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# 程序设计基础及语言

## --C++大学教程

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东南大学

计算机科学与工程学院

李慧颖（计算机楼406）

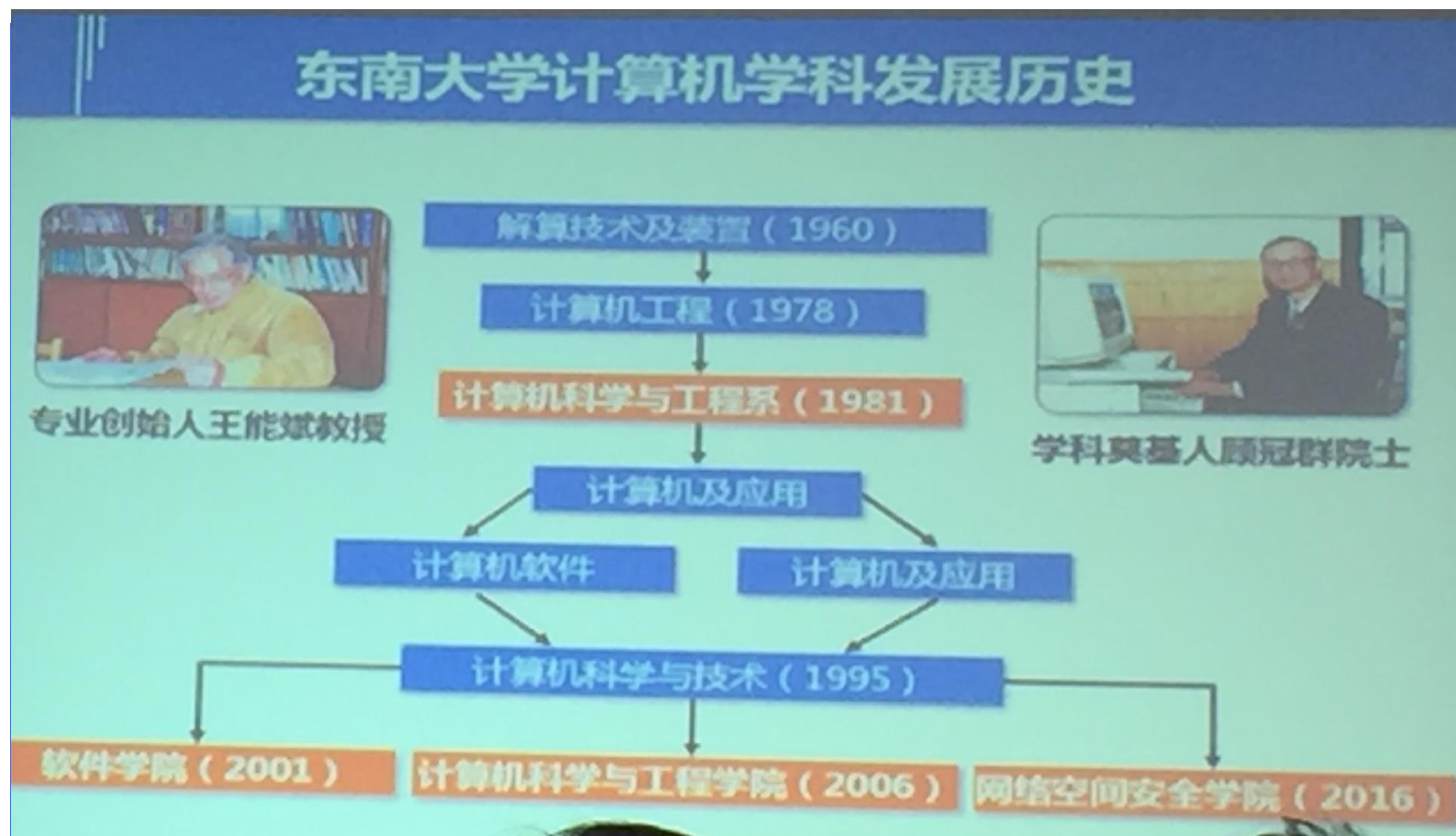
[huiyingli@seu.edu.cn](mailto:huiyingli@seu.edu.cn)



