



Ceng 111 – Fall 2020

Week 1

Overview and Introduction

[common lecture]

Credit: Some slides are from the “Invitation to Computer Science” book by G. M. Schneider, J. L. Gersting and some from the “Digital Design” book by M. M. Mano and M. D. Ciletti.



Today

- Course Overview
 - Syllabus
 - What the course is about
 - Homeworks, Labs
 - The book
- Introduction to Computer Science
 - What CS is and what it is not
 - Computing, computation, algorithm



COURSE OVERVIEW



Syllabus

CENG 111
Introduction to Computer Engineering Concepts
2020-2021 Fall

Instructors:

Sinan Kalkan (sections 1, 2), Göktürk Üçoluk (section 3)

Teaching Assistants:

Merve Asiler, Büşra Akarsu, Hüseyin Aydın, Abdullah Cem Önem, Deniz Sayın,
Can Duran Ünaldi, Doğuhan Yeke

Course Schedule:

Section 1	Section 2	Section 3
Tue: 13:40, 14:40 Thu: 15:40, 16:40	Tue: 13:40, 14:40 Wed: 15:40, 16:40	Tue: 13:40, 14:40 Wed: 10:40, 11:40



Contact

- Office hours: By appointment.
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- Sinan Kalkan:
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Labs

- There will be labs almost every week
- Labs are complementary to the lectures
 - Lectures are mostly theoretical
 - Labs give you the practical knowledge/abilities
- Attendance is mandatory
- Take them extremely seriously!



Content

Catalog Description:

Introduction to the fundamentals of computer systems, including computer organization, operating systems, language processors and user interfaces. Introduction to algorithms and programming. Reasoning informally about the correctness and efficiency of programs. A functional programming language will be used for practical work.

■ 1/3 of the course:

- What is CS, computing, computation, algorithm?
- Inside of a Computer: CPU, Memory, Gates, Boolean Logic.
- Von Neumann architecture
- Etc.

■ 2/3 of the course:

- Programming concepts with Python.

Text Books

- *For the 1. part:* “Invitation to Computer Science”,
by G. Schneider and J. Gersting, West.
- *For the 2. part:* “Introduction to Programming Concepts with Case Studies in Python”,
by G. Üçoluk and S. Kalkan, Springer.
 - <https://link.springer.com/book/10.1007/978-3-7091-1343-1>
 - *Downloadable in METU, for URL see Homepage>>Library*
- *cutt.ly/*



The textbook

IF YOU WANT THE BOOK IN PRINT, GIVE YOUR NAMES TO THE PHOTOCOPY ROOM AT
THE BASEMENT OF BUILDING-A (DEREAGZI FOTOKOPI)

**Göktürk Üçoluk**

Göktürk Üçoluk received his B.Sc. and M.Sc. degrees in Physics from the Bosphorus University, İstanbul, Turkey, and his Ph.D. degree from the Middle East Technical University, Ankara, Turkey, in 1980, 1982, and 1989, respectively. He is the developer of several symbolic computation software, among which are the first freeware Standard Lisp interpreter and the cross compiler.

He is currently a full professor at the Department of Computer Engineering at the Middle East Technical University. His recent interests are in evolutionary computing, modeling and simulation. His other research interests include symbolic algebraic computing, language processors, and natural language processing. Along with lectures in his subject field, he also has taught over 20 years the departmental freshman CS courses.

**Sinan Kalkan**

Sinan Kalkan graduated from the Middle East Technical University with a B.Sc. degree and a M.Sc. degree in Computer Engineering in 2001 and 2003, respectively. He received his Ph.D. degree in Informatics from one of the 5 elite universities of Germany, the University of Göttingen, in 2008.

He is currently an assistant professor at the Department of Computer Engineering at the Middle East Technical University, teaching freshman and sophomore courses as well as graduate level advanced courses. His research interests include Pattern Recognition, Image Processing, Computer Vision and Cognitive and Swarm Robotics. He is one of the main contributors of an open source computer vision library, CoViG (<http://www.covig.org>).



