[My Courses](#) / [CSC051001-S21R-2042](#) / [Section 0](#) / [Final Spring 2021](#)

Started on	Wednesday, May 19, 2021, 10:15 AM
State	Finished
Completed on	Wednesday, May 19, 2021, 12:14 PM
Time taken	1 hour 59 mins
Points	33.00/36.00
Grade	**183.33** out of 200.00 (**92**%)

Question **1**
Complete
1.00 points out of 1.00

In Quick Sort, $T(n) \in \Theta(nlogn)$ for the best case, average case, and worst case.

Select one:
- ○ True
- ◉ False

Question **2**
Complete
1.00 points out of 1.00

Assuming printing "Hello World" is the basic operation, what is the complexity function of the following psuedocode?

```
for (i=1; i ≤ n^3; i++)
    for (j=1; j ≤ n^2; j++)
        Print "Hello World";
```

Please note this is a nested for loop.

Select one:
- ◉ a. $T(n) = n^5$
- ○ b. $T(n) = 2n^5$
- ○ c. $T(n) = 2n^6$
- ○ d. $T(n) = n^6$

Question **3**
Complete
1.00 points out of 1.00

Use the limit ratio test to determine the complexity category of $3^n \in n^3$.

Please note that there may be more than one correct answer.

Select one or more:
- [ ] a. $3^n \in \Theta(n^3)$
- [x] b. $3^n \in \Omega(n^3)$
- [ ] c. $3^n \in O(n^3)$
- [ ] d. $3^n \in o(n^3)$
- [x] e. $3^n \in \omega(n^3)$

Question **4**
Complete
1.00 points out of 1.00

Using the Master Theorem, determine the Θ-category of $T(n) = 16T(\frac{n}{2}) + n^4$

Select one:
- ○ a. The Master Theorem does not apply here
- ◉ b. $T(n) \in \Theta(n^4 logn)$
- ○ c. $T(n) \in \Theta(n^4)$
- ○ d. $T(n) \in \Theta(n^2)$

Question **5**

Complete

1.00 points out of 1.00

If g(n) is bounded from above by $c \cdot f(n)$ then $g(n) \in \Omega(f(n))$

Select one:

- ( ) True
- (•) False

Question **6**

Complete

1.00 points out of 1.00

Use the limit ratio test to determine the complexity category of $(2n+1) \in (n^2)$?

Please note there may be more than one right answer

Select one or more:

- [x] a. $(2n+1) \in O(n^2)$
- [ ] b. $(2n+1) \in \Omega(n^2)$
- [x] c. $(2n+1) \in o(n^2)$
- [ ] d. $(2n+1) \in \Theta(n^2)$
- [ ] e. $(2n+1) \in \omega(n^2)$

Question **7**

Complete

1.00 points out of 1.00

▶ Algorithm 2.3 Merge

Problem: Merge two sorted arrays into one sorted array.

Inputs: positive integers h and m, array of sorted keys U indexed from 1 to h, array of sorted keys V indexed from 1 to m.

Outputs: an array S indexed from 1 to $h+m$ containing the keys in U and V in a single sorted array.

```
void merge (int h, int m, const keytype U[],
                          const keytype V[],
                                keytype S[])
{
  index i, j, k;

  i = 1; j = 1;  k= 1;
  while (i <= h && j <= m){
     if (U[i] < V[j]) {
        S[k] = U[i];
        i++;
     }
     else {
        S[k] = V[j];
        j++;
     }
     k++;
     }
  if (i>h)
     copy V[j] through V[m] to S[k] through S[h+m];
  else
     copy U[i] through U[h] to S[k] through S[h+m];
}
```

What is the basic operation from the given pseudocode?

Note there may be more than one correct answer

Select one or more:

- [ ] a. j <= m
- [ ] b. i > h
- [x] c. U[i] < V[j]
- [ ] d. i <= h

Question **8**

Complete

1.00 points out of 1.00

We are running Sequential Search of an array of size n, and we know that the item we are searching for is definitely present in the array. The probability that the item we are looking for is the last position of the array is $\frac{1}{4}$. The probabilities of all the other items have a uniform distribution. What is the average case time-complexity of the algorithm in this case?

Select one:

- a. $A(n) = \frac{3n}{8}$
- b. $A(n) = \frac{4n}{8}$
- c. $A(n) = \frac{5n}{8}$
- d. $A(n) = \frac{n}{8}$

Question **9**

Complete

1.00 points out of 1.00

$$\sum_{i=0}^{(\lg n)-1} 4^i =$$

What is the value of the summation?

