TSINGHUA UNIVERSITY

SCHOOL OF ECONOMICS AND MANAGEMENT

Computer Programming Language

Session 1
Computation,
Computers, and
Programming Languages

```
case IDE internal
i = internal  /* fich
if(i!= -1) {
  *value = (*intern_func[i].p
}
else
if(find_func(token)){  /* fich
call();
  *value = ret_value;
}
else  *value = find_v
get_token();
```

Lecturer

- 闻 中，Management Science & Engineering Dept.
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Goals

- **Audience**
  - Students with little programming experience
  - Want to explore the power of computation for personal interest, future study, research or work opportunities.
- **Goals**
  - To build the ability to write small pieces of programs
  - To understand programs written by others
  - Learn to map problems to computational solutions
  - To gain a deeper understanding of information technology

Why learn programming?

[最早接触HP1900时 你谈到自己编程的事]

[Now...when you were first coming in contact with these computers and inventing them before the HP1900, you do talk about writing programs.]

Syllabus

Textbook

- *A First Book of ANSI C, Fourth Edition,* by Gary J. Bronson
  ISBN: 7121025310
  - *Website: http://www.china-pub.com/30489*
  - *or search* "标准C语言基础教程(第4版)(英文版) " at *http://www.amazon.cn or dangdang.com*
- Reference book (more comprehensive):
  C Primer Plus, Fifth Edition, by Stephen Prata

TA:

网络学堂：http://learn.tsinghua.edu.cn/

- Teaching materials
- Assignment, submission
- Discussion Board

Hand-In Assignment

- **Name your solution**
  - Solve problem set *i*, exercise *j*
    - source code named as **ps*ij*.c**
    - Text named **ps*ij*.txt**.
    - For example, the solution to exercise 3 of problem set 2 should be named as ps23.c or ps23.txt.

- **2. Package and Submit**
  - Package **all solution files** into a **single** compressed RAR or ZIP file.
  - Name it as ***Student# NamePSi.rar***, or **Student# NamePS*i*.zip**.
  - For example, **20098100李明PS2.rar.**
  - Submit it to 网络学堂.

Collaboration Policy

- It’s OK to discuss how to solve assigned problems with your classmates
- However, each student should write the code **independently** and hand in the assignment separately
- **Identical codes** would be considered as plagiarism, each receiving **zero point**
- A free-rider will eventually be exposed and graded accordingly in the final exam

Grading Policy

Percentage of all the evaluation methods involved：

- Assignments: 40%
- Final Exam: 60%
  - Paper based
  - Open book
- No cheat or plagiarism

Agenda

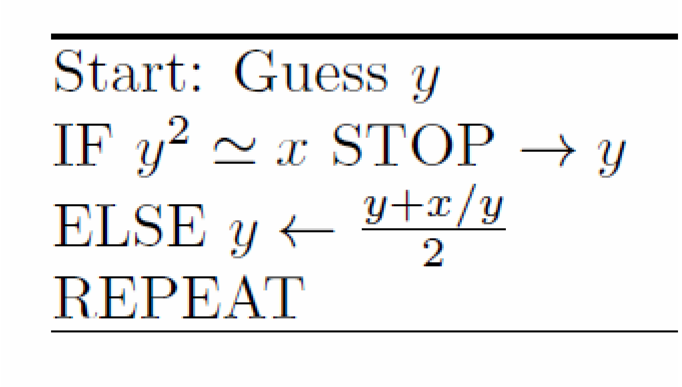
- Computation
- Computers
- Computer languages
- Programming environment
- Software engineering

What is computation?

- Declarative knowledge –**what is**

$$\sqrt{x} \text{ is } y \text{ s.t. } y^2 = x, y \geq 0$$

- Procedural knowledge – **how to**



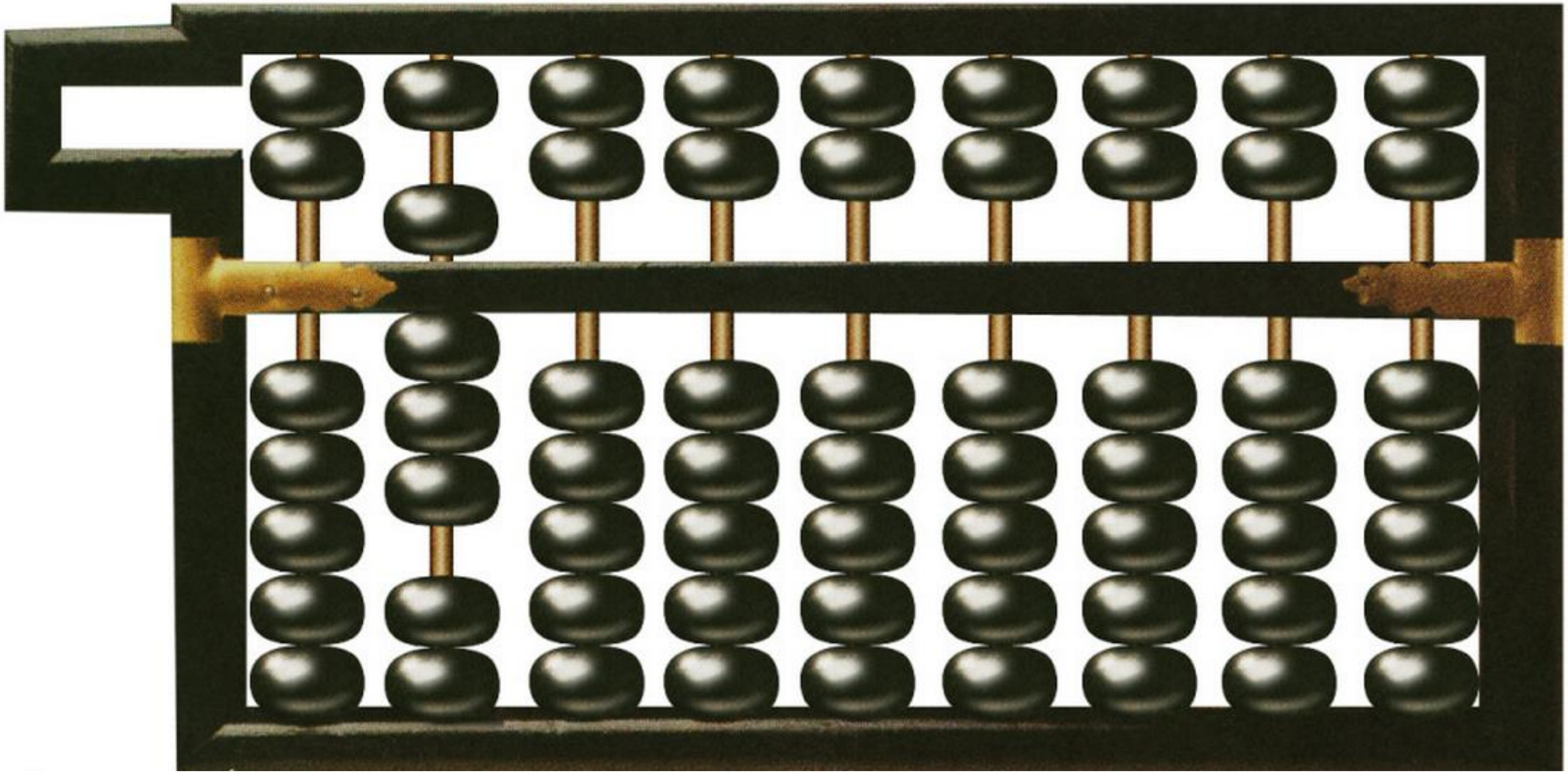
```
Start: Guess $y$
IF $y^2 \simeq x$ STOP $\rightarrow y$
ELSE $y \leftarrow \frac{y+x/y}{2}$
REPEAT
```

