C++ Program Design -- Introduction

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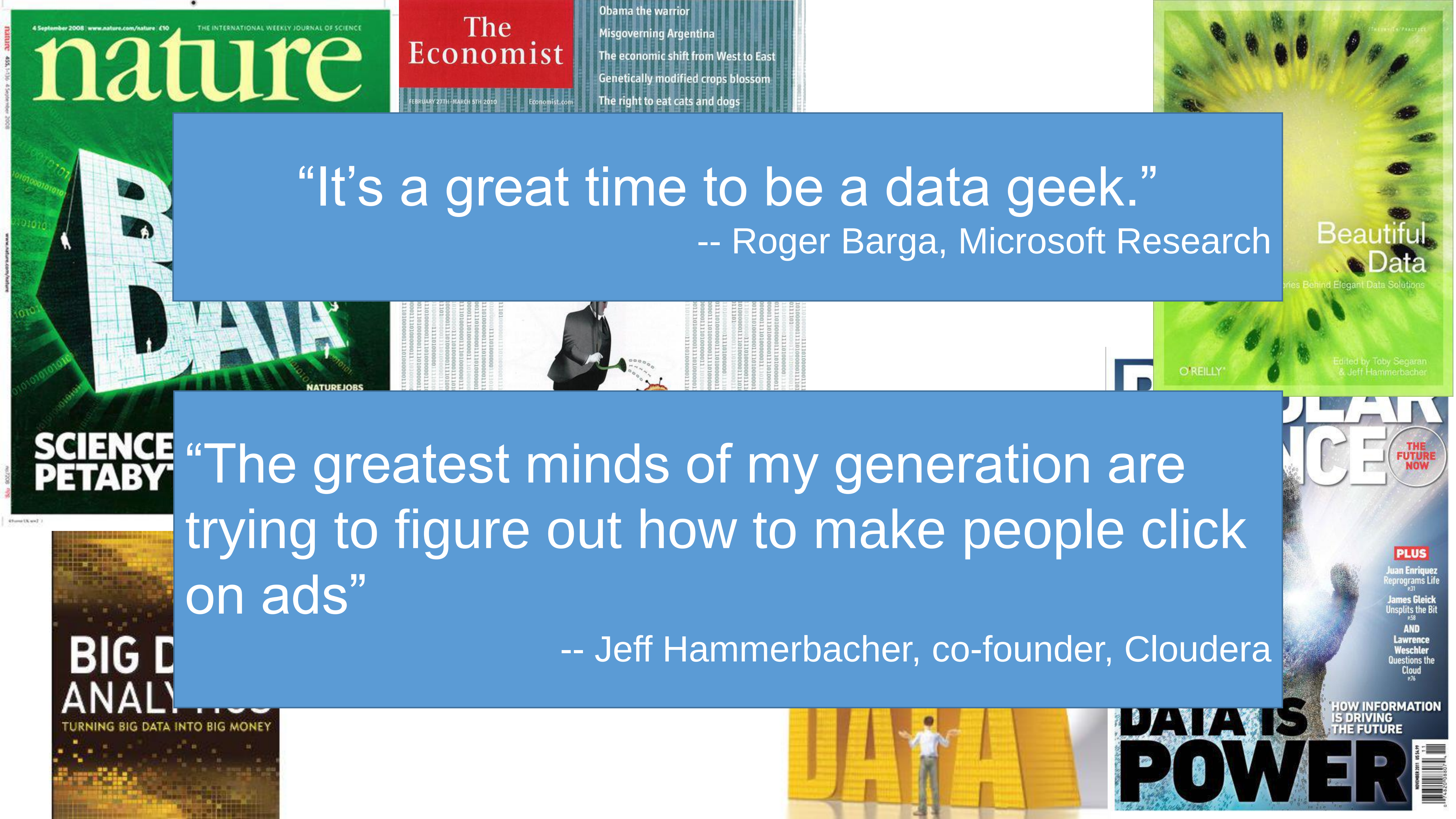
http://jjcao.github.io/cPlusPlus

- When human beings acquired language, we learned not just how to listen but how to speak.
- When we gained literacy, we learned not just how to read but how to write.
- And as we move into an increasingly digital reality, we must learn not just how to use programs but to make them.

- In the emerging, highly programmed landscape ahead, you will either create the software or you will be the software.
- It's really that simple: Program, or be programmed.
- Choose the former, and you gain access to the control panel of civilization. Choose the latter, and it could be the last real choice you get to make.