Select one:

- a. $-\frac{n-1}{3}$
- b. $\frac{n-1}{3}$
- c. $-\frac{n^2-1}{3}$
- d. $\frac{n^2-1}{3}$

Question **10**

Complete

1.00 points out of 1.00

Suppose $T(n) = n^2$ and our computer can run n=3 in 54 seconds. How long does it take the computer to perform one basic operation? (Find k with the correct units)

Answer: 6 seconds/operation

Question **11**

Complete

1.00 points out of 1.00

According the pseudocode for determining the nth Fibonacci term, which approach was more efficient?

Select one:

- a. Divide & Conquer (recursive)
- b. Brute Force
- c. Dynamic Programming (iterative)
- d. None of these approaches

Question **12**
Complete
1.00 points out of 1.00

According the pseudocode for determining the Binomial Coefficient, which approach was more efficient?

Select one:

- a. Divide & Conquer (recursive)
- b. None of these approaches
- c. Dynamic Programming (iterative)
- d. Brute Force

Question **13**
Complete
1.00 points out of 1.00

For the Traveling Salesman Problem, we are given the following adjacency matrix representing a weighted directed graph with 4 nodes.

W	1	2	3	4
1	0	2	∞	3
2	1	0	4	∞
3	∞	3	0	2
4	2	∞	1	0

Here is the partially completed D array corresponding the adjacency matrix above.

D	$\emptyset$	$\{2\}$	$\{3\}$	$\{4\}$	$\{2,3\}$	$\{2,4\}$	$\{3,4\}$	$\{2,3,4\}$
1	0	–	–	–	–	–	–	?
2	1	–	∞	∞	–	–	8	–
3	∞	3	–	4	–	∞	–	–
4	2	∞	∞	–	4	–	–	–

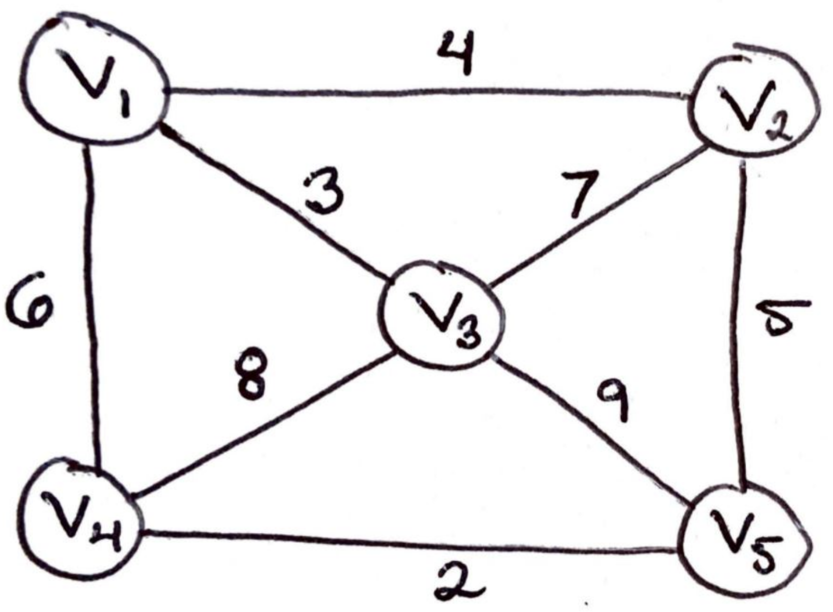
Here is the partially completed P array corresponding to the D array above. On the basis of your computations, what is the value of $P[1][\{2,3,4\}]$?

P	$\emptyset$	$\{2\}$	$\{3\}$	$\{4\}$	$\{2,3\}$	$\{2,4\}$	$\{3,4\}$	$\{2,3,4\}$
1	–	–	–	–	–	–	–	?
2	–	–	3	4	–	–	3	–
3	–	2	–	4	–	2, 4	–	–
4	–	2	3	–	3	–	–	–

Answer: 4

Question **14**
Complete
1.00 points out of 1.00

What is the total weight of the minimum spanning tree produced by Kruskal's algorithm with the given undirected weighted graph?



