# The Set of Programmers:

## How Math Restricts Us

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*Not their real names

In 2015, after working in technology for 10 years, I decided to finally see if I enjoyed programming.

I committed to taking the time to learning programming and decide if I liked it.


1 https://upload.wikimedia.org/wikipedia/commons/b/bc/Seattle_Community_College_Broadway_Performance_Hall.JPG

COLLEGE OF
MARIN

Dear Carol,

Your Application for Admission to College of Marin has been accepted!

Welcome to the College of Marin! We are very pleased that you have chosen our college to achieve your academic and personal goals. We want to ensure that your experience here is rewarding, challenging, exciting and successful at every level of your educational path. In order to assist you in your success, we have outlined the "Steps for Success" for you to follow:

I took a placement test for my math and english skills.

## Test Results

| Test Name | Score |
|---|---|
| Reading Comprehension | 99 |
| Sentence Skills | 116 |
| 0WPMarin | 5 |
| Elementary Algebra | 53 |
| Arithmetic | 91 |

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**1600**

You may enroll in Eng 150, Reading and Composition (1A) This course can be transferred to UC/CSU

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| Reading Comprehension | 99 |
| Sentence Skills | 116 |
| 0WPMarin | 5 |
| Elementary Algebra | 53 |
| Arithmetic | 91 |

**2400**
You are eligible to enroll in Math 101 Elementary Algebra--A counselor can help you determine which Math 101 section is best for you.

Exnum: | Branching Profile Name: 026 COM Engl/ESL/Algebra

Faculty
Mia Chia
Department Phone: 415-485-9510

**Transfer**

With an associate degree in computer science, students can transfer to bachelor degree programs in areas such as applied computer science and engineering, computer graphics, computer information systems, and computer information technology. Additionally, there are degrees with concentrations in artificial intelligence, computational linguistics, networks and security, software engineering, networking and data communication, bioinformatics, computer game design, homeland security, materials science and engineering, nuclear engineering, applied math, scientific computation, telecommunications, multimedia, and applied computing.

## A.S. IN COMPUTER SCIENCE

Computer science students may choose among several paths to meet requirements for the associate degree. There are three entry-level courses, Computer Science 130, 135, and 150 (C++, JAVA, and MATLAB), that each fulfill the requirements for any of the upper-level courses. Students who complete the requirements listed below, plus additional general education and graduation requirements, will be awarded the associate degree. Due to the diversity among degree programs, students should talk with a counselor or faculty member about their career goals and transfer requirements as they prepare to make their class choices. Note: Students are required to complete English 150 for the associate degree. All students should consult a counselor.

| REQUIREMENTS | | | UNITS |
|---|---|---|---|
| COMP | 130 | Introduction to Computer Programming Using C++ | 4 |
| Or | | | |
| COMP | 135 | Introduction to Programming in JAVA | 4 |
| Or | | | |
| COMP | 150 | Programming in MATLAB for Engineers | 4 |
| COMP | 160 | Computer Organization: An Assembly Language Perspective | 3 |
| COMP | 220 | Data Structures and Algorithms | 3 |
| COMP/MATH | 117 | Discrete Mathematics | 3 |
| MATH | 115 | Probability and Statistics | 4 |
| MATH | 116 | Linear Algebra | 3 |
| MATH | 123 | Analytic Geometry and Calculus I | 5 |

**COMP 130: Introduction to Computer Programming Using C++**

*4.0 Units. 3 lecture and 3 lab hrs/wk. Prerequisite: Math 103 or 103AB or 103XY or sufficient score on Math Assessment Test.*

An introduction to problem-solving using a structured, object-oriented programming language in C++ for those without prior programming experience. Examples and programming assignments are drawn from many areas, involving both numerical and non-numerical applications. (CSU/UC) AA/AS Area E

**COMP 135: Introduction to Programming in JAVA**

*4.0 Units. 3 lecture and 3 lab hrs/wk. Prerequisite: Math 103 or 103AB or 103XY or sufficient score on Math Assessment Test.*

Introduction to computer programming using JAVA for computer science majors and computer professionals. Course concepts include problem-solving techniques, program design, charting, control structures, primitive data types, array and string data structures, operations, algorithms, reading and writing files, exception handling, and applets. Object-oriented features are introduced, including classes, objects, inheritance, and parameter passing. (CSU/UC) AA/AS Area E

**COMP 150: Programming in MATLAB for Engineers**

*4.0 Units. 3 lecture and 3 lab hrs/wk. Prerequisite: Math 123. May be taken as COMP 150 or ENGG 150; credit awarded for only one course.*

Designed to meet computer programming requirements for engineering transfer students, this course utilizes the MATLAB environment to provide a working knowledge of computer-based problem-solving methods relevant to science and engineering, including programming and numerical analysis techniques. Students outline, write, test, and debug computer programs to solve problems and display results, emphasizing proper documentation of computer code and reports. Common examples and applications of physics and engineering are used throughout the course. (CSU/UC)

The Math 103 class has a prerequisite of Math 101, the class I was actually eligible to enroll in.

**MATH 101A: Elementary Algebra I**

*1.5 Units. 5 lecture hrs/wk. Prerequisite: Math 95 or 95B or 95Y or sufficient score on Math Assessment Test.*

An introduction to elementary algebra. Taken with Math 101B, this course is equivalent to Math 101. It is designed for students wishing to take more time learning elementary algebra. Topics include linear equations and inequalities, slope of lines, linear graphs, and systems of equations.

