

Genetic Algorithm

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Sunmoon Univ.
Shane Oh

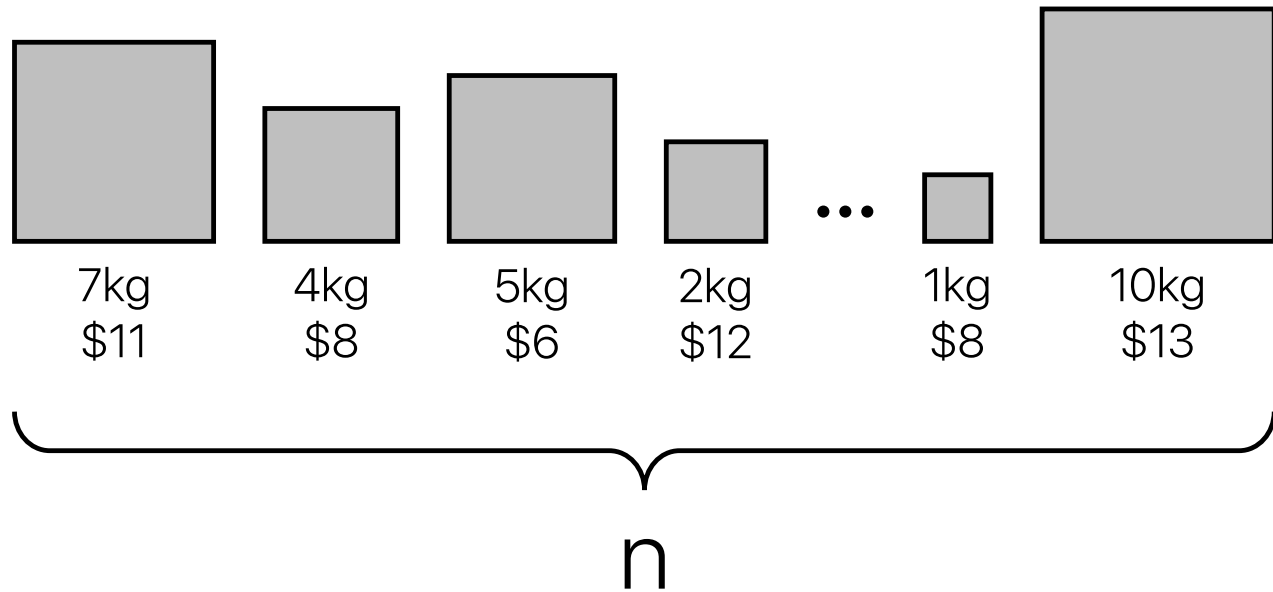
ohshane71@sunmoon.ac.kr
github.com/ohshane71

github.com/ohshane71/SnakeAI-pygame

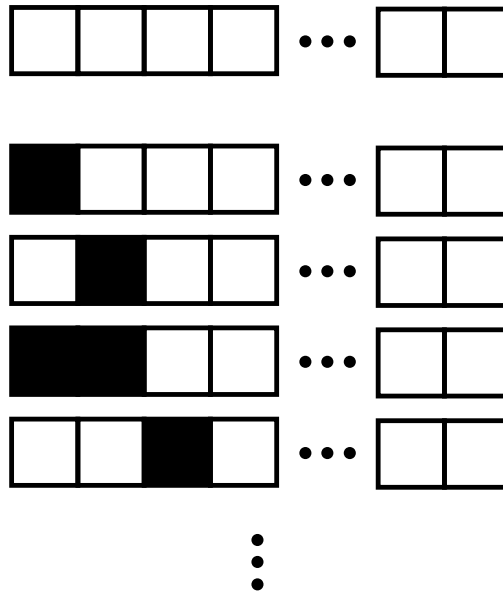
Knapsack problem



15kg



Knapsack problem

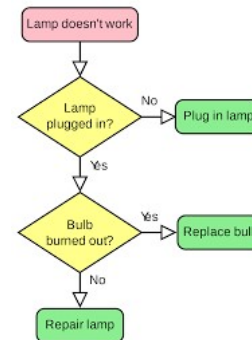
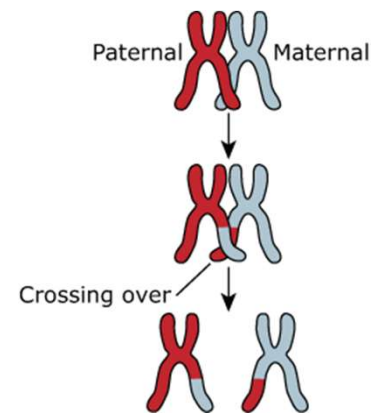


