Exam Computational Thinking

Course code: X_400475

Date: 08 January 2015

Time: 18.30-21.15u

Remarks

a) You are not allowed to use such devices as calculator, mobile, or similar.
b) Motivate your answer for each question.
c) Submit your exam questions and your answers to the supervisor.
d) You may answer the questions in Dutch or English.

Scoring

Question	Points
1a	5
1b	5
1c	5
2a	8
2b	5
3a	11
3b	5
4	10
5a	5
5b	11
5c	5
5d	10
5e	5
6	10

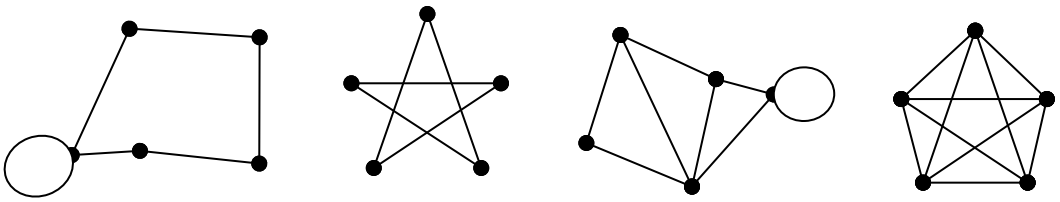
Grade = (total points) /10

Good luck!

1)

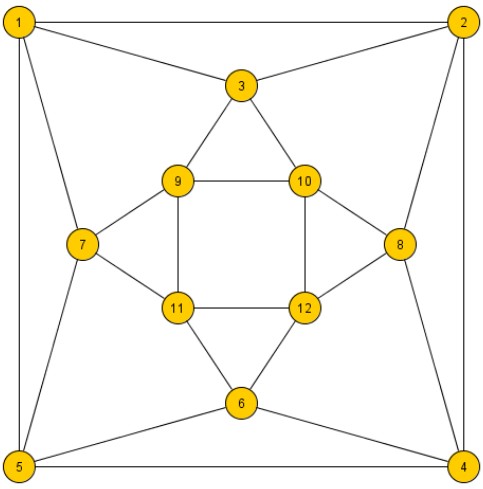
a) What is a Hamiltonian cycle?

b) Which of the following graphs contain a Hamiltonian cycle? Explain your answer.



A **B** **C** **D**

c) Find two Hamiltonian cycles in the following graph.



2) There are four people who want to cross a bridge; they all begin on the same side. It is night, and they have one flashlight. A maximum of two people can cross the bridge at one time. Any party that crosses, either one or two people, must have the flashlight with them. The flashlight must be walked back and forth; it cannot be thrown, for example. However, the batteries in the flashlight will last for only 18 minutes. Everyone walks at different pace: Person 1 takes 1 minute to cross the bridge, person 2 takes 2 minutes, person 3 takes 5 minutes, and person 4 takes 10 minutes. A pair must walk together at the rate of the slower person's pace. For example, if person 1 and person 4 walk across first, 10 minutes elapsed when they get to the other side of the bridge. If person 4 returns the flashlight, a total of 20 minutes have passed.

a) What is the minimal time (in minutes) for all the four people (together) to cross the bridge? Explain your answer.

b) Explain which solution strategy you used?

3) Consider the following sequence.

4	15	26	36	38	48	55	76	77	88	90	92	101

a) Show how you search number 26 in the above sequence by using binary search.

b) Show that linear search is faster than binary search in this case.

4) Show by using merge sort how you can sort the following sequence.

3	9	6	7	5	4	1	8	2	10

5) Consider the following distance table.

	A	B	C	D	E	F	G
A	-	**11**	**17**	**13**	-	-	-
B	**11**	-	**7**	-	**21**	**15**	**19**
C	**17**	**7**	-	**9**	**5**	-	-
D	**13**	-	**9**	-	**8**	-	-
E	-	**21**	**5**	**8**	-	**10**	**9**
F	-	**15**	-	-	**10**	-	**2**
G	-	**19**	-	-	**9**	**2**	-

a) Name three properties of the graph that is represented by the distance table.
Motivate your answer.

b) Show by means of the Dijkstra's algorithm what the shortest path is from A to G.

c) Is there another shortest path (with the same length) possible from A to G? If so, show the path.
Motivate your answer.

d) Determine the minimum spanning tree for the graph that is represented by the distance table?
Motivate your answer.

e) What is the weight of that minimum spanning tree?

6) The time taken by a particular algorithm for all its inputs of the size *n* is given by $23n^4 + 6n + 10$.
What is the time complexity of this algorithm?