-- Douglas Rushkoff, in Program or Be Programmed: Ten Commands for a Digital Age (2010)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HOW INFORMATION IS DRIVING THE FUTURE
DATA IS POWER
BIG D
ANALY
TURNING BIG DATA INTO BIG MONEY

“It’s a great time to be a data geek.”

-- Roger Barga, Microsoft Research

“The greatest minds of my generation are trying to figure out how to make people click on ads”

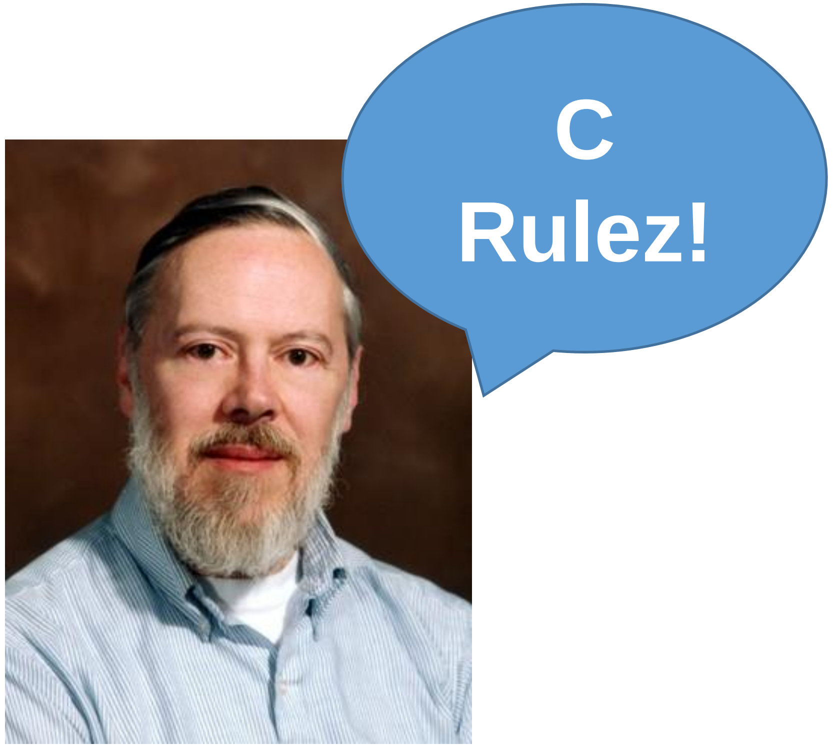
-- Jeff Hammerbacher, co-founder, Cloudera

Goal by the end of the semester

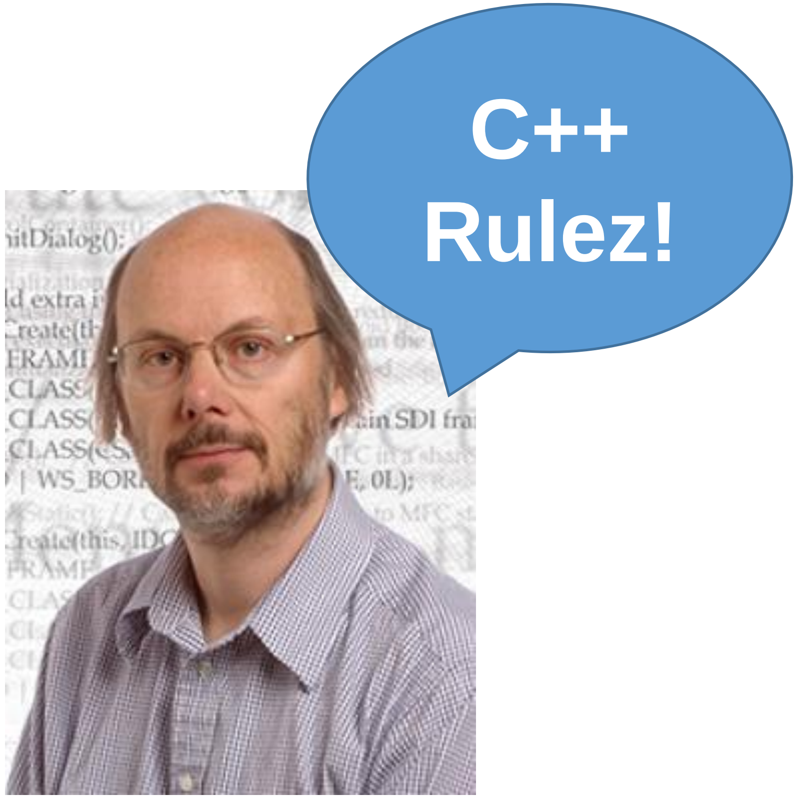
- Given a data source and a problem description, you can independently write a complete, useful program to solve the problem

Is Matlab the final weapon for us?

