Лабораторная работа №14. Средства, применяемые при разработке программного обеспечения в ОС типа UNIX/Linux.

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30 апреля, 2021

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Цель работы

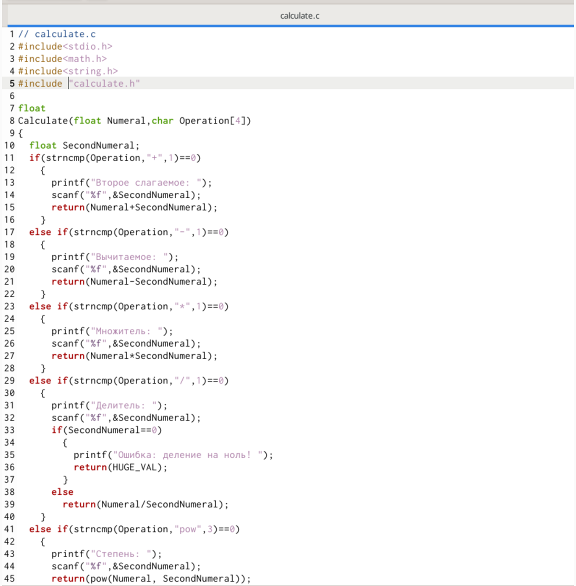
Приобрести простейшие навыки разработки, анализа, тестирования и отладки приложений в ОС типа UNIX/Linux на примере создания на языке программирования С калькулятора с простейшими функциями.

Задачи

1. В домашнем каталоге создайте подкаталог~/work/os/lab_prog.
2. Создайте в нём файлы:calculate.h,calculate.c,main.c.
3. Выполните компиляцию программы посредством gcc;
4. Создайте Makefile со следующим содержанием.
5. С помощью gdb выполните отладку программы calcul (перед использованием gdb исправьте Makefile)
6. С помощью утилиты splint попробуйте проанализировать коды файлов calculate.c и main.c.

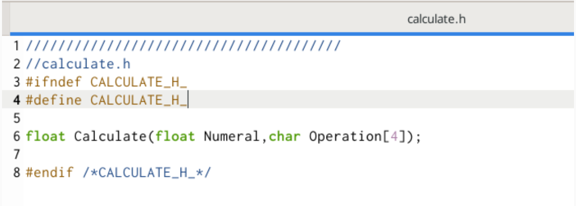
Выполнение лабораторной работы

Файл calculate.c



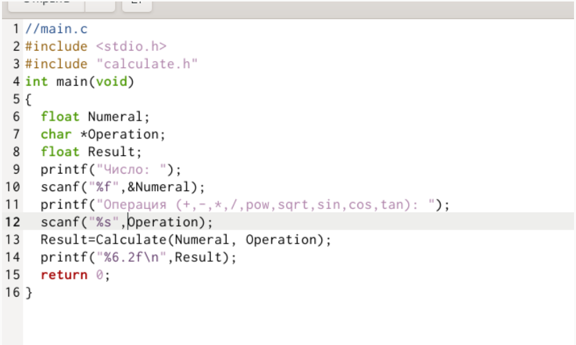
```
// calculate.c
#include<stdio.h>
#include<math.h>
#include<string.h>
#include "calculate.h"

float
Calculate(float Numeral,char Operation[4])
{
  float SecondNumeral;
  if(strncmp(Operation,"+",1)==0)
    {
      printf("Второе слагаемое: ");
      scanf("%f",&SecondNumeral);
      return(Numeral+SecondNumeral);
    }
  else if(strncmp(Operation,"-",1)==0)
    {
      printf("Вычитаемое: ");
      scanf("%f",&SecondNumeral);
      return(Numeral-SecondNumeral);
    }
  else if(strncmp(Operation,"*",1)==0)
    {
      printf("Множитель: ");
      scanf("%f",&SecondNumeral);
      return(Numeral*SecondNumeral);
    }
  else if(strncmp(Operation,"/",1)==0)
    {
      printf("Делитель: ");
      scanf("%f",&SecondNumeral);
      if(SecondNumeral==0)
        {
          printf("Ошибка: деление на ноль! ");
          return(HUGE_VAL);
        }
      else
        return(Numeral/SecondNumeral);
    }
  else if(strncmp(Operation,"pow",3)==0)
    {
      printf("Степень: ");
      scanf("%f",&SecondNumeral);
      return(pow(Numeral, SecondNumeral));
```

