

# презентация по лабораторной работе 13

Программирование в командном процессоре ОС UNIX. Расширенное программирование

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## Информация

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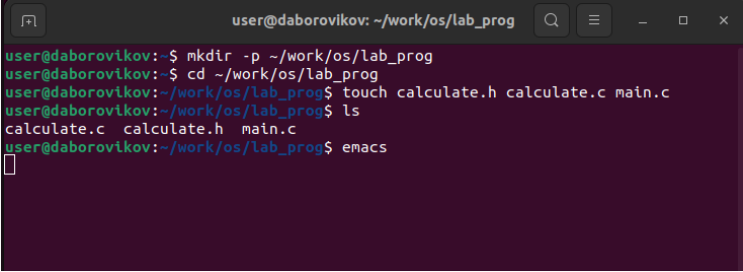
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- Студент ФМиЕН РУДН
- Группа НПИбд-01-22

## Вводная часть

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Приобрести простейшие навыки разработки, анализа, тестирования и отладки приложений в ОС типа UNIX/Linux на примере создания на языке программирования С калькулятора с простейшими функциями

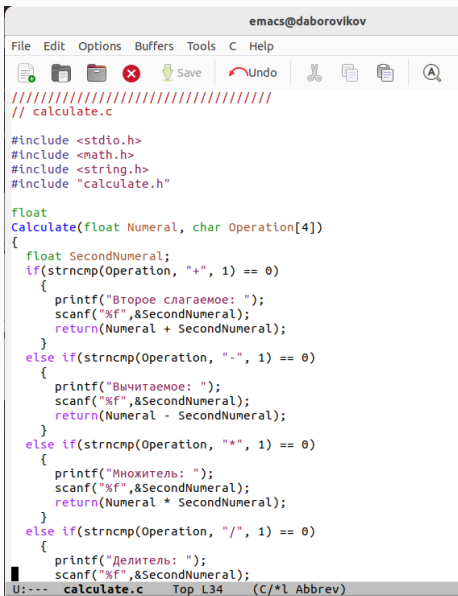
## Создание нового подкаталога и файлов в нем

A terminal window with a dark background and light-colored text. The window title bar shows 'user@daborovikov: ~/work/os/lab\_prog'. The terminal content shows a series of commands and their outputs: 'mkdir -p ~/work/os/lab\_prog' is executed, followed by 'cd ~/work/os/lab\_prog'. Then 'touch calculate.h calculate.c main.c' is run, and 'ls' shows the files 'calculate.c', 'calculate.h', and 'main.c'. Finally, 'emacs' is entered, and a cursor is visible on the next line.

```
user@daborovikov: ~/work/os/lab_prog
user@daborovikov:~$ mkdir -p ~/work/os/lab_prog
user@daborovikov:~$ cd ~/work/os/lab_prog
user@daborovikov:~/work/os/lab_prog$ touch calculate.h calculate.c main.c
user@daborovikov:~/work/os/lab_prog$ ls
calculate.c  calculate.h  main.c
user@daborovikov:~/work/os/lab_prog$ emacs
█
```

Рис. 1: Создание нового подкаталога и файлов в нем

## Реализация функций калькулятора в файле calculate.h:



The screenshot shows an Emacs editor window titled 'emacs@daborovikov'. The menu bar includes 'File', 'Edit', 'Options', 'Buffers', 'Tools', 'C', and 'Help'. The toolbar contains icons for opening files, saving, undo, and search. The code is written in C and is part of a file named 'calculate.c'. It includes standard headers and defines a 'Calculate' function that takes a float 'Numeral' and a character array 'Operation' of size 4. The function uses 'strcmp' to check the operation and 'scanf' to get the second operand. It supports addition, subtraction, multiplication, and division. The status bar at the bottom shows 'U: --- calculate.c Top L34 (C/\*l Abbrev)'.

```
emacsd@daborovikov
File Edit Options Buffers Tools C Help
[Icons: Open, Save, Undo, Search]

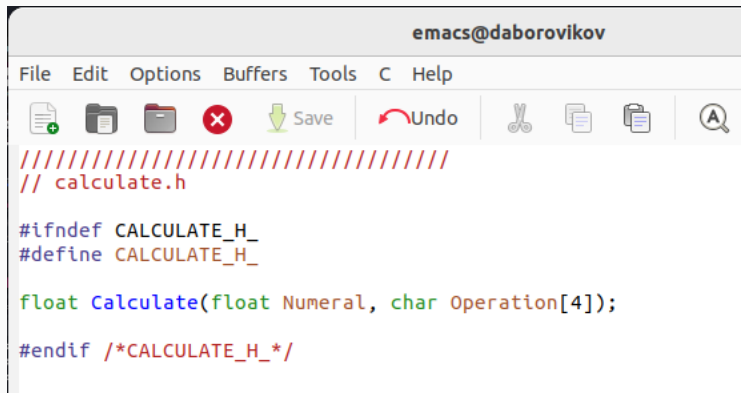
////////////////////////////////////
// calculate.c

#include <stdio.h>
#include <math.h>
#include <string.h>
#include "calculate.h"

float
Calculate(float Numeral, char Operation[4])
{
    float SecondNumeral;
    if(strcmp(Operation, "+", 1) == 0)
    {
        printf("Второе слагаемое: ");
        scanf("%f",&SecondNumeral);
        return(Numeral + SecondNumeral);
    }
    else if(strcmp(Operation, "-", 1) == 0)
    {
        printf("Вычитаемое: ");
        scanf("%f",&SecondNumeral);
        return(Numeral - SecondNumeral);
    }
    else if(strcmp(Operation, "*", 1) == 0)
    {
        printf("Множитель: ");
        scanf("%f",&SecondNumeral);
        return(Numeral * SecondNumeral);
    }
    else if(strcmp(Operation, "/", 1) == 0)
    {
        printf("Делитель: ");
        scanf("%f",&SecondNumeral);
        return(Numeral / SecondNumeral);
    }
}

U: --- calculate.c Top L34 (C/*l Abbrev)
```

