Question 1(a) [3 marks]

What is the purpose of a for loop in Python? Write an example.

Answer:
A for loop is used to iterate over a sequence (like list, tuple, string) or other iterable objects and execute a block of code for each item in the sequence.

Code Example:

```
# Print each fruit in a list
fruits = ["apple", "banana", "cherry"]
for fruit in fruits:
    print(fruit)
```

- **Iteration**: Automatically repeats code for each item
- **Simplicity**: Cleaner than using while loops with counters

Mnemonic: "For Each Item Do"

Question 1(b) [4 marks]

List out rules for defining variables in python and list out data types in python.

Answer:

Rules for defining variables:

Rule	Example	Invalid Example
Must start with letter or underscore	`name = "John"`	`1name = "John"`
Can contain letters, numbers, underscores	`user_1 = "Alice"`	`user-1 = "Alice"`
Case-sensitive	`age` and `Age` are different	
Cannot use reserved keywords	`count = 5`	`if = 5`

Python Data Types:

Data Type	Description	Example
int	Integer numbers	`x = 10`
float	Decimal numbers	`y = 10.5`
str	Text strings	`name = "John"`
bool	Boolean values	`is_active = True`
list	Ordered, changeable collection	`fruits = ["apple", "banana"]`
tuple	Ordered, unchangeable collection	`coordinates = (10, 20)`
dict	Key-value pairs	`person = {"name": "John", "age": 30}`
set	Unordered collection of unique items	`numbers = {1, 2, 3}`

- **Variable rules**: Make them descriptive and meaningful
- **Data types**: Python automatically determines the type

Mnemonic: "SILB-DTS" (String, Integer, List, Boolean, Dictionary, Tuple, Set)

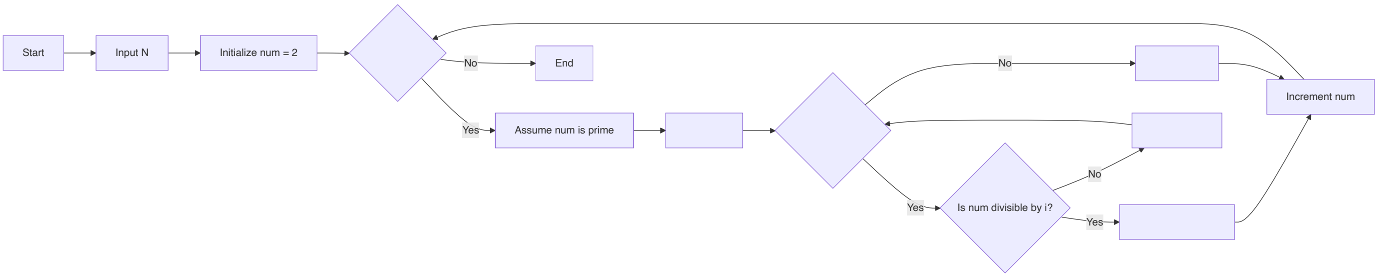
Question 1(c) [7 marks]

Create a program to print prime numbers between 1 to N.

Answer:

```
def print_primes(n):
    print("Prime numbers between 1 and", n, "are:")

    for num in range(2, n + 1):
        is_prime = True

        # Check if num is divisible by any number from 2 to sqrt(num)
        for i in range(2, int(num**0.5) + 1):
            if num % i == 0:
                is_prime = False
                break

        if is_prime:
            print(num, end=" ")

# Get input from user
N = int(input("Enter a number N: "))
print_primes(N)
```

Algorithm Diagram:



- **Time complexity**: O(N√N) - Optimized with square root approach
- **Space complexity**: O(1) - Only uses constant space

Mnemonic: "Divide To Decide Prime"

Question 1(c) OR [7 marks]

Explain working of break, continue and pass statement in Python with examples.