Файл calculate.h



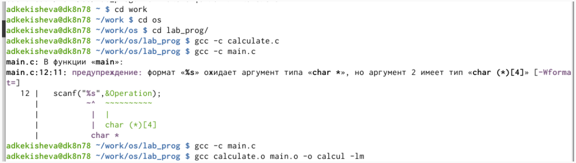
```
////////////////////////////////////////
//calculate.h
#ifndef CALCULATE_H_
#define CALCULATE_H_

float Calculate(float Numeral,char Operation[4]);

#endif /*CALCULATE_H_*/
```

Файл main.c



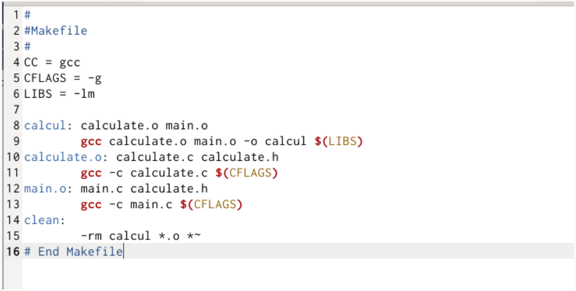
```
//main.c
#include <stdio.h>
#include "calculate.h"
int main(void)
{
  float Numeral;
  char *Operation;
  float Result;
  printf("Число: ");
  scanf("%f",&Numeral);
  printf("Операция (+,-,*,/,pow,sqrt,sin,cos,tan): ");
  scanf("%s",Operation);
  Result=Calculate(Numeral, Operation);
  printf("%6.2f\n",Result);
  return 0;
}
```

Компиляция программ



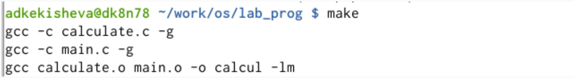
```
adkekisheva@dk8n78 ~ $ cd work
adkekisheva@dk8n78 ~/work $ cd os
adkekisheva@dk8n78 ~/work/os $ cd lab_prog/
adkekisheva@dk8n78 ~/work/os/lab_prog $ gcc -c calculate.c
adkekisheva@dk8n78 ~/work/os/lab_prog $ gcc -c main.c
main.c: В функции «main»:
main.c:12:11: предупреждение: формат «%s» ожидает аргумент типа «char *», но аргумент 2 имеет тип «char (*)[4]» [-Wforma
t=]
   12 |   scanf("%s",&Operation);
      |          ~^  ~~~~~~~~~~
      |           |  |
      |           |  char (*)[4]
      |           char *
adkekisheva@dk8n78 ~/work/os/lab_prog $ gcc -c main.c
adkekisheva@dk8n78 ~/work/os/lab_prog $ gcc calculate.o main.o -o calcul -lm
```

Makefile



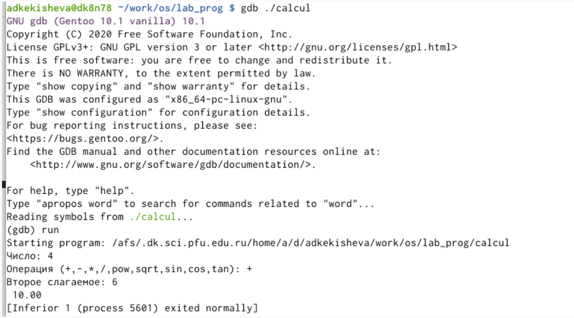
```
#
#Makefile
#
CC = gcc
CFLAGS = -g
LIBS = -lm

calcul: calculate.o main.o
        gcc calculate.o main.o -o calcul $(LIBS)
calculate.o: calculate.c calculate.h
        gcc -c calculate.c $(CFLAGS)
main.o: main.c calculate.h
        gcc -c main.c $(CFLAGS)
clean:
        -rm calcul *.o *~
# End Makefile
```

