Student Name: _____ _____ J#: _____

Jackson State University
CSC 323 Algorithm Design and Analysis, Spring 2020
Instructor: Dr. Natarajan Meghanathan
Exam 3 (Take Home Exam)
Maximum Points: 100 **Due on: April 16th, 11.59 PM (in Canvas)**

Submission Options (choose one of the three): You can either
(a) Print this exam, write the solutions in the space provided, scan and upload as a PDF file or
(b) Use the space provided to type the solutions, save the file to a word or PDF and upload or
(c) Write the solutions for some questions by hand and type the solutions for some other questions. In this case, you should scan the written text to a PDF file, merge it with the PDF file for the typed content and submit everything together as a single PDF file.

Q1 - 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)

Abate, Biruk

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

Akintade, Oluwaseun

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

Alharbi, Abdullah

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

Alharbi, Abdulmajeed

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

Atkins, Nayaa

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

Barnett, Isaiah

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

Dent, Kaitlyn

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

Drake, Keilah

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

Harris, Chawne

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

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McGee, Bria

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

Redmond, Brandon

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

Roberts, Cambria

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

Stubbs, Jasmine

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

Swami, Shaurya

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

Tchakoua, Landrie

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

Teshome, Nahom

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

Triplett, Marzell

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

Wilkes, Kyla

Item	Value ($)	Weight (lb)
1	12	4
2	16	3
3	9	2
4	15	6
5	10	4

Student Name: _____ _____ J#: _____

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Q2 - 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**
Abate, Biruk	13	8
Akintade, Oluwaseun	10	7
Alharbi, Abdullah	12	9
Alharbi, Abdulmajeed	10	6
Atkins, Nayaa	13	5
Barnett, Isaiah	13	10
Dent, Kaitlyn	12	7
Drake, Keilah	11	7
Harris, Chawne	13	11
McGee, Bria	10	4
Redmond, Brandon	11	9
Roberts, Cambria	12	8
Stubbs, Jasmine	11	5
Swami, Shaurya	10	8
Tchakoua, Landrie	15	7
Teshome, Nahom	14	8
Triplett, Marzell	13	9
Wilkes, Kayla	15	8

Student Name: _____ _____ J#: _____

Q3 - 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**
Abate, Biruk	TCGCCTT	GGGGTAACT
Akintade, Oluwaseun	TAAAATCTAG	CTTGGATC
Alharbi, Abdullah	GTGTGGAAAC	GCTTCTTTCT
Alharbi, Abdulmajeed	AGGACGGTGAA	AATTTTTA
Atkins, Nayaa	CGGCCAGGCGAT	CGAGGTAAGTAG
Barnett, Isaiah	GCTATTAT	ATAGAAATC
Dent, Kaitlyn	TTCTGATGTT	TCGGGAT
Drake, Keilah	CAGATGTATCTG	GAGACAGGAT
Harris, Chawne	CTCAGGT	GTGAGGGGGA
McGee, Bria	GATTGCACTA	GTAGCAGT
Redmond, Brandon	GCTAAGC	AGTGCCG
Roberts, Cambria	ATCACC	GCTCGATCTGCA
Stubbs, Jasmine	TTTTAATCCAGC	TGCAGAGAACTA
Swami, Shaurya	GAGTAAG	GCGACG
Tchakoua, Landrie	CCCCTATAGT	CTGACG
Teshome, Nahom	AGAGGC	CAATCGCAACGC
Triplett, Marzell	TATCAA	TGGACTCCGCAC
Wilkes, Kayla	CCATGCATG	GACTCGAACATG