**MATH 101B: Elementary Algebra II**

*1.5 Units. 5 lecture hrs/wk. Prerequisite: Math 101A or 101X.*

**MATH 103A: Intermediate Algebra I**

*2.5 Units. 5 lecture hrs/wk. Prerequisite: Math 101 or 101AB or 101XY or satisfactory score on Math Assessment Test.*

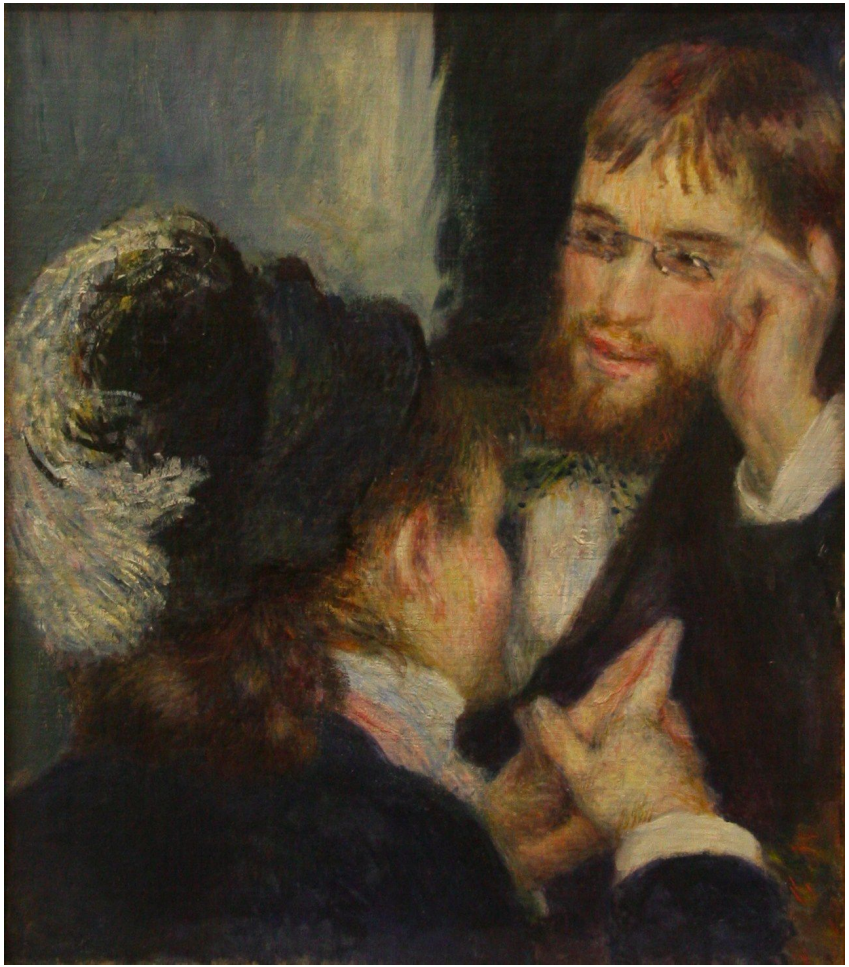
This course, taken with Math 103B, is equivalent to Math 103. It is designed for students wishing to take more time learning intermediate algebra. Topics include real number properties, polynomials, rational expressions, first degree equations, inequalities and applications, systems of linear equations with matrix elimination methods, linear programming, functions, and graphs. AA/AS Math Proficiency (combined with Math 103B); AA/AS Area E (combined with Math 103B)

I would need to take and pass two sections of math before I can even *enroll* in the Introduction to Programming classes.

I didn’t enroll in those math classes.

1 https://upload.wikimedia.org/wikipedia/commons/f/f8/Telephone_girl.JPG

1 https://upload.wikimedia.org/wikipedia/commons/9/91/Southern_Arkansas_University_Biology_student_with_microscope.jpg



1 https://upload.wikimedia.org/wikipedia/commons/5/55/Auguste_Renoir_Conversation.JPG

The methods of entry into this field and the hiring practices within the industry are both to blame.

1. Separate math and programming.
2. Separate programming and computer science.
3. Separate those fields in computer science that require math skills from those that don’t.

*“Math” here means what students learn beyond arithmetic.

1. Separate math and programming

# 29%

Percentage of Americans who report they are “not good at math.”

1 http://changetheequation.org/press/new-survey-americans-say-%E2%80%9Cwe%E2%80%99re-not-good-math%E2%80%9D

# 21%

Men who say they're "not good at math."

1 http://changetheequation.org/press/new-survey-americans-say-%E2%80%9Cwe%E2%80%99re-not-good-math%E2%80%9D

# 37%

Women who say they are “not good at math.”

1 http://changetheequation.org/press/new-survey-americans-say-%E2%80%9Cwe%E2%80%99re-not-good-math%E2%80%9D

# 39%

Percentage of Americans 18-24 years old who report not being good at math.

1 http://changetheequation.org/press/new-survey-americans-say-%E2%80%9Cwe%E2%80%99re-not-good-math%E2%80%9D

# 1/3

Portion of Americans who say they'd rather clean the bathroom than do a math problem.