Answer:

Statement	Purpose	Example
break	Terminates the loop completely	Stop loop when condition met
continue	Skips current iteration, continues with next	Skip specific items
pass	Null operation, does nothing	Placeholder for future code

1. break statement:

```python
# Exit loop when finding number 5
for num in range(1, 10):
    if num == 5:
        print("Found 5, breaking loop")
        break
    print(num)
# Output: 1 2 3 4 Found 5, breaking loop
```

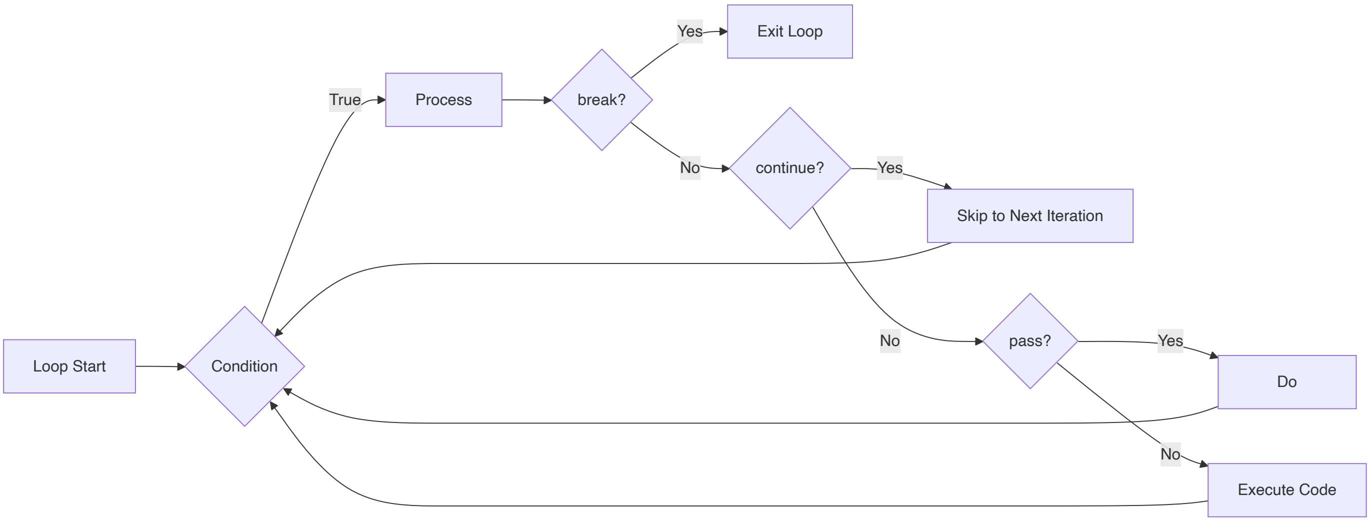
2. continue statement:

```python
# Skip even numbers
for num in range(1, 6):
    if num % 2 == 0:
        continue
    print(num)
# Output: 1 3 5
```

3. pass statement:

```python
# Empty function implementation
def my_function():
    pass

# Empty conditional block
x = 10
if x > 5:
    pass  # will implement later
```

Flow Control Diagram:



- **break**: Exits completely from the loop
- **continue**: Jumps to the next iteration
- **pass**: Does nothing, placeholder for future code

Mnemonic: "BCP - Break Completely, Continue Partially, Pass silently"

Question 2(a) [3 marks]

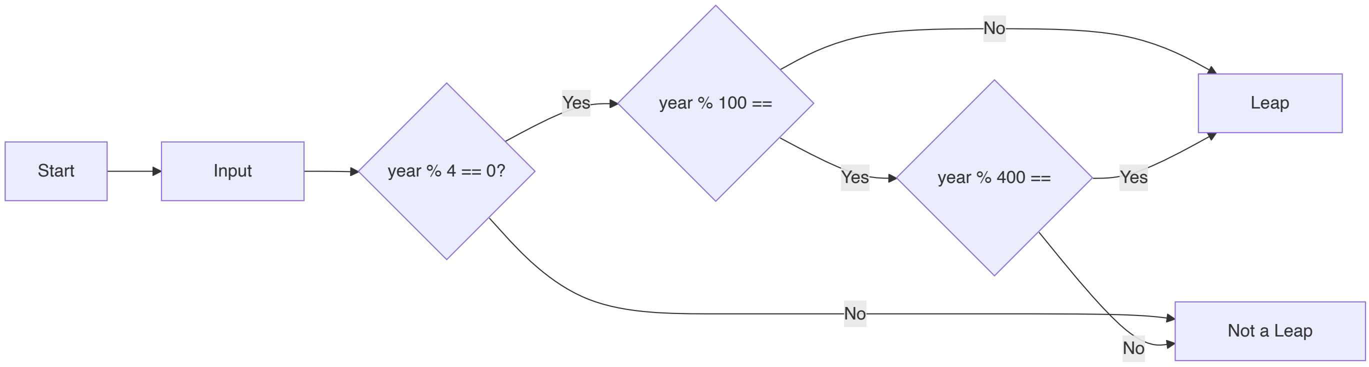
Create a program that asks the user for a year and prints out whether it is a leap year or not.

