INTRODUCTION TO PROGRAMMING USING PYTHON

ES 112

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Lab groups and the TA leading each group will be announced during the lab

1. TAs will evaluate your assignments and exams: be nice to them 😂😂
2. Reach out to your TA for starting off on weekly assignments and also for clearing doubts

Administrative Trivia

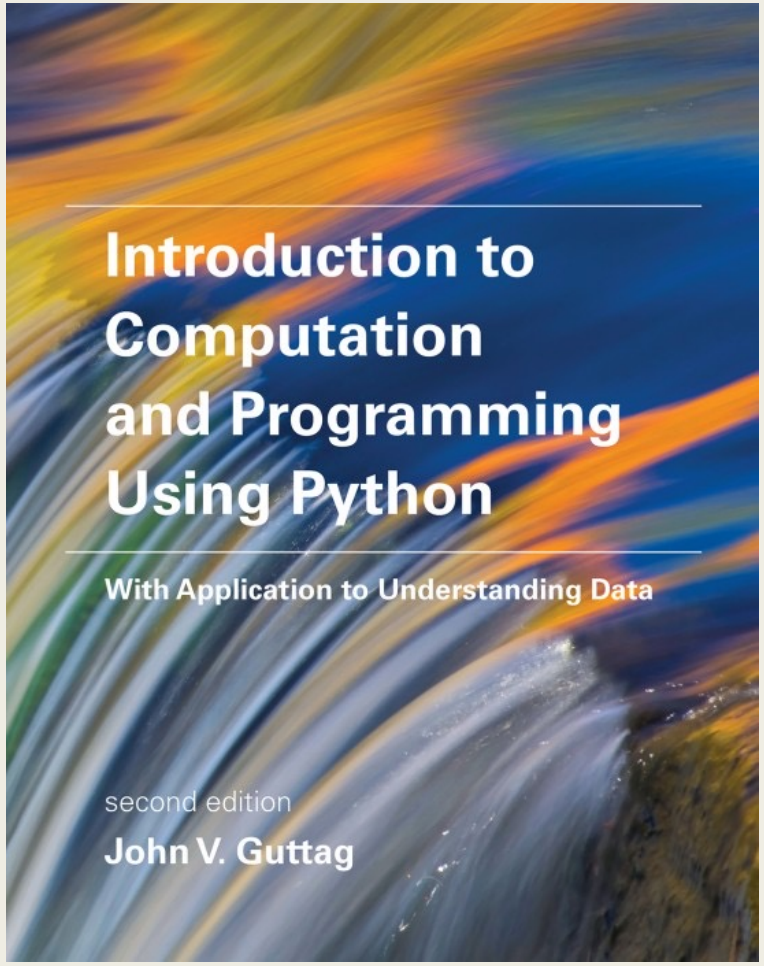
- Classroom: A106
- Lecture slot: Tuesdays 0915 - 1045
- Lab slot:
  - *Batch 1 (IMT2022001 – IMT2022100) : Monday 1330 – 1515*
  - *Batch 2 (IMT2022101 – IMT2022XXX) : Thursday 0900 – 1045*
- Evaluation Scheme
  - *Quizzes (4 quizzes in the class): 20%*
  - *Labs and Assignments: 20%*
  - *Mid sem exam: 30%*
  - *End sem exam: 30%*

Text Book

Introduction to Computation and Programming Using Python with Application to Understanding Data

John V Guttag

Prentice Hall India



- Text book is optional; course notes are mandatory ☺

Objectives of this Course

- Learn to think computationally!!
- Learn to solve problems using computers
- Learn to code in Python