- Computation: the **mechanic** process to find an answer

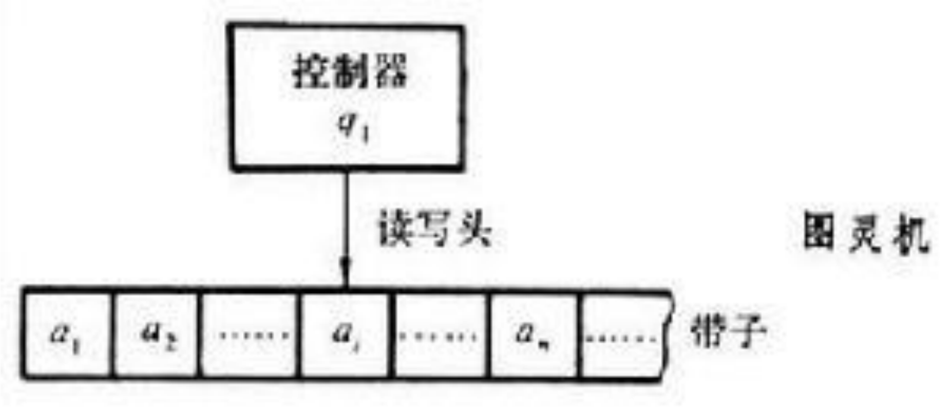
Computer

- Describe data
  - 00000010
- Define set of **basic steps**
  - Move data
  - Add/substract data
- Problem to solve
  - Define **input** data
  - Define **output** data
  - Find **Steps** to solve a problem - algorithm

Abacus-nonprogrammable computing machine



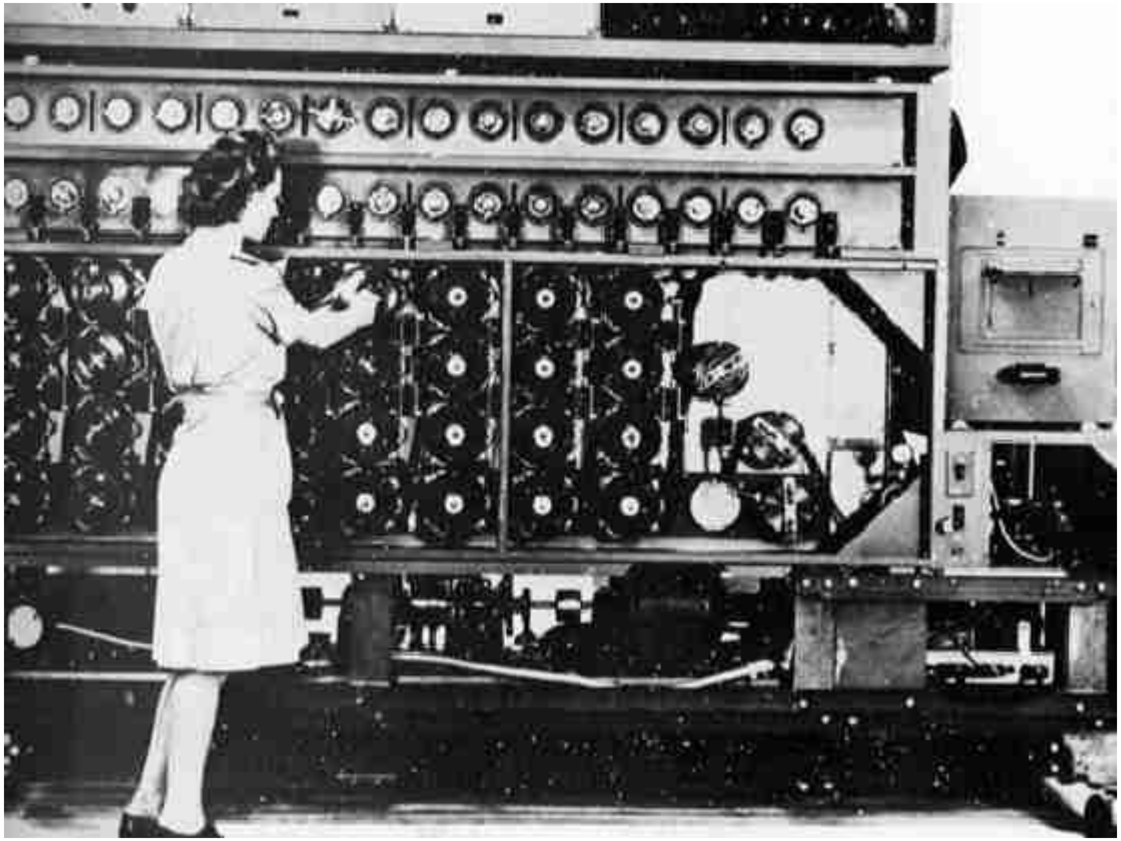
Turing machine (1936) 图灵机



- 一条无限长的纸带 **TAPE**。纸带被划分为一个接一个的小格子
- 一个读写头 **HEAD**。该读写头可以在纸带上左右移动，它能读出当前所指的格子上的符号，并能改变当前格子上的符号。
- 一个**状态寄存器**。它用来保存图灵机当前所处的状态。图灵机的所有可能状态的数目是有限的，并且有一个特殊的状态，称为停机状态。
- 一套控制规则 **TABLE**。它根据当前机器所处的状态以及当前读写头所指的格子上的符号来确定读写头下一步的动作，并改变状态寄存器的值，令机器进入一个新的状态。

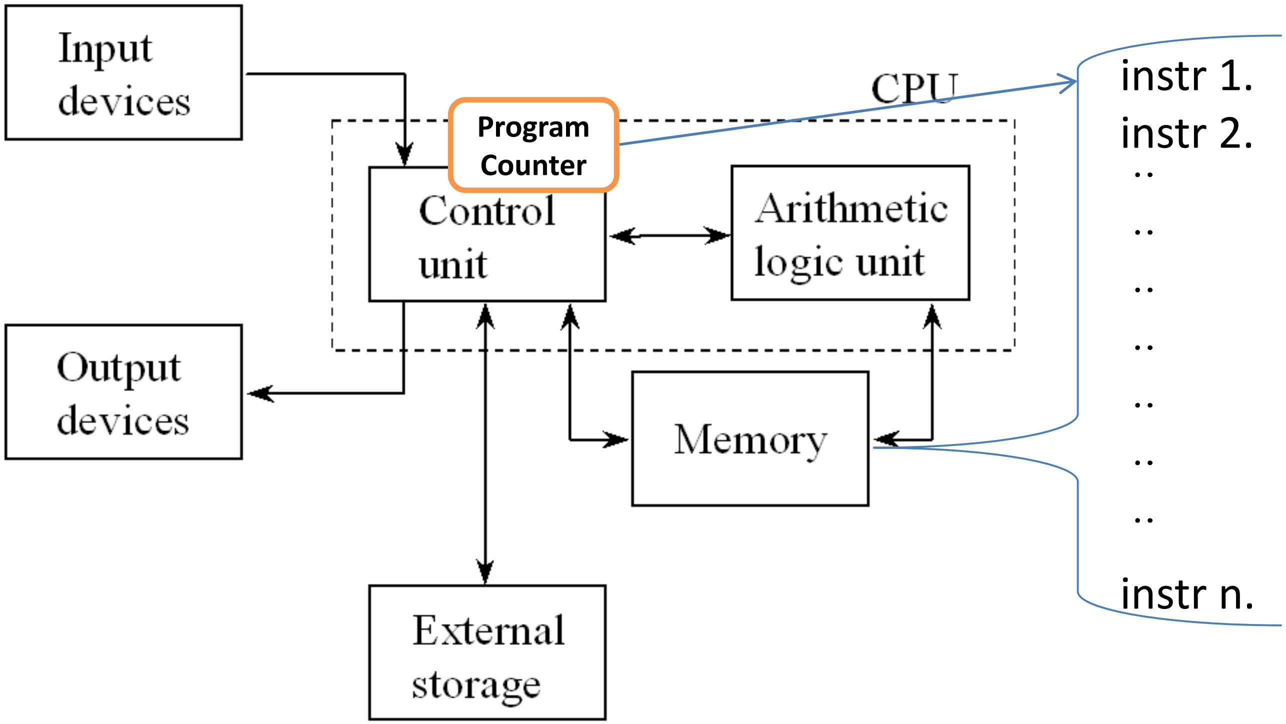
Computers

- Earliest computers – fixed program comp.
  - Calculator
  - Turing bomba – to break Enigma