Answer: 14

Question **15**

Complete

1.00 points out of 1.00

For the given matrix, what is the value of $D^5[4][1]$?

$$\left[\begin{array}{c|ccccc} D^4 & 1 & 2 & 3 & 4 & 5 \\ \hline 1 & 0 & 4 & 14 & \infty & 19 \\ 2 & 9 & 0 & 12 & 10 & 1 \\ 3 & 3 & \infty & 0 & 2 & 5 \\ 4 & 16 & 13 & 7 & 0 & 11 \\ 5 & 1 & 6 & 8 & \infty & 0 \end{array}\right]$$

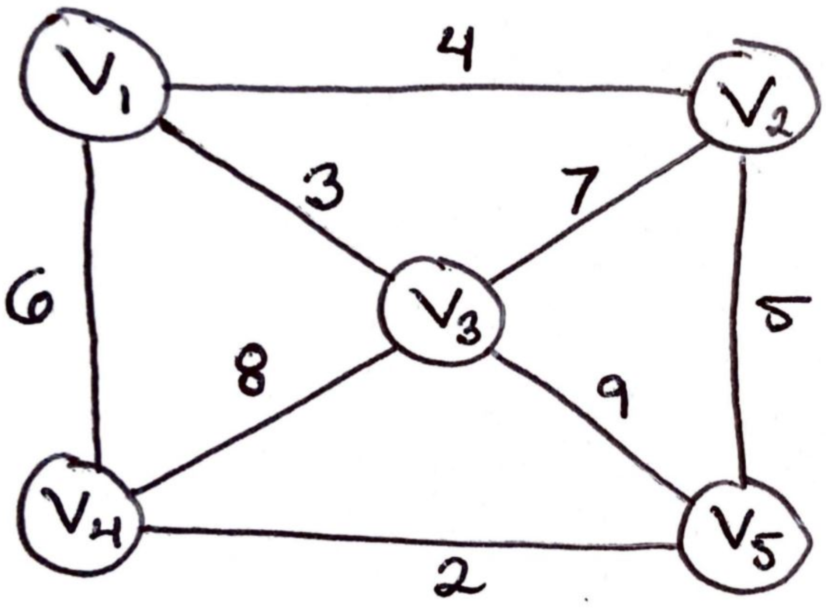
Answer: 12

Question **16**

Complete

1.00 points out of 1.00

Consider the following undirected weighted graph. Using Prim's algorithm, beginning with v_1, what is the last edge added to the tree?



Select one:

- a. (v_4, v_5)
- b. (v_3, v_5)
- c. (v_1, v_4)
- d. (v_2, v_5)

Question **17**

Complete

1.00 points out of 1.00

In the Traveling Salesman Problem (with a weighted directed graph), if we consider a tour beginning and ending in v_1, then a tour visiting the vertices in the reverse order as that tour will always have the same weight.

Select one:

- True
- False

Question **18**

Complete

1.00 points out of 1.00

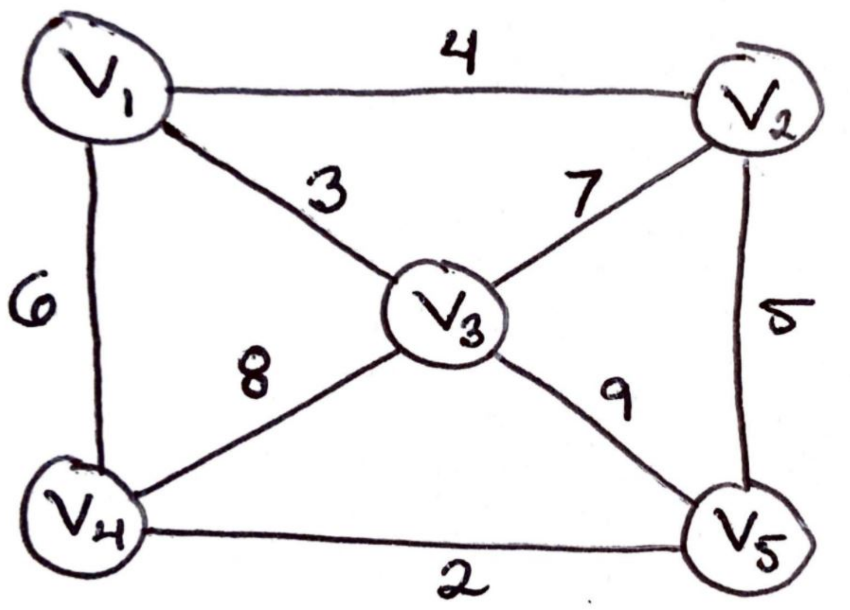
In the Floyd Algorithm, if the value of $P^n[i][j]$ is 0 then there is no direct path from v_i to v_j.

Select one:

- True
- False

Question **19**
Complete
1.00 points out of 1.00

Consider the following undirected weighted graph. Using Kruskal's algorithm, what is the last edge added to the tree?