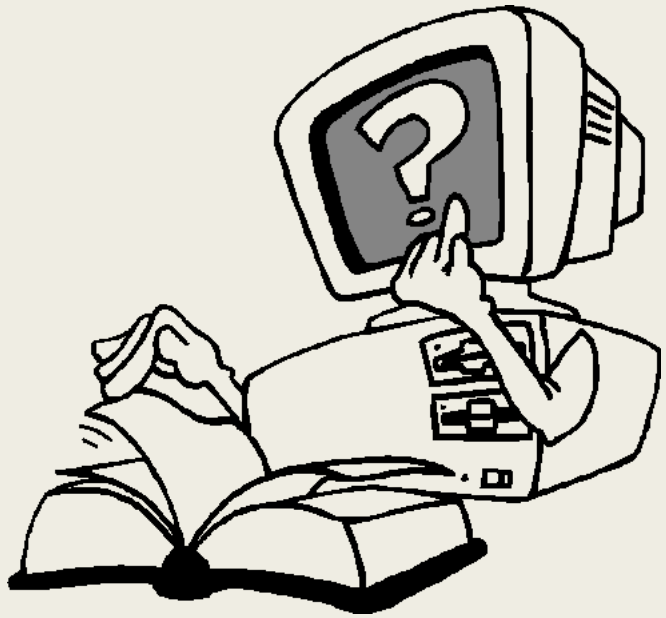
Course Contents

- Basics Of Python
  - *Objects and expressions*
  - *Variables and Assignment*
- Strings and Input / Output
- Conditionals
- Iteration: for and while loops
- Functions: Abstractions and arguments, scoping and global / local variables, recursion
- Modules and files
- Structured types: Tuples, Ranges and Lists
- Higher order functions: functions as objects; functional programming
- Introduction to Dictionaries
- Testing and debugging
- Exceptions and Assertions
- Introduction to Object Oriented programming

LET’S DIVE IN!

What is a Computer

- A computer is a dumb machine!
- A computer can only do what you tell it to do
- Garbage in; Garbage out



Biryani!!!

- Biryani is an rice-based dish that can be served with various meats and vegetables. This spicy dish normally contains an array of ingredients. The meat or vegetables and the rice are cooked separately with their own seasonings. The two parts of biryani are combined shortly before serving.

Declarative Knowledge

- Heat oil and add cumin seeds.
- Saute and add the onions, garlic-ginger paste. Saute till brown.
- Add vegetables, stir fry over low heat till half done.
- Add coriander powder, garam masala, haldi, salt, chilli powder and green chillies.
- Cook, covered for about 5 minutes and mix in the lemon juice and half the coriander.
- The water should be absorbed by now. Remove half the vegetables and layer with half the rice.
- Cover and [illegible] mixture
- Leave over [illegible] for 10 minutes or so and serve garnished with the coriander.

Imperative Knowledge

A Numerical Example

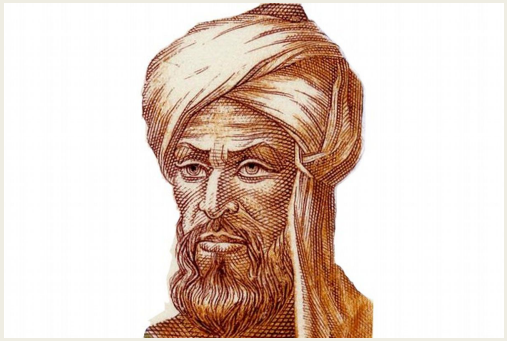
- Declarative knowledge: $\sqrt{49} = 7$
- Imperative knowledge: compute square root of a given number x (49 in our case)
  - *Guess a random number g*
  - *If g * g is close enough to x, then stop and say g is the answer*
  - *Otherwise make a new guess by averaging g and x / g*
  - *Repeat the process using the new guess*

g	g*g	x / g	(g + x/g)/2

What is a Recipe

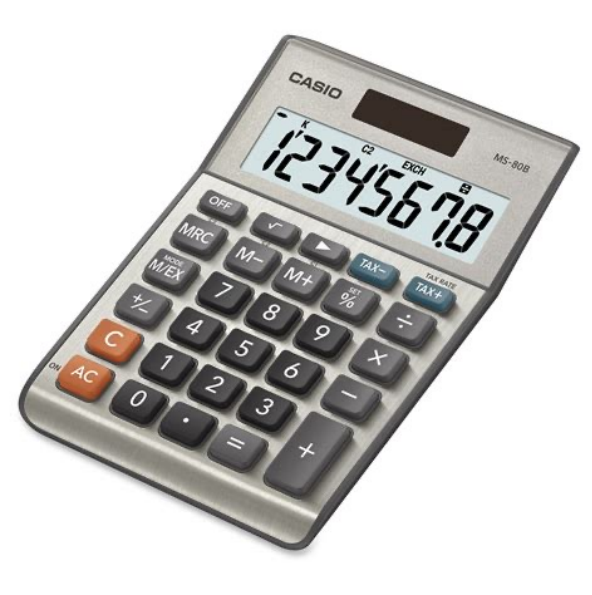
- A step-wise method to achieve a given goal
- Lists material needed
- Steps
  - *Lists tasks to be done step-by-step*
  - *Lists decisions you have to take along the way (if, repeat)*
  - *Tells you when to stop*
- Good Recipes try to use reusable patterns to make the task easier

