A Primitive emotion and its cooperative function simulated in neural networks:towards a theory of emotions as cognitive functions

A Primitive Emotion and Its Cooperative Function Simulated in Neural Networks

Towards a Theory of Emotions as Cognitive Functions

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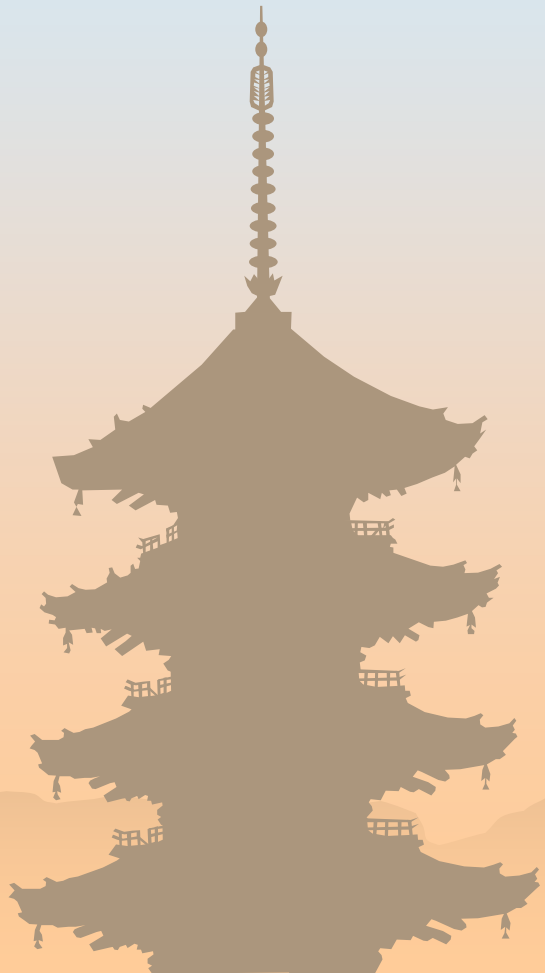


Purpose

- 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 evolutional process

Working Hypotheses

1 Multi-dimensionality of emotions

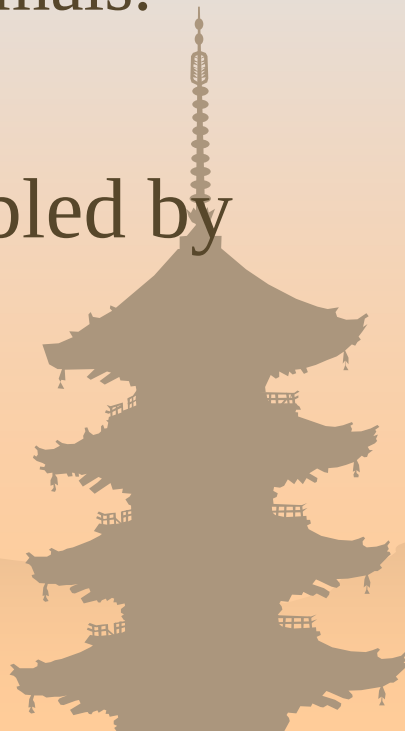
Emotions evolutionarily have got multiple layers operating differently in a variety of cognitive tasks.

