Introduction to Programming

Week – *2*, Lecture – *3*

Introduction to C – Part 1

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IIT KANPUR

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The language here is *C*

- … and that software tool is *gcc*

Shall we solve those quadratic equations?

Procedure QuadraticEquationWithRealRootSolver

```
Inputs: a, b, c

D = b * b - 4 * a * c;
x1 = (-b + √D) / (2 * a)
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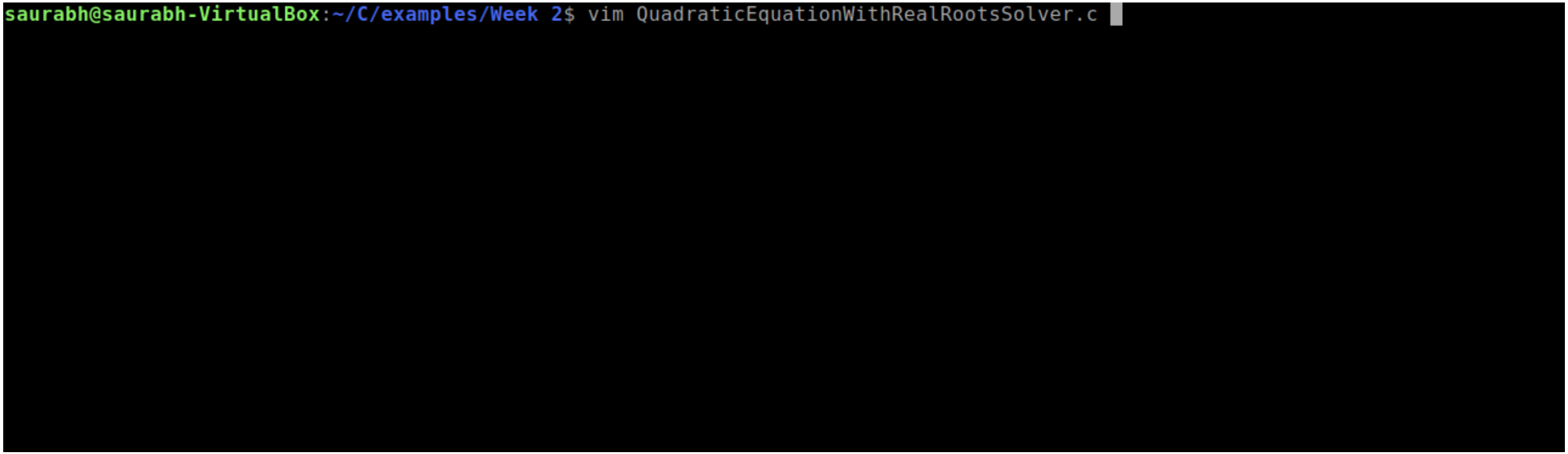
Assuming that we have to solve only equations with real roots, our pseudocode is very compact

Creating our first C Program !!



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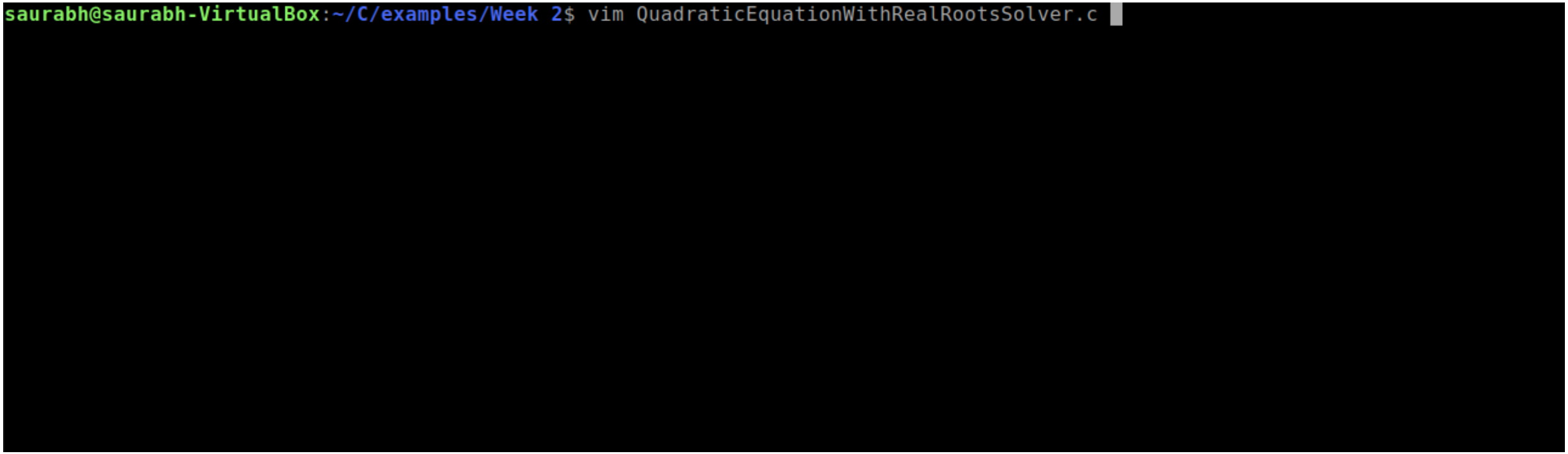

We begin by creating a new file, with extension `.c`

… and this is our first C Program

