Jackson State University
CSC 323 Algorithm Design and Analysis, Spring 2018
Instructor: Dr. Natarajan Meghanathan
Exam 2 (Take Home Exam)

Maximum Points: 100 **Due on: March 20th, 1 PM**

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

You should staple your exam.

Exam 2 should be submitted when I enter the class at 1 PM and say 'Submit'. Any late submission will not be accepted.

1) (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	
Leon Anderson	0.21	0.35	0.16	0.08	0.20	BEAAEDDEBB
Ujjwal Baskota	0.34	0.12	0.07	0.37	0.10	AADADDECCD
Albert Boateng	0.40	0.20	0.21	0.09	0.10	ACAAECEAEB
Nissi Campbell	0.25	0.20	0.28	0.15	0.12	BADBCDECBD
Samuel A. Dagne	0.15	0.24	0.14	0.27	0.20	AEBBADCBEE
James Daniel	0.50	0.2	0.1	0.05	0.15	ACBDAABDAC
Zakeia Davis	0.45	0.18	0.19	0.07	0.11	BEBAAABCBA
Justin Epps	0.29	0.07	0.10	0.20	0.34	EEAEAEDEEE
Amanuel E. Gebre	0.20	0.30	0.15	0.25	0.10	ABBCBAACBD
Melrondarius Groom	0.35	0.30	0.12	0.20	0.03	AADADBCABB
Yoseph Hailemariam	0.10	0.16	0.54	0.12	0.08	BCCADCCCCC
Antonie Hobson	0.44	0.22	0.11	0.04	0.19	AAABBEABEA
Portia Junius	0.28	0.27	0.15	0.14	0.16	ACEDDCBACA
Justin McGuffee	0.10	0.29	0.21	0.32	0.08	BBDBBADDDC
Ryun Moore	0.25	0.36	0.12	0.18	0.09	BBAEBACBBA
Keara Rogers	0.21	0.14	0.15	0.40	0.10	DDACEBADDA
Timothy Stewart	0.50	0.05	0.02	0.16	0.27	AAABAEECDA
Nebiyou Tadesse	0.09	0.08	0.25	0.40	0.18	DDABCCEADD
Phat Tran	0.17	0.19	0.36	0.12	0.16	CADECCDEABC

(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.

2) (15 points) Draw a binary search tree for the following sorted array, and determine the average number of comparisons for a successful search and an unsuccessful search.

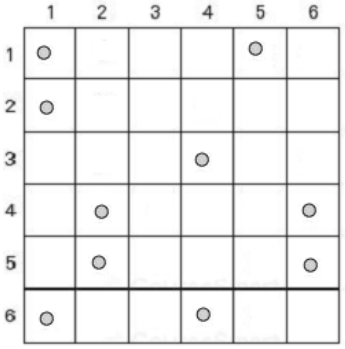
Student # / Name	**Array**
Leon Anderson	[8, 13, 25, 27, 27, 39, 46, 55, 57, 71]
Ujjwal Baskota	[14, 23, 33, 33, 51, 58, 69, 75, 82, 86]
Albert Boateng	[3, 11, 11, 30, 33, 50, 69, 83, 98, 99]
Nissi Campbell	[5, 11, 13, 31, 37, 42, 58, 66, 78, 97]
Samuel A. Dagne	[9, 16, 18, 23, 31, 42, 44, 49, 53, 67]
James Daniel	[0, 10, 21, 27, 29, 46, 50, 55, 59, 73]
Zakeia Davis	[15, 32, 47, 55, 63, 77, 80, 96, 100, 108]
Justin Epps	[7, 12, 22, 41, 59, 77, 87, 89, 89, 102]
Amanuel E. Gebre	[1, 20, 34, 37, 49, 49, 60, 77, 83, 98]
Melrondarius Groom	[4, 9, 13, 13, 31, 42, 58, 67, 78, 85]
Yoseph Hailemariam	[8, 27, 30, 42, 51, 51, 61, 77, 93, 94]
Antonie Hobson	[13, 19, 31, 31, 36, 42, 57, 58, 73, 80]
Portia Junius	[3, 17, 30, 41, 54, 71, 89, 93, 93, 99]
Justin McGuffee	[18, 20, 23, 28, 33, 40, 50, 65, 80, 94]
Ryun Moore	[19, 28, 36, 49, 56, 71, 73, 83, 98, 108]
Keara Rogers	[16, 24, 32, 40, 53, 61, 80, 93, 95, 97]
Timothy Stewart	[10, 17, 26, 40, 57, 72, 85, 100, 112, 131]
Nebiyou Tadesse	[11, 13, 20, 21, 31, 37, 45, 51, 62, 71]
Phat Tran	[16, 25, 40, 40, 41, 56, 67, 78, 90, 96]

