0x03. C - Debugging

C Debugging

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Weight: 1

Project over - took place from Oct 11, 2023 6:00 AM to Oct 14, 2023 6:00 AM

An auto review will be launched at the deadline

In a nutshell…

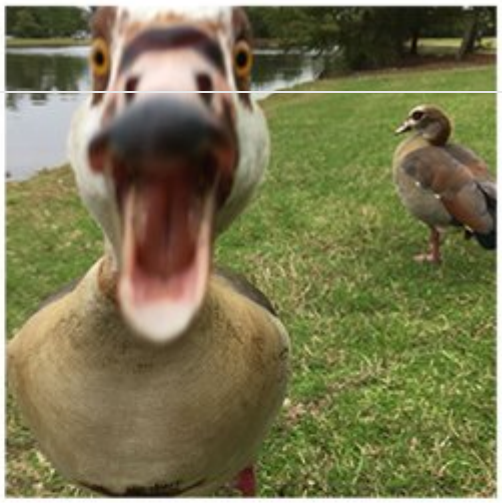
- **Auto QA review:** 24.7/40 mandatory
- **Altogether: 61.75%**
  - Mandatory: 61.75%
  - Optional: no optional tasks

Resources

Read or watch:

- Debugging (/rltoken/faGcpiJiejHH6GhqpmbhUw)
- Rubber Duck Debugging (/rltoken/RaecqJBNkmZ92vLMpNDuGg)

Debugging is the process of finding and fixing errors in software that prevents it from running correctly. As you become a more advanced programmer and an industry engineer, you will learn how to use debugging tools such as `gdb` or built-in tools that IDEs have. However, it's important to understand the concepts and processes of debugging manually.



Learning Objectives

At the end of this project, you are expected to be able to explain to anyone (/rltoken/b8uX1nly0A55tWVllRTaHQ), without the help of Google:

General

- What is debugging

- What are some methods of debugging manually
- How to read the error messages

Copyright - Plagiarism

- You are tasked to come up with solutions for the tasks below yourself to meet with the above learning objectives.
- You will not be able to meet the objectives of this or any following project by copying and pasting someone else's work.
- You are not allowed to publish any content of this project.
- Any form of plagiarism is strictly forbidden and will result in removal from the program.

Requirements

General

- Allowed editors: `vi`, `vim`, `emacs`
- All your files will be compiled on Ubuntu 20.04 LTS using `gcc`, using the options `-Wall -Werror -Wextra -pedantic -std=gnu89`
- All your files should end with a new line
- Your code should use the `Betty` style. It will be checked using `betty-style.pl` and `betty-doc.pl`
- A README.md file at the root of the repo, containing a description of the repository
- A README.md file, at the root of the folder of this project (i.e. `0x03-debugging`), describing what this project is about

Quiz questions

Great! You've completed the quiz successfully! Keep going! (Hide quiz)

Question #0

Look at the following code.

(7)

```
carrie@ubuntu:/debugging$ cat main.c
#include <stdio.h>

/**
 * main - debugging example
 * Return: 0
 */
int main(void)
{
        char *hello = "Hello, World!";

        for (i = 0; hello[i] != '\0'; i++)
        {
                printf("%c", hello[i]);
        }

        printf("\n");

        return (0);
}
carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ gcc -Wall -Werror -Wextra -pedantic main.
c
main.c: In function ‘main’:
main.c:11:7: error: ‘i’ undeclared (first use in this function)
  for (i = 0; hello[i] != '\0'; i++)
       ^
main.c:11:7: note: each undeclared identifier is reported only once for each functio
n it appears in
main.c:9:8: error: variable ‘hello’ set but not used [-Werror=unused-but-set-variabl
e]
  char *hello = "Hello, World!";
        ^
cc1: all warnings being treated as errors
carrie@ubuntu:/debugging$
```

In the `main.c` file, on what line is the first error that the compiler returns?

- 11
- 9
- 7

Tips:

You do not have to know exactly what this code does yet (but you will soon!).

