Information units

1 bit – elementary unit
1B (Byte) = 8 bits
1KB (KiloByte) = 2^{10} B (1024 B)
1MB (MegaByte) = 2^{10} KB (1024 KB)
1GB (GigaByte) = 2^{10} MB (1024 MB)
1TB (TeraByte) = 2^{10} GB (1024 GB)

Information units

1 Kbit (Kilobit) = 2^{10} bits = 1024 bits
1 Mbit (Megabit) = 2^{10} Kbits (1024 Kbits)
1 Gbit (Gigabit) = 2^{10} Mbits (1024 Mbits)
1 Tbit (Terabit) = 2^{10} Gbits(1024 Gbits)

Conversion table

octal	binary
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

Table of powers of number 2

$2^0 = 1$		
$2^1 = 2$	$2^9 = 512$	$2^{-1} = 0,5$
$2^2 = 4$	$2^{10} = 1024$	$2^{-2} = 0,25$
$2^3 = 8$	$2^{11} = 2048$	$2^{-3} = 0,125$
$2^4 = 16$	$2^{12} = 4096$	$2^{-4} = 0,0625$
$2^5 = 32$	$2^{13} = 8192$	$2^{-5} = 0,03125$
$2^6 = 64$	$2^{14} = 16384$	$2^{-6} = 0,015625$
$2^7 = 128$	$2^{15} = 32768$	$2^{-7} = 0,0078125$
$2^8 = 256$	$2^{16} = 65536$	$2^{-8} = 0,00390625$

Conversion table

hexadecimal	binary	hexadecimal	binary
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

Tick the programming language which you will use to perform the problems proposed in the topics II and III:

❑ **Pascal** ❑ **C/C++**

Nr	Item	Score	
	Topic I. (25 points)		
1	**19** short films attended an ecology conference. The films titles were encoded using binary words of the same length. The **19** titles make up all the possible messages of a source of information. They were encoded using binary words of minimum length. a) Determine the minimum length of the binary words used for the unique encoding and decoding of all the messages of the given source. Tick in the third column of the answer table the rightness of the proposed codes of minimum length. Write the used formula: _____ Write the calculations performed to determine the minimum length of the binary words: Answer**:** Message / Code / Code rightness Film A / **101101** / ❑ Right ❑ Wrong Film B / **00111** / ❑ Right ❑ Wrong b) It is known that the amount of information of a film is equal to **4500 MB**, the frame rate is equal to **25** frames per second, and the amount of information of a frame is equal to **4 Mbits**. Determine and write in the answer space the duration in minutes of a film with the given characteristics. Write the used formula: _____ Write the calculations: Answer**: T = _____ minutes**	L 0 1 2 3 4 5 6 7 8 9	L 0 1 2 3 4 5 6 7 8 9
2	a) Let three numbers be given: $(172,2)_8$, $(122,5)_{10}$, $(6A,2)_{16}$. Write the given numbers in descending order in the space provided for the answer. Answer**: (_____)__ > (_____)__ > (_____)__** Write two conversions of given numbers from one numbering system to another: b) For each of the following statements tick the right answer: o The Roman numbering system is: ❑ Positional ❑ Non-positional o The number 8 belongs to the octal numbering system: ❑ True ❑ False	L 0 1 2 3 4 5 6 7 8 9	L 0 1 2 3 4 5 6 7 8 9

3	Let the logical function be given: $Y(x_1, x_2, x_3) = x_1 \,\&\, x_3 \vee \overline{x_2 \vee x_3}$ a) Draw the combinational circuit, which materializes the logic function Y:	b) Write the values of the logic function $Y(x_1, x_2, x_3)$ for each set of values of the independent variables: ○ **Y(0,1,0)= _____** ○ **Y(1,0,0)= _____** c) A right-to-left shift register is initially in state **1110**. Complete the table below with two consecutive states of the given register: *Time* | d_3 d_2 d_1 d_0 *initial* | 1 1 1 0 *t1* | _____ *t2* | _____	L 0 1 2 3 4 5 6 7	L 0 1 2 3 4 5 6 7
Topic II. (32 points)				

1	Let the declarations of variables in the **Pascal language** be given:
	`Var a, c: integer;  b : boolean;`
	Let the declarations of variables be given:
	`a := 5;  c := 16;  b := true;`
	and the expression: `(c mod a <> 3) and (not b or (3 + 2 * a > c))`
	a) In the following image each operator is accompanied by a data entry cassette. Write in the empty cassettes the distinct numbers that correspond to the order in which the given operations are performed.
	If there are several right solutions, present any of them.
	1 □ □ □ □ □ □ □
	`(c mod a <> 3) and (not b or (3 + 2 * a > c))`
	b) Write the type of the given expression: _____
	c) Calculate and write the value of the given expression: _____
			L 0 1 2 3 4 5 6 7 8 9	L 0 1 2 3 4 5 6 7 8 9

