Introduction to Computer Science

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课程定位

- ✓ 本课程是一门先导课程，通过学习，使学生对计算机科学涵盖的内容及其相互关系有更加全局系统的认识，力求保持广度同时兼顾深度。
- ✓ 沿着“抽象作用”的学习主线，掌握计算机软、硬件基础知识理论和工作原理。
- ✓ 系统地了解计算机专业中各门课程所要研究的问题和达到的要求，通过对计算机体系结构、操作系统、网络、数据结构和算法等重点知识的学习，奠定对复杂工程问题进行分析建模的基础。
- ✓ 通过网站设计以及计算机研究领域调研大作业，鼓励学生将所学理论应用到实际工程中解决具体问题，强调团队合作及创新实现。
- ✓ 为学习后续的专业课程打好基础。

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Textbook

全英文教材

- **Textbook:**

Computer Science: An Overview by J. Glenn Brookshear

- Wechat + contact person

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Outline of Our Study

- Chapter 0: Introduction
- Chapter 1: Data Storage
- Chapter 2: Data Manipulation
- Chapter 3: Operating Systems
- Chapter 4: Networks and the Internet
- Chapter 5: Algorithms
- Chapter 6: Programming Languages

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Outline of Our Study (continued)

- Chapter 7: Software Engineering
- *Chapter 8: Data Abstractions*
- Chapter 9: Database Systems
- Chapter 10: Computer Graphics
- Chapter 11: Artificial Intelligence
- Chapter 12: Theory of Computation

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Schedule

Week	Module	Content	Assignment & Quiz
1		Introduction	
2	Part I	Data storage	
3		Data manipulation	
4		Operating system1	Assignment 1
5		Holiday (National Day)	
6		Operating system2	
7		Network1	Assignment 2
8		Network2	
9	Part II	Algorithm1	
10		Algorithm2	
11		Programming language 1	Assignment 3
12		Programming language 2	
13	Part III	Presentation: project 1	Assignment 4; Project 1
14		Presentation: project 1	Project 1
15		Presentation: project 2	Project 2
16		Presentation: project 2	Project 2
17		Examination	

Grading

- 总评成绩 = 大作业1（15%）+ 大作业2（20%）+ 平时成绩（10%）+ 考勤（10%）+ 期末考试（45%）

  期末考试全英文笔试、闭卷

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大作业说明

- 大作业1：计算机领域调研
- 大作业2：网页设计

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Projects

- Project 1: Presentation: A Glimpse of Computer Science

参考选题，也可自由选择

Big Models 大模型
Hacking and Security 黑客与安全
VR and AR 虚拟现实和增强现实
Artificial Intelligence 人工智能
Computer Architecture 计算机系统结构
Cloud Computing, Internet of Things, and Big Data 云计算、物联网及大数据
Software Engineering 软件工程
Embedded Systems 嵌入式系统
Multimedia Technology 多媒体技术
Computer Networks 计算机网络
Computer Vision 计算机视觉
Open Source Movement 开源运动
Brain-Computer Interface 脑机接口

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Projects Scoring-Project 1: Presentation

以下标准仅为参考基准，作业的专业程度、美观、创新度、工作量、观感等将影响成绩的评定

优 汇报组织优秀，逻辑条理连贯明晰，辅有实验或者示例展示，表达生动
良 汇报内容丰富，逻辑清晰，有自主思考和见解，汇报表达准确
中 每人参与完成汇报，汇报内容较为完整，报告形式正确

- **提交材料：**演示PPT。
- 演示时间将根据组数调整。

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Project 2： Website

要求：设计一个主题不限的网站。网站应包括前端和后端。

技术：开发前端应基于前端三件套（HTML、CSS、Javascript）或某些前端框架如 Vue 等，后端应基于 Django、FLASK 或类似的框架。数据库的选择是灵活的，强烈建议使用 MySQL。

- **提交材料：**网站及其源代码压缩包，演示PPT或视频。
- 演示时间将根据组数调整。

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以下标准仅为参考基准，作业的专业程度、美观、创新度、工作量、观感等将影响成绩的评定

Basic，80~85：网站具备基本功能；包含前端和后端且前后端交互正常；代码主体部分由本小组内成员独立完成，不存在抄袭，不与教程中所提供示例相仿；汇报 PPT 基本美观、汇报内容基本完整无误、汇报时间把控得当。

Intermediate，85~90：在 Basic 基础上，要求网站功能完备，包含数据添加，修改和查询等操作功能；要求小组成员对网站实现中的核心技术细节了解清楚；要求汇报 PPT 排版工整、设计美观；要求汇报内容丰富完整、条理清晰、体现技术细节。

Advanced，90~100：在 Intermediate 基础上，进阶加分项：网页 UI 设计合理美观；项目包含对后端性能的思考和优化；有数据库支持的动态网站设计；汇报时表达清晰语言简洁。

What are computers?











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- Computer
  - A computer is an electronic machine, operating under the control of instructions stored in its own memory that can accept data (input), manipulate the data according to specified rules (process), produce results (output), and store the results for future use (storage).

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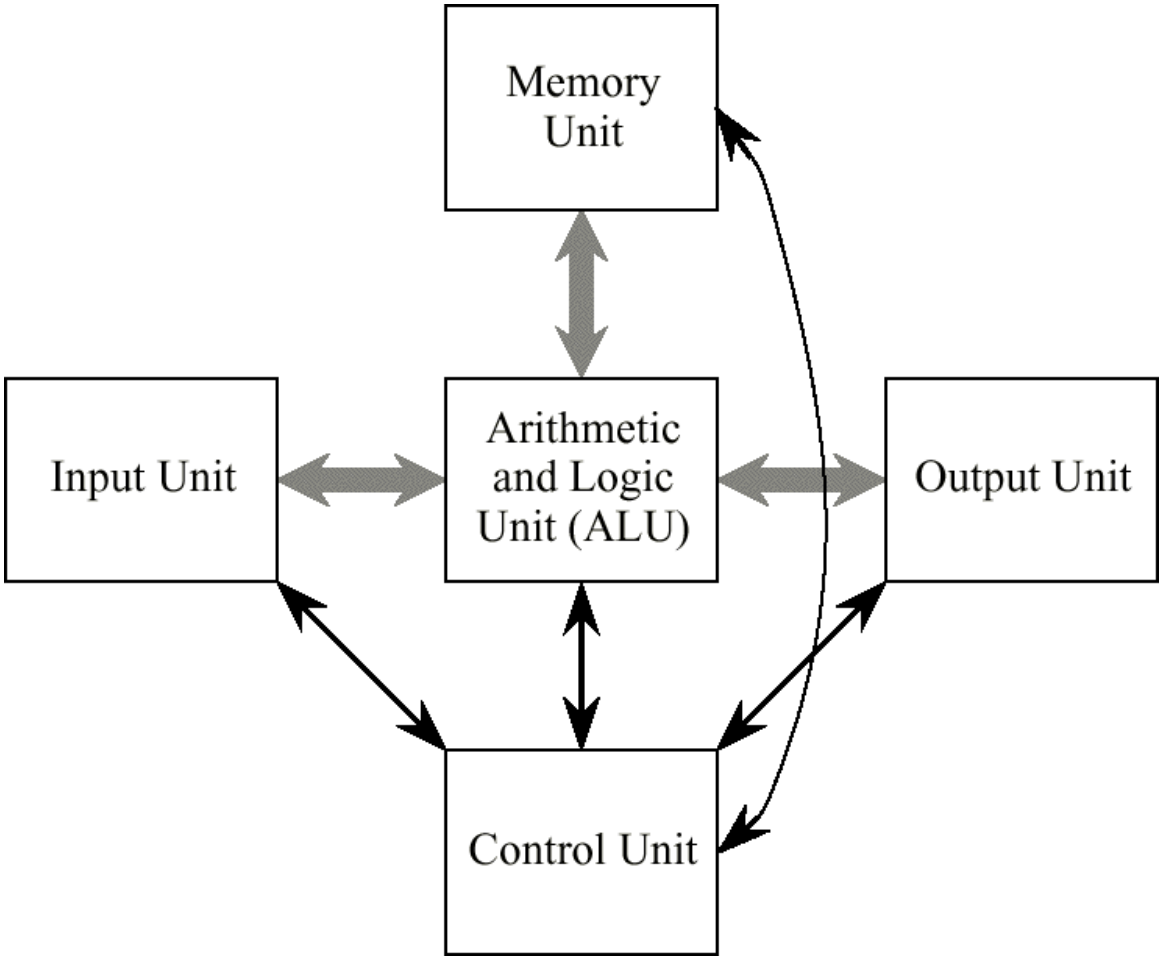
Von Neumann structure（冯诺依曼结构)