2 Computational intractability

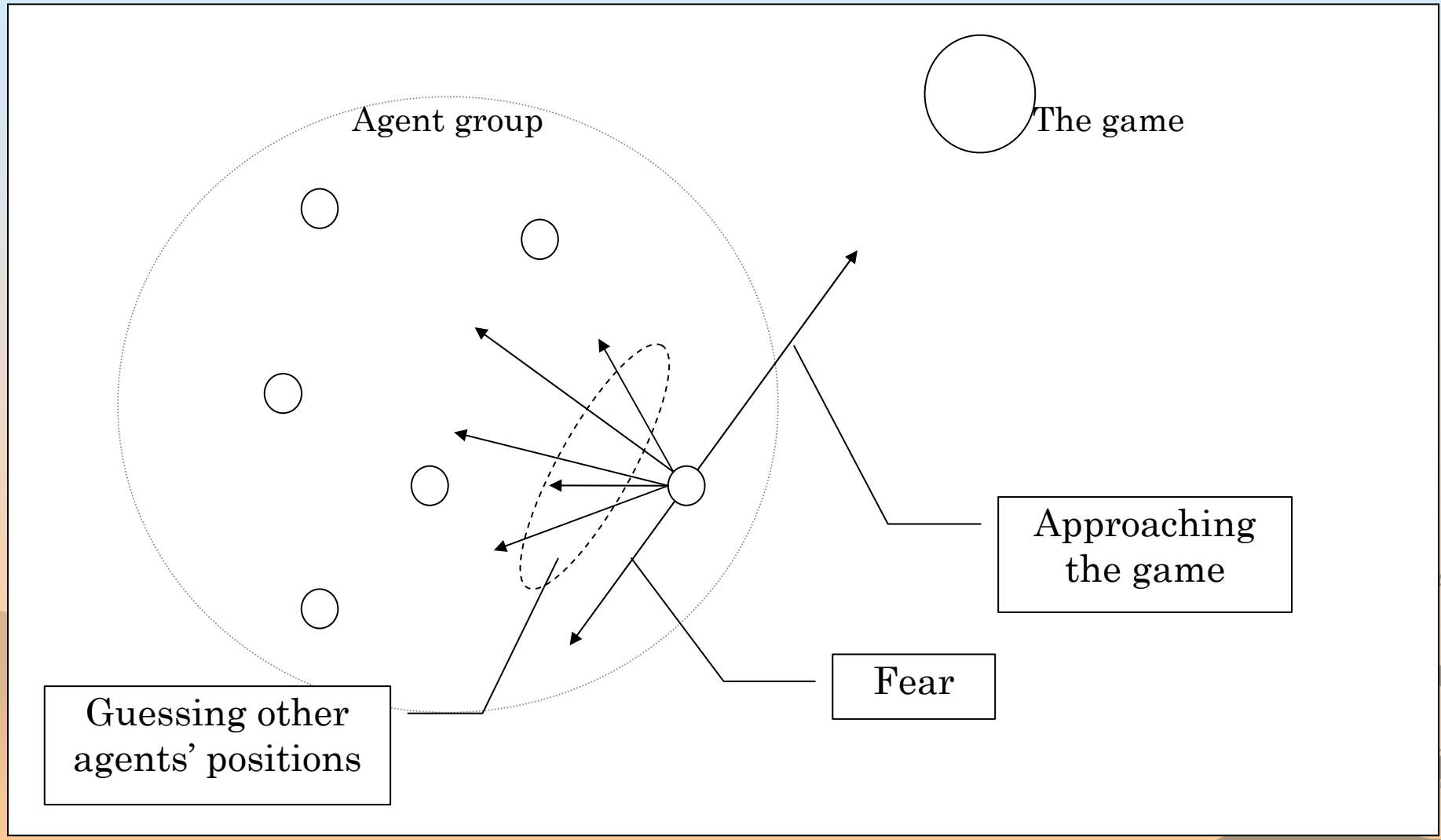
Emotions have mechanisms that attain rationality not by means of computation but bio-chemical causation.

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

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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