$$O(2^n)$$

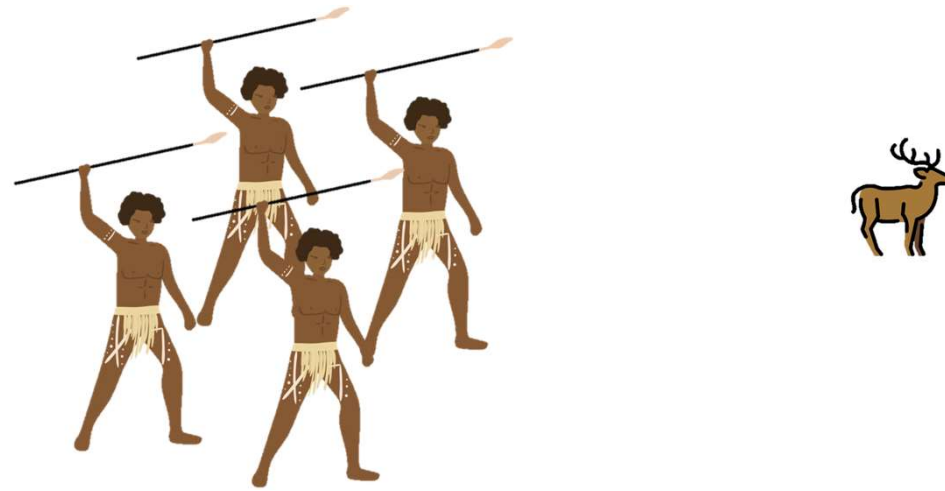
near-best

Finding the ~~best~~ **combination**

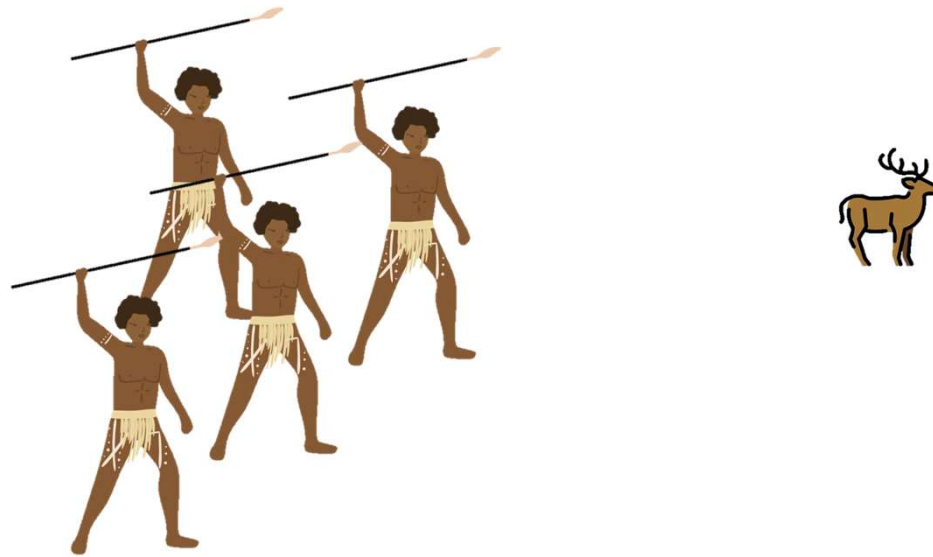
Genetic Algorithm