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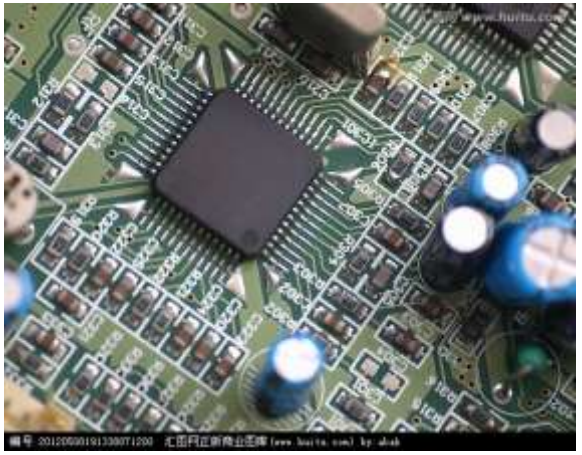

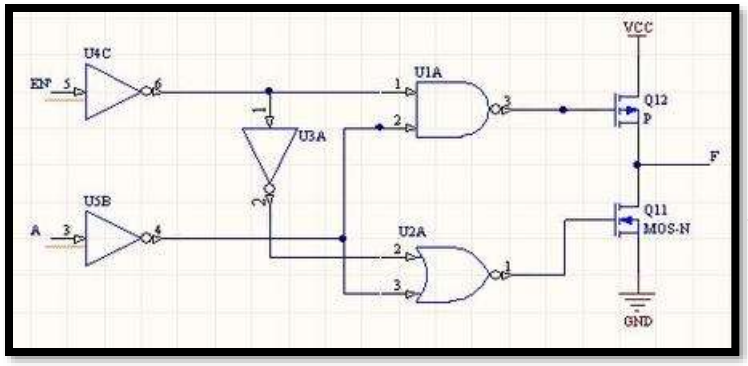

门电路
010010001

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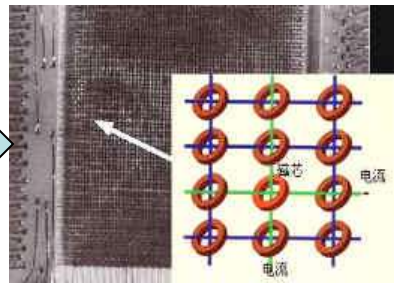
Generations: 1-4

真空管

Vacuum Tube Computer

晶体管



Transistorized Computers

指甲盖大小的CPU中，可有几百亿个晶体管

大规模集成电路

Very large scale integrated circuits (VLSI) Computers

集成电路

Integrated Circuit Computers

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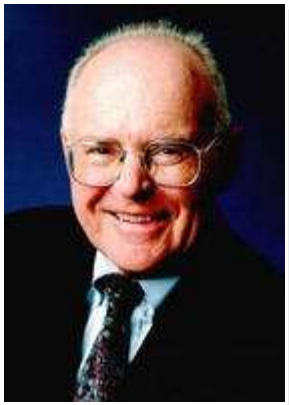
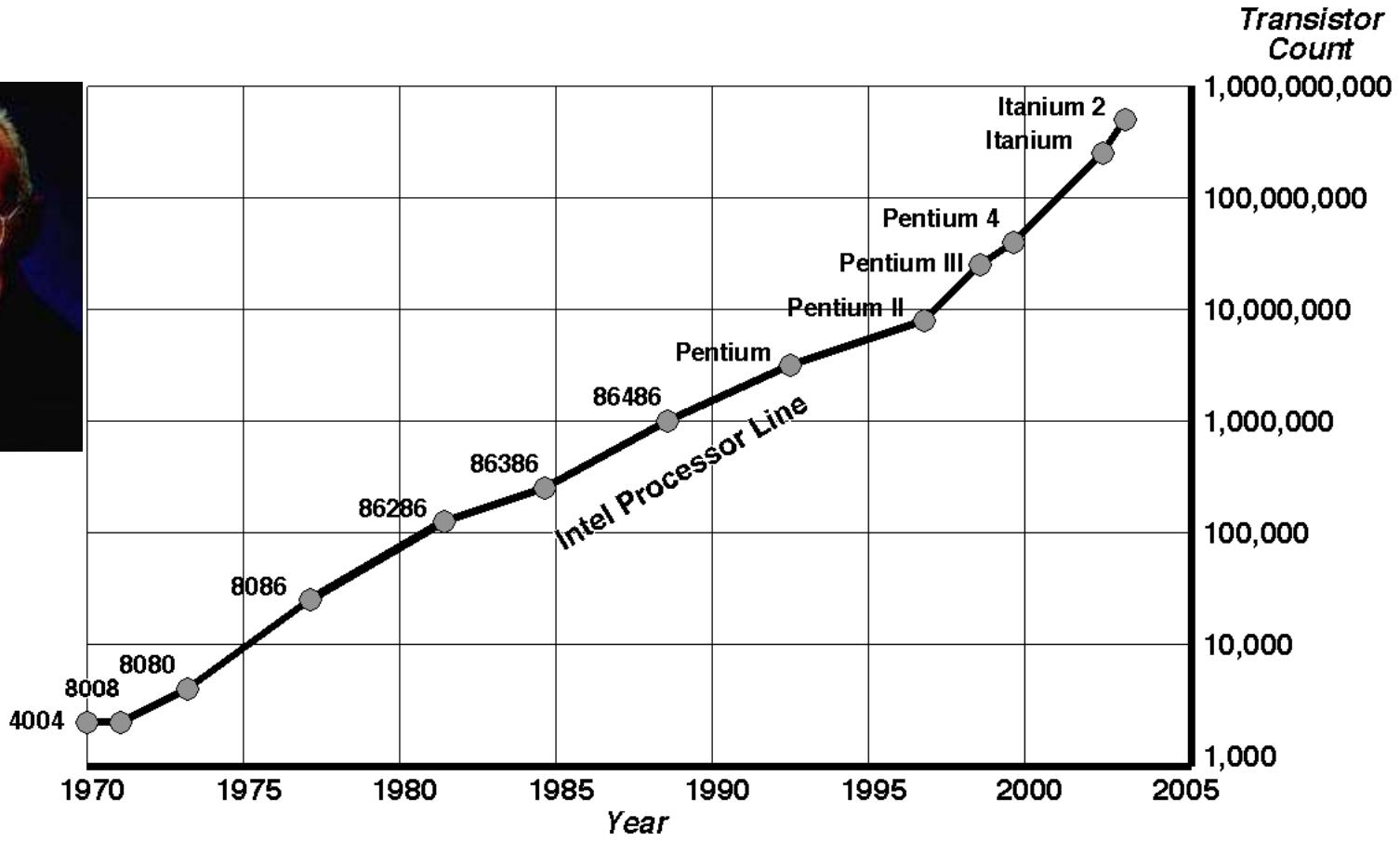
Moore's Law (摩尔定律)

- Computing power doubles every 18 months, for the same price.





