Fri, Apr. 19, 2024

Announcements:

→ HW 5 due Monday, April 22
2 questions using Hill-Climbing

Topic 12 - Particle Swarm Optimization

In all of our MHs so far, we have tracked a single solution moving through the search space.

Particle Swarm Optimization (PSO) is from 1995. Is a "population metaheuristic"
we will track many solutions at a time, not just one

they will interact with each other.

Idea: You have N particles, each representing a solution in the search space. They all start at random positions.

Each particle has a position (sol. it represents) and a velocity.

The velocity of a particle depends on 3 things:

1) its current velocity (inertia)
2) the best solution that that particle has ever seen
3) the best solution that any particle has ever seen

Let $x_i(t)$ and $v_i(t)$ denote the position and velocity of particle i at time t.

* $x_i(t+1) = x_i(t) + v_i(t+1)$

$$v = \frac{\Delta x}{\Delta t} = \frac{x_n - x_0}{t_n - t_0} = x_n - x_0$$

$t_n - t_0 = 1$

$$v = x_n - x_0 \quad \Rightarrow \quad x_n = x_0 + v$$

$$v_i(t+1) = \alpha \cdot v_i(t) + \beta \cdot \underbrace{r_1}_{\text{vector}} \cdot \underbrace{(b_i(t) - x_i(t))}_{\text{vector}} + \gamma \cdot r_2 \cdot (B(t) - x_i(t))$$

$b_i(t)$ = best sol. particle i has ever seen up to time t

$B(t)$ = best sol. any particle has ever seen up to time t

α, β, γ: weighting factors of the three components (1) inertia, (2) personal best, (3) global best

typically, $\alpha \approx 0.9$, $\beta \approx 1$, $\gamma \approx 1$

r_1 and r_2 are random vectors whose components are in $[0, 1]$.

Code