Why teaching C++



Dennis Ritchie



Bjarne Stroustrup

Why teaching C++

1. **Most common for research**, and some areas of **industry**.
2. Java and Python are not suitable for learning algorithms and data structures.
3. Lisp maybe better than C++ for leaning algorithms and data structures. But it is not so common and **limited** in research field.
4. **Matlab** is better for research, but sometimes c & c++ is still a necessary **complement**.
5. The most of **libraries** for science computation are still implemented in C++.
6. Java is not, generally, a **hard** enough programming language that it can be used to discriminate between great programmers and mediocre programmers.

C and C++’s philosophy

- Underlying design philosophy: “**trust the programmer**”
  - Wonderful
    - compiler will not stand in your way if you try to do something unorthodox that makes sense,
  - Dangerous
    - compiler will not stand in your way if you try to do something that could produce unexpected results.
    - That is one of the primary reasons why knowing **what you shouldn’t do** in C/C++ is almost **as important as knowing what you should do** -- because there are quite a few pitfalls that new programmers are likely to fall into if caught unaware.

Matlab, Python & C++

- Versatile
  - Python > C++ > Matlab
- Easy to master
  - Python (free) > Matlab (commercial)
  - Python leads to more beautiful & maintainable code
    - Programming courses in famous universities, CMU, MIT, etc.: c, c++ => Python
    - Big data analysis
- Performance
  - C++

Programming language & Thought

- Assembly language
- Computation: Fortran 1954
- System programming: C 1969, **C++** 1979, C# 1999, Objective-C
- Application: Java 1995, Java script, PHP
- Unix shell to everything: Perl, **Python**, Ruby
- Computation: **Matlab**, Mathematics, Mapple, R
- The"concept"of"programming"languages"are"quite"similar"

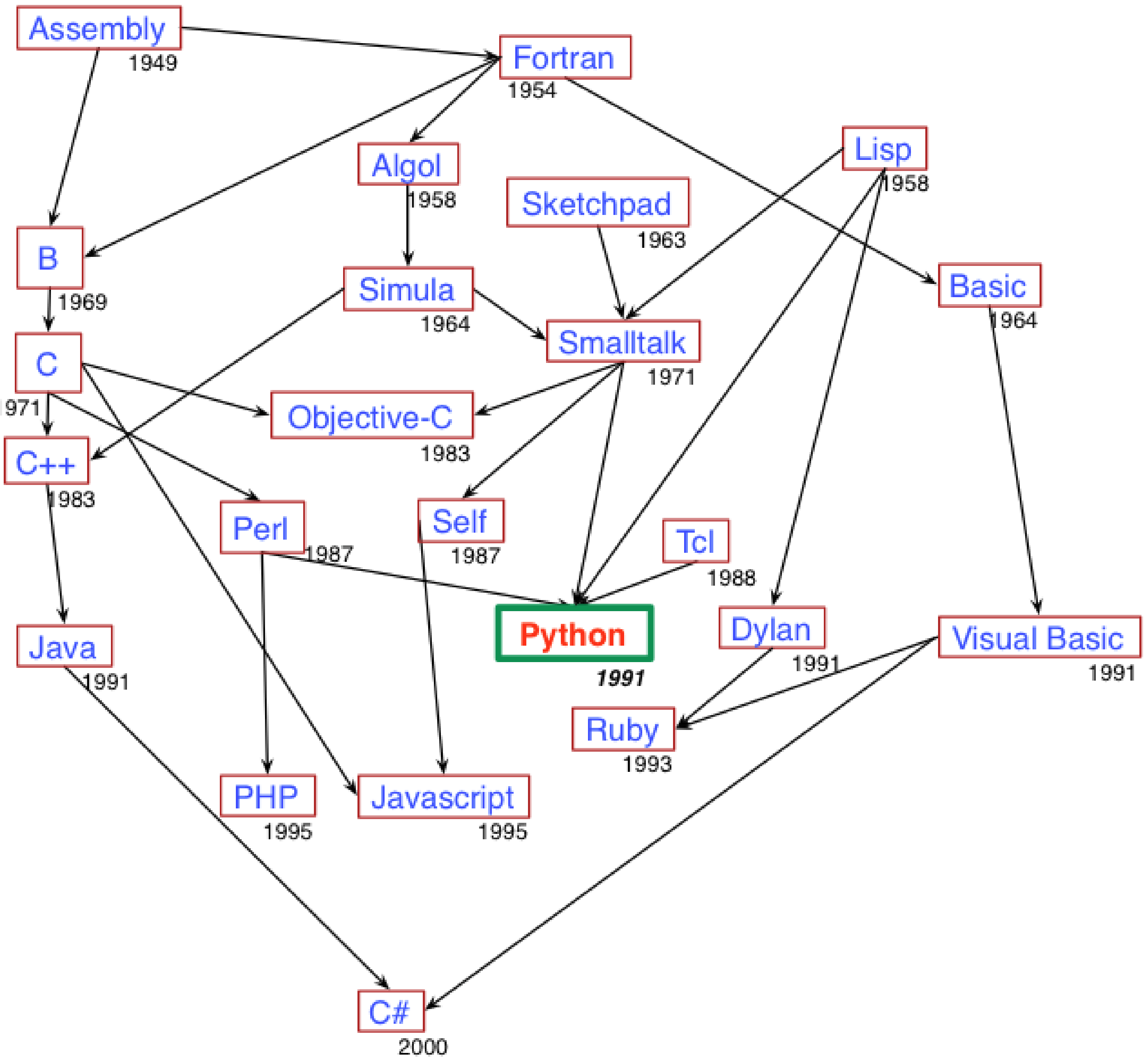
Language is the dress of thought.