```c
#include <stdio.h>
#include <math.h>

int main()
{
        int a = 1;
        int b = 2;
        int c = -15;

        int D = b * b - 4 * a * c;

        double rootD = sqrt(D);

        double x1 = (-b + rootD) / (2 * a);
        double x2 = (-b - rootD) / (2 * a);

        printf("The roots of the equation (%d)x^2 + (%d)x + (%d) = 0 are %lf and %lf", a, b, c, x1, x2);
        return 0;
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Ignore this part for now !!

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Focus on this part

Inspecting sections of the code

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Let us start here

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This is why, a, b and c are variables – they appear here at the LHS of the = sign

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What this statement essentially instructs your computer to do is:

1. Reserve some space in main memory to store one **integer**
2. Create a name for that location – **a**; from now on, every time I say “a”, just understand I am talking about this memory location.
3. Store the integer **1** at that memory location

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Library functions are made available to you “on demand” (not by default)

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Usually, one header file contains many library functions

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We will have a look in the next lecture, where you should ideally use them (and where they are not really required)

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We will discuss main() at length, later… for now, just understand that all the code you write, lies "inside" the `main()` procedure

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- … and we provide the name of the variables, in that order, after the String

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- This order should match the "placeholders" in the string
- These placeholders, also called format specifiers, are fixed for a particular type of value
- For integers, it is `%d`, and for real numbers it is `%lf`
- The variables that we provide as arguments, must honour the order in which format specifiers are provided

“Running” the first C Program (1/3)

```
saurabh@saurabh-VirtualBox:~/C/examples/Week 2$ vim QuadraticEquationWithRealRootsSolver.c
saurabh@saurabh-VirtualBox:~/C/examples/Week 2$ gcc QuadraticEquationWithRealRootsSolver.c
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The syntax to use `gcc` is: `gcc <name of a C code file>`

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collect2: error: ld returned 1 exit status
```

… well… usually it will work !! But this time, we need a little more

The problem is that `sqrt()` library function !! Actually, `gcc` doesn’t know where to find it…

Basically, it doesn’t know what “library” does it need to bring, while compiling your code… but you can give that information

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The “translated code”, which your computer can understand, is saved to a file called `a.out` in the current directory

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saurabh@saurabh-VirtualBox:~/C/examples/Week 2$ gcc QuadraticEquationWithRealRootsSolver.c -lm
saurabh@saurabh-VirtualBox:~/C/examples/Week 2$ ./a.out
The roots of the equation (1)x^2 + (2)x + (-15) = 0 are 3.000000 and -5.000000saurabh@saurabh-VirtualBox:~/C/examples/Week 2$
```

Actually, `gcc` does not “link” all the libraries that come with it by default, when it compiles a program

“Linking” is a process, where you can supply libraries written by other developers, for use with your code

The “translated code”, which your computer can understand, is saved to a file called `a.out` in the current directory

Which, when called on shell, shows you the “output” of the program !!

Homework !! (They'll get intense now…)

Since the memory allocated to a variable is "limited", there are some restrictions on the values

- For example, a variable of type `int`, can only store `65536` possible integers (can you find out why?)
- Find out more about the range of other types of variables

Also, see if you have any control over "which" 65536 values it would be !!

- Is it possible to "store more positive numbers", if you do not require the variable to "store negative values"
- See if you can get some hints here: https://www.cs.utah.edu/~germain/PPS/Topics/unsigned_integer.html

There are many types of variables that you can create in C, in addition to `int` and `double`

- Read about other data types in C
- Also, find out their associated format specifier to use, with the `printf()` function
- A good starting point is this link: https://www.programiz.com/c-programming/c-data-types

Additional Reading

See if you can grasp something from the discussions at this page https://stackoverflow.com/questions/10409032/why-am-i-getting-undefined-reference-to-sqrt-error-even-though-i-include-math