Üçoluk
Kalkan INTRODUCTION TO PROGRAMMING CONCEPTS



INTRODUCTION TO PROGRAMMING CONCEPTS

with case STUDIES in Python

Göktürk Üçoluk Sinan Kalkan



Home page

■ <http://ceng.metu.edu.tr/ceng111>

- Home
- Course Info
 - Conduct
 - Weekly Coverage
 - Grading
- Faculty
- Take Home Exam
- Lab
- Library



CENG account

- user name/passwd has been mailed to your METU account (the one **used for registration**).
- **use**

webmail.metu.edu.tr

to view mails there.



Grading

Grading:

Midterm	%18
Take-home Exams (4)	%25
Labs	%32
Participation	%3
Final	%22

- Most assignments will be programming assignments (some could be exercises to be written up).
- Laboratory schedule will be announced later. Keep watching.
- Starting from week 4-5 the laboratory sessions will go in parallel with the lectures. You will be asked to solve problems by using the ideas introduced in the lectures of that week. Earlier lab sessions will build your computing/communicating literacy.

Take-home Exams

- We will have four take-home exams:
 - Heavy programming!
- They are extremely important:
 - You get the chance to practice what you learn
 - You can get your hands “dirty”
 - Well, they are your first “few walking steps” towards programming



- In this department, we teach you a new occupation!
 - In this sense, if you cheat, you fool yourselves; not us!
- Cheating is not acceptable in this department or any other departments or teaching institutions.

- Rent-a-coder 
- Asking help in forums 
- Violation => disciplinary action!!



What is cheating in programming?

- You can talk about how to solve Take-home Exams but **DO NOT PROGRAM TOGETHER!**
- We have sophisticated software for finding the cheaters!
 - Trust me: It finds everything!





- The following are not accepted as excuses for cheating (in fact, nothing is acceptable for cheating):
 - “Ama hocam, ödev metninde yazmamışsınız kopya çekemeyeceğimizi”
 - “Ama hocam, üst sınıflar «çekin çekin, bi şey olmuyo, ben geçtim» demişti”
 - “Ama hocam, arkadaşın kodunu değiştirdim, aynını göndermedim ki!”
 - “Ama hocam, bir tek ben çekmedim, herkes birbirine mail atıyor kodunu”

Nature of 111

- How does it feel?
- How to study?



Common questions about CENG

- Will we write code in professional life?
- How will we find a job?
- An academic vs. professional path? Which one?
- How shall I improve myself in my free time?
- Do CENG people have a “Chamber”?

Common questions about 111

- Why do we “start” with Python
- Is Python the best/ultimate programming language?
- Will we learn Python to its full extent?
- Is it an advantage to “know programming” prior to 111?
- Shall I buy a desktop or a laptop? If yes, which brand and where to buy it?
- Shall I install Linux? Why are you so “UNIX” biased?