3) (10 points) Using Dynamic Programming, compute the binomial coefficient for the numbers assigned below. Show the table and all the work.

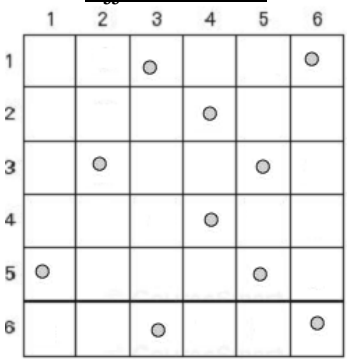
Student # / Name	**n**	**k**
Leon Anderson	13	8
Ujjwal Baskota	10	7
Albert Boateng	12	9
Nissi Campbell	10	6
Samuel A. Dagne	13	5
James Daniel	13	10
Zakeia Davis	12	7
Justin Epps	11	7
Amanuel E. Gebre	13	11
Melrondarius Groom	10	4
Yoseph Hailemariam	11	9
Antonie Hobson	12	8
Portia Junius	11	5
Justin McGuffee	10	8
Ryun Moore	15	7
Keara Rogers	14	8
Timothy Stewart	13	9
Nebiyou Tadesse	15	9
Phat Tran	14	7

4) (15 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).

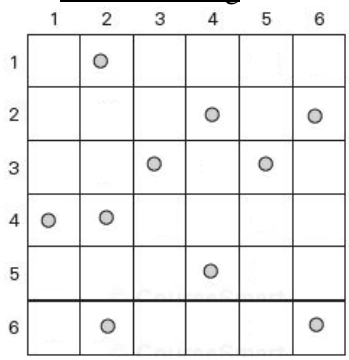
Leon Anderson



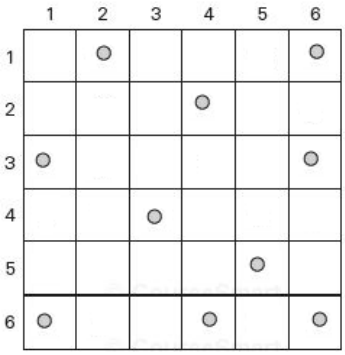
Ujjwal Baskota



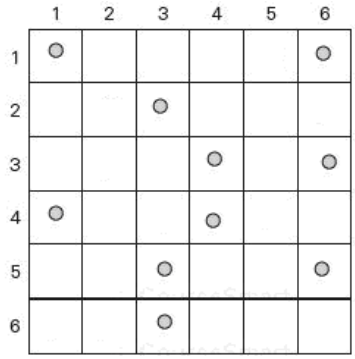
Albert Boateng



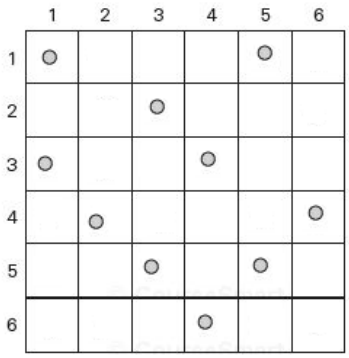
Nissi Campbell



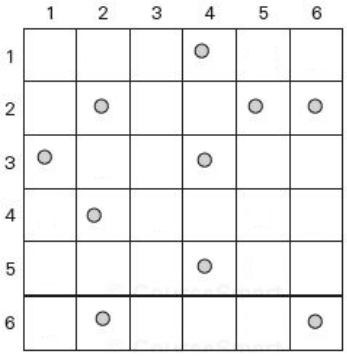
Samuel Dagne



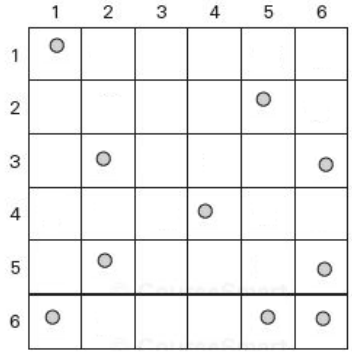