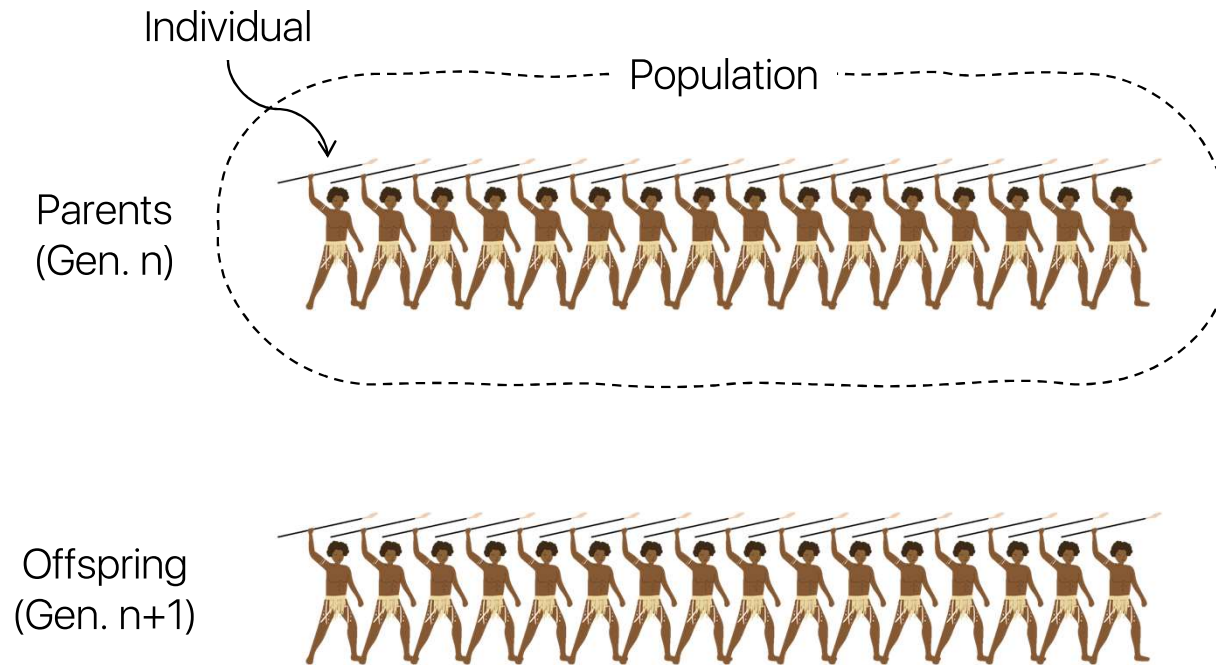


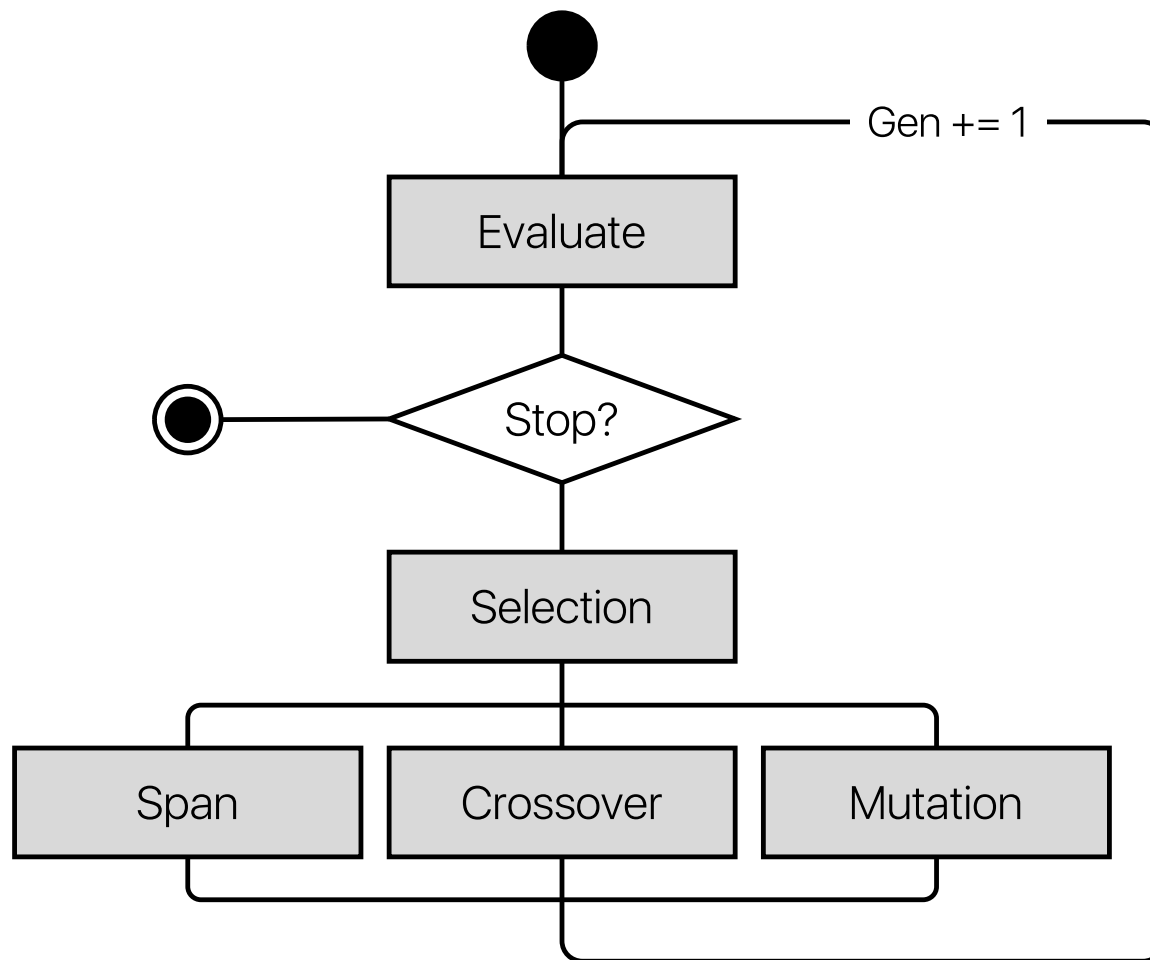
Selection

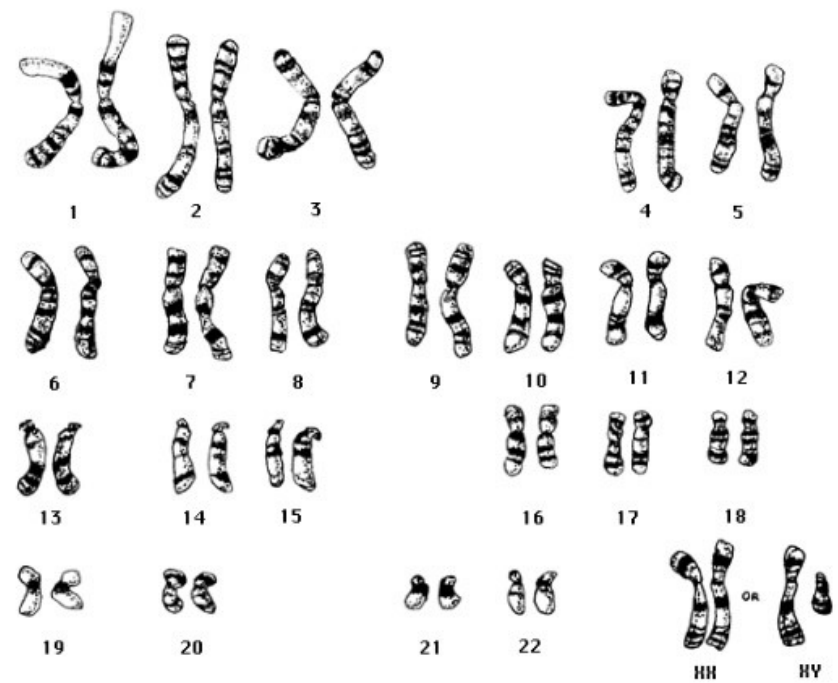
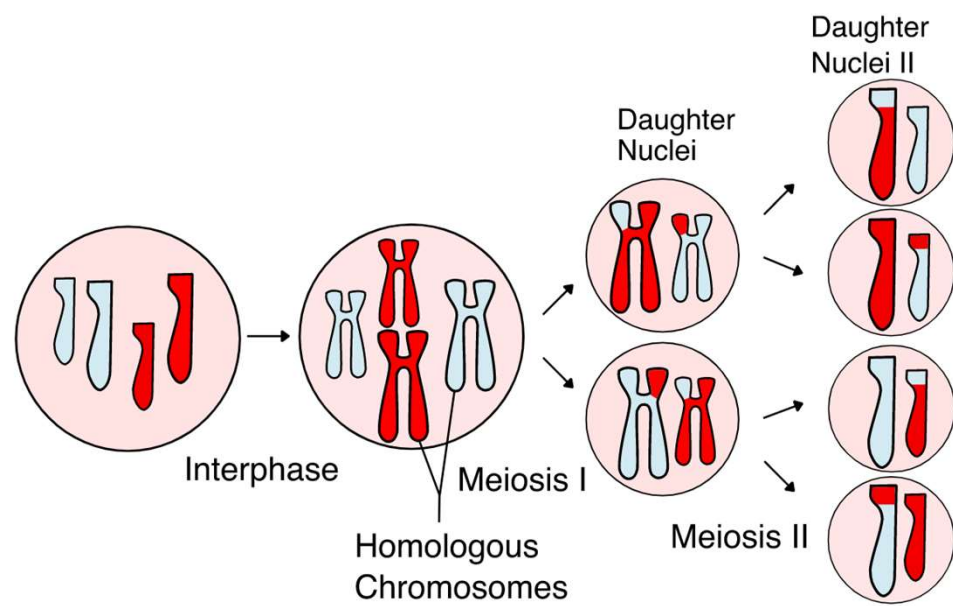