# 课前简介

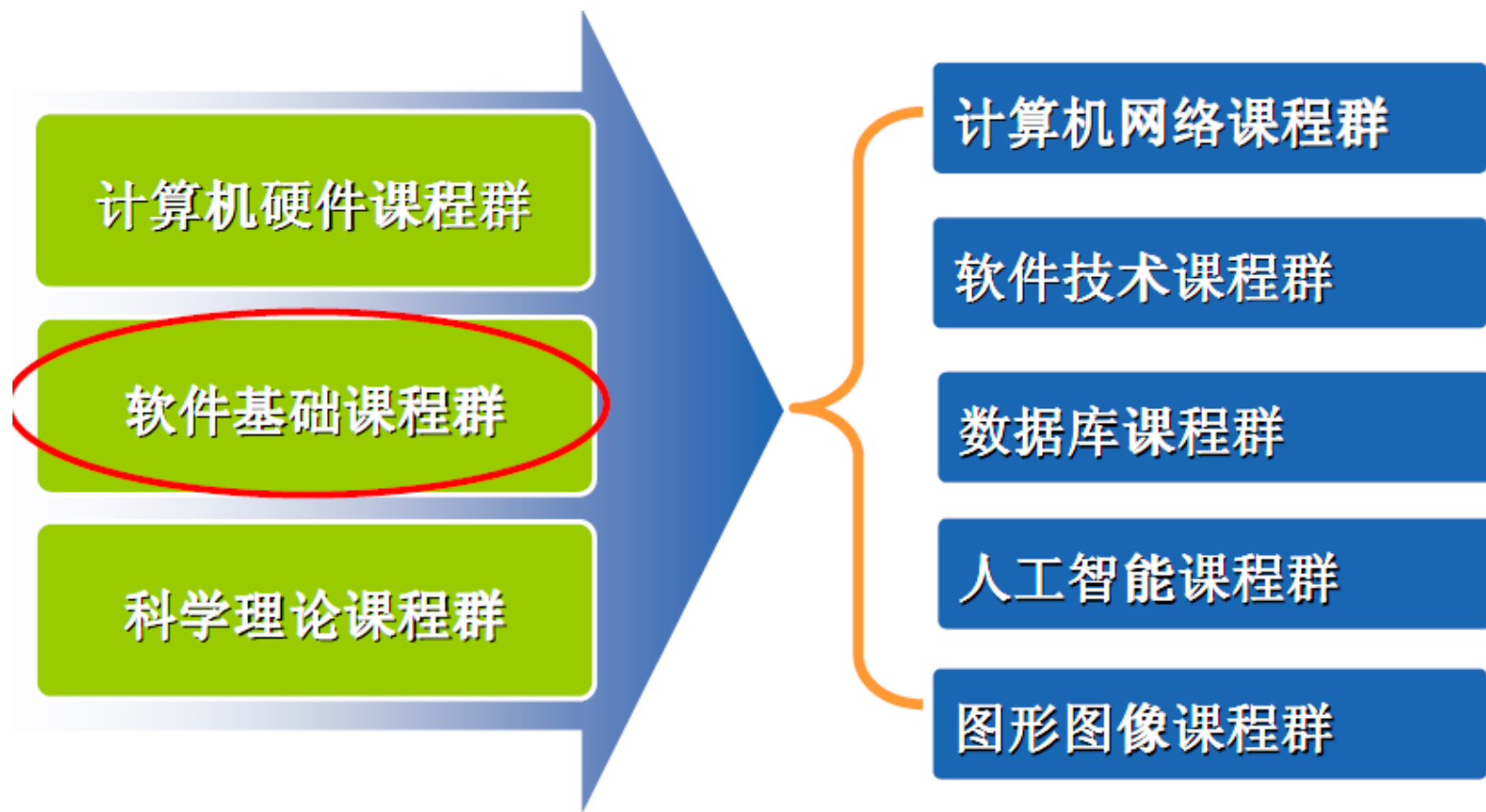


□ 1960-1978-1981-2006





# 课前简介

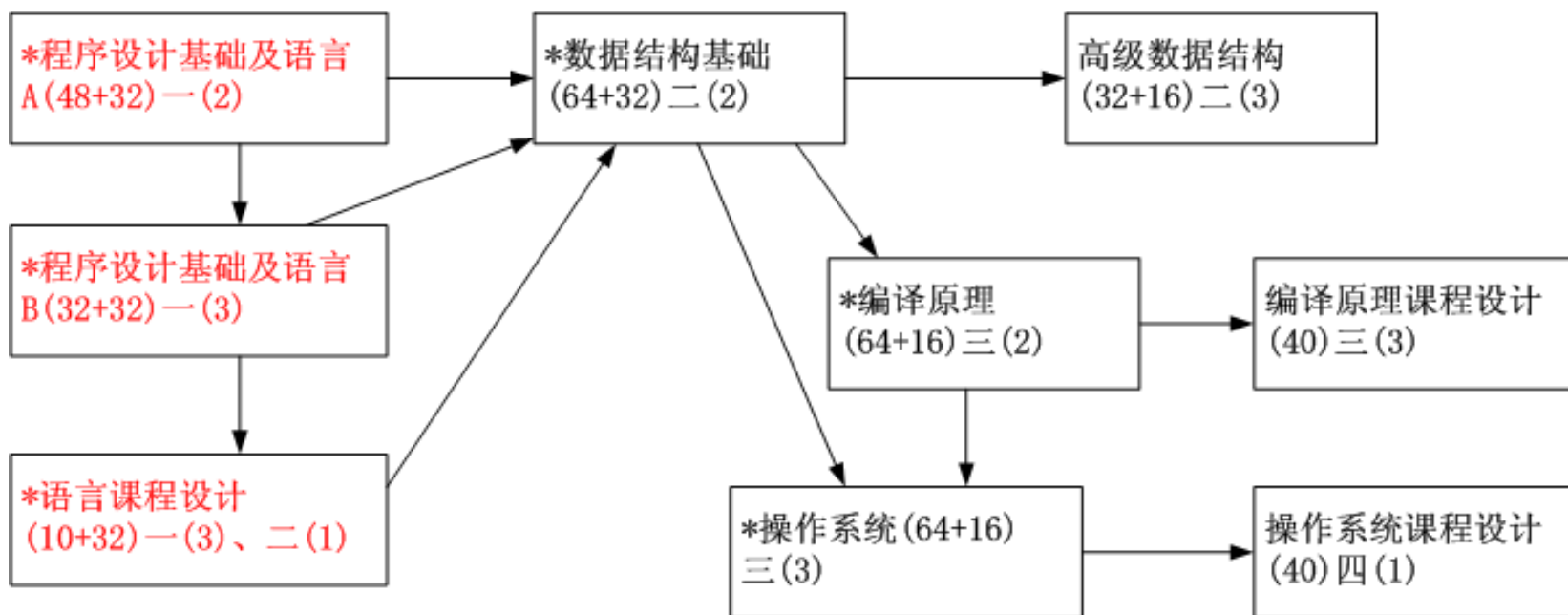




# 课前简介

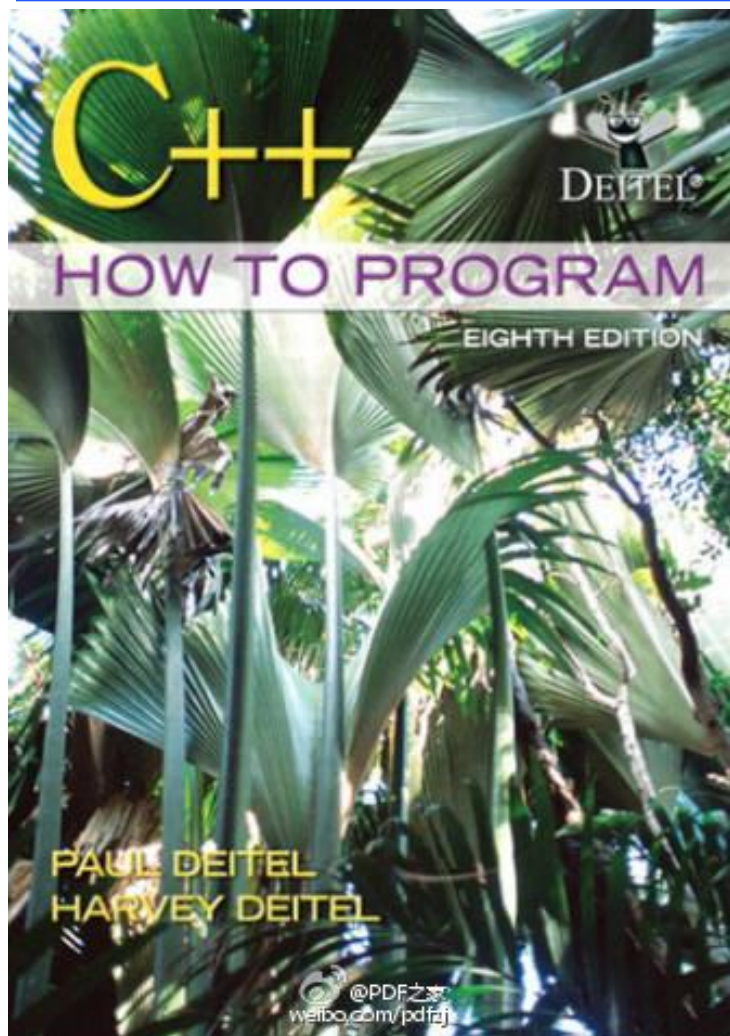


- ❑ “软件基础”课程群
- ❑ 课程目标
- ❑ 支持数据结构、算法、软件工程等课程





# 课前简介

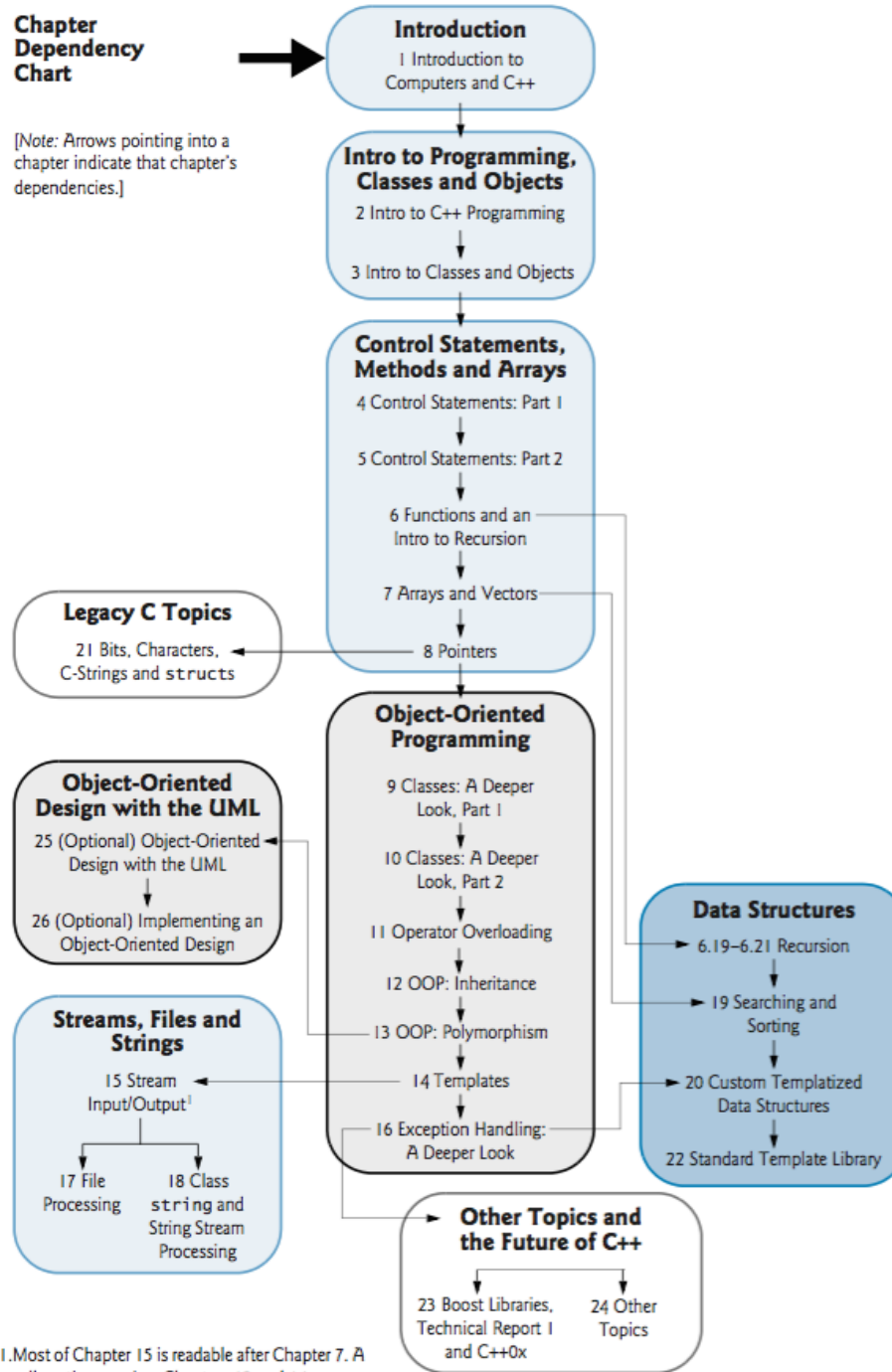


C++ 大学英语教程  
(第八版) (英文版)  
(美) H.M.Deitel, P.J.Deitel  
电子工业出版社



## Chapter Dependency Chart

[Note: Arrows pointing into a chapter indicate that chapter's dependencies.]