Select one:

- a. (v_1, v_3)
- b. (v_3, v_5)
- c. (v_2, v_5)
- d. (v_4, v_5)

Question **20**
Complete
1.00 points out of 1.00

The sum of coefficients in the expansion of $(x+y)^8$ is:

Answer: 256

Question **21**
Complete
1.00 points out of 1.00

The algorithm for the Sum of Subset Problem has produced the following 7x21 boolean table. The set of values is S= {2,7,4,3,8,5}. Using the algorithm discussed in class, determine the value if we were to include all items from the subset to reach the desired sum W=20.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	T	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
1	T	F	T	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
2	T	F	T	F	F	F	F	T	F	T	F	F	F	F	F	F	F	F	F	F	F
3	T	F	T	F	T	F	T	T	F	T	F	T	F	T	F	F	F	F	F	F	F
4	T	F	T	T	T	T	T	T	F	T	T	T	T	T	T	F	T	F	F	F	F
5	T	F	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F
6	T	F	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	**?**

Select one:

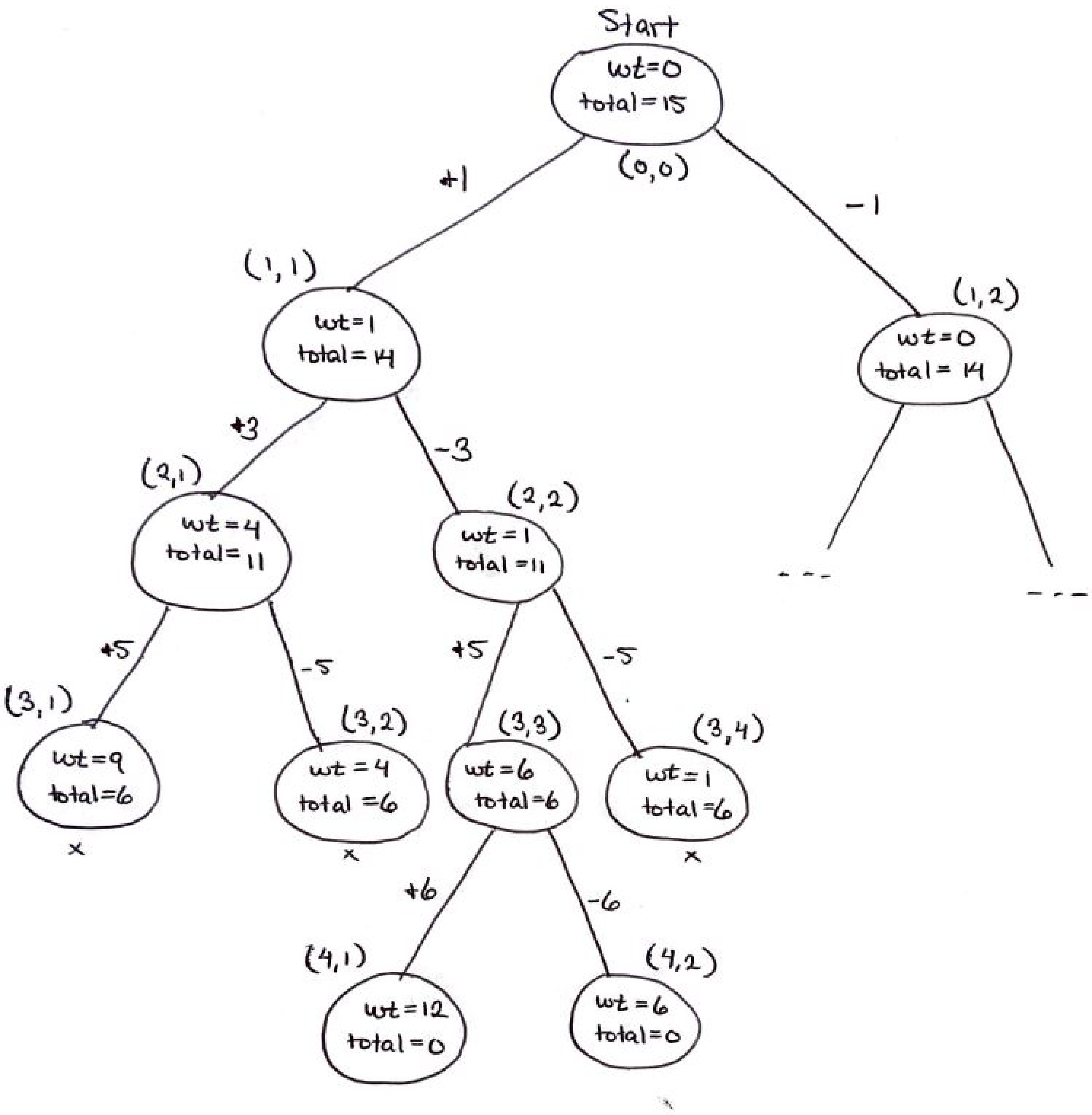
- True
- False

Question **22**

Complete

1.00 points out of 1.00

Here is a portion of the state space tree for the Sum of Subsets Problem with S={1, 3, 5, 6} and W=12. In each node, "wt" represents the sum of items included to that point and "total" represents the sum of the items remaining to be considered.



