ITM 517 Algorithm

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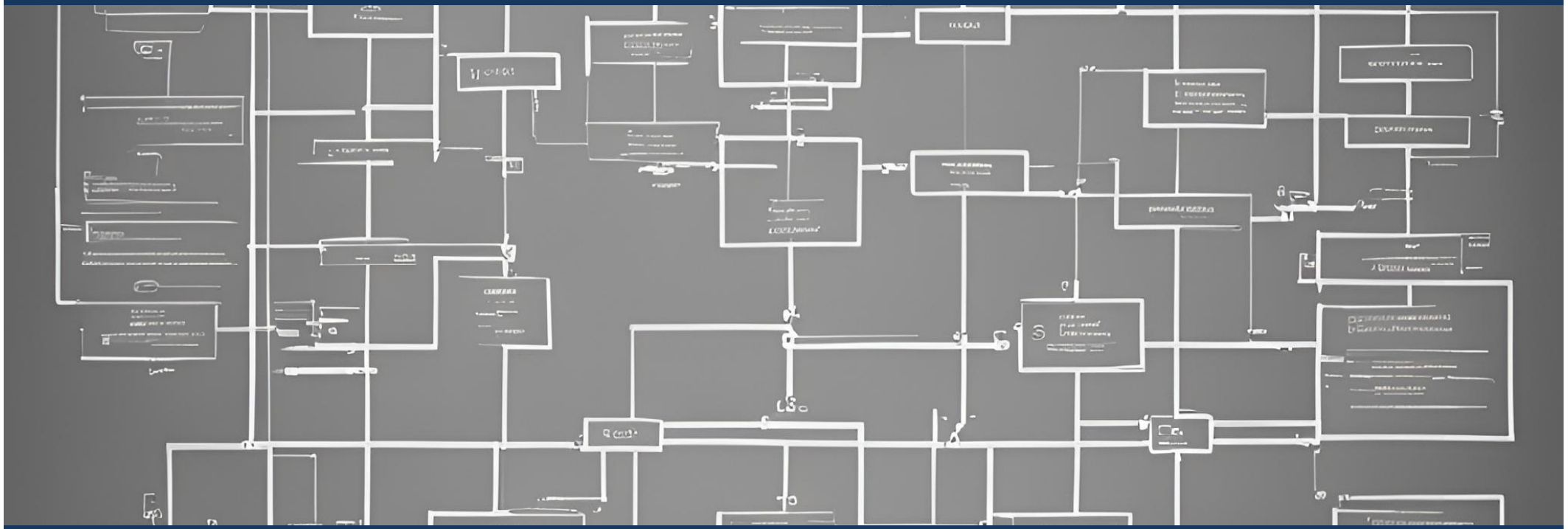
Greedy Algorithm