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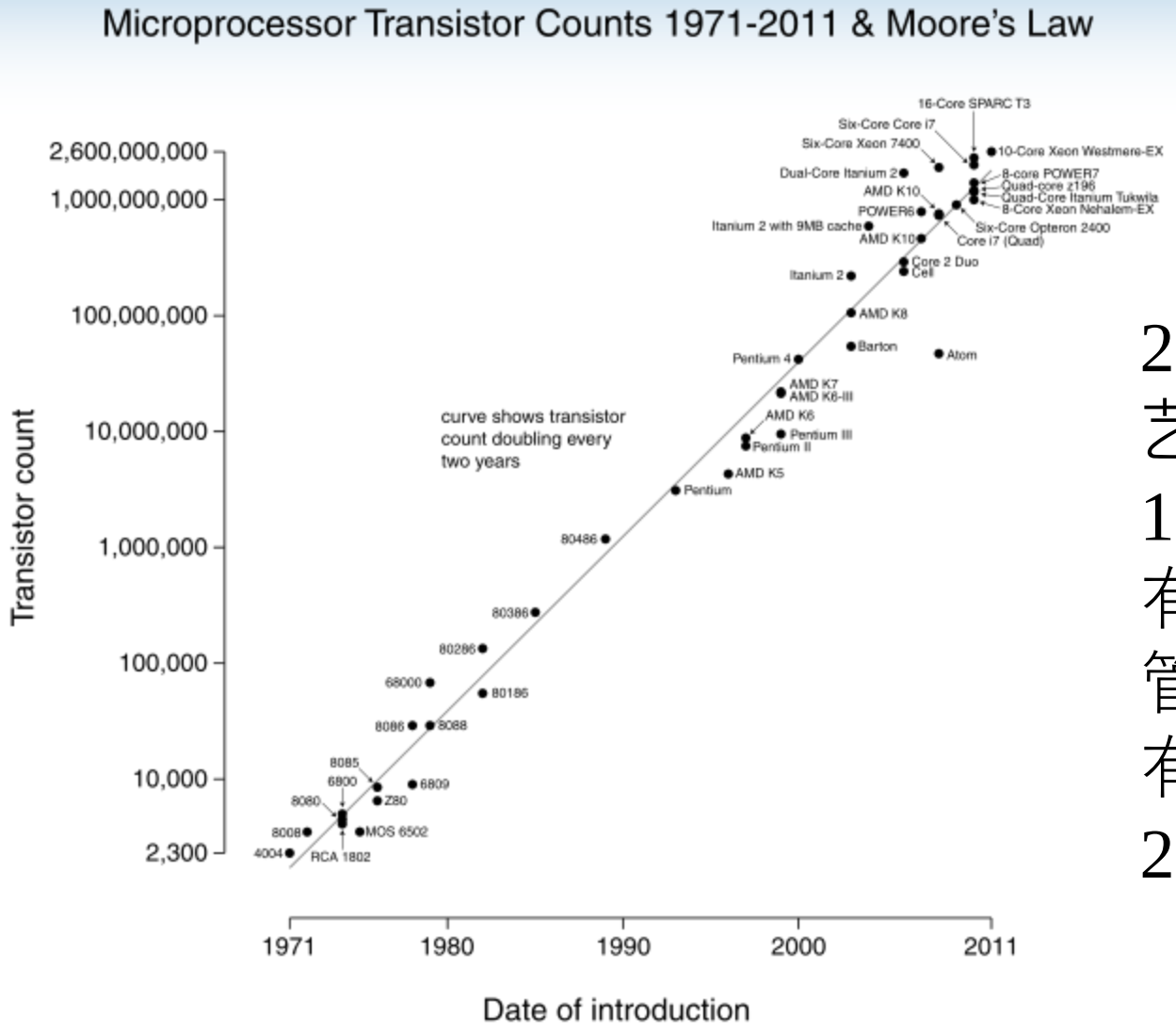

2011，22nm工艺制作Core i7，160平方毫米上有14亿个晶体管。2015年后有10，7，5，3，2nm工艺。

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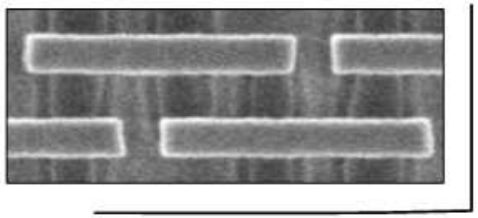
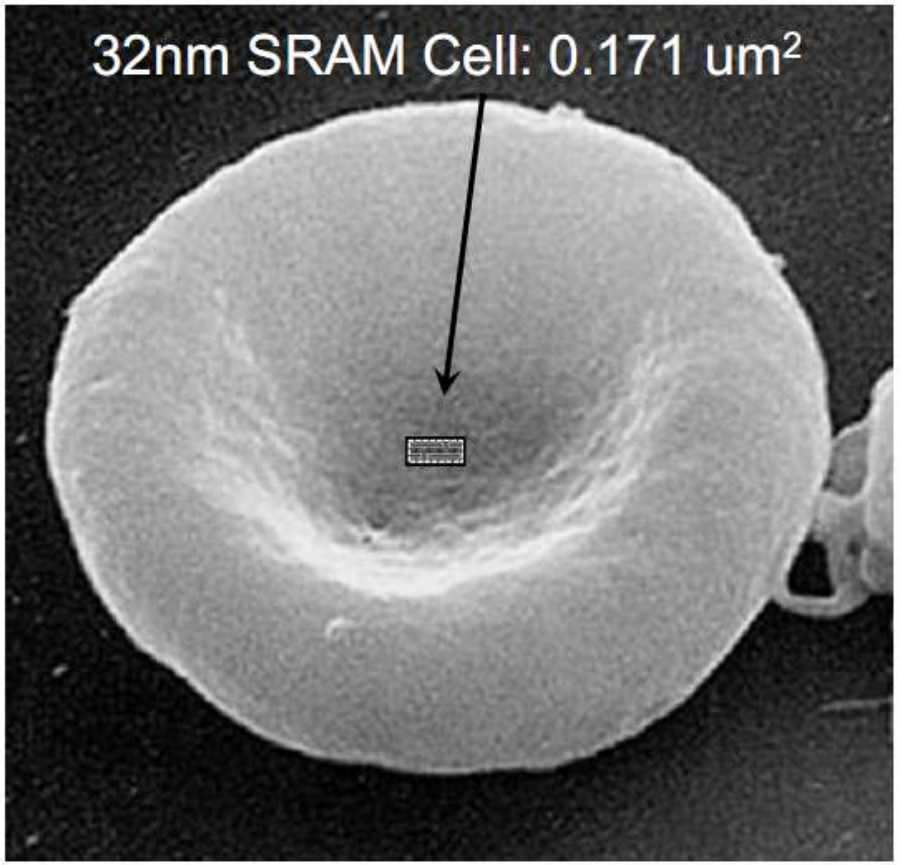
How small is a 32nm memory cell?



~300nm

~500nm

1983-84 limits on gate size, are ommensurate with the dimensions of 2008's entire 32nm SRAM cell!



Blood cell: Elec. Mic. Fac. (NCI-Frederick) 2007

Small enough that a 2008 32nm SRAM cell is dwarfed by a human redblood cell

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- **The general idea of Computer Science**

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Computer science

- **Computer science** is the scientific and practical approach to computation and its applications
- Computer science deals with the theoretical foundations of information and computation, together with practical techniques for the implementation and application of these foundations

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Characteristics of computer science