Answer:

```python
def is_leap_year(year):
    # A leap year is divisible by 4
    # But if it's divisible by 100, it must also be divisible by 400
    if (year % 4 == 0 and year % 100 != 0) or (year % 400 == 0):
        return True
    else:
        return False

# Get input from user
year = int(input("Enter a year: "))

# Check if it's a leap year
```

```
if is_leap_year(year):
    print(f"{year} is a leap year")
else:
    print(f"{year} is not a leap year")
```

Decision Tree:



- **Rule 1**: Divisible by 4, not by 100
- **Rule 2**: Or divisible by 400

Mnemonic: "4 Yes, 100 No, 400 Yes"

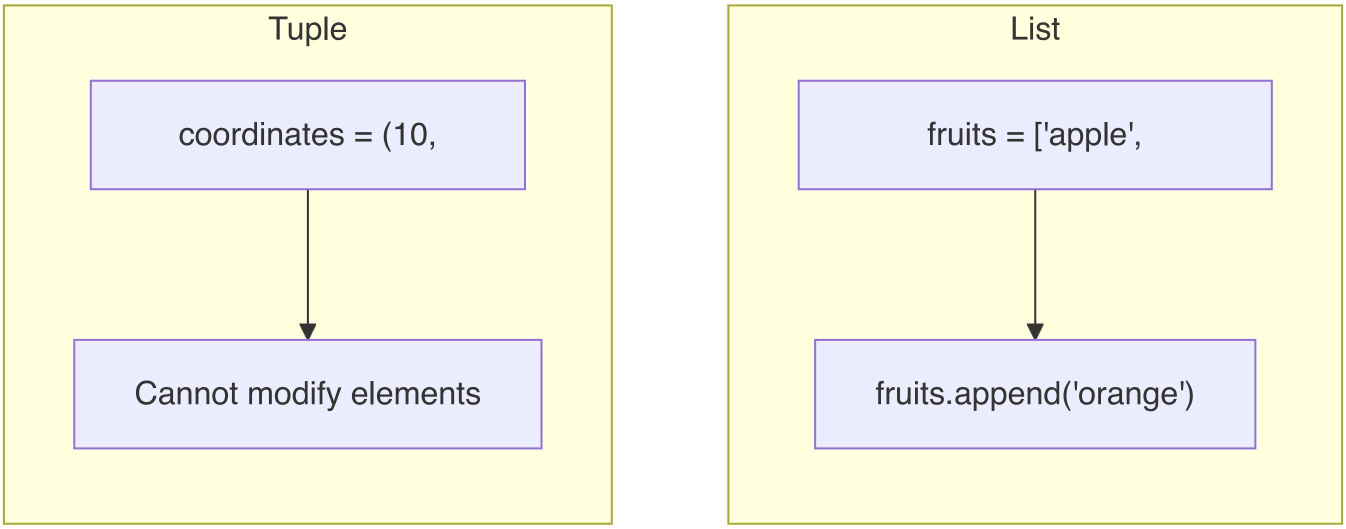
Question 2(b) [4 marks]

What are the key differences between a list and a tuple in Python?

