

Practice exam Algorithmics

Monday 7 April 2014 13:00-16:00 K.Duppenhal

Instructions:

- Write your answers using the separate answer sheet. You will not require any loose paper.
- Please fill in the details on that sheet completely.
- Write clearly and neatly.
- The exam consists of **20 multiple choice questions**.
- All questions have the same weight.
- Unless stated otherwise, all questions just have one right answer.

NOTE: you must hand in the *complete* exam and the answer sheet.

Question 1.

The following values are given:

```
a = 1 : 2 : 3 ;  
a(3) = 9 ;
```

Which of the equations is true (select only one):

- a) `length(a) == 1`
- b) `length(a) == 3`
- c) `length(a) == 9`
- d) the statements result in an error message

Question 2.

The following values are given:

```
a = [1 2 3 5 8 13 21 34] ;  
b = find (a>=7) ;
```

Which of the equations is true:

- a) `b == [1 2 3 5]`
- b) `b == [8 13 21 24]`
- c) `b == [5 6 7 8]`
- d) `b == [1 2 3 4]`

Question 3.

The following function is given:

```
function ans = test (n)  
    if n == 0  
        ans = 'yes' ;  
    elseif n == 9 || n > 10  
        ans = 'maybe' ;  
    else  
        ans = 'no' ;  
    end  
end
```

alongside the following code fragment:

```
test (d)
```

For which value or values generated by the variable `d` is the result 'no' (select only one):

- a) ...-4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 10
- b) ...-4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
- c) ...-4, -3, -2, -1, 1, 2, 3, 4, 5, 6, 7, 8, 10
- d) ...-4, -3, -2, -1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Question 4.

The following code is given:

```
for a = 1:3:11
    b(a) = a
end
```

The result is (select only one):

- a) b == [1 4 7]
- b) b == [1 4 7 11]
- c) b == [1 0 0 4 0 0 7 0 0 10]
- d) b == [1 0 0 4 0 0 7 0 0 10 11]

Question 5.

Which of the following while loops produces the same result as the loop in question 4 (select only one):

- a)

```
a = 1 ;
while a <= 11
    b(a) = a ;
    a = a + 3 ;
end
```
- b)

```
a = 1 ;
while a <= 11
    b(a) = a ;
end
```
- c)

```
a = 1 ;
while a <= 11
    a = a + 3 ;
    b(a) = a ;
end
```
- d) None of the above

Question 6.

Given is:

```
i = 6 ;
while (i ~= 0)
    i = i - 3 ;
    a(i + 1) = i - 1 ;
end
```

Which of the following is true? (select only one)

- a) After this loop has finished, a has value [0 2]
- b) After this loop has finished, a has value [-1 0 0 2]
- c) After this loop has finished, a has value [-1 0 0 2 0 0 5]
- d) The loop never finishes.

Question 7.

Someone writes the following function:

```
function [value, number] = X ( a , b)
    loc = length(a) ;
    number = 0 ;
    while (loc > 0)
        if (a(loc) == b)
            number = number + 1 ;
        end
        loc = loc - 1 ;
    end
    value = number > 0 ;
end
```

Which of the following is **not true** when calling this function with `[w,p]=X(a,b)` (select only one):

- a) If `w == true` then `b` is present as a value in `a`
- b) If `w == true` then `a(p) == b`
- c) If `w == false` then `p == 0`
- d) If `b` is not present in vector `a`, then `w == false`

Question 8.

The following values are given:

A = true

B = false

Determine the value of each of the following expressions:

E1 = (A || B) && (A || B)

E2 = (~ (A && B)) || (A && B)

E3 = (~A || B) && (A && B)

Which of the following is correct (select only one):

- a) E1 == true E2 == true E3 == false
- b) E1 == true E2 == true E3 == true
- c) E1 == true E2 == false E3 == false
- d) E1 == false E2 == true E3 == true

Question 9.

Consider the following matrix multiplication:

$$R = \begin{bmatrix} 1 & 2 \\ 7 & 6 \end{bmatrix} * \begin{bmatrix} 9 & 2 \\ 1 & 0 \end{bmatrix}$$

What is the correct result? (Select only one)

- a) $R = \begin{bmatrix} 2 & 11 \\ 14 & 69 \end{bmatrix}$
- b) $R = \begin{bmatrix} 11 & 69 \\ 2 & 14 \end{bmatrix}$
- c) $R = \begin{bmatrix} 14 & 11 \\ 2 & 69 \end{bmatrix}$
- d) $R = \begin{bmatrix} 11 & 2 \\ 69 & 14 \end{bmatrix}$

Question 10.

Consider (N*N) matrices A, B and C with $A * B = C$. Assume that the inverse matrices of A, B and C exist. Which of the following statements is **not** correct (select only one):

- a) $C * A * B = C * C$
- b) $B = A^{-1} * C$
- c) $B = C * A^{-1}$
- d) $C * A * B * C^{-1} = C$

Question 11.

