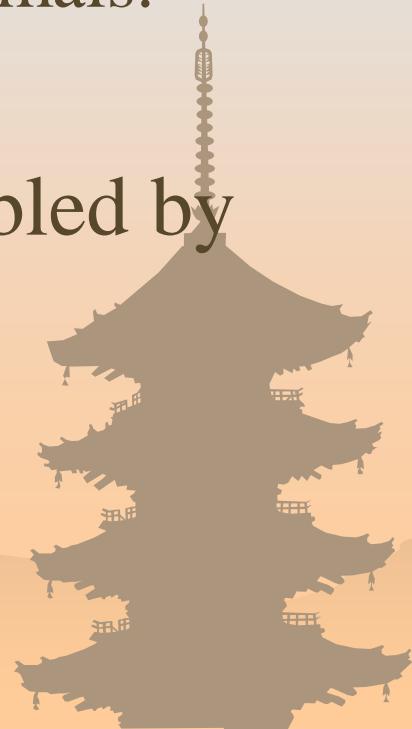
2 Computational intractability

Emotions have mechanisms that attain rationality not by means of computation but bio-chemical causation.

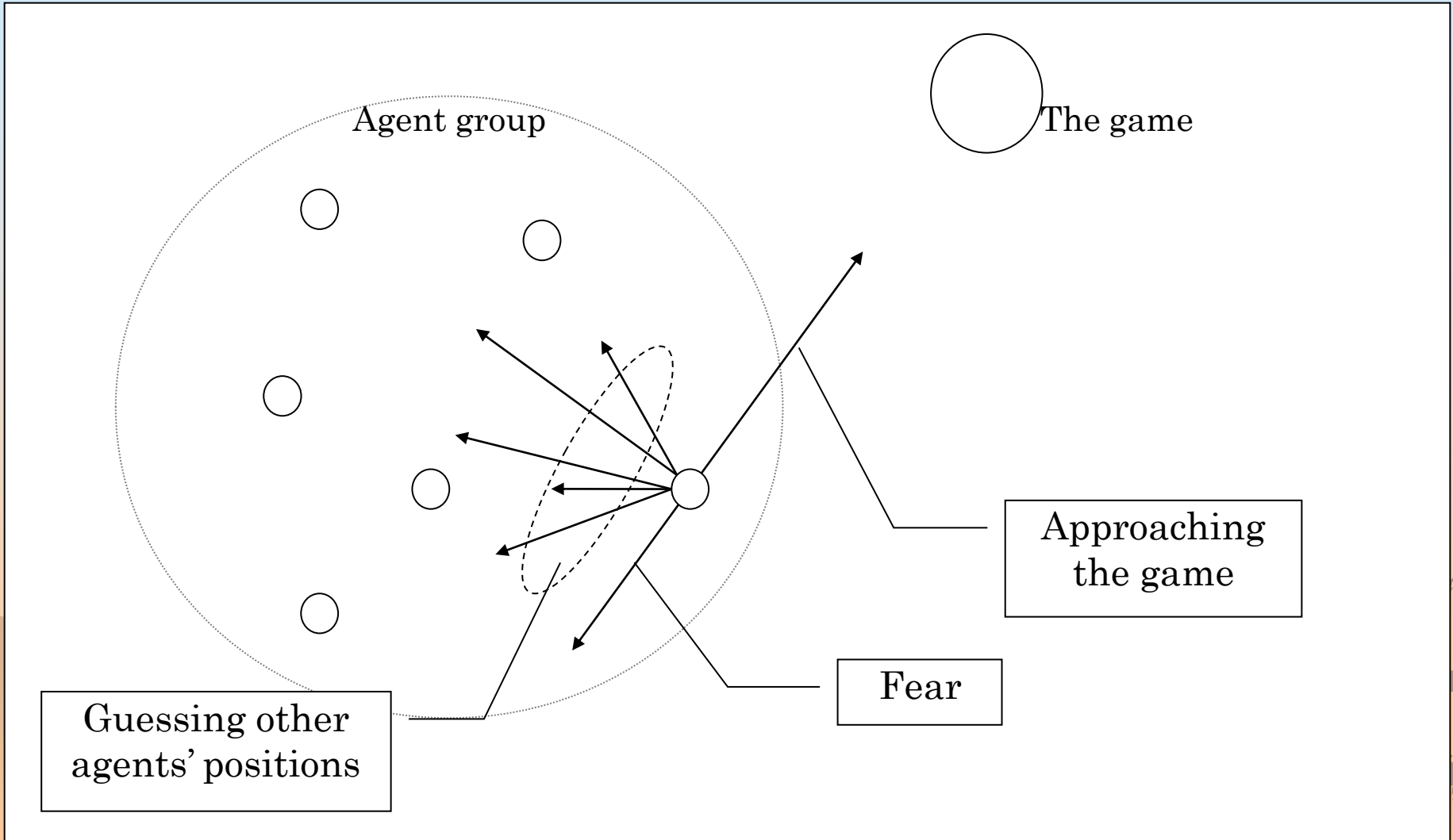


Evolution

- ❁ Humans acquire emotions through evolution.
 - For example, hunting required us to get cooperative behaviors against the most primitive disposition of fleeing from dangerous animals.
- ❁ These cooperative behaviors were enabled by having emotions.



Outline of the model



Model

Neural networks (NN): learning

+

Genetic algorithms (GA) : evolution

Each NN represents an agent (organism)

By BP, each agent learns to hunt the big game, while guessing other agents' positions and overcoming his/her fear.



BP Learning

Goal: hunting together the game guessing every other agent's position

Conditions

1. The game can be hunted only by multiple agents → It requires cooperativeness.
2. Agents' learning consists in overcoming fear.