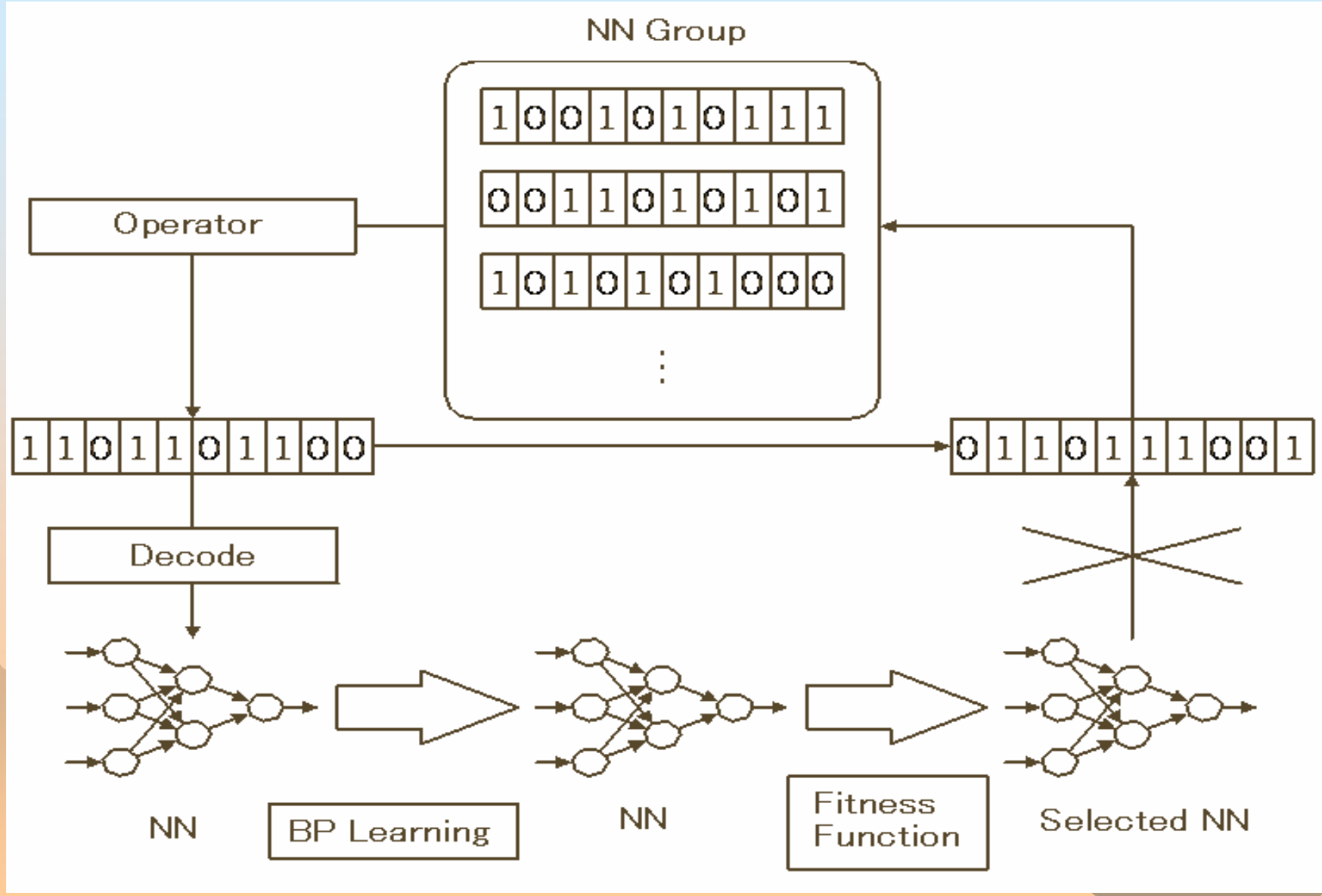
GA operators

- Three operations:

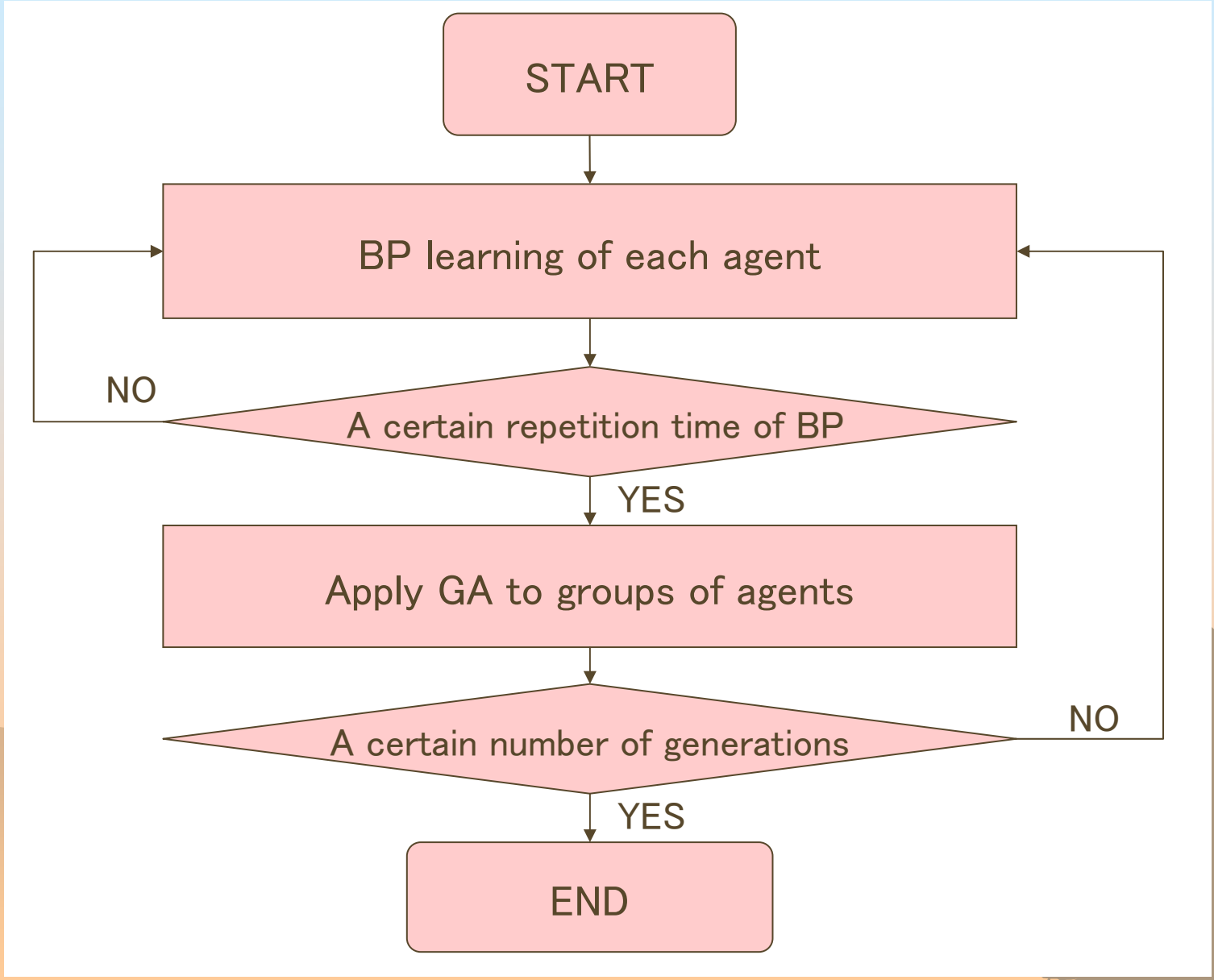
  Selection, Crossover, Mutation

- Searching for adaptive agents by applying these GA operations.

