IMPERATIVE PROGRAMMING PARADIGM

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Topics

- Program state, instructions to change the program state
- Combining Algorithms and Data Structures
- Imperative Vs Declarative Programming
- Other Languages: PHP, Ruby, Perl, Swift
- Demo: Imperative Programming in Python

INTRODUCTION

- In a computer program, a **variable** stores the data. The contents of these locations at any given point in the program's execution are called the **program's state**. Imperative programming is characterized by **programming with state** and commands which **modify the state**.
- The first imperative programming languages were **machine languages.**

Machine Language

- Each instruction performs a very specific task, such as a load, a jump, or an ALU operation on a unit of data in a CPU register or memory. For example:
  - ***rs, rt,*** *and* ***rd*** *indicate register operands*
  - ***shamt*** *gives a shift amount*
  - *the* ***address*** *or* ***immediate*** *fields contain an operand directly*

So, adding the registers 1 and 2 and placing the result in register 6 is encoded:

[op | rs | rt | rd |shamt| funct]

0 1 2 6 0 32 decimal

000000 00001 00010 00110 00000 100000 binary

Assembly Code

- 10110000 01100001
- **Equivalent Assembly code**
- B0 61
  - *B0 - 'Move a copy of the following value into AL' (AL is a register)*
  - *61 is a hexadecimal representation of the value 01100001 – 97*
- **Intel assembly language**
- MOV AL, 61h; Load AL with 97 decimal (61 hex)

Other Languages

- **FORTRAN** (FORmula TRANslation) was the first high level language to gain wide acceptance. It was designed for **scientific applications** and featured an algebraic notation, types, subprograms, and formatted input/output.
- **COBOL** (COmmon Business Oriented Language) was designed at the initiative of the U. S. Department of Defence in 1959 and implemented in 1960 to meet the need for **business data processing applications.**
- **ALGOL 60** (ALGorithmic Oriented Language) was designed in 1960 by an international committee for use in **scientific problem solving**

Evolutionary developments

Algol to PL /I	PL / I to FORTRAN	COBOL to PL/I	LISP to PL/I
• Block structure • Control statements • Recursion	• Subprograms • Formatted IO	• File manipulation • Record	• Dynamic storage allocation • Linked structures