Crossover/Mutation









Crossover

Chromosome



Crossover



Crossover



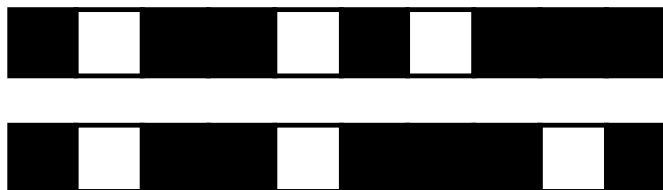
Single point
crossover

Mutation

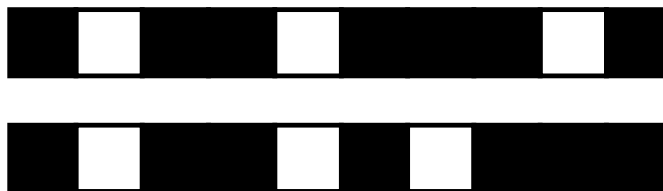


Crossover

Serialized binary chromosome



Crossover




Mutation




Mutation





$(7, 5)$
 $(0111_{(2)}, 0101_{(2)})$



$(3, 2)$
 $(0011_{(2)}, 0010_{(2)})$

Multi-point crossover

01110101

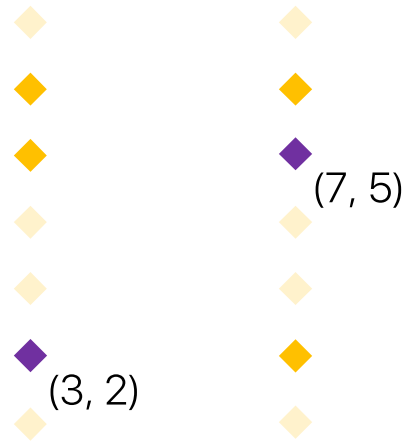
00110010

0_110____