Why is node (3, 1) non-promising?

Select one:

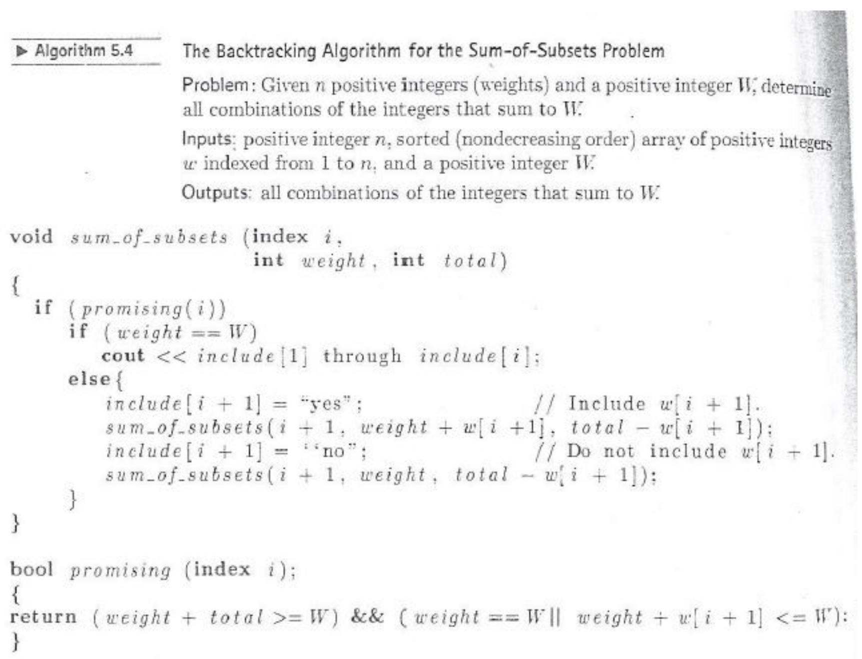
- a. There is an insufficient amount left in the "total" to possibly reach the desired sum
- b. Becuse node (3, 1) is our solution
- c. Observing the next item would be guaranteed to exceed our desired sum
- d. Exhuasted the available items and thus cannot reach the desired sum without any more children

Question **23**

Complete

1.00 points out of 1.00

In the pseudocode for the Sum of Subsets backtracking Algorithm the recursive process from a non-promising node to its parent node is handled by an implicit stack data structure implemented by the recursive calls to the function “sum-of-subsets”.



▶ Algorithm 5.4 The Backtracking Algorithm for the Sum-of-Subsets Problem

Problem: Given n positive integers (weights) and a positive integer W, determine all combinations of the integers that sum to W.

Inputs: positive integer n, sorted (nondecreasing order) array of positive integers w indexed from 1 to n, and a positive integer W.

Outputs: all combinations of the integers that sum to W.

```
void sum_of_subsets (index i,
                     int weight, int total)
{
  if (promising(i))
     if (weight == W)
        cout << include[1] through include[i];
     else{
        include[i + 1] = "yes";                // Include w[i + 1].
        sum_of_subsets(i + 1, weight + w[i + 1], total - w[i + 1]);
        include[i + 1] = "no";                 // Do not include w[i + 1].
        sum_of_subsets(i + 1, weight, total - w[i + 1]);
     }
}

bool promising (index i);
{
return (weight + total >= W) && (weight == W || weight + w[i + 1] <= W);
}
```

Select one:

- True
- False

Question **24**
Complete
1.00 points out of 1.00

Consider the following items in the Knapsack Problem:

$item$	$weight$	$\$$
1	2	10
2	6	45
3	8	50
4	12	100

In the 0-1 Knapsack Problem, the Dynamic Programming algorithm has produced the following array. What is the maximum value that can be put in the knapsack when W=22?

$$\left[\begin{array}{c|cccccccccccc} & 0 & 2 & 4 & 6 & 8 & 10 & 12 & 14 & 16 & 18 & 20 & 22 \\ \hline 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 \\ 2 & 0 & 10 & 10 & 45 & 55 & 55 & 55 & 55 & 55 & 55 & 55 & 55 \\ 3 & 0 & 10 & 10 & 45 & 55 & 60 & 60 & 95 & 105 & 105 & 105 & 105 \\ 4 & 0 & 10 & 10 & 45 & 55 & 60 & 100 & 110 & 110 & 145 & 155 & \textbf{?} \end{array}\right]$$

Answer: 160

Question **25**
Complete
0.00 points out of 1.00

In the Sum of Subsets Problem, the values in the Boolean matrix will always have monotonically non-decreasing rows from left to right & monotonically non-decreasing columns from top to bottom.