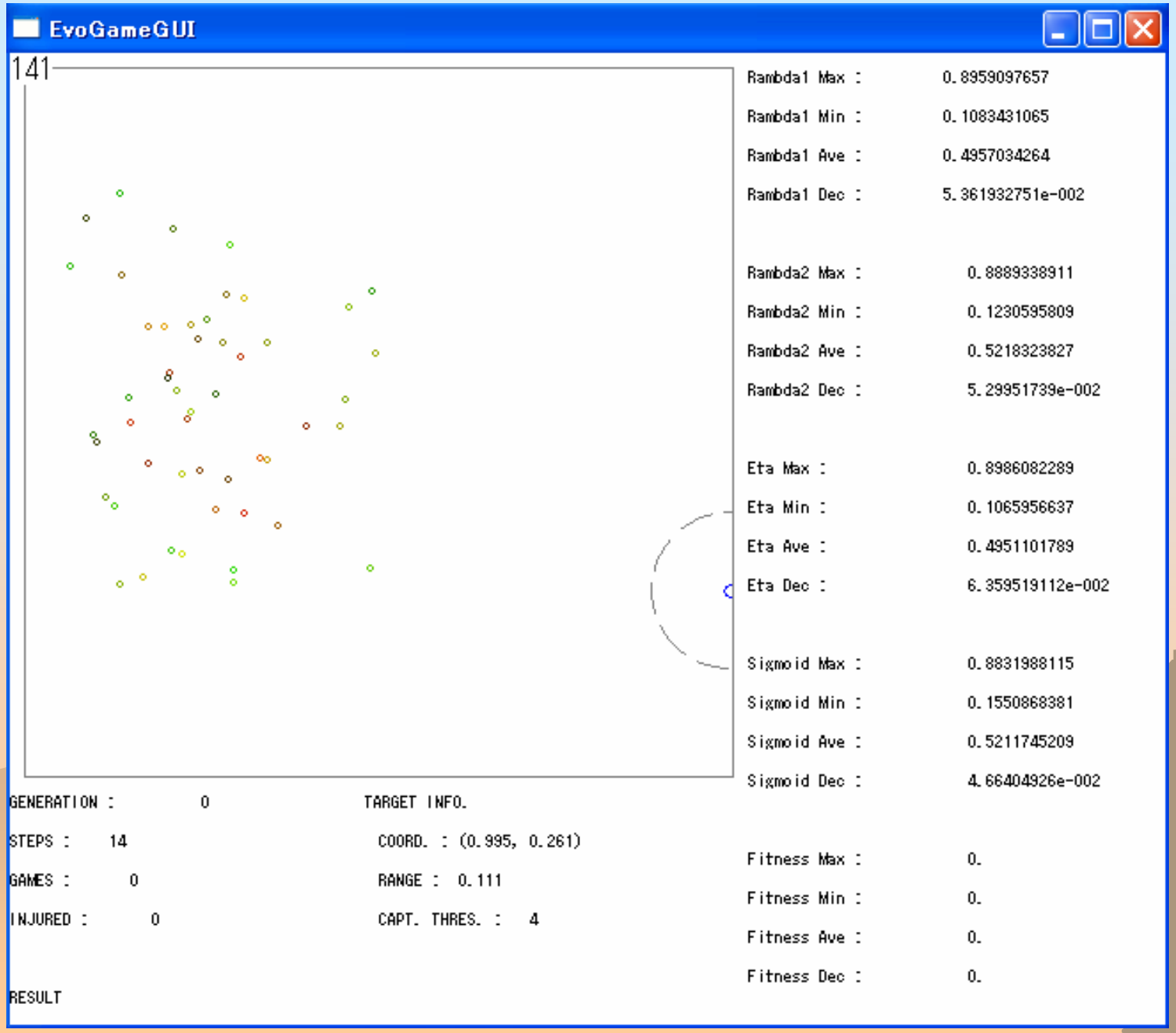
Mechanism of GA



Flow chart of simulation model



Picture of simulation

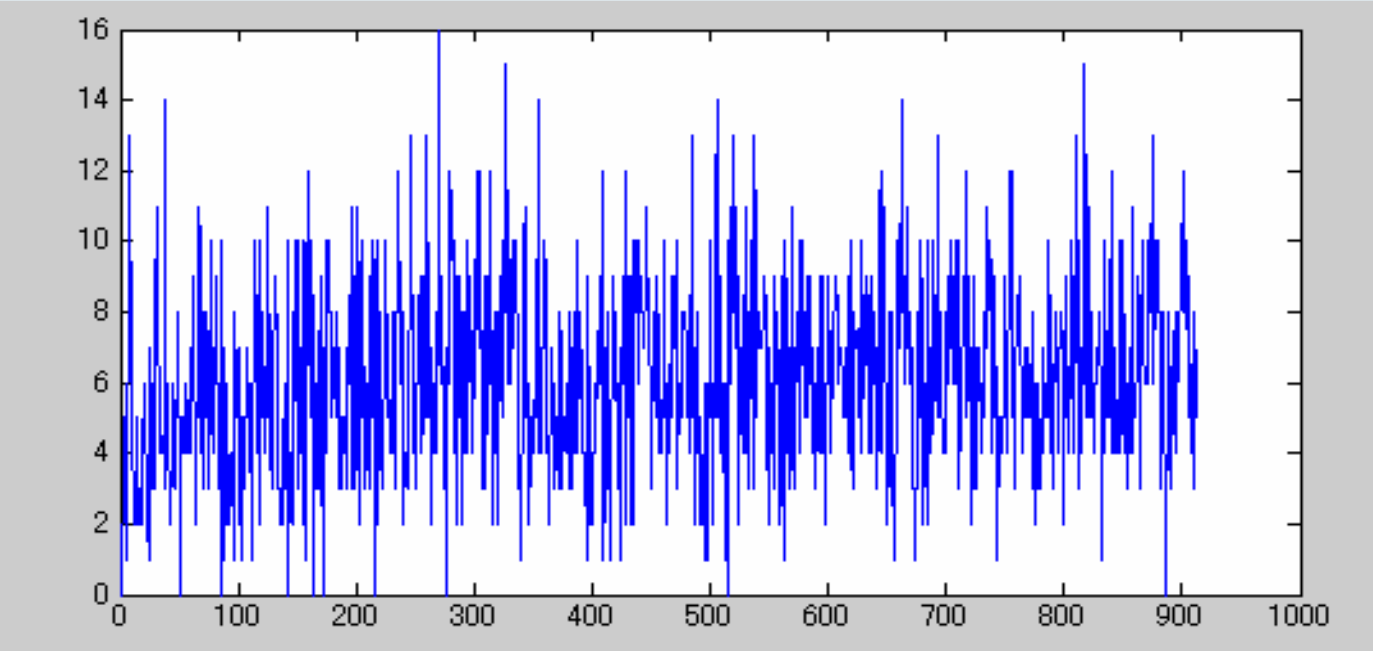


Details of Simulation

- GENERATION
- STEP: repetition time of BP
- GAME： number of BP learning
- INJURED： number of injured agents
- RESULT：applying GA on each session
- 〇：success　×：failure