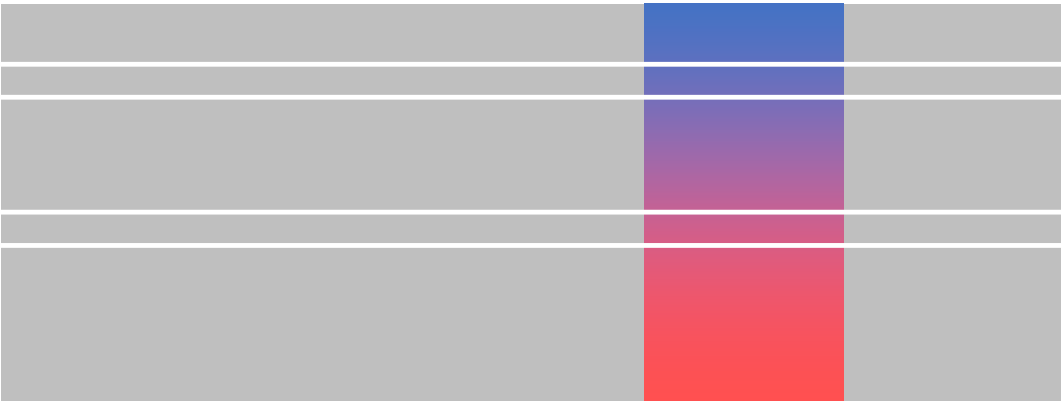
◆ 00110010

◆ 01110101

Single point crossover coverage \subseteq Multi-point crossover coverage



Single point crossover coverage \subseteq Multi-point crossover coverage

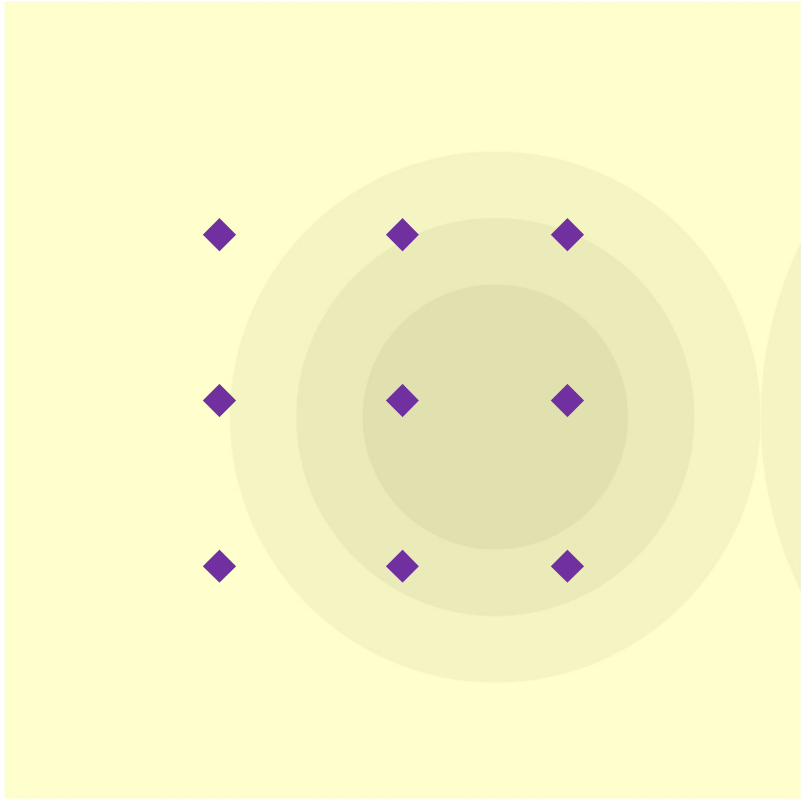


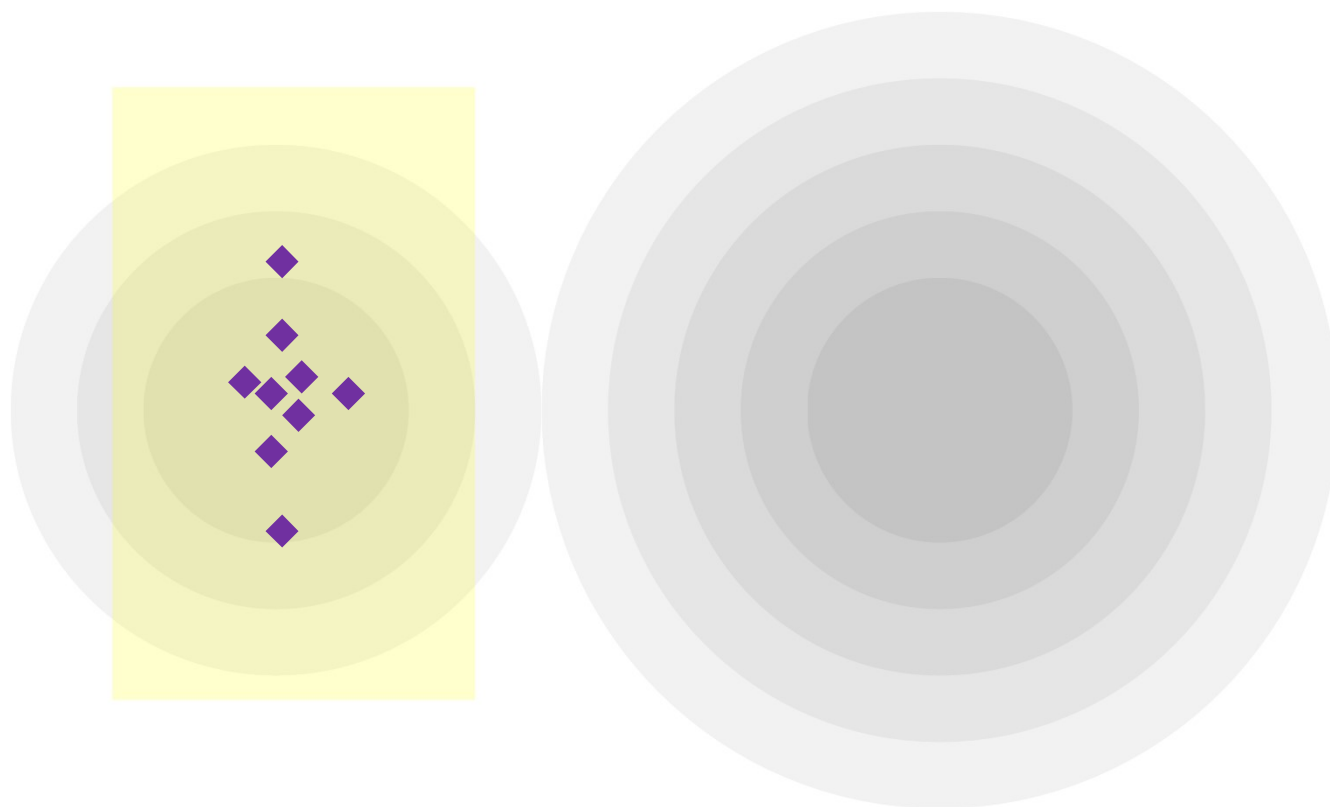


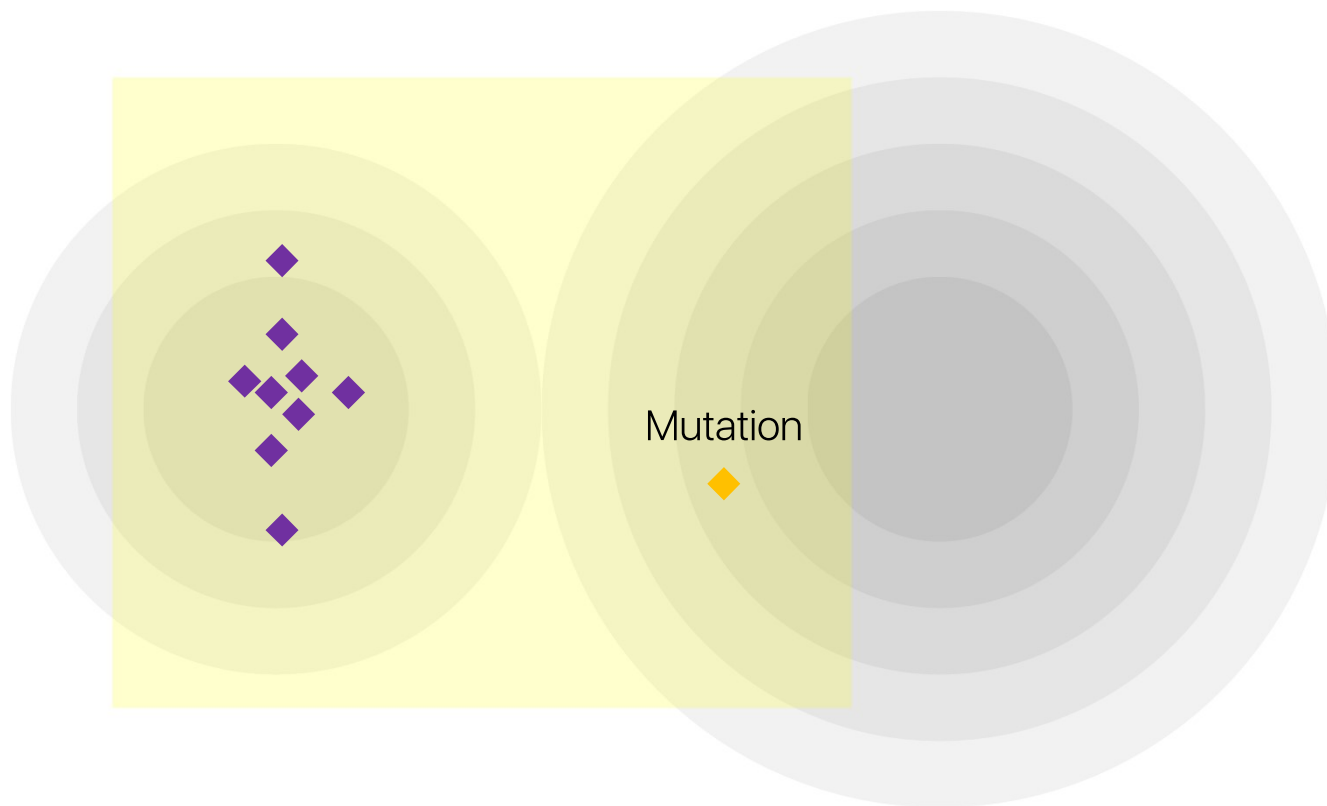


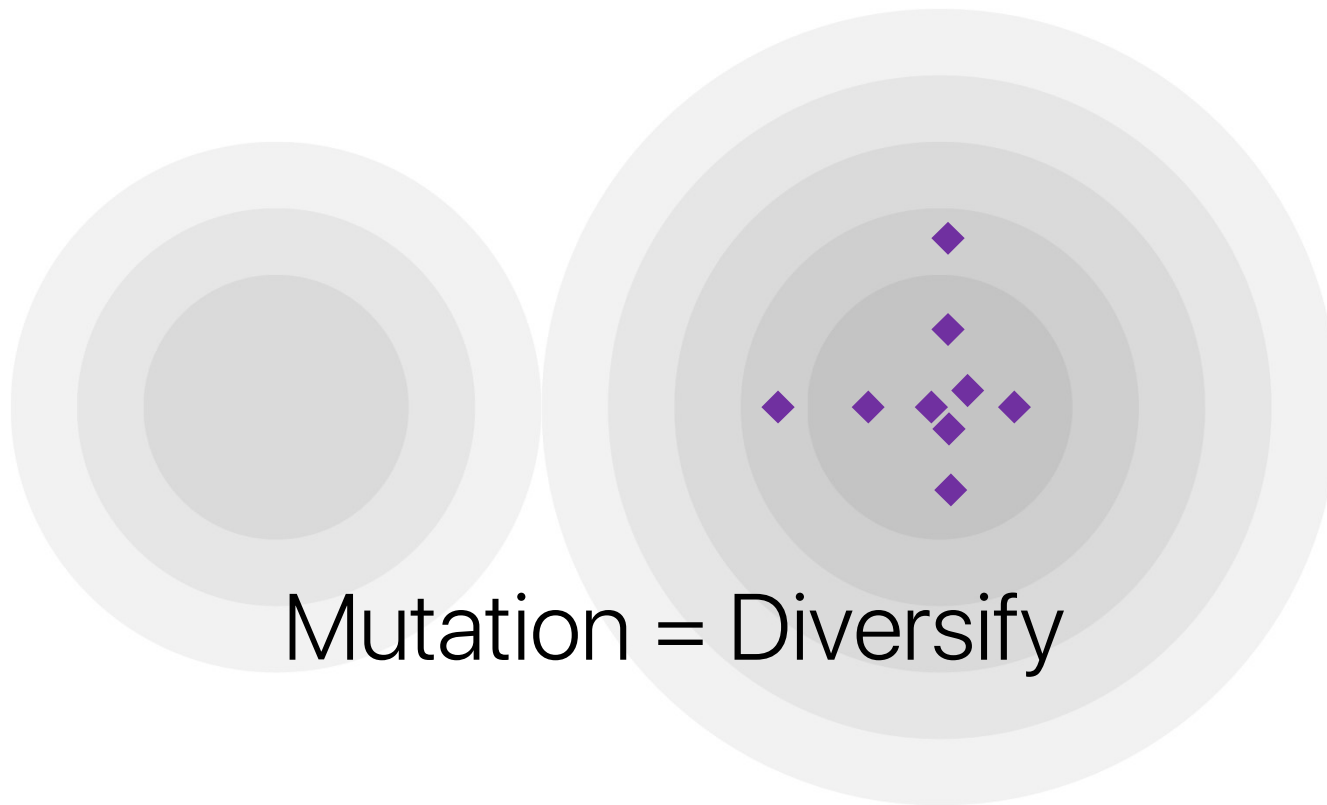


Crossover = Converge









Mutation = Diversify



Rule-based
Reinforcement Learning (RL)
