Midterm Examination 1
GEM 1501: Problem Solving for Computing

10.02.2006, 10.00-10.45h

Student Number: _____

Rules
All Questions are 12 Points, if there are several subquestions, marks are equally distributed on the answers to these.
Page 1: 24 marks _____, Page 2: 24 marks _____, Page 3: 36 marks _____, Page 4: 24 marks _____, Page 5: 12 marks, Total: 120 marks _____.

Question 1. Numbers can be represented in different bases where one uses n digits for basis n. The following are representations for fifteen, one hundred and two hundred fifty six in various bases.
Basis two (binary, digits $0, 1$): 1111, 1100100, 100000000.
Basis three (ternary, digits $0, 1, 2$): 120, 10201, 100111.
Basis five (quintary, digits $0, 1, 2, 3, 4$): 30, 400, 2011.
Basis ten (decimal, digits $0, 1, 2, 3, 4, 5, 6, 7, 8, 9$): 15, 100, 256.
What are the representations for the number nineteen in these four bases:
binary _____, ternary _____, quintary _____, decimal _____.
How is a unit of 8 bits (binary digits) called? _____.
A kilobit has 1024 bits. Why not 1000? _____
_____.

Question 2. Programming languages have keywords, for example the word "var" in the declaration `var x = 5;` is a key word. What are the Java Script keywords used in loops: _____, _____, _____.
Complete the keywords in the following loop:

```
var x=5; var y=5;
_________ { x=x+2; y=y-1; } ___________________(y>0)
```

What is the value of x after leaving the loop? _____

Question 3. Complete the below Java Script program below at the underlined places such that it computes the number $1 * 2 * ... * n$ where n is the value of the variable of the same name. It can be assumed that n is a positive integer. Use a for-loop.

```
__________ k = __________;
for(__________ = __________; m<=n; __________ = __________+__________) { k = k*m; }
__________.__________("The factorial of "+__________+" is "+__________+".<br>");
```

What is the output if n is 4? Please write the whole sentence:

_____.

Question 4. The following gives some sample codes to add up numbers from various programming languages. Please write the names of these langauges.

(a)
```
x:=5; y:=0;
for z:=0 to x do begin y:=y+z end;
writeln("The result is ",y,".");
```

The name of this programming language is _____.

(b)
```
x=5; y=0;
for (z=0;z<=x;z=z+1) { y=y+z; }
document.write("The result is "+y+".<br>");
```

The name of this programming language is _____.

(c)
```
x=5; y=0;
for (z=0;z<=x;z=z+1) { y=y+z; }
printf("The result is %d.\n",y);
```

The name of this programming language is _____.

(d)
```
10 I=5
20 J=0
30 J=J+I
40 I=I-1
50 IF (I) 60,60,30
60 PRINT *, 14HThe result is , J, 1H.
```

The name of this programming language is _____.
What is the output? Give the complete line printed:

_____

Which of the following commands was quite common in early programming languages but is now rare?

☐ For-loops; ☐ Goto-commands; ☐ If-commands; ☐ While-loops.

Question 5. Write the full names of the following acronyms of the names of programming languages:
APL stands for _____;
BASIC stands for _____;
COBOL stands for _____;
FORTRAN stands for _____.
Are there programming languages named after famous people? ☐ Yes; ☐ No.
What programming language is named after a coffee-brand and island? _____

Question 6. Consider the following function:

```
function f(a,i,j)
  { var k = i+Math.floor(0.5*(j-i));
    var u = 0;
    if (i+1 == j) { u = a[i]; }
    if (i+1 <  j) { u = f(a,i,k)+f(a,k,j); }
    return(u); }
```

Answer the following questions:
What is `Math.floor(2.8)`? _____.
The programmer of this function assumes that `a` is an array. In which line of the code does the programmer use a command which refers to arrays:
☐ first; ☐ fourth; ☐ fifth; ☐ there is no such line.
What is computed?
☐ The sum of some array elements; ☐ The product of some array elements.
Assume that `a` is an array of length `9` with all array-elements having the value `3`. Compute the following values: `f(a,3,5)` is _____, `f(a,4,7)` is _____.
How is the type of algorithm used called:
☐ Divide and Conquer; ☐ Greedy; ☐ Dynamic Programming.

Question 7. Complete the definition of the following function f such that

$$f(x,y,z) = \begin{cases} x^2+y^2 & \text{if } z<0; \\ xyz & \text{if } z>0; \\ 256 & \text{otherwise.} \end{cases}$$

in the following Java Script template.

```
function f(x,y,z)
  { var u =_____;
    if (_____) { u =_____; }
    if (_____) { u =_____; }
    return(_____); }
```

Question 8. Look at the following program:

```
function gcd(x,y);
  { var v = x; var w = y;
    while (v != w)
     { if (v>w) { v = v-w; }
       if (w>v) { w = w-v; } }
    return(v); }
```

This function implements the oldest nontrivial algorithm. How is this algorithm called: ☐ Abel's Algorithm, ☐ Euclid's Algorithm, ☐ Euler's Algorithm.
What is the syntax error in the above program:
☐ semicolon in first line; ☐ some variable undeclared;
☐ return-statement should not have a parameter.
Which value does gcd(400,1000) return? ☐ 8, ☐ 40, ☐ 200, ☐ 1000.
A faster variant uses the operator % instead of the substraction, $a\%b$ is called "the remainder of a divided by b" or just "a modulo b". What is 44%8? _____.
Complete in the following improved variant the while-condition and the statement after "else".

```
function fastgcd(x,y)
  { var v = x; var w = y;
    while (____________________)
     { if (v>=w) { v = v%w; } else  { w = __________; } }
    return(v+w); }
```

Question 9. Complete the following function digitsum which computes the digital sum, that is the sum of the digits of a number. So digitsum(222) is 6 and digitsum(128) is 11. The input x is a positive integer.

```
function digitsum(x)
  { var y;





    return(y)}
```

Question 10. Some discount airline offers flights, but only in one direction between each two cities.

PRICE TABLE	TO	AKL	BNE	CHC	JKT	HKG	KUL	MNL	SIN
FROM AKL	(Auckland)	--	20	20	80	190	80	170	250
BNE	(Brisbane)	--	--	20	60	190	80	170	200
CHC	(Christchurch)	--	--	--	80	80	200	200	250
JKT	(Jakarta)	--	--	--	--	90	200	90	200
HKG	(Hong Kong)	--	--	--	--	--	200	100	200
KUL	(Kuala Lumpur)	--	--	--	--	--	--	50	80
MNL	(Manila)	--	--	--	--	--	--	--	20
SIN	(Singapore)	--	--	--	--	--	--	--	--

A travel agent wants to offer optimal routes for her customers to come from various cities to Singapore with this airline. Find the cheapest way for each city to Singapore from this table. Do this by completing the below table which gives the costs and cheapest route for each of the cities. You can apply the method called dynamic programming to fill out the table (by hand), but at the end it is your choice. Some values are already prefilled.

Town	Costs	Route
AKL	_____	_____
BNE	_____	_____
CHC	_____	_____
JKT	_____	_____
HKG	120	HKG-MNL-SIN
KUL	070	KUL-MNL-SIN
MNL	020	MNL-SIN
SIN	000	– – –