⇒ Particle Swarm Optimization Example

Q. $a+2b+3c=10$. Find the optimal value of a, b, c using PSO.

$f(x) = |a+2b+3c-10|$

$F(x) = \frac{1}{1+f(x)}$ → Minimization

No. of particles = 2.

c1 = 1

c2 = 1

ω = 0.5

⇒Step1: Particles 1 and 2 are initialized randomly.

P1 : (2, 9, 5)

P2 : (1, 1, 1)

Initially $P_1Best = P_2Best = GBest = 0$

Velocity : → $V_1 = V_2 = 0$

⇒Step2: Calculate the fitness value of P_1 and P_2

P1 : (2,9,5)

$f(x) = |a+2b+3c-10|$

$= |2+18+15-10| = 25$

$F(x) = 0.0385$ $\left(\because \frac{1}{1+f(x)}\right)$

P2 : (1, 1, 1)

$f(x) = |a+2b+3c-10|$

$= |1+2+3-10|$

$= 4$

$$F(x) = \frac{1}{1+4}$$

$$= \frac{1}{5}$$

$$\underline{P_2} = 0.2$$

⇒Step 3: Update P_1Best, P_2Best, $GBest$ based on newly calculated fitness values.

$P_1Best = 0.0385$

$P_2Best = 0.2$

$GBest = 0.2$ ($\because P_2Best > P_1Best$)

⇒Step 4: Compute the velocity of P_1 and P_2.

iter : t

$\underline{P1}$:

$$V_1(t+1) = \omega V_1(t) + c_1 r_1 [P_1Best(t) - P_1(t)] + c_2 r_2 [GBest(t) - P_1(t)]$$

Assume $r_1 = 0.3$, $r_2 = 0.5$

$\omega = 0.5$, $c_1 = 1 = c_2$, $V_1(t) = 0$

$$V_1(t+1) = 0 + 1 \times 0.3 [(2,9,5) - (2,9,5)] + 1 \times 0.5 [(1,1,1) - (2,9,5)]$$

$$= (-0.5, -4, -2).$$

Update position of P_1 :-

$$P_1(t+1) = P_1(t) + V_1(t+1)$$

$$= (2,9,5) + (-0.5, -4, -2)$$

$$P_1(t+1) = (1.5, 5, 3).$$

Similarly, for particle 2

P_2 : $V_2(t) = 0$.

$$V_2(t+1) = \omega V_2(t) + c_1 r_1 [P_2Best_i - P_2(t)] + c_2 r_2 [GBest - P_2(t)]$$

$r_1 = 0.1$
$r_2 = 0.5$

$$= \vec{0} + \vec{0} + \vec{0}$$

as $P_2Best = P_2(t) = (1, 1, 1)$. and $GBest = P_2(t) = (1, 1, 1)$

$V_2(t+1) = (0, 0, 0)$.

Update position of P_2.

$$P_2(t+1) = P_2(t) + V_2(t+1)$$
$$= (1, 1, 1)$$

∴ After iteration 1, the new positions are.

$P_1 = (1.5, 5, 3)$
$P_2 = (1, 1, 1)$

Repeate steps 2 - 4 till convergence criteria is met.