Particle swarm optimization in games

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Particle Swarm Optimization (PSO)

♦ Population based stochastic optimization technique developed by Kennedy and Eberhart in 1995

♦ Based on social behavior of species in nature, e. g. a flock of birds or a school of fish

♦ Applied in many areas: function optimization, artificial neural network training, fuzzy system control.

How it works

♦ Swarm: a set of uniformly spread particles (S)

♦ Particle: a potential solution

◊ Position: $x_i = (x_{i,1}, x_{i,2}, \ldots, x_{i,n}) \in R^n$

◊ Velocity: $v_i = (v_{i,1}, v_{i,2}, \ldots, v_{i,n}) \in R^n$

♦ Each particle maintains individual best position (pBest)

♦ Swarm maintains its global best achieved so far (gBest)

♦ At each step, particle's velocity and position are updated based on its pBest and gBest

♦ Algorithm stops when global optimum is reached or after N iterations
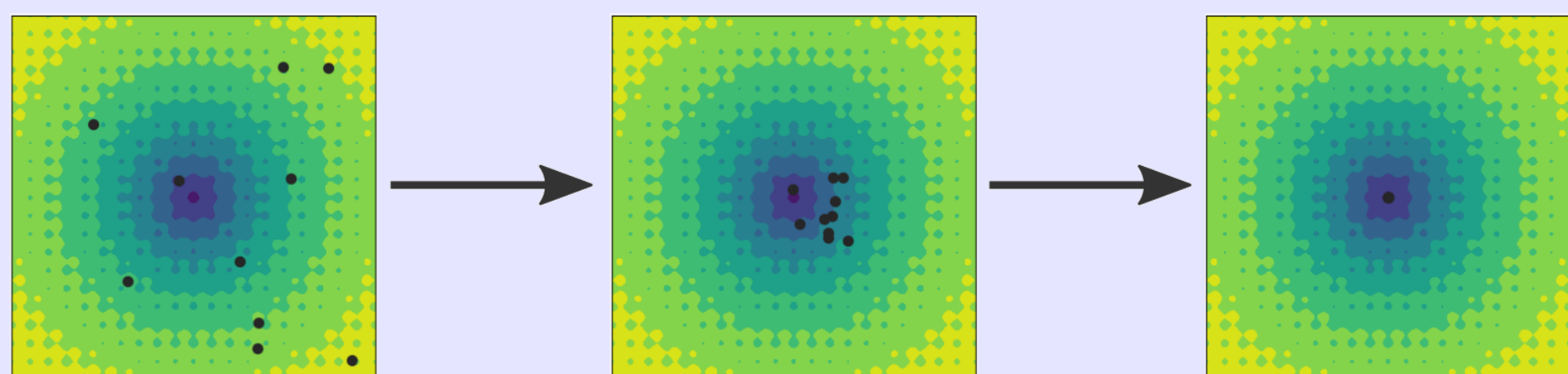
Comparison with Genetic algorithm (GA)

PSO shares many common points with GA. Both algorithms start with a population of randomly generated solutions and have fitness functions for its evaluation. They produce new populations and search for the optimum.

However, PSO doesn't have genetic operators like crossover and mutation. Particles update themselves with the internal velocity. The information sharing mechanism in PSO is significantly different. In GA, chromosomes share information with each other, thus the whole population moves like a one group towards an optimal area. In PSO, only gBest gives out the information to others. It is a one-way information sharing mechanism. The evolution only looks for the best solution. Compared with GA, all the particles tend to converge to the best solution quickly in most cases.

