

What are Programming Paradigms?

PROGRAMMING PARADIGM CONCEPTS



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What is a paradigm?

- A standard, a perspective, or a set of ideas for operating
- A way of thinking about a topic or approaching a problem
- **Example:** the view that the Earth is round, and not flat.



What is a programming paradigm?

- **Program:** set of written instructions to tell a computer what to do
- **Programming paradigm:** style or way of approaching writing programs
- Can be used to classify programs based on their features
- Different programming paradigms for different tasks
- Examples:
 - Procedural programming
 - Functional programming
 - Object-oriented programming

What is a programming language?

- Programming languages vs. programming paradigms
- **Programming language:** a specific system of notation for writing programs
- **Examples:**
 - Python
 - Java
 - Scala
 - C++

Programming paradigms vs. programming languages

- Can have more than one programming *language* per programming *paradigm*
- New languages created for the same paradigm
- Also possible to have more than one programming *paradigm* per programming *language*
- Python can be used for procedural, functional, and object-oriented programming

Let's practice!

PROGRAMMING PARADIGM CONCEPTS

Imperative and Declarative Programming Paradigms

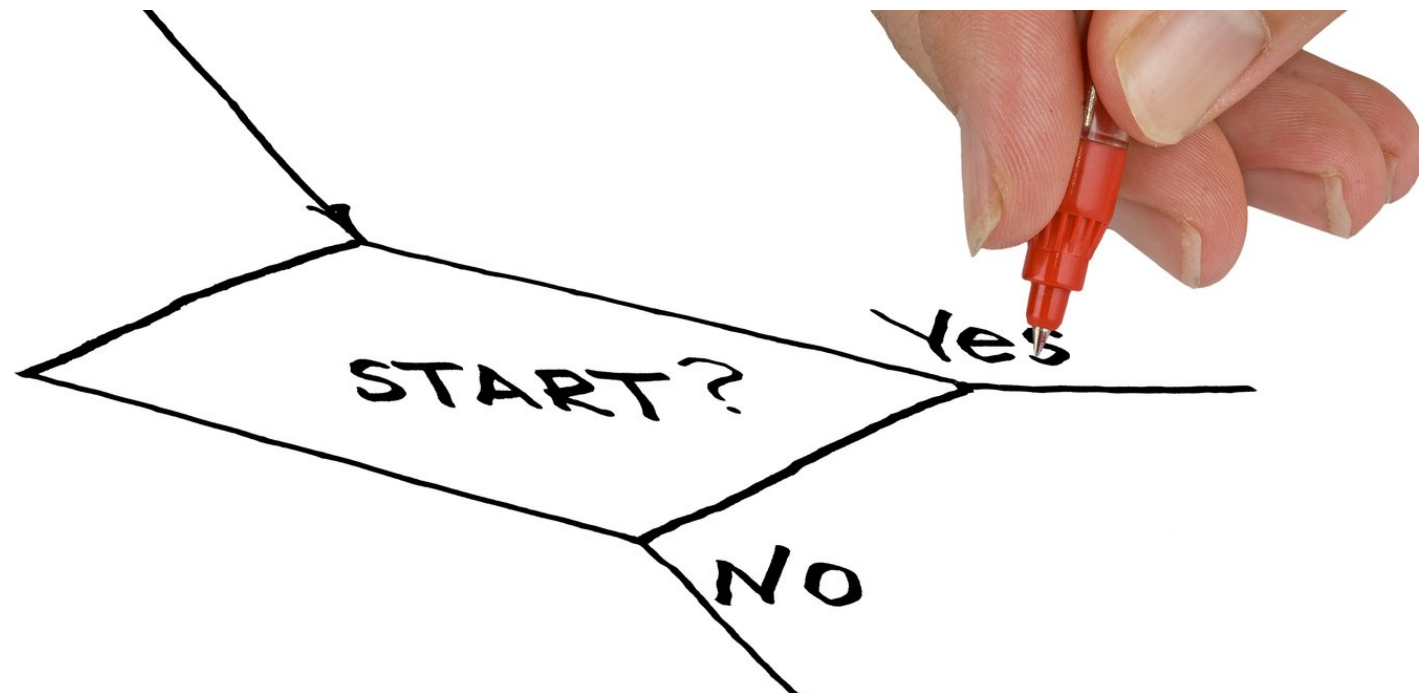
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Imperative and declarative programming

- Two broad categories: Imperative
 - Programmer spells out the exact instructions for the program to follow, step-by-step
 - *How* the program should execute
- ... and declarative
 - Programmer defines the logic of the program without details of the exact steps to follow
 - *What* the program should execute



Imperative programming

- Imperative programming is used in most mainstream programming languages
- Includes procedural and object-oriented programming
- More common because it is more similar to how a computer works
- *Note:* Procedural programming is a *type* of imperative programming, although the terms are sometimes used interchangeably



Declarative programming

- Less commonly used than imperative programming
- Functional programming is a type of declarative programming
- Declarative programming is also used in specific programming languages that are not general-purpose

**Functional
Programming**



...a type of

**Declarative
Programming**

Let's practice!

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Why do we need Programming Paradigms?

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Why do we need programming paradigms?

- Different problems are best solved with different approaches
- **Example:** Solve a Sudoku puzzle vs. Calculate annual revenue
- **Common goals:**
 - Accurate results
 - Reasonable time to run
 - Understandable code
- Paradigms mean having a *standard approach*
 - Saves time and effort

Benefits of modular code

- **Modular code:** code that is broken up into reusable sections that can be re-run or reused in different contexts
- Avoid rewriting identical code
- **Separation of responsibilities:** certain sections of code have distinct responsibilities and don't duplicate logic
- Important from the beginning, not just when the total amount of code becomes large
- Reduce chance of introducing bugs
- Save development time in the long run



Separation of responsibilities in different paradigms

- Each paradigm handles *separation of responsibilities* differently
- Procedural, functional, and object-oriented programming: broken down into *procedures*, *functions*, and *objects*

Procedures



Procedural
Programming

Functions



Functional
Programming

Objects



Object-Oriented
Programming

Modular code example

Original code

```
sum_values1 = 1 + 2
avg_values1 = sum_values1 / 2

sum_values2 = 3 + 4
avg_values2 = sum_values2 / 2
```

Modular code

```
def avg_two_values(x, y):
    sum_values = x + y
    avg_values = sum_values / 2
    return avg_values

avg_values1 = avg_two_values(1, 2)
avg_values2 = avg_two_values(3, 4)
```

Let's practice!

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