Abu Ja'far Muhammad ibn Musa al-Khwarizmi

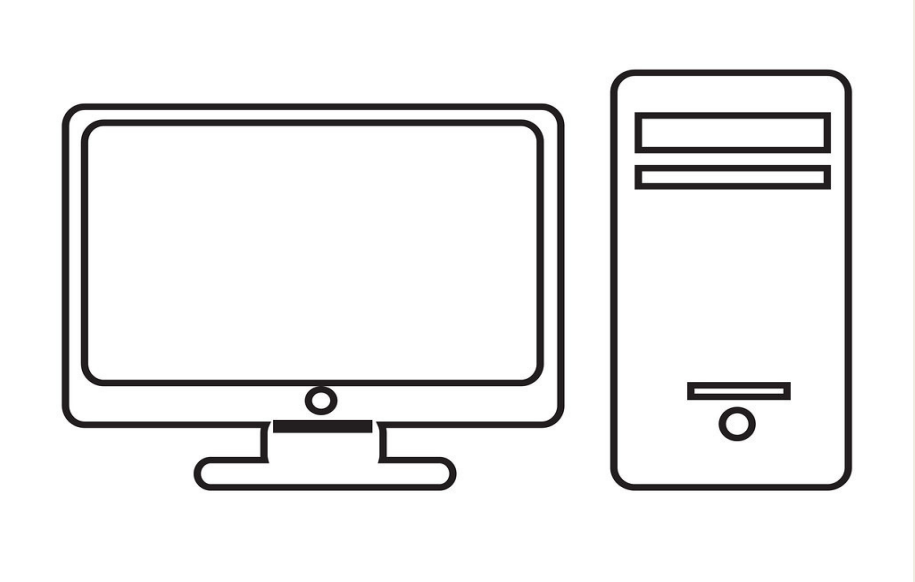


- Lived in Baghdad c.780 – c.850
- Wrote
  - *kitāb al-ḥisāb al-hindī (On the Calculation with Hindu Numerals) c. 820*
  - *al-mukhtasar fi hisab al-jabr wa al-muqabala in c.813-833*
- *On the Calculation with Hindu Numerals* was translated into Latin as *Algoritmi de numero Indorum*