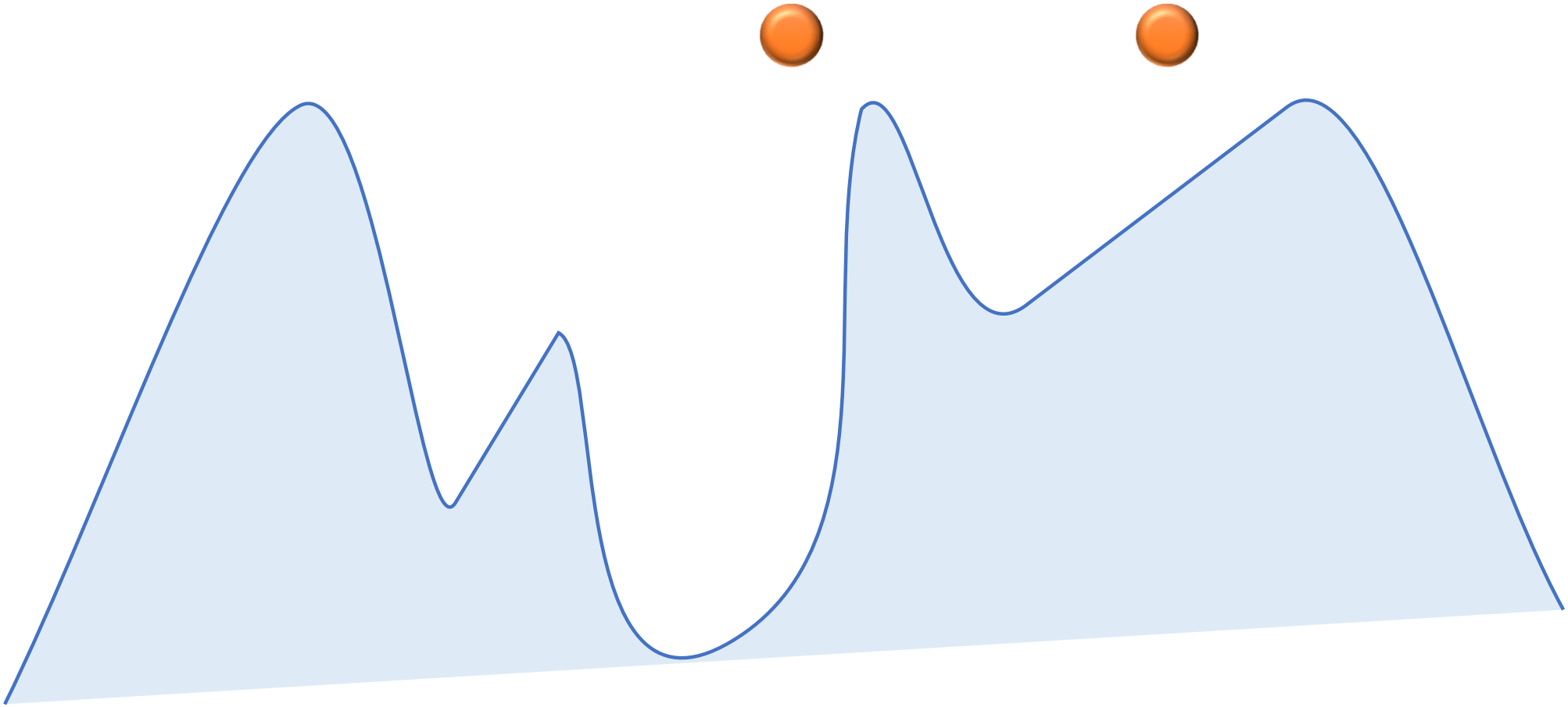
Introduction

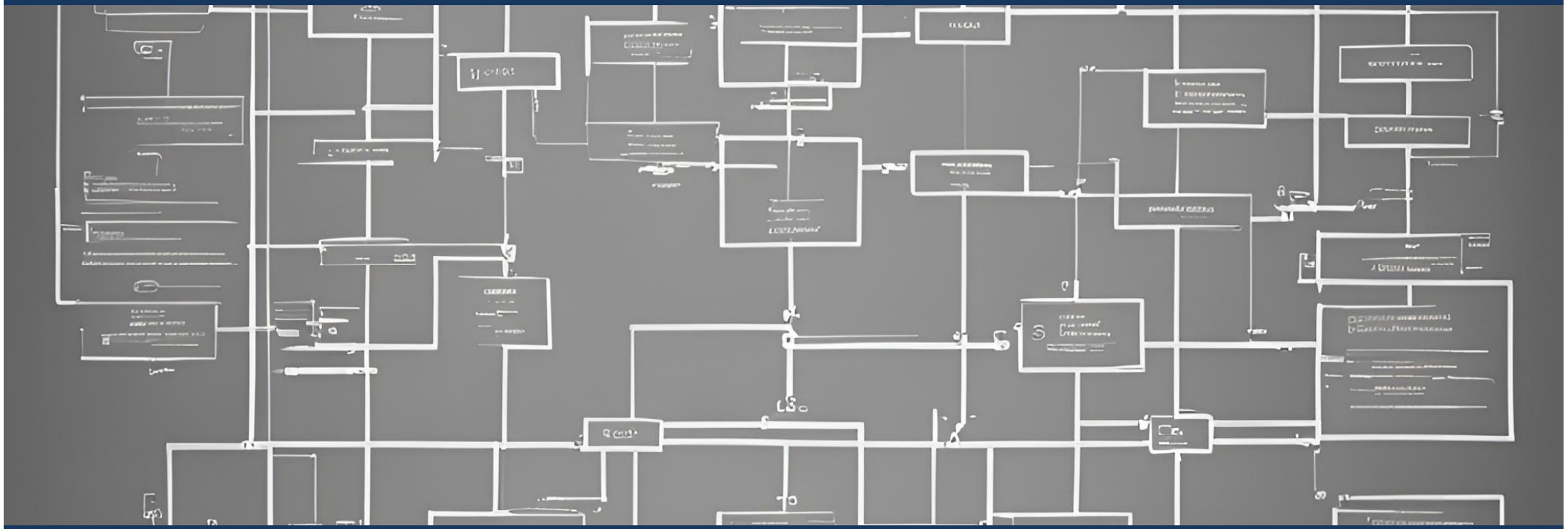
Greedy algorithm

- "**take what you can get now**" strategy
- For most optimization problems you want to find, not just a solution, but the best solution.
- A **greedy algorithm** sometimes works well for optimization problems. It works in phases. At each phase:
  - You take the best you can get right now, without regard for future consequences.
  - You hope that by choosing a local optimum at each step, you will end up at a global optimum.

Weakness

- **Local optimum**
- In many problems, a greedy strategy does not usually produce an optimal solution.
- Example: Finding the deepest valleys





Techniques

Components of greedy algorithms

- We repeat step 1 & step 2, until a **solution function** indicate that we find the solution.

  Step 1: A greedy algorithm selects a solution from a **candidate set** using a **selection function** to optimize **objective function**.

  Step 2: After that, it checks whether the solution is feasible using a **feasibility function**.

  - Where
    - A **solution function**, which will indicate when we have discovered a complete solution.
    - A **candidate set**, from which a solution is created
    - A **selection function**, which chooses the best candidate to be added to the solution
    - An **objective function**, which assigns a value to a solution, or a partial solution, and
    - A **feasibility function**, that is used to determine if a candidate can be used to contribute to a solution