Student Name: _____ _____ J#: _____

Student Name: _____ _____ J#: _____

Q4 - 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 (CD) Array	Sum of the Coin Values (S)
Abate, Biruk	1 4 5 6	20
Akintade, Oluwaseun	2 3 6 7	18
Alharbi, Abdullah	2 4 5 7	22
Alharbi, Abdulmajeed	1 3 6 7	16
Atkins, Nayaa	1 3 5 6	22
Barnett, Isaiah	2 5 6 7	23
Dent, Kaitlyn	2 4 5 8	23
Drake, Keilah	1 2 5 6	22
Harris, Chawne	1 2 4 7	19
McGee, Bria	2 3 6 7	19
Redmond, Brandon	4 5 6 7	25
Roberts, Cambria	3 5 7 8	25
Stubbs, Jasmine	1 2 5 6	21
Swami, Shaurya	3 5 6 7	25
Tchakoua, Landrie	1 2 5 7	24
Teshome, Nahom	1 3 6 7	20
Triplett, Marzell	2 4 5 6	21
Wilkes, Kayla	3 5 7 8	25

Student Name: _____ _____ J#: _____

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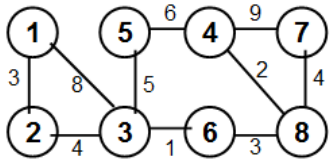
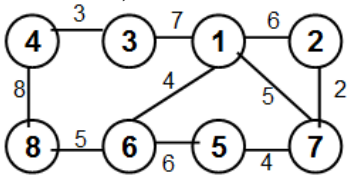
Q5: 18 pts) Run the **Dijkstra's shortest path algorithm** on the graph assigned to you, starting from Vertex 1, and determine the shortest path tree rooted from Vertex 1 to the rest of the vertices. If any edge does not have weight assigned, assume the weight of that edge to be 5. Show your work for each iteration in the skeletal graphs (see next page). For each skeletal graph, indicate the vertices and all the edges that are selected as part of the particular iteration as well as carried over from the previous iterations. Show all the steps.

