

An Introduction to Computer Science
(Guidance)

Jingde Cheng
Southern University of Science and Technology

Welcome to CS101 (An Introduction to Computer Science)

Welcome to SUSTech!

Welcome to CS101!

CS101 will teach you
“what is computing?” and
“how to automate computing?”



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CS101: An Introduction to Computer Science

♣ Teaching professor

- ◆ Jingde Cheng (程京德), chengjd@sustech.edu.cn
- ◆ HP: <http://www.aise.ics.saitama-u.ac.jp/~cheng/index.html>
- ◆ Blog: <http://blog.scientenet.cn/u/JingdeCheng>
(科学网博客: 计算机科学, 数理逻辑, 人工智能, 等等)
- ◆ Use Google or 百度 to find more information about me.

♣ Teaching assistant teacher

- ◆ Yun Shen (沈昀), sheny@mail.sustech.edu.cn
- ◆ Answering class (optional): Will be announced.

♣ QQ groups

- ◆ CS101-I2CS-2021S: 857894597

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Two Classes

♣ **CS101A-E (Elective, for future/current students of CSE dept)**

- ◆ Purpose: Give you an introduction to the fundamentals and up-to-date developments of CS for your study and research in the next few years.
- ◆ Teaching materials / language: English / English + Chinese (summary)

♣ **CS101B-C (Compulsory for learning “programming” course)**

- ◆ Purpose: Give you an introduction to the fundamentals of CS for your study in the next few years, especially for the course “Introduction to Computer Programming”.
- ◆ Teaching materials / language: English / Chinese



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Two Classes

♣ **CS101A-E (Elective)**

- ◆ My suggestion: Any student who wants to choose/enter the CSE department should take this course.

♣ **CS101B-C (Compulsory)**

- ◆ The data of this year
- ◆ 306/1097 , 0-43 vs 44-90
- ◆ All of you should think “I’m so lucky”, but not “I’m so unlucky”.
- ◆ My claim: This course will certainly be beneficial and valuable to any student who takes the course, in the sense that you (as a professional in the future) can gain enough useful knowledge than those who do not, without regard to which department you will choose/enter.

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An Introduction to Computer Science

- ◆ **Guidance** and Mathematical Preliminaries (Naïve Set Theory)

- ◆ Computer Science: What Is It and Why Study It?

- ◆ Computation: What Is It and Why Study It?

- ◆ Computability

- ◆ Computational Complexity (CS101A class only)

- ◆ Algorithms

- ◆ Data, Information, and Knowledge, and Their Representations

- ◆ Data Storage

- ◆ Computer Architecture

- ◆ Data Manipulation in Computer Systems

- ◆ Programming Languages and Compilers

- ◆ Operating Systems

- ◆ System Software and Application Software

- ◆ Software Engineering (CS101A class only)

- ◆ Knowledge Engineering and Artificial Intelligence (CS101A class only)

- ◆ Information Security Engineering (CS101A class only)



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The BEST Course on “Introduction to CS” in China

**I will provide you with
the BEST course on
“Introduction to
Computer Science”
in China !**



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My Teaching Style**For important notions/concepts**

- ◆ What is it?
- ◆ Why study it?

For important assumptions and/or principles

- ◆ Why CS needs it?
- ◆ Why it is fundamental? / What is underlain by it?

For important problems

- ◆ What is its background?
- ◆ Why it is interesting?

Using QQ groups

- ◆ Send various advices/materials/notices to you, and answer your questions.



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Assessment Grading**Homework (50% of final score, 100/130 points)**

- ◆ Answer questions, read materials, and submit reports
- ◆ Penalty for answer and report copies: Give minus points to all similar answers and reports.
- ◆ You can (should!) get full points if you do homework hard.

Final examination (50% of final score, 100/120 points)

- ◆ Open-book examination (two hours)
- ◆ **Do not consider that the open-book examination is easy !!!** (Only those students who have studied and reviewed the course contents very seriously can get good score)
- ◆ The examination questions are the same for the two CS101B (Chinese/English) classes.



