

FUNDAMENTALS OF PROGRAMMING WITH C#

INTRODUCTION TO PROGRAMMING

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Total: 24

Agenda

- What is Programming?
- Software Development Lifecycle
- Different kind of software
- Programming Languages
- Algorithms
- Explore programming with Blockly Games

What is Programming

Making computers do what you want them to do
by expressing your intentions and instructions
clearly in a structured and un-ambiguous way



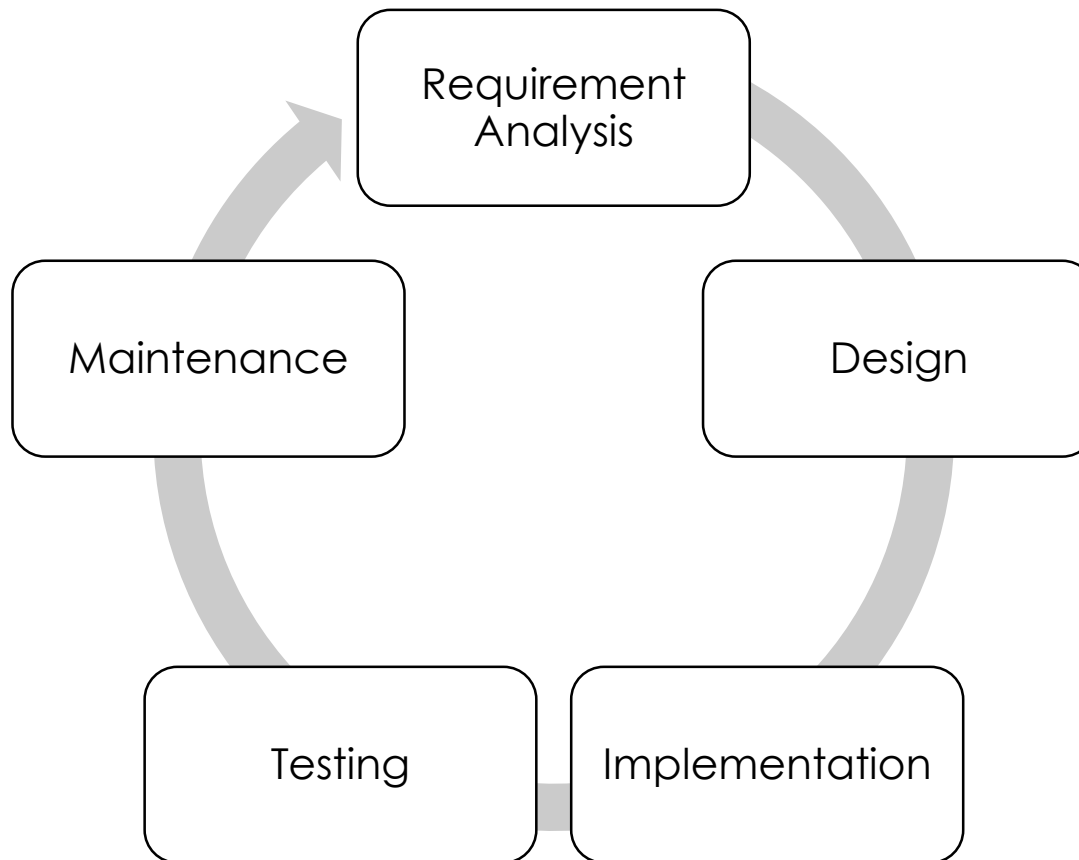
programming language

Application of Programming

- Many different domains and industry
 - Websites
 - Apps
 - Games
 - Robots
 - Self-driving cars
 - Infrastructures
 - Healthcare
 - Entertainment
 - Arts
 - Movies special effects
 - And many more...