Result

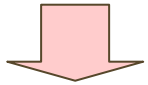
Numbers of getting the game



Verification: Prisoner's Dilemma

Prisoner's Dilemma

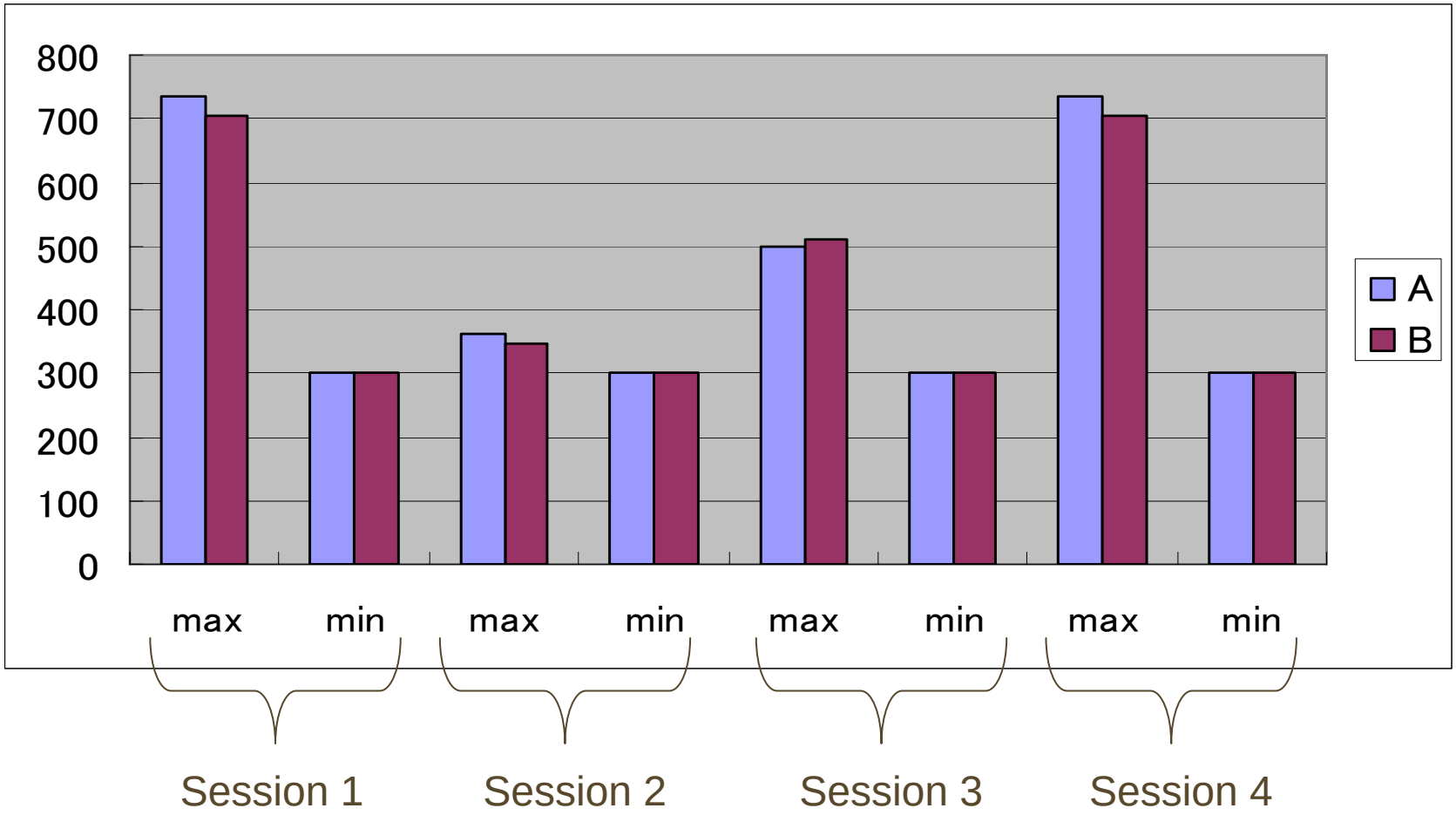
	B: Cooperates	B: Betrays
A: Cooperates	Both serve 6 months	A serves 10 years B goes free
A: Betrays	A goes free B serves 10 years	Both serve 2 years



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