



## Algorithms Analysis & Design

# Lab 10

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## Knapsack Problem:-

Solve the following knapsack problem using **branch and bound** given the following data.

Capacity of knapsack **M = 10**

Item	Weight	Value	V/W
1	4	40	10
2	7	42	6
3	5	25	5
4	3	12	4

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## Job Assignment Problem:-

You are given 4 jobs and 4 workers. The cost matrix is:

	Job 1	Job 2	Job 3	Job 4
W1	9	2	7	8
W2	6	4	3	7
W3	5	8	1	8
W4	7	6	9	4

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## MCQ:-

**Q1. Which data structure would be most appropriate for implementing BFS in Branch-and-Bound?**

- A) Stack
- B) Queue
- C) Priority Queue
- D) Tree

**Q2. Why is Branch-and-Bound considered more efficient than Backtracking for optimization problems?**

- A) It visits all nodes.
- B) It uses depth-first traversal.
- C) It prunes non promising nodes based on bound values.
- D) It does not require calculating bounds.

**Q3. If a node has a total weight of 7 kg and a bound of \$115, while the current maxprofit is \$70, is it promising?**

- A) Yes
- B) No

**Q4. What makes a node non promising in the Knapsack problem?**

- A) Its weight is less than W
- B) Its bound is less than the current maxprofit
- C) It represents the root node
- D) It contains fewer items

**Q5. What is the primary benefit of using Best-First over BFS in Branch-and-Bound?**

- A) It avoids using bounds
- B) It expands fewer total nodes
- C) It ensures all nodes are expanded
- D) It avoids using any data structure

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**Q6. Which node should be expanded next?**

Given:

- Node A: bound = \$98
- Node B: bound = \$115
- Node C: bound = \$82

**Answer:** B) Node B

**Q7. What is the lower bound (LB) of the root node in the Job Assignment problem?**

- A) Sum of maximum values in each row
- B) Sum of minimum values in each row
- C) Product of diagonal elements
- D) Sum of all elements

**Q8. If Person A is assigned Job 2 (cost = 2), what's the next step?**

- A) Recompute LB for remaining submatrix
- B) Assign all remaining jobs randomly
- C) Prune all other nodes
- D) End the process

**Q9. In Branch and Bound, which nodes are explored first in Best-First Search?**

- A) Nodes with highest cost
- B) Nodes with smallest bound
- C) Leaf nodes
- D) Randomly selected nodes

**Q10. When is a node considered "promising" in a Branch and Bound tree for Knapsack?**

- A) When its value-to-weight ratio is highest
  - B) When it has the lowest weight
  - C) When its bound is greater than current max profit
  - D) When it's the root node
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## True or False Questions:-

- Q1.** Branch and Bound always finds the optimal solution.
- Q2.** The Knapsack problem can be solved optimally using a greedy algorithm.
- Q3.** In Job Assignment using Branch and Bound, each job must be assigned to multiple workers.
- Q4.** A node in the search tree is pruned if its bound is less than the current best solution.
- Q5.** Branch and Bound is only applicable to decision problems.