Calculator or Computer

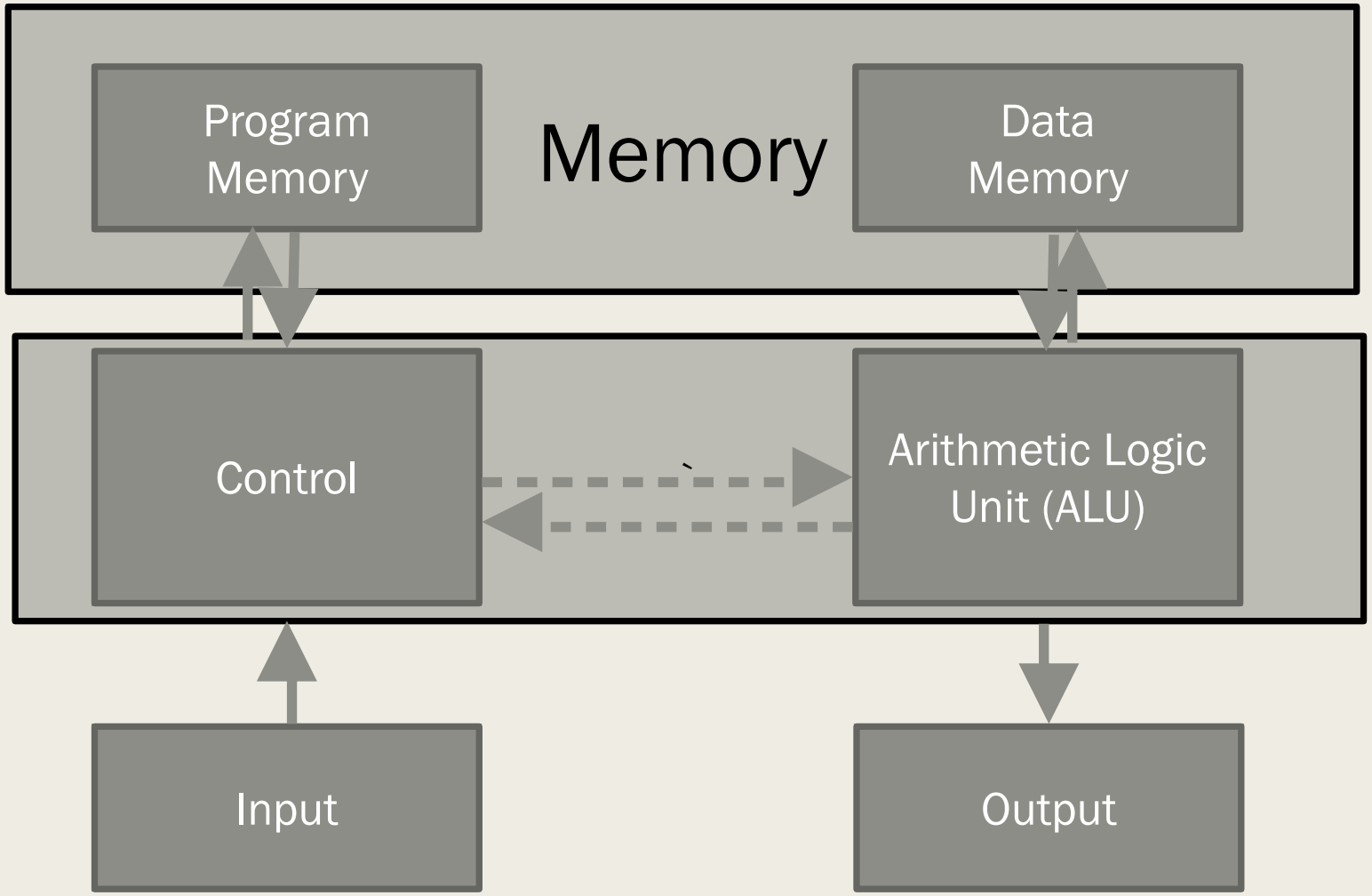


Stores values; not recipes



Stores values and recipes
Also executes recipes

Block Diagram of a Basic Computer

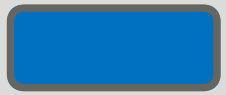
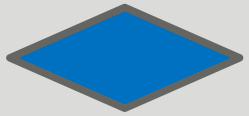


Understanding What a Computer Does

- Fetch an instruction from (program) memory
- Based on the instruction, do the following
  - *Instruct the ALU on what to do*
- Test the result of the computation and decide which instruction to do next or stop

- Instructions can do the following
  - *Read input or write to output*
  - *Basic Arithmetic and Logic*
  - *Fetch the relevant data from (data) memory*
  - *Simple tests*

Flow Charts

Symbol	Name
	Start / Stop
	Process Flow
	Task or process step
	Input / Output
	Decision

RAMUKAKA, I AM THIRSTY

Pop Quiz!!

