A Gentle Introduction to Programming (& GenAI)

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Pre-course

What is programming?

Providing instructions on how to perform a task

- This can take many forms; just look at the history of computers!
- Nowadays, we are usually talking about computer programming - writing code

Programming vs. Algorithms

Programming

A sequence of instructions used to tell the computer to perform a task.

Algorithm

A sequence of steps used to solve a specific problem.

Within the scope of programming, you will be both:

- using existing algorithms and
- designing your own

How does the computer follow your instructions?

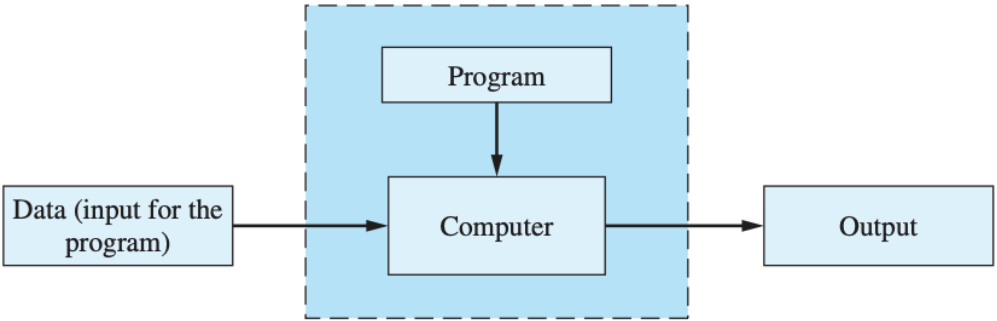
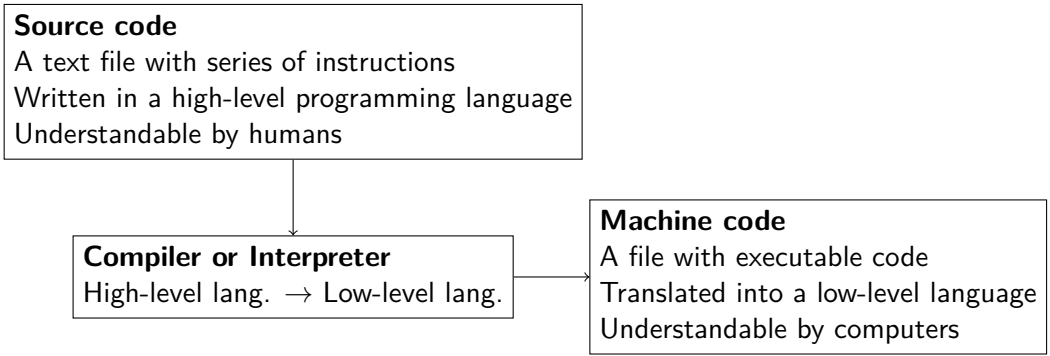


Figure: From 'Java: An Introduction to Problem Solving & Programming'

How does the computer understand your code?



How do you actually go about writing a program?

Theoretical part

When faced with a real-world problem we want to solve:

- Analyse the problem - understand it as a series of discrete logical steps
- Design a way to solve it - again, thinking in steps
  This could be done on paper; it's not about coding, it's about thinking!
- Instruct the computer to follow your solution

How do you actually go about writing a program?

Practical part

1. **Write code** - *it's just plaintext files*
   text editors provide helpful tools and features for writing code
2. **Run & Test code** - text files interpreted/compiled and instructions executed
   Use the command line to tell the computer to run the source file
3. **Debug code** - find and correct errors
   manually or with a debugger

Repeat 1. - 3.

- **Tools:** countless apps, workflows, and ways of writing code - personal preferences + imposed requirements
  IDEs - write, run, and debug in one app

How does one choose a programming language?

- Personal preference/knowledge
- Imposed requirements - platform, project, group, or a company standardisation
- Advantages - use-case, speed, available libraries/packages,...

