**Problem Session Week 13 Wednesday 23 May**

# Question 1

Given the following instance of the 0/1 Knapsack problem

|  |  |  |
| --- | --- | --- |
| item | weight | value |
| 1  2  3 | 2  1  3 | $12  $10  $20 |

The Knapsack Capacity W=3

Let V[i, j] be the value of the most valuable subset of the first i items that fit into the Knapsack of capacity j. Then V[i, j] can be recursively defined as following:

0 if *i*  0 *or j*  0

*V* [*i*, *j*]  max{*V* [*i*  1, *j*], *v*  *V* [*i*  1, *j*  *w* ]} if *j*  *w*  0



*i i i*

 *V* [*i*  1, *j*]



if *j*  *wi*  0

1. Using dynamic programming, complete the following table.

capacity j

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item *i* | 0 | 1 | 2 | 3 |
| 0 |  |  |  |  |
| *w*1=2, *v*1=12 1 |  |  |  |  |
| *w*2=1, *v*2=10 2 |  |  |  |  |
| *w*3=3, *v*3=20 3 |  |  |  |  |

2.

1. Give an optimal subset of the instance based on the table.
2. Based on the recurrence relation given above, write a pseudocode of the bottom-up dynamic programming algorithm for the knapsack problem.
3. What is the value of the most valuable subset if the capacity of the knapsack is 2?

# Question 2

## Continue the backtracking search for a solution to the four-queens problem, which was given in week 11’s lecture, to find the second solution to the problem. Explain how the board’s symmetry can be used to find the second solution to the four-queens problem.

**Question 3**

1. Is the following graph a Euclidean graph?
2. Apply Twice-Around-the-Tree algorithm to solve the travelling salesman problem for the following graph.



2

a

b

5

4

3

3

c

d

1. What is the best solution?



1

1. What is the accuracy ratio?