

Algoritmer och datastrukturer DV2,

Exam August 2007

Rules:

1. No textbook. 2. You are allowed to bring one paper with notes; that paper must be handed in together with your answers. 3. Write clear answers. 4. Answer at most one question per sheet. 5. Only write on one page per sheet. 6. Think! 7. Good luck!

NOTE: Apart from this exam, there will also be an oral exam, so please contact Arne Andersson 0733 66 55 15 in order to make an appointment.

Name:

Personnr:

Mark which questions you have answered:

Question	Answered?	Grade
1		
2		
3		
4		
5		
6		
7		
8		
TOTAL		

1. Arrange the functions below in increasing order according to asymptotic growth.

n^n , $\frac{\log \log n}{\log n}$, $\sqrt{\sqrt{n}}$, n^2 , $\log n$, $n^{\log n}$, $\sqrt{\log n}$

2p

2. The Fibonacci numbers are defined as follows::

$$F_0 = 1, F_1 = 1, F_i = F_{i-1} + F_{i-2}$$

- a) Write the first 10 Fibonacci numbers 1p
- b) Write in pseudo-code an algorithm that uses dynamic programming to compute the first n numbers. Furthermore, analyze the complexity of reporting the first n Fibonacci numbers. 2p

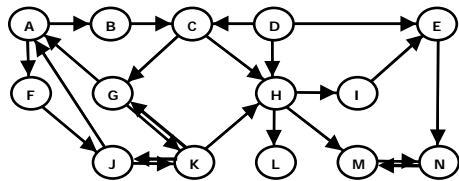
- 3.
- a) We all know that binary search among n elements take $O(\log n)$ time. Write the recurrence equation for binary search! 2p
 - b) Solve $T(n) = T(n/2) + n$, $T(1) = 1$. Explain the solution! 2p

4. We search for the pattern ABAABC in a long text. Draw an automata that, once constructed, can be used to find all occurrences of the pattern in $O(n)$ worst-case time, n being the length of the text. 3p

- 5.
- a) Show the resulting Huffman Tree when using Huffman coding to compress the following string: 3p
 agbcbcbcdffbcbedcfcfcdffddcfcfcfcbfcbfffcbbfcbbcb
 bbbabbbbfabbab

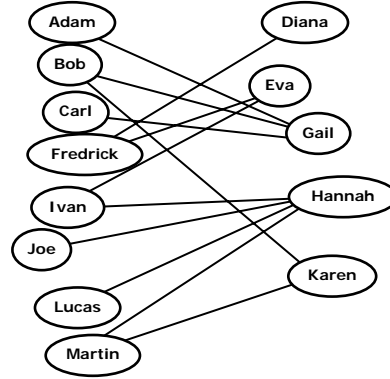
b) What is the length (in number of bits) of the encoded text (we do not include the space taken by representing the Huffman tree, just the encoded characters)? 1p

- 6.
- a) Show how the directed graph below is represented as an adjacency matrix 1p
 - b) Show how the directed graph below is represented as adjacency lists 1p
 - c) Write the nodes in the order they are visited during a breadth-first search, starting from A 2p



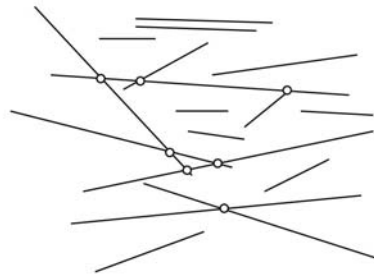
7. Suppose that in a group of single women and single men who desire to get married, each participant indicates who among the opposite sex would be acceptable as a potential spouse. This situation can be represented by a bipartite graph in which the vertex classes are the set of women and the set of men, and a woman x is joined by an edge to a man y if they like each other. The Marriage Problem, one version of it is: *What is the maximum number of marriages that can be arranged in this set of people, provided that a couple can only marry if the both like each other?*

Describe how this problem can be rephrased as a maximum flow problem.



3p

8. Describe an efficient *plane sweep algorithm* for reporting all intersection points in a set of line segments. Analyze the complexity of the described algorithm. In the example picture below, there are 7 intersections, all marked by circles.



3p