1 http://changetheequation.org/press/new-survey-americans-say-%E2%80%9Cwe%E2%80%99re-not-good-math%E2%80%9D

# 3 ways a person gets into programming:

# 1. Academia

# 2. Self-taught through tutorials and/or textbooks

# 3. Coding bootcamps or other formal online training

# 1. Academia

- Applying
- Application Deadlines
- Information Kit
- Information Sessions
- Immersion Courses / Prerequisites
  - Programming Prerequisites
  - Math Prerequisites
- International Applicants
- Tuition and Fees
- FAQ

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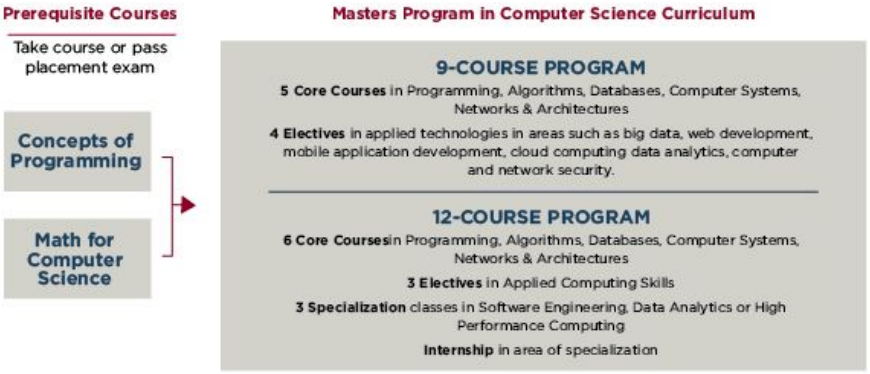



We offer two foundation courses Concepts of Programming and Math for Computer Science: Discrete Math that all incoming Masters in Computer Science students are required to take or place out of prior to beginning the course curriculum in the MPCS. These courses are very important for students with little or no computer science education or experience to build their foundational knowledge for the rest of the program.

Quick Links

- Autumn 2016 Course Schedule
- 2016 - 2017 Course Schedule
- Online Application
- MPCS Alumni Profiles
- Computer Science Job Board
- Computer Science Student Activities Committee
- Course Request Form for Non-MPCS Students
- my.UChicago
- Department of Computer Science
- The University of Chicago

University of Chicago

1 https://csmasters.uchicago.edu/page/programming-and-math-prerequisites-0


# Requirements for the Sc.B.Degree in Math and Computer Science

## Concentration Prerequisites (4 courses)

### Math

- Three semesters of calculus through Math 180, 200, or 350
- Math 520 or 540

## Concentration Requirements (15 courses)

### Core - Math

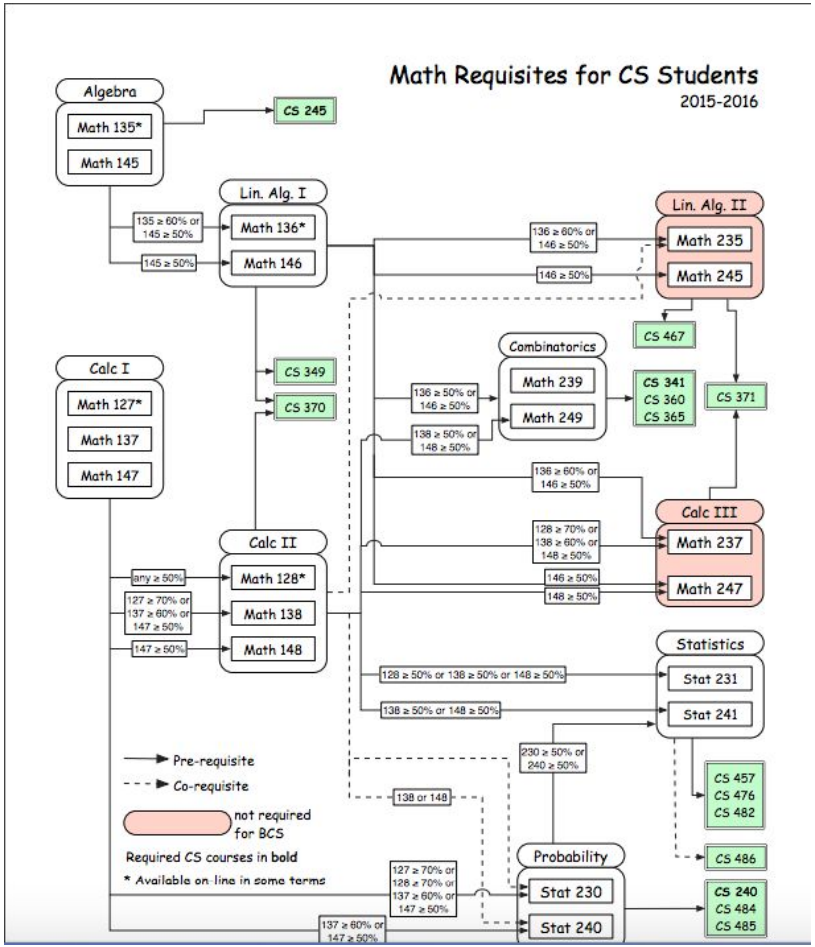
- Math 1530

### Core - Computer Science

- (CSCI 150 and CSCI 160) or (CSCI 170 and CSCI 180) or (CSCI 190 and an additional CS course not otherwise used to satisfy a concentration requirement; this course may be CSCI 180, an intermediate-level course [220, 320,330,510], or a 1000-level course)
- One of
  - CSCI 320
  - CSCI 330
- One of
  - CSCI 220
  - CSCI 510

