Chapter 2: Introduction to C++

Computer Program Basics

- Program
  - A series of instructions executed by the computer
- Instruction Types
  - Input
  - Process
  - Output
- Variables
  - Refer to data
- PA: A first programming activity

Programming Basics

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Computational Thinking

- **Algorithm**:A sequence of instructions to solve a problem
- PA: Computational Thinking

Programming Basics

- ZyBooks Development Environment (ZyDE)
  - A first program

Basic Input: cin

- ZyDE: Basic Input

Basic Output: String Literals

```
#include <iostream>
using namespace std;

int main() {

    cout << "Keep calm";
    cout << "and";
    cout << "carry on";

    return 0;
}
```

Basic Output: Variables

```cpp
#include <iostream>
using namespace std;

int main() {
   int wage;

   wage = 20;

   cout << "Wage is: ";
   cout << wage;
   cout << endl;
   cout << "Goodbye.";
   cout << endl;

   return 0;
}
```

Basic Output: Compound Statements

- ZyDE: Single output statement

Challenge Activities

- Enter the output
- Fix the output
- Read and output multiple inputs

Comments and White Space

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Coding Style

- Everyone has their own coding style
- General rule: Be consistent within a codebase
- Some organizations have very specific style guides, e.g.
  - Maximum line length
  - Indentation
  - Bracket style
  - Comments
  - etc.

Comments

- Comments Example

Whitespace

- Blank spaces between items and blank lines between statements
  - Ignored by the compiler
- Good use of whitespace
- Bad use of whitespace

Errors and warnings

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Syntax Errors

- Syntax Error Example
- Misleading error message
- zyDE: Fixing syntax errors
- Strategies
  - Fix the first error and then recompile
  - Compile frequently

Logic Errors

- Code compiles, but does not work properly
    - i.e. a bug
- Logic error example
- ZyDE: Fix the bug

Compiler warnings

```
if ( x = 5 )
{
    /*..*/
}
```

Compiler warnings

```
main{}
{
    int total;

    cout << total;
}
```

Computers and programs

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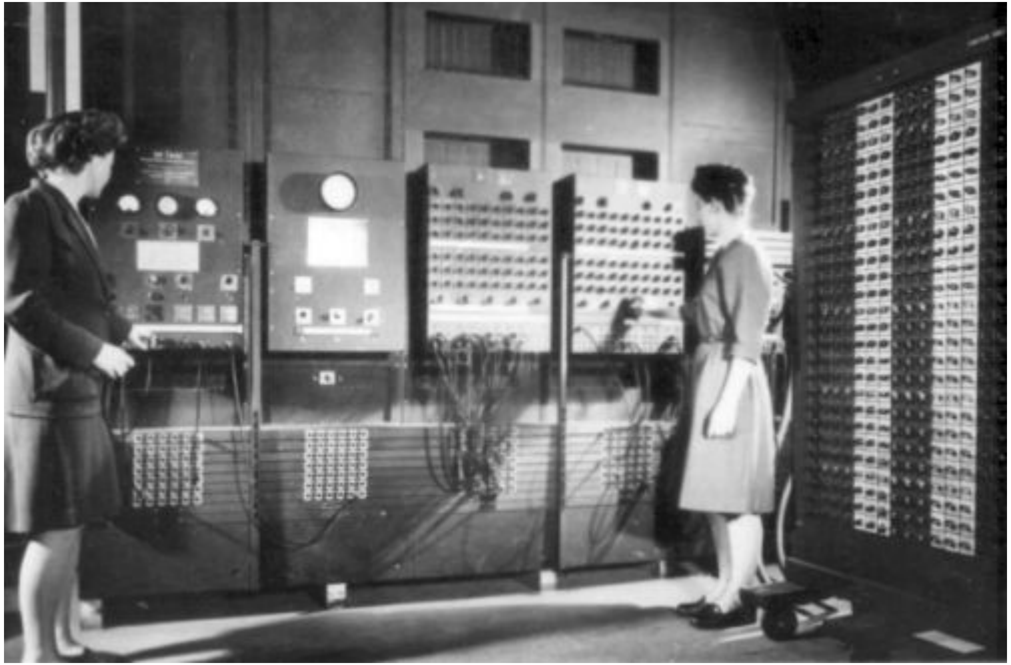
Switches

