

# Particle Swarm Optimization

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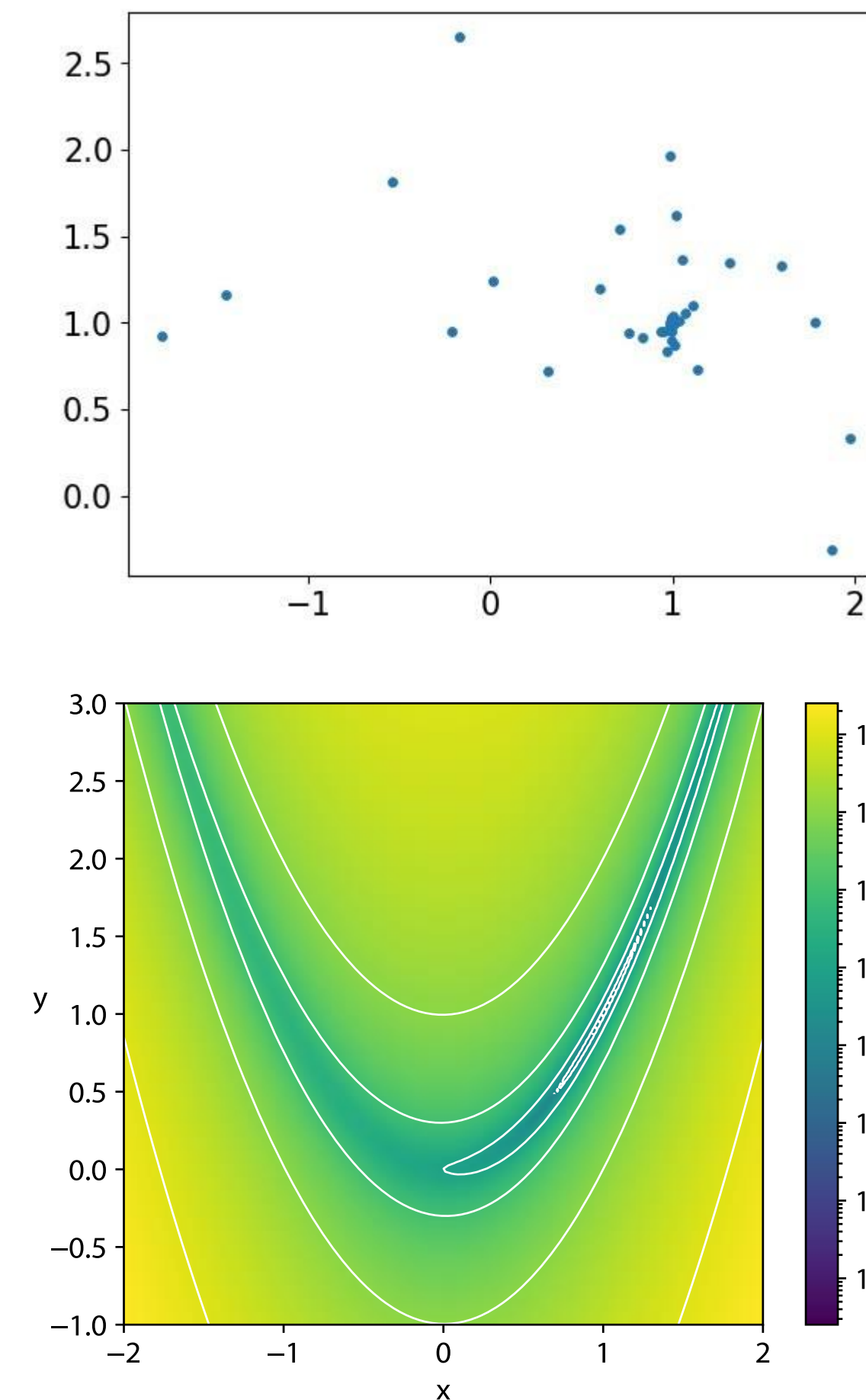
