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Introduction to Term Project Topic

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1. RCPSP
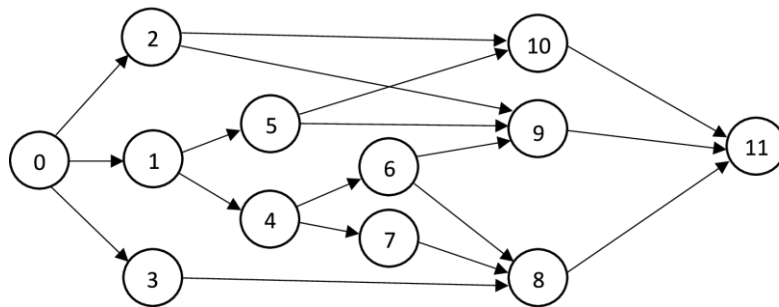
1. RCPSP

- Definition

  ✓ **Resource-Constrained Project Scheduling Problem (RCPSP)** is a combinatorial optimization problem in the field of operations research and project management.

  ✓ It involves scheduling a set of activities or tasks with given durations and resource requirements in such a way that the project is completed as quickly as possible while respecting resource constraints.

Job	p_j	$u_{(j,1)}$	$u_{(j,2)}$
1	3	5	1
2	2	0	4
3	5	1	4
4	4	1	3
5	2	3	2
6	3	3	1
7	4	2	4
8	2	4	0
9	4	5	2
10	6	2	5

AoN network for project instance
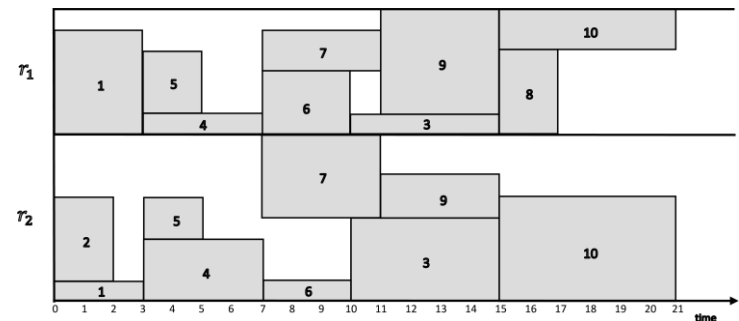
optimal schedule for instance

1. RCPSP

- Key considerations (Constraints)

✓ Activities

  These are tasks or jobs that need to be scheduled.

  ☞ Each activity has a defined duration, a set of required resources, and precedence relationships with other activities.

✓ Resources

  There are limited resources available for executing the activities.

  ☞ Resources can include labor, machinery, materials, or any other constraints that can affect the scheduling

✓ Precedence Relationships

  These dependencies are represented as precedence relationships.

  ☞ Activities may have dependencies on each other, meaning that certain activities must be completed before others can start.

1. RCPSP

- ## Objective and difficulty

✓ The objective in RCPSP is to find a schedule that **minimizes the project's makespan** while satisfying the resource constraints and respecting the precedence relationships between activities

✓ RCPSP is known to be an **NP-hard problem**, which means that finding an optimal solution can be computationally challenging, especially for large and complex projects.

$$\text{Minimize} \quad \sum_{t=0}^{T} t \cdot x_{J+1,t}$$

subject to

$$\sum_{t=0}^{T} x_{jt} = 1 \quad j = 0, \ldots, J+1$$

$$\sum_{t=0}^{T} t \cdot x_{ht} \le \sum_{t=0}^{T} (t - p_j) \cdot x_{jt} \quad j = 0, \ldots, J+1, \ h \in P_j$$

$$\sum_{j=1}^{J} \sum_{q=t}^{t+p_j-1} r_{j,k,t+p_j-q} \cdot x_{jq} \le R_{kt} \quad k = 1, \ldots, K, \ t = 1, \ldots, T$$

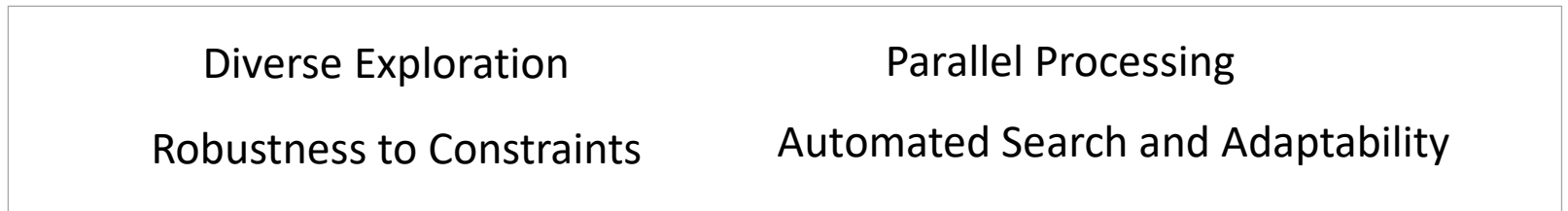$$x_{jt} \in \{0, 1\} \quad j = 0, \ldots, J+1, \ t = 0, \ldots, T$$

2. Reasons for using GA to solve RCPSP

2. Reasons for using GA to solve RCPSP

- Key points

  ✓ Applying Genetic Algorithms (GAs) to the resource-constrained project scheduling problem (RCPSP) is advantageous for the following key reasons :

Diverse Exploration	Parallel Processing
Robustness to Constraints	Automated Search and Adaptability

  ➢ **In summary,**
  GAs are favored in RCPSP due to their ability to explore diverse solutions, handle complex constraints, perform parallel processing, and adapt to various scheduling scenarios, which gives them a competitive edge over other heuristic methods.

Thanks