1. Most of Chapter 15 is readable after Chapter 7. A small portion requires Chapters 12 and 14.







# 课前简介



- 程序设计基础与语言：2学期
- 本学期学时：80学时（48+32）
  
- 平时成绩：作业+上机实验+到课率
- 期末考试（英文）成绩：
  - ❖ 笔试部分（代码阅读+代码填空+编程）
  - ❖ 机考部分（编程）
- 总成绩： $30\% * \text{平时成绩} + 70\% * \text{期末考试成绩}$



# 课前简介



## □ 课程主要参考书

- ❖ 《C++程序设计教程》，钱能, 清华大学出版社
- ❖ 《C++编程思想》 / 《Thinking in C++》，Bruce Eckel, 机械工业出版社

## 网络资源

- ❖ <http://www.deitel.com/Books/C/CHowtoProgram6e/tabid/2046/Default.aspx>
- ❖ <http://msdn.microsoft.com/zh-cn/default.aspx>





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# Chapter 1

## Introduction to **Computers**, and C++



# OBJECTIVES



- ❑ Basic hardware(硬件) and software(软件) concepts.
- ❑ Basic object-technology(对象技术) concepts:  
classes(类), objects(对象), attributes(属性),  
behaviors(行为), encapsulation(封装) and  
inheritance(继承).
- ❑ Different types of programming languages.
- ❑ Typical C++ development environment
- ❑ Internet (互联网) and the World Wide Web(万维网)
- ❑ UML, Unified Modeling Language(统一建模语言)



# Topics



- ☐ **1.1 Internet, WWW and Computer**
- ☐ 1.2 Information representation(机内信息表示)
- ☐ 1.3 Machine languages, Assembly Languages and High-level Languages
- ☐ 1.4 C, C++, Java and other High-level languages
- ☐ 1.5 Object Technology
- ☐ 1.6 Typical C++ Development Environment
- ☐ 1.7 Test-Driving a C++ Application
- ☐ 1.8 UML



# 1.1 Internet, WWW and Computer



❑ U.S.DoD ARPANet (1960s)

❑ Internet (互联网, 1973)

❖ 工作更方便

❖ 信息获取更容易

❑ WWW (万维网, 1991)

❖ 发明人 Tim Berners-Lee

• 2017年获得图灵奖

❖ HTML (超文本标记语言)

❖ HTTP (超文本传输协议)





# 1.1 Internet, WWW and Computer



## □ Web 2.0

❖ Social Networking

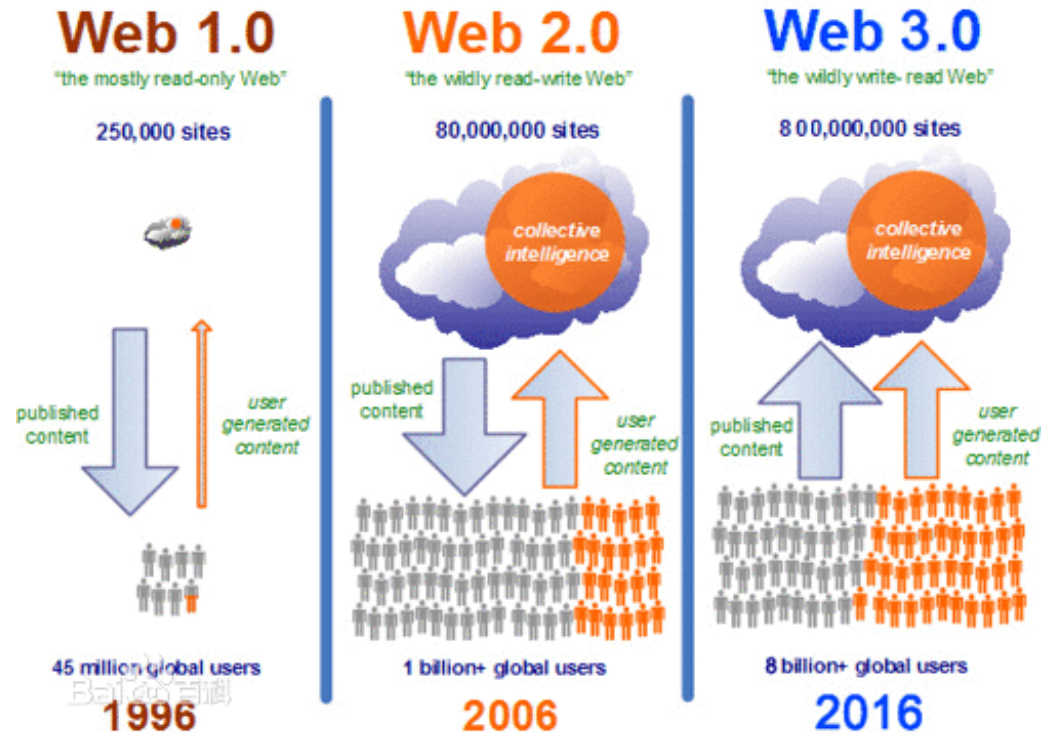
❖ Blogs

❖ Facebook

❖ YouTube

❖ 微信

❖ 优酷





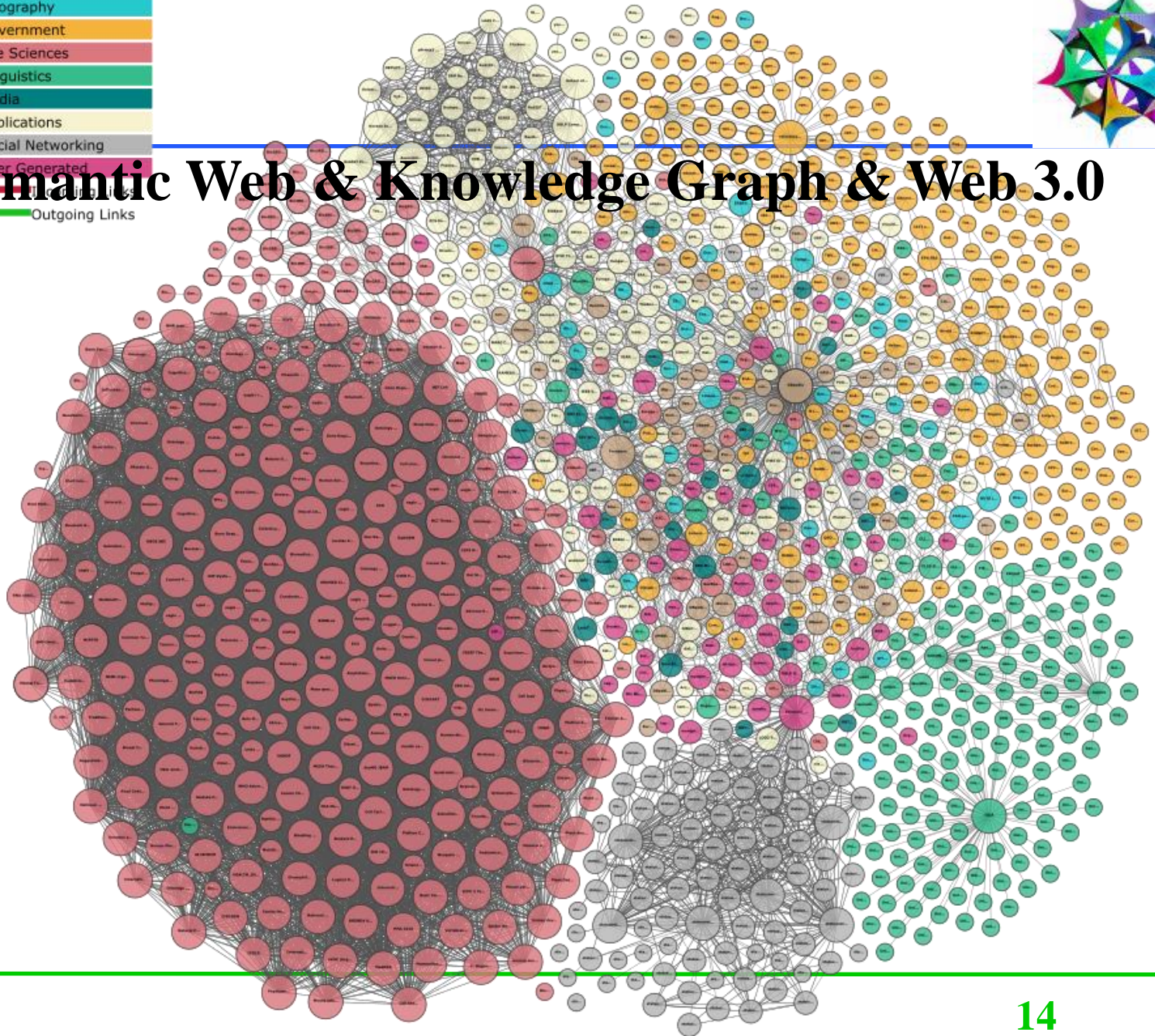


Legend

Cross Domain
Geography
Government
Life Sciences
Linguistics
Media
Publications
Social Networking
User Generated
Incoming Links
Outgoing Links



# Semantic Web & Knowledge Graph & Web 3.0







# 1.1 Internet, WWW and Computer



算盘



电子管计算机



晶体管计算机



集成电路计算机



1946年，美国物理学家莫奇利任总设计师，研制成功世界上第一台电子管计算机ENIAC(图中左为莫奇利)

