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Advanced Optimization: Techniques and Industrial Applications

Module 2: Heuristics and Metaheuristics

Universidade do Minho

Curriculum Development
of Master’s Degree Program in
Industrial Engineering for Thailand Sustainable Smart Industry

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Session 2.4:

Multiobjective optimization

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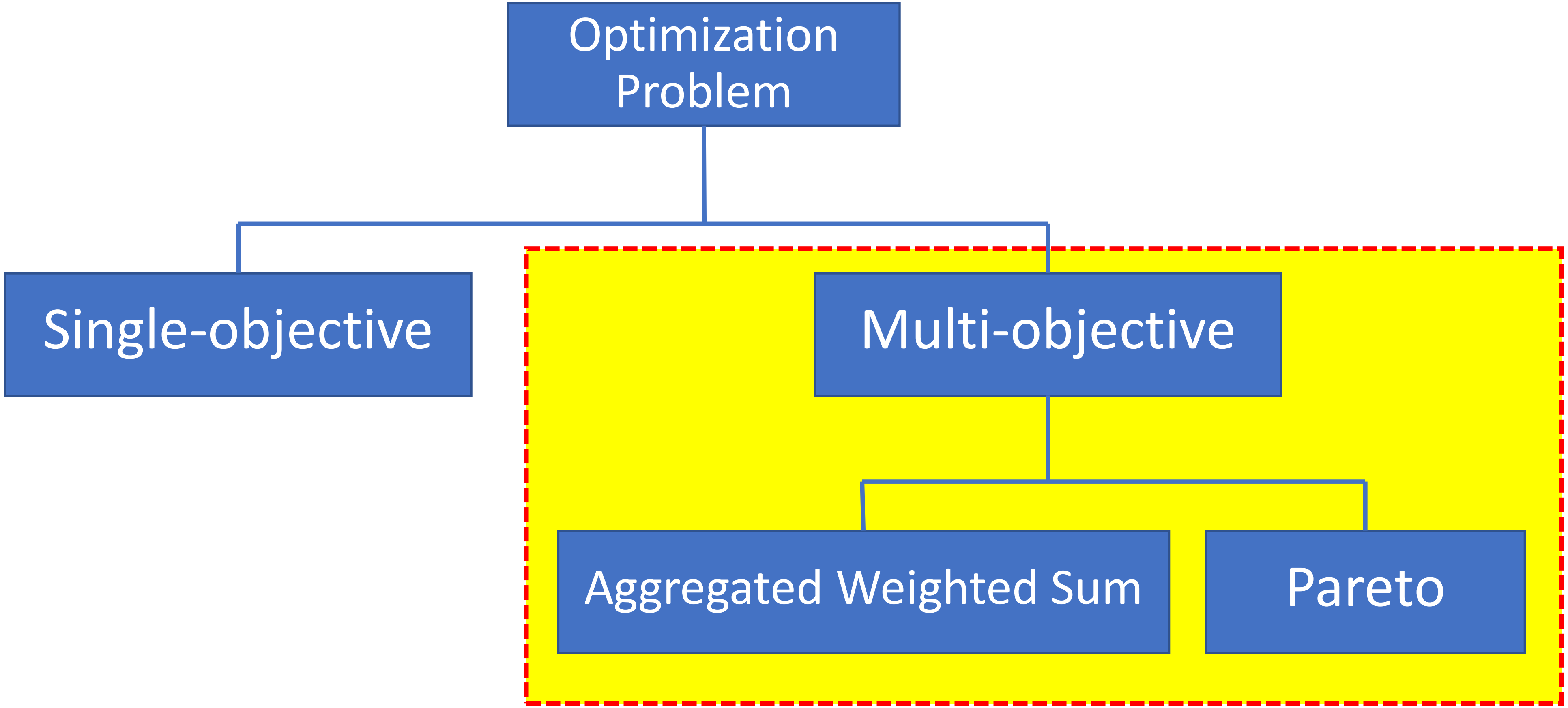
Multi-objective Optimization



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Multi-objective Optimization

Aggregated weighted sum

Different objectives are assigned different weights and combined into a single objective

$$\text{Optimize } f(x) = w_1.f_1(x) + w_2.f_2(x) + \ldots + w_k.f_k(x)$$

where w_k is the weight assigned to the objective k

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Multi-objective Optimization

