Адаптивный вызов процедур и настройка параметров в эволюционных алгоритмах для задач составления расписаний

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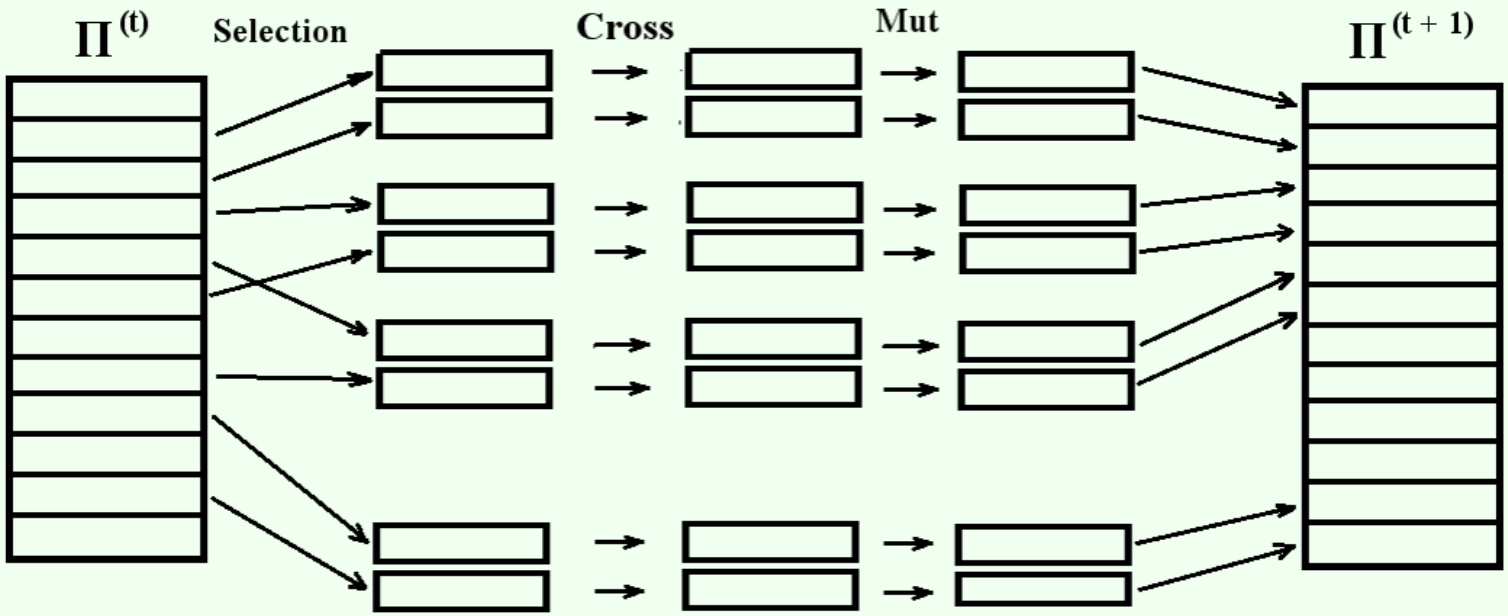
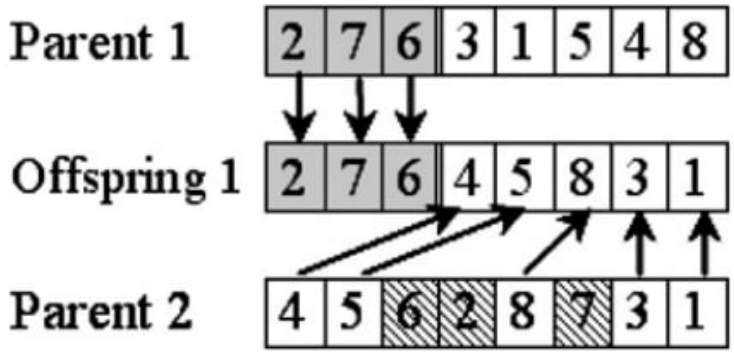
Genetic Algorithm with Generational Scheme