Question #1

The following code gives this incorrect output. Which of the following statements about what is causing the error is true?

```
carrie@ubuntu:/debugging$ cat main.c
#include <stdio.h>

/**
 * main - debugging example
 * Return: 0
 */
int main(void)
{
        int i;
        int j;

        for (i = 0; i < 10; i++)
        {
                j = 0;
                while (j < 10)
                {
                        printf("%d", j);
                }
                printf("\n");
        }

        return (0);
}
carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ gcc -Wall -Werror -Wextra -pedantic main.c
carrie@ubuntu:/debugging$ ./a.out
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000 <...>
^Ccarrie@ubuntu:/debugging$
```

- [ ] `j` is always equal to `i` so the loop will never end
- [x] `j` never increments so it will always be less than `10`
- [x] `j` never increments so it is always going to print `0`

Question #2

This code doesn't work as intended.

(/)

```
#include "main.h"

/**
* main - prints even numbers from 0 to 100
* Return: 0
*/

int main(void)
{
        int i;

        for (i = 0; i < 100; i++)
        {
                if (i % 2 != 0)
                {
                        continue;
                }
                else
                {
                        break;
                }

                printf("%d\n", i);
        }

        return(0);
}
```

Let's add `printf` statements to the code. What information do the `printf` statements tell us about how our code is executed?

(7)

```
#include "main.h"

/**
* main - prints even numbers from 0 to 100
* Return: 0
*/

int main(void)
{
        int i;

        printf("Before loop\n");

        for (i = 0; i < 100; i++)
        {
                if (i % 2 != 0)
                {
                        printf("i is not even so don't print\n");
                        continue;
                }
                else
                {
                        printf("i is even, break to print\n");
                        break;
                }

                printf("Outside of if/else, still inside for loop\n");

                printf("%d\n", i);
        }

        printf("For loop exited\n");

        return(0);
}
```

- [ ] A `printf` statement shows exactly how many times the loop executes
- [x] A `printf` statement shows when the `for` loop is finished
- [x] `printf` statements shows that `break` will cause “For loop exited” to print, indicating that the even number is never printed
- [ ] A `printf` statement shows that there is an infinite loop in the code

Question #3

The following code gives this output. What is the error?

(7)

```
carrie@ubuntu:/debugging$ cat main.c
#include <stdio.h>

/**
 * main - debugging example
 * Return: 0
 */
int main(void)
{
        int i;
        int j;
        int k;

        i = 0;
        j = 1000;
        while (i < j)
        {
                k = j / 98;
                i = i + k;
                printf("%d\n", i);
                j == j - 1;
        }

        return (0);
}
carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ gcc -Wall -Werror -Wextra -pedantic main.
c
main.c: In function ‘main’:
main.c:20:3: error: statement with no effect [-Werror=unused-value]
   j == j - 1;
   ^
cc1: all warnings being treated as errors
carrie@ubuntu:/debugging$
```

- We want to assign `j` a new value, not compare it, so it should be `j = j - 1` instead of `j == j - 1`
- We don’t need to assign a new value to `j` because it doesn’t do anything
- We want to compare `j` so we need an `if` statement before `j == j - 1`

Tasks

0. Multiple mains

mandatory

Score: 56.88% (*Checks completed: 87.5%*)

In most projects, we often give you only one main file to test with. For example, this main file is a test for a `postitive_or_negative()` function similar to the one you worked with in an earlier C project (/rltoken/lKcOFkG-GCivSDXgWgld2g):

```
carrie@ubuntu:/debugging$ cat main.c
#include "main.h"

/**
* main - tests function that prints if integer is positive or negative
* Return: 0
*/

int main(void)
{
        int i;

        i = 98;
        positive_or_negative(i);

        return (0);
}
carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ cat main.h
#ifndef MAIN_H
#define MAIN_H

#include <stdio.h>

void positive_or_negative(int i);

#endif /* MAIN_H */
carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 positive_or
_negative.c main.c
carrie@ubuntu:/debugging$ ./a.out
98 is positive
carrie@ubuntu:/debugging$
```

Based on the `main.c` file above, create a file named `0-main.c`. This file must test that the function `positive_or_negative()` gives the correct output when given a case of `0`.