Evolutionary Algorithms (EAs)



Rule-based

Reinforcement Learning (RL)

Evolutionary Algorithms (EAs)

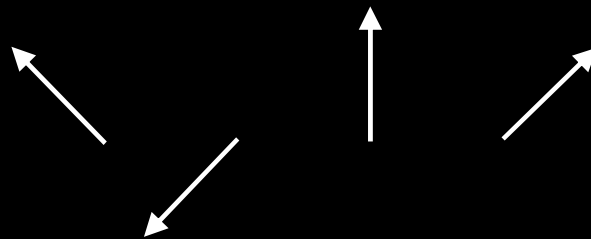
- └ **Genetic Algorithm (GA)**

- └ Particle Swarm Optimization (PSO)

- └ Differential Evolution (DE)

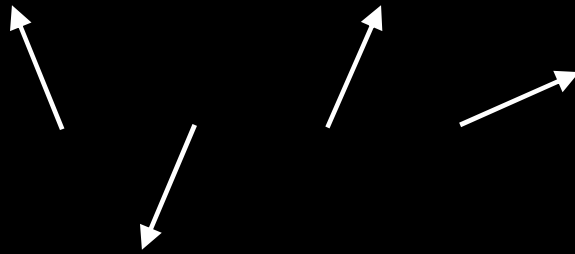
Reinforcement **Learning** (RL) vs Genetic **Algorithm** (GA)

Reinforcement **Learning** (RL)



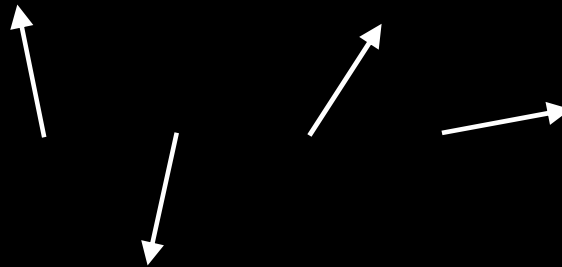
w

Reinforcement **Learning** (RL)