Image A

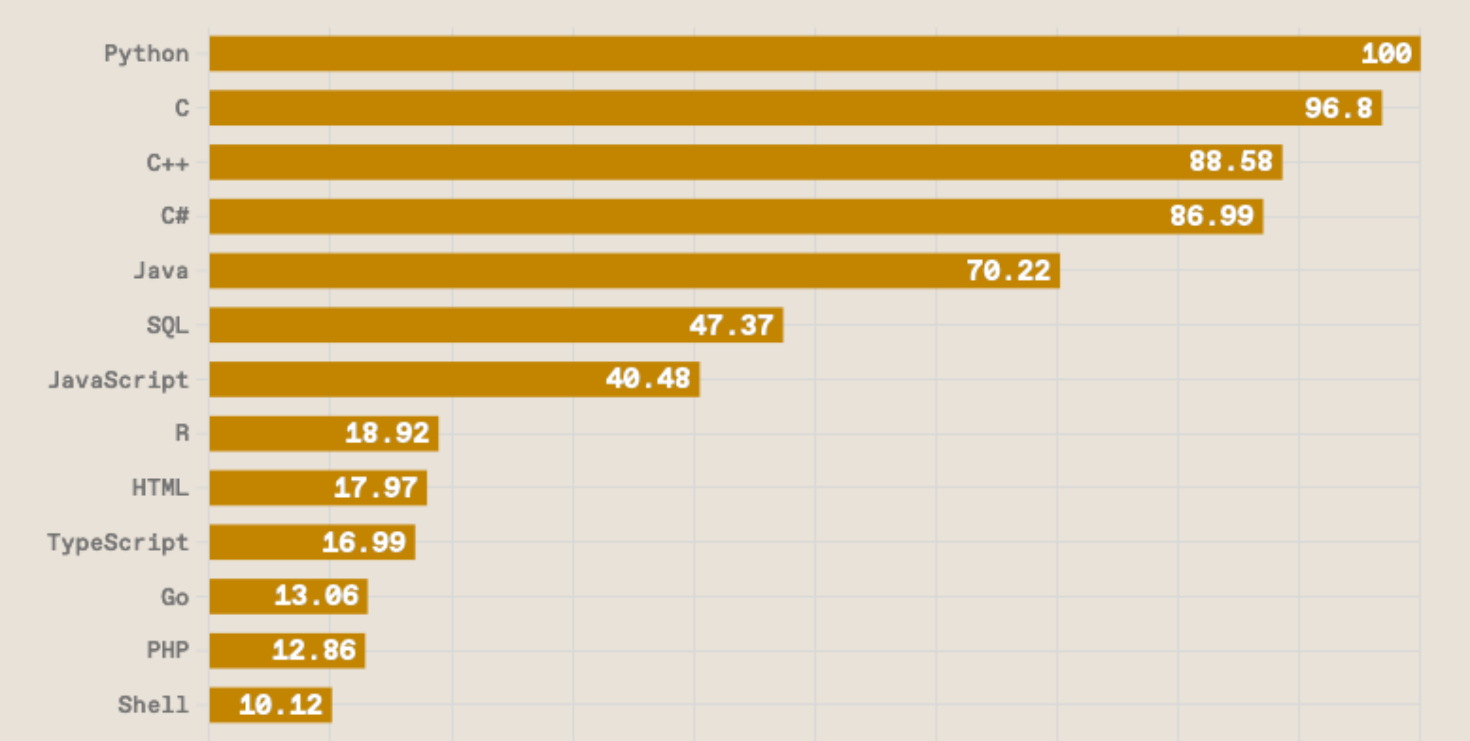
Image B

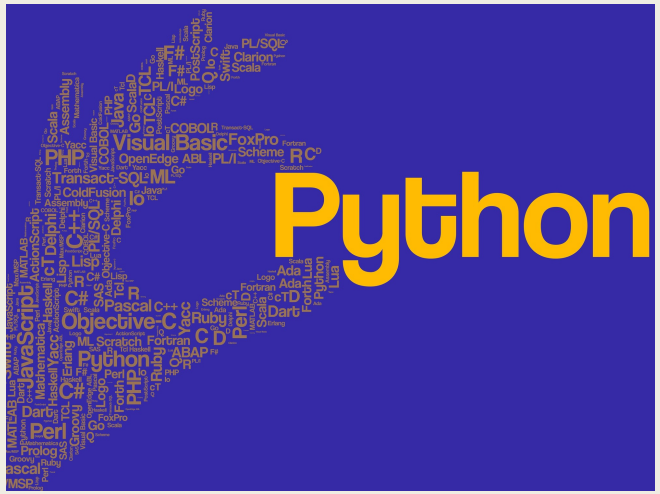
Which of these two images are remotely linked to our class?

A (Brief) History of Python

- Designed by Guido von Rossum (December 1989)
- Goals of Python (1999)
  - *An easy and intuitive language just as powerful as major competitors*
  - *Open source, so anyone can contribute to its development*
  - *Code that is as understandable as plain English*
  - *Suitability for everyday tasks, allowing for short development times*
- Version
  - *Version 2.0 launched in 2000*
  - *Version 3.0 launched in 2008 : not backward compatible*
  - *Current version is 3.11 (I use 3.10)*

Top Programming Language 2022: IEEE Spectrum





Python

- High level language
  - *Performs abstract operations*
  - *Not bit level operations*
- General purpose language
  - *Can be used for multiple tasks*
- Interpreted
  - *commands executed one at a time*
  - *Compiled languages translate entire programs to machine code, and then execute*
  - *Easier to debug, but typically less efficient*

Where is Python Used?

- GUI applications.
- Web apps.
- Scrape data from websites.
- Analyze Data.
- System administration utilities.
- Game Development.
- Data Science

What Do We Need To Write Python Programs

- Python interpreter (version 3.5 or later)
  - I use version 3.10
- An editor to edit text files
  - We will use vim
  - I use version 9.0
- Our lab machines will run Unix
  - Python runs on Windows, but check version compatibility
  - 3.7 and earlier version will not run on Windows XP or earlier
  - 3.8/9/10 will not run on Windows 7 or earlier