You are not coding the solution / function, you're just testing it! However, you can adapt your function from 0x01. C - Variables, if, else, while - Task #0 (/rltoken/lKcOFkG-GCivSDXgWgld2g) to compile with this main file to test locally.

- You only need to upload `0-main.c` and `main.h` for this task. We will provide our own `positive_or_negative()` function.
- You are not allowed to add or remove lines of code, you may change only **one** line in this task.

```
carrie@ubuntu:/debugging$ gcc -Wall -pedantic -Werror -Wextra -std=gnu89 positive_or
_negative.c 0-main.c -o 0-main
carrie@ubuntu:/debugging$ ./0-main
0 is zero
carrie@ubuntu:/debugging$ wc -l 0-main.c
16 1-main.c
carrie@ubuntu:/debugging$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x03-debugging`
- File: `0-main.c, main.h`

☐ Done? | Help | Check your code | Ask for a new correction | QA Review

1. Like, comment, subscribe

mandatory

Score: 57.78% (*Checks completed: 88.89%*)

Copy this main file. Comment out (don't delete it!) the part of the code that is causing the output to go into an infinite loop.

- Don't add or remove any lines of code, as we will be checking your line count. You are only allowed to comment out existing code.
- You do not have to compile with `-Wall -Werror -Wextra -pedantic` for this task.

(/)

```
carrie@ubuntu:/debugging$ cat 1-main.c
#include <stdio.h>

/**
* main - causes an infinite loop
* Return: 0
*/

int main(void)
{
        int i;

        printf("Infinite loop incoming :(\n");

        i = 0;

        while (i < 10)
        {
                putchar(i);
        }

        printf("Infinite loop avoided! \\o/\n");

        return (0);
}
carrie@ubuntu:/debugging$
```

Your output should look like this:

```
carrie@ubuntu:/debugging$ gcc -std=gnu89 1-main.c -o 1-main
carrie@ubuntu:/debugging$ ./1-main
Infinite loop incoming :(
Infinite loop avoided! \o/
carrie@ubuntu:/debugging$ wc -l 1-main.c
24 1-main.c
carrie@ubuntu:/debugging$
```

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x03-debugging`
- File: `1-main.c`

☐ Done? | Help | Check your code | Ask for a new correction | >_ Get a sandbox | QA Review

2. 0 > 972?

mandatory

Score: 65.0% (*Checks completed: 100.0%*)

(/)

This program prints the largest of three integers.

```
carrie@ubuntu:/debugging$ cat 2-main.c
#include <stdio.h>
#include "main.h"

/**
* main - prints the largest of 3 integers
* Return: 0
*/

int main(void)
{
        int a, b, c;
        int largest;

        a = 972;
        b = -98;
        c = 0;

        largest = largest_number(a, b, c);

        printf("%d is the largest number\n", largest);

        return (0);
}
carrie@ubuntu:/debugging$
```

(/)

```
carrie@ubuntu:/debugging$ cat 2-largest_number.c
#include "main.h"

/**
 * largest_number - returns the largest of 3 numbers
 * @a: first integer
 * @b: second integer
 * @c: third integer
 * Return: largest number
 */

int largest_number(int a, int b, int c)
{
    int largest;

    if (a > b && b > c)
    {
        largest = a;
    }
    else if (b > a && a > c)
    {
        largest = b;
    }
    else
    {
        largest = c;
    }

    return (largest);
}

carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ gcc -Wall -Werror -Wextra -pedantic -std=gnu89 2-largest_n
umber.c 2-main.c -o 2-main
carrie@ubuntu:/debugging$ ./2-main
0 is the largest number
carrie@ubuntu:/debugging$
```

? That's definitely not right.

Fix the code in `2-largest_number.c` so that it correctly prints out the largest of three numbers, no matter the case.

- Line count will not be checked for this task.

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x03-debugging`

- File: `2-largest_number.c, main.h`

(/)

Done! | Help | Check your code | Get a sandbox | QA Review

3. Leap year

mandatory

Score: 65.0% (*Checks completed: 100.0%*)

This program converts a date to the day of year and determines how many days are left in the year, taking leap year into consideration.