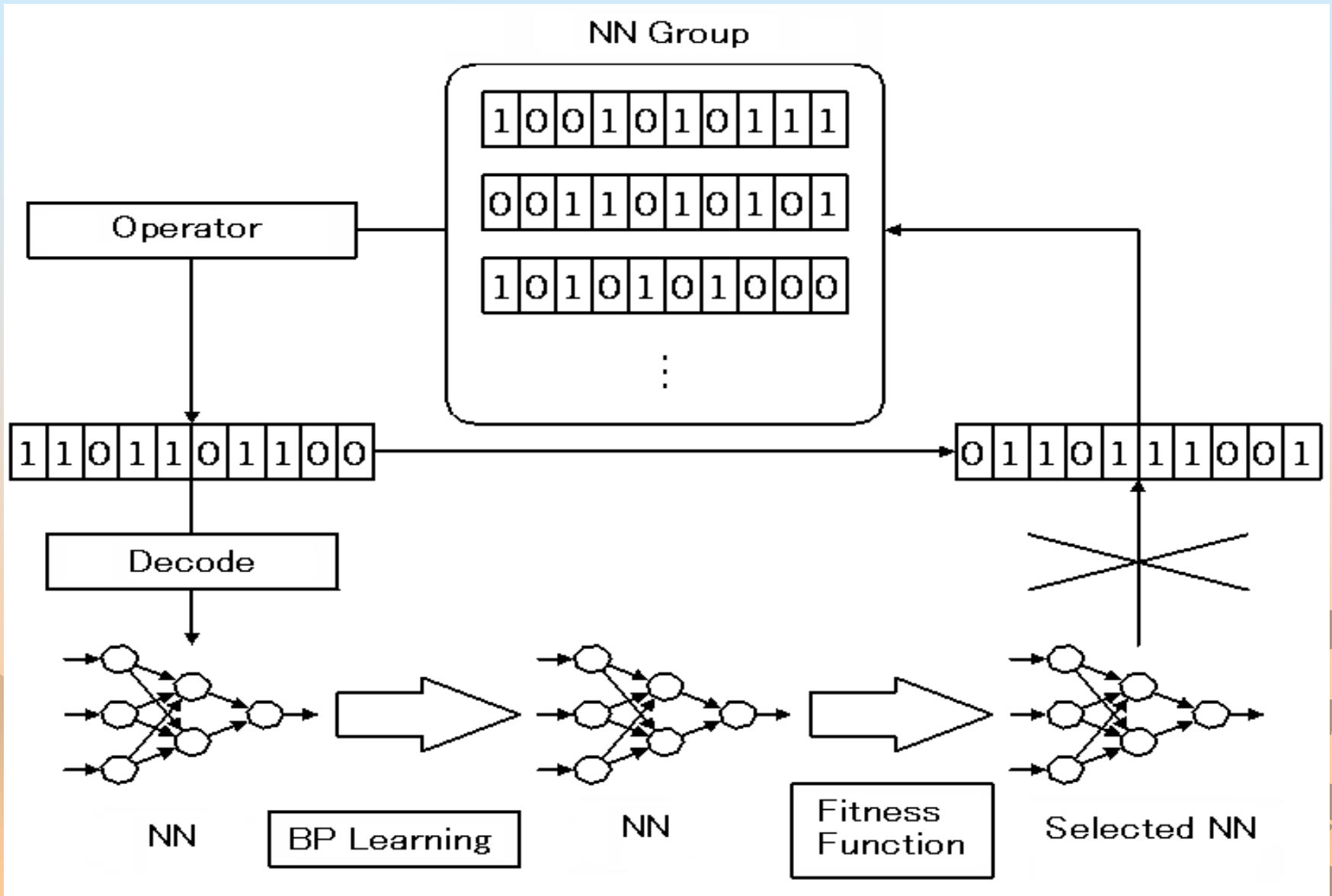
GA

GA operators

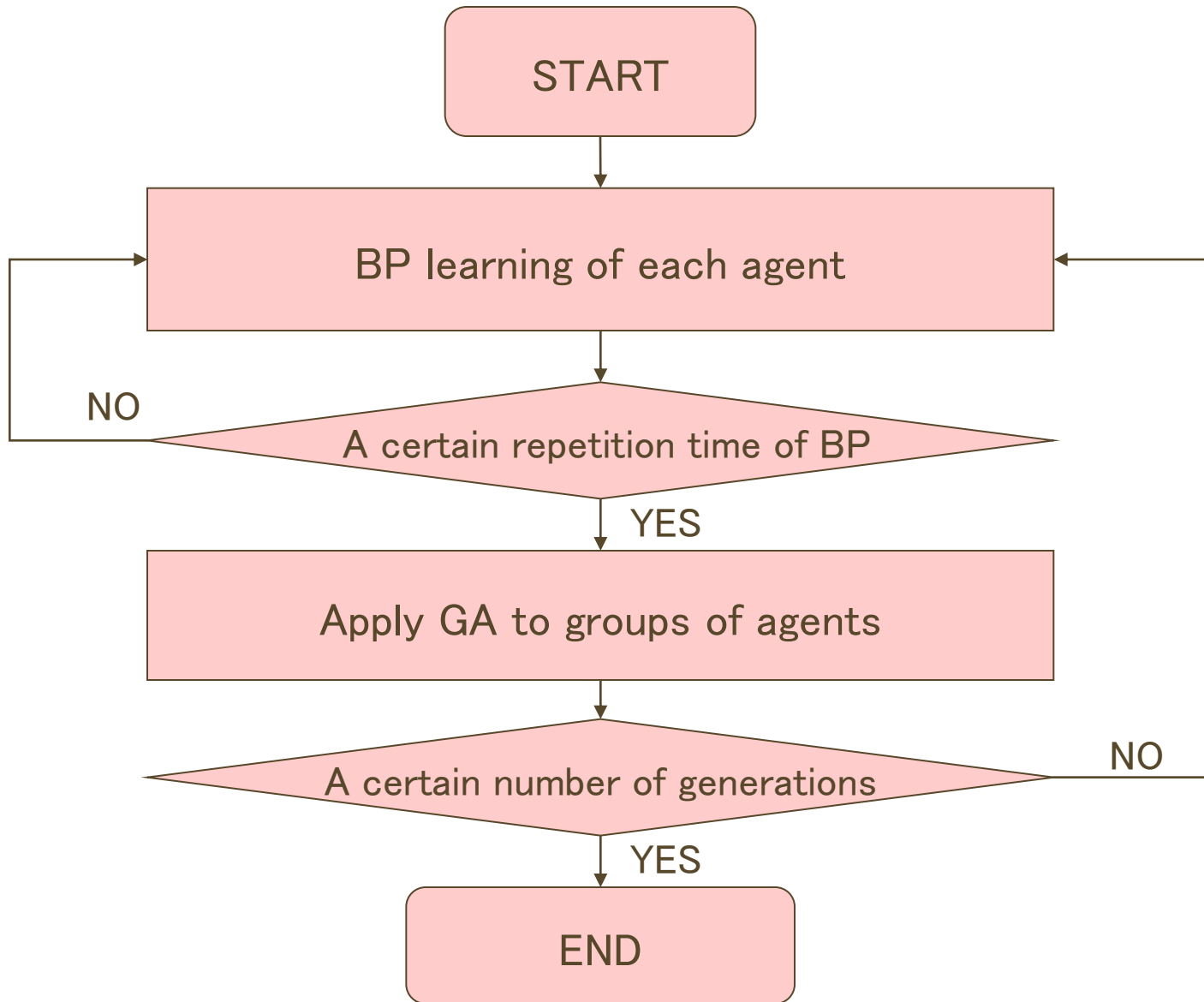
- Three operations:
Selection, Crossover, Mutation
- Searching for adaptive agents by applying these GA operations.