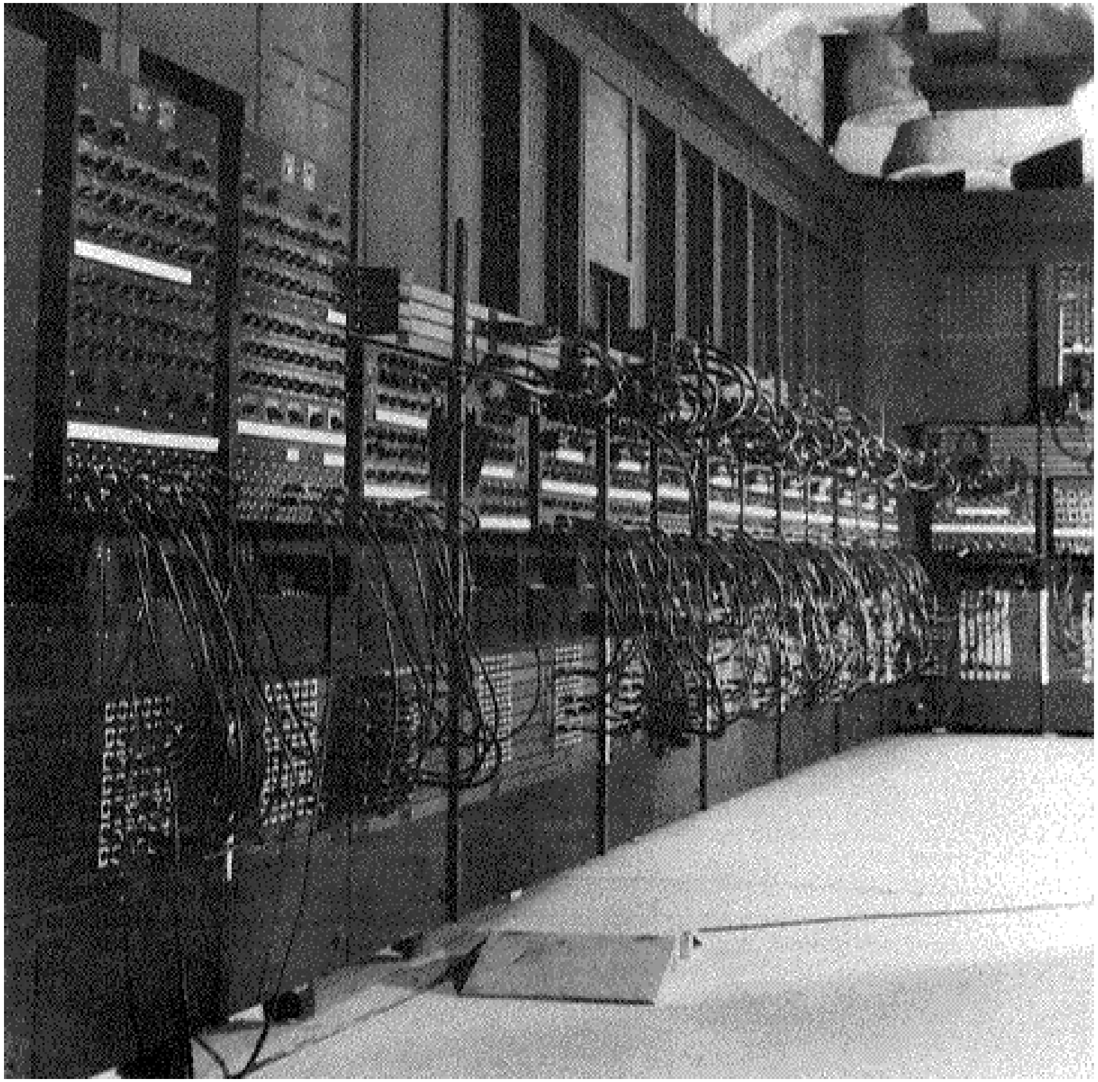


von Neumann architecture (冯.诺依曼体系结构)

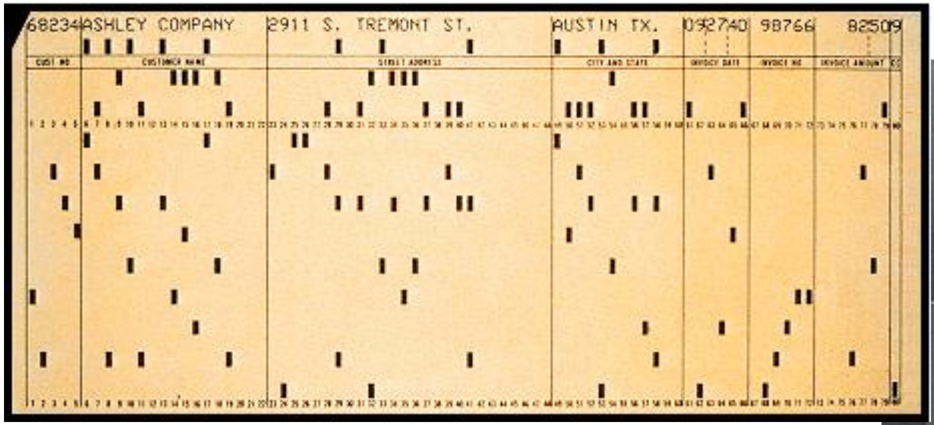
- Modern computers – stored program comp.

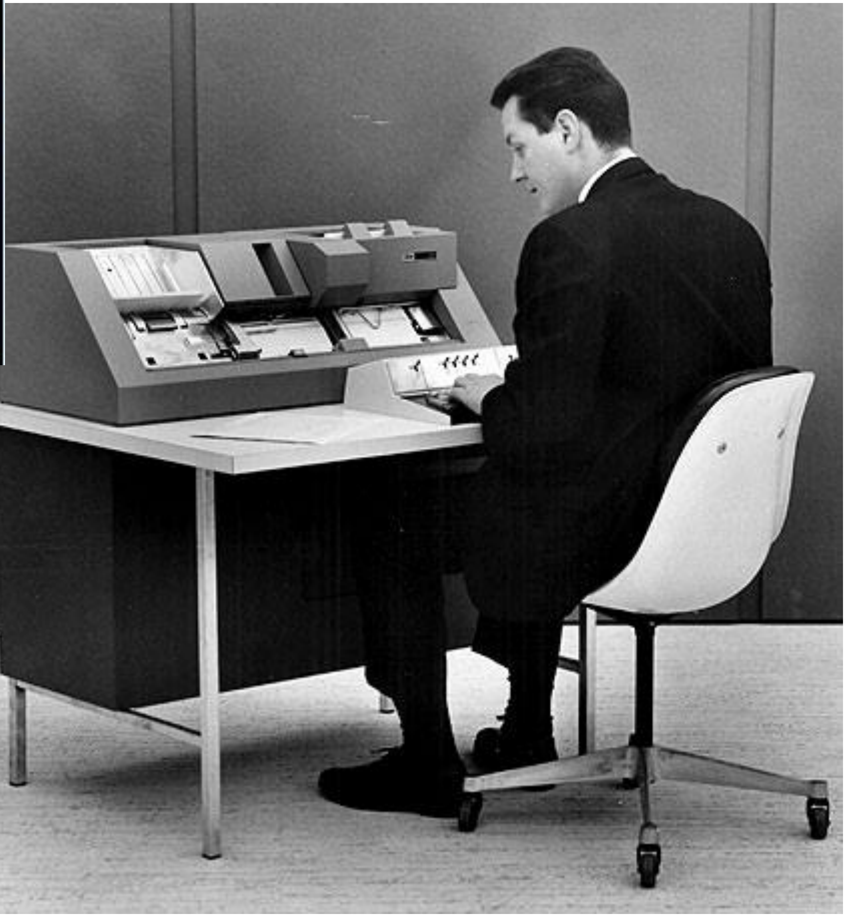


ENIAC (1946) – programmable computer



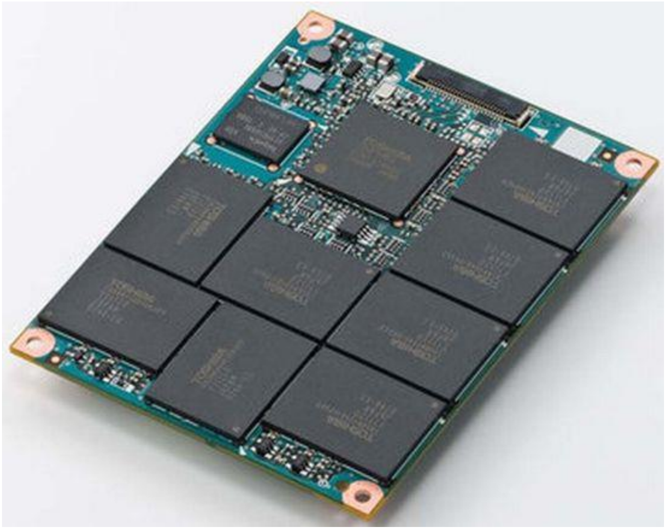
From Computer Desktop Encyclopedia
© 2000 The Computer Language Co. Inc.