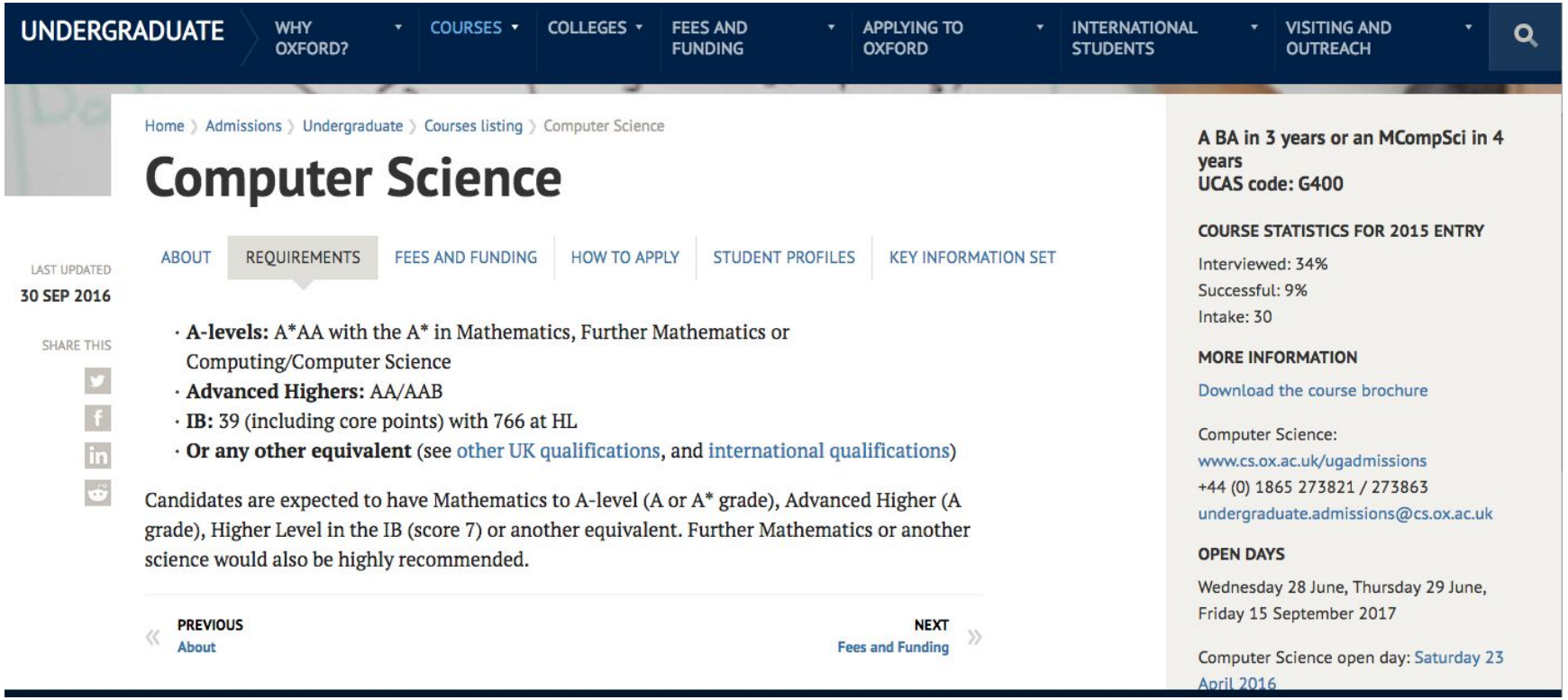
Brown University

1 https://cs.brown.edu/degrees/undergrad/concentrations/cs-ma_reqs/




University of Waterloo

1 https://cs.uwaterloo.ca/current-undergraduate-students/math-prerequisite-chain-computer-science-major-courses




Oxford University

1 https://www.ox.ac.uk/admissions/undergraduate/courses-listing/computer-science?wssl=1

Academia is clearly making math a prerequisite for entering the computer science field.

# 2. Self-taught through programming textbooks and tutorials

By page 41 of Programming in C by Stephen Kochan has introduced polynomials.

Maybe you're saying, oh, don't start with C. Start with Python.

By page 58 of Introduction to Programming in Python by Robert Sedgewick and Kevin Wayne the quadratic formula is being used.

Maybe you’re saying, oh, don’t start with Python. Start with Java.

Head First Java by Kathy Sierra doesn’t introduce numbers until page 274.

“Math class (do you really need an instance of it)?”

Math is also a prerequisite to teaching yourself to program, albeit there are some counterexamples.

# 3. Coding Bootcamps

# 17,966 coding bootcamp graduates in 2016

1 https://www.coursereport.com/reports/2016-coding-bootcamp-market-size-research

# 119,919 total computer science or computer engineering undergraduates in the US and Canada in 2015

1 http://cra.org/wp-content/uploads/2016/05/2015-Taulbee-Survey.pdf

Bootcamps are offering courses in HTML/CSS, Ruby, React, and other languages.

Coding bootcamps spend much less of their curriculum on math and are much more open to other teaching methods.

However, the main method most people still use to get jobs in the technology industry is through a degree.

Coding bootcamps and self-taught learners are still not on a level playing field with peers who have computer science degrees.


1 http://maxpixel.freegreatpicture.com/static/photo/1x/Separation-Heart-Longing-Figures-Danbo-Miss-Love-1863422.jpg

# 2. Separate programming and computer science.

“A **computer scientist** is a scientist who has acquired the knowledge of computer science, the study of the theoretical foundations of information and computation and their application.”

1 https://en.wikipedia.org/wiki/Computer_scientist

“A **computer programmer** [...] is a person who writes computer software. The term computer programmer can refer to a specialist in one area of computer programming or to a generalist who writes code for many kinds of software [...] A programmer’s primary **computer language** (Assembly, COBOL, C, C++, C#, Java, Lisp, Python, etc.) is often prefixed to these titles...”

1 https://en.wikipedia.org/wiki/Programmer

“Computer science” is a catch-all major for all topics in technology, no matter a person’s specific interests.

Let’s give people the ability to major in computer programming or computer science based on their career interests.