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My Hope/Statement and Your Attitude**My hope/statement**

- ◆ I really like to teach and guide you to become world-class scientists and/or engineers in the future, by laying a good foundation for you.

Your attitude

- ◆ (I want you) to listen carefully, think deeply, ask questions actively, and read text books and reference materials carefully.

“青出于蓝而胜于蓝”

- ◆ “青，取之于蓝，而胜于蓝；冰，水为之，而寒于水。”
— 荀子，“劝学”，约公元前230年
- ◆ 我将把你们视为清华的学生来教授你们知识和能力；期待着你们“青出于蓝而胜于蓝”。



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Some Rules You Should Follow**Preview**

- ◆ I will distribute courseware, teaching main points (in Chinese), and reading materials one week before lectures every week.
- ◆ You should preview the materials before the lectures every week.
- ◆ Note: It is very difficult to understand all the teaching contents at once just by listening in the class !!!

Ask questions at classes but not at break time

- ◆ I will give you time at classes to let you ask questions.
- ◆ You should ask questions at classes, but not at break time, because my answers at classes are beneficial and useful to all students.



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How to Get a Good Score

- ◆ Preview courseware and its main points (in Chinese) that will be sent to you two weeks in advance !
- ◆ About “What is it”
 - ◆ CS101A: must know; CS101B: must know
- ◆ About “Why study it”
 - ◆ CS101A: must know; CS101B: should know
- ◆ About “Why CS needs it”
 - ◆ CS101A: must know; CS101B: should know
- ◆ About “Why it is fundamental / What is underlain by it”
 - ◆ CS101A: should know; CS101B: had better know
- ◆ About “What is its background”
 - ◆ CS101A: must know; CS101B: had better know
- ◆ About “Why it is interesting”
 - ◆ CS101A: should know; CS101B: had better know



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Text and Reference Books

- ◆ J. G. Brookshear, "Computer Science: An Overview," Addison-Wesley, 2011 (11th Edition), Pearson, 2014 (12th Edition). [JB-CS-11]
- ◆ N. Dale and J. Lewis, "Computer Science: Illuminated," Jones and Bartlett Learning, 2002, 2004, 2006, 2009, 2012, 2016 (6th Edition). [DL-CS-16]
- ◆ B. Forouzan, "Foundations of Computer Science" Cengage Learning, 2002, 2007, 2013, 2018 (4th Edition). [F-CS-18]
- ◆ M. Sipser, "Introduction to the Theory of Computation," Cengage Learning, 2013 (3rd Edition). [S-ToC-13]
- ◆ P. Linz, "An Introduction to Formal Languages and Automata," Jones & Bartlett Learning, 2017 (6th Edition). [L-ToC-17]
- ◆ T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to Algorithms," 1990, 2001, 2009 (3rd Edition). [CLRS-I2A-09]
- ◆ A. Butterfield and G. E. Ngondi (Eds.), "A Dictionary of Computer Science," Oxford University Press, 2016 (7th Edition). [BN-DCS-OUP-16]
- ◆ IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries, IEEE, 1990. [IEEE-90]



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Text and Reference Books

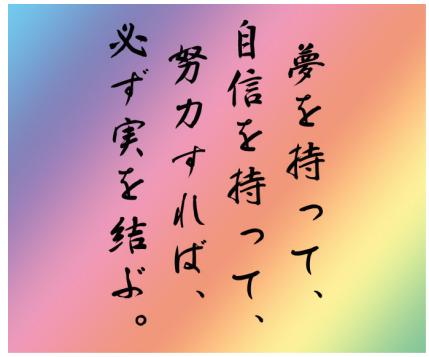


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程研究室のスローガン (Saitama University, Japan)



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Dijkstra's Three Golden Rules for Successful Scientific Research

Raise your standards as high as you can live with, sid wasting your time on routine problems, and always try to work as closely as possible at the boundary of your abilities. Do this because it the only way of discovering how that boundary could be moved forward.