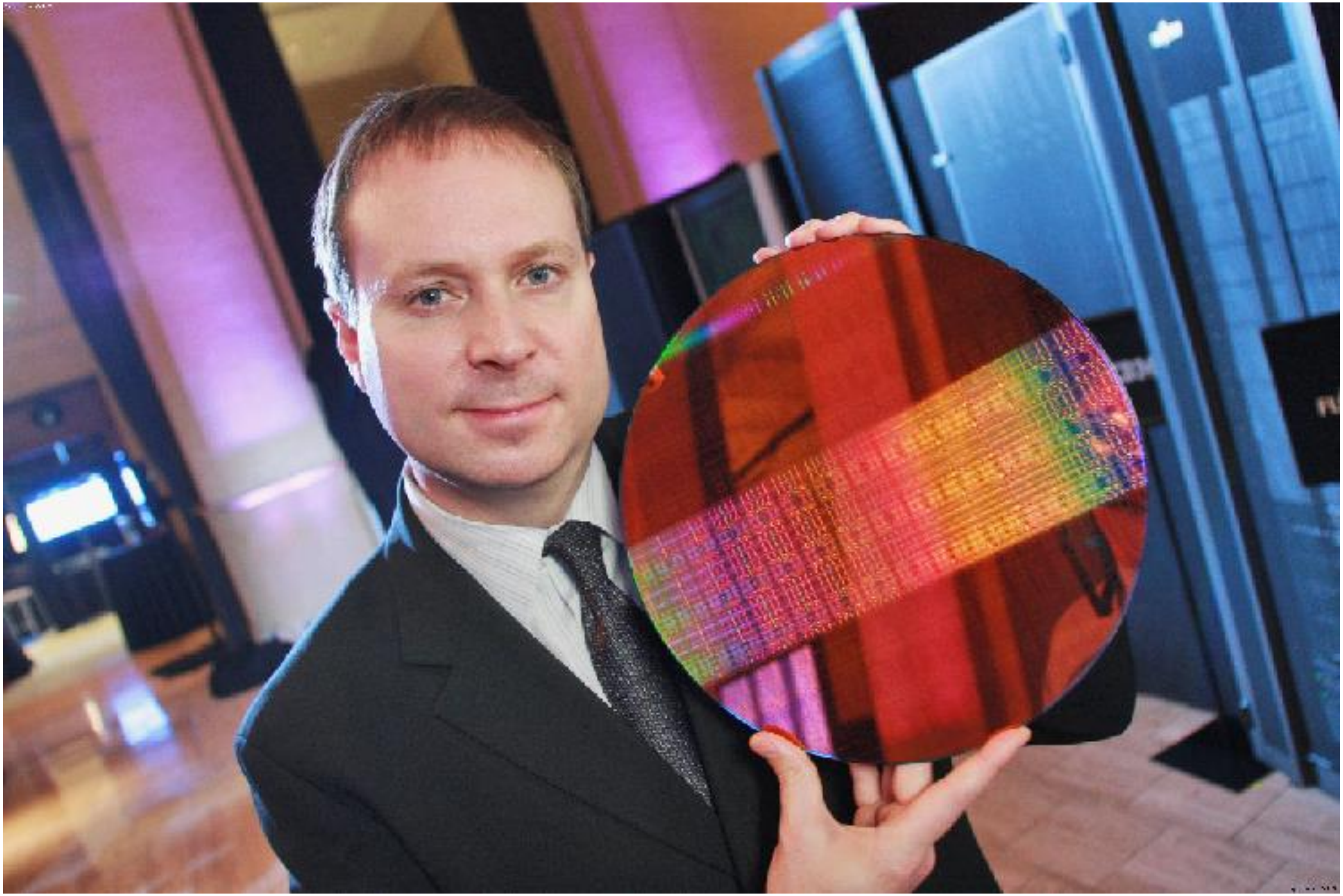


www.ArchMemory.com

intel
Xeon™



CPUs on Silicon



Program/Code

- A fixed set of instructions (指令）
  - Given a small set of instructions, can program anything
  - Intel 80x86 instruction set http://www.penguin.cz/~literakl/intel/intel.html

Languages: low to high

- Low
  - Machine language

    11000000 000000000001000000000010

    11110000 000000000010000000000011

    - **Opcode** is short for operation code; tells the computer the operation to be performed
  - Assembly language (汇编语言）

    LOAD first

    ADD second

    MUL factor

    STORE answer

- MOV copies data from one location to another
- ADD Add
- SUB Subtraction
- MUL Unsigned multiply
- JMP Jump
- INT Call to interrupt

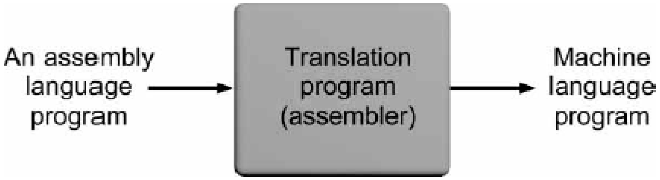


Figure 1.9 Assembly programs must be translated

High languages: general or targeted

- High level language
  - a set of richer instructions, close to human language
  - General
    - to program a broad set of application
    - C, C++, C#, Java, Fortran, Pascal, Lisp, etc.
  - Targeted
    - To program for a specific kind of application
    - php, java script, Matlab, etc.

High languages: interpreted or compiled

- Interpreted (解释语言)
  - interpreter (解释器) translates and immediately executes each statement
  - Matlab, Basic

- Compiled (编译语言）
  - Editor 编辑器-> Source code 源代码
  - Compiler 编译器->Object code 目标代码
  - Linker 连接器->Executable code 可执行代码