~Samuel Johnson

But if thought corrupts language, language can also corrupt thought.

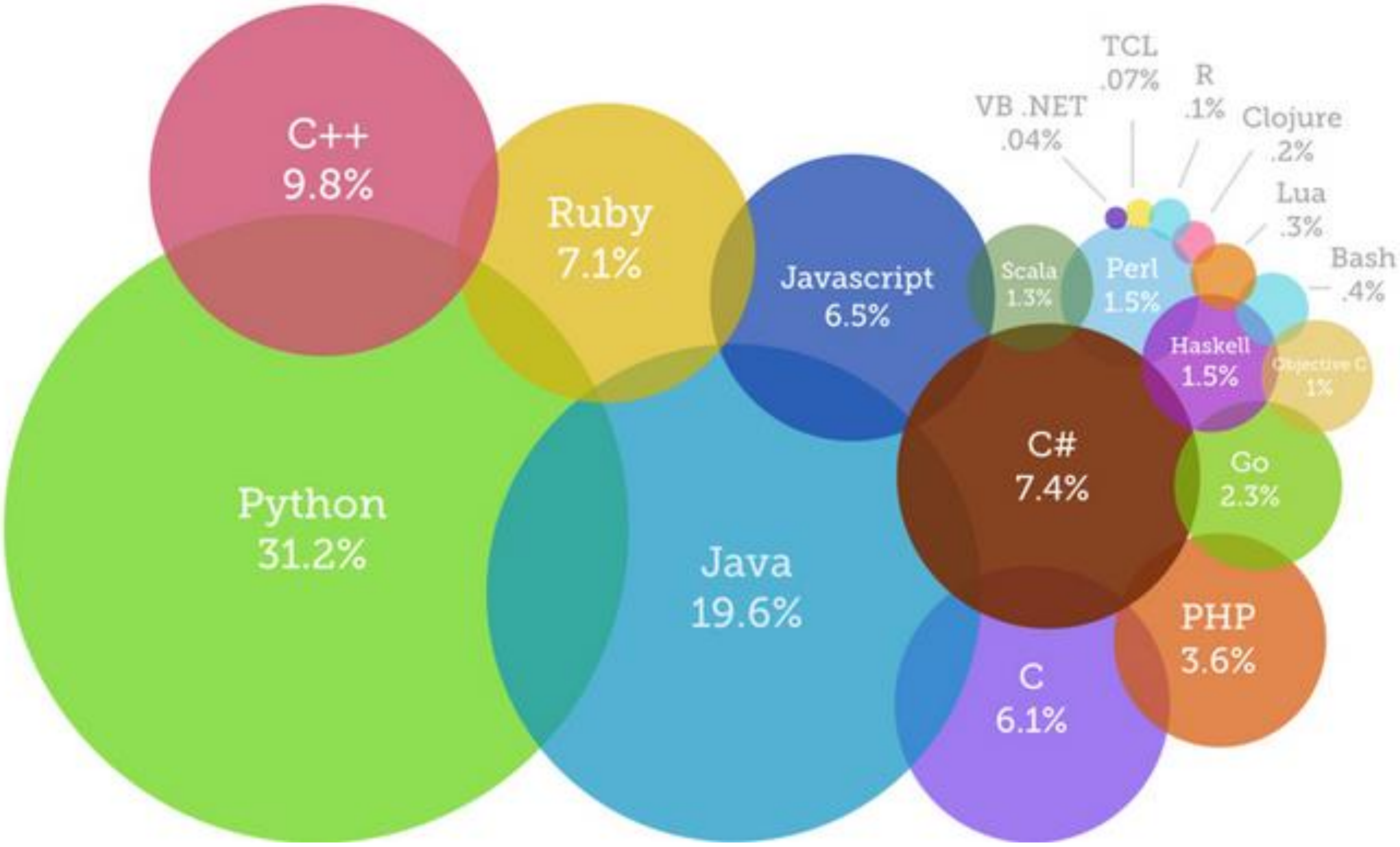
~George Orwell

Evolution of Programming Languages



http://web.cs.hacettepe.edu.tr/~bbm101

Most Popular Coding Languages of 2015