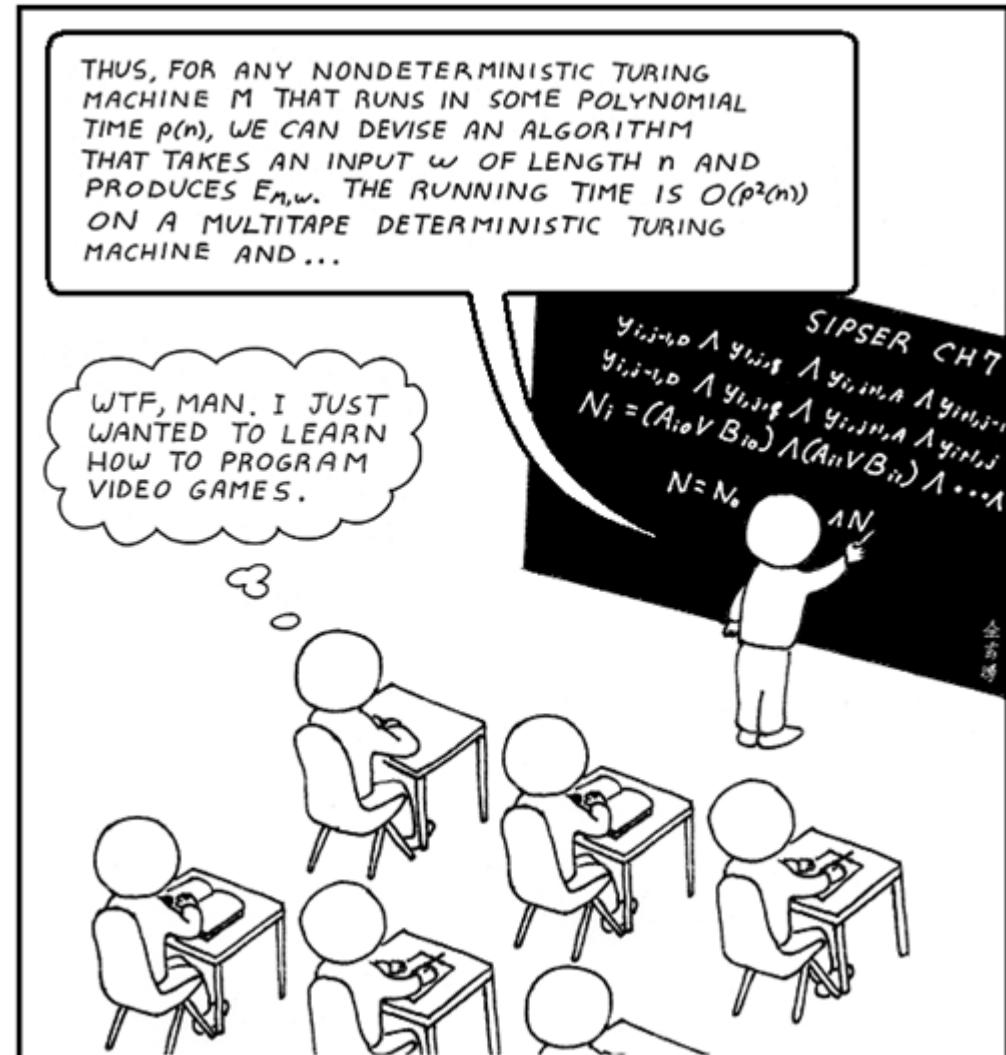
Common questions about 111

- Can I take CENG 111 again next year?
 - No, unless you fail the course (FF/FD) or you are in probation



So, at the end

- CS is about mostly analysis, design, implementation, interpretation and usage of algorithms.
- If you have come here for a different purpose, it is not too late 😊





But, at the end

- Although you might have some difficulties at the beginning, you will love it after 1-2 years ☺
 - (I don't guarantee it though ☺)





Now

- What is computer science?
- Computation, Computing
- Digital Computation



C/C++

```
#include <stdio.h>
int main(void)
{
    printf("Hello World!\n");
    return 0;
}
```



WHAT IS COMPUTER SCIENCE?

What is Computer Science?

- “Computer science **is the study of computers**”
- Incomplete – theoretical work began (1920-1940) before computers
- CS became an independent field of study late 1950’s, early 1960’s
- Theoretical CS – relies on formal models rather than “real” machines
- CS “is no more about computers than astronomy is about telescopes”

From “Invitation to Computer Science”

What is Computer Science?

- “Computer science is the study of how to write computer programs” **WRONG!**
- Programming is important, but it is just a tool for studying new ideas, representing information or testing the solution to a problem.
- A Program is a means to an end, not the end itself.

From “Invitation to Computer Science”

What is Computer Science?

- “*Computer science is the study of the uses and applications of computers and software*”
WRONG!
- E.g. word processors, databases, spreadsheets, etc.
- Many people USE software, but the Computer Scientist is responsible for specifying, designing, building and testing software packages and the systems on which they run.

From “Invitation to Computer Science”



What is Computer Science?

- All of the following concepts are incomplete and do not capture the richness and diversity of this exciting field:
 - computers,
 - programming languages,
 - software applications, and uses.

From “Invitation to Computer Science”

Computer Science is the study of algorithms (= methods)

including:

1. their formal and mathematical properties
2. their hardware realizations
3. their linguistic realizations
4. their applications

From “Invitation to Computer Science”



Computer Science is the study of Algorithms

Including:

1. their formal and mathematical properties
 - studying the behavior of algorithms to see that they are correct and efficient

From “Invitation to Computer Science”



Computer Science is the study of Algorithms

Including:

2. their hardware realizations
 - designing and building computer systems to execute the algorithms

From “Invitation to Computer Science”



Computer Science is the study of Algorithms

Including:

3. their linguistic realizations
 - designing programming languages and translating the algorithms into these languages so that they can be executed by the hardware

From “Invitation to Computer Science”



Computer Science is the study of Algorithms

Including:

4. their applications
 - identifying important problems and designing correct and efficient software packages to solve them.

