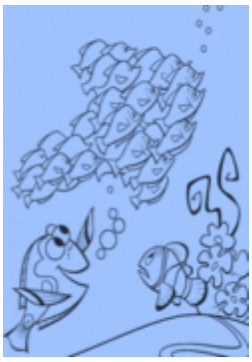
PARTICLE SWARM OPTIMIZATION



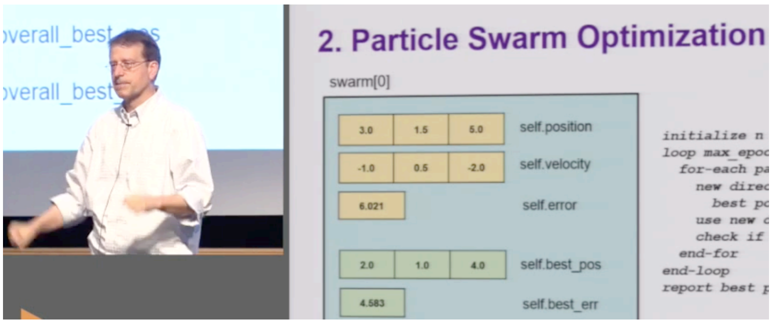
1. **Listen to the following video:**
   https://www.youtube.com/watch?v=UcNm1c8kggE :

2. **Linking words:**

Birds •	• school
Bees •	• flock
Fish •	• colony
Ant •	• swarm

They do this because the group is ________________ *when* ________________ *together*

3. **Listen to the following video:**
https://www.youtube.com/watch?v=bVDX_UwthZI (from 19'08 to 25')



4. **Complete the following sentences:**

Instead of having just three points you have a whole bunch of points, the ____________

the _____________________, and each point is called a __________________.

Each _____________ has a _________________, which is just a ___________ solution

It also has a ___________________, the _______________________ is a value that

indicates where the particle will move to next.

Each particle has a measure of error at its current position and it also has memory of the best position it found and the associate error.

There's a global ____________________ ________________ position found by any particle and its associates

There's a __________________ loop and then you process each particle and at each _______________________ you calculate a new velocity and the new velocity will determine where that point ___________________ ____________________

The velocity has three components:

- _________________: a particle that's moving tends to keep moving in the same direction
- and also it has another component that tends to move towards the best position that __________________________ __________________________
- The third component that moves it towards the best position found by any ________________________ in the ______________________________

Every optimization method has parameters you have to _____________________

5. Looking for the hidden treasure …

In a room of $M \times N$ cells there exists a particular position where the most delicious food is present, and we are going to find out using PSO.
You are a particle belonging to a population of 10 elements, and you are given an initial position and velocity, as well as, the three parameters:

w=0.8: inertia
cp=0.7: influence of the particular best position
cg=0.8: influence of the global best position

You must calculate your new position and velocity in each iteration, according to the following equations and keep the track of your particular best evaluation as well as the global best evaluation.
The modification of the particle's position can be mathematically modeled according to the following equation:

$$V_i^{k+1} = wV_i^k + c_p\, r_p(S_{pbest_i} - S_i^k) + c_g\, r_g(S_{gbest} - S_i^k)$$
$$S_i^{k+1} = S_i^k + V_i^{k+1}$$

where,

V_i^k : velocity of agent i at iteration k,
w: influence of the previous velocity,
c_j : influence of the global or local previous solution,
r_j : uniformly distributed random number between 0 and 1,
S_i^k : current position of agent i at iteration k,
$pbest_i$: pbest of agent i,
gbest: gbest of the group.

k=0	k=1	k=2	k=3	k=4	k=5	k=6
	r_p= 0.6824 r_g= 0.8041	r_p= 0.4306 r_g= 0.8663	r_p= 0.0218 r_g= 0.9667	r_p= 0.1656 r_g=0.0554	r_p= 0.1340 r_g= 0.6693	r_p= 0.0536 r_g= 0.9297
S^0= V^0=0	S^1= V^1=	S^2= V^2=	S^3= V^3=	S^4= V^4=	S^5= V^5=	S^6= V^6=
p_{best}= g_{best}=	p_{best}= g_{best}=	p_{best}= g_{best}=	p_{best}= g_{best}=	p_{best}= g_{best}=	p_{best}= g_{best}=	p_{best}= g_{best}=

6. **Implement a PSO strategy** based on exercise 1.
   - Evaluation function: the particles can smell the food, **the closer the food the stronger the smell** … *(To simulate this smell evaluation function let's assume that the treasure is hidden at position (x, y))*

Decimal Numbers

https://www.englishclub.com/vocabulary/numbers-decimal.htm

We can describe numbers **smaller than one** by using fractions or **decimals**. Today, the decimal system is more common than fractions.
To indicate a decimal number we use a point (.) and this includes money such as dollars and cents.

Look at these decimal examples:

We write:	We say:
0.3	nought **point** three zero **point** three
3.45	three **point** four five (NOT three point forty-five)
98.4	ninety-eight **point** four
$1.55	one dollar, fifty-five cents one dollar, fifty-five
$700.00	seven hundred dollars
€3,500.50	three thousand five hundred euro and fifty cents three thousand five hundred euro, fifty cents

Remember that we use commas to separate thousands. Be careful with commas and points. Some languages use them in the opposite way!