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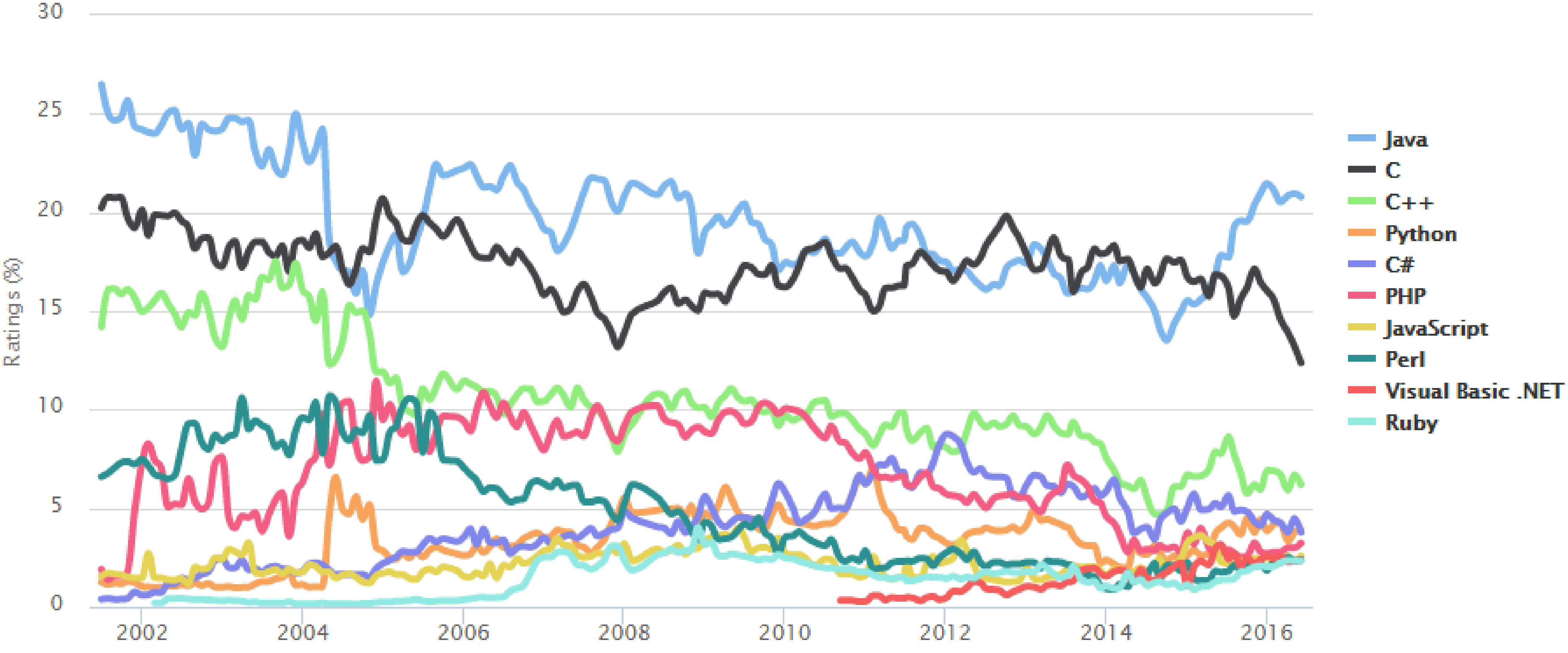


TIOBE Programming Community Index

Source: www.tiobe.com

Course Logistics

- Staff
  - Junjie Cao, http://jjcao.github.io
  - jjcao@dlut.edu.cn
- Website: http://jjcao.github.io/cPlusPlus/

How to Succeed?