From “Invitation to Computer Science”

Measure the height of a tall building with a barometer



- What would be your answer?
- One student answered:
 - “I would tie the barometer to a rope, hang it down from the top of the building to the bottom and measure the length of the rope!”
 - Of course, the instructor rejects the answer since it doesn’t include any “physics”

Check the following for two different versions of the ‘legend’: <http://www.snopes.com/college/exam/barometer.asp>



Measure the height of a tall building with a barometer (cont'd)

- There are other ways:

1. Drop the barometer from the top, and measure the time it takes to reach the ground.
2. Make a pendulum and time its frequency at the top and the bottom of the building.
3. Walk down the stairs marking "barometer units" on the wall.
4. Measure its shadow and the buildings shadow.
Workout the height of the building from barometer's height.

Analyze/Compare Algorithms = Pros and Cons of Algorithms =

What are the disadvantages of these?

Cons:

1. Drop the barometer from the top, and measure the time it takes to reach the ground. → 1. You lose the barometer; it breaks.
2. Make a pendulum and time its frequency at the top and the bottom of the building. → 2. You need a loooong rope and how long that rope is going to be depends on the answer to the question.
3. Walk down the stairs marking "barometer units" on the wall. → 3. It takes too long. It is too tiring.
4. Measure its shadow and the buildings shadow. Workout the height of the building from barometer's height. → 4. What if there is no sun?

Where does the word ‘algorithm’ come from?

- From a Persian mathematician, astronomer and geographer: Mohammed ibn-Musa al-Khwarizmi
 - “Algorithmi” is the latin form of his name
 - He contributed to science by
 - Decimal positional number system
(e.g., $32 = 10^1 \times 3 + 10^0 \times 2$)
 - Presented the first systematic solutions to linear and quadratic equations
- In fact, the word “Algebra” comes from one of his operators (al-jabr: subtracting a number from both sides of an equation) for solving equations



Mohammed ibn-Musa
al-Khwarizmi
(780-850)

Source: Wikipedia

Where does the word ‘algorithm’ come from? (cont’d)

■ al-Khwarizmi reduced equations to one of the following six forms by using al-jabr (in Arabic: restoring, completion):

- squares equal roots ($ax^2 = bx$)
- squares equal number ($ax^2 = c$)
- roots equal number ($bx = c$)
- squares and roots equal number ($ax^2 + bx = c$)
- squares and number equal roots ($ax^2 + c = bx$)
- roots and number equal squares ($bx + c = ax^2$)

■ For example, $x^2 = 40x - 4x^2$ is reduced to $5x^2 = 40x$. From this reduced form, it is easily deducable that the variable is either 0 or 8.



al-Khwarizmi's
Compendious Book
on Calculation by
Completion and
Balancing

Source: Wikipedia

What does ‘algorithm’ mean?

- “A procedure or formula for solving a problem”
- “A set of instructions to be followed to solve a problem”
- “an effective method expressed as a finite list of well-defined instructions for calculating a function”
- “step-by-step procedure for calculations”

A formal definition of algorithm

- “Starting from an initial state and initial input (perhaps empty), the instructions describe a **computation** that, when executed, will proceed through a finite number of well-defined successive states, eventually producing "output" and terminating at a final ending state.”



What is an algorithm?