We all like our work to be socially relevant and scientifically sound. If we can find a topic satisfying both desires, we are lucky; if the two targets in conflict with each other, let the requirement scientific soundness prevail.

Never tackle a problem of which you can be pretty sure that (now or in the near future) will be tackled by others who are, in relation that problem, at least as competent and well-equipped as you are.



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Improve Your Position/Value Forever

◆ Acknowledging your past honestly

- ◆ It is all over. No effort of yours can change what has passed.

◆ The past does not tell you the future at all

- ◆ Self-abandonment will drag you to quagmire.
- ◆ The polarization of students after entering the school is the characteristic of a school like SUStech !!!

◆ Your future is in your hand

- ◆ Life lies in evolution continually; Success lies in diligent correctly.
- ◆ "Raise your quality standards as high as you can live with, Do this, because it is the only way of discovering how that boundary should be moved forward." – E. W. Dijkstra

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Dijkstra's Three Golden Rules for Successful Scientific Research

◆ E. W. Dijkstra (The winner of 1972 ACM Turing Award)

- ◆ Edsger Wybe Dijkstra
(Rotterdam, Netherlands, May 11, 1930 – Nuenen, Netherlands, August 6, 2002)



◆ First, "internal" one

- ◆ "Raise your quality standards as high as you can live with, avoid wasting your time on routine problems, and always try to work as closely as possible at the boundary of your abilities. Do this, because it is the only way of discovering how that boundary should be moved forward."
- ◆ "It has nothing to do with your relation with others, it concerns you yourself in isolation."

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Dijkstra's Three Golden Rules for Successful Scientific Research

❖ Second, “external” one

- ◆ “We all like our work to be socially relevant and scientifically sound. If we can find a topic satisfying both desires, we are lucky; if the two targets are in conflict with each other, let the requirement of scientific soundness prevail.”
- ◆ “It deals with the relation between “the scientific world” and “the real world.”

❖ Third, “internal/external” one

- ◆ “Never tackle a problem of which you can be pretty sure that (now or in the near future) it will be tackled by others who are, in relation to that problem, at least as competent and well-equipped as you.”
- ◆ “It deals with the relation between you and your scientific colleagues.”



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Differences of Study in Senior High School and University

❖ Senior high school

- ◆ Purpose: Learn and remember basic elementary knowledge; pass the entry examination for university.
- ◆ Contents: Basic elementary knowledge for daily life.
- ◆ Method: Completely passively follow from the teacher's instructions.

❖ University

- ◆ Purpose: Learn basic general knowledge and master learning/studying methods; get a professional job or pass the entry examination for graduate school.
- ◆ Contents: Basic general knowledge for professional work and study.
- ◆ Method: Actively/autonomously learn according to the professor's advice/guidance.



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Differences of Study in Senior High School and University

❖ Graduate school

- ◆ Purpose: Learn advanced special knowledge, master learning/studying research methods, and find new results; get a professional research job.
- ◆ Contents: Advanced special knowledge for professional research work and study.
- ◆ Method: Learn actively/autonomously from professors' advice/guidance and perform research work independently under professors' direction.

❖ My advices for you

- ◆ Understand notions/concepts clearly and accurately.
- ◆ Pay more attention to “why” rather than “how”.
- ◆ A suitable representation/formulation of a problem is more than the half of solving it.



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为学日益，为道日损

◆ 为学日益，为道日损。

- 老子，道德经，第四十八章，约纪元前600年。

な ひ ま な ひ そ ん
◆ 学を為すは日に益す。道を為すは日に損ず。

- 老子，道德经，第四十八章，纪元前600年頃。

- ◆ To attain knowledge, add things every day.
- ◆ To attain wisdom, remove things every day.

- Lao Tzu, Tao Te Ching, ch. 48, about 600 B.C.