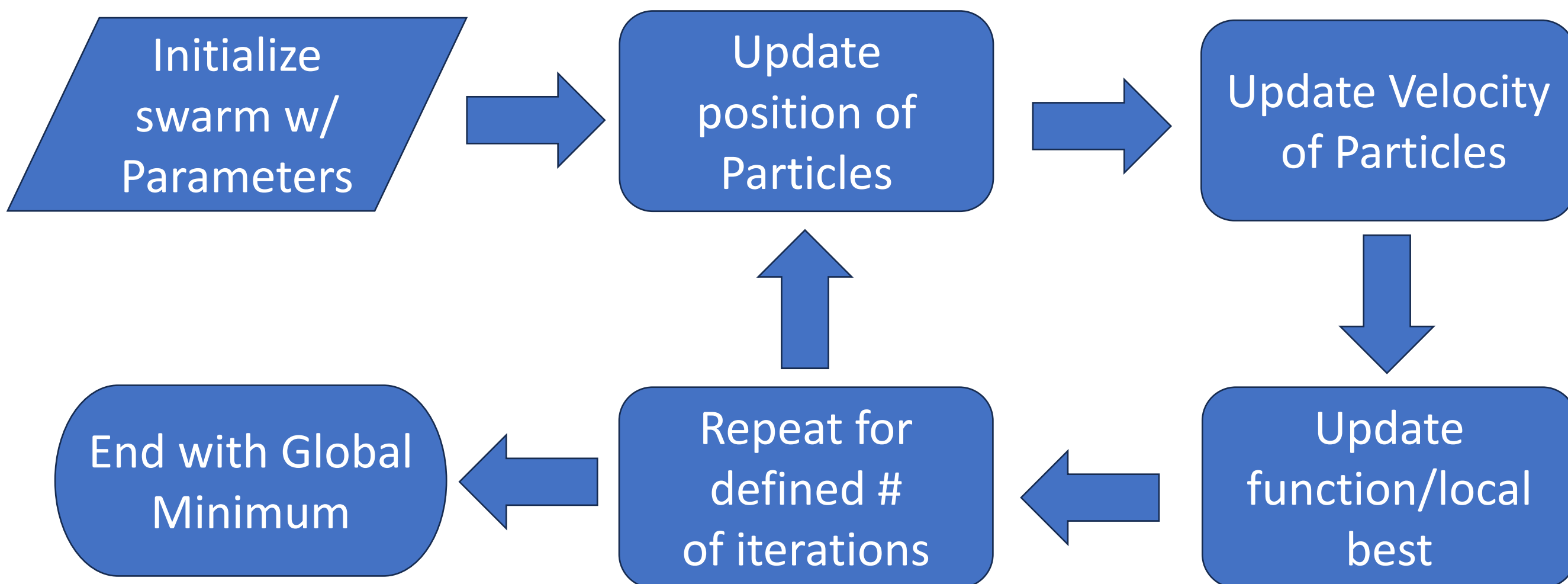
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## Intro To Particle Swarm Optimization