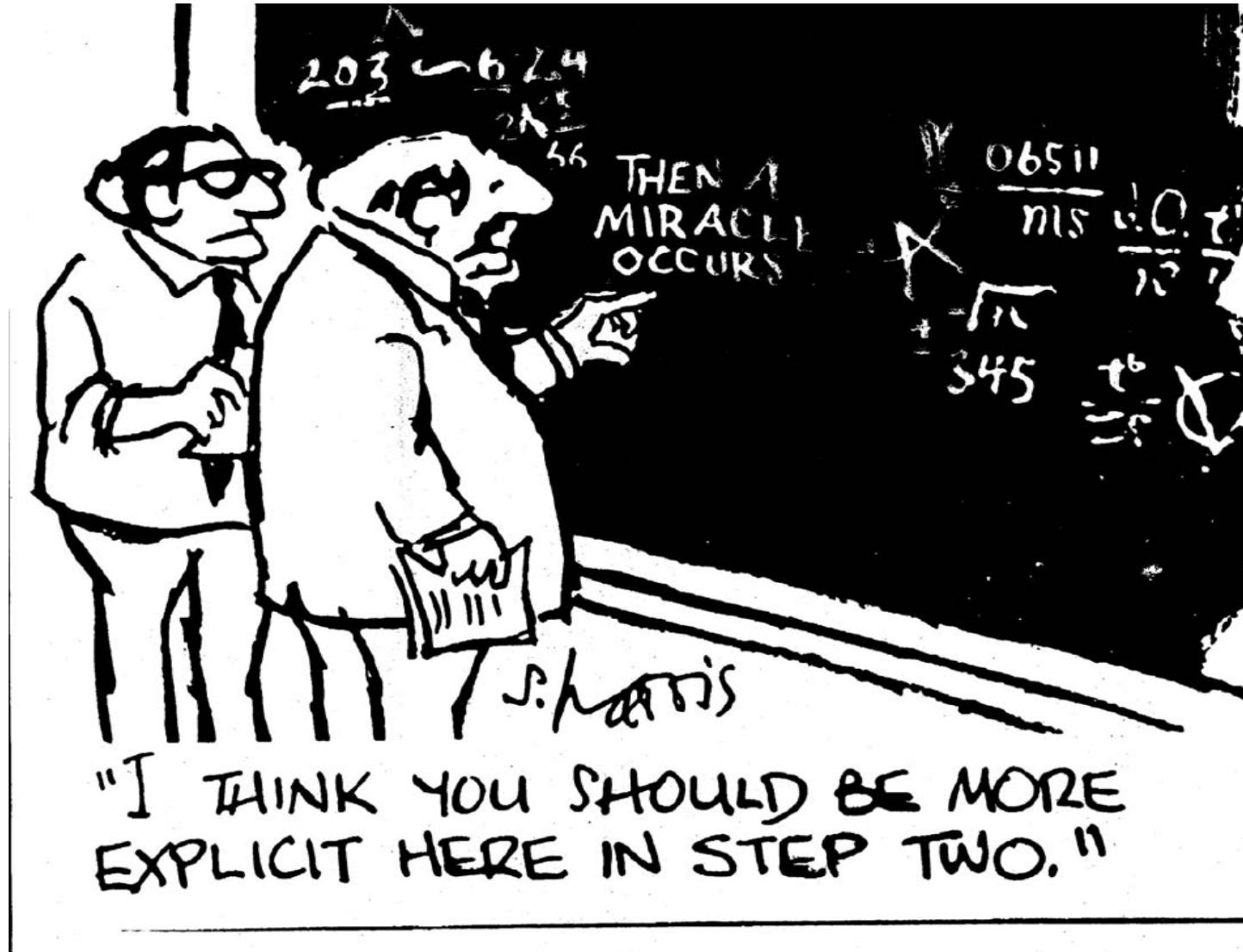
- An algorithm is a list that looks like
 - STEP 1: Do something
 - STEP 2: Do something
 - STEP 3: Do something
 - .
 - .
 - .
 - STEP N: Stop, you are finished

From “Invitation to Computer Science”

Valid Operations in Algorithms

- **Sequential** – simple well-defined task, usually declarative sentence.
- **Conditional**- “ask a question and select the next operation on the basis of the answer to the question – usually an “if-then” or “if then else”
- **Iterative**- “looping” instructions – repeat a set of instructions

From “Invitation to Computer Science”



From "Invitation to Computer Science"



Algorithms

- We use them all the time.
- Can you give examples?
 - Following directions
 - Recording a DVD
 - Adding two numbers
 - Finding Greatest Common Divisor
 - ...

From “Invitation to Computer Science”

An example algorithm from our daily lives

Algorithm for Shampooing Your Hair

STEP	OPERATION
1	Wet your hair
2	Set the value of <i>WashCount</i> to 0
3	Repeat steps 4 through 6 until the value of <i>WashCount</i> equals 2
4	Lather your hair
5	Rinse your hair
6	Add 1 to the value of <i>WashCount</i>
7	Stop, you have finished shampooing your hair

From “Invitation to Computer Science”



THIS "EXACT INSTRUCTIONS CHALLENGE" IS SO HILARIOUS

<https://www.youtube.com/watch?v=Ct-IOOUqmyY>