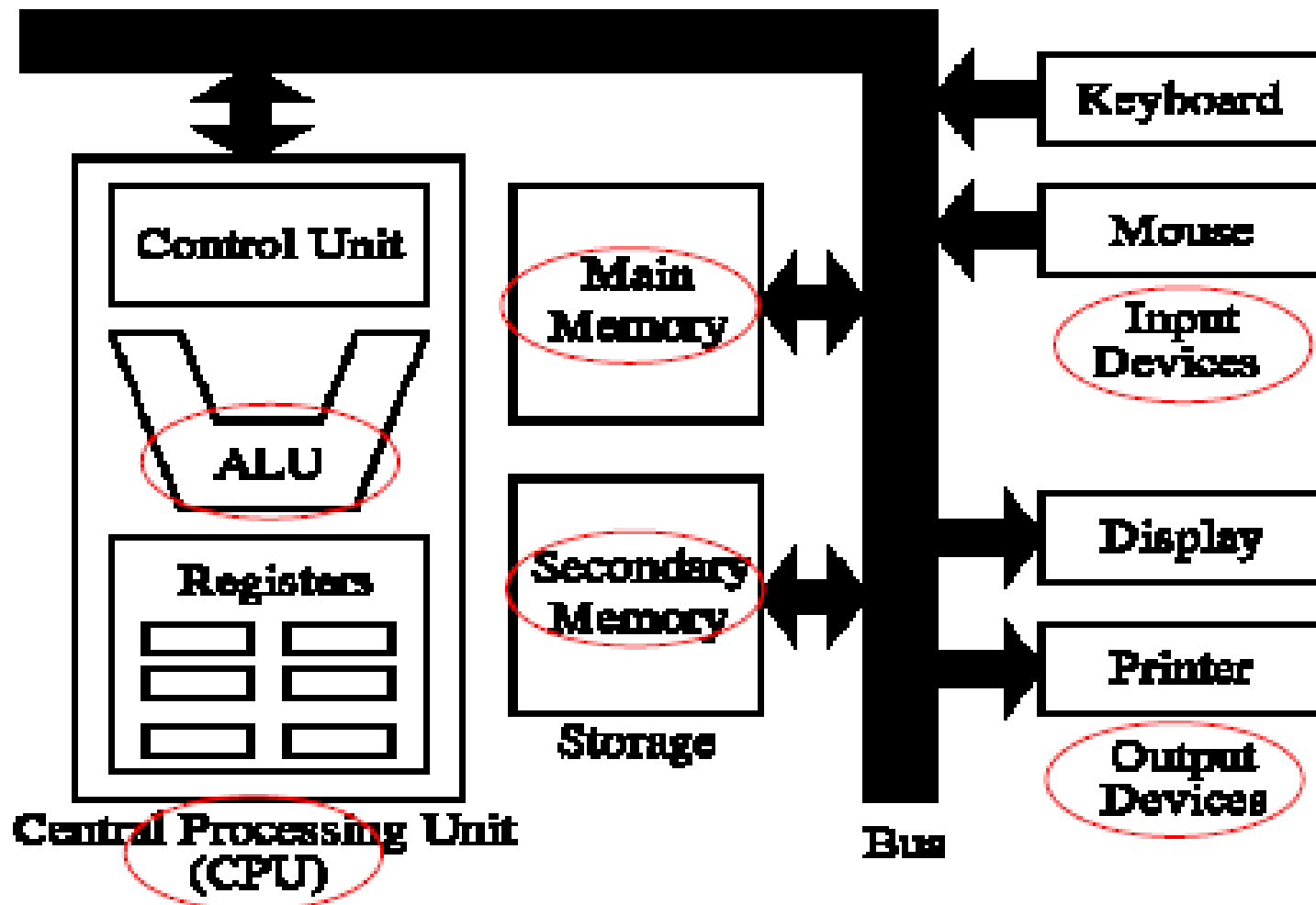


1964年，美国IBM公司研制成功一个采用集成电路的电子计算机





# 1.1 Internet, WWW and Computer





# IU (Input Unit)





# IU (Input Unit)



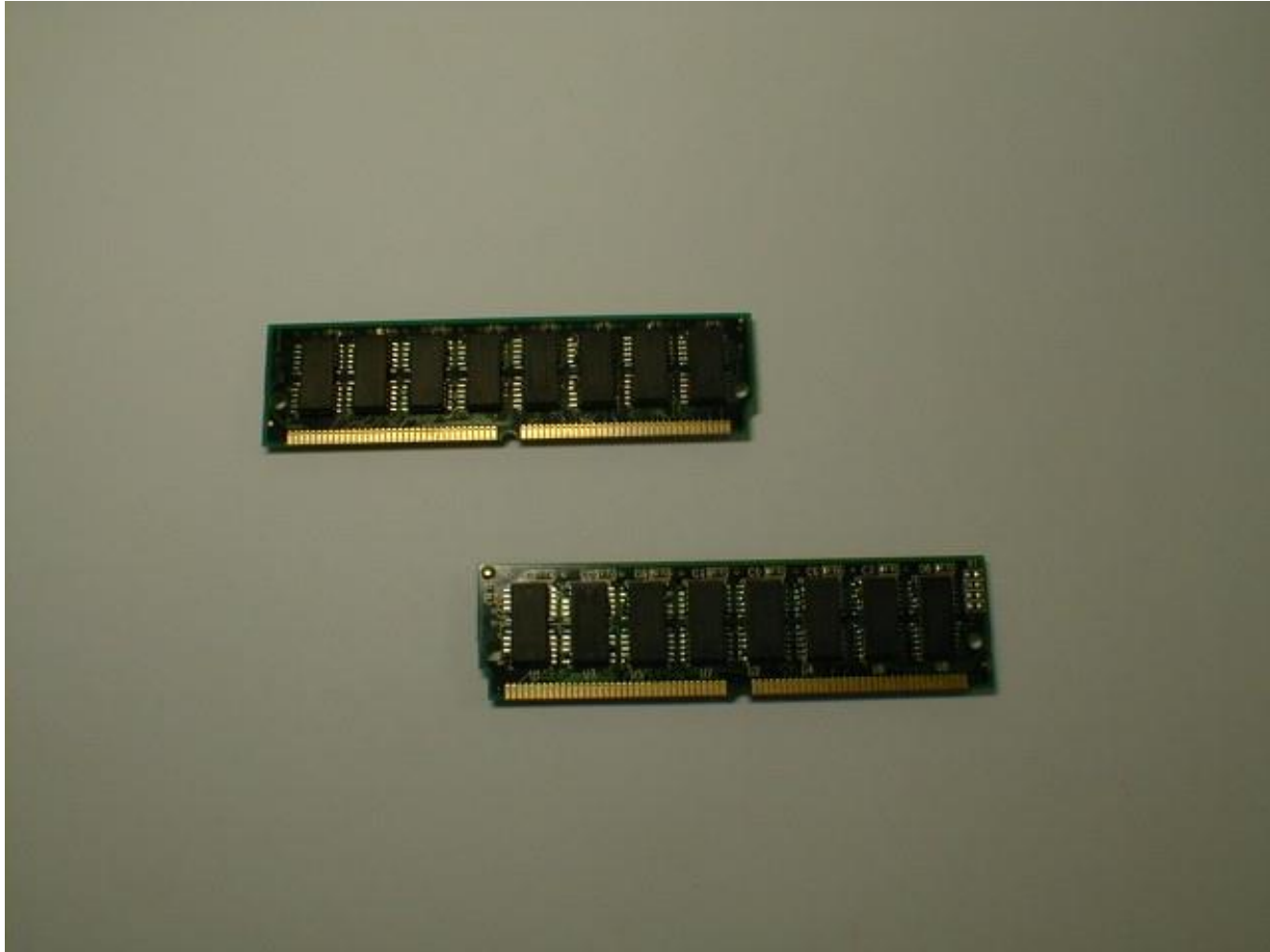


# OU (Output Unit)





# MU (Memory Unit)





# Secondary Storage Unit)

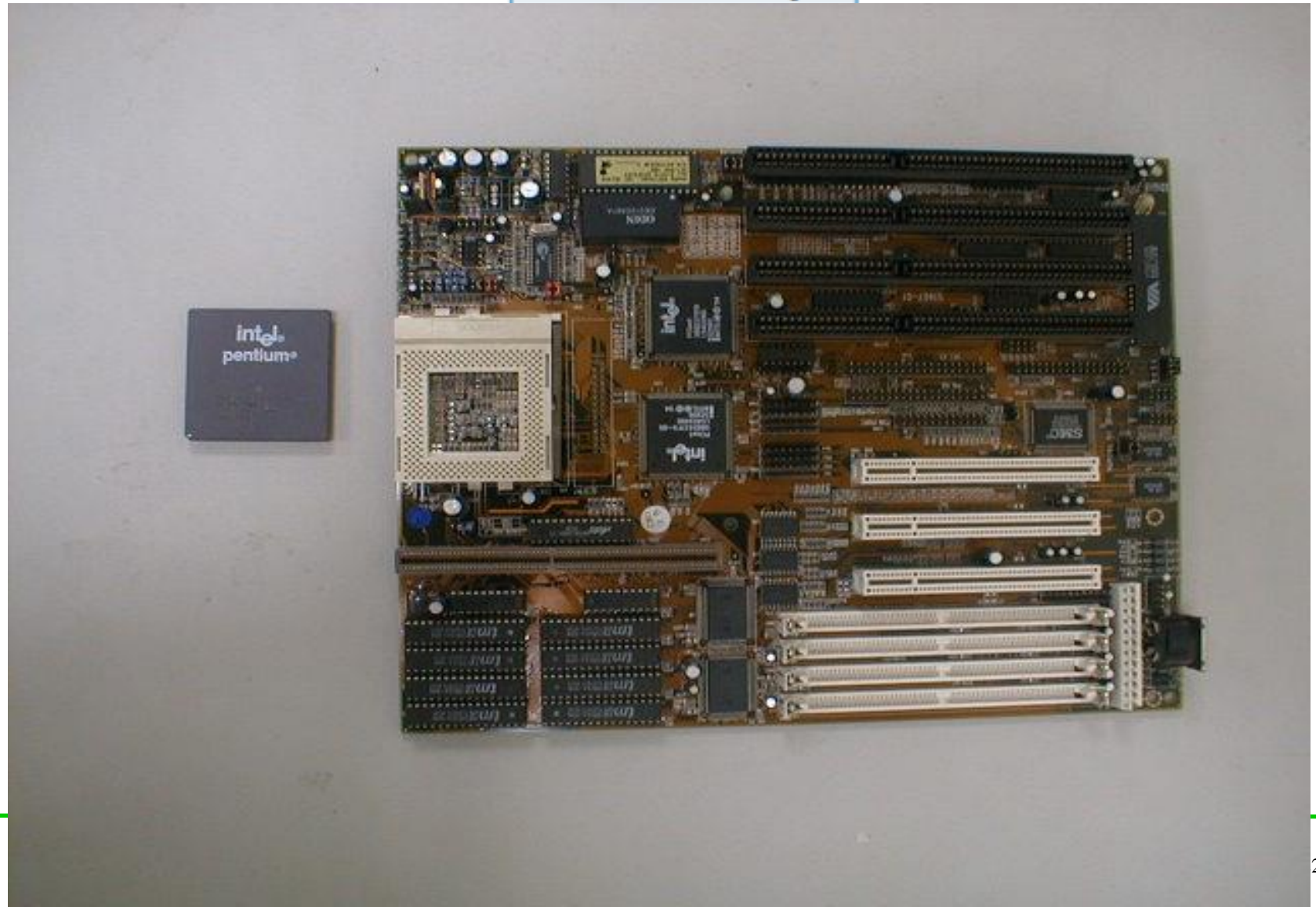
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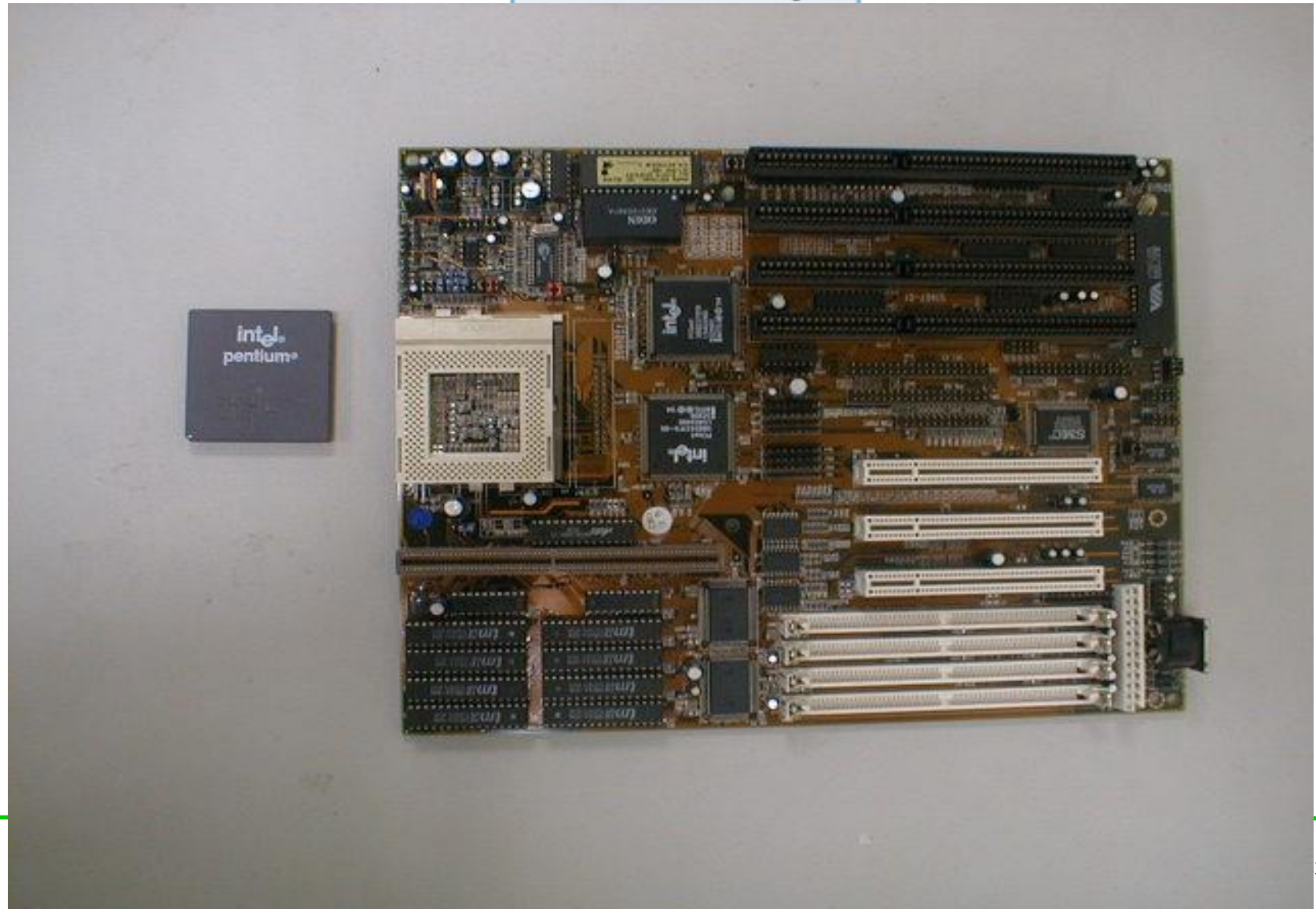
# ALU (Arithmetic and Logic Unit)







# CPU (Central Processing Unit)





# 1.1 Internet, WWW and Computer



冯·诺伊曼

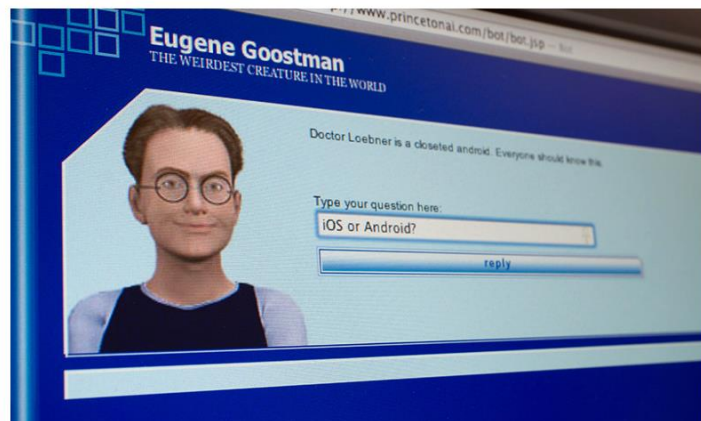
冯·诺伊曼: 计算机之父

- 二进制
- 存储程序

艾伦·图灵: 计算机科学之父

- 图灵机
- 1966, Turing Award (ACM, Association for Computing Machinery), 图灵奖
- 姚期智, 2000年  
2017年放弃美国国籍, 中科院
- 谷歌 AlphaGo (2016李世石  
2017 柯洁)

计算机首次通过图灵测试





# 1.1 Internet, WWW and Computer

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- ❑ **Computer** – programmable machine designed to follow instructions
- ❑ **Program**– instructions tell computer to do something
- ❑ **Programmer** – person who writes instructions (program) to make computer perform a task



# Topics



- ☐ 1.1 Internet, WWW and Computer
- ☐ **1.2 Information representation(机内信息表示)**