	Let the declarations of variables in the **C++ language** be given:
	`int a = 5, c = 16;  bool b = true;`
	and the expression: `(c % a != 3) && (! b || (3 + 2 * a > c))`
	a) In the following image each operator is accompanied by a data entry cassette. Write in the empty cassettes the distinct numbers that correspond to the order in which the given operations are performed.
	If there are several correct solutions, present any of them.
	1 □ □ □ □ □ □ □
	`(c % a != 3) && (! b || (3 + 2 * a > c))`
	b) Write the type of the given expression: _____
	c) Calculate and write the value of the given expression: _____			

2	a) The following program fragment in the **Pascal language**, where the variables **x** and **s** are of the **integer** data type, is given:
	`s := 0;`
	`while s < 100 do`
	`  begin`
	`  read(x);`
	`  if (x > 0) and (x mod 2 <> 0) then s := s + x`
	`  else write(x, ' ')`
	`  end;`
	`writeln; write(s);`
	Write in the space reserved below what the given program fragment will display if the following data sequence is entered: **-5 55 40 105 -60 77 0 200**
	_____
	_____
	b) Write in the space reserved below an **if** statement in **Pascal language** that will display the value **True** if a variable **c** of **char** type has the value **'+'** or **'-'**, otherwise the statement will display the value **False**.
	If there are several right solutions present any of them.
	a) The following program fragment in the **C++ language**, where the variables **x** and **s** are of the **int** data type, is given:
	`s = 0;`
	`while (s < 100)`
	`  {`
	`  cin >> x;`
	`  if (x > 0 && x % 2 != 0 ) s = s + x;`
	`  else cout << x << ' ';`
	`  }`
	`cout << endl; cout << s;`
	Write in the space reserved below what the given program fragment will display if the following data sequence is entered: **-5 55 40 105 -60 77 0 200**
	_____
	_____
	b) Write in the space reserved below an **if** statement in **C++ language** that will display the value **1** if a variable **c** of **char** type has the value **'+'** or **'-'**, otherwise the statement will display the value **0**.
	If there are several right solutions, present any of them.
		L
		0
		1
		2
		3
		4
		5
		6
		7
		8
		9
			L
			0
			1
			2
			3
			4
			5
			6
			7
			8
			9

3	The program **Pr3** from which some cod fragments are omitted is given.
	Complete the missing fragments so that the program reads integer numbers from the keyboard, calculates and displays the arithmetic mean of all the read numbers whose module is greater than **10**. The last number read from the keyboard will be **100**.
	If there are several correct solutions, present any of them.
	Pascal language
	`Program Pr3;`
	` var x, s, nr : integer;`
	`  ____ : real;`
	`begin`
	` s := 0;`
	` nr := ____ ;`
	` repeat`
	`  read( x );`
	`  if ______ ( x ) > 10 then`
	`  begin`
	`  s := s + _____ ;`
	`  nr := nr + _____ ;`
	`  end;`
	` until x __________ ;`
	`  m := s / nr ;`
	`  writeln( m );`
	`end.`
	C++ language
	`// Program Pr3`
	`#include <iostream>`
	`#include <cmath>`
	`using namespace std;`
	`int main()`
	`{`
	`  int x, s = 0, nr = ____ ;`
	`  float ____ ;`
	` do`
	`  {`
	`  cin >> x ;`
	`  if (_______ ( x ) > 10)`
	`  {`
	`  s = s + _____ ;`
	`  nr = nr + _____ ;`
	`  }`
	`  } while (x _________ );`
	`  m = s / nr;`
	`  cout << m ;`
	` return 0;`
	`}`
		L
		0
		1
		2
		3
		4
		5
		6
			L
			0
			1
			2
			3
			4
			5
			6

4	A natural number **n** - the number of the sides of a regular polygon is given. **Task**: Write a program that determines whether the **n**-sided regular polygon is a **triangle** or a **hexagon** and calculates in degrees the size of the angles of this regular polygon. **Input**. A natural number **n** is read from the keyboard. **Output**. A word will be displayed on the screen on the first line - **Triunghi** if **n = 3** or **Hexagon** if **n = 6**. On the second line will be displayed the size in degrees of the angles of the given regular polygon. **Note**. The size in degrees of the angles of the regular polygon with **n** sides is equal to: $$\frac{(n-2)\cdot 180}{n}$$	L 0 1 2 3 4 5 6 7 8	L 0 1 2 3 4 5 6 7 8

Topic III. (30 points)

1 **The following Pascal program is given:**

```
Program pr1;
Type tt = array [1..10] of integer;

var     t : tt;
        n : integer;

function w(x : integer): integer;
  var s, k : integer;
 begin
   s := 0;  k := 1;
   while k <= x do
     begin
        s := s + x div k;
        k := k + 1;
     end;
   w := s;
 end;

procedure q ;
  var i:integer;
 begin
  for i:=1 to n do
   begin
    if i mod 2 = 0 then t[i] := w(i)
                   else t[i] := sqr(i);

   write( t[i], ' ');
   end;
 end;

Begin
 n := 4;
 q ;
end.
```

Perform the following tasks for the program **pr1**:

a) Write the name of the structured data type variable used in the program **pr1**:

_____

b) Write all the values of the actual parameter in the calls of function **w** (separated by commas) used at the execution of the program **pr1**:

_____

c) Write the name of the subprogram which uses the global variables for communication:

_____

d) Write the name of the standard function used in the program **pr1**:

_____

e) Write what will be displayed in the result of executing the program **pr1**:

_____

L 0 1 2 3 4 5 6 7

L 0 1 2 3 4 5 6 7

The following C++ program is given:

```
// Program pr1
#include <iostream>
#include <cmath>
using namespace std;
 typedef int tt [10];
       tt t;
       int n;

int w( int x )
 {
  int s = 0, k = 1;

  while ( k <= x )
     {
        s = s + x / k;
        k ++;
     }
   return s;
 }

void q ()
 {
  int i;
  for (i = 1; i <= n; i++)
  {
    if ( i % 2 == 0 ) t[i] = w(i);
             else t[i] = pow( i, 2 );

   cout << t[i] <<' ';
  }
 }

int main()
{
 n = 4;
 q ();
 return 0;
}
```

Perform the following tasks for the program **pr1**:

a) Write the name of the structured data type variable used in the program **pr1**:

_____

b) Write all the values of the actual parameter in the calls of function **w** (separated by commas), used in the execution of the program **pr1**:

_____

c) Write the name of the function which uses the global variables for communication:

_____

d) Write the name of the standard function used in the program **pr1**:

_____

e) Write what will be displayed as a result of executing the program **pr1**:

_____

2

In the contest of mathematics, physics and computer science participated **n(1≤n≤30)** students. Each student has received an index from **1** to **n**. The students' results were assessed with a number of points for each of the three tests - mathematics, physics, computer science.

Task: Write a program that determines the index of the student with the maximum total score. The program will contain a subprogram named **DE**, which will receive as a parameter an integer **i** - a student's index and will return the total amount of points accumulated by that student.

Input: The text file `Exact.in` contains on the first line an integer **n(1≤n≤30)** – the number of students participating in the contest. Each of the following **n** lines contains **3** integers separated by space - the points accumulated by a student in three tests - mathematics, physics, computer science. The numbers in line **i+1** represent the scores of the student **i** in the competition tests.

Output: The text file `Exact.out` will contains in a line a single integer - the index of the student with the maximum total score.

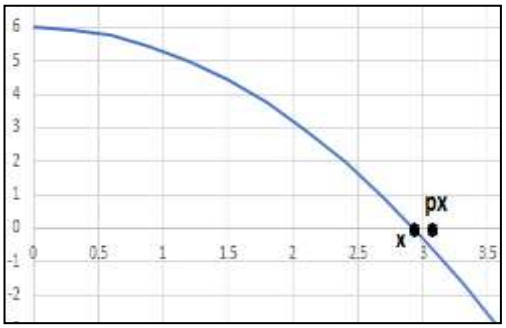
Note. It is known that only one student earned a maximum total score.

L 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

L 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Example:

Exact.in	Exact.out	**The solution will be appreciated for**: types and variable declarations; operations with the text files; reading and writing data; algorithm organization.
3 30 12 20 20 20 15 25 28 30	3	

3	A marine research probe was launched from a helicopter. When lowering the probe, it follows the trajectory described by the function $f(x) = -0{,}7\mathrm{x}^2 + 6$ on the segment $[a; b]$. Write a program that will determine the distance from the probe landing point **`x`** to the destination point with the coordinates **`(3,3; 0)`**. The program will calculate the abscissa of the probe landing point, solving the equation $f(x) = 0$ on the segment $[0; 3{,}5]$ by the **string method** for **`n=30`** divisions of the given segment, having the fixed extremity at point **`b=3,5.`** **Input**: The values of the extremities of the segment $[0;\ 3{,}5]$, the number of divisions **`n=30`** of the given segment and the abscissa **`px=3,3`** of the destination point are assigned directly in the program text. **Output**: A real number - the difference between **`px`** and the calculated abscissa of the probe landing point - is displayed on the screen.  **The following algorithm can be used to solve the equation:** **Step 0.** *Initialization:* a⇐0, b⇐3,5, n⇐30. **Step 1.** *Assignment:* e⇐b, x_0⇐a. **Step 2**. For all **`i`** from **`1`** to **`n`** calculate x_i according to the formula: $x_i \Leftarrow x_{i-1} - \frac{f(x_{i-1})}{f(e) - f(x_{i-1})}(e - x_{i-1})$	L 0 1 2 3 4 5 6 7	L 0 1 2 3 4 5 6 7

Topic IV. (13 points)

1 A database was created in the MS Access. Fragments of the tables of this database are shown in *Image 1*:

Plante

Cod_pl	Denumire	Cod_arb	Pret	Imagine	Stoc
P001	Hibiscus	A04	67,9	Package	☑
P002	Dafin	A04	78,3	Package	☐
P003	Artar rosu	A03	195,7	Package	☑
P004	Tuia	A01	150,5	Package	☑
P005	Magnolia	A02	210	Package	☐

Arbori

Cod_arb	Tip_arbore
A01	Ornamental
A02	Conifer
A03	Forestier
A04	Arbust

Comenzi

Cod_com	Cod_pl	Cantitatea	Data livrarii	Email_cumparator
1	P001	20	15.02.2022	parc10@gmail.com
2	P004	40	25.02.2022	parc10@gmail.com
3	P003	15	22.02.2022	izvor_ao@yahoo.com
4	P004	60	17.03.2022	izvor_ao@yahoo.com
5	P005	20	05.03.2022	decorfirm@mail.ru

Image 1

Using the data from the database tables:

a) Fill in all the necessary elements in *Image 2,* including the relations between the tables and define a parameter query in ***Design View*** mode that:

- displays data from three fields: *Denumire, Tip_arbore, Data livrarii;*
- displays data only about trees that are in stock (*Stoc* field)*;*
- the type of the trees is indicated as a parameter at the time of the query execution (*Tip_arbore* field)*;*
- sorts records ascending according to the date of delivery (*Data livrarii* field).

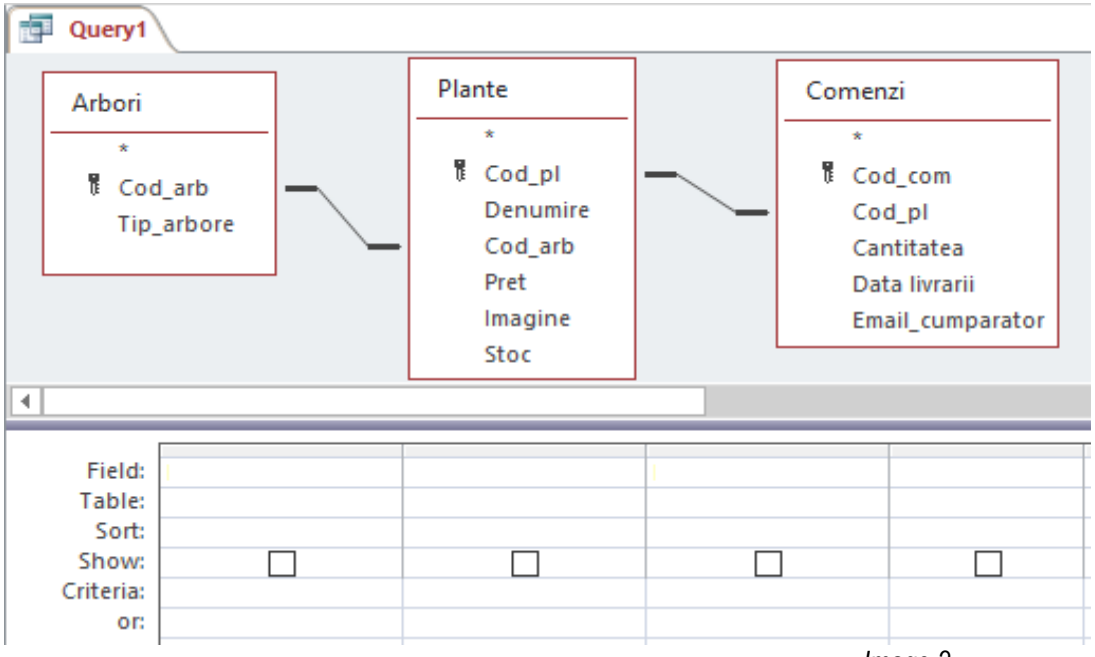


Image 2

b) For each type in the left column of the following table, write in the right column a field name whose data can correspond to the given type:

The field type	Field name
Number	
Ole Object	
Hyperlink	

L 0 1 2 3 4 5 6 7 8 9 10 11 12 13

L 0 1 2 3 4 5 6 7 8 9 10 11 12 13