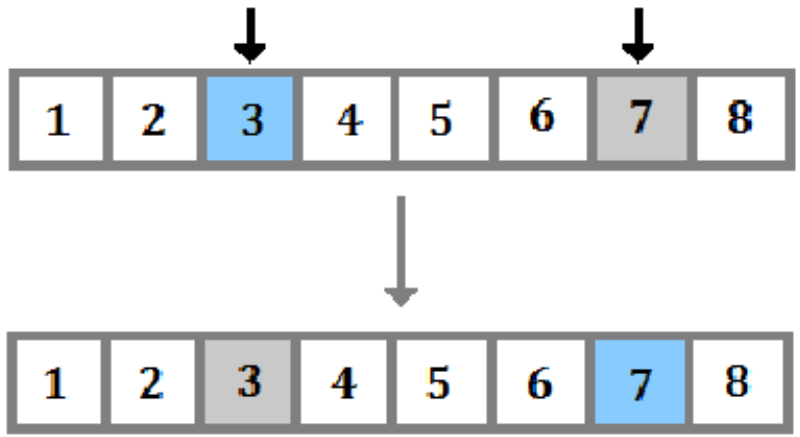


Crossover and Mutation Operators

One Point Crossover (1PX)



Exchange (swap) mutation



Speed Scaling Scheduling

Processors and Jobs

2 speed-scalable processors

$\mathcal{J} = \{1, \ldots, n\}$ is the set of jobs:
V_j is the processing volume (work) of job j
$size_j$ is the number of processors required by job j
$W_j := \frac{V_j}{size_j}$ is the work on one processor
E is the energy budget

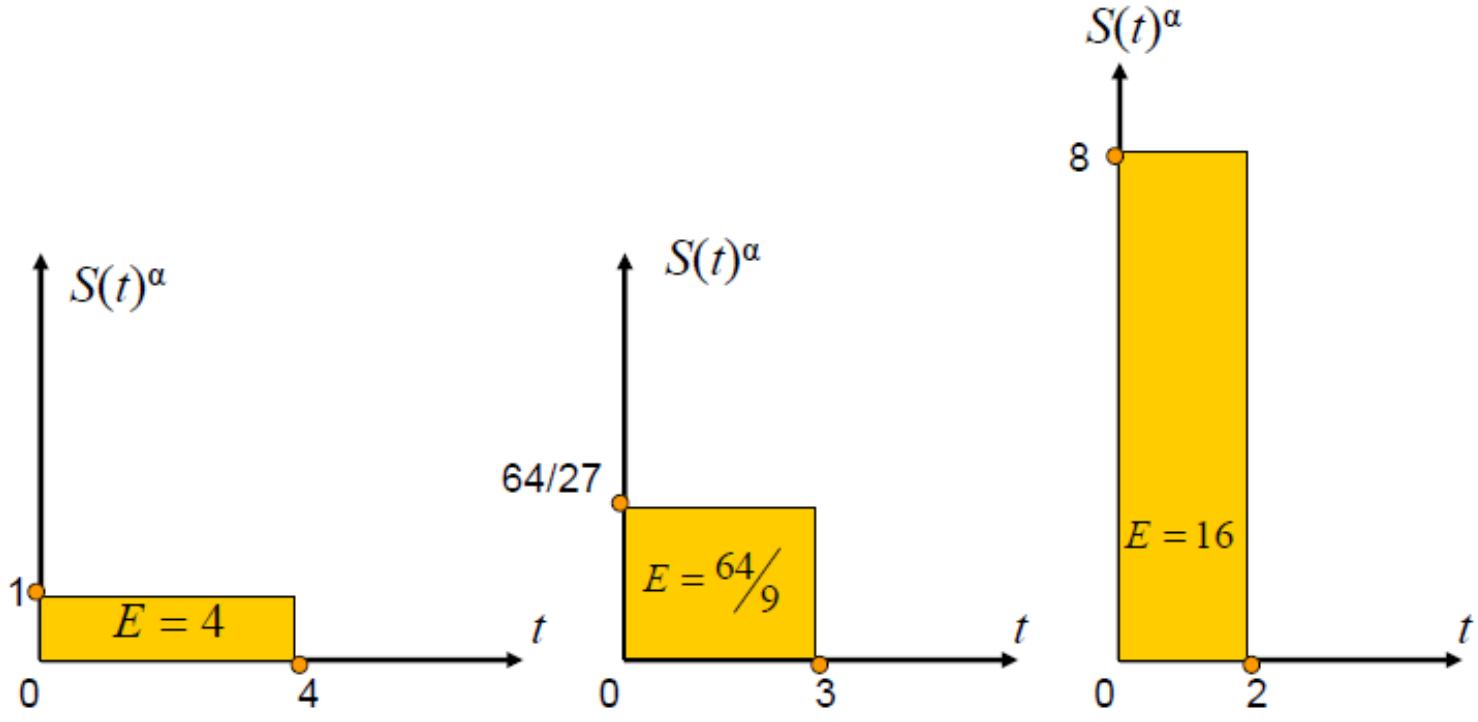
Parameters

Preemption and migration are characterized for the systems with single image of the memory.
Non-preemptive instances arise in systems with distributed memory.