## Интерфейсный файл calculate.h, описывающий формат вызова функции калькулятора:




```
////////////////////////  
// calculate.h  
  
#ifndef CALCULATE_H_  
#define CALCULATE_H_  
  
float Calculate(float Numeral, char Operation[4]);  
  
#endif /*CALCULATE_H_*/
```

Рис. 3: Интерфейсный файл calculate.h, описывающий формат вызова функции калькулятора:



## Основной файл main.c, реализующий интерфейс пользователя к калькулятору



```
//////////////////////////  
// main.c  
  
#include <stdio.h>  
#include "calculate.h"  
  
int  
main (void)  
{  
    float Numeral;  
    char Operation[4];  
    float Result;  
    printf("Число: ");  
    scanf("%f",&Numeral);  
    printf("Операция (+, -, *, /, pow, sqrt, sin, cos, tan): ");  
    scanf("%s",&Operation);  
    Result = Calculate(Numeral, Operation);  
    printf("%.2f\n",Result);  
    return 0;  
}
```

## Компиляция программы посредством gcc:

```

user@daborovikov: ~/work/os/lab_prog
user@daborovikov:~$ gcc -c calculate.c
cc1: fatal error: calculate.c: Нет такого файла или каталога
compilation terminated.
user@daborovikov:~$ cd ~/work/os/lab_prog
user@daborovikov:~/work/os/lab_prog$ gcc -c calculate.c
user@daborovikov:~/work/os/lab_prog$ gcc -c main.c
main.c: In function 'main':
main.c:16:11: warning: format '%s' expects argument of type 'char *', but argume
nt 2 has type 'char (*)[4]' [-Wformat=]
   16 |     scanf("%s",&operation);
       |           ~^ ~~~~~
       |           | |
       |           | char (*)[4]
       |           char *
user@daborovikov:~/work/os/lab_prog$ gcc calculate.o main.o -o calcul -lm
user@daborovikov:~/work/os/lab_prog$ ls
calcul      calculate.c~ calculate.h~  main.c      main.o
calculate.c calculate.h  calculate.o  main.c~
user@daborovikov:~/work/os/lab_prog$

```

Рис. 5: Компиляция программы посредством gcc:

Создайте Makefile со следующим содержанием:

```
emacs@daborovikov
File Edit Options Buffers Tools Makefile Help
[Icons: New, Open, Save, Close, Undo, Cut, Copy, Paste, Find]

#
# Makefile
#

CC = gcc
GFLAGS = -g
LIBS = -lm

calcul: calculate.o main.o
    $(CC) calculate.o main.o -o calcul $(LIBS)

calculate.o: calculate.c calculate.h
    $(CC) -c calculate.c $(CFLAGS)

main.o: main.c calculate.h
    $(CC) -c main.c $(CFLAGS)

clean:
    -rm calcul *.o *~

# End Makefile
```

# Отладка программы calcul

```
user@daborovikov:~/work/os/lab_prog$ emacs Makefile
user@daborovikov:~/work/os/lab_prog$ emacs
user@daborovikov:~/work/os/lab_prog$ make clean
rm calcul *.o *-
user@daborovikov:~/work/os/lab_prog$ make calculate.o
gcc -c calculate.c
user@daborovikov:~/work/os/lab_prog$ make main.o
gcc -c main.c
main.c: In function 'main':
main.c:16:11: warning: format '%s' expects argument of type 'char *', but argument 2 has type 'char (*)[4]' [-Wformat=]
   16 |     scanf("%s", &operation);
      |           ~^ ~~~~~
      |           |   |
      |           |   | char (*)[4]
      |           |   +~+
      |           +~+
      |           char *
user@daborovikov:~/work/os/lab_prog$ make calcul
gcc calculate.o main.o -o calcul -lm
user@daborovikov:~/work/os/lab_prog$ gdb ./calcul
GNU gdb (Ubuntu 12.0.90-0ubuntu1) 12.0.90
Copyright (C) 2022 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<https://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./calcul...
(No debugging symbols found in ./calcul)
(gdb) run
Starting program: /home/user/work/os/lab_prog/calcul
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".
Число: 5
Операция (+,-,*,/,pow,sqrt,sin,cos,tan): *
Множитель: 6
30.00
[Inferior 1 (process 30033) exited normally]
(gdb) █
```