Answer:

Feature	**List**	**Tuple**
Syntax	Created using `[]`	Created using `()`
Mutability	Mutable (can be changed)	Immutable (cannot be changed)
Methods	Many methods (append, remove, etc.)	Limited methods (count, index)
Performance	Slower	Faster
Use Case	When modification needed	When data shouldn't change
Memory	Uses more memory	Uses less memory

Comparison Diagram:



- **Lists**: When you need to modify the collection
- **Tuples**: When you need immutable data (faster, safer)

Mnemonic: "LIST - Lets Items Stay Transformable, TUPLE - Totally Unchangeable Permanent List Elements"

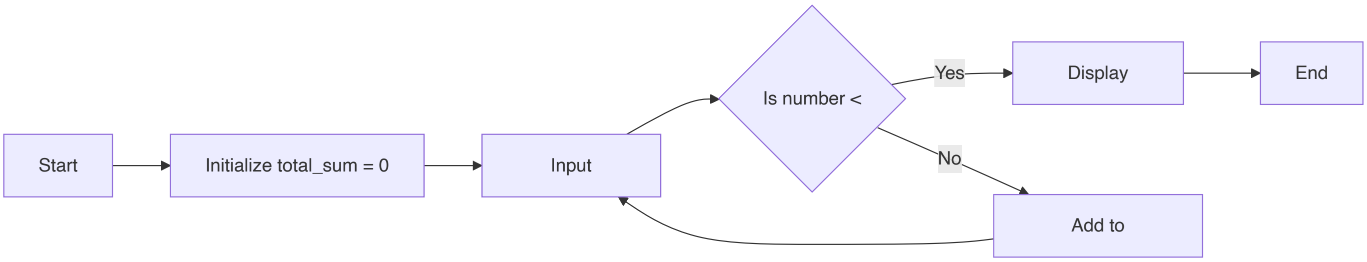
Question 2(c) [7 marks]

Create a program to find the sum of all the positive numbers entered by the user. As soon as the user enters a negative number, stop taking in any further input from the user and display the sum.

Answer:

```
def sum_positives():
    total_sum = 0

    while True:
        num = float(input("Enter a number (negative to stop): "))

        # Check if number is negative
        if num < 0:
            break

        # Add positive number to total
        total_sum += num

    print(f"Sum of all positive numbers: {total_sum}")

# Run the function
sum_positives()
```

Process Flow:



- **Loop control**: Terminates on negative input
- **Accumulator**: Adds each positive number to running total

Mnemonic: "Sum Till Negative"

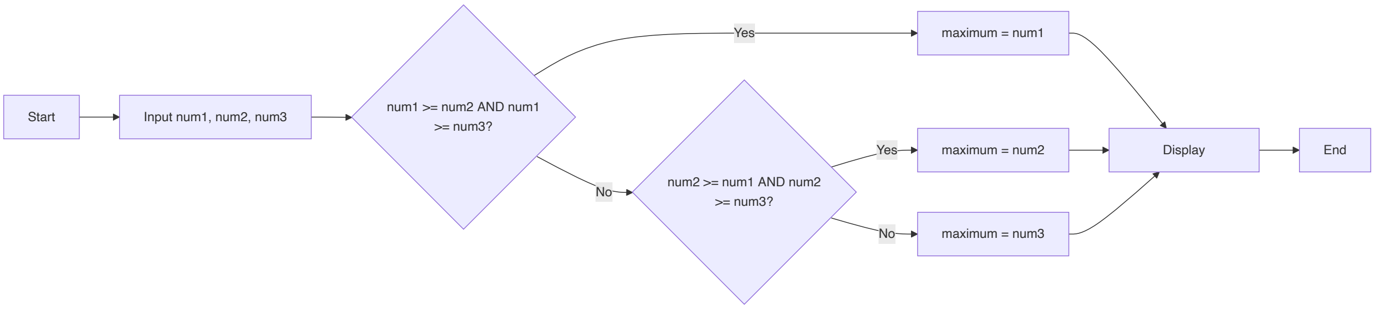
Question 2(a) OR [3 marks]

Create a program to find a maximum number among the given three numbers.