Компиляция Makefile



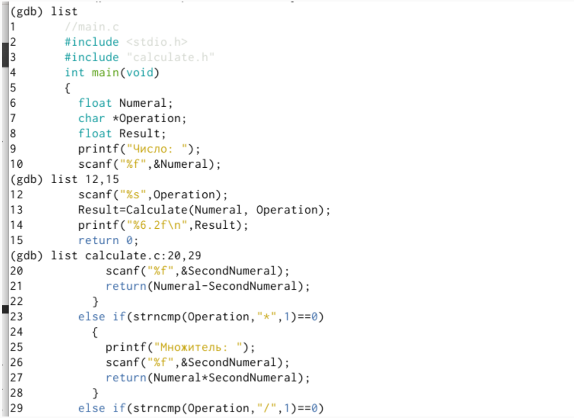
```
adkekisheva@dk8n78 ~/work/os/lab_prog $ make
gcc -c calculate.c -g
gcc -c main.c -g
gcc calculate.o main.o -o calcul -lm
```

Отладку программы calcul, запуск через gdb



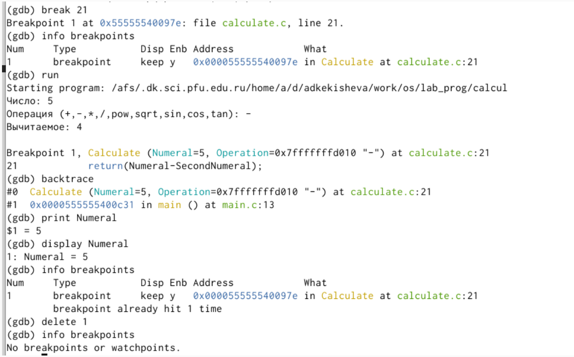
```
adkekisheva@dk8n78 ~/work/os/lab_prog $ gdb ./calcul
GNU gdb (Gentoo 10.1 vanilla) 10.1
Copyright (C) 2020 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-pc-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<https://bugs.gentoo.org/>.
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...
(gdb) run
Starting program: /afs/.dk.sci.pfu.edu.ru/home/a/d/adkekisheva/work/os/lab_prog/calcul
Число: 4
Операция (+,-,*,/,pow,sqrt,sin,cos,tan): +
Второе слагаемое: 6
 10.00
[Inferior 1 (process 5601) exited normally]
```

Просмотр кода: list



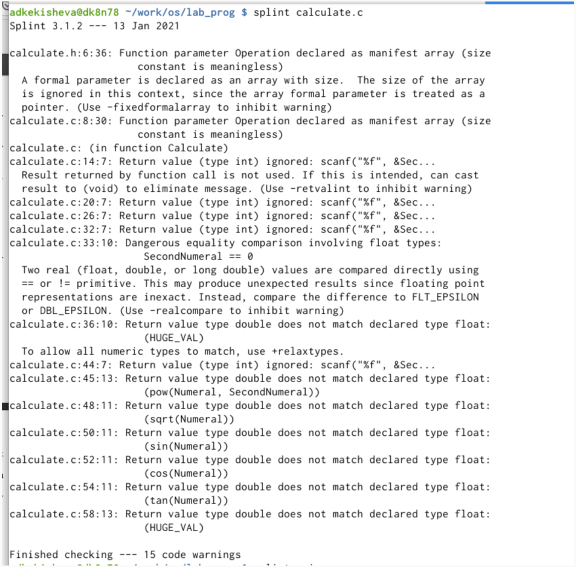
```
(gdb) list
1         //main.c
2         #include <stdio.h>
3         #include "calculate.h"
4         int main(void)
5         {
6           float Numeral;
7           char *Operation;
8           float Result;
9           printf("Число: ");
10          scanf("%f",&Numeral);
(gdb) list 12,15
12          scanf("%s",Operation);
13          Result=Calculate(Numeral, Operation);
14          printf("%6.2f\n",Result);
15          return 0;
(gdb) list calculate.c:20,29
20              scanf("%f",&SecondNumeral);
21              return(Numeral-SecondNumeral);
22            }
23          else if(strncmp(Operation,"*",1)==0)
24            {
25              printf("Множитель: ");
26              scanf("%f",&SecondNumeral);
27              return(Numeral*SecondNumeral);
28            }
29          else if(strncmp(Operation,"/",1)==0)
```