- ☐ 1.3 Machine languages, Assembly Languages and High-level Languages
- ☐ 1.4 C, C++, Java and other High-level languages
- ☐ 1.5 Object Technology
- ☐ 1.6 Typical C++ Development Environment
- ☐ 1.7 Test-Driving a C++ Application
- ☐ 1.8 UML



# 1.2 Information representation

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- **1.2.1** 数制的基本概念
- **1.2.2** 常用的数制
- **1.2.3** 不同数制间的转换
- **1.2.4** 二进制编码
- **1.2.5** 计算机中信息的存储



# 1.2 Information representation



- **基数**：数制中数字的个数
- **数位**：每个数字在数中的位置
- **数位值（权）**：每个数位对应的单位值



# 1.2 Information representation



## □十进制数:

组成：由**0 - 9** 十个数字组成

基数：**10**      逢十进一

表示方法：**(15)<sub>10</sub>**

多项式表示：

$$(115)_{10} = 1 \times 10^2 + 1 \times 10^1 + 5 \times 10^0$$





# 1.2 Information representation



## □ 二进制数:

组成: 由**0** – **1**两个数字组成

基数: **2** 逢二进一

表示方法: (**101**)<sub>2</sub>

多项式表示:

$$(111)_2 = 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$



# 1.2 Information representation



- 二进制数转换为十进制数
- 方法：先将被转换的数用多项式表示法表示出，再求出对应的和

举例：  $(101)_2$

$$= 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$
$$= 4 + 0 + 1$$
$$= 5$$



# 1.2 Information representation



## □ 十进制整数转为二进制数

方法：求余法，即“除以2，取余数，将所得余数倒读”

