Project : Session 5
Job Shop Scheduling Problem x Particle Swarm Optimization

Problem Definition

Job Shop Scheduling Problem

Definition: A classical JSSP can be described as follows: in a job shop environment containing several machines, $M = \{M_1, M_2, ..., M_m\}$, there are a number of jobs $J = \{J_1, J_2, ..., J_i, ..., J_n\}$, each job, say J_i , contains a serial of operations $O_i = \{O_{i\,1}, O_{i\,2}, ..., O_{i\,j}, ..., O_{i\,ni}\}$ which need to be processed in a predefined chronological sequence. Each operation is assigned a machine in M to be processed with a given processing time $P_{i\,j}$. Sequencing needs to be done for operations in all machines to minimize the maximum completing time of all jobs, i.e., to minimize the makespan. <**video**>

Benchmark:
http://mistic.heig-vd.ch/taillard/problemes.dir/ordonnancement.dir/ordonnancement.html
use: Taillard, 20 jobs 15 machines + Taillard, 30 jobs 15 machines + Taillard, 50 jobs 15 machines + Taillard, 100 jobs 20 machines

Resolution Method

Particle Swarm Optimization
Metaheuristics are optimization techniques that help find approximate solutions within a reasonable time. They are particularly useful when traditional methods cannot be applied due to the problem's size or complexity.
In this project you are asked to define A solution, the solution space and its size, and the fitness function for the given problem. Then to implement and solve the problem using the Particle Swarm Optimization (PSO) and **Adapt it to the discrete nature of the problem**.

Each group of three must submit a detailed report of the work completed before the deadline of **April 13, 2025**. The report, with a maximum of **15 pages**, must include at least:
- Description of the inspiration behind the metaheuristic
- Functioning and algorithm of the metaheuristic
- Experimentation for metaheuristic parameter tuning
- Experimentation on different problem instances (sizes)
- Comparison (Graphs/Tables, Analysis, and Discussion)
- Comparison with DFS
- Visualisation of a solution (give gantt chart if possible)

The group will also present its work during the PW session of **April 13, 2025** within à maximum timing of **30min** that includes **PPT** presentation and execution of their code, followed by some questions (other students are highly encouraged to ask questions).

The last page of the report should contain each member's contribution to the project.

Each member of the group should be able to respond to any question on the project.

Good Luck!