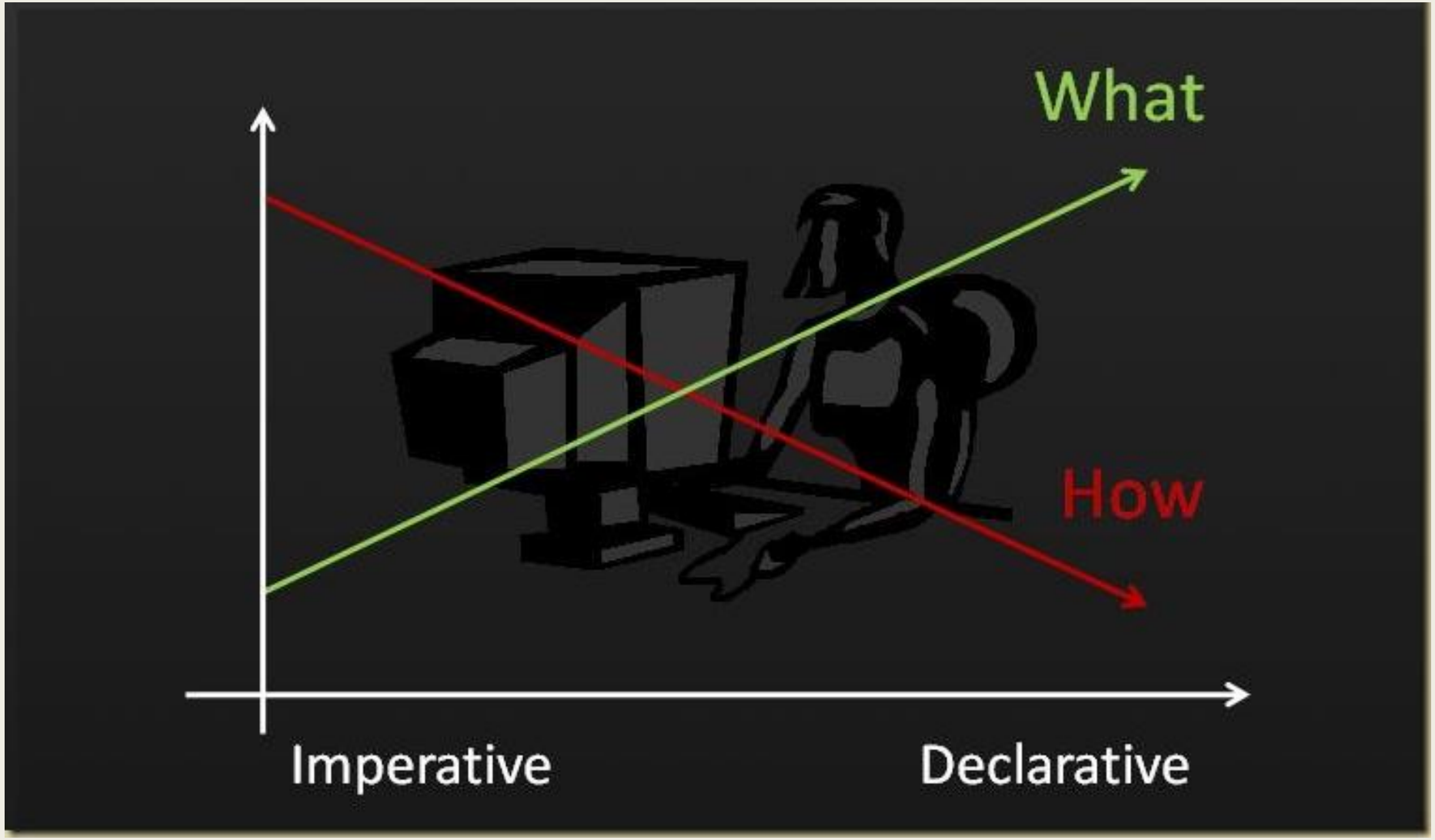
OVERVIEW

- In imperative programming, a name may be assigned to a value and later reassigned to another value.
- The collection of names and the associated values and the location of control in the program constitute the state.
- The state is a logical model of storage whichis an association between memory locations and values.
- A program in execution generates a sequence of states.
- The transition from one state to the next is determined by assignment operations and sequencing commands.

Highlights on

- Assignment,
- goto commands
- structured programming
- Command
- Statement
- Procedure
- Control-flow
- Imperative language
- Assertions
- Axiomatic semantics
- State
- Variables
- Instructions
- Control structures

Declarative Vs Imperative



Declarative Vs Imperative

Declarative

```
# Declarative
small_nums = [x for x in range(20) if x < 5]
```

Imperative

```
# Imperative
small = []
for i in range(20):
    if i < 5:
        small.append(i)
```

```
0
1
2
3
4
```

DEMO

An algorithm to add two numbers entered by user

Step 1: Start

Step 2: Declare variables num1, num2 and sum.

Step 3: Read values num1 and num2.

Step 4: Add num1 and num2 and assign the result to sum. sum←num1+num2

Step 5: Display sum

Step 6: Stop

Addition two numbers entered by user

```
num1 = 0
num2 = 0
sum = 0
num1 = input("Enter the First number ")
num2 = input("Enter the Second number ")
sum = int(num1) + int(num2)
print("\nSum:", sum)
```

```
Enter the First number 10

Enter the Second number 20

Sum: 30
```

An Algorithm to Get n number, print the same and find Sum of n numbers

Step 1: Start

Step 2: Declare variable sum = 0.

Step 3: Get the value of limit “n”.

Step 4: If limit is reached, goto Step 7 else goto Step 5

Step 5: Get the number from user and add it to sum

Step 6: Goto Step 4

Step 7: If limit is reached, goto Step 9 else goto Step 8

Step 8: Print the numbers

Step 9: Goto Step 7

Step 9: Display sum

Step 10: Stop

```python
sum = 0
num=[]
n = input("Enter the Total number of values ")
num = [ int(input("Enter value ")) for i in range(int(n))]
for i in range(int(n)):
    sum = sum + num[i]
print("\nYou have entered")
for i in range(int(n)):
    print(num[i])
print("..and the sum is", sum)
```

```
Enter the Total number of values 5

Enter value 55

Enter value 62

Enter value 12

Enter value 34

Enter value 20

You have entered
55
62
12
34
20
..and the sum is 183
```

```
Dict = {1: 'Song A', 2: 'Song B', 3: 'Song C'}

n=input("Select the number to play your favorite song ")
# accessing a element using key
print("You are listening to ")
print(Dict[int(n)])
```

```
Select the number to play your favorite song 3
You are listening to
Song C
```