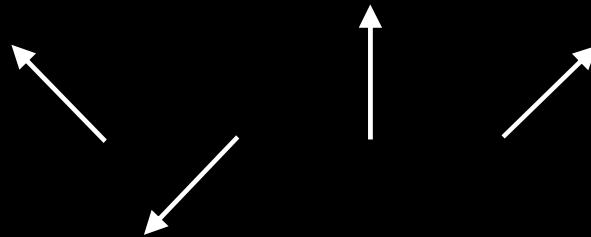
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Reinforcement **Learning** (RL)



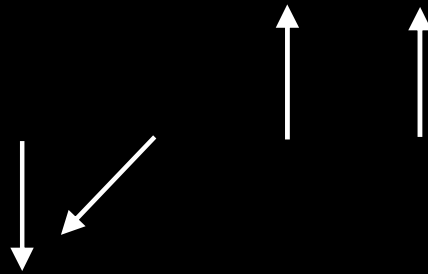
w

Neural Network w/
Genetic **Algorithm** (GA)



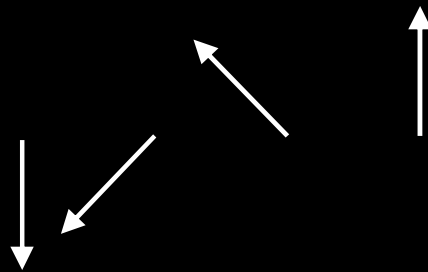
w

Neural Network w/
Genetic **Algorithm** (GA)



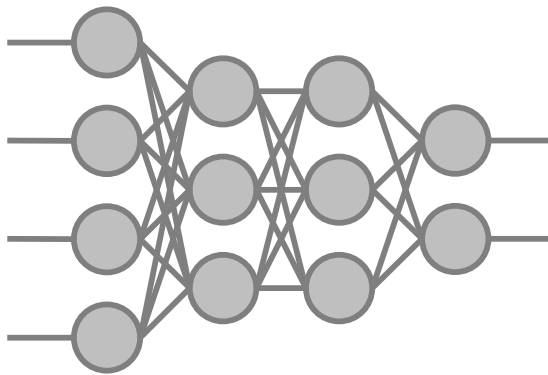
w

Neural Network w/
Genetic **Algorithm** (GA)



w

"Finding the near-best combination of weights"