https://github.com/kopylash/algorithmics-project/

Simulation of PSO
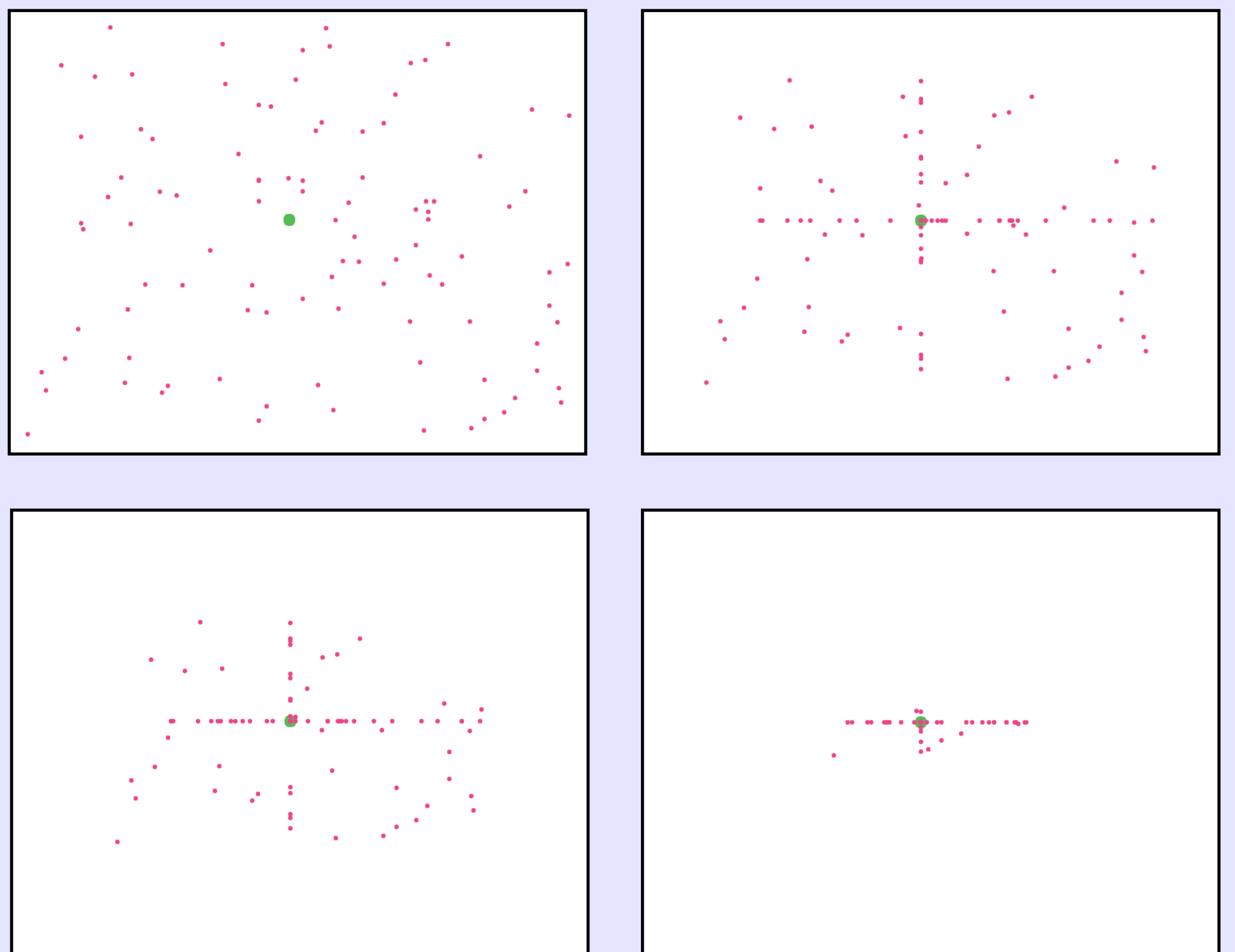
The Game
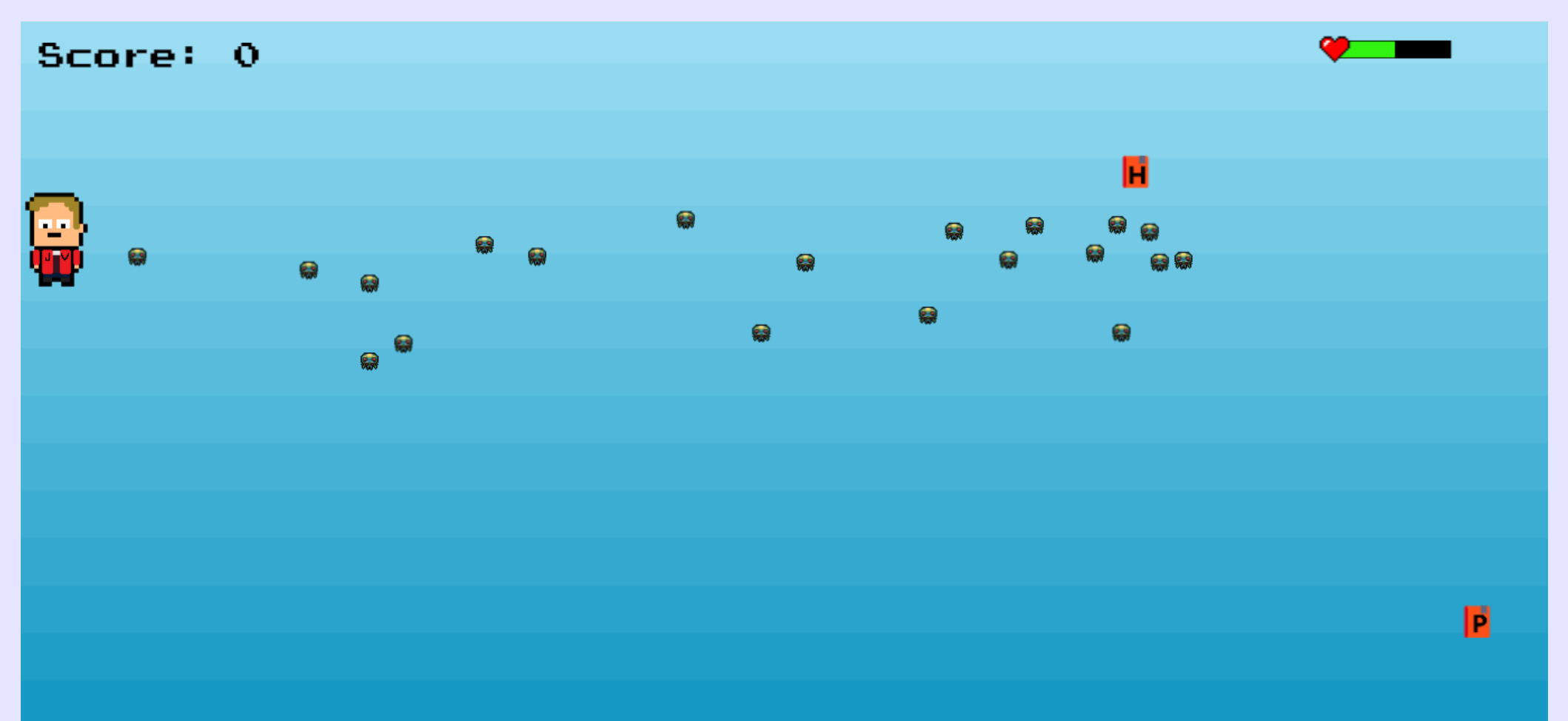
In the first part of the game particles chase the character using the particle swarm optimization

In the second phase of the game particles escape from the character following the maximum distance greedy algorithm

Play it here: