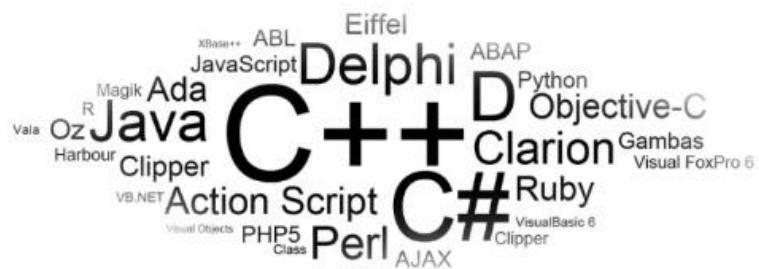


Laboratory works



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LABORATORY WORK №1

PROGRAMMING OF LINEAR AND BRANCHING ALGORITHMS

For implementation **ALL labs** you can use any C++ development system

DEV C++

Ms Visual studio

And any online system (more convient)

<https://www.jdoodle.com/online-compiler-c++/>

<https://replit.com/languages/cpp>

You can use C++ system for mobile devices -smartphone and tablet

The work consists of 2 parts

1. Programming of linear algorithms

The purpose of this work is to study the methods of programming linear and branching algorithms.

Assignment for self-learning

1. To study methods of writing constants, variables, standard functions and mathematical expressions in C / C ++

The rules for writing assignment and input / output statements.

2. In accordance with the individual task to develop an algorithm for solving the problem.

3. Develop a program for solving the problem.

4. Run the program into the computer, translate (if necessary, correct errors) and execute with the given data.

Table 1

Variant	Expression	Given data
1	2	3
1.	$y = \frac{2\cos(x - \pi/6)}{1/2 + \sin^2 t}$ $w = y + \frac{z^2}{3 + z^2/5}$	$x=1.426$ $t=-1.220$ $z=3.5$
2.	$z = x^{t/x} - \sqrt[2]{t/x} $ $w = (t-x) \frac{t-z/(t-x)}{1+(t-x)^2} y$	$x=1.825$ $t=-18.225$ $z=-3.298$
3.	$y = e^{bt} \sin(at+b) - \sqrt{ bt+a }$ $w = (b \sin(at^2 \cos 2t) - 1) \sqrt[2]{3y^2}$	$a=-0.5$ $b=1.7$ $t=0.44$
4.	$y = \cos^2 x^2 - x/\sqrt{a^2 + b^2}$	$a=1.5$ $b=-15.5$

1	2	3
	$w = \sqrt{x^2 + by} - b^2 \sin^2(x+a)/x$	$x=-2.99$
5.	$z = x^2 \operatorname{tg}^2(x+b)^2 + a/\sqrt{x+b}$ $w = \frac{bx^2 - ay}{e^{ax} - 1}$	$a=16.5$ $b=3.4$ $x=0.61$
6.	$y = x^2(x+1)/b - \sin^2(x+a)$ $w = \sqrt{xb/a} + y^2 \cos^2(x+b)^2$	$a=0.7$ $b=0.06$ $x=0.5$
7.	$y = \sin^2(x^2 + a)^2 - 4x/b$ $w = \frac{x^2 y}{a} + \cos(x+b)^2$	$a=1.1$ $b=0.004$ $x=0.2$
8.	$y = \sqrt[2]{mtgt + c \sin t }$ $w = m \cos(bt \sin t) + c y $	$m=2$ $c=-1$ $t=1.2$ $b=0.7$
9.	$y = btg^2 x - \frac{a}{\sin^2(x/a)}$ $w = ae^{-\sqrt{a}} \cos(bx/a) + y $	$a=3.2$ $b=17.5$ $x=-4.8$
10.	$y = \ln(a+x^2) + \sin^2(x/b)$ $w = e^{-x} \frac{x + \sqrt{x+a}}{x - \sqrt{ x-b }} \sqrt[2]{y}$	$a=10.2$ $b=9.2$ $x=2.2$ $c=0.5$
11.	$y = \frac{a^{2x} + b^{x^2} \cos(a+b)x}{x+1}$ $w = \sqrt{x^2 + b}/y - b^2 \sin^2(x+a)/x$	$a=0.3$ $b=0.9$ $x=0.61$
12.	$y = \sqrt{ax \sin 2x + e^{-2x}(x+b)}$ $w = 1/y \cos^2 x^2 - x/\sqrt{a^2 + b^2}$	$a=0.5$ $b=3.1$ $x=1.4$
13.	$y = \frac{ax + e^{-x} \cos bx}{bx - e^{-x} \sin bx + 1}$ $w = ye^{2x} \ln(a+x) - b^{2x} \ln(b-x)$	$a=0.5$ $b=2.9$ $x=0.3$
14.	$y = \frac{\sin x}{\sqrt{1+m^2 \sin^2 x}} - cm \sin x$ $w = e^{-ax} \sqrt{x+1} + e^{ax} y^a \sqrt{x+1,5}$	$m=0.7$ $c=2.1$ $a=0.5$ $b=1.08$ $x=1.7$
15.	$y = t - (a/b)^2 + bt^2$ $w = \operatorname{tg}(\sqrt{2y^2 + x}/(y^2 + 1))$	$a=1.5$ $b=0.75$ $t=-3.76$ $x=8.43$

Example

Using following expressions for **Y** and **W** calculate on base of given data.

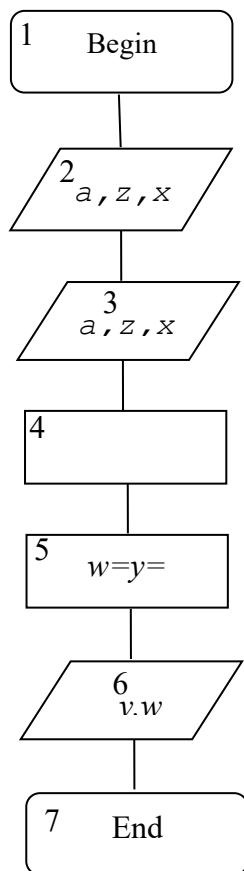
$$y = tg^2 x^2 + \sqrt{\frac{z^2}{a^2 + x^2}}$$

$$w = \ln(a + x^2) + \sin^2 \frac{y}{a}$$

Here $a=0,59$, $z=-4,8$, $x=2,1$.

Algorithm is presented on Fig. 1

Ib block 2 is entered values of a , x , z . I block 3 given data are displayed. In 4 block and 5 block y and w are calculated. In block 6 results are outputted on the printer.



Program in C++ language is presented below

```
#include <iostream>
using namespace std;
#include <math.h>
main ()
{
/* Laboratory work №1 Student Agabalayev Jafar, group 606.*/

float a,z,x,y,w;
cin>>a>>z>>x;
y=pow(tan(x*x),2)+sqrt(z*z/(a*a+x*x));
w=log(a+x*x)+pow(sin(y/a),2);
cout<<y<<w;
}
```

Mathematical functions in C/C++

Name in C/C++	Name in mathematics
abs(x)	$ x $
sin(x)	$\sin x$
cos(x)	$\cos x$
tan(x)	$\operatorname{tg} x$
atan(x)	$\operatorname{arctg} \left[-\frac{\pi}{2}; \frac{\pi}{2} \right]$
exp(x)	e^x
log(x)	$\ln(x)$, $x > 0$
log10(x)	$\log_{10}(x)$, $x > 0$
pow(x,y)	x^y . Not allowed if $x=0$, $y \leq 0$ or $x < 0$ and y –not integer
sqrt(x)	\sqrt{x} , $x \geq 0$

2. Programming of branching program

The purpose of the work is to study the methods of design, programming and debugging branching algorithms.

Assignment for student

1. Learn the operators of C / C ++ language for the organization conditional computing processes.
2. In accordance with the individual assignment develop an algorithm for solving the problem.
3. Develop a program in C / C ++
4. Run the program with the initial data of the variant

Variants of tasks are given in Table 2

Table 2.

Nº	Function	Condition	Data
1	2	3	4
1.	$y = \begin{cases} at^2 \ln t \\ 1 \\ a \cos bt \end{cases}$	$t < 2$ $t = 2$ $t > 2$	$a = -0.5$ $b = 2$
2.	$y = \begin{cases} x^2 - 1/x^2 \\ ax^2 + 1/x \\ \lg(x + 1/x) \end{cases}$	$x < 1.3$ $x = 1.3$ $x > 1.3$	$a = 1.5$
3.	$y = \begin{cases} ax^2 + bx + a \\ a/x + \sqrt{x^2 + 1} \\ (a + bx)/\sqrt{x^2 + 1} \end{cases}$	$x < 1.3$ $x = 1.3$ $x > 1.3$	$a = 2.8$ $b = 0.3$
4.	$y = \begin{cases} x^2 - 4x^2 \\ ax + 4\sqrt{x} \\ \ln(x + 4)\sqrt{(x + a)} \end{cases}$	$x < 1.4$ $x = 1.4$ $x > 1.4$	$a = 1.65$
5.	$y = \begin{cases} 1.5 \cos^2 x \\ 1.8ax \\ (x - 2)^2 + 6 \\ 3tgx \end{cases}$	$x < 1$ $x = 1$ $1 \leq x \leq 2$ $x > 2$	$a = 2.3$
6.	$y = \begin{cases} x\sqrt{x-a} \\ x \sin ax \\ e^{-ex} \cos ax \end{cases}$	$x > a$ $x = b$ $x < a$	$a = 2.5$ $b = 1.5$
7.	$y = \begin{cases} ax - \lg x \\ 1 \\ bx + \operatorname{tg} bx \end{cases}$	$bx < 1$ $bx = 1$ $bx > 1$	$b = 1.5$
8.	$y = \begin{cases} \sin x \operatorname{tg} x \\ \cos^2 x \end{cases}$	$x > 3.5$ $x \leq 3.5$	
9.	$y = \begin{cases} \operatorname{tg}(x+1) \\ \sin^2 \sqrt{ ax } \end{cases}$	$x > 1$ $x \leq 1$	$a = 20.3$

1	2	3	4
10.	$y = \begin{cases} \ln x + x^2 \sqrt{x+1} \\ \sqrt{x+1} + 1/x \\ \cos x + t \sin^2 x \end{cases}$	$x < 0.5$ $x = 0.5$ $x > 0.5$	$a = 2.2$
11.	$y = \begin{cases} e^x + \frac{a+b}{\cos x} \\ (a+b)/(x+1) \\ e^x + \sin x \end{cases}$	$x <= 2.8$ $2.8 < x < 6$ $x >= 6$	$a = 2.6$
12.	$y = \begin{cases} atg x^2 \sqrt{ x } \\ 2 \cos x + 3x^2 \end{cases}$	$x = > 1$ $x < 1$	$a = 0.9$
13.	$y = \begin{cases} a/t + bt^2 + c \\ t \\ at + bt^2 \end{cases}$	$t <= 1$ $4 < t < 6$ $t >= 6$	$a = 2.1$ $b = 1.8$ $c = -0.5$
14.	$y = \begin{cases} a \sin(t^2 + 1)/n \\ \cos(t + (1/n)) \end{cases}$	$\sin \frac{t^2 + 1}{n} > 0$ $\sin \frac{t^2 + 1}{n} < 0$	$a = 0.3$ $n = 10$
15.	$\omega = \begin{cases} \sqrt{at^2 + b \sin t + 1} \\ at + b \\ \sqrt{at^2 + b \cos t + 1} \end{cases}$	$t < 0.1$ $t = 0.1$ $t > 0.1$	$a = 2.5$ $b = 0.4$

Example

Develop algorithm, program and execute it to calculate following function

$$s = \begin{cases} at + b, & at < 1; \\ \cos at, & at = 1; \\ e^{-a} \cos at & at > 1. \end{cases}$$

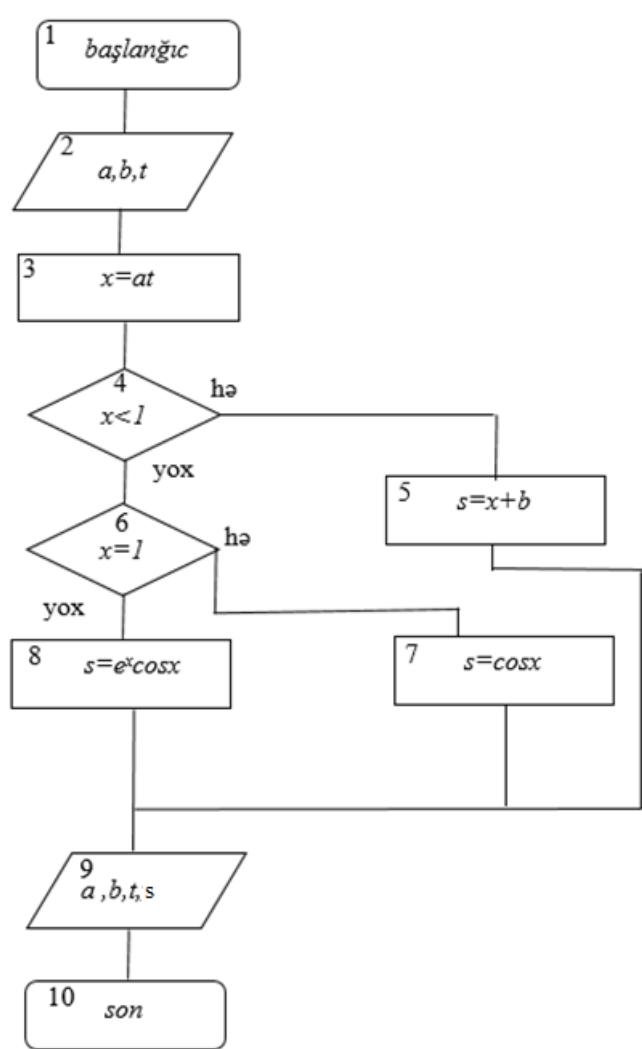
Here $a = 1.3$, $b = 1.29$, $t = 0.38$

Algorithm is presented on Fig. 2

In block 2 given data are entered, in block 3 calculate y for variant $at < 1$. In blocks 4 and 6 value of at are tested for > 1 and $= 1$.

In blocks 5 and 7 are calculated corresponding values and result is outputted in block 8.

Program in C++ is presented below.



```
#include <iostream>
using namespace std;
#include <math.h>
main ()
{
/* Laboratory work student Agabalayev J. group 606*/
float a,b,t,x,s;
cin>>a>>b>>t;
x=a*t;
if (x<1)
s=x+b;
else if (x==1 )
s=cos(a*t);
else
s=exp(-x)*cos(x);
cout<<"s="<<s;
}
```

