Midterm Examination 1
GEM 1501: Problem Solving for Computing

14.02.2007, 12.00-12.30h

Matriculation Number: _____

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

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: _____;
the following vairables are false: _____.

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;
- ☐ Jaquards 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 eduction 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.

☐ OL: APL,	EP: PASCAL,	SP: FORTRAN,	VO: COBOL;
☐ OL: APL,	EP: BASIC,	SP: C,	VO: PASCAL;
☐ OL: BASIC,	EP: LISP	SP: PASCAL,	VO: APL;
☐ OL: BASIC,	EP: PASCAL,	SP: C,	VO: APL;
☐ OL: FORTRAN,	EP: BASIC,	SP: PASCAL,	VO: APL;
☐ OL: FORTRAN,	EP: PASCAL,	SP: LISP,	VO: COBOL;
☐ OL: PASCAL,	EP: BASIC,	SP: FORTRAN,	VO: COBOL;
☐ 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) _____ means the process to prove formaly that a program is correct.

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

(3) _____ means the process to write down formaly 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 = __________________;
        if (x.charAt(z) == "1") { k=1; } else { k=0; }
        y = __________________;
        u = __________________; }
    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(_____); }
    else if (x>1) { y = x%2; z = Math.floor(x/2);
           binaryprint(_____); binaryprint(_____); }
    else { document.write("-"); binaryprint(-x); }
    return; }
```

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

```
function poweroffiwe(n)
  { int m = 1; int k;
    for (k=1 to n;k=k+1)
      { 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 $1^3 + 2^3 + 3^3 + ... + n^3$ on input n.

```
function sum(n)
  { var m=0; var 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 (____________________) { return(y); } }
      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.

Worksheet

Do not remove this sheet from the test.

You can use this sheet to do calculations, but you should write the answers into the space provided. Answers found here are not evaluated.