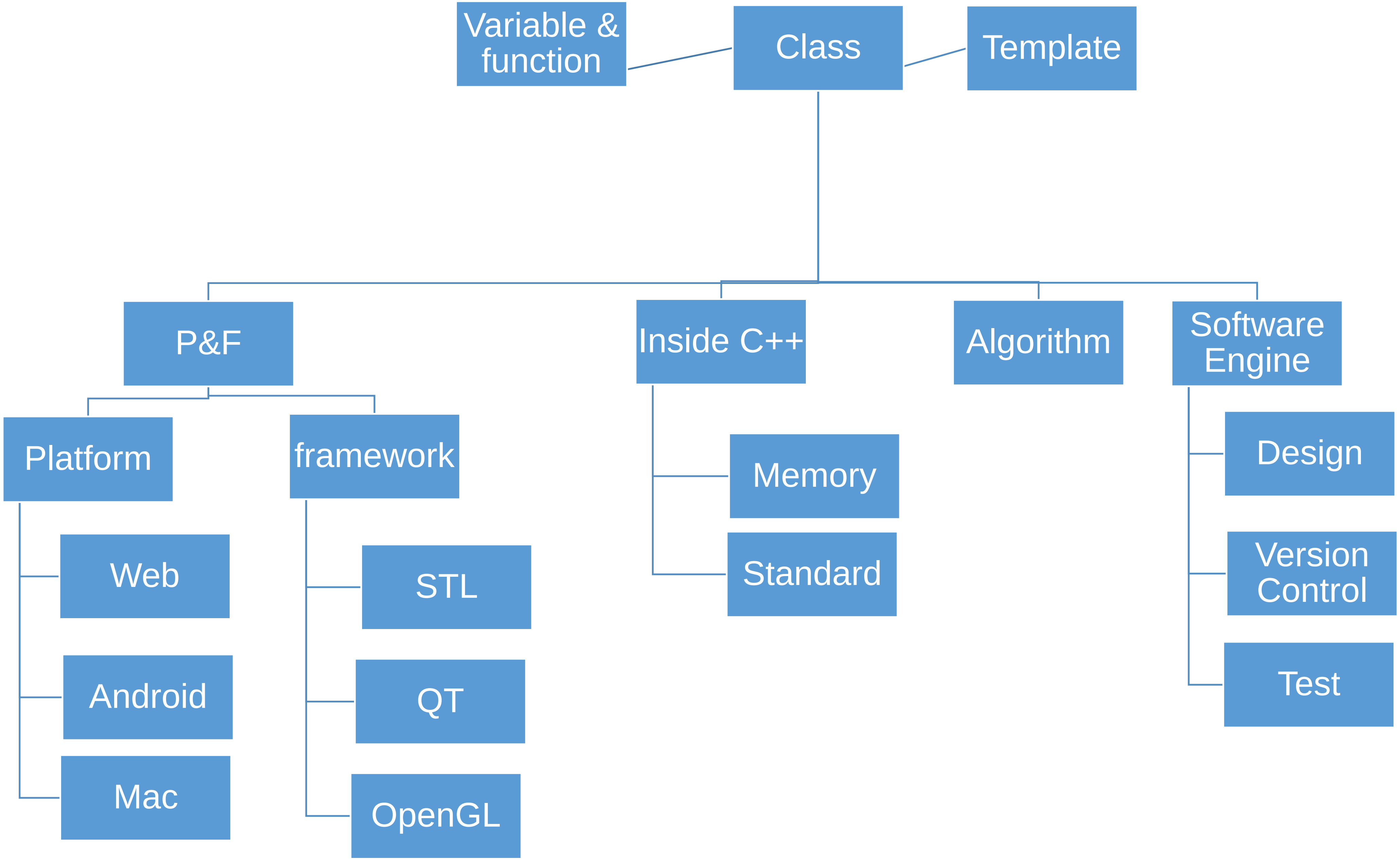
- **An introductory course, including C**
- **56 hours (32 talks + 24 practices) in 4 weeks**

- Every one of you can succeed
  - Little, even without programming background is acceptable
  - There is no such thing as a “**born programmer**”
  - **Work hard**
  - Follow directions
  - Be methodical: Think before you act
  - Try on your own, then ask for help
  - **Start early**

Research and Interview Oriented

- Scientist
  (**thesis** + research)