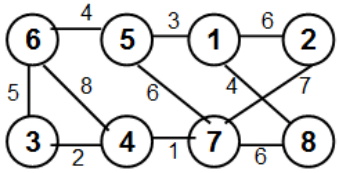
Abate, Biruk



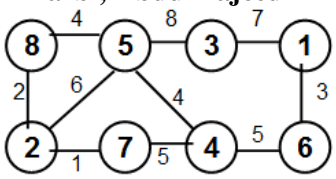
Akintade, Oluwaseun



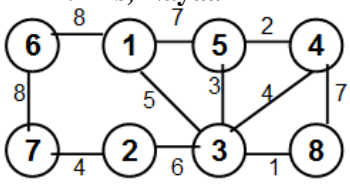
Alharbi, Abdullah



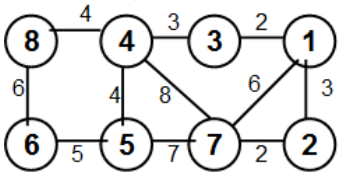
Alharbi, Abdulmajeed



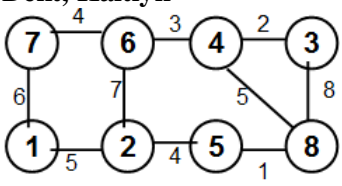
Atkins, Nayaa



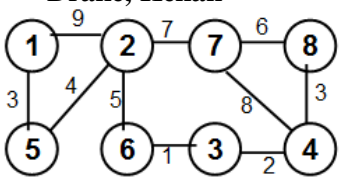
Barnett, Isaiah



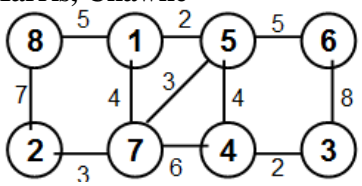
Dent, Kaitlyn



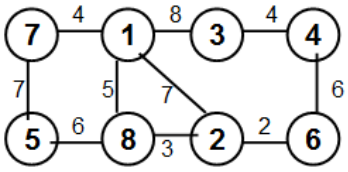
Drake, Keilah



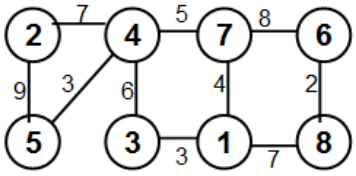
Harris, Chawne



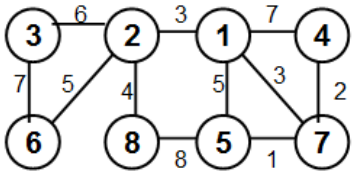
McGee, Bria



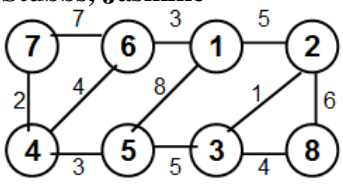
Redmond, Brandon



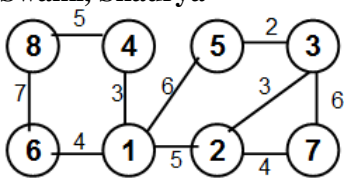
Roberts, Cambria



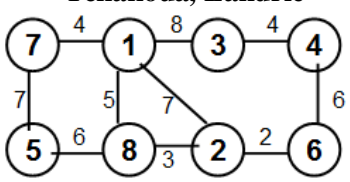
Stubbs, Jasmine



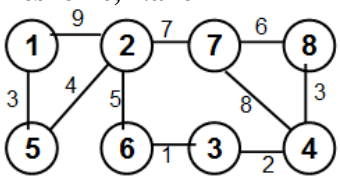
Swami, Shaurya



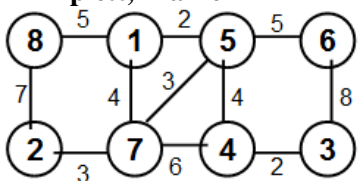
Tchakoua, Landrie



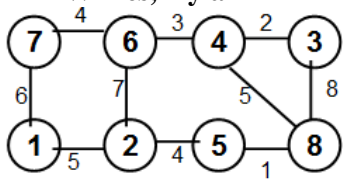
Teshome, Nahom



Triplett, Marzell



Wilkes, Kyla



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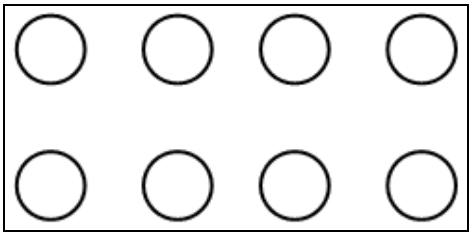
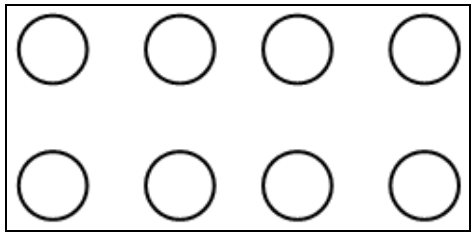
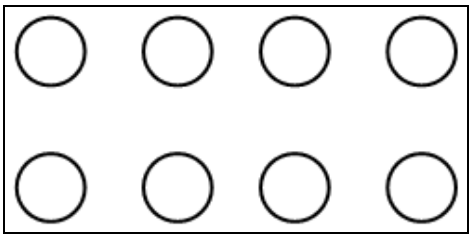
Skeletal Graphs (Iterations)