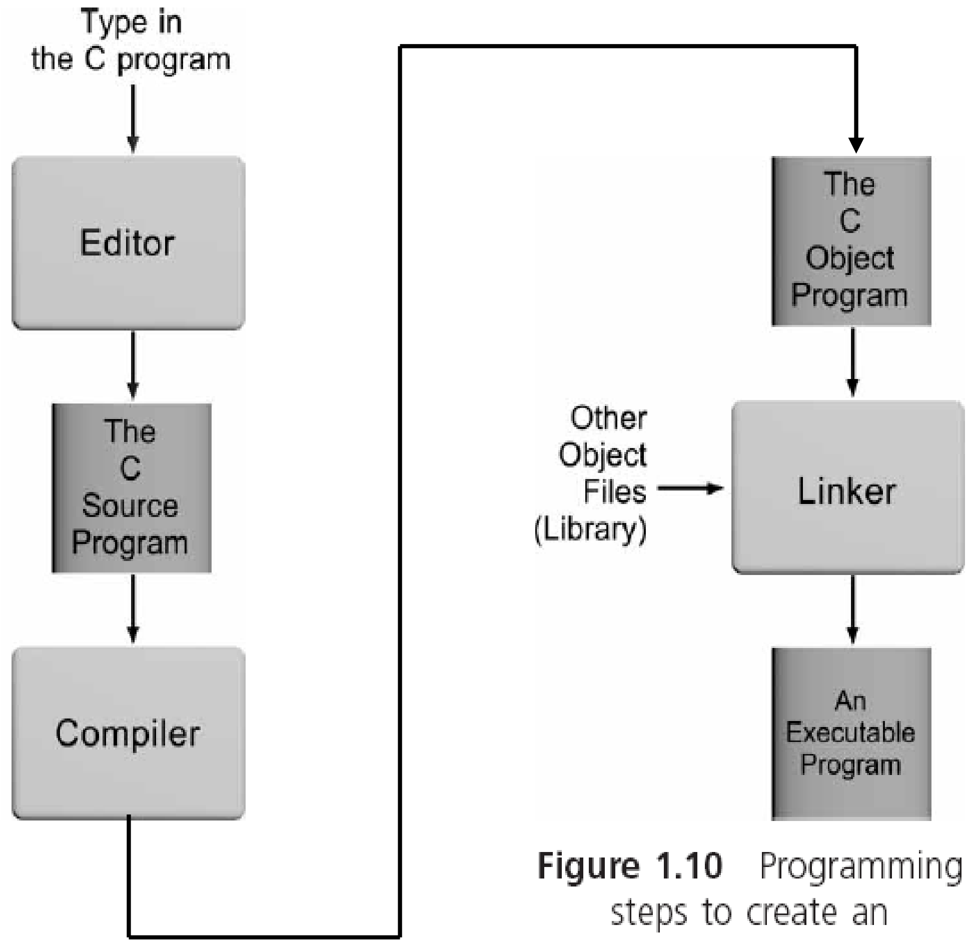
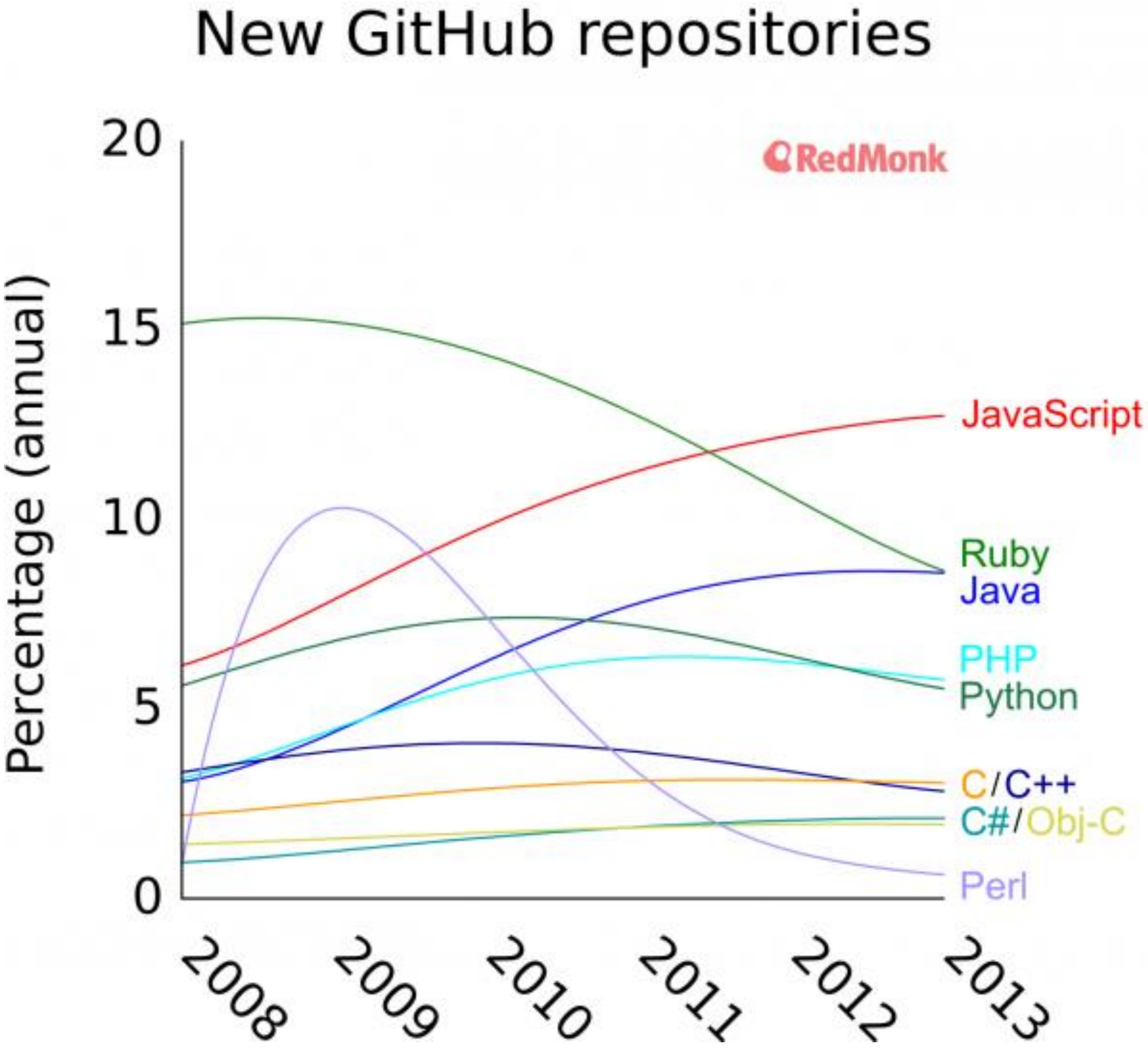


Figure 1.10 Programming steps to create an executable C program

C language - brief history

- Developed between 1969 and 1973 along with Unix, by Ken Thompson, D. Ritchie, and B. Kernighan, AT&T Bell lab
- High-level, general-purpose, compiled language
  - Can also access the internal hardware of a computer
- Standard maintained by the American National Standards Institute (ANSI)
- In the 1980s, Bjarne Stroustrup (working at AT&T) developed C++
  - C with object-oriented capabilities

Popular languages



First C Program

```c
/* Hello.c
   Our first program */

#include <stdio.h>

/* function main begins program execution */
int main()
{
      printf("hello, world\n");
}
```

The #include Directive (指令)

include information about standard library

```
/* Hello.c
   Our first program */

#include <stdio.h>

/* function main begins program execution */
int main()
{
      printf("hello, world\n");
}
```

Entry Point of C Programs

```
/* Hello.c
   Our first program */

#include <stdio.h>

/* function main begins program execution */
int main()
{
      printf("hello, world\n");
}
```

define a function called
main
that receives no argument

Function body

C Statements

```c
/* Hello.c
   Our first program */

#include <stdio.h>

/* function main begins program execution */
int main()
{
      printf("hello, world\n");
}
```

a C statement

C statements end with ;

Comments (注释）

/* . . . */ for multiple lines

or

// (c++) for single line

```
/* Hello.c
   Our first program */

#include <stdio.h>

/* function main begins program execution */
int main()
{
      printf("hello, world\n");
}
```

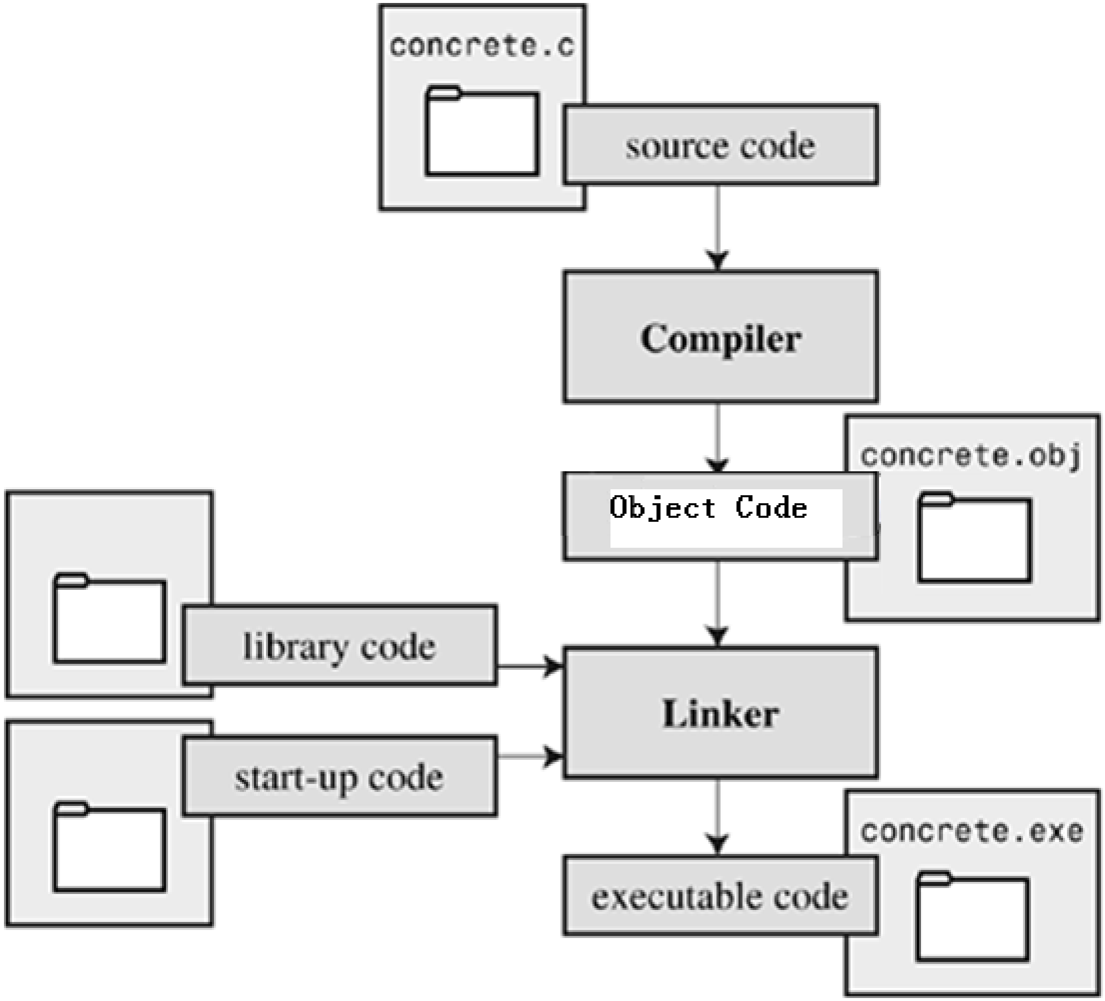
printf — 输出信息

```
// Hello.c
// Our first program

#include <stdio.h>

// function main begins program execution
int main()
{
        printf("hello, world\n");
}
```

