Introduction to Programming

Week – *3*, Lecture – *1*

Conditionals in C – Part 1

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IIT KANPUR

The use of braces

Procedure QuadraticEquationSolver

```
    Inputs: a, b, c

    D = b * b - 4 * a * c;
    if (D = 0)
    {
        x1 = x2 = -b / (2 * a)
    }
    else if (D > 0)
    {
        x1 = (-b + √D) / (2 * a)
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Remember the full pseudocode for solving Quadratic Equations?

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Remember the full pseudocode for solving Quadratic Equations?

What purpose did these braces serve?

They simply marked start and end of a set of steps for a particular scenario

Code “blocks”

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There is a code block for the `main()` method, inside which, we wrote the code in previous examples

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

int main()
{
        int a, b, c, D;

        printf("Please formulate your equation in the form ax^2 + bx + c = 0\n");
        printf("Then provide the values for the parameters in the order a, b and c\n");
        printf("Example: a=1, b=2, c=-15\n");
        scanf("a=%d, b=%d, c=%d", &a, &b, &c);

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

        double rootD = sqrt(D);

        double x1 = (-b + rootD) / (2 * a);
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        printf("The roots of the equation (%d)x^2 + (%d)x + (%d) = 0 are %lf and %lf\n", a, b, c, x1, x2);
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}
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These are the braces I am talking about !!