James Daniel



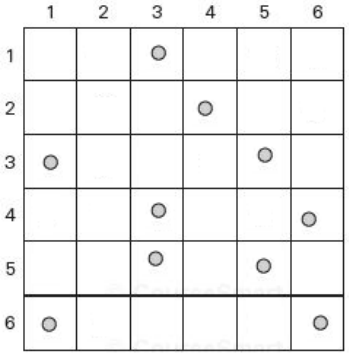
Zakeia Davis



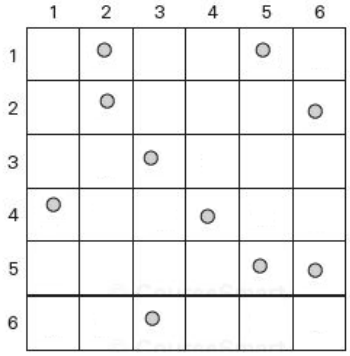
Justin Epps



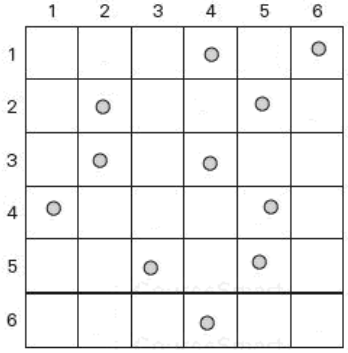
Justin McGuffee



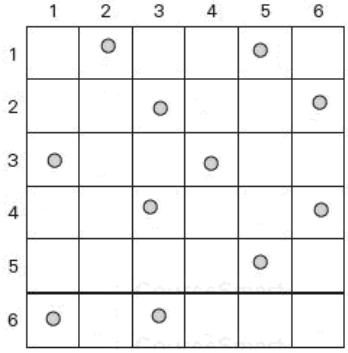
Amanuel Gebre



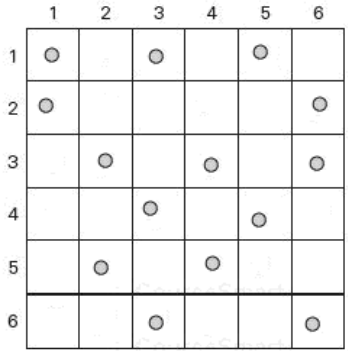
Mel Groom



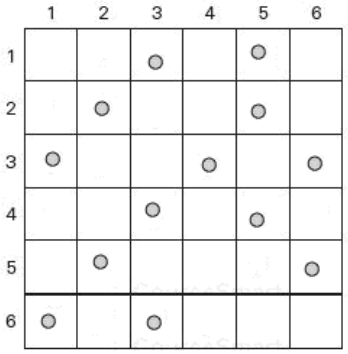
Antoine Hobson



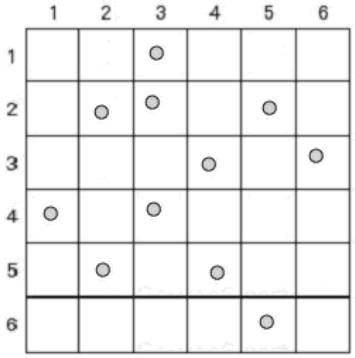
Portia Junius



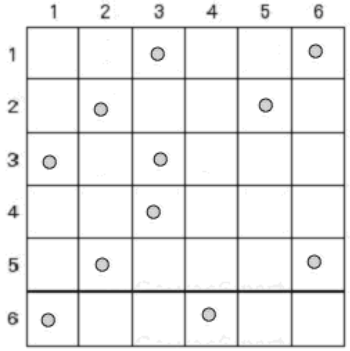
Ryun Moore



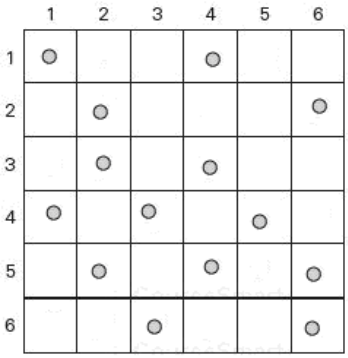
Keara Rogers



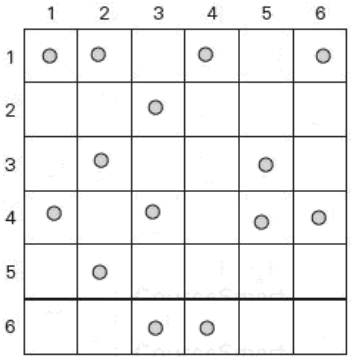
Timothy Stewart



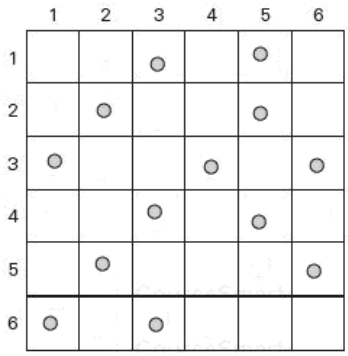
Yoseph Hailemariam



Nebiyou Tadesse



Phat Tran



6) (20 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**
Leon Anderson	TCGCCTT	GGGGTAACT
Ujjwal Baskota	TAAAATCTAG	CTTGGATC
Albert Boateng	GTGTGGAAAC	GCTTCTTTCT
Nissi Campbell	AGGACGGTGAA	AATTTTTA
Samuel A. Dagne	CGGCCAGGCGAT	CGAGGTAAGTAG
James Daniel	GCTATTAT	ATAGAAATC