Which of the following matrices does have an inverse? (Select only one)

- a) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
- b) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$
- c) $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$
- d) $\begin{bmatrix} 1 & 5 \\ 3 & 15 \end{bmatrix}$

Question 12.

Consider the following matlab function:

```
function result = rf1(N)
    if N==0
        result = 1;
    else
        result = N * rf1(N+1);
    end
```

Which of the following requirements for recursive functions has not been met?
If all requirements are met, check option IV. (Select only one answer)

- a) A recursive function evokes itself or a clone of itself
- b) There is an end-condition which ends the recursive process
- c) This end-condition must be met eventually
- d) All the requirements have been met

Question 13.

Assume the following recursive matlab function:

```
function result = rf2(N)
    if N==0
        result = 1;
    else
        result = N * rf2(N-2);
    end
```

Which of the following results **cannot** be achieved with this function (select only one):

- a) $\text{rf2}(4) == 8$
- b) $\text{rf2}(3) == 3$
- c) $\text{rf2}(0) == 1$
- d) $\text{rf2}(2) == 2$

Question 14.

The sum of the first n integers is:

$$fs(n) = \sum_{j=1}^n j$$

Which of the following matlab functions calculates the sum of the first n integers correctly? (Select only one)

- a)

```
function result=fs(n)
    if (n==0)
        result = 1;
    else
        result = n + fs(n-1);
    end
```
- b)

```
function result=fs(n)
    result = sum(0:n-1);
end
```
- c)

```
function result=fs(n)
    result=0;
    for i=1:n
        result = result + i;
    end
```
- d)

```
function result=fs(n)
    if (n==1)
        result = 1;
    else
        result = result + fs(n-1);
    end
```

Question 15.

Assume that the $f(x_i)$ function values are known for a series of equidistant arguments x_i with $i = 1, 2, \dots, n$. Consider the following integral: $K = \int_a^b f(x)dx$

Which of the following statements concerning this integral is **not** true (select only one):

- a) The trapezoidal rule for numerical integration corresponds to a piecewise linear approximation of the function f
- b) The trapezoidal rule for numerical integration corresponds to a piecewise cubic approximation of the function f
- c) The cumulative sum `cumsum` can be used to calculate K as a function of the upper limit b
- d) The approximation of K is, in general, more accurate if the distances between the successive points $|x_{i+1} - x_i|$ are smaller

Question 16.

Assume that the $f(x_i)$ function values are known for a series of arguments x_i with $i = 1, 2, \dots, n$.

Which of the following expressions **does not** approximate the first derivative of the f function in x_i ? (Select only one):

- a) $\frac{f(x_{i+1}) - f(x_i)}{x_{i+1} - x_i}$
- b) $\frac{f(x_i) - f(x_{i-1}))}{x_i - x_{i-1}}$
- c) $\frac{f(x_{i+1}) - f(x_{i-1}))}{2(x_{i+1} - x_{i-1})}$
- d) $\frac{f(x_{i+1}) - f(x_{i-1}))}{x_{i+1} - x_{i-1}}$

Question 17.

Consider the values $a = [1, 2, 3, 4, 5]$

Which of the following matlab outputs is **not** correct? (Select only one)

- a)

```
>> size(cumsum(a))
ans =
      1      5
```
- b)

```
>> size(diff(a))
ans =
      1      5
```
- c)

```
>> diff(diff(a))
ans =
      0      0      0
```
- d)

```
>> sum(a)
ans =
     15
```


Question 18.

Which of the following options is true? (Select only one)
Matlab represents true-colour images as

- a) Complex data structures that are dependent on the input values
- b) Binary trees with colour branches
- c) Two-dimensional arrays of the `color` type
- d) Three-dimensional arrays of the `uint8` type

Question 19.

Which of the following options is true? Select only one:
The command `nv(mask) = w(mask)`

- a) Places a colour map with the name `mask` over the arrays `nv` and `w`
- b) Allocates the values of the elements of `w` to the respective elements of `nv` for the values of the indices for which `mask` is `true`
- c) Deletes all elements of `nv`
- d) Reads the values of an image in a file with the name `mask`

Question 20.

Matlab provides the function `polyfit(x, y, k)`
Which of the following statements is correct? (Select only one)

- a) The argument `k` specifies the length of the lists `x` and `y`
- b) `x` and `y` must have the same size
- c) The output of the function is `'true'` or `'false'`
- d) The function draws a polygon that connects the points `x, y` by straight lines

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Answers:

question	Right answer
1	B
2	C
3	C
4	C
5	A
6	B
7	B
8	A
9	D
10	C
11	A
12	C
13	B
14	C
15	B
16	C
17	B
18	D
19	B
20	B