Answer:

```
# Get three numbers from user
num1 = float(input("Enter first number: "))
num2 = float(input("Enter second number: "))
num3 = float(input("Enter third number: "))

# Find maximum using if-else
if num1 >= num2 and num1 >= num3:
    maximum = num1
elif num2 >= num1 and num2 >= num3:
    maximum = num2
else:
    maximum = num3

print(f"Maximum number is: {maximum}")

# Alternative using built-in max() function
# maximum = max(num1, num2, num3)
# print(f"Maximum number is: {maximum}")
```

Comparison Logic:



- **Comparison**: Uses logical operators to find maximum

- **Alternative**: Built-in max() function for simplicity

Mnemonic: "Compare Each, Take Largest"

Question 2(b) OR [4 marks]

Given the str="abcdefghijklmnopqrstuvwxyz". Write a python program to extract every second character from above string.

Answer:

```
# Given string
str = "abcdefghijklmnopqrstuvwxyz"

# Extract every second character using slicing
# The syntax is [start:end:step]
# start=0 (beginning), end=len(str) (end of string), step=2 (every second character)
result = str[0::2]

print("Original string:", str)
print("Every second character:", result)
# Output: Every second character: acegikmoqsuwy
```

String Slicing Diagram:

```
+---+---+---+---+---+---+---+---+---+---+---+
| a | b | c | d | e | f | g | h | i | j | k |...
+---+---+---+---+---+---+---+---+---+---+---+
  ^       ^       ^       ^       ^
  |       |       |       |       |
  0       2       4       6       8   (indices)
```

- **String slicing**: [start🔚step] syntax
- **Step value**: 2 selects every second character

Mnemonic: "Slice Step Selector"

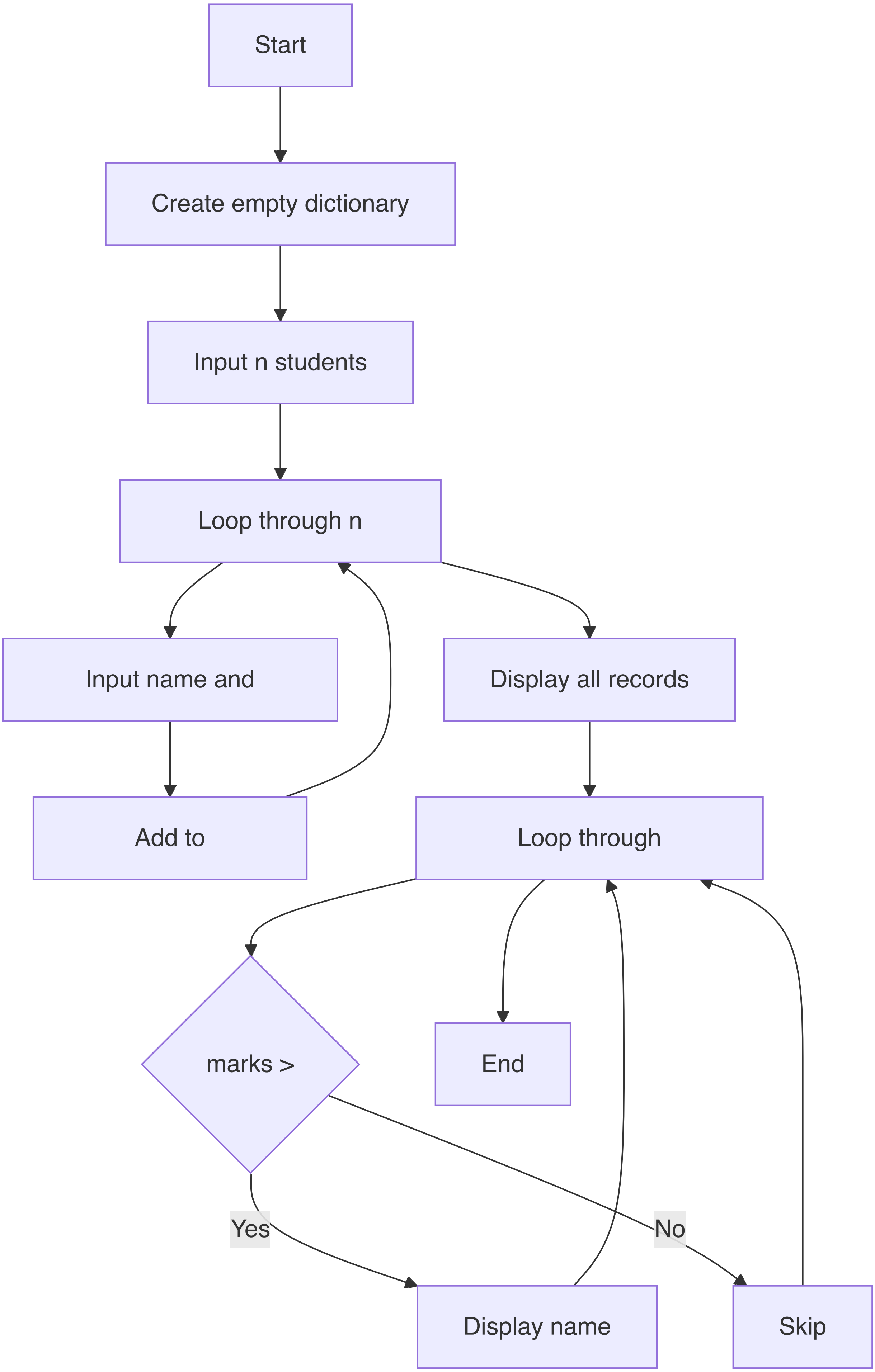
Question 2(c) OR [7 marks]

