KTH Computer Science and Communication

Exam in DD2325 Applied Programming and Computer Science
DA7011 Programming and Computer Science for Physicists
2015-01-15, kl 14.00 – 18.00

No means of help allowed.

The grades are: E (7 points needed), D (11 points needed), C (15 points needed), B (19 points needed) and A (22 points needed). Bonus points (maximum 5bp) are converted to points (maximum 5p) on the exam.

1. Programming concepts (4 p)

Explain and give examples of the following concepts:

a) function

b) pointer

2. Sorting algorithm (4 p)

a) State two constraints for a binary tree to be a *binary heap*.

b) Describe the algorithm for *Heap sort* given a binary heap.

3. Fibonacci series (6 p)

The fibonacci series may be defined by:

$$f(n) = \begin{cases} 1, & n = 1 \\ 1, & n = 2 \\ f(n-1) + f(n-2) & \text{otherwise} \end{cases}$$

a) Write a recursive function in C for calculating the n'th Fibonacci number.

b) Show with an example and explain why the recursive solution is considered inefficient.

c) Write a function which is efficient.

4. Lists (6 p)

a) Choose and state the data structures and type definitions in C needed for a *linked list* of integers.

b) Make a sketch of a list with the integers: 9 17 26 33 using your data structures and type definitions.

c) Mention a couple of advantages of *linked lists* over *arrays*.

5. Huffman coding (5 p)

Three different encodings of the symbols a, b, c and d are shown in the table.

a_i	$c_1(a_i)$	$c_2(a_i)$	$c_3(a_i)$
a	1000	0	0
b	0100	10	1
c	0010	110	00
d	0001	1110	11

a) For each of the symbol codes how is $acbd$ encoded?

b) One of the code sets is not very useful. Which one and why?

c) Write the binary tree for the encoding c_2.

d) Briefly describe the purpose of Huffman coding.

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