- Particle swarm optimization is an optimization method that iteratively improves candidate solutions for a cost function.
- These candidate solutions (or particles) to a problem move within the search space. Each particle dynamically adjusts its velocity based on its own position and the positions of the other particles for a set number of iterations, swarming on the global minimum.
- The solution is a heuristic solution where the best solution is never exact but is a good enough approximation.



## Limitations

- If there are multiple local minima, it is hard to find the global minimum; particles will get stuck at local minima and never reach the global minimum.
- It is difficult to model real life interactions using PSO as more complex interactions have many parameters in the cost function, which makes the particles more complex. Our code has 2 parameters, the x and y, while a real-life problem could have hundreds.

## QR Codes



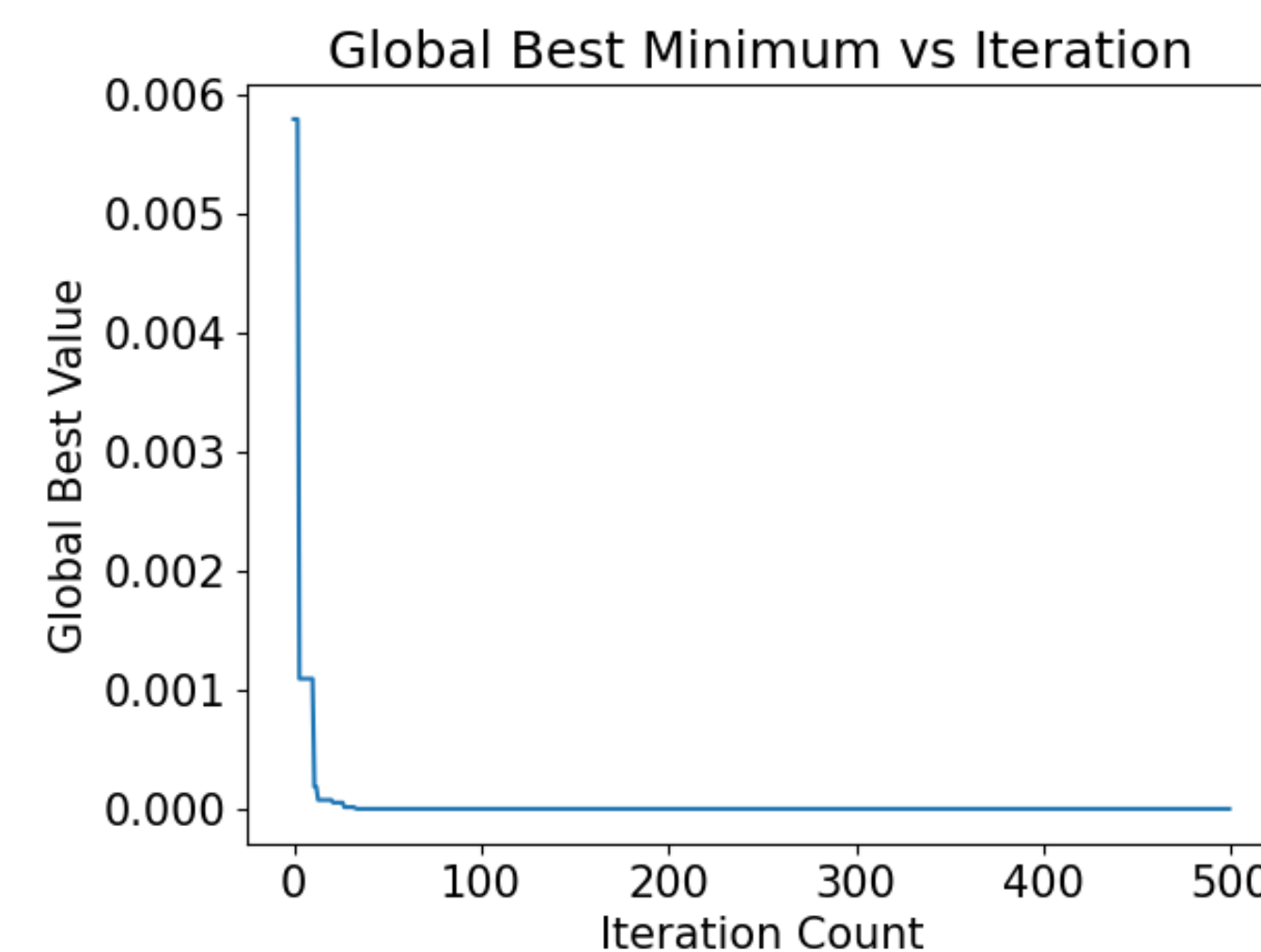
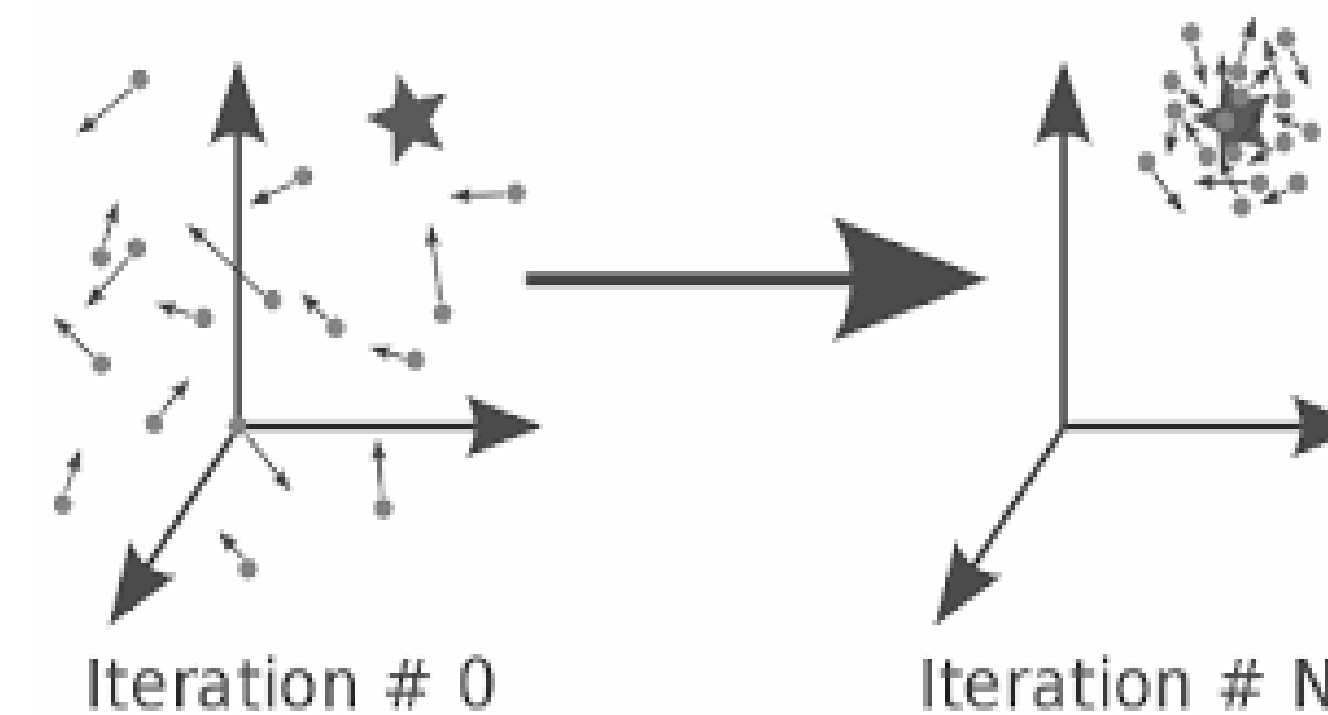
Code



Visual Representation

## Real Life Application

- PSO is intended to simulate social behaviors such as the movement of a school of fish or flock of birds.
- It may also be used to optimize the timing of traffic signals at intersections to minimize congestion, reduce travel time, and improve overall traffic flow.
- The model would consider variables such as the duration of the green light and wait time to find the ideal timing of the traffic light changes.



## References

- Tam, Adrian. "A Gentle Introduction to Particle Swarm Optimization - MachineLearningMastery.com." MachineLearningMastery.com, 15 Sept. 2021, machinelearningmastery.com/a-gentle-introduction-to-particle-swarm-optimization/
  - Dai, Hou-Ping, et al. "Effects of Random Values for Particle Swarm Optimization Algorithm." ResearchGate, MDPI, 15 Feb. 2018, [www.researchgate.net/publication/323281605\\_Effects\\_of\\_Random\\_Values\\_for\\_Particle\\_Swarm\\_Optimization\\_Algorithm](https://www.researchgate.net/publication/323281605_Effects_of_Random_Values_for_Particle_Swarm_Optimization_Algorithm).
  - Clerc, Maurice. "Standard Particle Swarm Optimisation." Hal.science, Sept. 2012, <https://hal.science/hal-00764996>
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