Student Name: ______________________ ________ J#: ___________________

Jackson State University
CSC 323 Algorithm Design and Analysis, Spring 2019
Instructor: Dr. Natarajan Meghanathan
Exam 2 (Take Home Exam)

Maximum Points: 100 **Due on: April 4th, 1 PM**

Print this exam and answer in the space provided. Use additional sheets, if necessary.

<u>You should staple your exam.</u>

<u>Exam 2 should be submitted exactly at 1 PM. Any late submission will not be accepted.</u>

Q1 - 20 points) Construct a Huffman code for the following data (show all the steps):

Student Name	**Frequency of Symbols**					**Test Symbol Sequence**
	A	**B**	**C**	**D**	**E**	
Brown, Demetrius	0.21	0.35	0.16	0.08	0.20	BEAAEDDEBB
Cato, Jahelle	0.34	0.12	0.07	0.37	0.10	AADADDECCD
Chukwuma, Nzefili	0.40	0.20	0.21	0.09	0.10	ACAAECEAEB
Clark, Armon	0.25	0.20	0.28	0.15	0.12	BADBCDECBD
Collins, Taylor	0.15	0.24	0.14	0.27	0.20	AEBBADCBEE
Harmon, Alfred	0.50	0.2	0.1	0.05	0.15	ACBDAABDAC
Jackson, Martice	0.45	0.18	0.19	0.07	0.11	BEBAAABCBA
Langat, Vincent	0.29	0.07	0.10	0.20	0.34	EEAEAEDEEE
Stewart, Jessica	0.20	0.30	0.15	0.25	0.10	ABBCBAACBD
Tchakoua, Astride	0.35	0.30	0.12	0.20	0.03	AADADBCABB
Washington, Daren	0.10	0.16	0.54	0.12	0.08	BCCADCCCCC
Wynn, Marcus	0.44	0.22	0.11	0.04	0.19	AAABBEABEA
	0.28	0.27	0.15	0.14	0.16	ACEDDCBACA
	0.10	0.29	0.21	0.32	0.08	BBDBBADDDC
	0.25	0.36	0.12	0.18	0.09	BBAEBACBBA
	0.21	0.14	0.15	0.40	0.10	DDACEBADDA
	0.50	0.05	0.02	0.16	0.27	AAABAEECDA

(a) Determine the average number of bits per symbol.

(b) Determine the generic compression ratio compared to fixed-length encoding.

(c) Encode the given text symbol sequence using the Huffman code that you determined. Compute the compression ratio achieved for this text compared to fixed-length encoding.

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Q2 - 23 pts) Given the following items, their weights and values, compute the maximum value of the items that could be accumulated in a knapsack of weight W = 6 lb (also listed in the table). Compute your solutions as:

(i) Fractional Knapsack problem
(ii) Integer Knapsack problem (W = 6 lb)
(iii) Using the result of (ii), determine the total maximum value and the corresponding items that can be picked if the Knapsack weight is reduced to 5 lb.

Show all the work (including the value and history tables for the Integer Knapsack problem)

Brown, Demetrius

Item	Value($)	Weight (lb)
1	12	2
2	25	3
3	30	4
4	18	3
5	10	1

Cato, Jahelle

Item	Value ($)	Weight (lb)
1	20	2
2	13	1
3	25	2
4	39	4
5	27	3

Chukwuma, Nzefili

Item	Value ($)	Weight (lb)
1	45	3
2	62	4
3	18	1
4	35	2
5	20	1

Clark, Armon

Item	Value($)	Weight (lb)
1	11	1
2	31	4
3	10	2
4	18	3
5	12	2

Collins, Taylor

Item	Value ($)	Weight (lb)
1	41	3
2	28	2
3	46	4
4	24	2
5	13	1

Harmon, Alfred

Item	Value ($)	Weight (lb)
1	19	1
2	80	4
3	25	2
4	45	3
5	15	1

Jackson, Martice

Item	Value($)	Weight (lb)
1	15	2
2	19	3
3	28	4
4	20	3
5	8	1

Langat, Vincent

Item	Value ($)	Weight (lb)
1	10	2
2	12	3
3	19	4
4	8	1
5	14	2

Stewart, Jessica

Item	Value ($)	Weight (lb)
1	24	3
2	35	4
3	19	2
4	13	1
5	11	1

Tchakoua, Astride

Item	Value($)	Weight (lb)
1	10	1
2	19	2
3	25	2
4	40	4
5	32	3

Washington, Daren

Item	Value ($)	Weight (lb)
1	100	2
2	120	4
3	90	3
4	110	3
5	115	2

Wynn, Marcus

Item	Value ($)	Weight (lb)
1	14	2
2	20	3
3	15	2
4	10	1
5	30	4

Item	Value($)	Weight (lb)
1	23	2
2	33	3
3	40	4
4	21	2
5	11	1

Item	Value ($)	Weight (lb)
1	17	2
2	24	3
3	33	4
4	11	1
5	30	3

Item	Value ($)	Weight (lb)
1	15	3
2	20	4
3	22	3
4	12	1
5	17	2

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Item	Value($)	Weight (lb)
1	32	4
2	23	3
3	30	4
4	11	2
5	7	1

Item	Value ($)	Weight (lb)
1	7	2
2	14	3
3	23	4
4	11	1
5	20	3

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Q3 - 7 points) Using Dynamic Programming, compute the binomial coefficient for the numbers assigned below. Show the table and all the work.