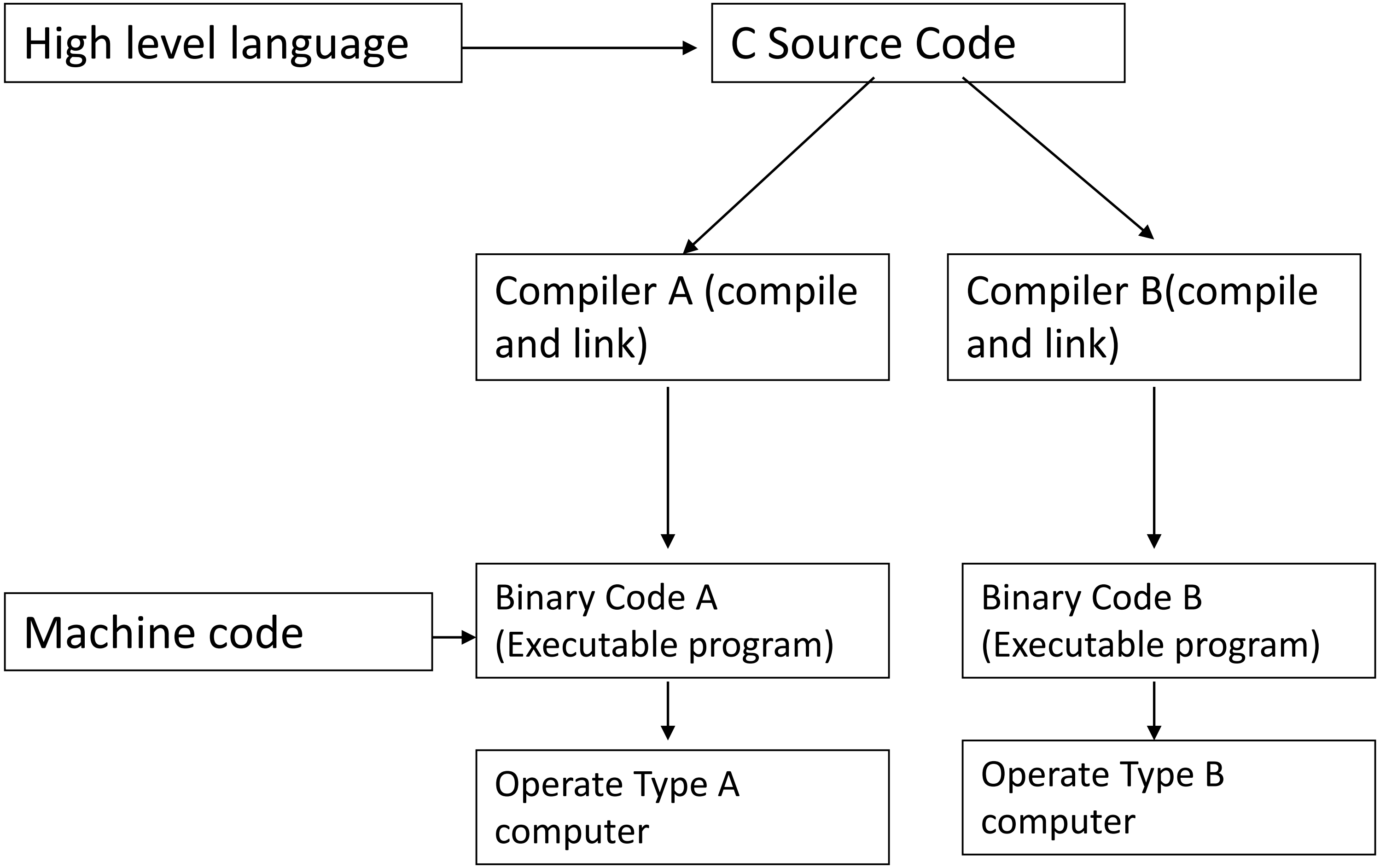
function name

function Parameter (string)

Compiling process



Portability(可移植性)



High level language

C Source Code

Compiler A (compile and link)

Compiler B(compile and link)

Machine code

Binary Code A (Executable program)

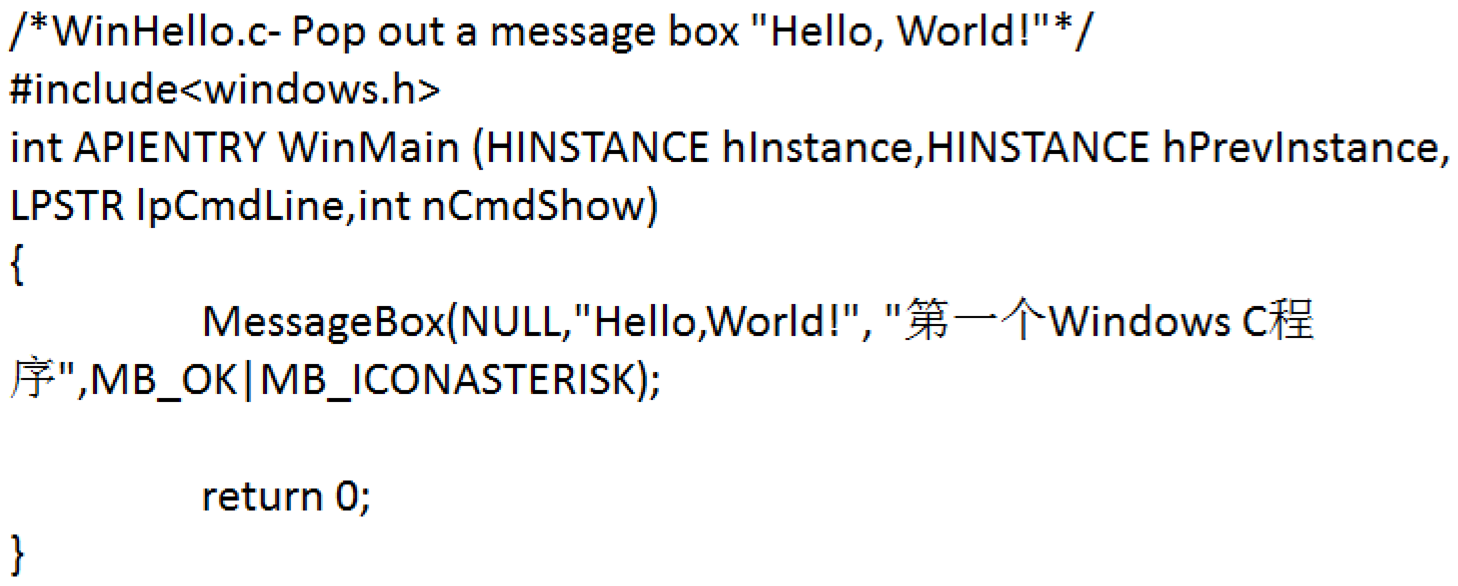
Binary Code B (Executable program)

Operate Type A computer

Operate Type B computer

CLI & GUI Software

- GUI - invented by Xerox; intuitive, user-friendly
- CLI – flexible, powerful
- Some software provide both interfaces
- We only program CLI (console) applications



```
/*WinHello.c- Pop out a message box "Hello, World!"*/
#include<windows.h>
int APIENTRY WinMain (HINSTANCE hInstance,HINSTANCE hPrevInstance,
LPSTR lpCmdLine,int nCmdShow)
{
		MessageBox(NULL,"Hello,World!", "第一个Windows C程
序",MB_OK|MB_ICONASTERISK);

		return 0;
}
```

Compiler interface - CLI

- CLI (command line interface,命令行界面)

- *Gcc: compiler & linker – gcc.exe*
- *Lcc: compiler – c:\lcc\bin\lcc.exe*
  linker – c:\lcc\bin\lcclnk.exe
- *Visual C++:*
  compiler -"c:\Program Files\Microsoft Visual Studio 9.0\VC\bin\cl.exe“
  linker -"c:\Program Files\Microsoft Visual Studio 9.0\VC\bin\link.exe

Compiler interface - GUI

IDE: Integrated Developing Environment (集成开发环境)