Homogeneous Model in Speed-scaling

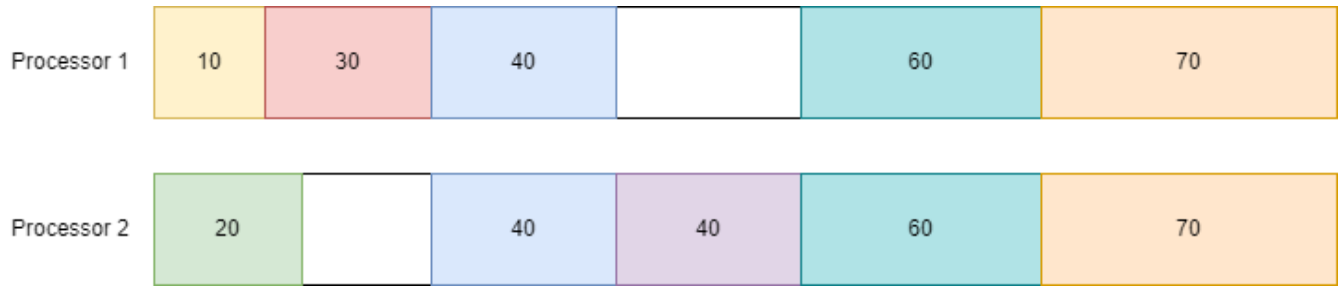
If a processor runs at speed s then the energy consumption is s^α units of energy per time unit, where $\alpha > 1$ is a constant (practical studies show that $\alpha \leq 3$).

It is supposed that a continuous spectrum of processor speeds is available.

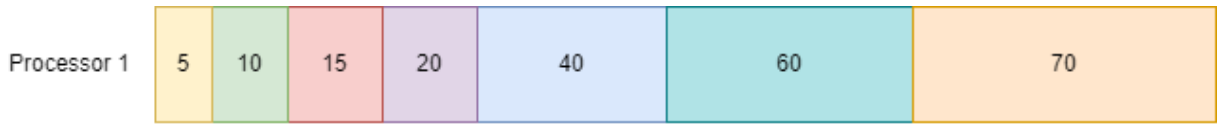


The aim is to find a feasible schedule with the minimum total completion time so that the energy consumption is not greater than a given energy budget.

Solution



Lower Bound



Results

30 instances, $n = 50$

Parameter values of genetic algorithm

Parameter name	Parameter value
k	200
P_{Cross}	0.8
P_{Mut}	0.2

Relative deviation of objective function found by the GA from the lower bound

avg: 2.03%
min: 0.83%
max: 3.83%

Results for Problem using IRACE package

30 instances, $n = 50$

Parameter values of genetic algorithm found by IRACE

Parameter name	Parameter value
k	244
P_{Cross}	0.7
P_{Mut}	0.63

Relative deviation of objective function found by the GA from the lower bound

avg: 1.99%
min: 0.82%
max: 3.86%

Adaptive Technique

1: Choose a crossover. The probability of choosing each operator is proportional to its weight.
2: Apply chosen crossover to the parent genotypes.
3: Update the weight of the chosen crossover:

$$\phi_a = \begin{cases} w_1, \text{if the new solution is a new global best,} \\ w_2, \text{if the new solution is better than the current one,} \\ w_3, \text{if the new solution is better than one of the parents or both.} \end{cases}$$

$$\rho_a = \lambda \rho_a + (1 - \lambda)\phi_a.$$

Results of Genetic Algorithm with Adaptation

30 instances, $n = 50$

Crossover operator: 1PX

	GA_{adapt}	$GA_{adapt-irace}$
avg	2.06%	2.05%
min	0.83%	0.83%
max	3.88%	3.76%

Table: Relative deviation of objective function found by the GA with Adaptation from the lower bound

Conclusions and Further Research

We recommend

- Apply IRACE for parameters.

Further Plans

- Add Poisson Mutation
- Add Optimized Operators

Thank you for your attention!