- 是计算机硬件与软件相结合、面向系统、侧重应用的宽口径专业
- 计算机学科的特色主要体现在：理论性强，实践性强，发展迅速。

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计算机专业的特征和强项

- 系统思维
- 培养能设计和制造计算机、在计算机领域实现创新的人才
- 系统层面的理解能力，站在系统高度解决问题

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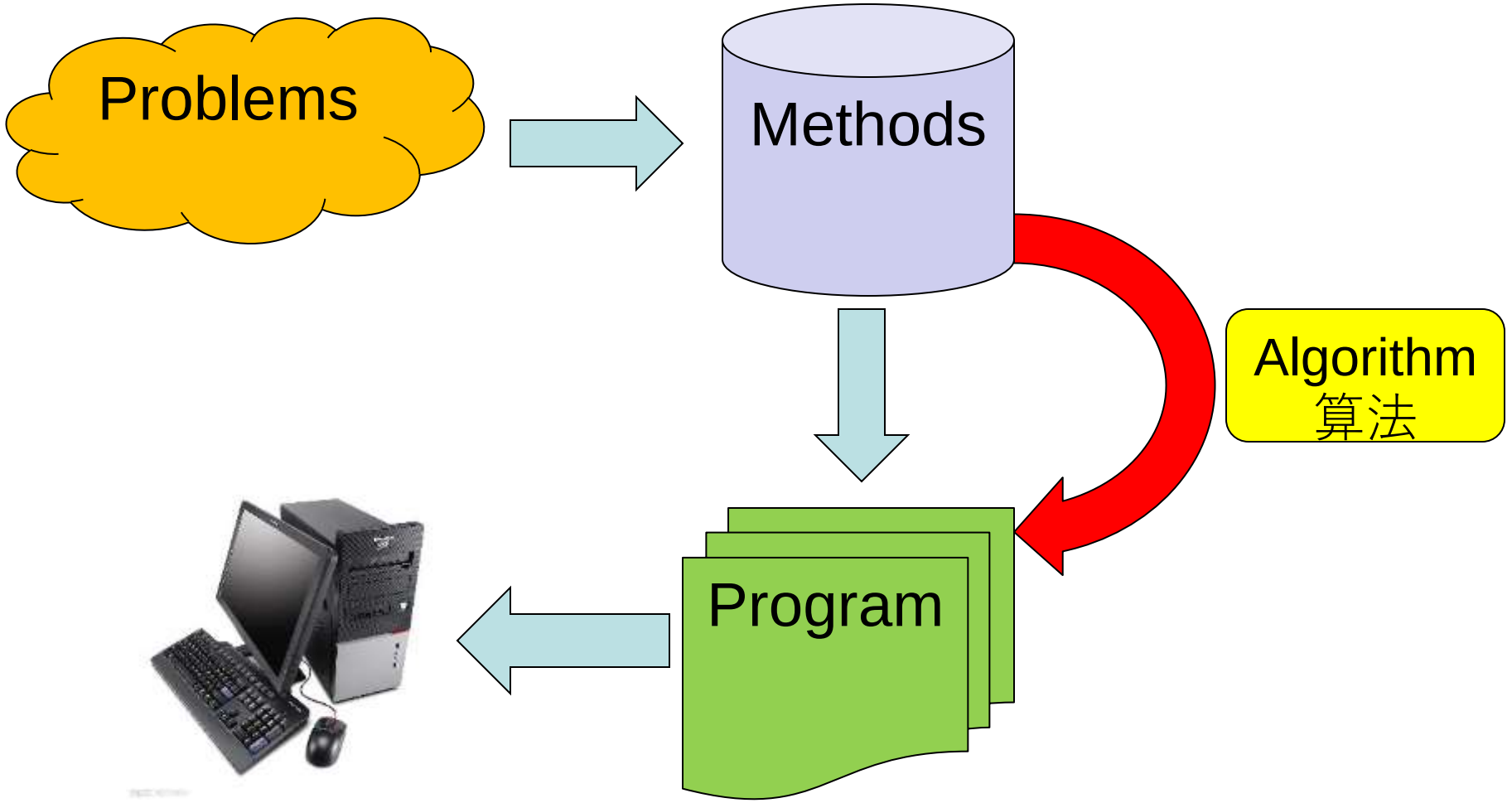
计算机科学的核心



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How to Make a Cappuccino?

- 材料：咖啡豆、牛奶、肉桂粉

- 用具：磨豆机、摩卡壶、牛奶发泡器

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The Recipe

- 材料：咖啡豆、牛奶、肉桂粉或可可粉
- 用具：磨豆机、摩卡壶、牛奶发泡器

Input

Hardware

1.将咖啡豆磨成粉，倒入摩卡壶杯内
2.将摩卡壶下半部倒入水，上下套好，锁紧壶身
3.将咖啡壶置于瓦斯炉上煮沸，待热水全部上升至上半部时离火，将咖啡倒进咖啡杯里。
4.在发泡器中倒入1/3壶鲜奶，加热至60度C
5.将滤网盖放入发泡器中上下抽动约60次
6.将发泡器底层之奶水倒入咖啡杯中约1/3杯，再刮入1/3杯奶泡，洒上可可粉或肉桂粉

Algorithm (算法)

Program

→完成一杯卡布奇诺咖啡

Output

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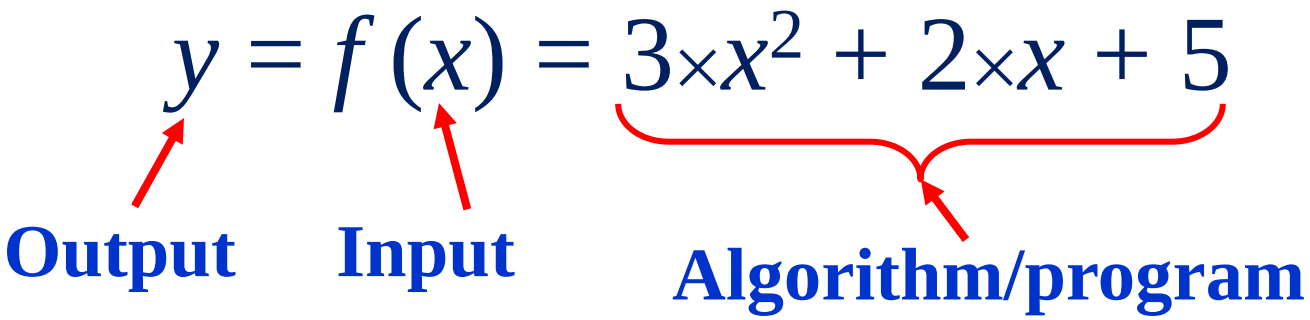
What's the Point?

- Making cappuccino and writing computer programs are just like solving math problems



  - "Algorithm" can be composed using basic steps and operations (+ – × ÷)

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Terminology术语

- **Algorithm算法:** A set of steps that defines how a task is performed
- **Program程序:** A representation of an algorithm
- **Programming编程:** The process of developing a program
- **Software软件:** Programs and algorithms
- **Hardware硬件:** Equipment

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The Euclidean algorithm for finding the greatest common divisor of two positive integers

Description: This algorithm assumes that its input consists of two positive integers and proceeds to compute the greatest common divisor of these two values.

Procedure:

Step 1. Assign M and N the value of the larger and smaller of the two input values, respectively.

Step 2. Divide M by N, and call the remainder R.

Step 3. If R is not 0, then assign M the value of N, assign N the value of R, and return to step 2; otherwise, the greatest common divisor is the value currently assigned to N.

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Central Questions of Computer Science

- Which problems can be solved by algorithmic processes?
- How can algorithm discovery be made easier?
- How can techniques of representing and communicating algorithms be improved?
- How can characteristics of different algorithms be analyzed and compared?

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Central Questions of Computer Science (continued)

- How can algorithms be used to manipulate information?
- How can algorithms be applied to produce intelligent behavior?
- How does the application of algorithms affect society?

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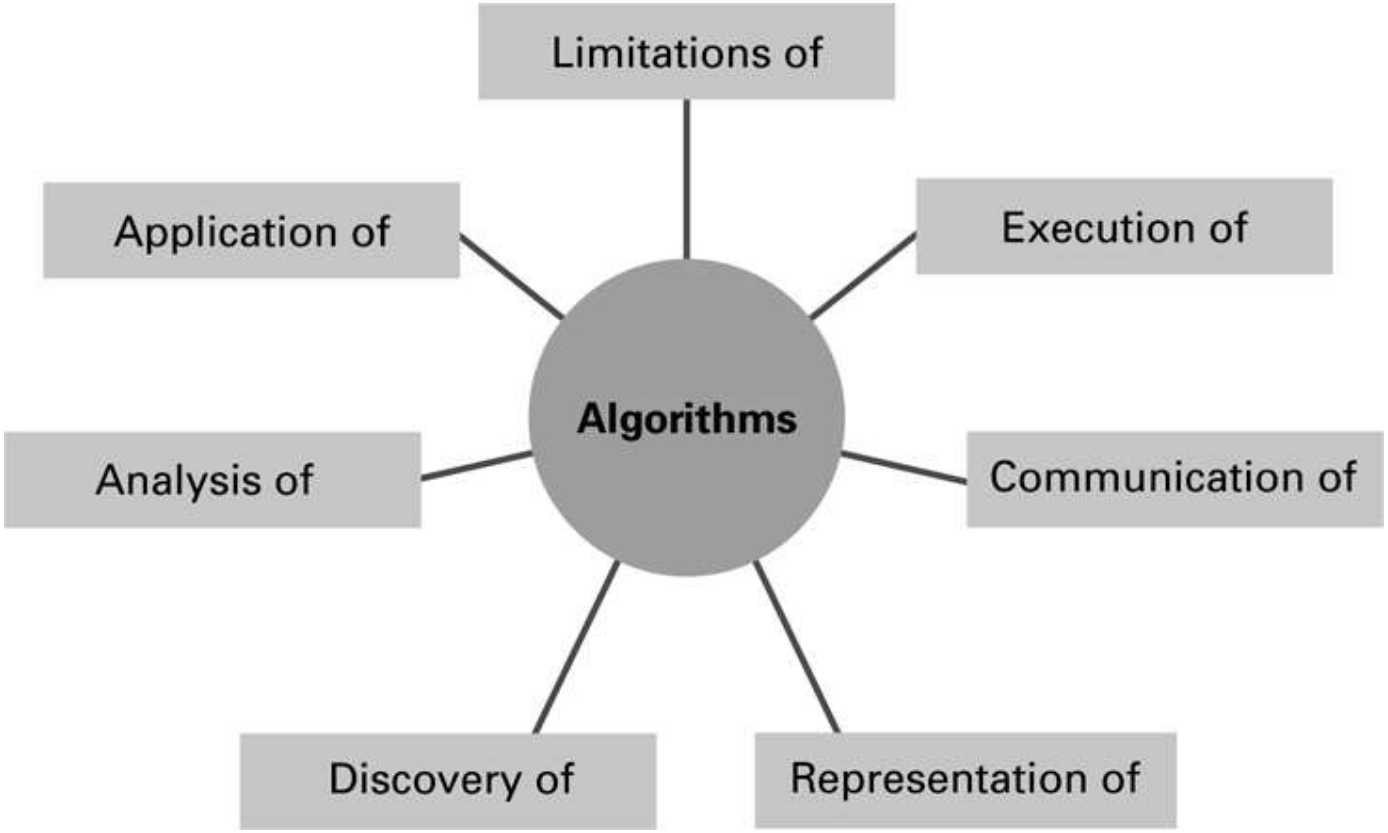
Central role of algorithms