Write a Python program to create a dictionary that stores student names and their marks. Display the names of students who have scored more than 75 marks.

Answer:

```
def high_scorers():
    # Create empty dictionary
    students = {}

    # Get number of students
    n = int(input("Enter number of students: "))
    # Input student data
    for i in range(n):
        name = input(f"Enter name of student {i+1}: ")
        marks = float(input(f"Enter marks of student {i+1}: "))
        students[name] = marks

    # Display dictionary
    print("\nStudent Records:", students)

    # Display high scorers
    print("\nStudents who scored more than 75 marks:")
    for name, marks in students.items():
        if marks > 75:
            print(f"{name}: {marks}")

# Run the function
high_scorers()
```

Process Diagram:


Start
Create empty dictionary
Input n students
Loop through n
Input name and
Display all records
Add to
Loop through
marks >
End
Yes
No
Display name
Skip

- **Dictionary**: Key-value pairs of student names and marks
- **Conditional filtering**: Selects high scorers (>75)

Mnemonic: "Store All, Filter Some"

Question 3(a) [3 marks]

Write a program to find the length of a string excluding spaces.

Answer:

```
def length_without_spaces():
    # Get input string
    input_string = input("Enter a string: ")

    # Remove spaces and calculate length
    # Method 1: Using replace
    no_spaces = input_string.replace(" ", "")
    length = len(no_spaces)

    # Method 2: Using a counter
    # count = 0
    # for char in input_string:
    #     if char != " ":
    #         count += 1

    print(f"Original string: '{input_string}'")
    print(f"Length excluding spaces: {length}")

# Run the function
length_without_spaces()
```

String Processing:

```
"Hello World" → "HelloWorld" → Length: 10
```

- **Space removal**: Using replace() or filtering
- **String length**: Calculated after space removal

Mnemonic: "Count Characters, Skip Spaces"

Question 3(b) [4 marks]

List the dictionary methods in python and explain each with suitable examples.

Answer:

Method	Description	Example
`clear()`	Removes all items	`dict.clear()`
`copy()`	Returns a shallow copy	`new_dict = dict.copy()`
`get()`	Returns value for key	`value = dict.get('key', default)`
`items()`	Returns key-value pairs	`for k, v in dict.items():`
`keys()`	Returns all keys	`for k in dict.keys():`
`values()`	Returns all values	`for v in dict.values():`
`pop()`	Removes item with key	`value = dict.pop('key')`
`update()`	Updates dictionary	`dict.update({'key': value})`