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There is a code block for the `main()` method, inside which, we wrote the code in previous examples

- Since we have not yet used any branching, it means the code inside the block is executed *sequentially*
- This means, “all the instructions” of the program will be executed

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- Since we have not yet used any branching, it means the code inside the block is executed *sequentially*
- This means, “all the instructions” of the program will be executed

But sometimes, not all the instructions in a program should be executed in every case

- For example, if `D < 0`, you would not like the following statement to be executed:
  `double rootD = sqrt(D);`
- For this you need some “branching” mechanism

What is branching?

Remember the Program Counter or PC register?

- It gets incremented by one after each instruction is executed
- … this is the default processing mode of a computer, unless it is not explicitly changed
- … something like the first law of motion !! ;)

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- … like in our example, you would like different instructions to be executed for different values of `D`

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All programming languages provide constructs for branching

- At Assembly level, we have instructions to explicitly change the value of PC to something else

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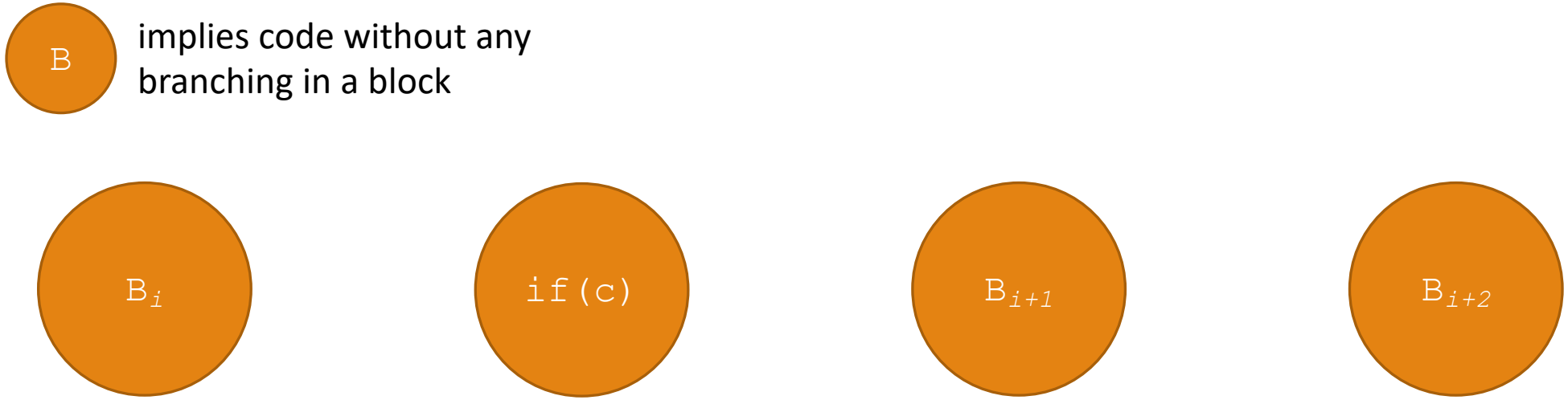

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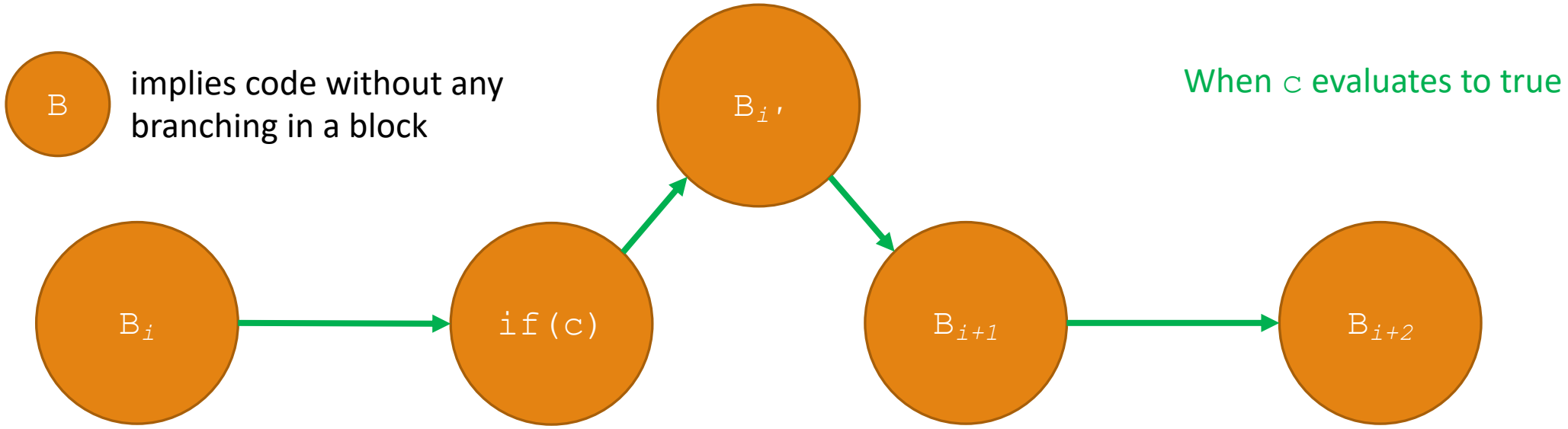

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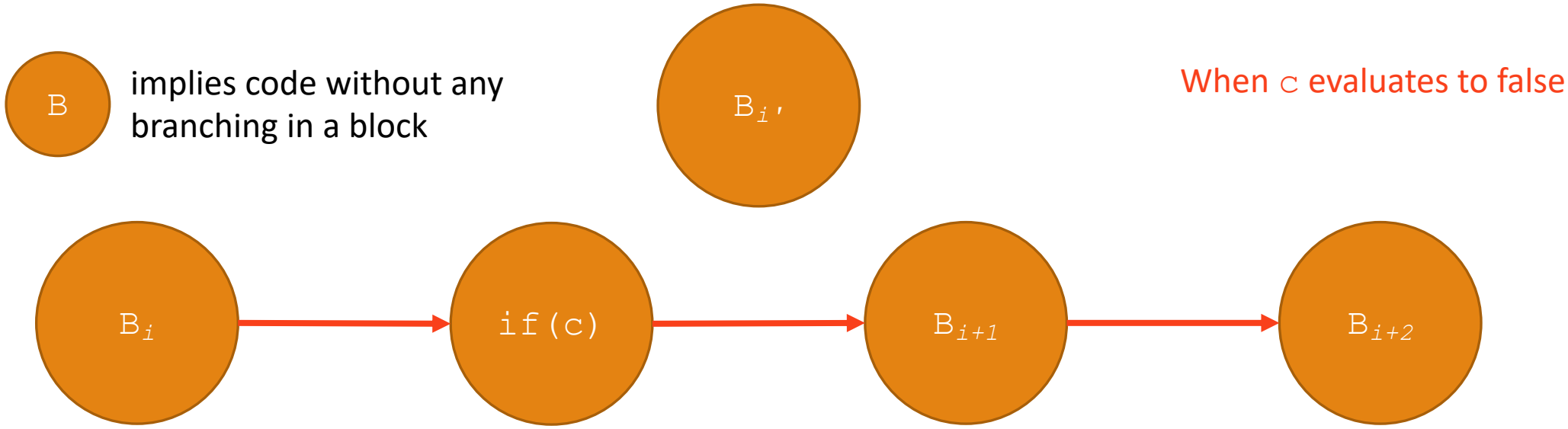

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        printf("... and the maximum  marks: ");