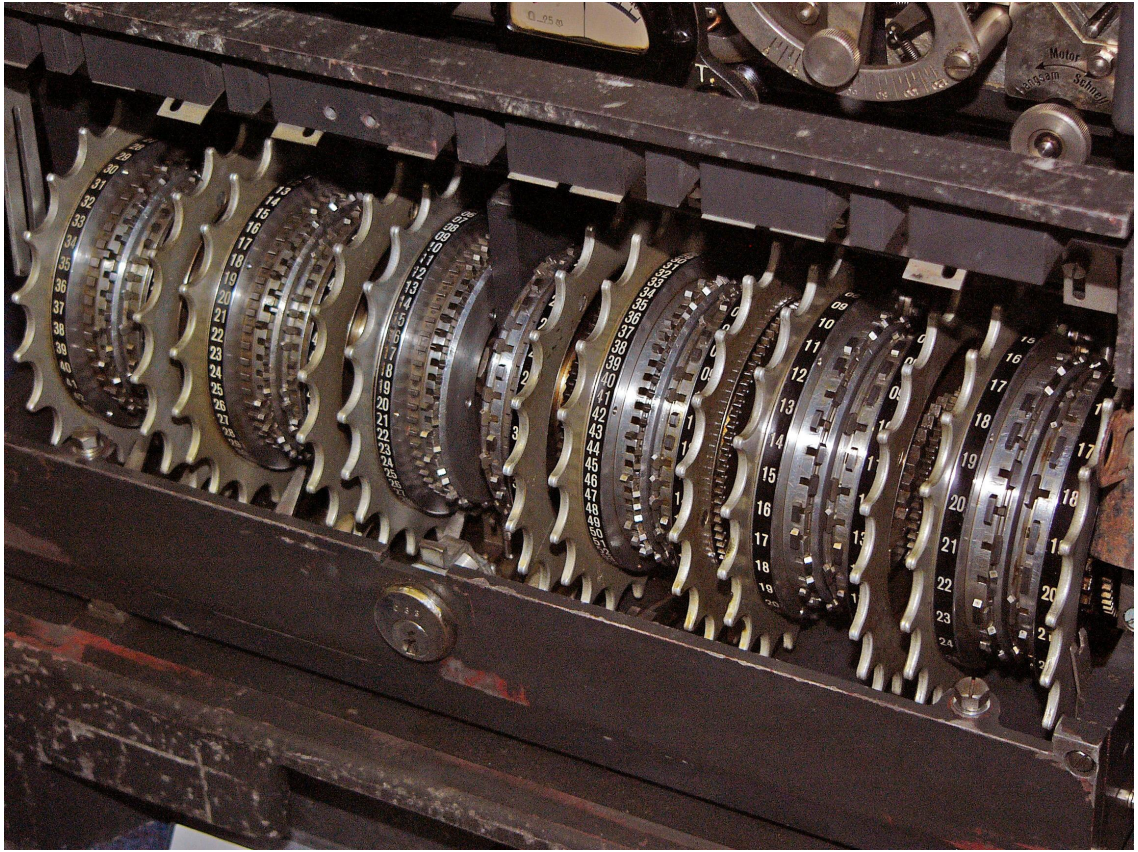
# “Information technology”

# *Applied* computer science vs. *Theoretical* computer science


1 https://upload.wikimedia.org/wikipedia/commons/thumb/d/d5/No_Trespassing_Through_Between.jpg/1014px-No_Trespassing_Through_Between.jpg

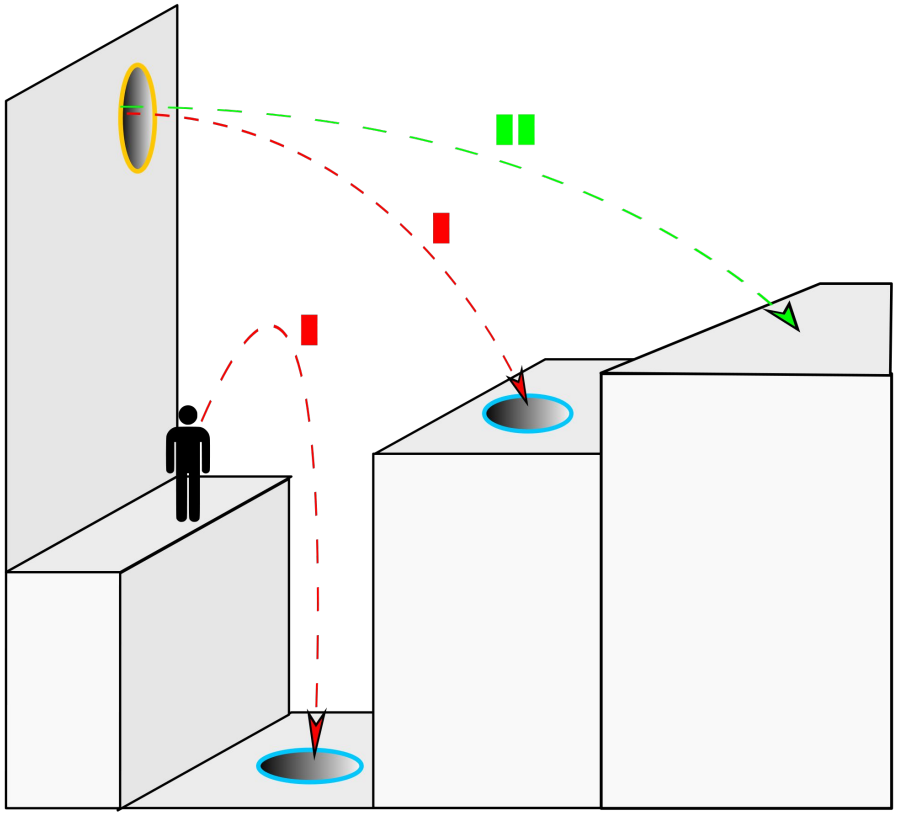
# 3. Separate those fields of computer science that require math skills from those that don’t.