Concepts and skills are highly transferable from one language to another
knowing any programming language means others will be easier to pick up

Java

Classes you will use it in include: DSA I, DSA II

- Fast
- Compiled
- Platform independent
- Object oriented
- Quite in-demand by employers
- A tad wordy

```java
public static void main(String[] args) {
    String vowels = "aeiou";
    int numVowels = 0;
    Scanner keyboard = new Scanner(System.in);
    System.out.print("Enter your name: ");
    String name = keyboard.nextLine();
    for(char letter: name.toCharArray()){
        if (vowels.indexOf(Character.toLowerCase(letter))≠-1)
            numVowels++;
    }
    if (numVowels==1) {
        System.out.println("Your name contains 1 vowel.");
    }
    else{
        System.out.println("Your name contains "+  numVowels + " vowels.");
    }
}
```

Python

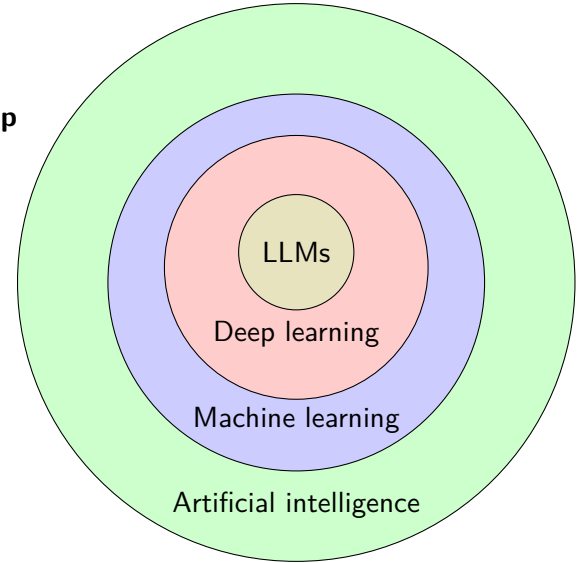
Classes you will use it in include: Programming and Data Analysis, DSA III

- Not as fast but more versatile
- Interpreted
- Platform independent
- Object oriented
- Quite in-demand by employers
- Simpler Syntax

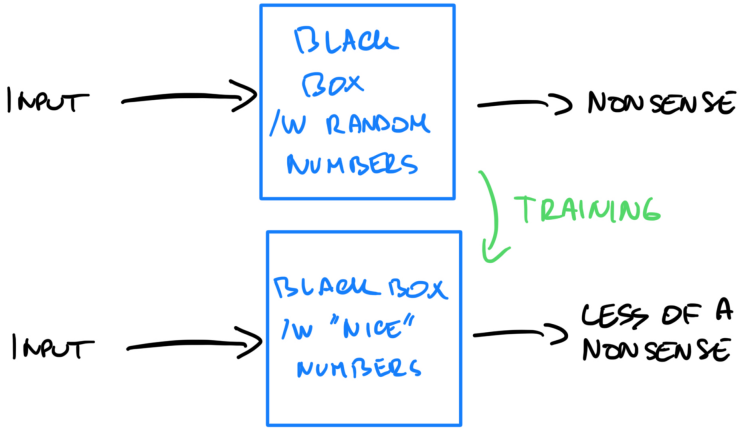
```python
def main():
    vowels = ['a','e','i','o','u']
    numVowels = 0
    name = input("Enter your name:")
    for letter in name:
        if letter.lower() in vowels:
            numVowels +=1
    if numVowels==1:
        print("Your name contains 1 vowel.")
    else:
        print(f"Your name contains {numVowels} vowels.")
```

People 'not in the know' like to mix up and misuse:

- Artificial Intelligence
  - Generative AI
- Deep learning
- Machine learning
- Large Language Models
- Neural Networks
- ...



How can machines (e.g. LLMs) learn?



Large Language Models - ChatGPT, Gemini, Claude, Llama,...

Why are they models?

attempt to 'do stuff' like 'we would'

Why language specifically?

trained on natural language, good for tasks such as modelling, translation, summarisation, classification,...

What makes them large?

learned knowledge about language and the world from vast amounts of text

Inherent limitations

Bias

if its in the training data, it may appear in the output (toxic language, gender bias, race bias,...)

Hallucinations

prone to make things up - text is coherent, but false

Copyright/Privacy Issues

Where did its knowledge come from?
Where did *my* knowledge come from?

Issues you might encounter

- Doesn't actually follow the instructions or makes its own instructions to follow
- Gives you absolute bullshit[1] at times
- You are not as sneaky as you think you are
- And of course, **if you outsource the learning process to someone/something else, you don't learn**

[1] Hicks, M.T., Humphries, J. & Slater, J. Correction: ChatGPT is bullshit. Ethics Inf Technol 26, 46 (2024). https://doi.org/10.1007/s10676-024-09785-3

Example research areas...

- Cognitive modeling with LMs
- Linguistic capabilities of LMs
- Mechanistic Interpretability
- Using it for whatever and seeing what sticks

Think critically, like a (computational) linguist

Don't be reliant

Use with care and consideration

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