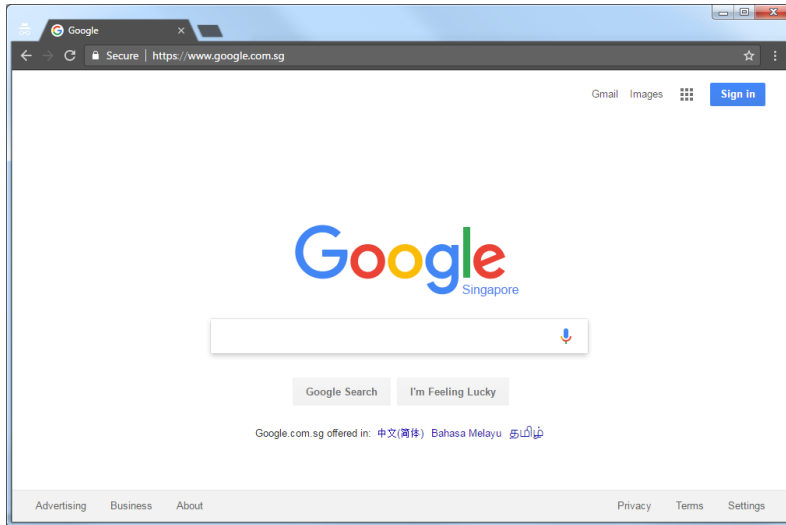
Software Development Life Cycle

How people build software?



At which stage would programming skill be needed?

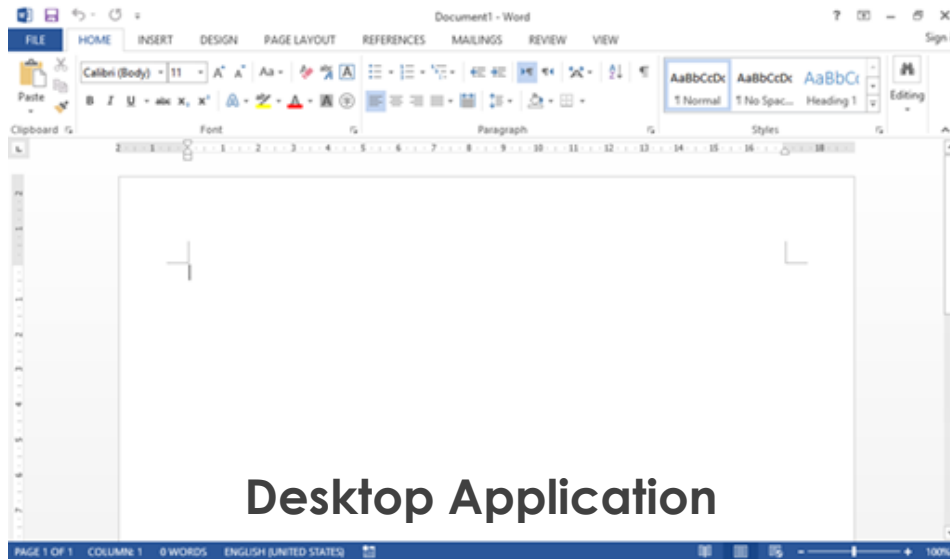
Different Kinds of Software



Web Application



Mobile Application



Desktop Application



Embedded Application

Software, Application and Program

- Software
 - A collection (or a package) of data and computer instructions (or programs) that tell computer how to work
 - Can contains computer programs, libraries, and data (such as documentation and digital media)
 - Software vs. hardware: digital vs physical assets
 - There are many different kinds of software e.g.: application, operating systems, etc.
- Application (or application software)
 - Software designed for users which contains a group of coordinated functions, tasks or activities

Software, Application and Program

- System Software
 - Software that directly operates the hardware
 - Operating System: provide common services to run other software. E.g. Microsoft Windows, Linux, MacOS, Android, iOS
 - Device Drivers: software that allows operating system to control a particular type of device
- Program
 - A collection of instructions that performs a specific task when executed by a computer
 - Written by computer programmers using a programming language and stored as source code file(s).
 - A program may be compiled by a compiler into machine code that can be executed directly by machine (e.g. C language), or
 - A program may be executed directly from the source code by an interpreter (e.g. Python, JavaScript)

Software, Application and Program

- Library
 - A packaged collection of behaviour or capabilities that can be called (or invoked) by a program.
 - Libraries allows programs to be written more productively because common behaviour and functionality can be packaged into libraries and made available for the programmers.
 - Programming languages have standard libraries that is shipped by default with the programming tools.