Some computer science topics absolutely require math skills.



# Cryptography

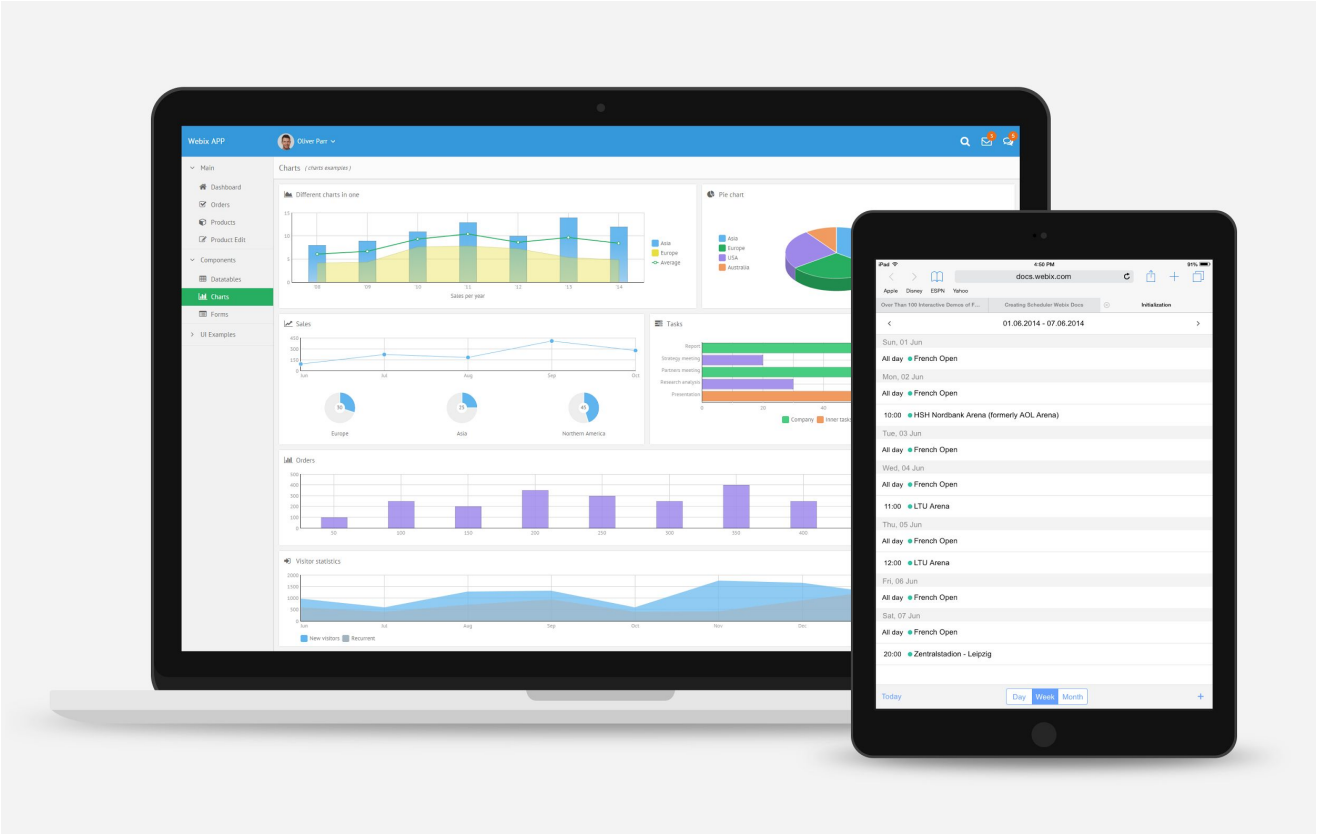
1 https://upload.wikimedia.org/wikipedia/commons/3/39/SZ42-6-wheels-lightened.jpg