Select one:

- (selected) True
- False

Question **26**
Complete
1.00 points out of 1.00

Yuckdonald is considering opening a chain of restaurants around Interstate-80. The possible locations are in a straight line and the distances from these locations from the start of I-80 are in miles and is shown in increasing order $m_1, m_2, \ldots, m_7$. The constraints are as follows:

At each location, Yuckdonald may open a restaurant. The expected profit from opening a restaurant at location i is p_i where $p_i > 0$ and $i = 1, 2, \ldots, n$. Any two restaurants should be at least k miles apart where k=6. Consider the following instance of this problem such that $Dist$ denotes the Distance from the origin.

$Location$	m_1	m_2	m_3	m_4	m_5	m_6	m_7
$Dist$	2	5	9	12	19	20	23
p_i	3	7	6	4	8	5	1

Which locations were included in order to achieve the maximum profit obtainable while considering all locations m_1 through m_7?

Select one:

- a. m_2 & m_4 & m_6 & m_7
- b. m_1 & m_3 & m_6 & m_7
- c. m_1 & m_3 & m_5 & m_7
- (selected) d. m_2 & m_4 & m_5 & m_7

Question **27**
Complete
1.00 points out of 1.00

In the 0-1 Knapsack Problem, the values in the P-matrix will always have monotonically non-decreasing rows from left to right & monotonically non-decreasing columns from top to bottom.

Select one:

- (selected) True

False

Question **28**

Complete

1.00 points out of 1.00

Consider the following items in the Knapsack Problem:

$item$	$weight$	$\$$
1	2	10
2	6	45
3	8	50
4	12	100

In the 0-1 Knapsack Problem, the Dynamic Programming algorithm has produced the following array. Which items were included in the knapsack to achieve the maximum value at [4][22]?

$$\left[\begin{array}{c|cccccccccccc} & 0 & 2 & 4 & 6 & 8 & 10 & 12 & 14 & 16 & 18 & 20 & 22 \\ \hline 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 \\ 2 & 0 & 10 & 10 & 45 & 55 & 55 & 55 & 55 & 55 & 55 & 55 & 55 \\ 3 & 0 & 10 & 10 & 45 & 55 & 60 & 60 & 95 & 105 & 105 & 105 & 105 \\ 4 & 0 & 10 & 10 & 45 & 55 & 60 & 100 & 110 & 110 & 145 & 155 & ? \end{array}\right]$$

Select one:

- a. item 1 & item 2 & item 3 & item 4
- b. item 1 & item 2 & item 4
- c. item 2 & item 3 & item 4
- d. item 1 & item 3 & item 4

Question **29**

Complete

1.00 points out of 1.00

Consider the n-Queens Problem for n = 6 (i.e., placing 6 queens on a 6x6 chessboard so that no two queens threaten each other along any row, column, or diagonal). Assume, that we do not try to place two queens on the same row. In the state space tree we find that a node is non-promising if it places a queen on any column or diagonal already controlled by a previously placed queen.

How many **leaves** are there in the complete state space tree? That is, how many potential solutions are there to the 6-Queens Problem?

Answer: 46656

Question **30**

Complete

1.00 points out of 1.00

Consider the following items in the Knapsack Problem:

$item$	$weight$	$\$$
1	2	10
2	6	45
3	8	50
4	12	100

Determine the maximum value in the knapsack if we allow repetitions (i.e. if there are an unlimited number of each item such that more than one of each item can possibly be chosen)

$$\left[\begin{array}{c|cccccccccccc} & 0 & 2 & 4 & 6 & 8 & 10 & 12 & 14 & 16 & 18 & 20 & 22 \\ \hline P(w) & 0 & 10 & 20 & 45 & 55 & 65 & 100 & 110 & 120 & 145 & 155 & \mathbf{?} \end{array}\right]$$

Answer: 165

Question **31**

Complete

1.00 points out of 1.00

The max profit of the Fractional Knapsack Problem is an upper bound of what can be achieved in the 0-1 Knapsack Problem assuming both approaches are observing the same items with the same weights and values.

