

First exam Algorithmics

30 March 2016

Answers:

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

Question 1.

The following values are given:

`a = 9 : -3 : 0 ;`

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

- a) `a(1) == 0`
- b) `a(2) == 6`
- c) `a(4) == 9`
- d) `length(a) == 3`

Question 2.

The following values are given:

`a = [1 1 2 3 5 8 13 21 34 55 89] ;`
`b = find (a>4) ;`

Which of the equations is true:

- a) `b == [5 6 7 8 9 10 11]`
- b) `b == [0 0 0 0 1 1 1 1 1 1 1]`
- c) `b == [5 8 13 21 34 55 89]`
- d) `b == []`

Question 3.

The following function is given:

```
function ans = test (n)
    if n > 0
        ans = 'no way' ;
    elseif n < 10 && n > -10
        ans = 'ok' ;
    else
        ans = 'may be' ;
    end
end
```

alongside the following code fragment:

```
test (d)
```

For which set of values generated by the variable `d` is the result 'ok' (select the largest possible set):

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

Question 4.

The following code is given:

```
for a = 2:2:2
    b(a) = a + 1 ;
end
```

The result is (select only one):

- a) b == [3]
- b) b == [0 2]
- c) b == [0 3]
- d) b == [0 0 3]

Question 5.

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

- a)

```
a = 2 ;
while a <= 2
    b(a) = a + 1 ;
end
```
- b)

```
a = 2 ;
while a <= 2
    b(a) = a + 1 ;
    a = a + 2 ;
end
```
- c)

```
a = 2 ;
while a <= 2
    a = a + 2 ;
    b(a) = a ;
end
```
- d) None of the above

Question 6.

Given are two functions:

```
function result = f(n)
    if (n==1)
        result = 1;
    else
        result = n * f(n-1);
    end
end
```

```
function result = g(n)
    result = 1 ;
    for i=1:n
        result = result * i;
    end
end
```

Which of the following is **not** true? (select only one)

- a) $f(1) == g(1)$
- b) $f(2) == 2$
- c) $g(0) == 1$
- d) $f(0) == 1$

Question 7.

Reconsider the functions from question 6. Which of the following is **not** true? (select only one)

- a) the functions f and g return the same value for each integer $n > 0$
- b) the function call $f(-1)$ will return an error in Matlab
- c) the function call $g(-1)$ will return an error in Matlab
- e) $f(2) == g(1) + 1$

Question 8.

Someone writes the following function:

```
function [yn, s] = X (a , b)
    yn = false ;
    s = length(a) ;
    while (s > 0) && ~yn
        if (a(s) == b)
            yn = true ;
        else
            s = s - 1 ;
        end
    end
end
```

After calling this function with

```
[w,p] = X( [1 2 2 3 4 5] , 2 )
```

which of the following is **true** (select only one):

- a) $w == \text{false}$
- b) $p == 2$
- c) $p == 3$
- d) $p == 6$

Question 9.

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

Question 10.

Consider the following matlab function:

```
function result = h(N)
    if N<=1
        result = 1;
    else
        result = h(N-1) + h(N-2) + 1 ;
    end
```

Which of the following requirements for recursive functions has not been met?
If all requirements are met, check option **d**). (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 11.

Consider the following matrices:

$$A = \begin{bmatrix} 2 & 1 \\ 1 & 6 \end{bmatrix} \quad B = \begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix}$$

What is the correct result of the multiplication $R = A .* B$ in matlab? (Select only one.)

- a) $R = \begin{bmatrix} -3 & 1 \\ -7 & 6 \end{bmatrix}$
- b) $R = \begin{bmatrix} 3 & -3 \\ 7 & -7 \end{bmatrix}$
- c) $R = \begin{bmatrix} 3 & 7 \\ -3 & -7 \end{bmatrix}$
- d) $R = \begin{bmatrix} 2 & -1 \\ 1 & -6 \end{bmatrix}$

Question 12.

Consider the matrix $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$. Which of the following statements is true?
(Select only one)

- a) all column vectors of the form $\begin{bmatrix} a \\ b \end{bmatrix}$ with arbitrary a, b are eigenvectors of A
- b) A is the identity matrix given as `eye(2)` in matlab.
- c) A does have a well defined inverse.
- d) One eigenvalue of A is 0 (zero).

Question 13.

Which of the following matrices does have a well-defined inverse? (Select only one)

- a) $\begin{bmatrix} 1 & 3 \\ 1 & 3 \end{bmatrix}$
- b) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
- c) $\begin{bmatrix} 6 & 2 & 4 \\ 5 & 3 & 4 \end{bmatrix}$
- d) $\begin{bmatrix} 5 & 1 \\ 0 & 0 \end{bmatrix}$

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

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

```
function result=fs(n)
    result=1;
    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 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 quadratic approximation of the function f
- c) The cumulative sum `cumsum` can be used to estimate K only for polynomial functions of degree n .
- d) The approximation of K is, in general, more accurate if n is smaller (for given limits a and b)

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** give a proper approximation of the first derivative of the f function in x_i ? (Select only one):

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

b)
$$\frac{f(x_{i-1}) - f(x_i)}{x_{i-1} - x_i}$$

c)
$$\frac{f(x_{i+1}) - f(x_{i-1}))}{(x_{i+1} - x_{i-1})}$$

d)
$$\frac{f(x_{i+1}) - f(x_i)}{x_{i+1} - x_i}$$

Question 17.

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

Which of the following matlab outputs is correct? (Select only one)

a) `>> size(cumsum(a))`
`ans =`
1 4

b) `>> size(diff(a))`
`ans =`
1 5

c) `>> diff(diff(a))`
`ans =`
0 0 0

d) `>> diff(cumsum(a))`
`ans =`
3 4 5 6

Question 18.

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

- a) Text files describing the image content in words
- b) Binary trees with coloured branches
- c) Four-dimensional matrices of the `color` type
- d) Three-dimensional arrays of the `uint8` type

Question 19.

Consider the unsigned integers `j=uint8(250)` and `k =uint8(10)` in Matlab.
When entering `j+k` in Matlab, which of the following results is the correct one?
If you expect an error message, select (d). (Select only one answer.)

- a) `ans = 5`
- b) `ans = 255`
- c) `ans = 260`
- d) Undefined function for input of type '`uint8`'.

Question 20.

Matlab provides the function `plot`. Consider the command `plot(x,y,'kx')`
Which of the following statements is correct? (Select only one)

- a) `k` determines the color of the displayed symbols
- b) `x` and `y` must be equal
- c) The command plots a polynomial $y(x)$ of order `k`
- d) The command plots a linear function $y=k \cdot x$