- IT, even other **job**
  (interview + work)



Variable & function

Class

Template

P&F

Platform

Web

Android

Mac

framework

STL

QT

OpenGL

Inside C++

Memory

Standard

Algorithm

Software Engine

Design

Version Control

Test

Objectives and Philosophy

Example driven

Interview question based

Examination

item	ratio
Attendance & Quizzes	30%
Exam	70%

Video

- The birth of the computer, George Dyson
- SageMath – Open source is ready to compete with Mathematica for use in the classroom, William Stein

程序员 vs 程序猿

General ideas about C++

- A computer is a **processor** with some **memory**, capable of running tiny **instructions** like “store 5 in memory locations 23459.”
- C++: **more abstract, easy**:
  - Conciseness: 1 = many
  - Maintainability: easier to modify
  - Portability: suitable for different types of processor

```
int main(){
     return 0;
}
```

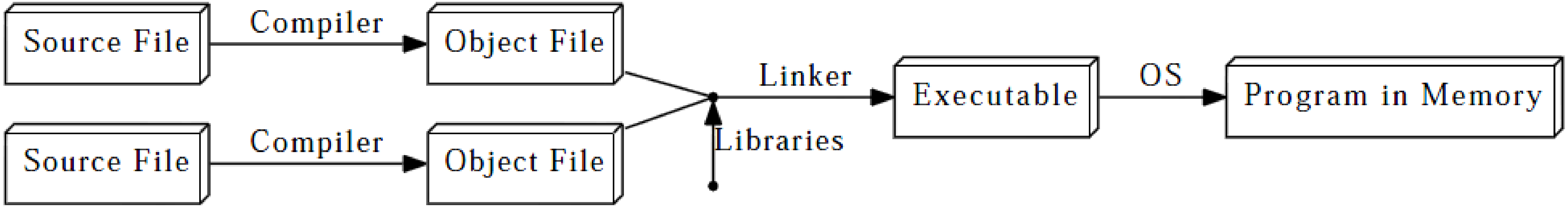
- C++ is a **high-level** language, **compiled** language, strong **types**, **case sensitive**.

The Compilation Process

Our language v.s. binary language the computer used

C++ is like natural language

Compiler: make computer understand C++



More

- Created in 1979 by (Extensions to C)

Bjarne Stroustrup

[bijani sdʒəusdʒup]

- **Console** programs is much easy and more portable than graphical programs

Hello World

```
// A Hello World program
# include <iostream>
int main()
{
    std::cout << "Hello, world!\n";
    return 0;
}
```

Line-By-Line Explanation

- //

indicates that everything following it until the end of the line is a **comment**: it is ignored by the compiler.

- /* and */
  - (e.g. x = 1 + /*sneaky comment here*/ 1;
  - multiple lines;

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- Usages
  - Comments exist to **explain non-obvious** things going on in the code. Use them: **document** your code well!

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- # **preprocessor commands**
  - Lines beginning with # are preprocessor commands, which usually change what code is actually being compiled.
  - #include tells the **preprocessor** to dump in the contents of another file, here the iostream file, which defines the procedures for input/output.

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- int main()
  - main is a function name
  - Brackets () with main tells that main() is a function
  - int before main() indicates integer values is being returned by main()
  - When program is loaded in the memory, the control is handed over to function main ( ) and it is the **first** function to be executed.

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- Curly bracket and body of function main()
  - A C++ program starts with function called main().
  - The body of the function is enclosed between curly braces. They represent grouping of multiple commands into a block.
  - Each commands/statement must end by a semicolon.
  - More about this syntax in the next few lectures.

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- cout <<
- This is the syntax for outputting some piece of text to the screen.

- :: Namespaces

```
// A Hello World program
# include <iostream>
int main() {
     std::cout << "Hello, world!\n";
     return 0;
}
```

  - In C++, identifiers can be defined within a context – sort of a directory of names – called a namespace.
  - When we want to access an identifier defined in a namespace, we tell the compiler to look for it in that namespace using the scope resolution operator (::).
  - Here, we're telling the compiler to look for cout in the std namespace, in which many standard C++ identifiers are defined.
  - A cleaner alternative is to add the following line below line 2:

using namespace std;

  - This line tells the compiler that it should look in the std namespace for any identifier we haven't defined.
  - If we do this, we can omit the std:: prefix when writing cout. This is the recommended practice.

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- Strings
  - A sequence of characters such as *Hello, world* is known as a string.
  - A string that is specified explicitly in a program is a **string literal**.