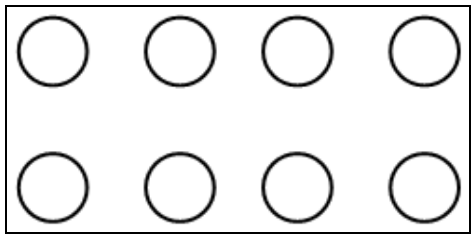
Given Graph



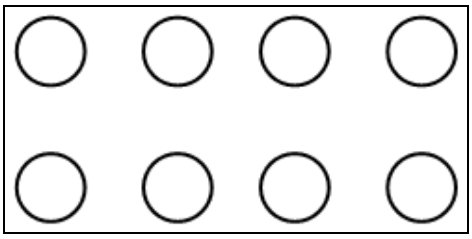
Initialization



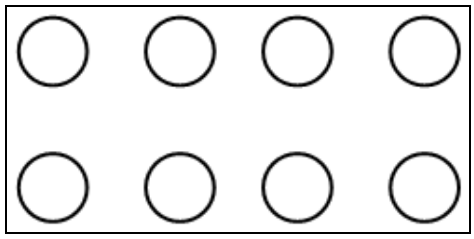
Iteration 1



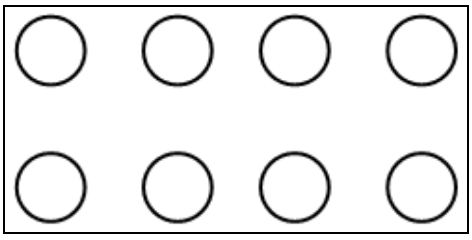
Iteration 2



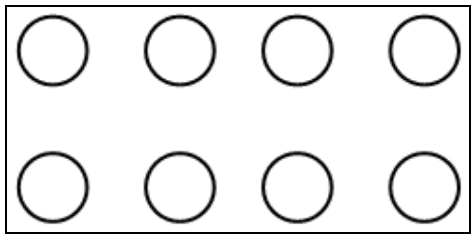
Iteration 3



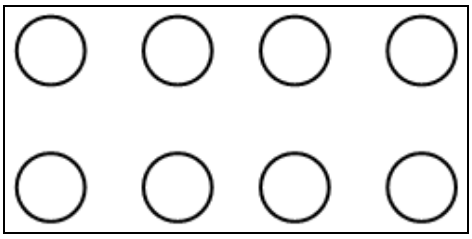
Iteration 4



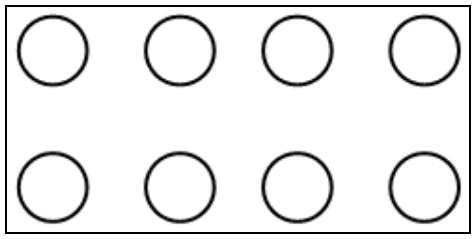
Iteration 5



Iteration 6



Iteration 7



Shortest Path Tree

Sum of the Weights of the Shortest Path Tree: _____

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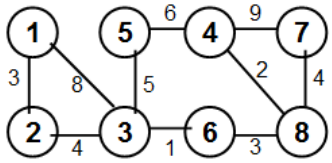
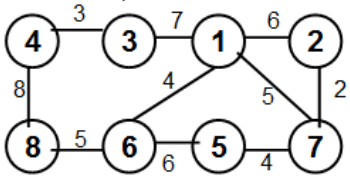
Q6: 15 pts) Run the Kruskal's algorithm for **maximum weight spanning tree** on the graph assigned to you. If any edge does not have weight assigned, assume the weight of that edge to be 5. Show your work for each iteration in the skeletal graphs (see next page). For each skeletal graph, indicate the vertices and all the edges that are selected as part of the particular iteration as well as carried over from the previous iterations. Show all the steps.