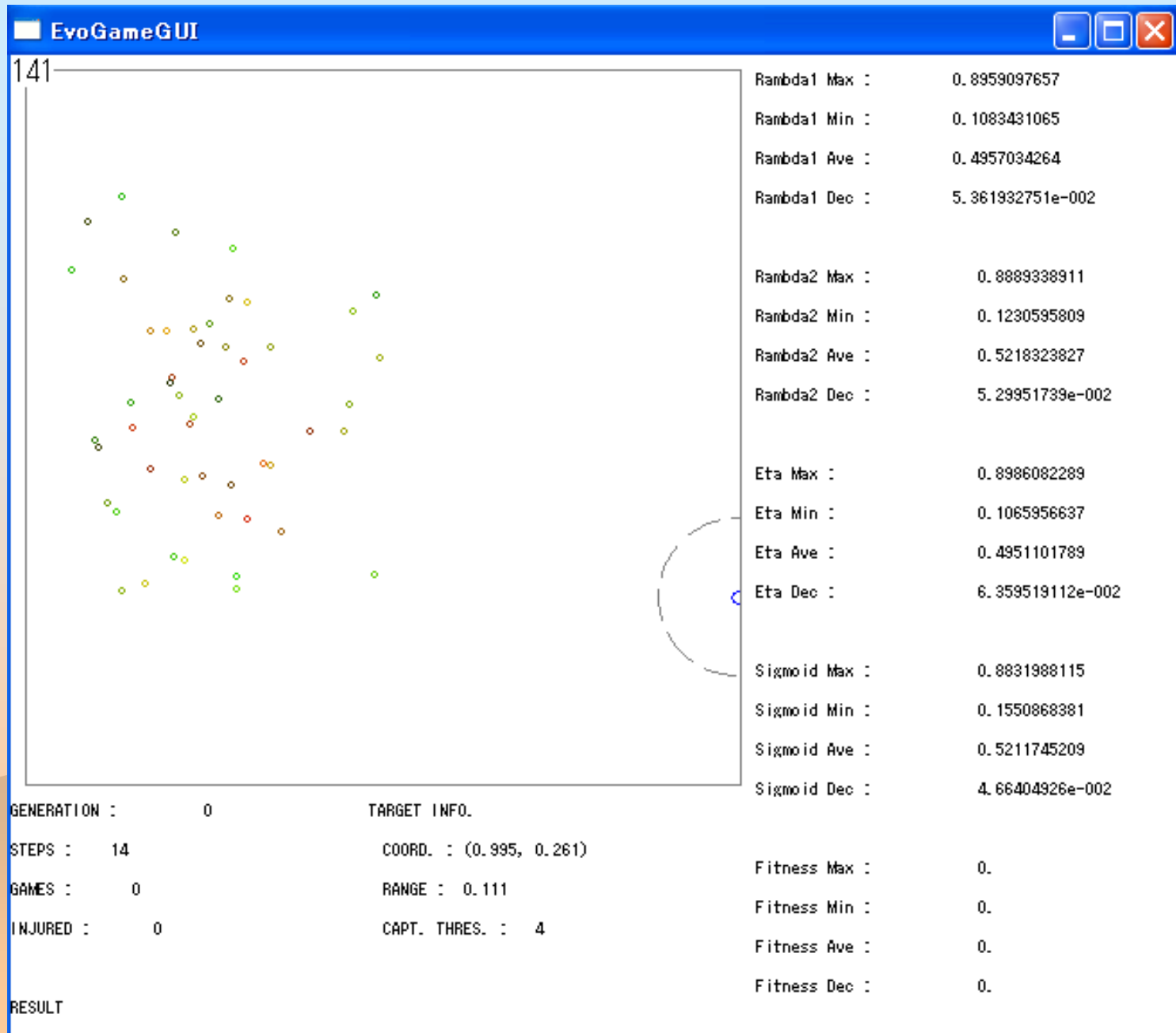
Mechanism of GA



Flow chart of simulation model



Picture of simulation



Details of Simulation

- ❁ GENERATION

- ❁ STEP: repetition time of BP