# Video game physics

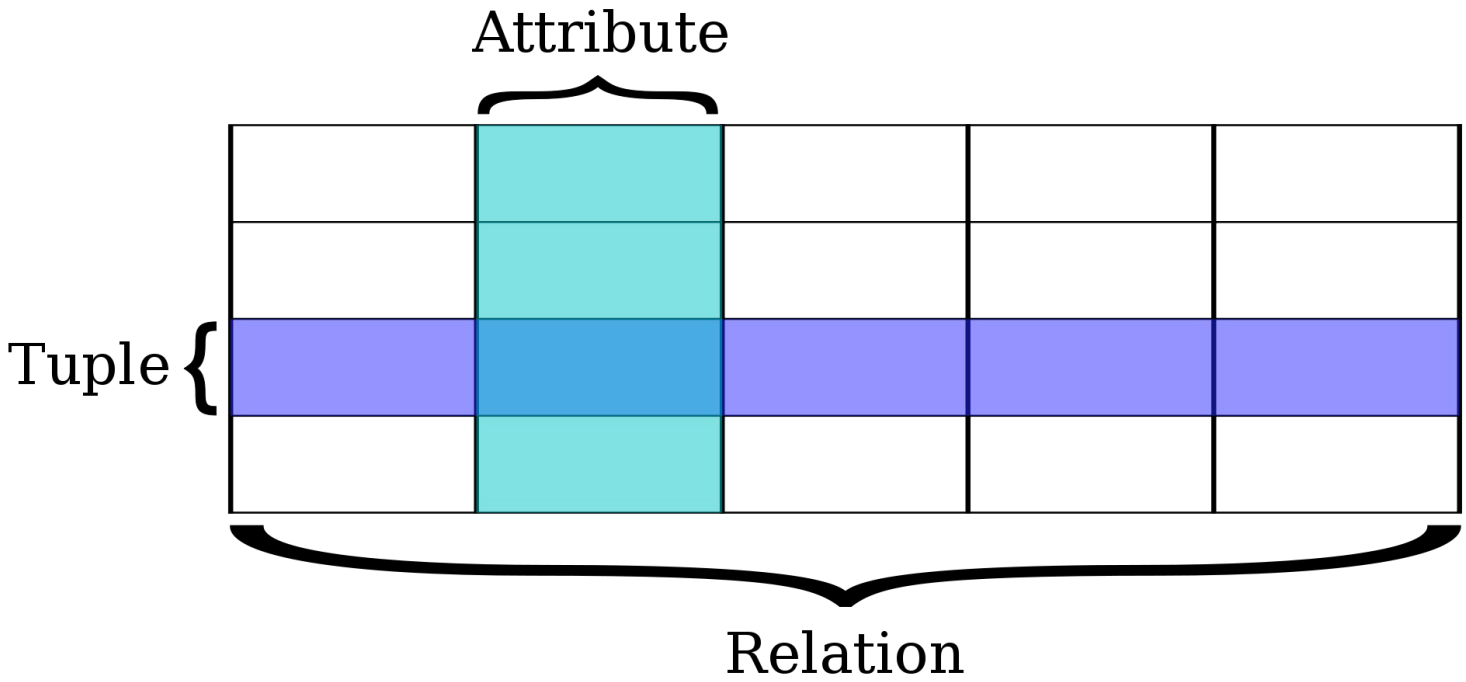
1 https://upload.wikimedia.org/wikipedia/commons/thumb/3/39/Portal_physics-3.svg/2000px-Portal_physics-3.svg.png

# But what about...




# User Interface Design

1 https://upload.wikimedia.org/wikipedia/commons/6/6a/JavaScript_UI_widgets_library_for_building_desktop_and_mobile_web_apps.png




# Databases

1 https://upload.wikimedia.org/wikipedia/commons/thumb/7/7c/Relational_database_terms.svg/2000px-Relational_database_terms.svg.png

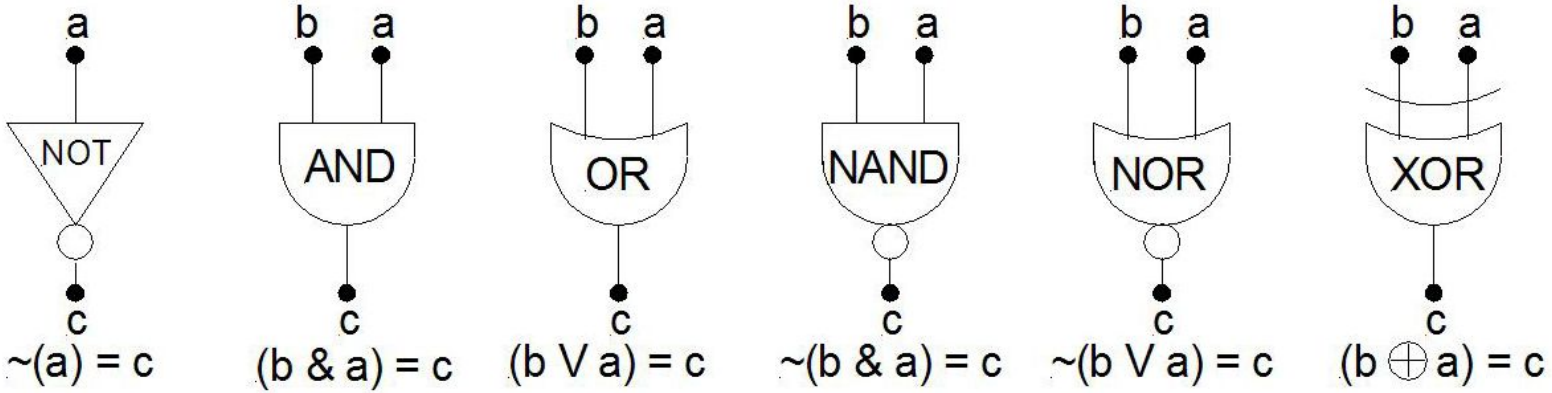
We can write academic curriculum from either perspective: the computer programmer or the computer scientist, depending on their interest.

We can also write tutorials and textbooks from either perspective as well.

# Skills that are more important to learning to program:

# Logic

## Symbols for common engineering connectives




1 https://upload.wikimedia.org/wikipedia/en/c/ca/Propositional_formula_connectives_1.png

# LSAT

An advertising executive must schedule the advertising during a particular television show. Seven different consecutive time slots are available for advertisements during a commercial break, and are numbered one through seven in the order that they will be aired. Seven different advertisements – B, C, D, F, H, J, and K – must be aired during the show. Only one advertisement can occupy each time slot. The assignment of the advertisements to the slots is subject to the following restrictions:

B and D must occupy consecutive time slots.
B must be aired during an earlier time slot than K.
D must be aired during a later time slot than H.
If H does not occupy the fourth time slot, then F must occupy the fourth time slot.
K and J cannot occupy consecutively numbered time slots.

