KTH Computer Science and Communication

Exam in DD2325 Applied Programming and Computer Science
DA7011 Programming and Computer Science for Physicists
2016-01-11, kl 14.00 – 18.00

No means of help allowed.

The passing grades are: E (7 points needed), D (11 points needed), C (15 points needed), B (19 points needed) and A (23 points needed).

The lab bonus points are converted to points (maximum 5 points) on the exam for upgrading unless the grade is F.

1. Sorting algorithm (4 p)

a) Describe and write the algorithm for Merge sort.

b) Show how the numbers 3 8 1 9 6 7 are sorted according to the Merge sort algorithm.

2. Pointer and scope (4 p)

Consider the following program.

```
# include <stdio.h>

void func(int a, int *b, int c){
  a = a + 100;
  *b = *b + 200;
  c = c + 300;
  printf("2nd printout: %d %d %d \n", a, *b, c);
}

main(){
  int a = 10, *b, c = 30;
  b = &a;
  printf("1st printout: %d %d \n", a, *b);
  func(c, &a, *b);
  printf("3rd printout: %d %d %d \n", a, *b, c);
}
```

a) What are the two values printed as the 1st printout?

b) What are the three values printed as the 2nd printout?

c) What are the three values printed as the 3rd printout?

3. 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: 17 9 33 42 using your data structures and type definitions.

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

4. Abstract Data Types (ADTs) (4 p)

Answer the following questions regarding Abstract Data Types (ADTs).

a) What is a `stack`? Include at least two operations that characterise it in your explanation.

b) What are the differences between a `queue` and a `tree`?

5. Huffman coding (7 p)

Imagine that you would like to represent a message `MISSISSIPPI` in Huffman binary code.

a) Draw a Huffman tree for encoding the symbols in the message.

b) Suggest a code word for each symbol.

c) How many bits are required in total?

d) How does the length in c) compare with ASCII (using a byte)?

e) Briefly summarise the purpose of Huffman coding.