        scanf("%d", &maximum);

        float percentage = 100.0 * total / maximum;

        if(percentage >= 75) {
                printf("Looks like you got a Distinction !!\n");
        }

        printf("You got %f%% marks\n", percentage);
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$B_{i'}$

B_{i+1}

The `if` construct

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saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ gcc -o PercentageCalculator DistinctionPrinter.c
saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ ./PercentageCalculator
Tell me your total marks: 395
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Since the condition is true, the evaluation goes on like:

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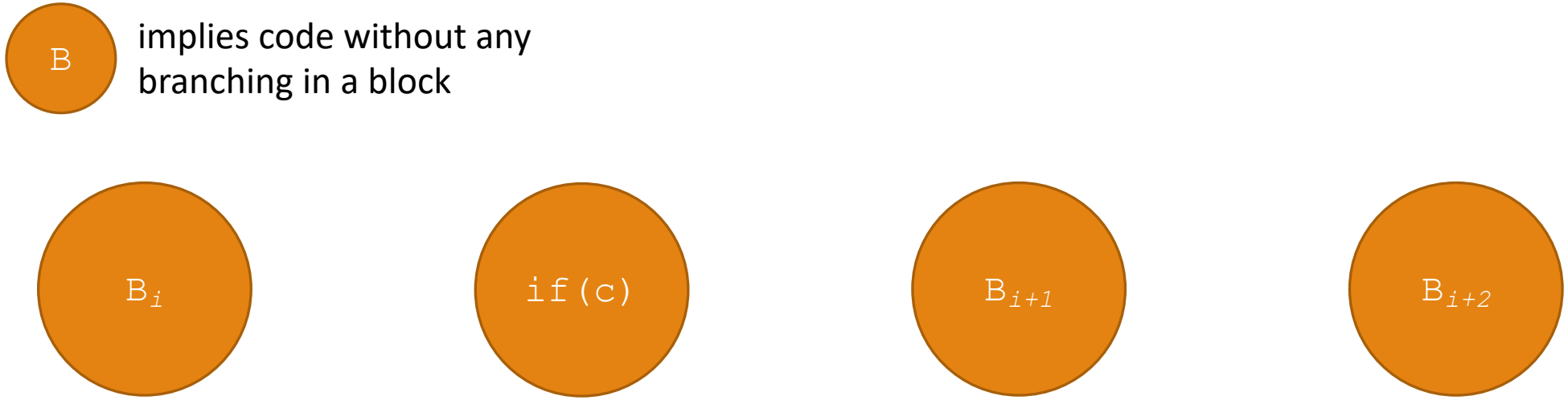
The `if-else` ladder

An `if` statement can be accompanied by an `else` statement to allow another detour



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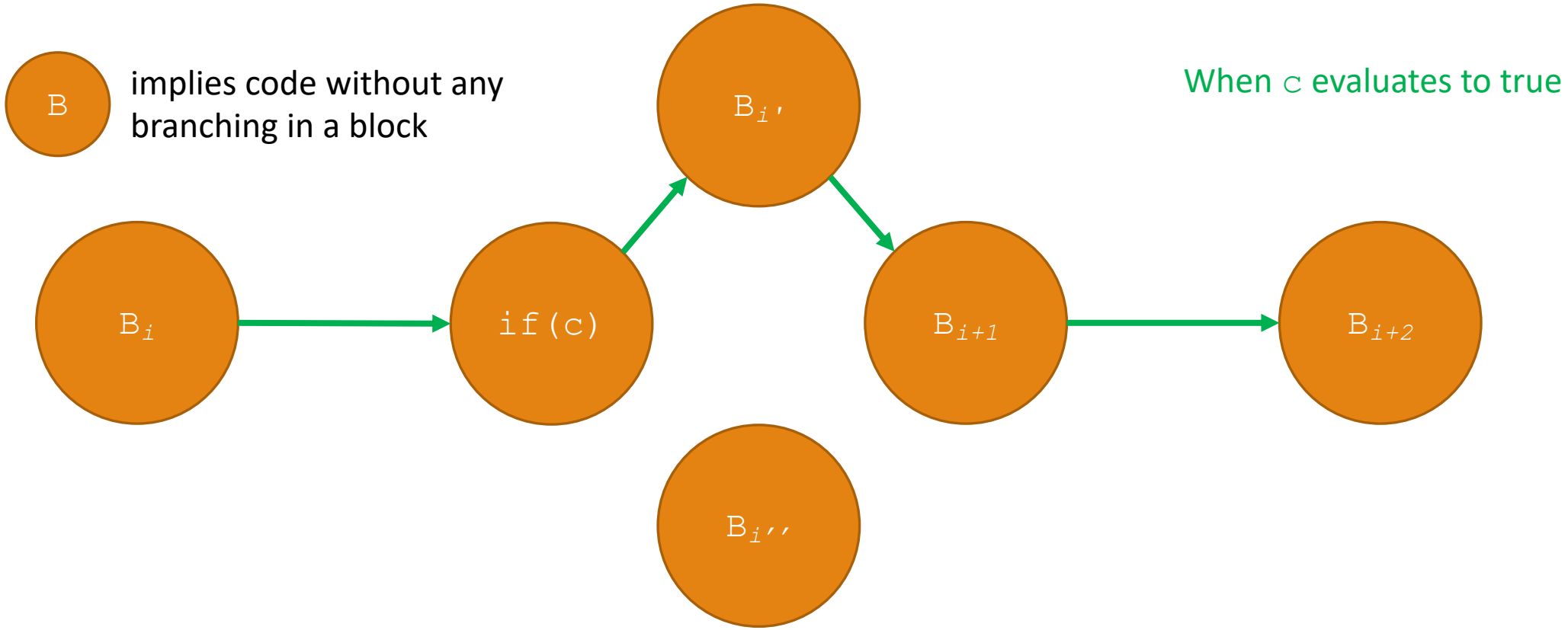

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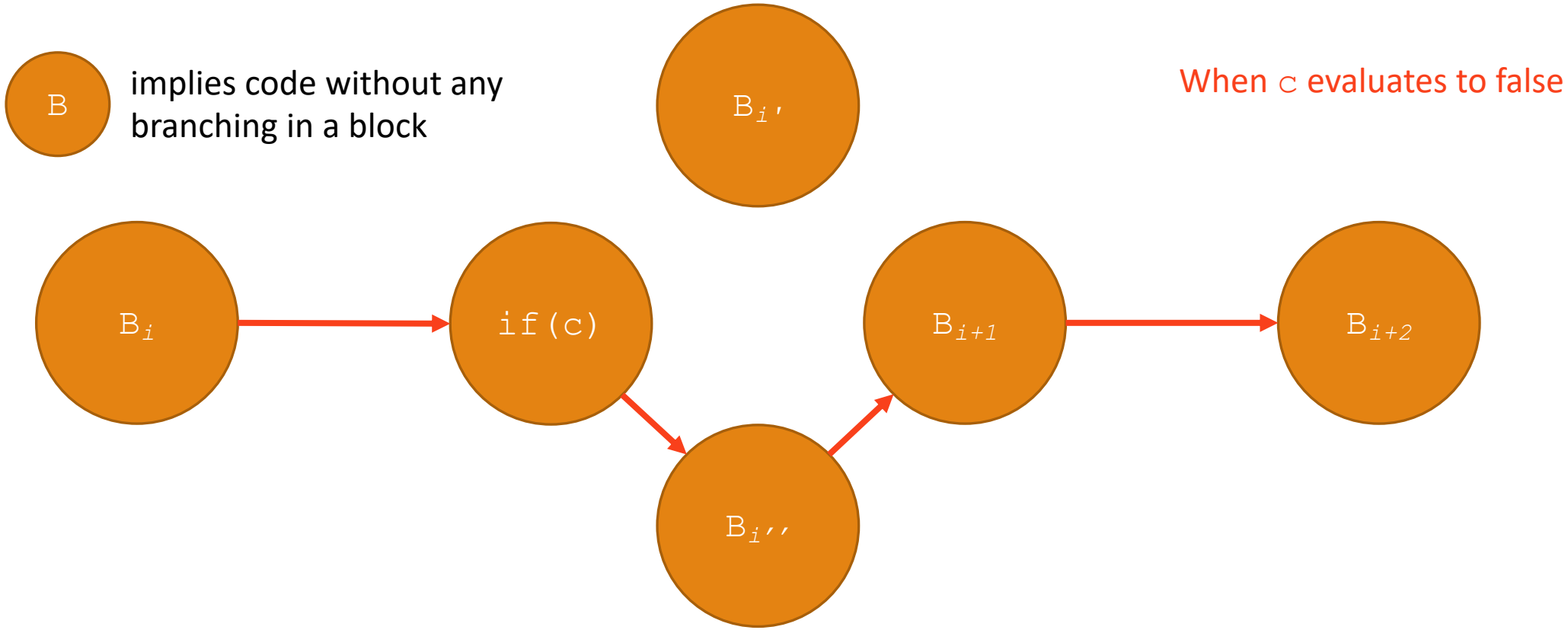

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An if statement can also be added right after an else, to create an `if-else-if` ladder

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

        if(D == 0) {
                double x = -b / 2 * a;
                printf("The root of the equation (%d)x^2 + (%d)x + (%d) = 0 is %lf\n", a, b, c, x);
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        return 0;
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Something like this !!

Finer points about conditions in C – (1/3)

A condition always results an `int` value after evaluation

- This value is 0 if the condition is false, and non-zero (usually 1) if the condition is true

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One of the most common confusions for beginners in C, is the difference between = and ==

- = is assignment, it "assigns" the "value" on the right to a "variable" on the left
- You **cannot** have a constant on the LHS of =; on RHS, you can have either a variable or a constant
- == is a condition, it "checks" if the "value" on the right is equal to the "value" on the left
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Assignment operator also "returns" a value – the value on RHS

- So, if you write something like this by mistake: `if(i = j)` instead of `if(i == j)`
- there won't be an error, but will be evaluated as true, if `j` is anything but `0`

Finer points about conditions in C – (2/3)

The statements to execute when a particular condition is true (or false) are put inside braces

- Basically, you create a code block for each case

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However, they have higher precedence than assignment and logical operators

Finer points about conditions in C – (3/3)

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Finer points about conditions in C – (3/3)

What if you need to create a more complex condition?

You can use the logical operators

Finer points about conditions in C – (3/3)

What if you need to create a more complex condition?

You can use the logical operators

C has three logical operators to represent the three operations in Boolean Algebra

- && is the operator to represent AND operation
- || is the operator to represent OR operation
- ! Is the operator to represent NOT operation

Using logical operators in conditions