```
carrie@ubuntu:/debugging$ cat 3-main_a.c
#include <stdio.h>
#include "main.h"

/**
* main - takes a date and prints how many days are left in the year, taking
* leap years into account
* Return: 0
*/

int main(void)
{
    int month;
    int day;
    int year;

    month = 4;
    day = 01;
    year = 1997;

    printf("Date: %02d/%02d/%04d\n", month, day, year);

    day = convert_day(month, day);

    print_remaining_days(month, day, year);

    return (0);
}

carrie@ubuntu:/debugging$
```

(7)

```
carrie@ubuntu:/debugging$ cat 3-convert_day.c
#include "main.h"

/**
* convert_day - converts day of month to day of year, without accounting
* for leap year
* @month: month in number format
* @day: day of month
* Return: day of year
*/

int convert_day(int month, int day)
{
    switch (month)
    {
        case 2:
            day = 31 + day;
            break;
        case 3:
            day = 59 + day;
            break;
        case 4:
            day = 90 + day;
            break;
        case 5:
            day = 120 + day;
            break;
        case 6:
            day = 151 + day;
            break;
        case 7:
            day = 181 + day;
            break;
        case 8:
            day = 212 + day;
            break;
        case 9:
            day = 243 + day;
            break;
        case 10:
            day = 273 + day;
            break;
        case 11:
            day = 304 + day;
            break;
        case 12:
            day = 334 + day;
            break;
        default:
            break;
    }
    return (day);
```

```
}
(/)
carrie@ubuntu:/debugging$
```

```
carrie@ubuntu:/debugging$ cat 3-print_remaining_days.c
#include <stdio.h>
#include "main.h"

/**
* print_remaining_days - takes a date and prints how many days are
* left in the year, taking leap years into account
* @month: month in number format
* @day: day of month
* @year: year
* Return: void
*/

void print_remaining_days(int month, int day, int year)
{
    if ((year % 4 == 0 || year % 400 == 0) && !(year % 100 == 0))
    {
        if (month >= 2 && day >= 60)
        {
            day++;
        }

        printf("Day of the year: %d\n", day);
        printf("Remaining days: %d\n", 366 - day);
    }
    else
    {
        if (month == 2 && day == 60)
        {
            printf("Invalid date: %02d/%02d/%04d\n", month, day - 31, year);
        }
        else
        {
            printf("Day of the year: %d\n", day);
            printf("Remaining days: %d\n", 365 - day);
        }
    }
}

carrie@ubuntu:/debugging$
```

(/)

```
carrie@ubuntu:/debugging$ gcc -Wall -Werror -Wextra -pedantic -std=gnu89 3-convert_d
ay.c 3-print_remaining_days.c 3-main_a.c -o 3-main_a
carrie@ubuntu:/debugging$ ./3-main_a
Date: 04/01/1997
Day of the year: 91
Remaining days: 274
carrie@ubuntu:/debugging$
```

Output looks good for `04/01/1997` ! Let's make a new main file `3-main_b.c` to try a case that is a leap year: `02/29/2000` .

```
carrie@ubuntu:/debugging$ gcc -Wall -Werror -Wextra -pedantic -std=gnu89 3-convert_d
ay.c 3-print_remaining_days.c 3-main_b.c -o 3-main_b
carrie@ubuntu:/debugging$ ./3-main_b
Date: 02/29/2000
Invalid date: 02/29/2000
carrie@ubuntu:/debugging$
```

? That doesn't seem right.

Fix the `print_remaining_days()` function so that the output works correctly for *all* dates and *all* leap years.

- Line count will not be checked for this task.
- You can assume that all test cases have valid months (i.e. the value of `month` will never be less than `1` or greater than `12`) and valid days (i.e. the value of `day` will never be less than `1` or greater than `31`).
- You can assume that all test cases have valid month/day combinations (i.e. there will never be a June 31st or November 31st, etc.), but not all month/day/year combinations are valid (i.e. February 29, 1991 or February 29, 2427).

Repo:

- GitHub repository: `alx-low_level_programming`
- Directory: `0x03-debugging`
- File: `3-print_remaining_days.c, main.h`

☑ Done! | Help | Check your code | QA Review