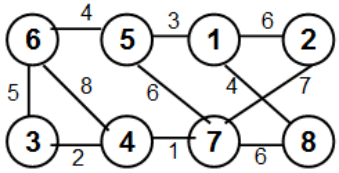
Abate, Biruk



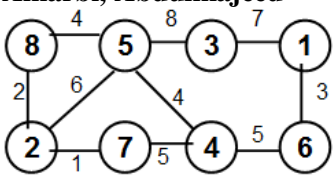
Akintade, Oluwaseun



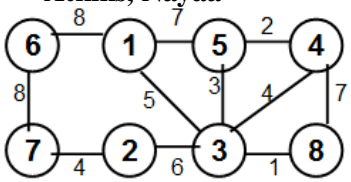
Alharbi, Abdullah



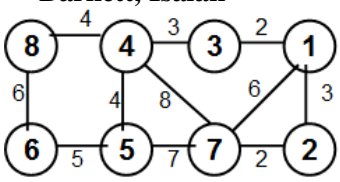
Alharbi, Abdulmajeed



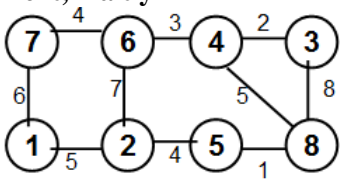
Atkins, Nayaa



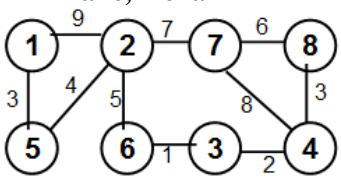
Barnett, Isaiah



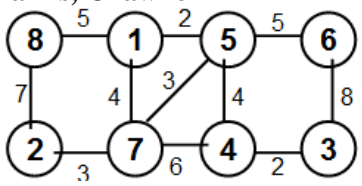
Dent, Kaitlyn



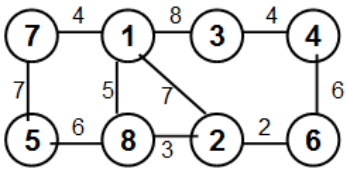
Drake, Keilah



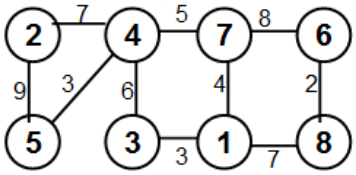
Harris, Chawne



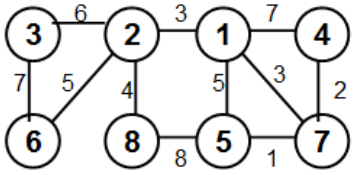
McGee, Bria



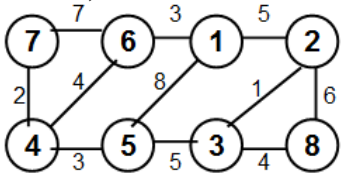
Redmond, Brandon



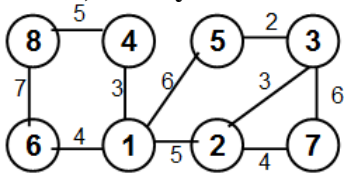
Roberts, Cambria



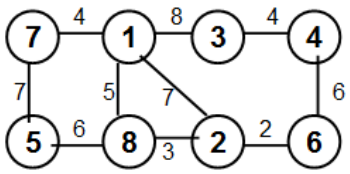
Stubbs, Jasmine



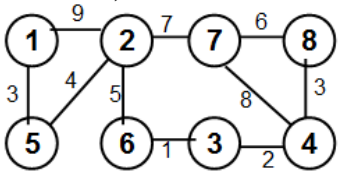
Swami, Shaurya