- 1800s: Manual switches
- Early 1900s: Electronically controlled switches
  - Positive voltage allows electricity to flow, zero voltage prevents it
  - Used (e.g.) to route telephone calls
- Electronically controlled switches can be used to perform simple calculations
  - Positive voltage => 1, Zero voltage => 0
  - aka bits (binary digits)
- Circuits
  - Collections of switches to perform calculations

Early Computers

- 1930s and 1940s



Processors and Memory

- Processors
  - Circuits created to process (execute) sequences of instructions
  - Millions or billions of switches
- Memory
  - Storage for instructions and data
  - Addressed by memory location

Instructions

- Sample processor executing instructions

Writing computer programs

- Machine instructions: binary
- Assembly language instructions
  - Low level processor commands
  - Converted to binary by the *assembler*
- High Level Languages
  - e.g. FORTRAN, ALGOL
  - Compiler: Translates high level language into either assembly language or machine instructions

Computer components

- Input/output devices
- Storage
    - disk, NVRAM
- Memory (RAM)
    - Stores bytes
- Processor
    - aka CPU
    - Operating System
    - Cache
- Clock
- PA: Computer Components

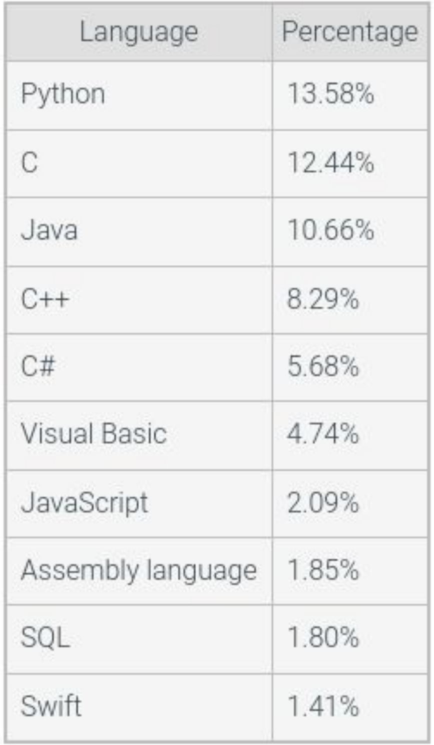
Moore’s Law

- Transistors
  - Smaller switches
- Integrated circuit (IC)
  - Multiple transistors on a single chip
- Moore’s Law
  - The capacity of IC’s doubles roughly every 18 months - 2 years
  - Held true for many years
- Currently: billions of transistors on an IC

Brief History of Programming Languages

1957	FORTRAN		1986	Objective C
1958	LISP		1987	Perl
1959	COBOL		1990	Python
1964	BASIC		1995	Ruby, Java, JavaScript
1969	B		2001	C#
1972	C		2003	Scala
1978	SQL		2009	Go
1980	C++ (C with classes)		2012	TypeScript

Languages Ranked by Search Popularity (2022)



Language	Percentage
Python	13.58%
C	12.44%
Java	10.66%
C++	8.29%
C#	5.68%
Visual Basic	4.74%
JavaScript	2.09%
Assembly language	1.85%
SQL	1.80%
Swift	1.41%

Programming vs. Problem Solving

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Matching Socks

- Three different colors of socks
- Why bother matching them? Just put them in a drawer and pull out a pair every day
- How would you ensure that you get a pair as quickly as possible every day?

Greeting People

- Meeting with 64 people
- Goal: Every person greets every other person at the meeting for 30 seconds
- How would you do it?

Sorting name tags

- 1,000 name tags sorted by first name
- Would like them sorted by last name
- How would you do it?

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Programming and Precision

Whitespace

- PA: Output formatting

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