Code Example:

```
student = {'name': 'John', 'age': 20, 'grade': 'A'}

# get method
print(student.get('name'))  # Output: John
print(student.get('city', 'Not found'))  # Output: Not found

# update method
student.update({'city': 'New York', 'grade': 'A+'})
print(student)  # {'name': 'John', 'age': 20, 'grade': 'A+', 'city': 'New York'}

# pop method
removed = student.pop('age')
print(removed)  # 20
print(student)  # {'name': 'John', 'grade': 'A+', 'city': 'New York'}
```

- **Access methods**: get(), keys(), values(), items()
- **Modification methods**: update(), pop(), clear()

Mnemonic: "GCUP-KPIV" (Get-Copy-Update-Pop, Keys-Pop-Items-Values)

Question 3(c) [7 marks]

Explain Python's List data type in detail.

Answer:

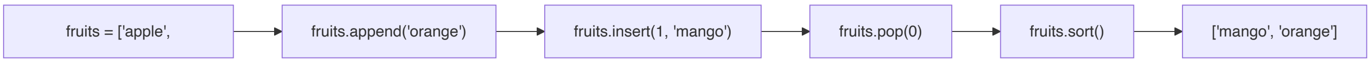
Python List: An ordered, mutable collection that can store items of different data types.

Feature	Description	Example
Creation	Using square brackets	`my_list = [1, 'hello', True]`
Indexing	Zero-based, negative indices	`my_list[0]`, `my_list[-1]`
Slicing	Extract parts	`my_list[1:3]`
Mutability	Can be modified	`my_list[0] = 10`
Methods	Many built-in methods	`append()`, `insert()`, `remove()`
Nesting	Lists within lists	`nested = [[1, 2], [3, 4]]`

Common List Methods:

Method	Purpose	Example
`append()`	Add item to end	`my_list.append(5)`
`insert()`	Add at position	`my_list.insert(1, 'new')`
`remove()`	Remove by value	`my_list.remove('hello')`
`pop()`	Remove by index	`my_list.pop(2)`
`sort()`	Sort list	`my_list.sort()`
`reverse()`	Reverse order	`my_list.reverse()`

List Operations Diagram:



- **Versatility**: Stores different data types in one collection
- **Dynamic sizing**: Grows or shrinks as needed

Mnemonic: "CAMP-IS" (Create, Access, Modify, Process, Index, Slice)

Question 3(a) OR [3 marks]

Write a program to input a string from the user and print it in the reverse order without creating a new string.

Answer:

```
def reverse_string():
    # Get input string
    input_string = input("Enter a string: ")

    # Print original string
    print(f"Original string: {input_string}")

    # Print reversed string using slice notation
    # The syntax is [start:end:step]
    # start=None (default), end=None (default), step=-1 (reverse)
    print(f"Reversed string: {input_string[::-1]}")

# Run the function
reverse_string()
```

String Reversing Visualization:

```
"Hello" → "olleH"

Indices:  0   1   2   3   4
String:   H   e   l   l   o
Reversed: o   l   l   e   H
Indices: -1  -2  -3  -4  -5
```

- **Slicing with negative step**: Reverses without new string
- **Efficient**: No extra memory used for new string

Mnemonic: "Slice Backwards"

Question 3(b) OR [4 marks]

List the dictionary operations in python and explain each with suitable examples.

Answer:

Operation	Description	Example
Creation	Create a new dictionary	`d = {'key': 'value'}`
Access	Access by key	`value = d['key']`
Assignment	Add or update items	`d['new_key'] = 'new_value'`
Deletion	Remove items	`del d['key']`
Membership	Check if key exists	`if 'key' in d:`
Length	Count items	`len(d)`
Iteration	Loop through items	`for key in d:`
Comprehension	Create new dict	`{x: x**2 for x in range(5)}`

Code Example:

```
# Creation
```

```python
student = {'name': 'John', 'age': 20}

# Access
print(student['name'])  # Output: John

# Assignment
student['grade'] = 'A'  # Add new key-value pair
student['age'] = 21     # Update existing value

# Membership test
if 'grade' in student:
    print("Grade exists")  # Will be printed

# Deletion
del student['age']
print(student)  # {'name': 'John', 'grade': 'A'}

# Dictionary comprehension
squares = {x: x**2 for x in range(1, 5)}
print(squares)  # {1: 1, 2: 4, 3: 9, 4: 16}
```

- **Key-based access**: Fast lookup by keys
- **Dynamic structure**: Add/remove items as needed

Mnemonic: "CADMIL" (Create, Access, Delete, Modify, Iterate, Length)

Question 3(c) OR [7 marks]

Explain Python's set data type in detail.