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Abstraction抽象

- Abstraction
  - Refers to the distinction between the external properties of an entity and the details of the entity's internal composition.
  - Ignore the internal details of a complex device
  - Complex device are constructed from components

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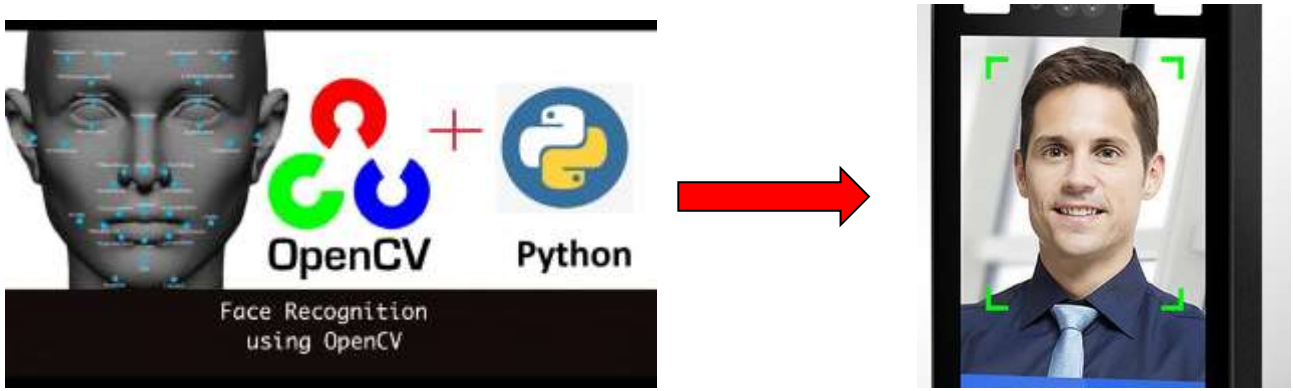
Abstraction

- **Abstract tool:** A “component” that can be used without concern for the component’s internal properties



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What Are We Going to Learn?

- Part I: How does the computer work?
  - Data representation
  - Data manipulation
  - Operating system
  - Computer network

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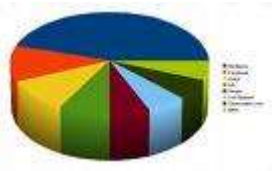
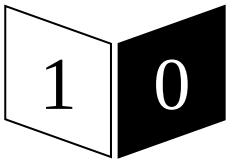
Data Representation



Data

Files

Byte



Bit

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Data Manipulation

- The tools

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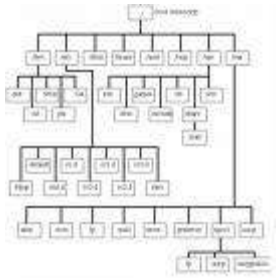
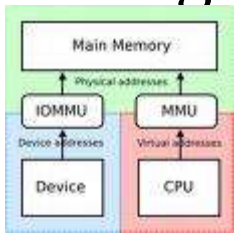
Operating System

- The manager of the house

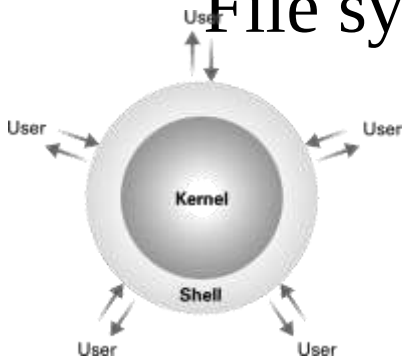


File system

Process management



Memory



User interaction

booting

Security

ent

Hardware management

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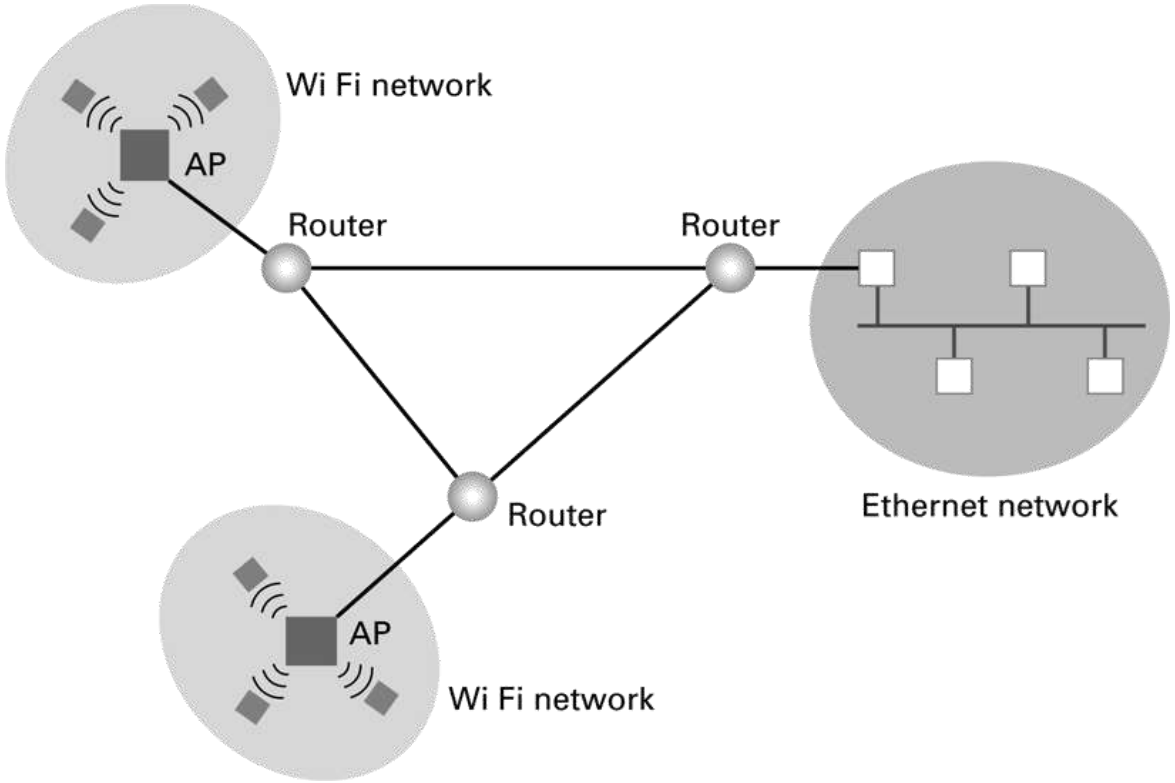
Computer Network

- The system to link computers and let them communicate



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- Part II: How to make computers work?
  - Algorithm
  - Programming
  - Software engineering
  - Data abstraction