## □ 举例：13

除以2	余数	余数排列
$2 \overline{) 13}$	.....1	
$2 \overline{) 6}$	.....0	
$2 \overline{) 3}$	.....1	
$2 \overline{) 1}$	.....1	
0		

$$13 = (1101)_2$$



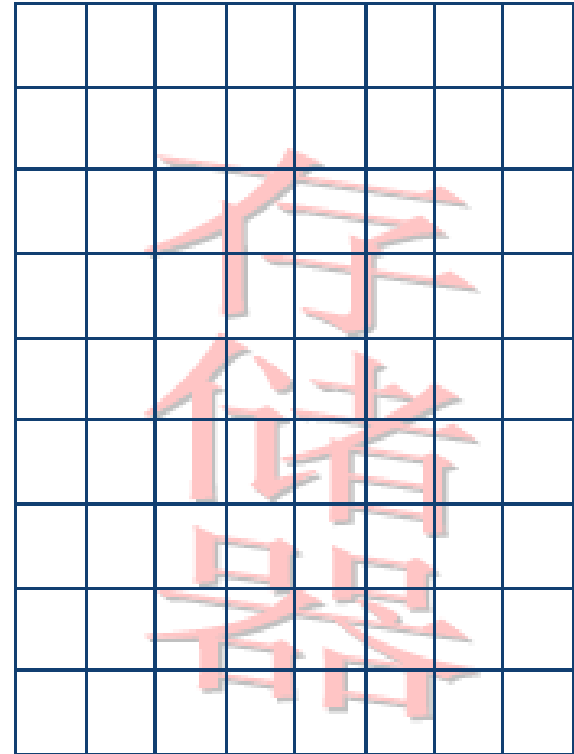
# 1.2 Information representation



□ 位(bit)



□ 字节(Byte)  
基本存储单元





# 1.2 Information representation



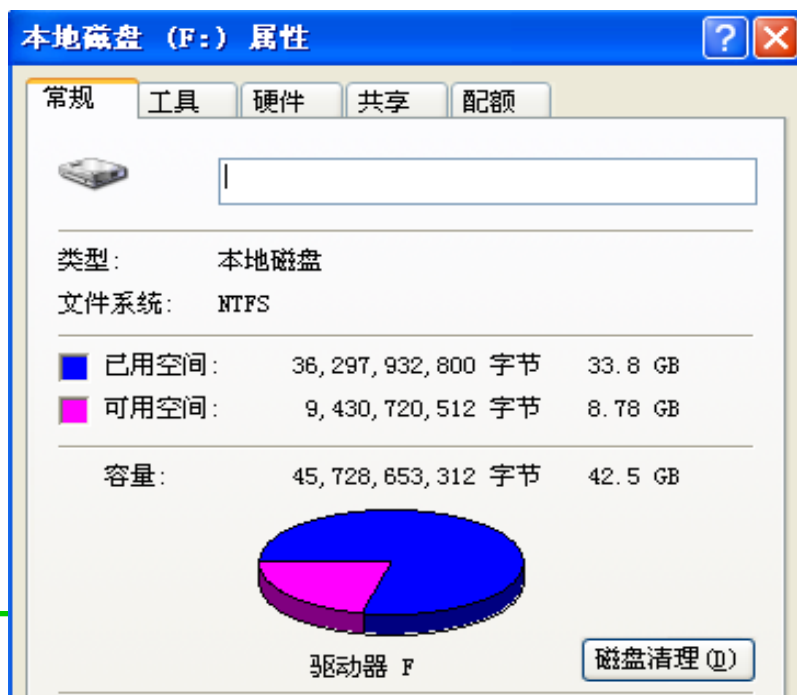
- **位(bit)**: 是计算机存储信息的最小单位, 指二进制数中的一个数位, 其值为“0”或“1”
- **字节(Byte)**: 8个二进制位称一个字节, 即一个存储单元
- **存储容量**: 存储器中包含存储单元的数量



# 1.2 Information representation



- KB: 1KB=1024B
- MB: 1MB=1024KB
- GB: 1GB=1024MB
- TB: 1TB=1024GB





# Topics



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- ☐ 1.8 UML





# 1.3 Machine, Assembly and High-level Languages



## □ Three types of programming languages

- ❖ Machine Language (机器语言)
- ❖ Assembly Language (汇编语言)
- ❖ High-Level Language (高级语言)



# 1.3 Machine, Assembly and High-level Languages



## □ Machine languages (机器语言)

❖ *Strings of numbers giving machine specific instructions*

□ machine dependent

□ Object Code (目标代码)

□ Example:

❖ +1300042774

❖ +1400593419

❖ +1200274027



# 1.3 Machine, Assembly and High-level Languages



## □ Assembly languages (汇编语言)

❖ *English-like abbreviations representing elementary computer operations*

## □ Translated via Assemblers 汇编器

## □ Example:

❖ **LOAD BASEPAY**

❖ **ADD OVERPAY**

❖ **STORE GROSSPAY**



# 1.3 Machine, Assembly and High-level Languages



## □ High-level languages (高级语言)

❖ *Codes similar to everyday English, Use mathematical notations*

□ Translated via Compilers 编译器,  
△ Interpreter 解释器

□ Example:

❖  $\text{grossPay} = \text{basePay} + \text{overTimePay}$



# Topics



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# 1.4 C, C++, Java and other High-level languages

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- ☐ 1.4.1 History of C and C++
- ☐ 1.4.2 C++ Standard Library
- ☐ 1.4.3 History of Java
- ☐ 1.4.4 FORTRAN, COBOL, Pascal and Ada



# 1.4.1 History of C and C++



1967, Martin Richards, OS & Compiler

BCPL

1972, Dennis Ritchie , Unix, BELL

C

1970, Ken Thompson , early Version  
of Unix, BELL

B

C++

ANSI C

Early 1980s, Bjarne Stroustrup,  
*object-oriented programming*

1990, ANSI & ISO, standardized,  
hardware-independent, Updated in  
1999





## 1.4.2 C++ Standard Library



□ C++ programs consist of pieces called  
**Functions(函数) & Classes(类)**

❖ A programmer can all create his own

**Advantage:** the programmer knows exactly how it works

**Disadvantage:** time consuming

❖ Otherwise he can use

- C++ Standard Library (C++标准库)
- C Standard Library



# 1.4.2 C++ Standard Library



## □ 学习

- ❖ C++ Language itself
- ❖ Functions and Classes in C++ Standard Library

## □ 项目开发

- ❖ 自己的函数和类
- ❖ 合作者开发的函数和类
- ❖ 标准库



# 1.4.3 History of Java



## ☐ Sun Microsystems

- ❖ A C++ based Language – OAK, 1991
- ❖ JAVA, 1995 formally announced

## ☐ Java is used to

- ❖ Intelligent consumer electronic devices
- ❖ WWW - Create Web pages with dynamic and interactive content (Applet)
- ❖ Develop large-scale enterprise applications
- ❖ Enhance the functionality of Web servers
- ❖ Provide applications for consumer devices (such as Cell phones, PDA)



## 1.4.4 FORTRAN, COBOL, Pascal and Ada



### ☐ FORTRAN

- ❖ IBM, Used for scientific and engineering applications

### ☐ COBOL

- ❖ Used to manipulate large amounts of data

### ☐ Pascal

- ❖ designed for teaching structured programming
- ❖ DELPHI (Object Pascal, MIS, 管理信息系统)

### ☐ Ada

- ❖ DoD's massive command-and-control software systems, multitasking



# Topics



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- ☐ **1.5 Object Technology**
- ☐ 1.6 Typical C++ Development Environment
- ☐ 1.7 Test-Driving a C++ Application
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# 1.5 Object Technology

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- ❑ 1.5.1 Why Object?
- ❑ 1.5.2 What is Object?



# 1.5.1 Why Object?



## ❑ Procedure Oriented (面向过程)

- ❖ ORTRAN, COBOL, Pascal, Basic and C

- ❖ 将复杂的过程按**功能**分层分解, 以解决问题

## ❑ Structured Programming (结构化编程, 1970s)

- ❖ 描述任何实体的操作序列只需要三种基本控制结构

  - Sequence (顺序结构)

  - Selection (选择结构)\*3

  - Repetition (循环结构)\*3

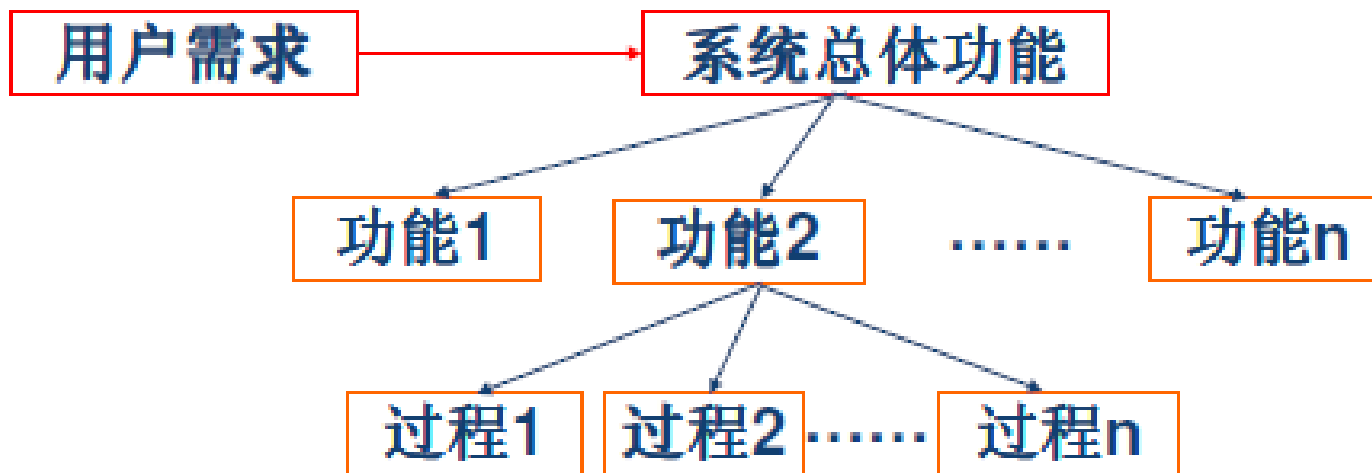
## ❑ 消除以往编程过程中无限制使用转移语句的情况

- : goto





# 1.5.1 Why Object?



## ❑ 主要问题

- ❖ 软件重用性差
- ❖ 软件可维护性差
- ❖ 开发出的软件不能很好地满足用户需要



# 1.5.1 Why Object?



Humans learn about existing objects by studying their **Attributes** and observing their **behaviors**.