Student # / Name	**n**	**k**
Brown, Demetrius	13	8
Cato, Jahelle	10	7
Chukwuma, Nzefili	12	9
Clark, Armon	10	6
Collins, Taylor	13	5
Harmon, Alfred	13	10
Jackson, Martice	12	7
Langat, Vincent	11	7
Stewart, Jessica	13	11
Tchakoua, Astride	10	4
Washington, Daren	11	9
Wynn, Marcus	12	8
	11	5
	10	8
	15	7
	14	8
	13	9

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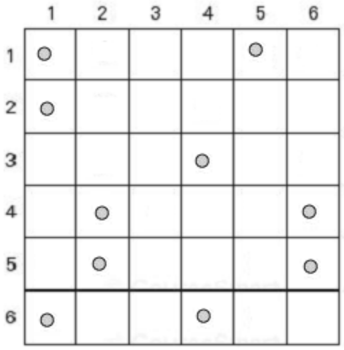
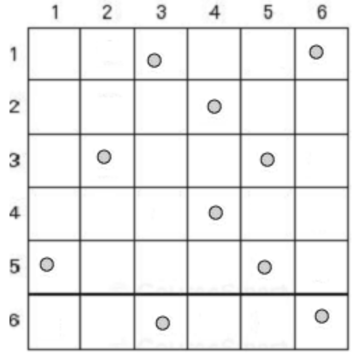
Q4 - 13 points) Several coins are placed in cells of a 6 x 6 board (*n* x *m* board) shown below for each student, with no more than one coin per cell. Assume the value of each coin is 1. Determine a path from cell (1, 1) to cell (6, 6) such that the path traced collects the maximum number of coins (also same as the maximum value of the coins).

