17 - The Firefly algorithm

- Inspired by PSO
- Fireflies attract a mate or prey by emitting light, the higher intensity the higher the attraction is
- For continuous optimization, but exists for discrete

ALGORITHM

Each firefly i, at iteration t, is at location $x_i(t)$ in the search space: $x_i(t) \in S \subseteq \mathbb{R}^d$

Each firefly emits a light with an intensity $I_i(t)$ which depends on the fitness of solution $x_i(t)$

For a maximization problem, we can simply say $I_i = f(x_i(t))$ where f is the fitness.

At each iteration, the fireflies move according to:

- One considers all pairs (i, j) of fireflies with $1 \leq i \leq n$, $1 \leq j \leq n$, where n is the number of fireflies
- If $I_i < I_j$ then firefly i moves towards firefly j, according to the observed attractivity

to be defined

Attractivity:

$$\exp\left(-\left(\frac{r_{ij}}{\gamma}\right)^2\right) \in [0, 1]$$

where r_{ij} is the distance separating fireflies i and j and γ is a parameter weighing this distance.

This quantity will be the fraction of the distance r_{ij} that the less intense firefly will move towards the more intense one.

Depending on how we define γ this attractivity will affect far away fireflies, depending on how it is tuned it will be exploration vs exploitation

Movement:

Let us assume that i moves towards j each compont $\in [-\frac{1}{2}, \frac{1}{2}]$

then

$$x_i^{new} = x_i + e^{-(r_{ij}/\gamma)^2}(x_j - x_i) + \alpha\left(\overbrace{rand_d() - \tfrac{1}{2}}^{\in [-\frac{1}{2}, \frac{1}{2}]}\right)$$

parameter $\alpha \in [0, 1]$

this a d-dimensional vector of random number between 0 and 1

fine for continuous optimisation

Code:

- ➔ Initialize the fireflies position randomly in the search space
- ➔ for every couple (i,j) of fireflies
- ➔ if intensity of i < intensity of j, we update position and intensity of firefly i

- ➔ we don't change firefly j!!!