- ❁ GAME: number of BP learning

- ❁ INJURED: number of injured agents

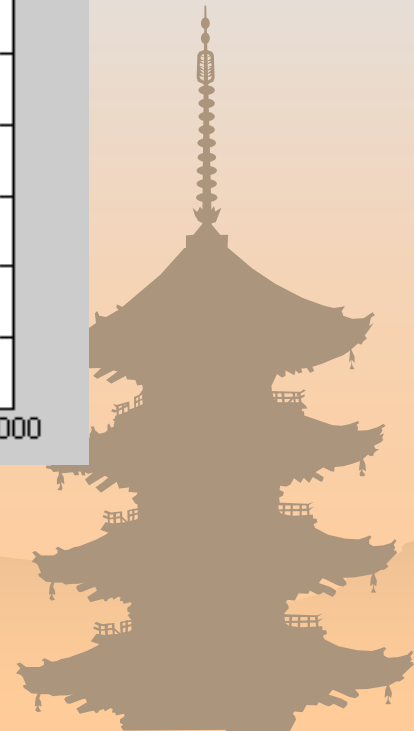
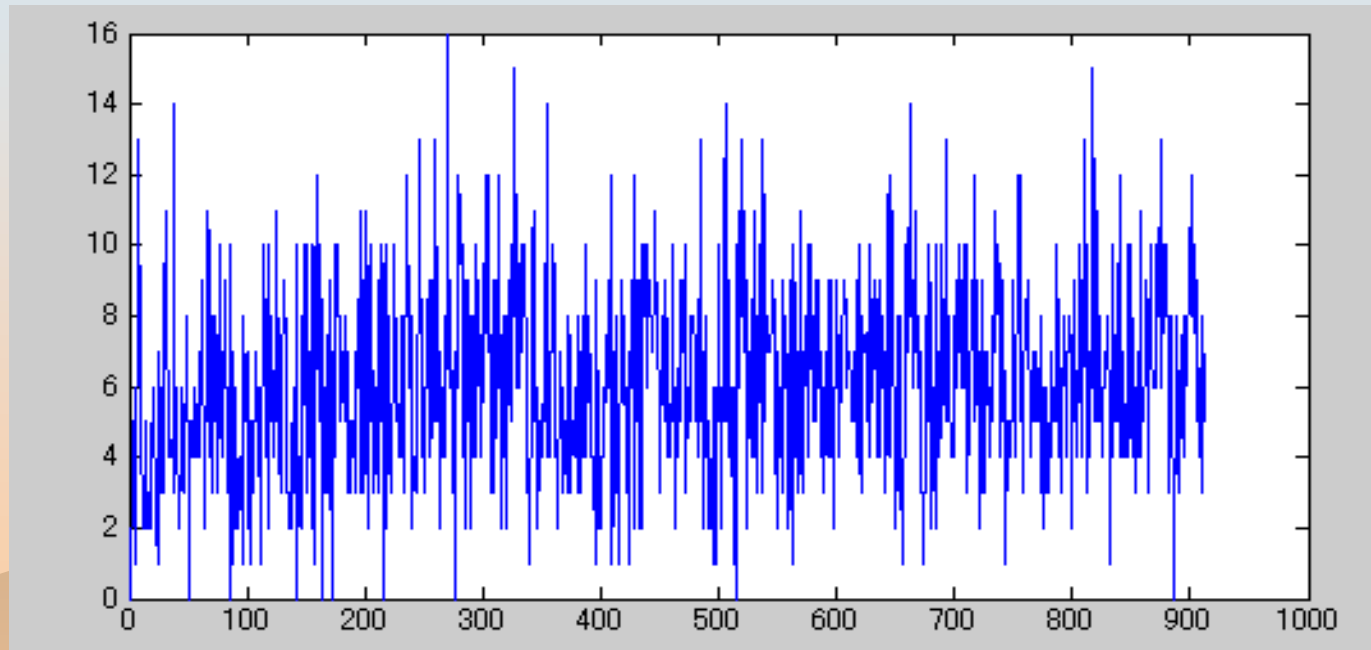
- ❁ RESULT: applying GA on each session