Select one:

- True
- False

Question **32**

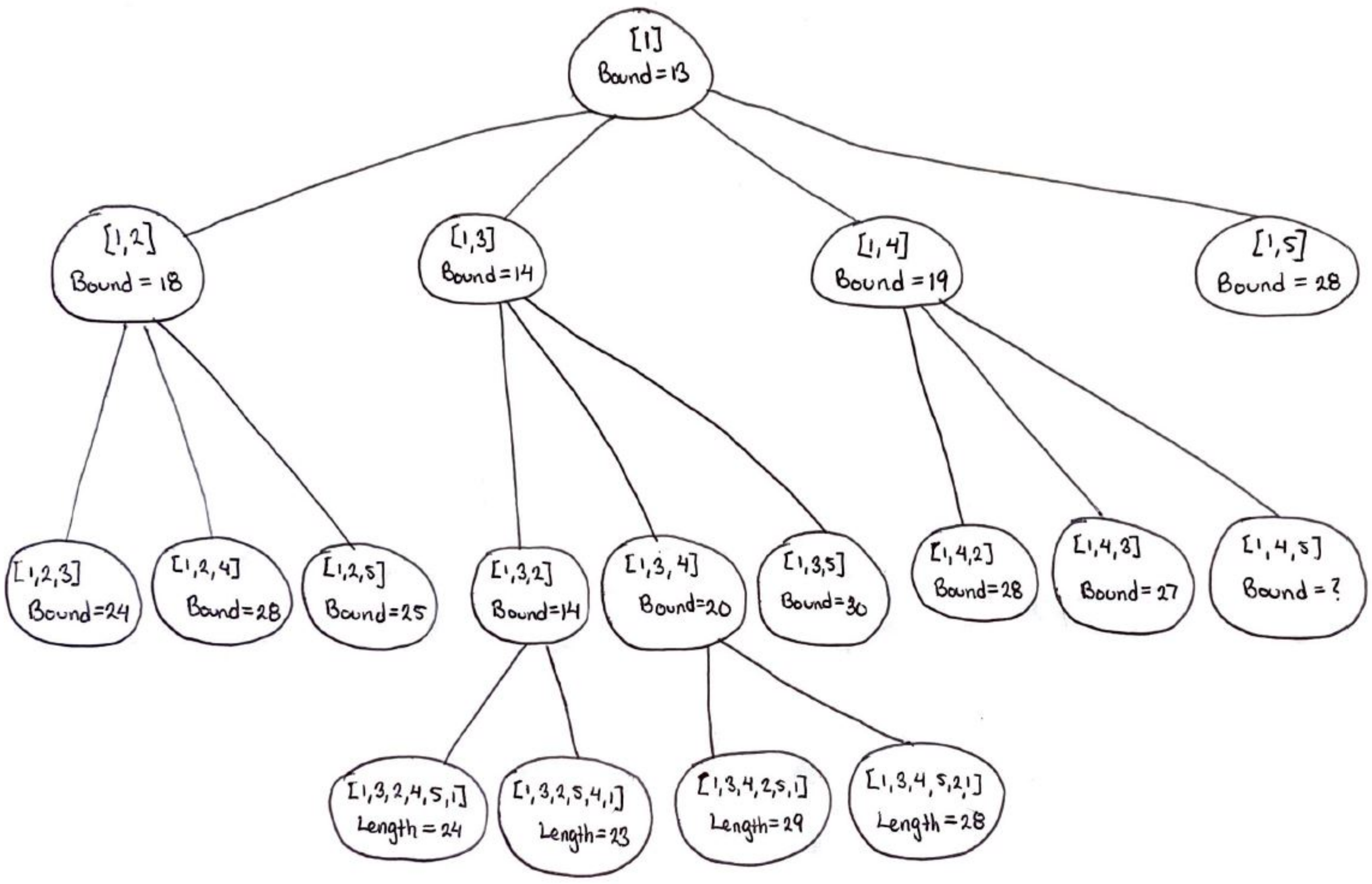
Complete

0.00 points out of 1.00

For the Traveling Salesman Problem, we have the following directed graph given as an adjacency matrix W. The value of the ith row and the jth column gives the direct distance from vertex i to vertex j.

W	1	2	3	4	5
1	0	7	2	5	10
2	12	0	6	7	4
3	4	5	0	8	13
4	11	7	9	0	2
5	8	4	10	1	0

Below is a portion of the state space tree for the given instance of the TSP using the branch and bound approach called best-first search. The bounds are computed as discussed in class.



If there were no pruning, how many total nodes would there be in the entire state space tree?

Select one:

- a. 24
- b. 3,125
- c. 41
- d. 3,901

Question **33**

Complete

1.00 points out of 1.00

In order to search a state space tree in breadth-first order, we need to implement what sort of data structure?