Programming Language

- A language system used to instruct computers
 - Each language has their own syntax and rules

4GL Language
High Level Language
Low Level Language
Assembler Language
Machine Language

Higher level = close to how human
express themselves



Lower level = closer to the
technical implementation of the
computer

Programming Language

Assembly Language (Low Level)

```
mov ax, 0x000D    ; set 320x200 graphics mode
int 0x10          ; bios video services
mov ax, 0x0C07    ; put pixel in white color
xor bx, bx        ; page number 0
mov cx, 200       ; x position 200
mov dx, 100       ; y position 200
l1: int 0x10       ; bios video services
dec dx            ; decrease y position
loop l1           ; decrease x position and repeat
mov ah, 0         ; service 0 - get keystroke
int 0x16          ; bios keyboard services
mov ax, 0x0003    ; 80x25 text mode
int 0x10          ; bios video services
mov ax, 0x4c00    ; terminate program
int 0x21
```

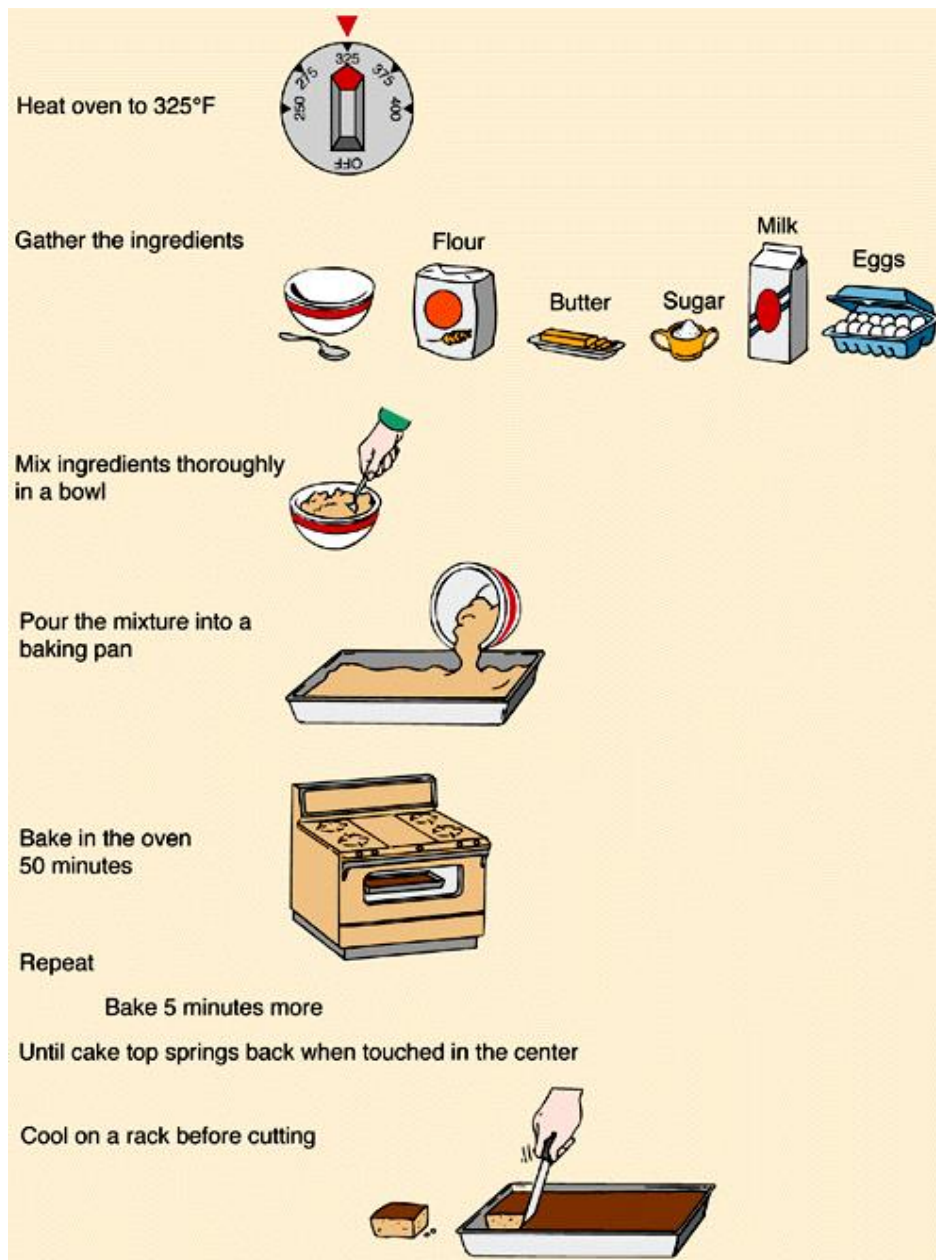
```
SELECT NAME, AVG(GRADE)
FROM STUDENT JOIN TERM1_GRADES
ON STUDENT.STUDENT_ID = TERM1_GRADE.STUDENT_ID
WHERE TERM1_GRADES.CLASS = 'ABC'
```

Standard Query Language / SQL (High Level)

- In many programming languages, you are supposed to write the program as a procedure to do something

`al-go-rithm` : an ordered set of steps to solve a problem.