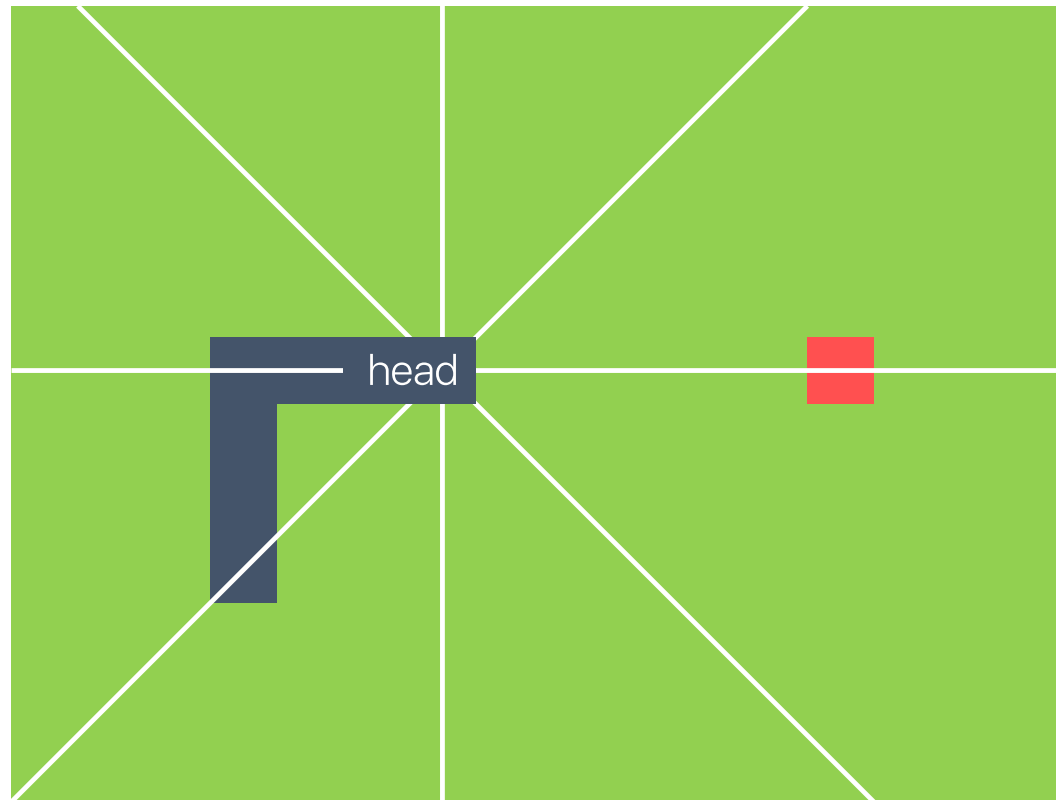


Feedforward Neural Network

Serialized binary chromosome



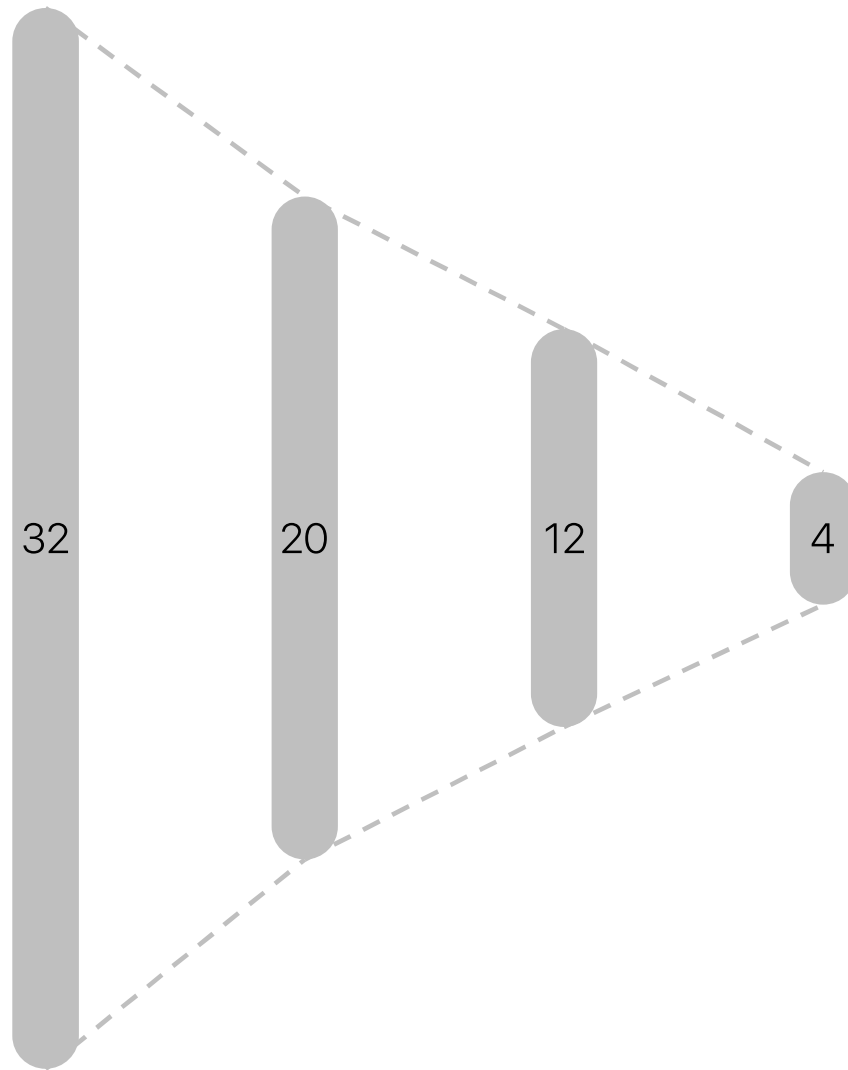
Environment



distance_to_wall
distance_to_apple
distance_to_self
head_direction
tail_direction

8-direction distance vision (normalized)
8-direction binary vision
8-direction distance vision (normalized)
4-direction distance vision (one-hot encoded)
4-direction distance vision (one-hot encoded)

Network



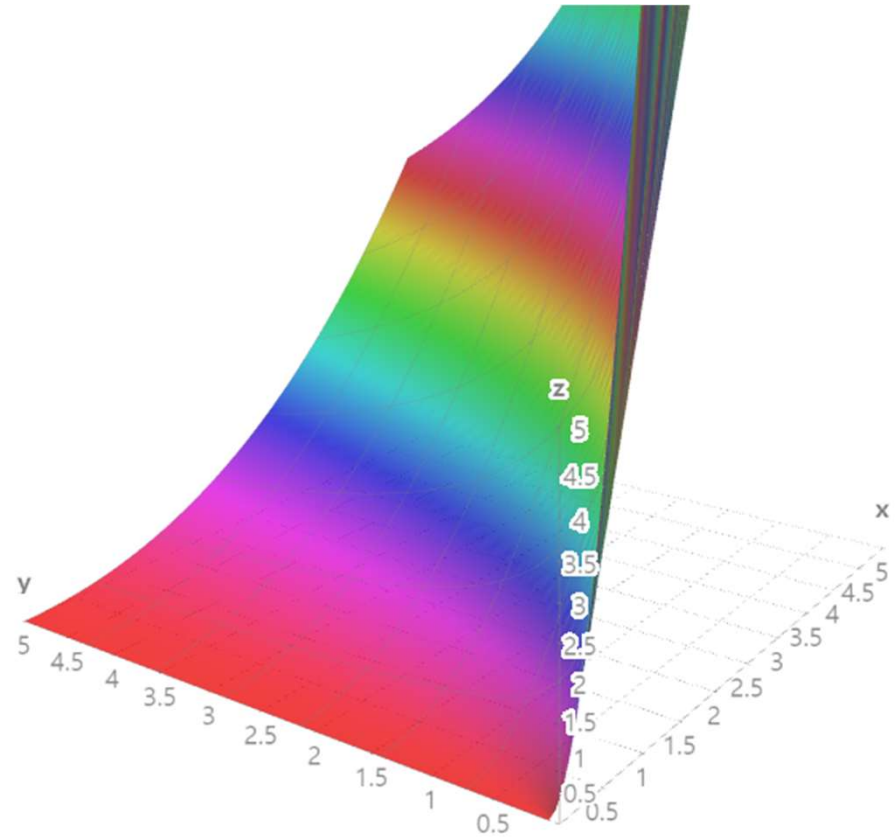
=====		
input_layer	ReLU	32
hidden_layer_1	ReLU	20
hidden_layer_2	ReLU	12
output_layer	Sigmoid	4

parameters		964
=====		

Evaluation

Score	x
Frames	y
Board size	b

$$f(x, y; b) = x^2 y^{\frac{x}{2b} - 1}$$
$$\max(f(x, y; b), 0.1)$$



Strategy



10X10

32X24

Strategy

10X10

10X10

10X10

32X24

Parents	500	500	50	50
Offspring	1000	1000	100	50
Selection type	Plus	Plus	Plus	Comma
Life span	∞	∞	∞	-
SPBX_type	R	R	C	R
Mutation ratio	0.05 (5%)	0.05 (5%)	0.05 (5%)	0.001 (0.1%)
Mutation rate type	Static	Static	Decaying	Decaying
Test avg. (10X10)	56.1 (56.1%)	71.7 (71.7%)	99.9 (99.9%)	33.0 (33.0%)
Test avg. (32X24)	-	-	679.3 (88.8%)	763.4 (99.8%)*

*gen_1493_153_460_126