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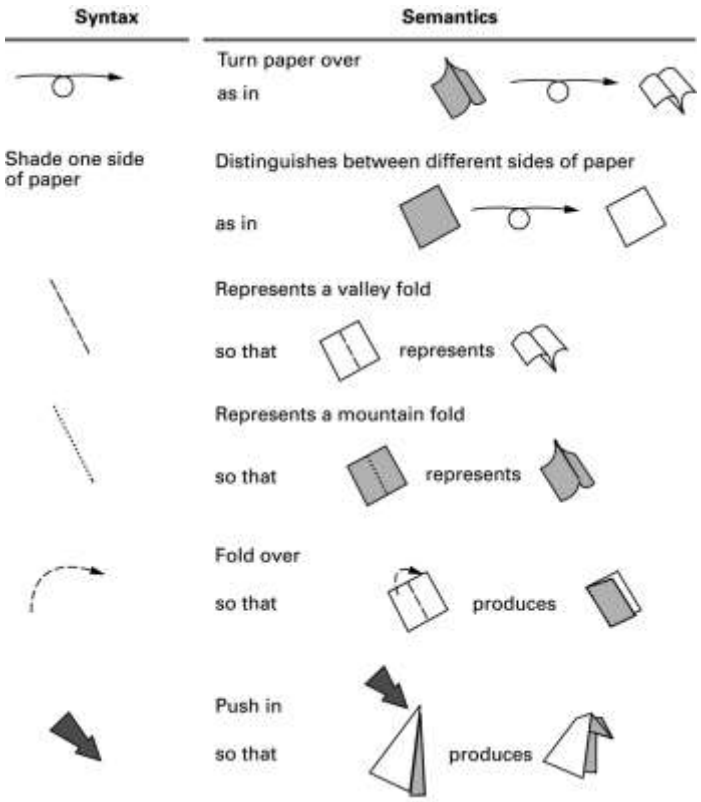
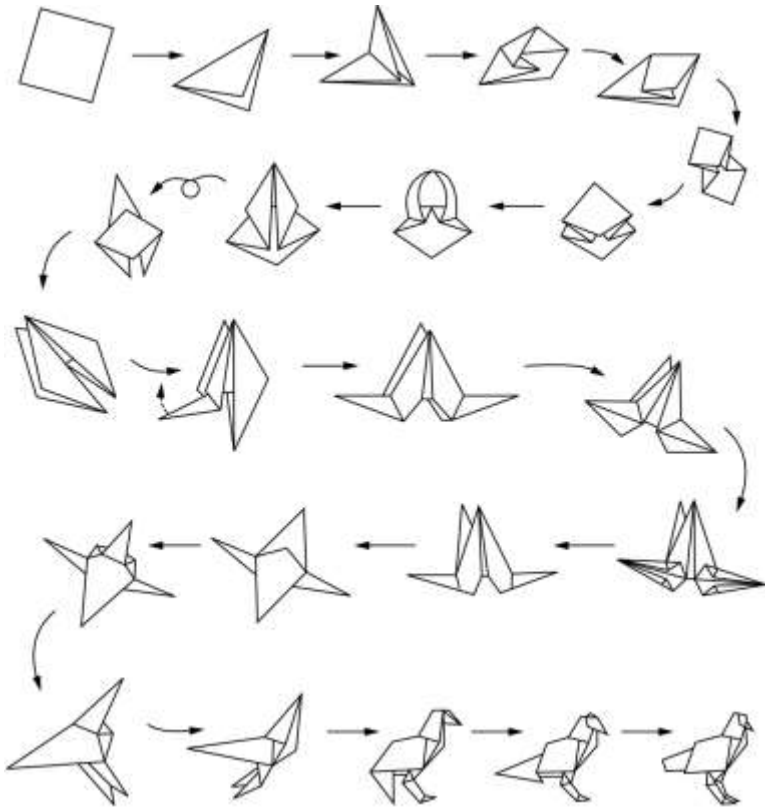
Algorithms

- The recipe to do everything on computers





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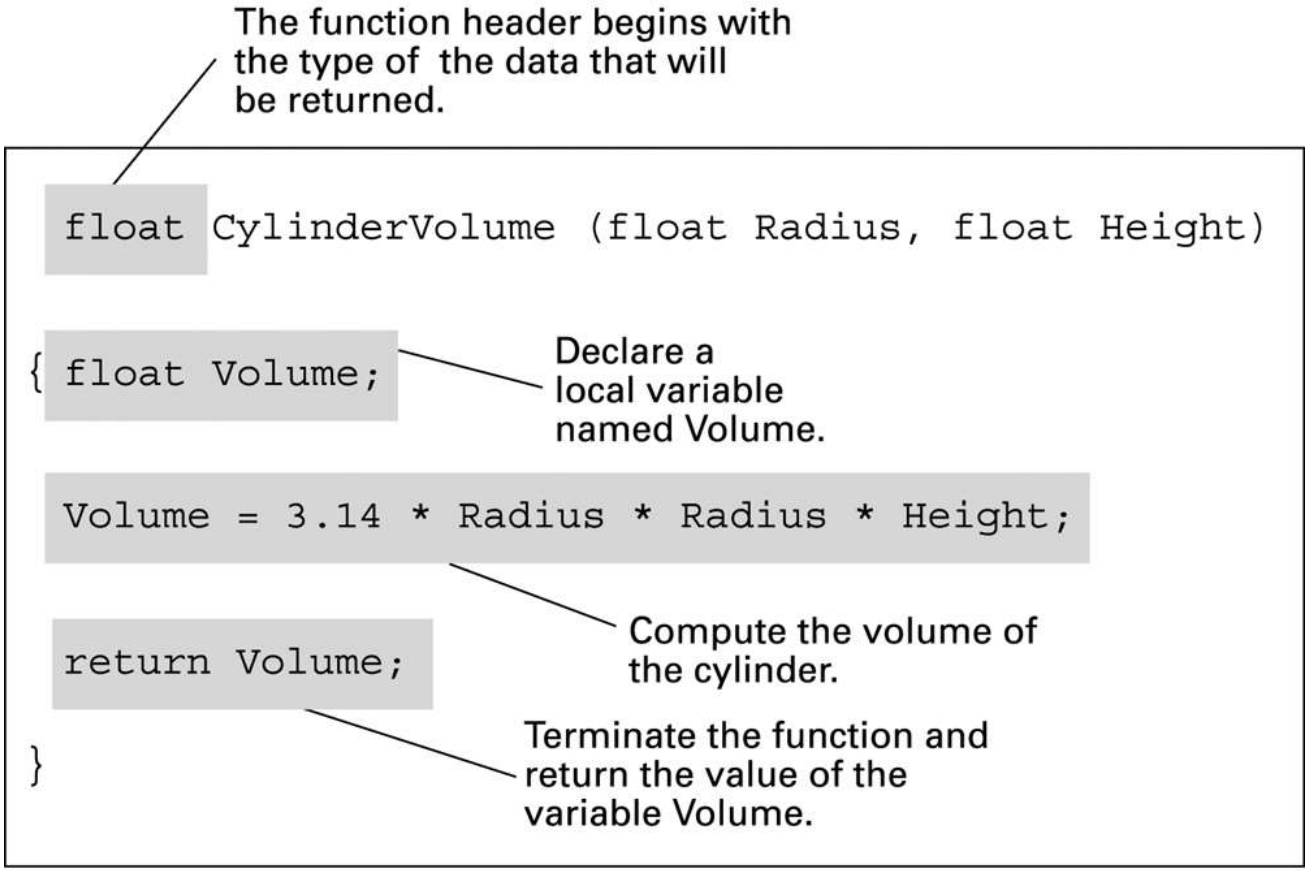
Programming Language