- Good algorithm should be:
 - Unambiguous
 - Have a defined set of input
 - Produce a defined set of output
 - Guaranteed to terminate
 - Guaranteed to produce a correct result



unambiguous

defined set of input

produce a defined output

always terminate

always produce correct result

Testing and Debugging

Programming	writing procedures to achieve an objective
Testing	executing the program to check that the program can achieve the objective
Bug	problem in the program that prevent the program to achieve the objective in some or all situations
Debugging	fixing a bug in your program

Programming Concepts

- Variables
 - Named storage for values
- Data Types
 - Different kind of values
- Expressions
 - Computation done on one or many values
- Conditionals
 - Provide a condition when the instruction should be performed
- Repetitions (loops)
 - Repeat a set of instructions until certain condition is met
- Function/Procedure/Method
 - A named set of instructions with a defined input and output

Example – Bubble Sort

- Bubble sort, sometimes referred to as sinking sort, is a simple sorting algorithm that repeatedly steps through the list to be sorted, compares each pair of *adjacent* items and swaps them if they are in the wrong order. The pass through the list is repeated until no swaps are needed, which indicates that the list is sorted.
- The algorithm, which is a comparison sort, is named for the way smaller elements "bubble" to the top of the list.

https://en.wikipedia.org/wiki/Bubble_sort

Example – Bubble Sort

- Bubble sort Algorithm:
 - Step 1. Begin with the first element.
 - Step 2. Look at the element just to the right of it
 - Step 3. If the element to the right should come before the element on the left, swap them so that they are in order
 - Step 4. Compare the next element in line, and repeat step 3. Do this until you run out of the array.
 - Step 5. Then repeat the process for $n-1$ passes when n is the number of elements in the array

Example – Bubble Sort

- Illustration

Unsorted Array: 8 5 7 3 1

Bubble Sort, $N = 5$, so there will be $N-1$ i.e. 4 pass

Iteration 1: 8 5 7 3 1 → 5 8 7 3 1 → 5 7 8 3 1 → 5 7 3 8 1 → 5 7 3 1 8

Iteration 2: 5 7 3 1 8 → 5 7 3 1 8 → 5 3 7 1 8 → 5 3 1 7 8 → 5 3 1 7 8

Iteration 3: 5 3 1 7 8 → 3 5 1 7 8 → 3 1 5 7 8 → 3 1 5 7 8 → 3 1 5 7 8

Iteration 4: 3 1 5 7 8 → 1 3 5 7 8 → 1 3 5 7 8 → 1 3 5 7 8 → 1 3 5 7 8

<https://dotnettutorials.net/lesson/bubble-sort-algorithm-in-csharp/>

Example – Bubble Sort in C#



```
static void BubbleSort(int[] array)
{
    for (int i = 0; i < array.Length - 1; i++)
    {
        for (int j = 0; j < array.Length - 1; j++)
        {
            if (array[j] > array[j + 1])
            {
                var temp = array[j + 1];
                array[j + 1] = array[j];
                array[j] = temp;
            }
        }
    }
}
```

First Step to Programming



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English



Games for tomorrow's programmers. [More info...](#)



Instructions

- Try the different games
- It is OK to get stuck in some level. Discuss with others to compare notes and ideas. It will help to cultivate your programming skills
- You may not be able to come up with general solution to the problem because you are only allowed to use limited number of capabilities.
- Don't give solution to others unless you're asked. Giving hint is probably better than direct solution – respect other people's rights to learn

Expected skills learned

- Maze
 - Path finding
 - Repetition and condition
- Bird
 - Setting up a rule
- Turtle
 - Programmatic drawing
 - State management
- Movie
 - Keyframe animation
 - Variables and expression
- Pond
 - Autonomous agent like robots

Summary

- What is programming?
- How do you program a computer software?
- Where does computer software located?

References

- Blockly Games
 - <https://blockly-games.appspot.com/>
- Scratch - a drag and drop programming language
 - <https://scratch.mit.edu/>