

## Self-Assessment Questions (Computer Science)

1) Write down the disjunctive normal form (DNF) for the Boolean XOR-function. Transform this formula into a conjunctive normal form (KNF) using the distributive laws of a Boolean algebra!

2) Complete the following recursive function definition (in Java). The function *toString* should return a string with the decimal representation of *x*. (e.g., *toString*(-163) = "-0163").

```
String[] digits = {"0","1","2","3","4","5","6","7","8","9"};
static public String toString(int x) {
    if (x == 0) { return "0"; }
    else { if (x < 0) {return "-" + toString( <SOLUTION1> ); }
          else {
              String digit = <SOLUTION2>;
              return toString(<SOLUTION3>) + digit; }
    }
}
```

3) Modify the definition of the function *toString* such that it uses a loop instead of recursion. The result of the function should remain unchanged.

```
String[] digits = {"0","1","2","3","4","5","6","7","8","9"};
public static String toString(int x){
    String result = < SOLUTION1>;
    String sign = "0";
    < SOLUTION2>
    while (<SOLUTION3>){
        < SOLUTION4>
    }
    return sign + result;
}
```

4) What is the running time in big O notation for the following methods depending on the length of the list *l*? Derive your answer step-by-step:

(10 min)

```
class IntList {
    public int head;
    public IntList tail;
    IntList(int head, IntList tail) { this.head = head; this.tail = tail; }
}

public static IntList append(IntList l, int x) {
    return (l == null) ? new IntList(x, l) : new IntList(l.head, append(l.tail, x));
}

public static IntList reverse(IntList l) {
    return (l == null) ? l : append(reverse(l.tail), l.head);
}
```

5) Let *n* be the number of leaves in a binary tree *T*. What is the minimum number of inner nodes in *T*?

6) How many KB memory does it take to hold a bit vector representation of the set of prime numbers less than 1.000.000?

- 7) Construct a binary search tree by inserting the sequence of keys H, T, M, D, V, G. The nodes of the search tree are ordered based on alphabetical order.
- 8) Why does one use queues and not stacks as data structures to collect pending service requests for process scheduling?
- 9) Draw a Petri-Net with two producers and two consumers which communicate using a common buffer with capacity 5!
- 10) Name one example for a simple data type and one example for a structured data type.