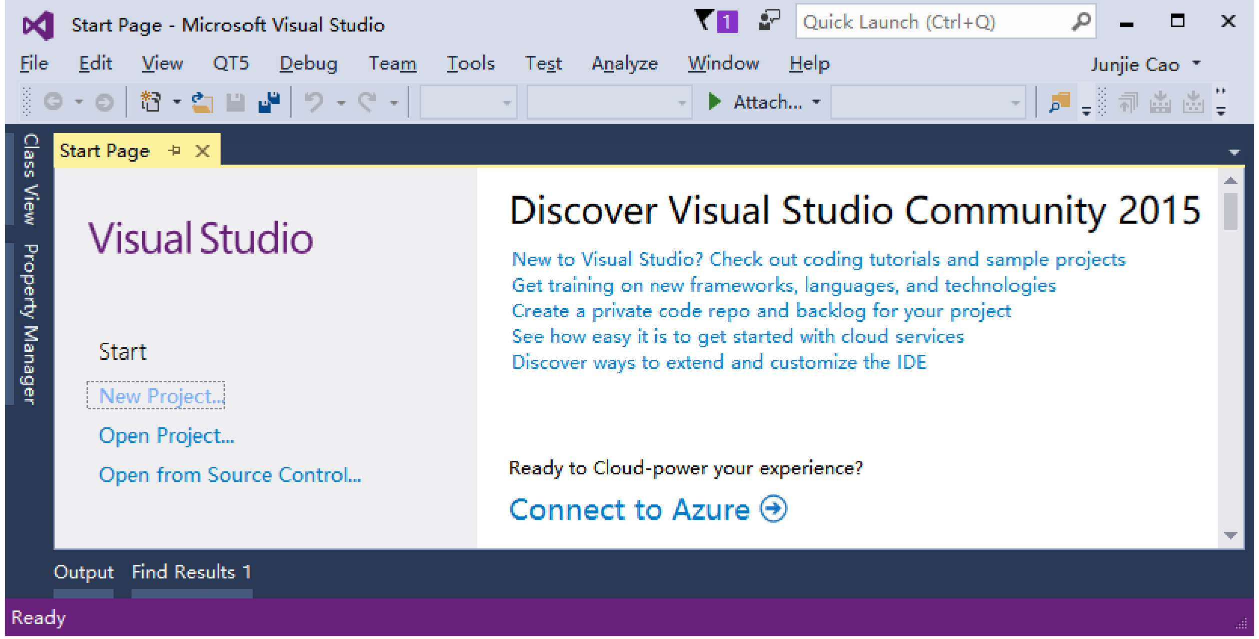
- \n
  - Escape sequences: The \n indicates a newline character. It is an example of an escape sequence – a symbol used to represent a special character in a **text literal**.

```
// A Hello World program
# include <iostream>
int main() {
    std::cout << "Hello, world!\n";
    return 0;
}
```

- return 0
  - Indicates that the program should tell OS it has completed successfully.
  - it as the last line in the main block.
- Note that every statement ends with a **semicolon** (except **preprocessor commands** and blocks using **{}**).
- **Forgetting** these semicolons is a common mistake among new C++ programmers.

Integrated Development Environment

- **Visual C++: Windows**
- **Code::Blocks: Linux**
- **Xcode, Eclipse: Mac**



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Get training on new frameworks, languages, and technologies
Create a private code repo and backlog for your project
See how easy it is to get started with cloud services
Discover ways to extend and customize the IDE

Ready to Cloud-power your experience?

Connect to Azure

- **CodeChef: Web based**
  - Web-based compilers are fine for dabbling and simple exercises. However, they are generally quite limited in functionality -- many won’t allow you to save projects, create executables, or effectively debug your programs. You’ll want to migrate to a full IDE when you can.

CODECHEF
A Directi Educational Initiative

- **Installing an Integrated Development Environment (IDE)**

Compiling your first program

- lab01_IDE_VC_Win32ConsoleApplication.pptx
- LearnCpp.com

A few common C++ problems

- LearnCpp.com

Reference Courses

- cpp for school
  - simpler and with assignments, projects, quiz and papers.
- LearnCpp.com
  - more detail explanations than cpp for school

Reference Books

1. **C++ Primer**
2. The C++ Programming Language. (more advance than 1)
3. The C++ Standard Library – A Tutorial and Reference
4. **Teach Yourself C++ in One Hour a Day**

5. **Code complete 2nd**
6. Clean Code A Handbook of Agile Software Craftsmanship

Useful Links

- http://www.cplusplus.com