

# Midterm Examination 1

## GEM 1501: Problem Solving for Computing

14.02.2007, 12.00-12.30h

Matriculation Number: 6516-2759

### Rules

Each correct question, 1 mark. Maximum score: 12 marks.  
Programming Language for Questions 7–12 is JavaScript.

**Question 1.** Computers are used for problem solving. One of such problems is find solutions to logical conditions. In the following problem, the logical variables  $x_1, x_2, x_3, x_4, x_5$  occur. Find a solution such that all five statements listed is true. For example, if  $x_1, x_2$  are true and  $x_3, x_4, x_5$  are false, then this would not be a solution since the second condition is false. Recall,  $\wedge$  means “and”,  $\vee$  means “or” and  $\neg$  means “not”. Here the conditions.

- $x_1 \vee x_2 \vee x_3$ ;
- $\neg x_2 \wedge \neg x_3$ ;
- $x_3 \vee \neg x_3$ ;
- $x_3 \vee x_4$ ;
- $(x_1 \wedge \neg x_2 \wedge x_5) \vee (x_2 \wedge x_3 \wedge \neg x_5)$ .

Give the solution here:

The following variables are true:  $x_1, x_4, x_5$  ;  
the following variables are false:  $x_2, x_3$  .

**Question 2.** Which two of the following sorting algorithms are of the type “divide and conquer”?

bubble sort;     merge sort;     pivot sort.

**Question 3.** Punch cards are cards with holes used to control machines or store data. Which of the following technologies apply punch cards? Check the appropriate three out of the five boxes.

- Abacus (for counting and computing) from the old Chinese and Romans;
- Jacquards weaving loom from 1801;
- First railway near London in 1803;
- Tabulating machines for American census in 1890;
- Early electronic digital computers around 1950–1960.

**Question 4.** Answer the following questions:

OL: Which programming language is the oldest (among those still in use)?

EP: Which famous language was invented for education purposes only?

SP: Which is one of the pioneering languages for structured programming?

VO: Which language is specialized on vector- and tensor operations?

Please tick that line where all answers are correct.

- |  |              |              |             |
|--|--------------|--------------|-------------|
| <input type="checkbox"/> OL: APL,                | EP: PASCAL,  | SP: FORTRAN, | VO: COBOL;  |
| <input type="checkbox"/> OL: APL,                | EP: BASIC,   | SP: C,       | VO: PASCAL; |
| <input type="checkbox"/> OL: BASIC,              | EP: LISP     | SP: PASCAL,  | VO: APL;    |
| <input type="checkbox"/> OL: BASIC,              | EP: PASCAL,  | SP: C,       | VO: APL;    |
| <input checked="" type="checkbox"/> OL: FORTRAN, | EP: BASIC,   | SP: PASCAL,  | VO: APL;    |
| <input type="checkbox"/> OL: FORTRAN,            | EP: PASCAL,  | SP: LISP,    | VO: COBOL;  |
| <input type="checkbox"/> OL: PASCAL,             | EP: BASIC,   | SP: FORTRAN, | VO: COBOL;  |
| <input type="checkbox"/> OL: PASCAL,             | EP: FORTRAN, | SP: BASIC,   | VO: LISP.   |

**Question 5.** What are (a) correctness, (b) specification and (c) verification? Write the words into the corresponding definitions:

(1) Verification means the process to prove formally that a programme is correct.

(2) Correctness means that a programme always terminates and always produces the output given in the specification.

(3) Specification means the process to write down formally what a programme has to do and which inputs are legal.

**Question 6.** Check those two of the following statements which are correct:

- $2n^3 \in O(n^2)$ ;      $2n^3 \in O(n^3)$ ;      $2n^3 \in O(n^4)$ ;      $2n^3 \in O(\log(n))$ .

**Question 7.** The following function should evaluate the binary number stored in the input string x. For example, the binary value of “000” is 0, of “11” is 3 and of “1010” is 10. Complete the programme of the function.

```
function binaryvalue(x)
{ var y = 0; var z = x.length; var u = 1; var k;
  while(z>0)
    { z = z-1;    // << update the loop-variable
      if (x.charAt(z) == "1") { k=1; } else { k=0; }
      y = y+u*k; // << u carries the correct power of 2;
      u = u+u; } // << u = u*2; also possible
  return(y); }
```

**Question 8.** Complete the three underlined statements of the function binaryprint. This function should print out an integer number in binary format, so input ten should give the output “1010”.

```
function binaryprint(x)
{ var y; var z;
  if (x==0) { document.write("0"); }
  else if (x==1) { document.write("1"); } // << print digit "1"
  else if (x>1) { y = x%2; z = Math.floor(x/2);
    binaryprint(z); binaryprint(y); } // << print digits in correct order
  else { document.write("-"); binaryprint(-x); }
  return; }
```

**Question 9.** Find the syntax errors in this function to compute  $5^n$ .

```
function poweroffiwe(n) // Users can call functions as they want
{ int m = 1; int k; // Wrong: Java Script variables do not have types !!
  for (k=1 to n;k=k+1) // Should be: for (k=1;k<=n;k=k+1) { m = m*5; }
    { m = m*5; } // update value of m
  return(m); }
```

Select the adequate error-report for this programme (check one line only):

- Function name misspelled and for-loop incorrect;
- Variable-declaration and for-loop incorrect;
- Variable-declaration incorrect and comment improperly marked;
- Only for-loop incorrect, should have two semicolons in third line;
- Programme syntactic correct, but result will be wrongly computed.

**Question 10.** Write a function which computes  $1^3 + 2^3 + 3^3 + \dots + n^3$  on input  $n$ .

```
function sum(n)
  { var m=0; var k;

      for (k=n;k>0;k=k-1)
        { m = m+k*k*k; }

      return(m); }
```

**Question 11.** Complete the following programme to find the smallest factor of a number.

```
function factorfind(x)
  { var y = 1;
    do
      { y = y+1;

        if ( (x%y) == 0 ) { return(y); } }
      // "%" computes the remainder, brackets optional

    while (y*y<x);
  return(x); }
```

**Question 12.** Determine what the following function does and check the appropriate formula. The input  $n$  is always a natural number.

```
function ff(n)
  { var m=n; var k;
    for (k=0;k<n;k=k+1)
      { m=k+m+k; }
    return(m); }
```

Which is the correct formula for  $ff(n)$ ?

$n$ ;      $\frac{n(n-1)}{2}$ ;      $n^2$ ;      $2n^2 + n$ ;      $\frac{n(n-1)(n-2)}{6}$ ;      $n^3$ .