Appropriate application

- Counting money: Suppose you want to count out a certain amount of money, using the fewest possible bills and coins
  - Solution function: making the amount of money
  - Objective function: minimize the number of bills and coins
  - Candidate set: bills and coins
  - Selection function: the largest possible bill or coin
  - Feasibility function: not overshoot

- For US money, the greedy algorithm always gives the optimum solution

Example of counting money

- Components
  - Solution function: making the amount of money
  - Objective function: minimize the number of bills and coins
  - Candidate set: $5, $1, 25¢, 10¢, 1¢
  - Selection function: the largest possible bill or coin
  - Feasibility function: not overshoot
- Example: To make $6.39, you can choose:
  - a $5 bill
  - a $1 bill, to make $6
  - a 25¢ coin, to make $6.25
  - A 10¢ coin, to make $6.35
  - four 1¢ coins, to make $6.39
  - Answer: 1+1+1+1+4= 8

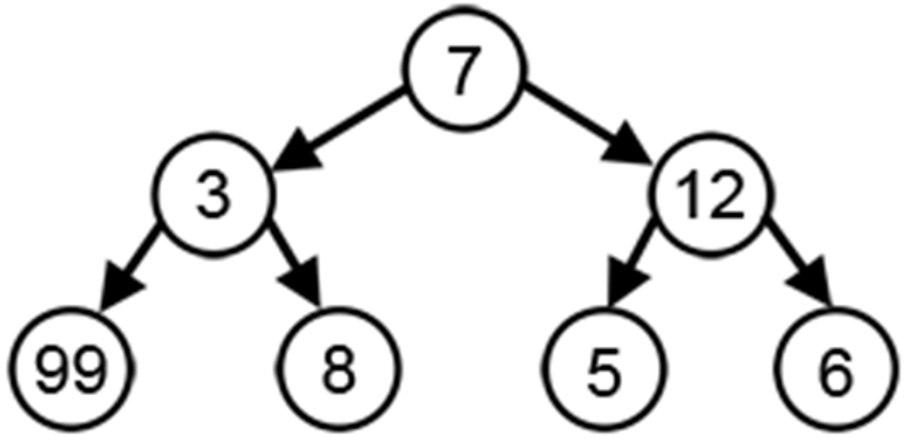
A failure of the greedy algorithm

- Fictional monetary system

- Make 15 krons
  - Result of Greedy algorithm
  - Result of Optimal algorithm

Misapplication

- Example: finding the root-to-leaf path of which sum is maximum.
  - Solution function: path from the root
  - Objective function: maximize the sum of values of the node in the path
  - Candidate set: children
  - Selection function: children that has the max value
  - Feasibility function: check wl



Thanks