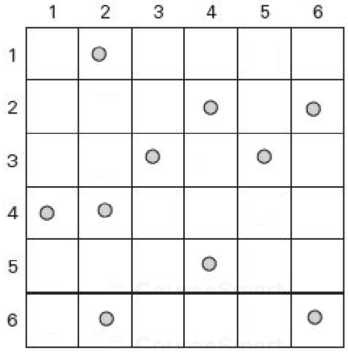
Brown, Demetrius



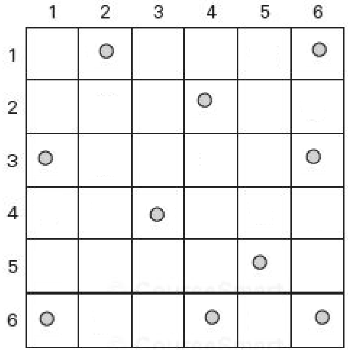
Cato, Jahelle



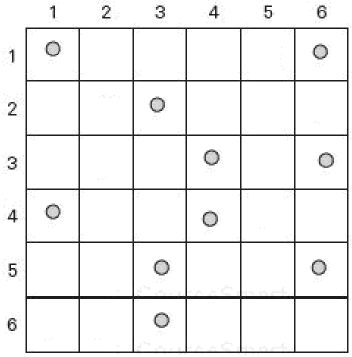
Chukwuma, Nzefili



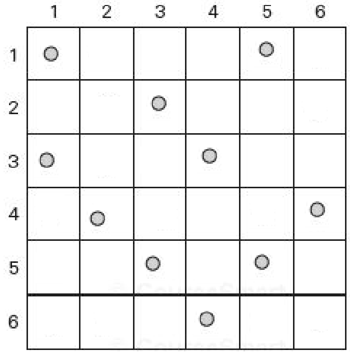
Clark, Armon



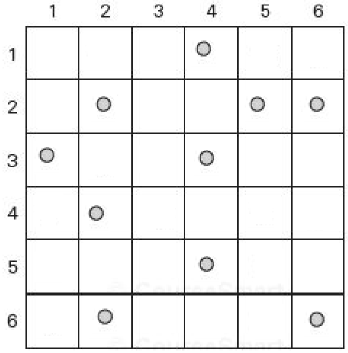
Collins, Taylor



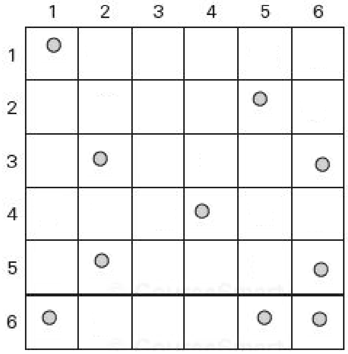
Harmon, Alfred



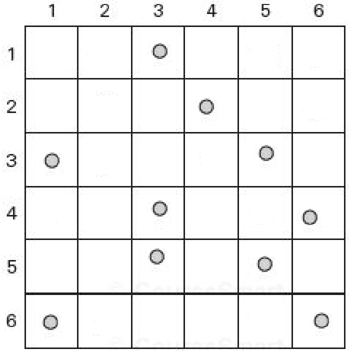
Jackson, Martice



Langat, Vincent



Stewart, Jessica



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Tchakoua, Astride

	1	2	3	4	5	6
1		○			○	
2		○				○
3			○			
4	○			○		
5					○	○
6			○			

Washington, Daren

	1	2	3	4	5	6
1				○		○
2		○			○	
3		○		○		
4	○				○	
5			○		○	
6				○		

Wynn, Marcus

	1	2	3	4	5	6
1		○			○	
2			○			○
3	○			○		
4			○			○
5					○	
6	○		○			

	1	2	3	4	5	6
1	○		○		○	
2	○					○
3		○		○		○
4			○		○	
5		○		○		
6			○			○

	1	2	3	4	5	6
1			○		○	
2		○			○	
3	○			○		○
4			○		○	
5		○				○
6	○		○			

	1	2	3	4	5	6
1			○			
2		○	○		○	
3				○		○
4	○		○			
5		○		○		
6					○	

	1	2	3	4	5	6
1			○			○
2		○			○	
3	○		○			
4			○			
5		○				○
6	○			○		

	1	2	3	4	5	6
1	○			○		
2		○				○
3		○		○		
4	○		○		○	
5		○		○		○
6			○			○

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Q5 - 17 points) Given the sequences below, find the longest common sub sequence using the dynamic programming formulation discussed in class. Show the table and all the work. Also, show the final alignment of the two sequences (along with the gaps).

Student Name	**Row Sequence**	**Column Sequence**
Brown, Demetrius	TCGCCTT	GGGGTAACT
Cato, Jahelle	TAAAATCTAG	CTTGGATC
Chukwuma, Nzefili	GTGTGGAAAC	GCTTCTTTCT
Clark, Armon	AGGACGGTGAA	AATTTTTA
Collins, Taylor	CGGCCAGGCGAT	CGAGGTAAGTAG
Harmon, Alfred	GCTATTAT	ATAGAAATC
Jackson, Martice	TTCTGATGTT	TCGGGAT
Langat, Vincent	CAGATGTATCTG	GAGACAGGAT
Stewart, Jessica	CTCAGGT	GTGAGGGGGA
Tchakoua, Astride	GATTGCACTA	GTAGCAGT
Washington, Daren	GCTAAGC	AGTGCCG
Wynn, Marcus	ATCACC	GCTCGATCTGCA
	TTTTAATCCAGC	TGCAGAGAACTA
	GAGTAAG	GCGACG
	CCCCTATAGT	CTGACG
	AGAGGC	CAATCGCAACGC
	TATCAA	TGGACTCCGCAC

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Q6 - 20 pts) Consider the coin denomination array (CD) and the sum of the coin values (S) assigned to you. Use the dynamic programming algorithm discussed in class to determine the minimum number of coins and the actual coin values that one would pick up so that the sum of the coin values is S.

Show the contents of the MNC and LCP arrays for each iteration, as discussed in the slides. Discuss how you would trace the solution to determine the actual coin values that need to be picked up for the given S.

Assume an infinite supply of coins for each value. Break any tie in favor of the coin with a lower index in the CD array.

	Coin Denomination Array (CD)	Sum of the Coin Values (S)
Brown, Demetrius	1 4 5 6	20
Cato, Jahelle	2 3 7 6	18
Chukwuma, Nzefili	2 5 7 4	22
Clark, Armon	3 6 1 7	16
Collins, Taylor	1 5 6 3	22
Harmon, Alfred	2 5 6 7	23
Jackson, Martice	5 7 2 4	23
Langat, Vincent	2 1 5 6	22
Stewart, Jessica	1 4 7 2	19
Tchakoua, Astride	7 6 2 3	19
Washington, Daren	5 6 7 4	25
Wynn, Marcus	2 7 3 6	25
	1 6 2 5	21
	7 6 5 3	25
	7 5 1 2	24
	4 1 6 3	20
	5 2 6 1	21