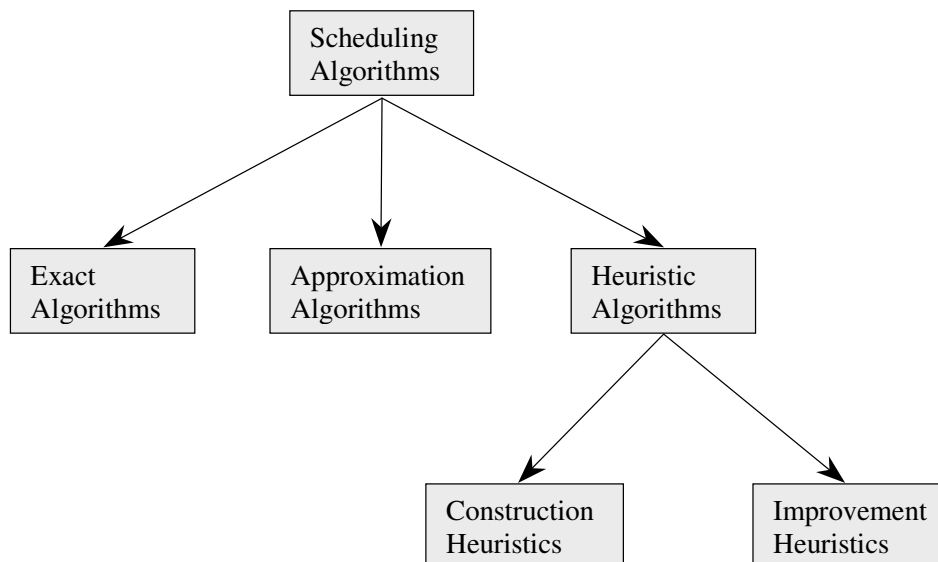


Types of algorithms

There are three major types of scheduling algorithms.

- *Exact algorithms* can find optimal solutions.
- *Approximation algorithms* produce solutions that are guaranteed to be within a fixed percentage of the actual optimum. *Approximation algorithms* are fast (have polynomial running time)
- *Heuristic algorithms* produce solutions, which are not guaranteed to be close to the optimum. The performance of heuristics is often evaluated empirically.



The heuristic algorithms can be classified as *Construction Heuristics* and *Improvement Heuristics*.

- Construction Heuristics
 - Start without a schedule
 - Add one job at a time
- Improvement Heuristics
 - Start with a schedule
 - Try to find a better ‘similar’ schedule

Dispatching rules are examples of the construction heuristics.

Local search methods (Iterative Improvement, Threshold Accepting, Simulated Annealing, Tabu Search) are examples of the improvement heuristics.

Dispatching rules

A **dispatching rule** is a rule that prioritises all the jobs that are awaiting for processing on a machine. Whenever a machine has been freed, a dispatching rule inspects the waiting jobs and selects the job with the highest priority.

For problems $F||C_{\max}$, $J||C_{\max}$, $O||C_{\max}$ there is no single priority rule that dominates the others, although the most successful rules are those favouring jobs with much processing remaining.

For problems $F||\Sigma C_j$, $J||\Sigma C_j$, $O||\Sigma C_j$, again, no single priority rule is clearly dominant, although SPT is usually more effective than the other rules.

In one of the early papers on experimental research with dispatching rules, Panwalkar & Iskander presented a summary of 113 rules:

Panwalkar S.S. & Iskander W. (1977) “A Survey of Scheduling Rules”, *Operations Research*, 25, 45-61.

Some of the main priority rules are listed in the following table.

Rule			Objectives
SPT	Shortest Processing Time first	$\uparrow p_j$	ΣC_j
LPT	Longest Processing Time first	$\downarrow p_j$	C_{\max}
ECT	Earliest Completion Time first (here t is the estimated starting time of job j in the partial schedule)	$\uparrow t + p_j$	ΣC_j
WSPT	Weighted Shortest Processing Time first	$\uparrow p_j / w_j$	$\Sigma w_j C_j$
WI	With Biggest Weight	$\downarrow w_j$	$\Sigma w_j C_j$
ERD	Earliest Release Date first (equivalent to First-Come-First-Served rule, FCFS)	$\uparrow r_j$	Various criteria
EDD	Earliest Due Date first	$\uparrow d_j$	L_{\max}

Advantages of dispatching rules:

- Very simple to implement
- Fast
- Can find a reasonably good solution in a relatively short time
- Optimal for special cases

Disadvantages of dispatching rules:

- Limited use in practice
- Can find unpredictably bad solution

Often a combination of basic dispatching rules can perform significantly better.

Composite Dispatching Rules

- It is a ranking expression that combines a number of basic dispatching rules.
- Each basic rule in the composite dispatching rule has its own scaling parameter that is chosen to properly scale the contribution of the basic rule to the total ranking expression.