Aggregated weighted sum

- Easy **but**
- Requires pre-determine weights for each objective function
- Yields only one single solution at a time
- To be more objective, this approach needs to be run several times in order to find sets of solutions corresponding to varying weights, and as the result, these approaches are highly time consuming

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Multi-objective Optimization

Pareto Approach

- Weight-free method
- Provide trade-offs in a single run without prejudice

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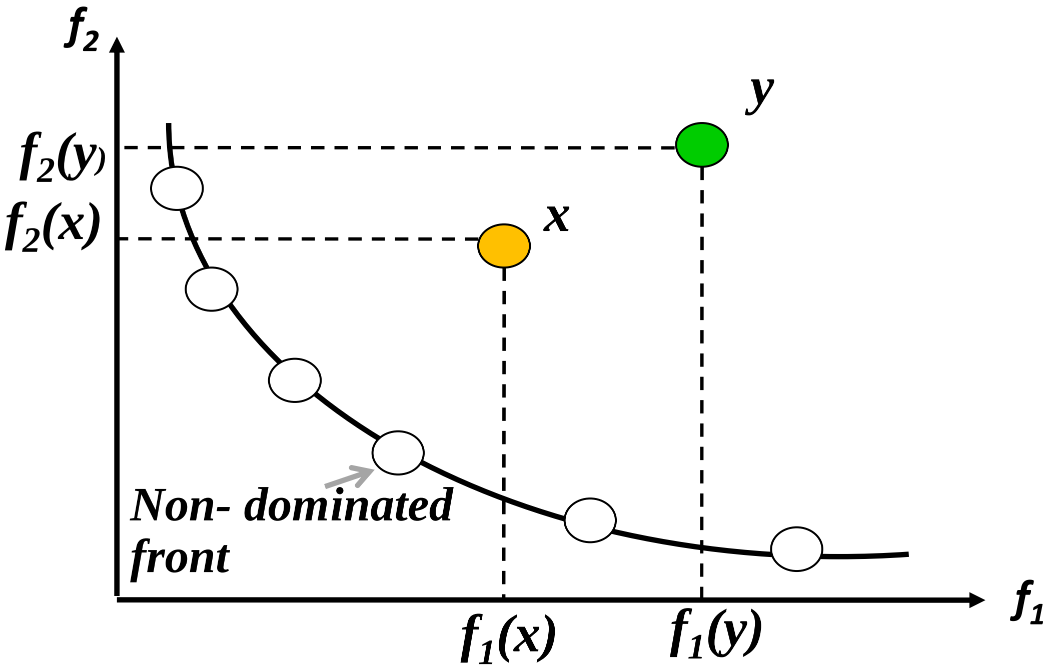
Multi-objective Optimization



x is considered to dominate y (denote $x < y$) if and only if $f_i(x) \leq f_i(y)$ for $i = 1, 2, \ldots, k$ and $j = 1, 2, \ldots, k \mid f_j(x) < f_j(y)$. For the case that neither $x < y$ nor $y < x$, x and y are called “non-dominated” solutions or “trade-off” solutions

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Metaheuristics for Multi-objective Optimization

- Multi-objective Genetic Algorithm
  - MOGA (Tadahiko Murata and Hisao Ishibuchi. 1995. “MOGA: Multi-Objective Genetic Algorithms”.
  - NSGA II (Kalyanmoy Deb, Samir Agrawal, Amrit Pratab, and T. Meyarivan. 2002 “A Fast Elitist Non-Dominated Sorting Genetic Algorithm for Multi-Objective Optimization: NSGA-II”)
- Multi-objective Particle Swarm Optimization
  - MOPSO (C.A. Coello and M.S Lechuga. 2002. “MOPSO: a proposal for multiple objective particle swarm optimization”)
  - TV-MOPSO (Tripathi, P. K., Bandyopadhyay, S., and Pal, S. K. 2007. “Multi-objective particle swarm optimization with time variant inertia and acceleration coefficients”.
  - CCS-MOPSO (Kaveh, A. andLaknejadi, K. 2011. “A novel hybrid charge system search and particle swarm optimization method for multi-objective optimization”.
  - MOLS-MOPSO (Xu, G., Yang, Y., Liu, B.-B., Xu, Y., and Wu, A. 2015. “An efficient hybrid multi-objective particle swarm optimization with a multi-objective dichotomy line search.”
- ETC.

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Workshop

Presentation of Metaheuristic Applications from Literature Review

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