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猎枪与干粮；授人以鱼不如授人以渔

❖ 何谓大学

- ◆ “所谓大学者，非谓有大楼之谓也，有大师之谓也。”
— 梅贻琦，清华大学校长就任演说，1931

❖ 在大学里应该学习什么？

- ◆ “猎枪与干粮”
— 蒋南翔，清华大学校长，1950s
- ◆ “授人以鱼不如授人以渔” — 中国古代谚语
- ◆ “Give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime.”

❖ 切不可“知其然不知其所以然”

- ◆ “知其然”不难，难在“知其所以然”。
◆ 如若仅知其然却不知其所以然，则不能成大事。



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The First Question and Some Questions about the First Question

❖ The first question

- ◆ $1 + 1 = ?$

❖ Some questions about the first question

- ◆ Can you define the number “1” mathematically (formally)?
- ◆ Can you define the addition “ $1 + 1 = ?$ ” (addition relation/function $(x + y)$) mathematically (formally)?
- ◆ Can you prove the equation “ $1 + 1 = 2$ ” mathematically (formally)?
- ◆ Can you compute the addition “ $1 + 1 = ?$ ” in a mathematical (formal) way?
- ◆ Can you make an automated computing machine to compute the addition “ $1 + 1 = ?$ ” ?
- ◆ Can you make an automated computing machine to prove the equation “ $1 + 1 = 2$ ” ?



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The First Question and Some Questions about the First Question

❖ More questions about the questions

- ◆ What “define something mathematically (formally)” means?
- ◆ What “prove something mathematically (formally)” means?
- ◆ What “compute something” means?
- ◆ What is “a mathematical (formal) way”?
- ◆ What is “an automated computing machine”?
- ◆ What “make” means?

❖ Where you can find the answers to the questions?

- ◆ CS101 will teach you “what is computing” and “how to automate computing”.

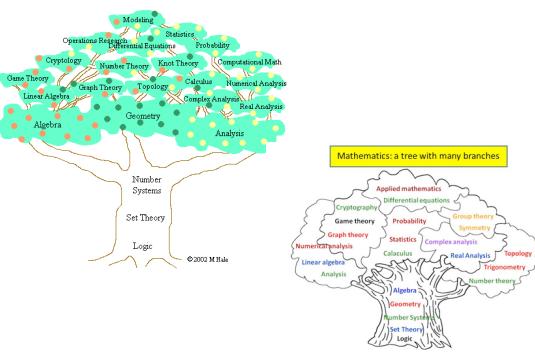


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What “mathematically (formally)” Means?



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“Fields of Science and Technology” by UNESCO

- ◆ “Proposed International Standard Nomenclature for Fields of Science and Technology,” UNESCO/NS/ROU/257 rev.1, 1988.
- ◆ 11. Logic, 12. Mathematics
- ◆ 21. Astronomy and Astrophysics, 22. Physics, 23. Chemistry, 24. Life Sciences, 25. Earth and Space Science
- ◆ 31. Agricultural Sciences, 32. Medical Sciences, 33. Technological Sciences
- ◆ 1203. Computer Science
- ◆ 3304. Computer Technology



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An Introduction to Computer Science

- ◆ Guidance and Mathematical Preliminaries (Naïve Set Theory)
- ◆ Computer Science: What Is It and Why Study It?
- ◆ Computation: What Is It and Why Study It?
- ◆ Computability
- ◆ Computational Complexity (CS101A class only)
- ◆ Algorithms
- ◆ Data, Information, and Knowledge, and Their Representations
- ◆ Data Storage
- ◆ Computer Architecture
- ◆ Data Manipulation in Computer Systems
- ◆ Programming Languages and Compilers
- ◆ Operating Systems
- ◆ System Software and Application Software
- ◆ Software Engineering (CS101A class only)
- ◆ Knowledge Engineering and Artificial Intelligence (CS101A class only)
- ◆ Information Security Engineering (CS101A class only)



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❖ Teaching professor

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❖ Teaching assistant teacher

- ◆ Yun Shen (沈昀), sheny@mail.sustech.edu.cn
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❖ QQ groups

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