Crash Course Example Questions

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1. (Fill-in-the-blank)

The 0/1 Knapsack problem is named 0/1 because each item can either be taken _____ or not taken _____.

Answer: entirely (1), at all (0)

2. (Multiple Choice)

The time complexity of the dynamic programming solution for the 0/1 Knapsack problem is:
a) O(n)
b) O(n^2)
c) O(nW)
d) O(2^n)

Answer: C

3. (Multiple Choice)

For the following 0/1 Knapsack problem instances, choose the optimal set of items to maximize the total value without exceeding the capacity of the knapsack.

Knapsack capacity: 10
Items: {(5, 3), (8, 4), (9, 5)}
a) {5, 8}
b) {5, 9}
c) {8, 9}
d) {5, 8, 9}

Answer: B

4. (Multiple Choice)

The 0/1 Knapsack problem is a classic example of problems that can be solved using which kind of optimization technique?
a) Local search
b) Unconstrained optimization
c) Combinatorial optimization
d) Convex optimization

Answer: C

5. (Fill-in-the-blank)

When using a dynamic programming approach to solve the 0/1 Knapsack problem, a common choice for the state is the tuple (i, W), where i is the index of the current item and W is the _____.

Answer: remaining weight

6. (Multiple Choice)

Which of the following is NOT a characteristic of the 0/1 Knapsack problem?
a) Each item has a weight and a value.
b) An item can be taken partially.
c) The knapsack has a weight limit.
d) The goal is to maximize the total value.

Answer: B

7. (Multiple Choice)

The 0/1 Knapsack problem can be formulated as an Integer Linear Programming (ILP) problem. Which of the following is a constraint in this formulation?
a) Sum of item weights multiplied by the corresponding decision variables <= knapsack capacity
b) Sum of item values multiplied by the corresponding decision variables >= knapsack capacity
c) Decision variables are real numbers between 0 and 1
d) Decision variables are real numbers between -1 and 1

Answer: A

8. (multiple choice)

For the following 0/1 Knapsack problem instances, choose the optimal set of items to maximize the total value without exceeding the capacity of the knapsack.

Knapsack capacity: 20
Items: {(3, 5), (5, 8), (8, 11), (10, 14)}
a) {3, 5, 8}
b) {3, 5, 10}
c) {5, 8, 10}
d) {3, 8, 10}

Answer: A

9. (Fill-in-the-blank)

In a recursive implementation of the dynamic programming solution for the 0/1 Knapsack problem, memorization is used to avoid _____.

Answer: redundant computations / overlapping subproblems

10. (Short Answer)

Can the greedy approach always find the optimal solution for the 0/1 Knapsack problem? Why or why not?

Answer: No, the greedy approach cannot always find the optimal solution for the 0/1 Knapsack problem because choosing the item with the best value-to-weight ratio at each step might not lead to the best overall solution.