- ❁ ○ : success × : failure



Result

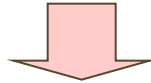
Numbers of getting the game



Verification: Prisoner's Dilemma

Prisoner's Dilemma

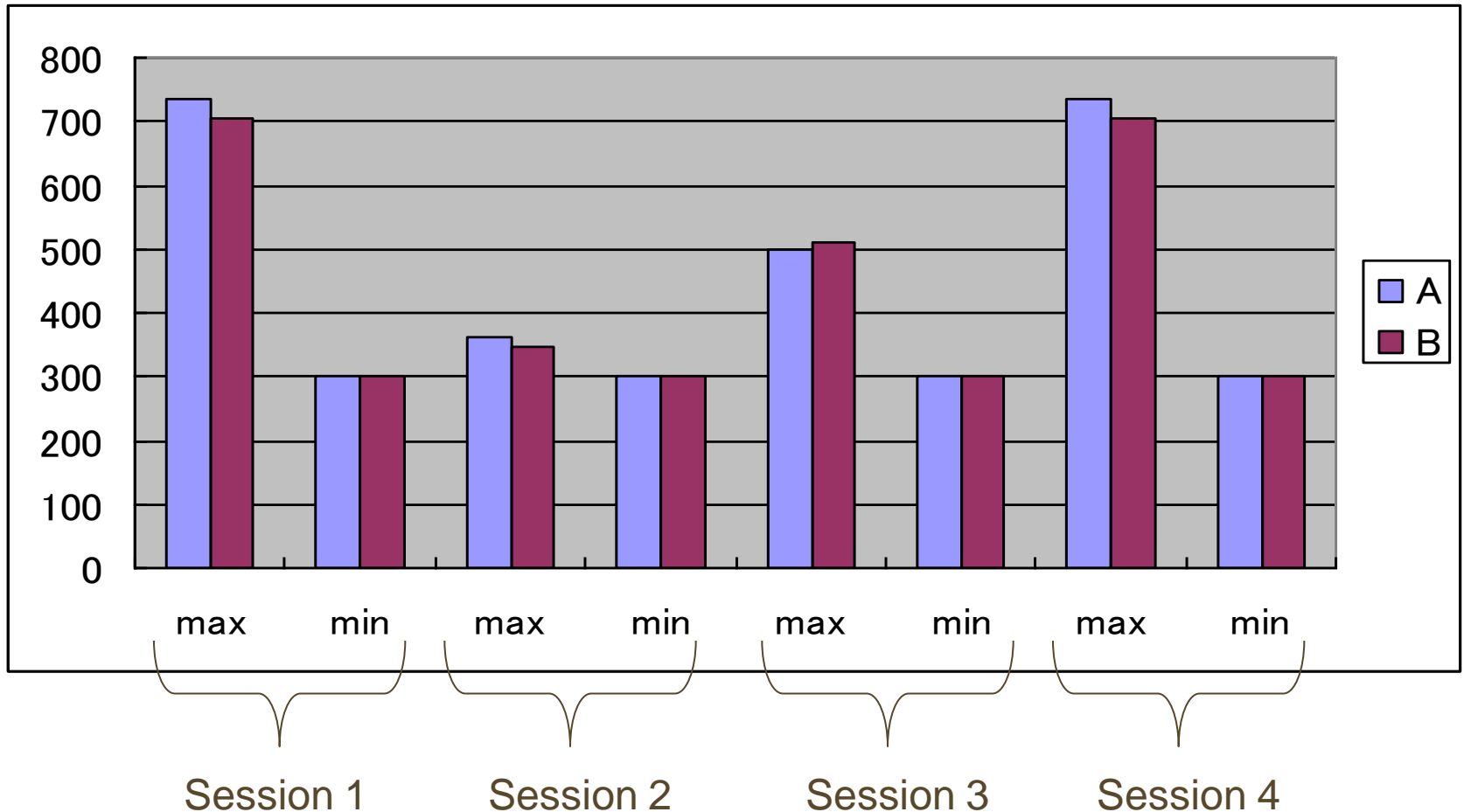
	B: Cooperates	B: Betrays
A: Cooperates	Both serve 6 months	A serves 10 years B goes free
A: Betrays	A goes free B serves 10 years	Both serve 2 years



Verification task

	B: Enters	B: Not enter
A : Enters	Both get 10 points	A gets 1 point B gets 15 points
A : Not enter	A gets 15 points B gets 1 point	Both get 3 points

Result of Verification



MAX : two best agents in fitness in the session

MIN : two worst agents in fitness in the session