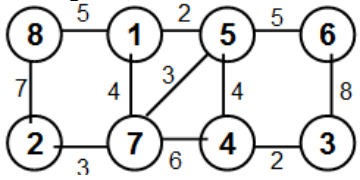
Tchakoua, Landrie



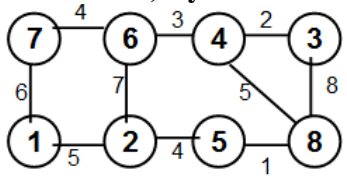
Teshome, Nahom



Triplett, Marzell

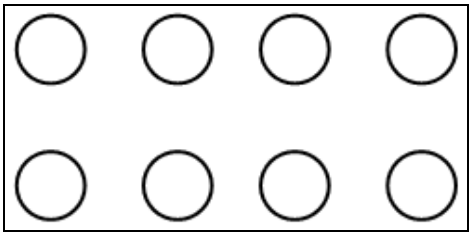


Wilkes, Kyla

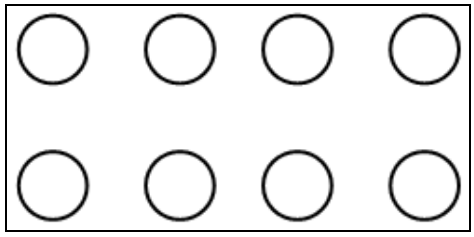


Student Name: _____ _____ J#: _____

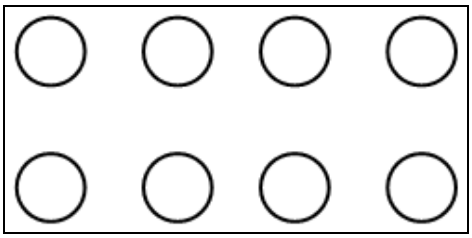
Skeletal Graphs (Iterations)



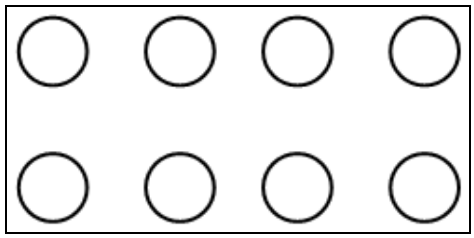
Given Graph



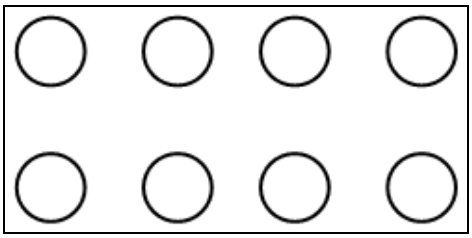
Initialization



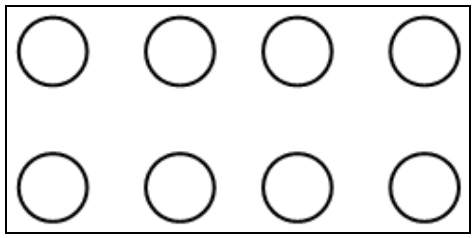
Iteration 1



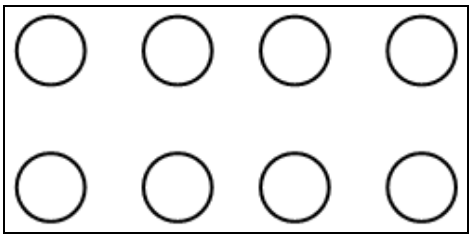
Iteration 2



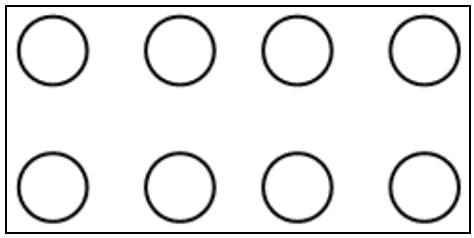
Iteration 3



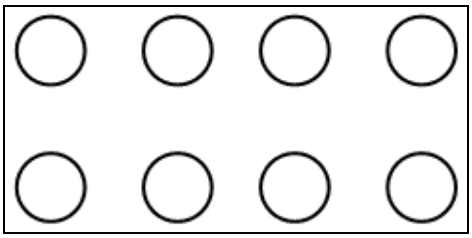
Iteration 4



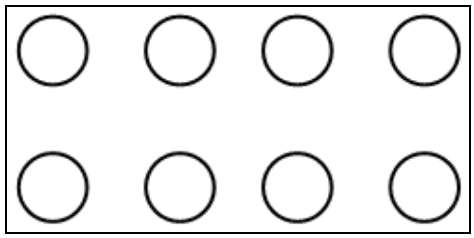
Iteration 5



Iteration 6



Iteration 7



Maximum Weight Spanning Tree

Sum of the weights of the Maximum Weight Spanning Tree: _____