- The spells to command computers



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Software Engineering

- The principles of (large-scaled) system development

Analysis

Maintain

Users input

Design

Implementation

Testing

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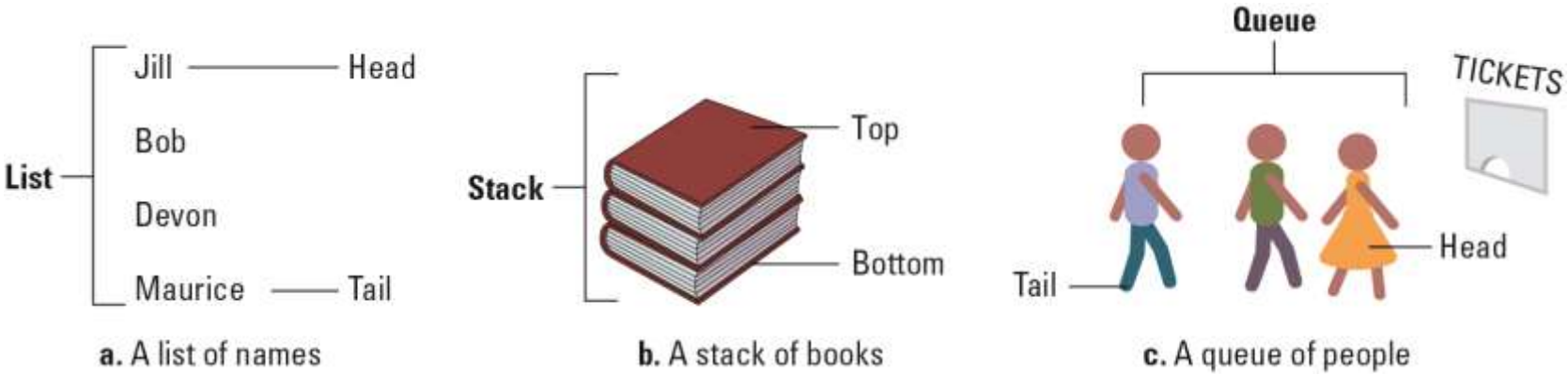
Data abstraction

- The data arrangement that makes algorithms and programs efficient



a. A list of names

b. A stack of books

c. A queue of people

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- Part III: What do computers work for?
  - Database
  - Computer graphic
  - Artificial intelligence
  - Theory of computation

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Database

- The system appearing everywhere in our daily life

Cashier system

ATM system

Phone bill

Parking violation bill

同济大学教务管理信息系统
Tongji University Management Information System

School's system

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Artificial Intelligence

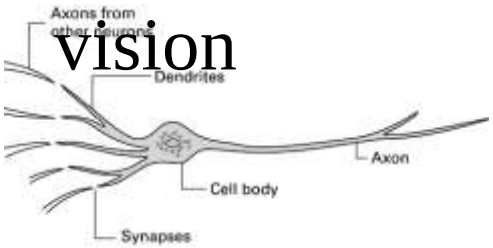
- The study and design of intelligent agents

Computer vision

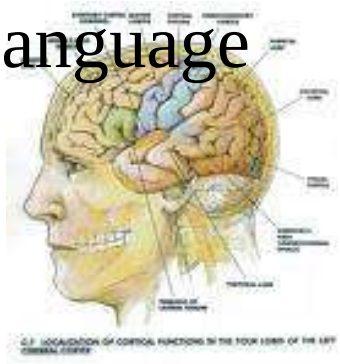
Natural language

Games

Robot



Neural network



Perception

Data mining

Software agent

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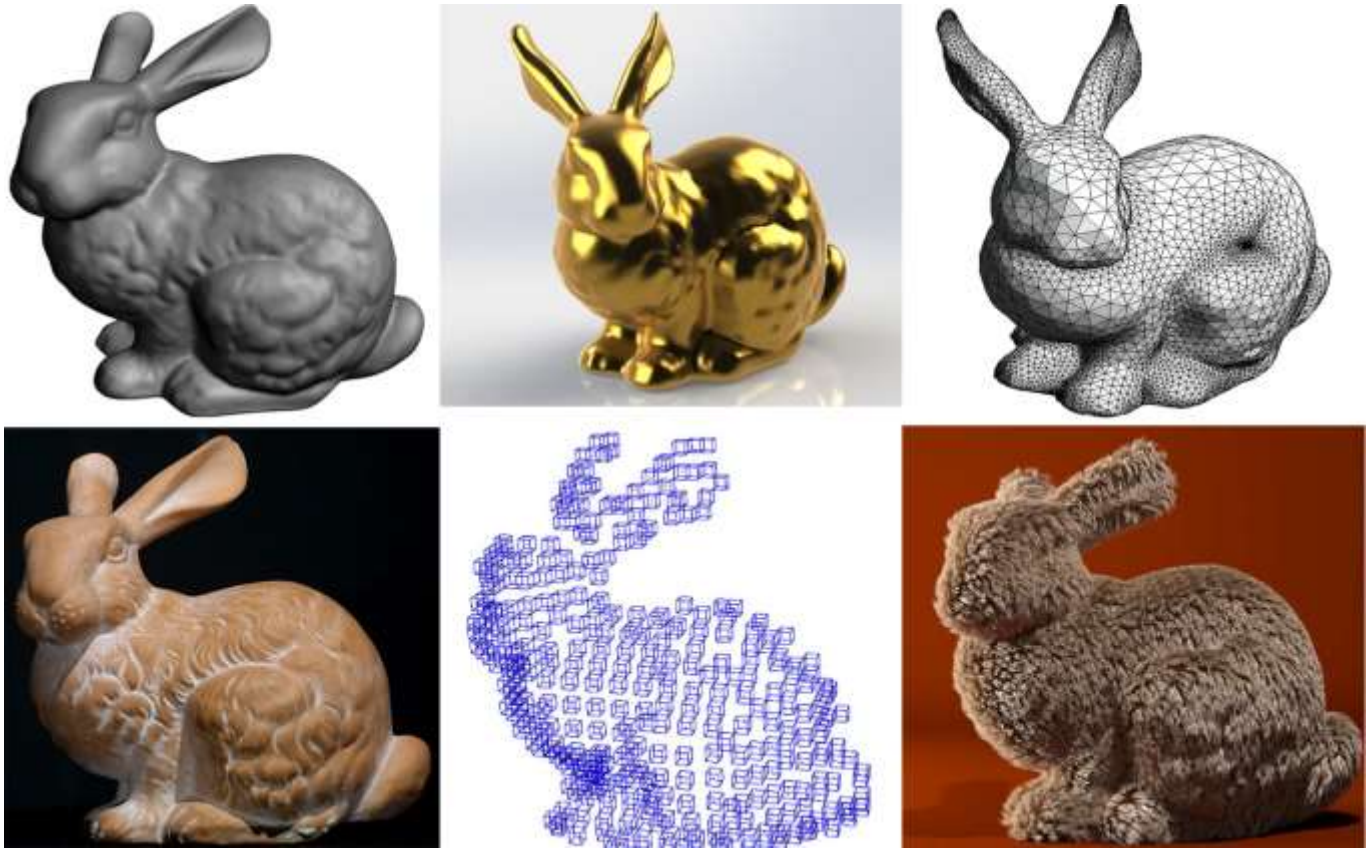
Computer graphics



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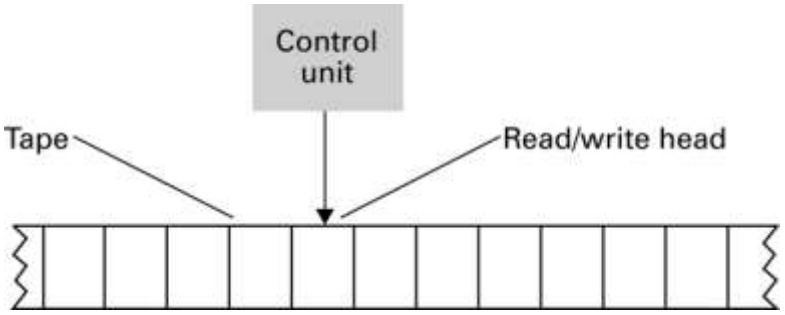
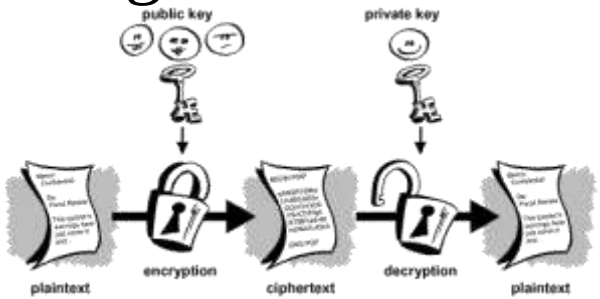
Theory of Computation

