**Introduction**

Particle swarm optimization (PSO) is a simple evolutionary algorithm that searches for an optimal solution in the solution space. It differs from other optimization techniques in that it simply requires the objective function and is unaffected by the gradient or any differential form of the objective. It also has a small number of hyperparameters. PSO is a metaheuristic as it makes few or no assumptions about the problem being optimized and can search very large spaces of candidate solutions.

Particle swarm optimization (PSO) optimizes a problem by iteratively attempting to enhance a candidate solution in terms of a particular quality measure. It solves a problem by generating a population of possible solutions, which are referred to as particles, and moving them around in the search space using a simple mathematical formula based on their position and velocity. The movement of each particle is controlled by its local best-known position, but it is also directed toward the best-known positions in the search space, which are updated when better positions are discovered by other particles. The swarm is predicted to migrate toward the best options as a result of this.

**Proposal**

Kennedy and Eberhart suggested particle swarm optimization in 1995. Sociobiologists believe that a school of fish or a flock of birds moving in a group "may profit from the experience of all other members," as stated in the original publication. In other words, while a bird is flying around looking for food at random, all of the birds in the flock can share what they find and assist the entire flock get the finest hunt possible.

While we may imitate the movement of a flock of birds, we can also assume that each bird is assisting us in locating the best solution in a high-dimensional solution space, with the flock's best solution being the best solution in the space. This is a heuristic approach because we can never be certain that the true global optimal solution exists, and it rarely does. However, we frequently discover that the PSO solution is very close to the global optimal.

**Algorithm**

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| **Variable** | **Definition** |
| ***xik*** | **Particle position at the kth iteration** |
| ***vik*** | **Particle velocity at the kth iteration** |
| ***pik*** | **Best individual particle position** |
| ***pgk*** | **Best swarm position** |
| **wk** | **Constant inertia weight** |
| **c1, c2** | **Cognitive and social parameters** |
| **r1, r2** | **Random number between 0 and 1** |

* The two equation that make up the PSO algorithm:
  + Particle position: ***xik+1 = xik + vik+1***
  + Particle velocity: ***vik+1 = wkvik +*** ***c1r1(pik - xik) +*** ***c2r2(pgk - xik)***
    - cognitive term: ***c1r1(pik - xik)***
    - social term: ***c2r2(pgk - xik)***
* PSO steps
  + Initialize
    - Set constants: kmax, wk, c1, c2
    - Randomly initialize particle positions.
    - Randomly initialize particle velocities.
    - Set k=1 (iteration counter).
  + Optimize
    - Evaluate cost function **fik** at each particle position ***xik***
    - If **fik <= fibest** then **fibest = fik** and ***pik*** = ***xik***
    - If **fik <= fgbest** then **fgbest = fik** and ***pgk*** = ***xik***
    - If stopping condition is satisfied, terminate.
    - Update all particle velocities.
    - Update all particle positions.
    - Increment k.
    - Go to B (1).
  + Terminate

**Analysis**

* Advantages
  + The fitness function can be non-differentiable so it can be applied to optimization problems of large dimensions, often producing quality solutions more rapidly than alternative methods.
  + PSO has only a few parameters which need to be fine-tuned.
* Disadvantages
  + There is no general convergence theory applicable to practical, multidimensional problems. For satisfactory results, tuning of input parameters and experimenting with various versions of the PSO method is sometimes necessary.
  + It is very easy for PSO to fall into a local optimum in high-dimensional spaces and has a low convergence rate in the iterative process.