1. Which of the following could be a possible list of the advertisements in the order that they are aired?
(A) BDFHJCK
(B) CJBHDKF
(C) HBDFJCK
(D) HDBFKJC
(E) HJDBFKC

2. If advertisement B is assigned to the third time slot, then which of the following must be true?
(A) C is assigned to the sixth time slot.
(B) D is assigned to the first time slot.
(C) H is assigned to the fourth time slot.
(D) J is assigned to the fifth time slot.
(E) K is assigned to the seventh time slot.

3. Which of the following could be true?
(A) B is assigned to the first time slot.
(B) D is assigned to the fifth time slot.
(C) H is assigned to the seventh time slot.
(D) J is assigned to the sixth time slot.
(E) K is assigned to the third time slot.

4. If C is assigned to the third time slot, then each of the following could be true EXCEPT:
(A) B is assigned to the fifth time slot.
(B) D is assigned to the sixth time slot.
(C) F is assigned to the fourth time slot.
(D) J is assigned to the first time slot.
(E) K is assigned to the second time slot.

5. If H is assigned to the first time slot, then which of the following is a complete and accurate list of all the time slots to which C could be assigned?
(A) second, fifth, sixth, seventh
(B) second, fourth, fifth, sixth, seventh
(C) second, fourth, sixth
(D) second, third, fifth, sixth, seventh
(E) second, third, sixth

6. If J is assigned to the seventh slot, then which of the following must be assigned to the fifth slot?
(A) B
(B) C
(C) D
(D) F
(E) K

1 http://www.griffonprep.com/logicgame.html

# Language learning skills

# Argument structure

# Could we introduce recursive concepts early in textbooks?

# Could we introduce loops before algebra in a textbook?

# The technology industry

Many jobs in technology still have formal education or degree requirements.

If you are interested in getting into technology professionally, you most likely need to have a computer science degree.

We also don’t talk in the technology industry about all the other opportunities available that aren’t related to programming.

Program/Product Management
Technical Writing
Legal
Human Resources
Sales
Operations

# What to do?

If you work in academia, consider advocating for your computer science degrees being split into applied and theoretical.

If you find yourself writing a textbook or a tutorial, please keep my friend Boris in mind.

If you find yourself mentoring someone in programming, keep in mind they may struggle with math.

If you are in a hiring position at your company, please consider eliminating the formal degree requirement for your technology-related jobs.

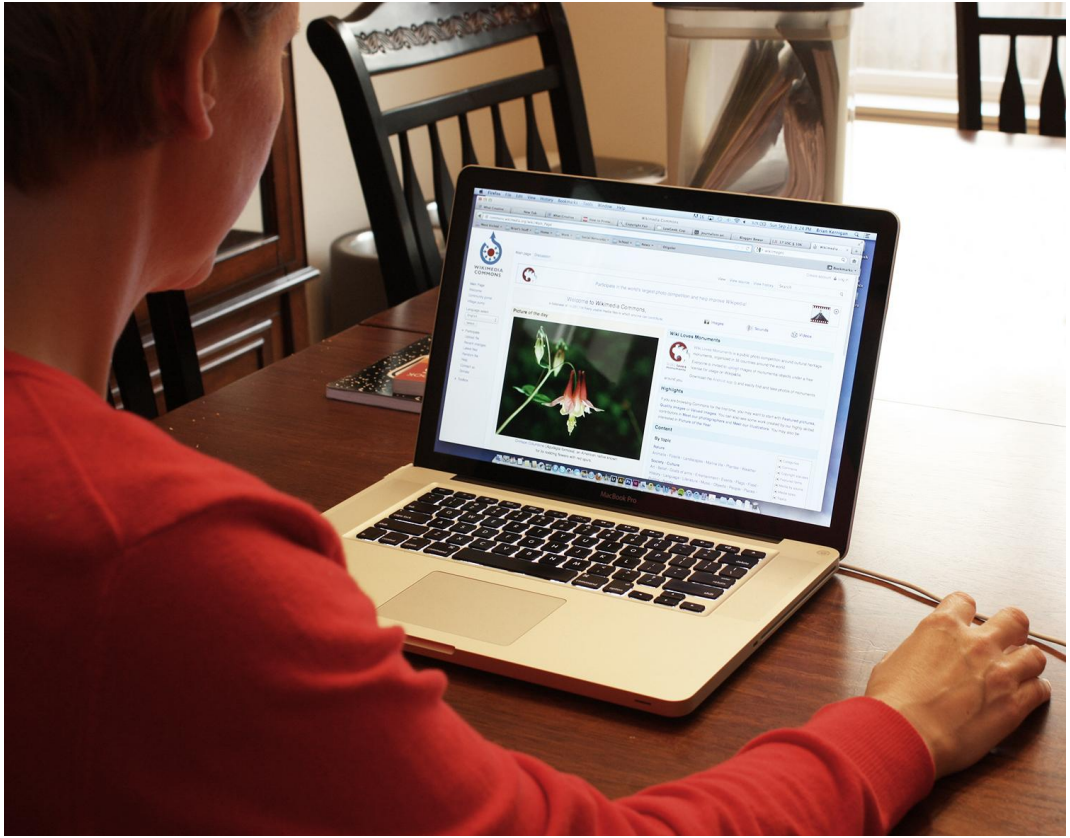
The mathematical concepts might make sense to you, but for some people they are a steep barrier to entry.

We may be unwittingly excluding people we'd like to get into our field without realizing it.

There’s lots of things that get someone into or out of technology.

Culture
Help getting started
Interest
Life factors

We don’t need to make math one of them.



1 https://upload.wikimedia.org/wikipedia/commons/c/c8/Woman_using_computer.jpg

# Questions?

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