Установка и удаление точки останова



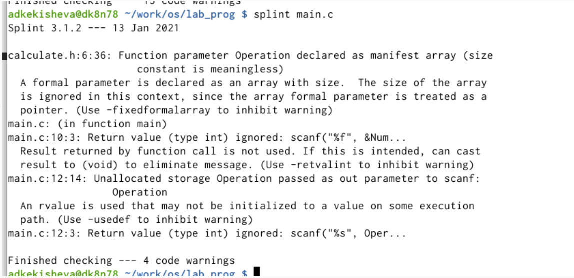
```
(gdb) break 21
Breakpoint 1 at 0x55555540097e: file calculate.c, line 21.
(gdb) info breakpoints
Num     Type           Disp Enb Address            What
1       breakpoint     keep y   0x000055555540097e in Calculate at calculate.c:21
(gdb) run
Starting program: /afs/.dk.sci.pfu.edu.ru/home/a/d/adkekisheva/work/os/lab_prog/calcul
Число: 5
Операция (+,-,*,/,pow,sqrt,sin,cos,tan): -
Вычитаемое: 4

Breakpoint 1, Calculate (Numeral=5, Operation=0x7fffffffd010 "-") at calculate.c:21
21            return(Numeral-SecondNumeral);
(gdb) backtrace
#0  Calculate (Numeral=5, Operation=0x7fffffffd010 "-") at calculate.c:21
#1  0x0000555555400c31 in main () at main.c:13
(gdb) print Numeral
$1 = 5
(gdb) display Numeral
1: Numeral = 5
(gdb) info breakpoints
Num     Type           Disp Enb Address            What
1       breakpoint     keep y   0x000055555540097e in Calculate at calculate.c:21
        breakpoint already hit 1 time
(gdb) delete 1
(gdb) info breakpoints
No breakpoints or watchpoints.
```

Код файла calculate.c



```
adkekisheva@dk8n78 ~/work/os/lab_prog $ splint calculate.c
Splint 3.1.2 --- 13 Jan 2021

calculate.h:6:36: 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:8:30: Function parameter Operation declared as manifest array (size
                     constant is meaningless)
calculate.c: (in function Calculate)
calculate.c:14:7: 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:20:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:26:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:32:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:33:10: 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:36:10: Return value type double does not match declared type float:
                      (HUGE_VAL)
  To allow all numeric types to match, use +relaxtypes.
calculate.c:44:7: Return value (type int) ignored: scanf("%f", &Sec...
calculate.c:45:13: Return value type double does not match declared type float:
                      (pow(Numeral, SecondNumeral))
calculate.c:48:11: Return value type double does not match declared type float:
                      (sqrt(Numeral))
calculate.c:50:11: Return value type double does not match declared type float:
                      (sin(Numeral))
calculate.c:52:11: Return value type double does not match declared type float:
                      (cos(Numeral))
calculate.c:54:11: Return value type double does not match declared type float:
                      (tan(Numeral))
calculate.c:58:13: Return value type double does not match declared type float:
                      (HUGE_VAL)

Finished checking --- 15 code warnings
```

Код файла main.c



```
Finished checking --- 15 code warnings
adkekisheva@dk8n78 ~/work/os/lab_prog $ splint main.c
Splint 3.1.2 --- 13 Jan 2021

calculate.h:6:36: 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)
main.c: (in function main)
main.c:10:3: Return value (type int) ignored: scanf("%f", &Num...
  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)
main.c:12:14: Unallocated storage Operation passed as out parameter to scanf:
                 Operation
  An rvalue is used that may not be initialized to a value on some execution
  path. (Use -usedef to inhibit warning)
main.c:12:3: Return value (type int) ignored: scanf("%s", Oper...

Finished checking --- 4 code warnings
adkekisheva@dk8n78 ~/work/os/lab_prog $
```

Вывод

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

Библиография

1. Ссылка 1