Zakeia Davis	TTCTGATGTT	TCGGGAT
Justin Epps	CAGATGTATCTG	GAGACAGGAT
Amanuel E. Gebre	CTCAGGT	GTGAGGGGGA
Melrondarius Groom	GATTGCACTA	GTAGCAGT
Yoseph Hailemariam	GCTAAGC	AGTGCCG
Antonie Hobson	ATCACC	GCTCGATCTGCA
Portia Junius	TTTTAATCCAGC	TGCAGAGAACTA
Justin McGuffee	GAGTAAG	GCGACG
Ryun Moore	CCCCTATAGT	CTGACG
Keara Rogers	AGAGGC	CAATCGCAACGC
Timothy Stewart	TATCAA	TGGACTCCGCAC
Nebiyou Tadesse	TGCGTGCAG	GGGTTC
Phat Tran	TTCCGTAA	ACGGTTGCT

7) (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)
Leon Anderson	1 4 5 6	20
Ujjwal Baskota	2 3 7 6	18
Albert Boateng	2 5 7 4	22
Nissi Campbell	3 6 1 7	16
Samuel A. Dagne	1 5 6 3	22
James Daniel	2 5 6 7	23
Zakeia Davis	5 7 2 4	23
Justin Epps	2 1 5 6	22
Amanuel E. Gebre	1 4 7 2	19
Melrondarius Groom	7 6 2 3	19
Yoseph Hailemariam	5 6 7 4	25
Antonie Hobson	2 7 3 6	25
Portia Junius	1 6 2 5	21
Justin McGuffee	7 6 5 3	25
Ryun Moore	7 5 1 2	24
Keara Rogers	4 1 6 3	20
Timothy Stewart	5 2 6 1	21
Nebiyou Tadesse	4 6 7 3	23
Phat Tran	6 7 1 3	23