- GCC
  - Codeblocks
    - Support many OS, (windows, codeblocks-12.11mingw-setup.exe)
    - http://www.codeblocks.org/downloads/26
  - Bloodshed Dev-C++, Free
    - Windows only
    - http://bloodshed-dev-c.en.softonic.com/

- Lcc-Win32, Free
  - Easy to use, small, Windows IDE, C compiler only
  - http://www.cs.virginia.edu/~lcc-win32/

- Visual C++ Express, Microsoft, free download from Microsoft Website
  - Rich features, user-friendly

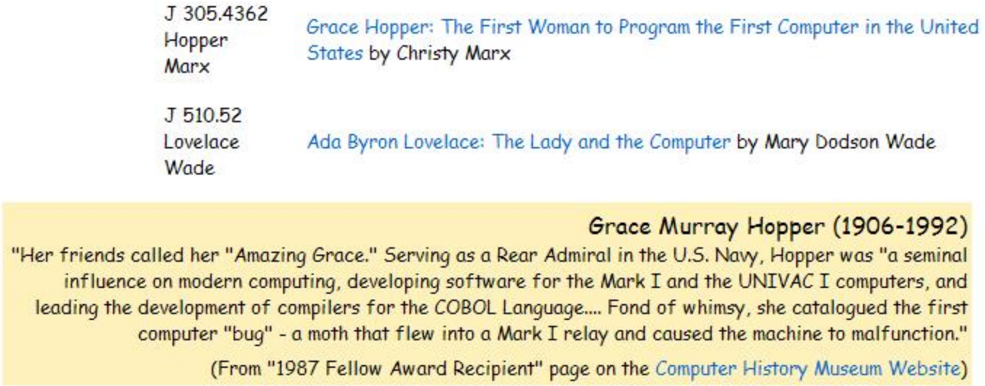
Write C programs

- Syntax (语法)– what are legal expressions?
  - “桌子人椅。”
- Semantics (语义)– what does the program do?
  - “我的书包是李明。”
- Style

```
    int
   main
    (
   ){printf
    ("Hello there world!"
   );return 0;}
```

- ***Programs must be written for people to read, and only incidentally for machines to execute.***
  — Abelson and Sussman

Bugs



J 305.4362
Hopper
Marx

Grace Hopper: The First Woman to Program the First Computer in the United States by Christy Marx

J 510.52
Lovelace
Wade

Ada Byron Lovelace: The Lady and the Computer by Mary Dodson Wade

Grace Murray Hopper (1906-1992)

"Her friends called her "Amazing Grace." Serving as a Rear Admiral in the U.S. Navy, Hopper was "a seminal influence on modern computing, developing software for the Mark I and the UNIVAC I computers, and leading the development of compilers for the COBOL Language.... Fond of whimsy, she catalogued the first computer "bug" - a moth that flew into a Mark I relay and caused the machine to malfunction."

(From "1987 Fellow Award Recipient" page on the Computer History Museum Website)

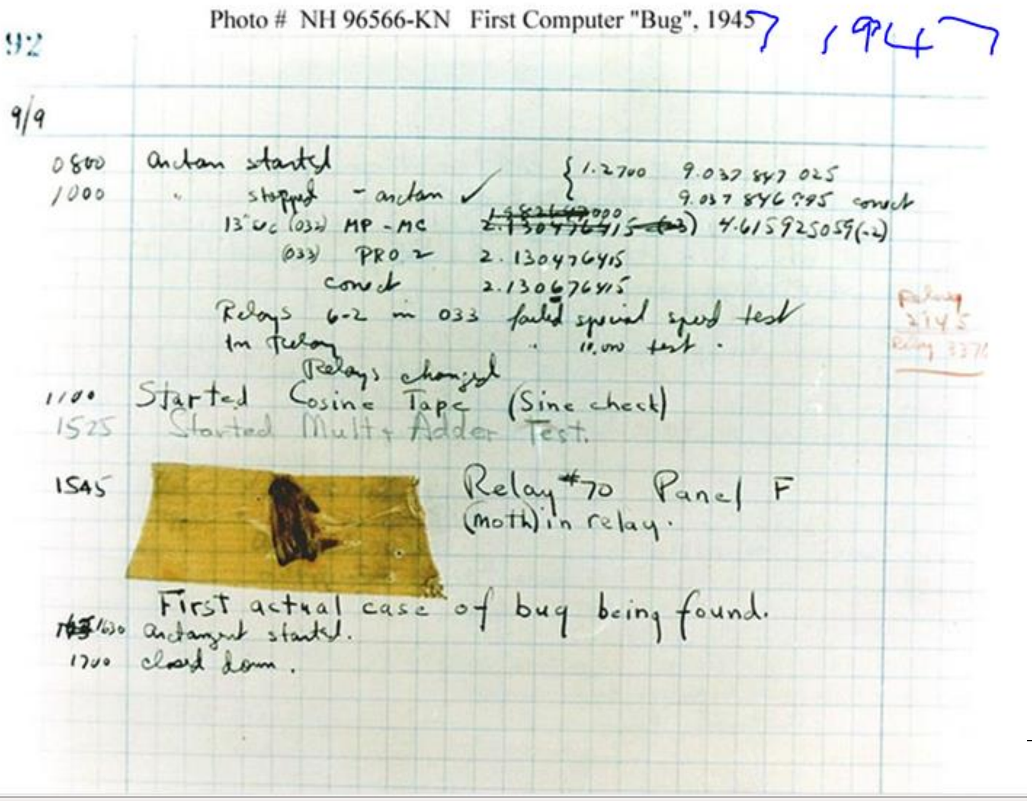


Photo # NH 96566-KN First Computer "Bug", ~~1945~~ 1947

92

9/9

0800 Anctan started {1.2700 9.037 847 025
1000 " stopped - anctan ✓ 9.037 846 995 conect
13" uc (032) MP - MC ~~1.982147000~~ ~~2.130476415 (-3)~~ 4.615925059(-2)
(033) PRO 2 2.130476415
conect 2.130676415
Relays 6-2 in 033 failed special speed test
in relay " 11.000 test .
Relays changed
1100 Started Cosine Tape (Sine check)
1525 Started Mult + Adder Test.
1545 Relay #70 Panel F
(moth) in relay.
First actual case of bug being found.
1630 antangent started.
1700 closed down.

Relay 2145
Relay 3376

Programming

Programming = Algorithm + Data Structure + Language

编程 = 算法 + 数据结构 +语言

Programming languages should be designed to express algorithms, and only incidentally to tell computers how to execute them.

— Paul Graham

- Describe an algorithm - **pseudocode (伪码)**

```
1. Input the three numbers into the computer
2. Calculate the average by adding the numbers
   and dividing the sum by three
3. Display the average
```

Describe an algorithm-Flowchart (流程图)