# 1.5.1 Why Object?



- ❑ **Conclusion: Structured Programming + Object oriented Programming (面向对象编程)**
  - ❖ Their **internal structure** is often built using structured-programming techniques.
  - ❖ Also, the **logic of manipulating objects** is occasionally expressed with structured programming.



# 1.5.2 What is Object?



## ❑ **Object oriented** (面向对象)

- ❖ **Reusable software components** (可重用的软件组件)
- ❖ **model items in the real world** (现实事物的建模)
- ❖ **Any noun can be represented as an object**
- ❖ **Object = Attribute + Behavior**

## ❑ **Class**(类): 对同一类**Objects**的共同描述和抽象

- ❖ **C++中的一种用户定义的数据类型**
- ❖ **Attribute: member data**
- ❖ **Behavior: method / Member Functions**



## 1.5.2 What is Object?



- ❑ **Encapsulates**(封装) **attributes**(属性) and **operations** (操作, behaviors) into objects
- ❑ **Inheritance**(继承) : 人/猩猩- 生物
- ❑ **Information hiding**
  - ❖ Communicating with one another across well-defined interfaces using Message
  - ❖ Without knowing how it is implemented



## 1.5.2 What is Object?



### Procedure oriented vs Object oriented

- ❑ focused on **actions** (verbs) rather than on things or **objects** (nouns)
- ❑ break down a programming task into
  - ❖ variables, data structures, and subroutines
  - ❖ **Objects, encapsulating its own data and methods**
- ❑ procedural programming uses **procedures** to operate on data structures
- ❑ object-oriented programming **bundles the two together** so an "object" operates on its "own" data structure



# Topics



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- ☐ **1.6 Typical C++ Development Environment**
- ☐ 1.7 Test-Driving a C++ Application
- ☐ 1.8 UML





# 1.6 Typing Development

□ 1. *Edit*

□ 2. *Preprocess*

宏、文件包含、条件编译

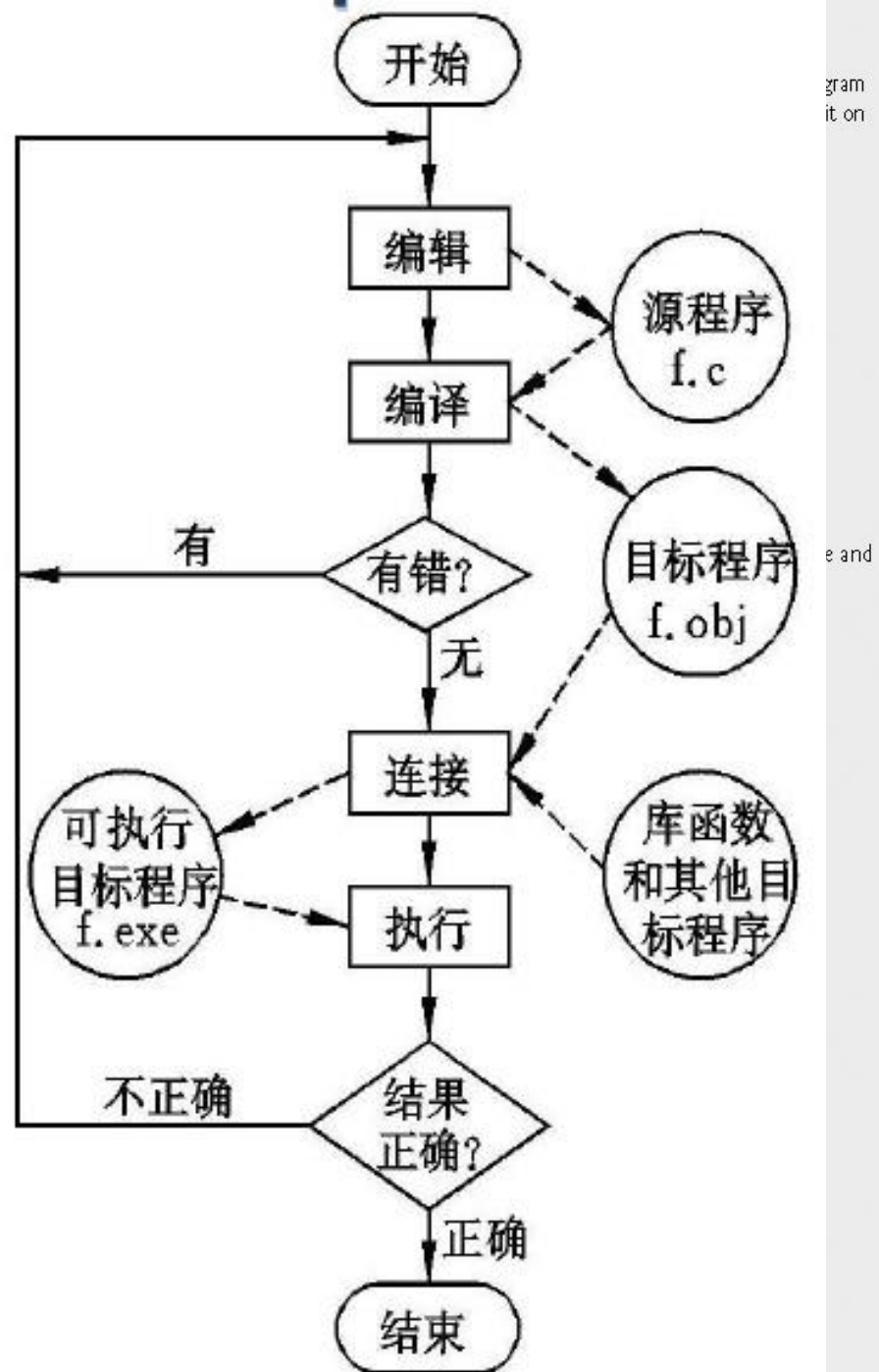
□ 3. *Compile*

编译错误(语法等)

□ 4. *Link*

□ 5. *Load*

□ 6. *Execute*





# Topics



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- ☐ **1.7 Test-Driving a C++ Application**
- ☐ 1.8 UML



# 1.7 Test-Driving a C++ Application



- ❑ **Open the Command Prompt window**
  - ❖ 开始-所有程序-附件-命令提示符
  - ❖ 开始-运行-输入 “cmd”
- ❑ **Locating** the completed application
- ❑ **Running** the GuessNumber application
  - ❖ Entering your first guess
  - ❖ Entering another guess
  - ❖ Entering additional guesses
  - ❖ Playing the game again or exiting the application
- ❑ **Close** the Command Prompt window



# 1.7 Test-Driving a C++ Application



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\yangming>cd E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug

C:\Documents and Settings\yangming>e:

E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>_
```



# 1.7 Test-Driving a C++ Application



```
C:\WINDOWS\system32\cmd.exe - GuessNumber
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\yangming>cd E:\03 教学\002 程序设计基础及语言\课件\Ch1
\GuessNumber\Debug

C:\Documents and Settings\yangming>e:

E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>GuessNumber
I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.
?
```



# 1.7 Test-Driving a C++ Application



```
C:\WINDOWS\system32\cmd.exe - GuessNumber
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\yangming>cd E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug

C:\Documents and Settings\yangming>e:

E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>GuessNumber
I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.
? 500
Too high. Try again.
? _
```



# 1.7 Test-Driving a C++ Application



```
C:\WINDOWS\system32\cmd.exe - GuessNumber
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\yangming>cd E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug

C:\Documents and Settings\yangming>e:

E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>GuessNumber
I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.
? 500
Too high. Try again.
? 250
Too high. Try again.
?
```





# 1.7 Test-Driving a C++ Application



```
C:\WINDOWS\system32\cmd.exe - GuessNumber

E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>GuessNumber
I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.
? 500
Too high. Try again.
? 250
Too high. Try again.
? 125
Too high. Try again.
? 62
Too high. Try again.
? 31
Too low. Try again.
? 46
Too high. Try again.
? 38
Too low. Try again.
? 42

Excellent! You guessed the number!
Would you like to play again (y or n)?
```



# 1.7 Test-Driving a C++ Application



```
Ca C:\WINDOWS\system32\cmd.exe - GuessNumber
? 42

Excellent! You guessed the number!
Would you like to play again (y or n)? y

I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.
?
```



# 1.7 Test-Driving a C++ Application



```
C:\WINDOWS\system32\cmd.exe
E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>GuessNumber
I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.
? 42