## Анализ кода файла calculate.

```
user@daborovikov:~/work/os/lab_prog$ splint calculate.c
Splint 3.1.2 --- 21 Feb 2021

calculate.h:7:37: Function parameter Operation declared as manifest array (size
      constant is meaningless)
    A formal parameter is declared as an array with size. The size of the array
    is ignored in this context, since the array formal parameter is treated as a
    pointer. (Use -fixedformalarray to inhibit warning)
calculate.c:10:31: Function parameter Operation declared as manifest array
      (size constant is meaningless)
calculate.c: (in function Calculate)
calculate.c:16:7: Return value (type int) ignored: scanf("%f", &Sec...
    Result returned by function call is not used. If this is intended, can cast
    result to (void) to eliminate message. (Use -retvalint to inhibit warning)
calculate.c:22:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:28:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:34:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:35:10: Dangerous equality comparison involving float types:
      SecondNumeral == 0
    Two real (float, double, or long double) values are compared directly using
    == or != primitive. This may produce unexpected results since floating point
    representations are inexact. Instead, compare the difference to FLT_EPSILON
    or DBL_EPSILON. (Use -realcompare to inhibit warning)
calculate.c:38:10: Return value type double does not match declared type float:
      (HUGE_VAL)
    To allow all numeric types to match, use +relaxtypes.
calculate.c:46:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:47:13: Return value type double does not match declared type float:
      (pow(Numeral, SecondNumeral))
calculate.c:50:11: Return value type double does not match declared type float:
      (sqrt(Numeral))
calculate.c:52:11: Return value type double does not match declared type float:
      (sin(Numeral))
calculate.c:54:11: Return value type double does not match declared type float:
      (cos(Numeral))
calculate.c:56:11: Return value type double does not match declared type float:
      (tan(Numeral))
calculate.c:60:13: Return value type double does not match declared type float:
      (HUGE_VAL)

Finished checking --- 15 code warnings
user@daborovikov:~/work/os/lab_prog$
```

## Анализ кода файла main.c.

```
user@daborovikov:~/work/os/lab_prog$ splint calculate.c
Splint 3.1.2 --- 21 Feb 2021

calculate.h:7:37: Function parameter Operation declared as manifest array (size
        constant is meaningless)
    A formal parameter is declared as an array with size. The size of the array
    is ignored in this context, since the array formal parameter is treated as a
    pointer. (Use -fixedformalarray to inhibit warning)
calculate.c:10:31: Function parameter Operation declared as manifest array
        (size constant is meaningless)
calculate.c: (in function Calculate)
calculate.c:16:7: Return value (type int) ignored: scanf("%f", &Sec...
    Result returned by function call is not used. If this is intended, can cast
    result to (void) to eliminate message. (Use -retvalint to inhibit warning)
calculate.c:22:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:28:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:34:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:35:10: Dangerous equality comparison involving float types:
        SecondNumeral == 0
    Two real (float, double, or long double) values are compared directly using
    == or != primitive. This may produce unexpected results since floating point
    representations are inexact. Instead, compare the difference to FLT_EPSILON
    or DBL_EPSILON. (Use -realcompare to inhibit warning)
calculate.c:38:10: Return value type double does not match declared type float:
        (HUGE_VAL)
    To allow all numeric types to match, use +relaxtypes.
calculate.c:46:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:47:13: Return value type double does not match declared type float:
        (pow(Numeral, SecondNumeral))
calculate.c:50:11: Return value type double does not match declared type float:
        (sqrt(Numeral))
calculate.c:52:11: Return value type double does not match declared type float:
        (sin(Numeral))
calculate.c:54:11: Return value type double does not match declared type float:
        (cos(Numeral))
calculate.c:56:11: Return value type double does not match declared type float:
        (tan(Numeral))
calculate.c:60:13: Return value type double does not match declared type float:
        (HUGE_VAL)

Finished checking --- 15 code warnings
user@daborovikov:~/work/os/lab_prog$
```

В ходе лабораторной работы мы приобрели простейшие навыки разработки, анализа, тестирования и отладки приложений в ОС типа UNIX/Linux на примере создания на языке программирования C калькулятора с простейшими функциями