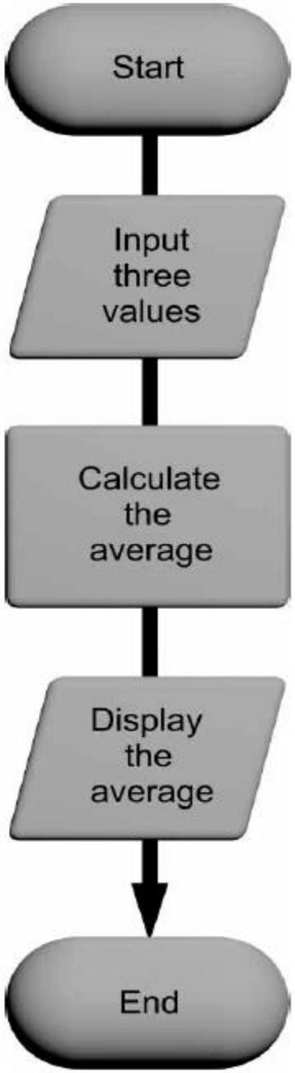
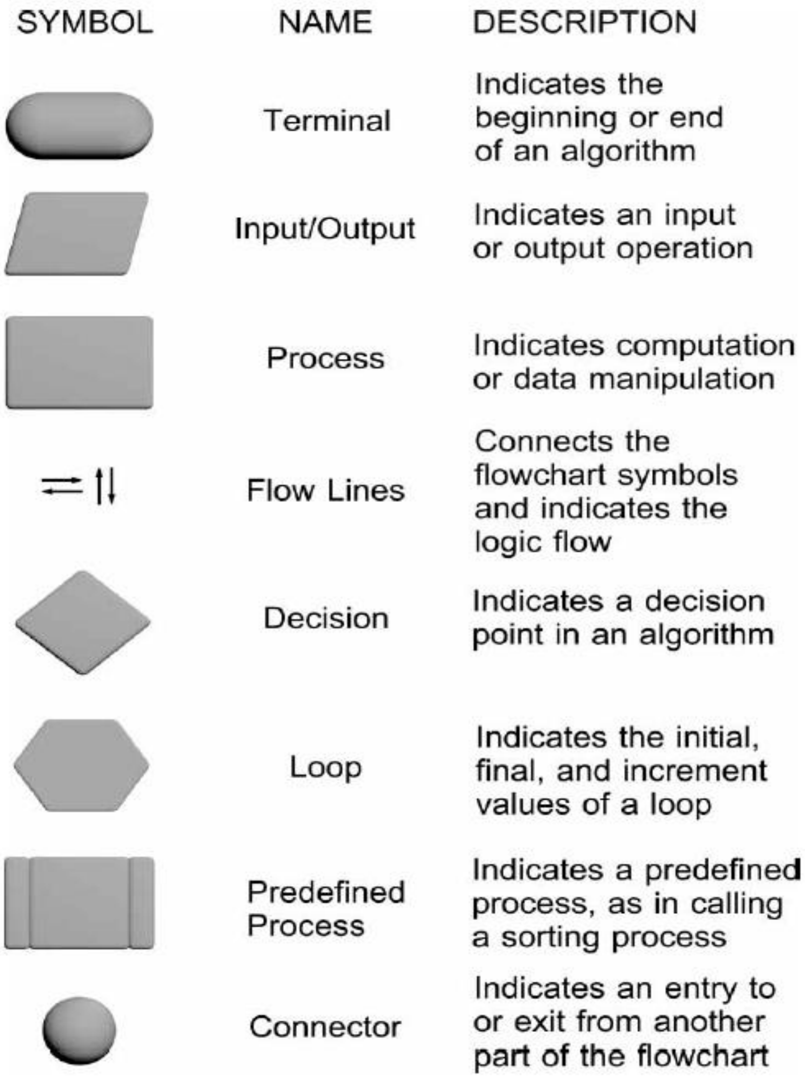


Figure 1.14 Flowchart for calculating the average of three numbers



SYMBOL	NAME	DESCRIPTION
⬭	Terminal	Indicates the beginning or end of an algorithm
▱	Input/Output	Indicates an input or output operation
▭	Process	Indicates computation or data manipulation
⇄ ⇅	Flow Lines	Connects the flowchart symbols and indicates the logic flow
◇	Decision	Indicates a decision point in an algorithm
⬡	Loop	Indicates the initial, final, and increment values of a loop
▥	Predefined Process	Indicates a predefined process, as in calling a sorting process
●	Connector	Indicates an entry to or exit from another part of the flowchart

Figure 1.13 Flowchart symbols

Coding

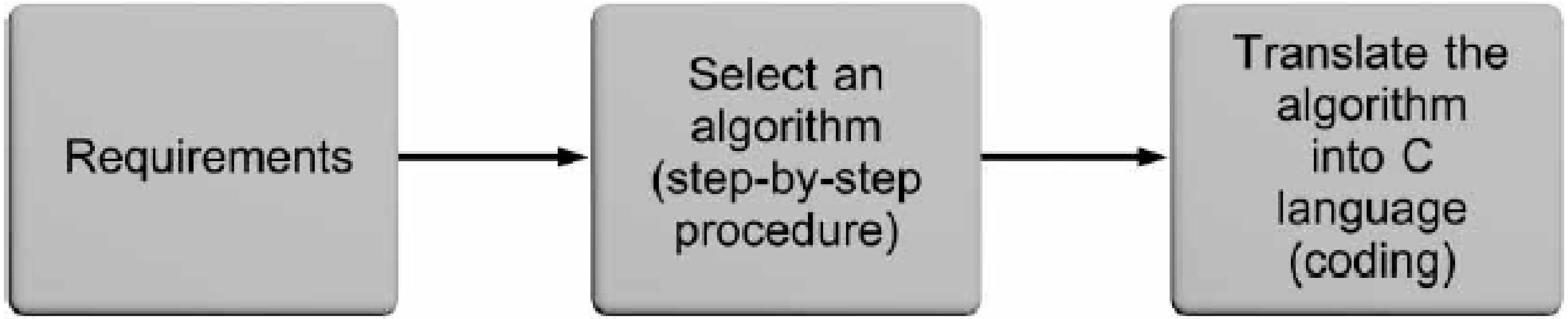
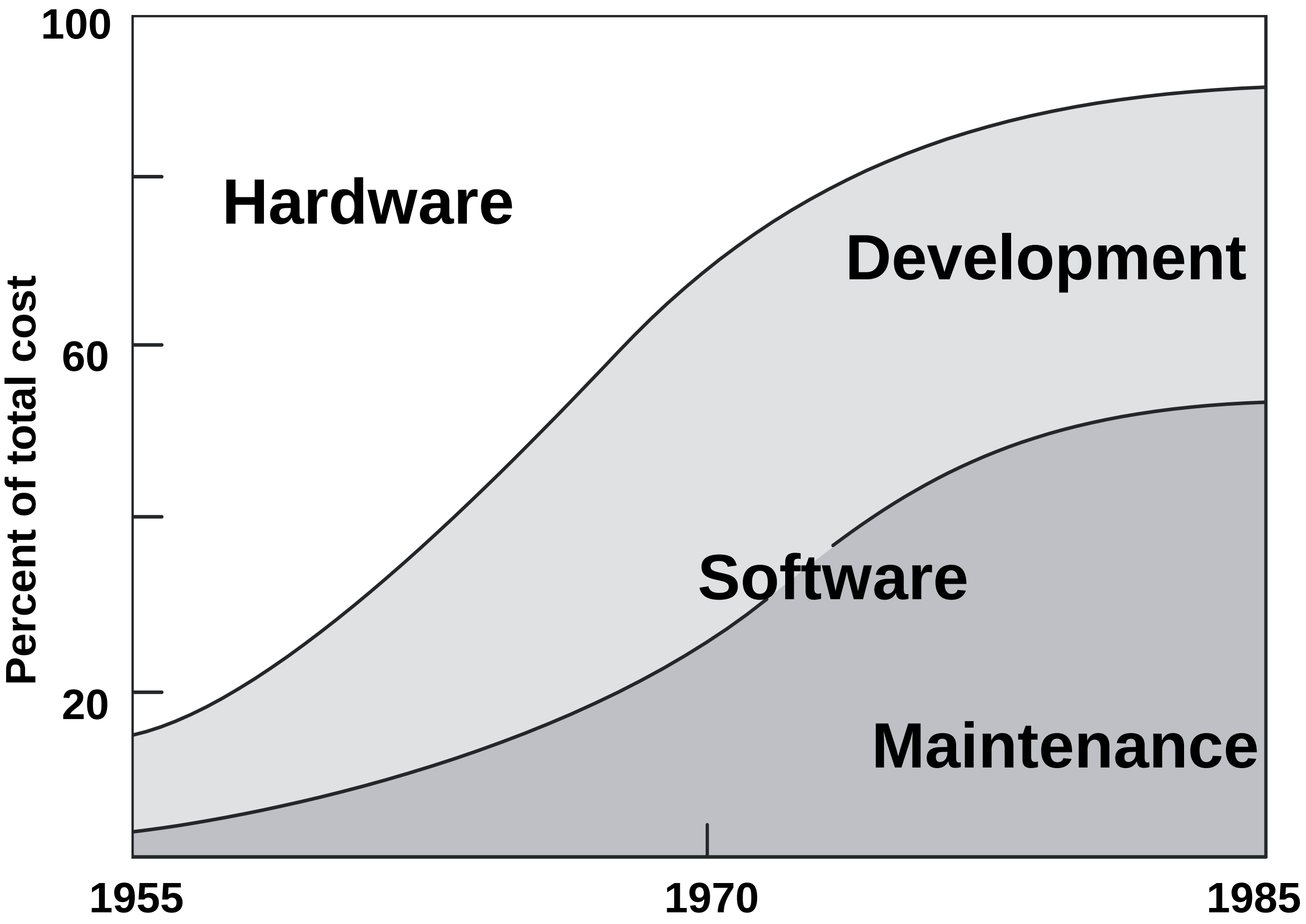

Requirements
Select an algorithm (step-by-step procedure)
Translate the algorithm into C language (coding)

Figure 1.15 Coding an algorithm

Relative distribution of software/hardware costs



Questions?