Student Name: ______________________ ________ J#: ___________________

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

Maximum Points: 100 **Due on: October 31st, 2.30 PM (in class)**

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

You should staple your exam.

Exam 2 should be submitted exactly at 2.30 PM. Any late submission will not be accepted.

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**	
Perry Butler	0.21	0.35	0.16	0.08	0.20	BEAAEDDEBB
Latamla Culley-Triggs	0.34	0.12	0.07	0.37	0.10	AADADDECCD
Justin Epps	0.40	0.20	0.21	0.09	0.10	ACAAECEAEB
Kalil-Dan Ford	0.25	0.20	0.28	0.15	0.12	BADBCDECBD
Chawne Harris	0.15	0.24	0.14	0.27	0.20	AEBBADCBEE
Ashly Horner	0.50	0.2	0.1	0.05	0.15	ACBDAABDAC
Martice Jackson	0.45	0.18	0.19	0.07	0.11	BEBAAABCBA
Jorian Lenard	0.29	0.07	0.10	0.20	0.34	EEAEAEDEEE
Damian Patterson	0.20	0.30	0.15	0.25	0.10	ABBCBAACBD
Brandon Redmond	0.35	0.30	0.12	0.20	0.03	AADADBCABB
Daren Washington	0.10	0.16	0.54	0.12	0.08	BCCADCCCCC
Alicia Wells	0.44	0.22	0.11	0.04	0.19	AAABBEABEA
Marcus Wynn	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)

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Perry Butler

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

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Latamla Culley-Triggs

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

Justin Epps

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

Kalil-Dan Ford

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

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Chawne Harris

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

Ashly Horner

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

Martice Jackson

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

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Jorian Lenard

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

Damian Patterson

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

Brandon Redmond

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

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Daren Washington

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

Alicia Wells

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

Marcus Wynn

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**
Perry Butler	13	8
Latamla Culley-Triggs	10	7
Justin Epps	12	9
Kalil-Dan Ford	10	6
Chawne Harris	13	5
Ashly Horner	13	10
Martice Jackson	12	7
Jorian Lenard	11	7
Damian Patterson	13	11
Brandon Redmond	10	4
Daren Washington	11	9
Alicia Wells	12	8
Marcus Wynn	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).

Perry Butler

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

Latamla Culley-Triggs

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

Justin Epps

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

Kalil-Dan Ford

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

Chawne Harris

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

Ashly Horner

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

Martice Jackson

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

Jorian Lenard

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

Damian Patterson

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

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Brandon Redmond

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

Daren Washington

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

Alicia Wells

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

Marcus Wynn

	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**
Perry Butler	TCGCCTT	GGGGTAACT
Latamla Culley-Triggs	TAAAATCTAG	CTTGGATC
Justin Epps	GTGTGGAAAC	GCTTCTTTCT
Kalil-Dan Ford	AGGACGGTGAA	AATTTTTA
Chawne Harris	CGGCCAGGCGAT	CGAGGTAAGTAG
Ashly Horner	GCTATTAT	ATAGAAATC
Martice Jackson	TTCTGATGTT	TCGGGAT
Jorian Lenard	CAGATGTATCTG	GAGACAGGAT
Damian Patterson	CTCAGGT	GTGAGGGGGA
Brandon Redmond	GATTGCACTA	GTAGCAGT
Daren Washington	GCTAAGC	AGTGCCG
Alicia Wells	ATCACC	GCTCGATCTGCA
Marcus Wynn	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)
Perry Butler	1 4 5 6	20
Latamla Culley-Triggs	2 3 7 6	18
Justin Epps	2 5 7 4	22
Kalil-Dan Ford	3 6 1 7	16
Chawne Harris	1 5 6 3	22
Ashly Horner	2 5 6 7	23
Martice Jackson	5 7 2 4	23
Jorian Lenard	2 1 5 6	22
Damian Patterson	1 4 7 2	19
Brandon Redmond	7 6 2 3	19
Daren Washington	5 6 7 4	25
Alicia Wells	1 6 2 5	21
Wynn, Marcus	2 7 3 6	25
	7 6 5 3	25
	7 5 1 2	24
	4 1 6 3	20
	5 2 6 1	21

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