Excellent! You guessed the number!
Would you like to play again (y or n)? n

E:\03 教学\002 程序设计基础及语言\课件\Ch1\GuessNumber\Debug>
```

- ❑ 输入数据的特点？（500、250、125、62、31、46、38、42）
- ❑ 为何每次执行该程序让猜的第一个数都是42？



# Topics



- ☐ 1.1 Internet, WWW and Computer
- ☐ 1.2 Information representation(机内信息表示)
- ☐ 1.3 Machine languages, Assembly Languages and High-level Languages
- ☐ 1.4 C, C++, Java and other High-level languages
- ☐ 1.5 Object Technology
- ☐ 1.6 Typical C++ Development Environment
- ☐ 1.7 Test-Driving a C++ Application
- ☐ **1.8 UML**



# 1.8 UML

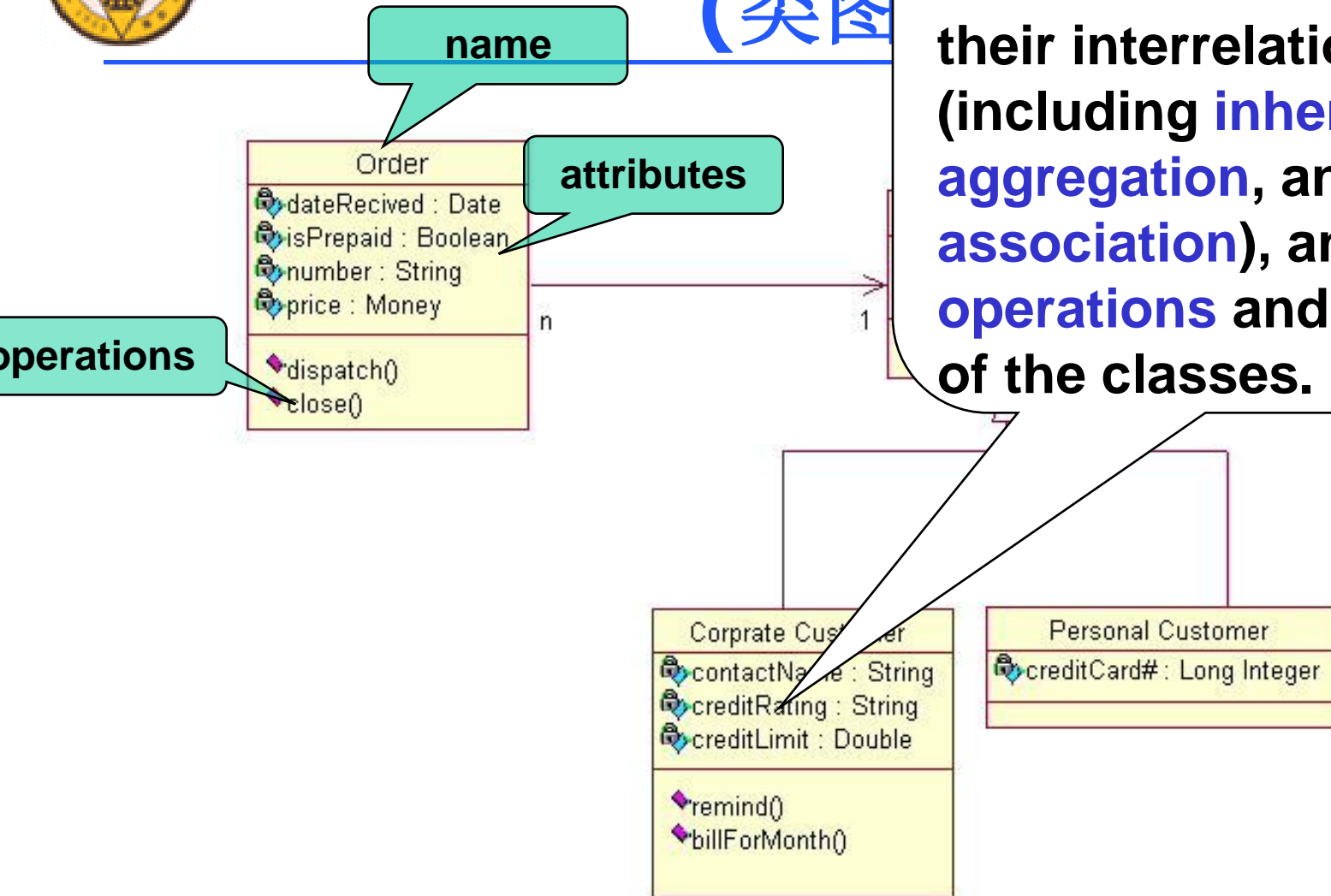


- UML (Unified Modeling Language, 统一建模语言). 1997年, OMG组织(Object Management Group对象管理组织)发布.
- 目标: 为开发团队提供**标准通用的图形化**设计语言来开发和构建计算机应用. 通过使用UML, 开发人员能够阅读和交流系统架构和设计规划.



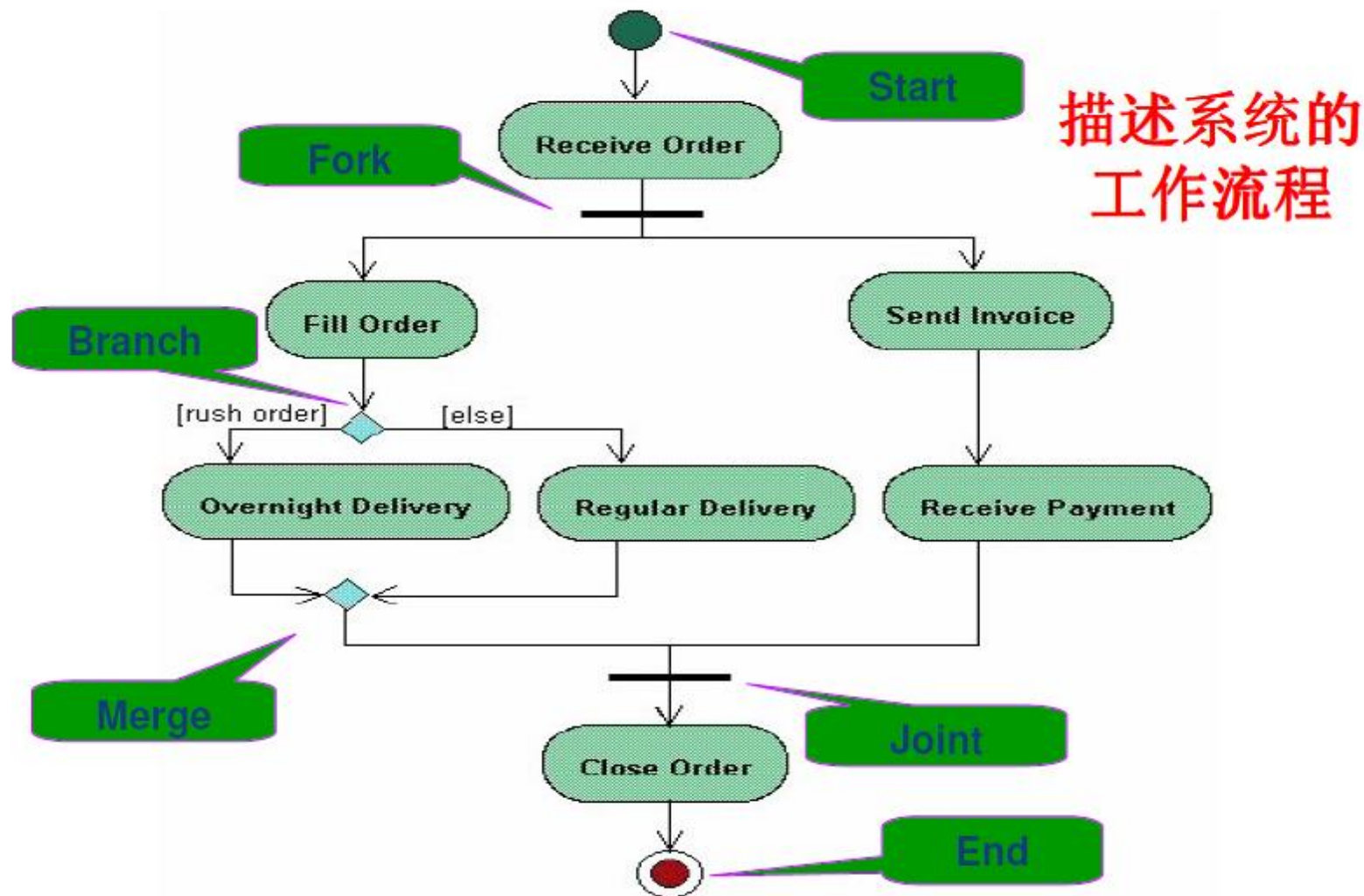
# UML ---- Class (类图)

Class diagrams show the **classes** of the system, their interrelationships (including **inheritance**, **aggregation**, and **association**), and the **operations** and **attributes** of the classes.





# UML ---- Action Diagram (活动图)





# 本章小结



## □ 计算机科学的基本概念

- ❖ What is Computer?

- ❖ Computer Organization

- ❖ 数制

## □ 熟悉面向对象的一些基本概念：类、对象、属性、行为和继承

## □ 熟悉不同类型的编程语言

- ❖ 机器语言

- ❖ 汇编语言

- ❖ 高级语言

## □ 初步了解UML





# 上机时间



- 第4, 6, 10, 12, 14, 16周周二上午3,4节
- 第7, 9, 11, 13, 15周周四晚上6:30-9:30
- 计算机实验中心3楼（金智楼）