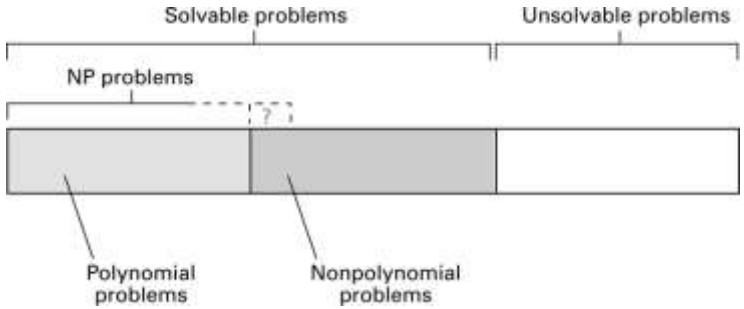
- Knowing the limitations of computers



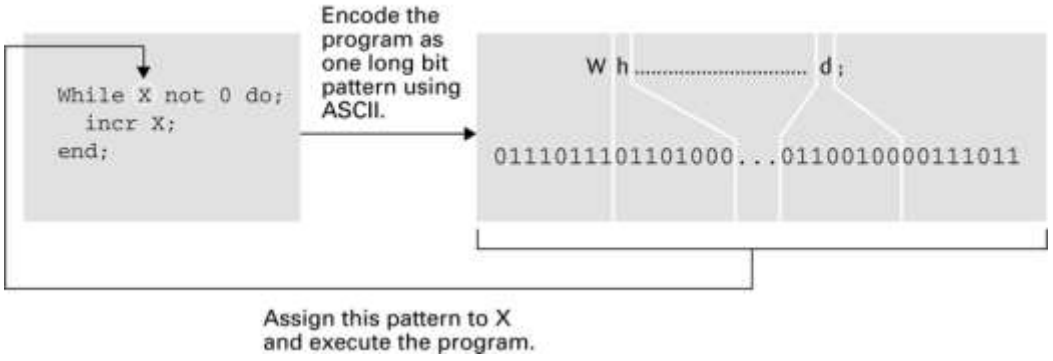
Turing machine



Problem of unknown difficulty



Problem classification



The unsolvable: the halting problem

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电子计算机分类

- 专用
  - 针对性强、特定服务、专门设计（导弹、火箭）
- 通用 （科学计算、数据处理、过程控制解决各类问题）
  - 超级计算机
  - 大型机
  - 服务器
  - 工作站
  - 微型机
  - 单片机

基本区别通常在于其体积大小、结构复杂程度、功率消耗、性能指标、数据存储容量、指令系统和设备、软件配置等的不同

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Supercomputer超级计算机

- 运算速度很高，可达每秒执行几亿条指令，数据存储容量很大，规模大结构复杂，价格昂贵，主要用于大型科学计算。它也是衡量一国科学实力的重要标志之一.

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大型机

- 大型机使用专用的处理器指令集、操作系统和应用软件。大型机一词，最初是指装在非常大的带框铁盒子里 的大型计算机系统，是从IBMSystem/360开始的一系列计算机及与其兼容或同等级的计算机，主要用于大量数据和关键项目的计算，例如银行金融交易及数据处理、人口普查、企业资源规划等等。

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服务器 Server

- **服务器**（Server）指一个管理资源并为用户提供服务的计算机，通常分为文件服务器、数据库服务器和应用程序服务器。运行以上软件的计算机或计算机系统也被称为服务器。相对于普通PC来说，服务器在稳定性、安全性、性能等方面都要求更高，因此硬件和普通PC有所不同

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工作站 Workstation

- 工作站是一种高端的通用微型计算机。它是为了单用户使用并提供比个人计算机更强大的性能，尤其是在图形处理能力，任务并行方面的能力。通常配有高分辨率的大屏、多屏显示器及容量很大的内存储器和外部存储器，并且具有极强的信息和高性能的图形、图像处理功能的计算机。

  另外，连接到服务器的终端机也可称为工作站。

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微型机及单片机

- 微型机
  - 台式机、笔记本电脑、pad
- 单片机
  - 单片机（Single chip microcomputer）是一种集成电路芯片，把具有数据处理能力的中央处理器CPU、存储器等集成到一块硅片上构成的一个小而完善的微型计算机系统，在工业控制领域广泛应用。

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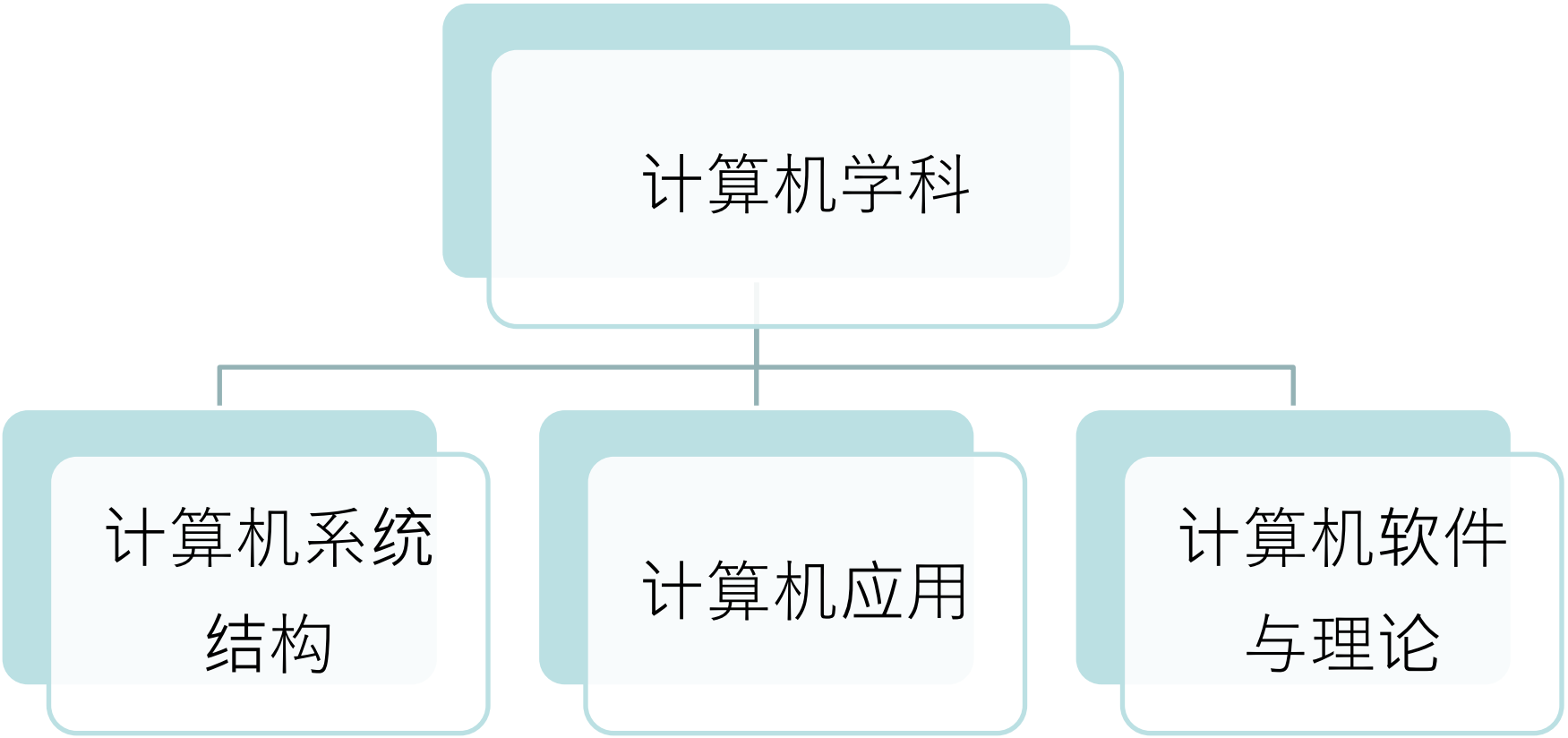
计算机学科分类



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计算机系统结构

- 并行/分布处理及高性能计算机系统；先进的计算机结构和网络计算
- 嵌入式技术及其应用；网络计算环境下的知识处理、网络体系结构、网络管理

计算机应用

- 人工智能；计算机视觉、语音及多媒体信息处理
- 信息安全技术及应用 ；数据库技术、数据仓库技术及应用

计算机软件与理论

- 软件工程与方法；语义理论及应用（自然语言、程序语言）
- 电子商务； 程序设计语言的设计与实现

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