Select one:

- a. Queue
- b. Hash Table
- c. Linked List
- d. Stack

Question **34**

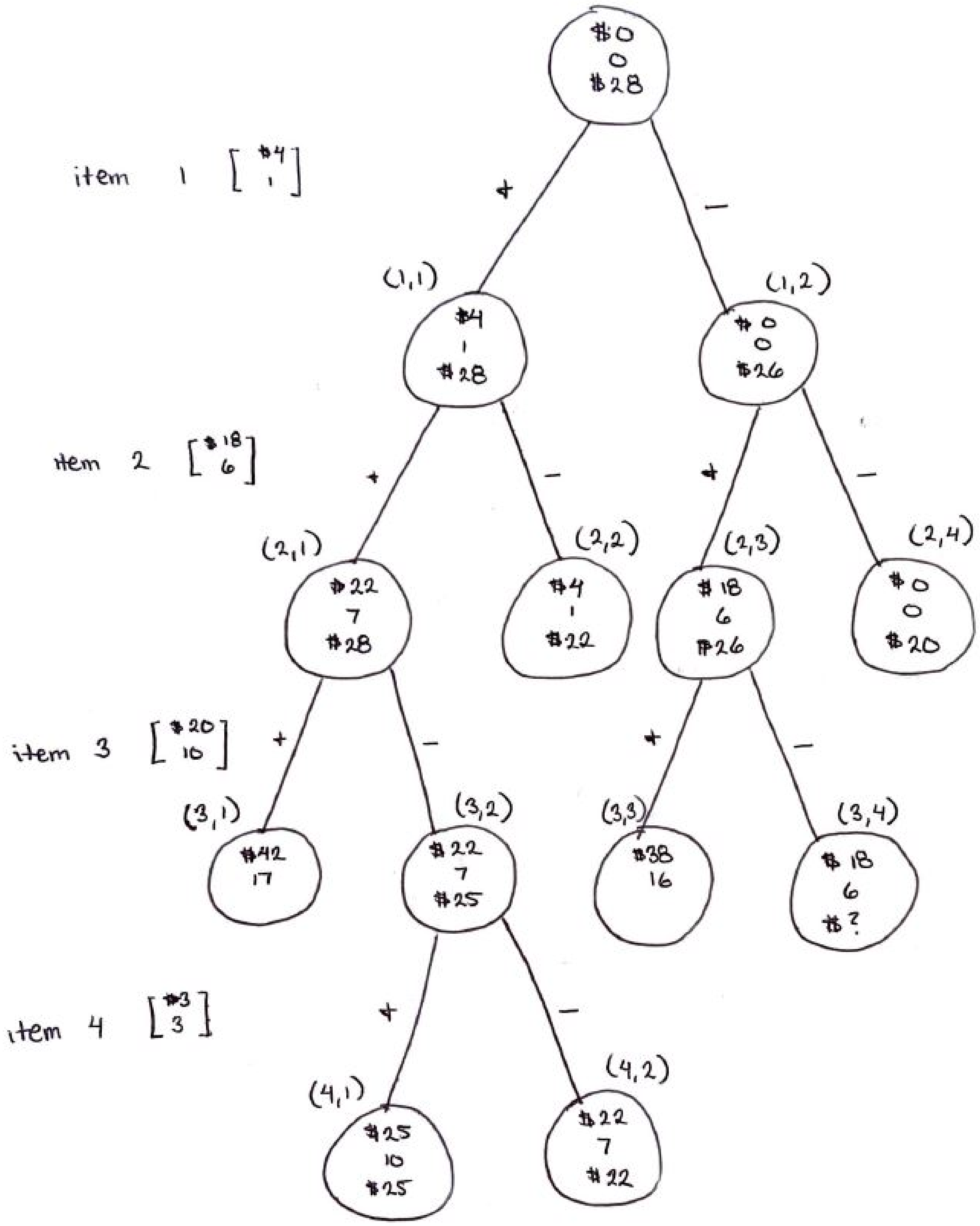
Complete

0.00 points out of 1.00

Consider the following items in the Knapsack Problem:

$item$	$weight$	$profit$
1	1	\$4
2	6	\$18
3	10	\$20
4	3	\$3

Below is the pruned state space decision tree for this problem using best-first branch-and-bound pruning. Each node, contains in this order, the total profit and total weight observed so far and the bound which is the maximum profit obtained by the Fractional Knapsack problem. A left branch indicates that the item is included and a right branch indicates that the item is not included. Determine the bound of node (3,4) when the capacity of the knapsack is W=10.



Answer: 24

Question **35**

Complete

2.00 points out of 2.00

I did my best on this exam. (Free points if answered True)

Select one:

- (selected) True
- False

◄ Midterm 1 and 2 Grade Distribution

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