```c
#include<stdio.h>

int main()
{
        int total, maximum;

        printf("Tell me your total marks: ");
        scanf("%d", &total);

        printf("... and the maximum  marks: ");
        scanf("%d", &maximum);

        float percentage = 100.0 * total / maximum;

        int passed = percentage >= 33;

        if(!passed)
        {
                printf("Sorry.. you have failed :(\n");
        }
        else {
                if(percentage >= 90)
                        printf("You are doing great !!\n");
                else if(percentage < 90 && percentage >= 75)
                        printf("You are doing well, kep going !!\n");
                else if(percentage < 75 && percentage >= 50)
                        printf("Keep working hard, you can do it !!\n");
                else
                        printf("There's still time... push hard !!\n");
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Similarly, || (not used in this example) would have returned true, if any of the condition was true

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```
saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ vim DetailedPercentageCommentator.c
saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ gcc -o DPC DetailedPercentageCommentator.c
saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ ./DPC
Tell me your total marks: 50
... and the maximum  marks: 500
Sorry.. you have failed :(
You got 10.000000% marks
saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ ./DPC
Tell me your total marks: 300
... and the maximum  marks: 500
Keep working hard, you can do it !!
You got 60.000000% marks
saurabh@saurabh-VirtualBox:~/C/examples/Week 3$ ./DPC
Tell me your total marks: 390
... and the maximum  marks: 500
You are doing well, kep going !!
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saurabh@saurabh-VirtualBox:~/C/examples/Week 3$
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You can see how different code blocks get executed in different cases

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

Find out what `-o` switch does with gcc

- While you are at it, also find out about `-g` and `-c` switches

In the examples related to calculation of percentages

- … replace "`100.0`" with "`100`", and try out some inputs
- Do you find anything interesting? Find out the reasons behind that !!
- May be this link could help you understand: https://stackoverflow.com/questions/3602827/what-is-the-behavior-of-integer-division

Read more about implicit and explicit type conversions in C

- See this link for getting an overview: https://www.guru99.com/c-type-casting.html