Answer:

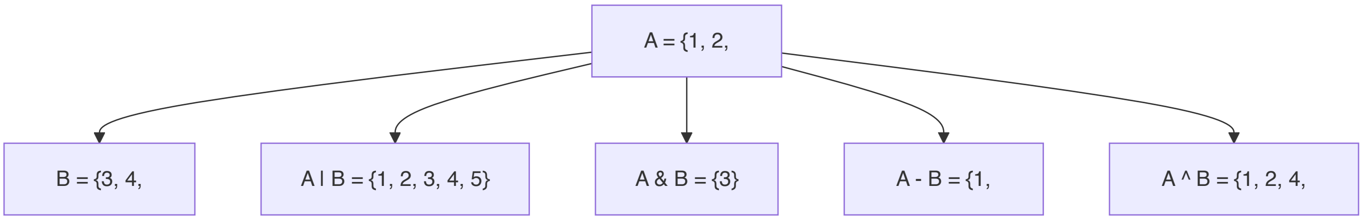
Python Set: An unordered collection of unique, immutable items.

Feature	Description	Example
Creation	Using curly braces or set()	`my_set = {1, 2, 3}` or `set([1, 2, 3])`
Uniqueness	No duplicates allowed	`{1, 2, 2, 3}` becomes `{1, 2, 3}`
Unordered	No indexing	Cannot use `my_set[0]`
Mutability	Set itself is mutable, but elements must be immutable	Can add/remove items
Math Operations	Set theory operations	union, intersection, difference
Use Cases	Remove duplicates, membership testing	Fast lookups

Common Set Operations:

Operation	Operator	Method	Description
Union	`|`	`union()`	All elements from both sets
Intersection	`&`	`intersection()`	Common elements
Difference	`-`	`difference()`	Elements in first but not second
Symmetric Difference	`^`	`symmetric_difference()`	Elements in either but not both

Set Operations Diagram:



- **Fast membership**: O(1) average time complexity
- **Mathematical operations**: Set theory operations built-in

Mnemonic: "SUMO" (Sets are Unique, Mutable, and Ordered-less)

Question 4(a) [3 marks]

Explain statistics module with any three methods.

Answer:

The statistics module provides functions for calculating mathematical statistics of numeric data.

Method	Description	Example
`mean()`	Arithmetic average	`statistics.mean([1, 2, 3, 4, 5])` returns 3.0
`median()`	Middle value	`statistics.median([1, 3, 5, 7, 9])` returns 5
`mode()`	Most common value	`statistics.mode([1, 2, 2, 3, 4])` returns 2
`stdev()`	Standard deviation	`statistics.stdev([1, 2, 3, 4, 5])` returns 1.58...

Code Example:

```
import statistics

data = [2, 5, 7, 9, 12, 13, 14, 5]

# Mean (average)
print("Mean:", statistics.mean(data))  # Output: 8.375

# Median (middle value)
print("Median:", statistics.median(data))  # Output: 8.0

# Mode (most frequent)
print("Mode:", statistics.mode(data))  # Output: 5
```

- **Data analysis**: Functions for statistical calculations
- **Built-in module**: No external installation needed

Mnemonic: "MMM Stats" (Mean, Median, Mode Statistics)

Question 4(b) [4 marks]

Explain function of user define function and user defined module in Python.

Answer:

Feature	User-defined Function	User-defined Module
Definition	Block of reusable code	Python file with functions/classes
Purpose	Code organization and reuse	Organizing related code
Creation	Using `def` keyword	Creating .py file
Usage	Call by function name	Import using `import` statement
Scope	Local to function	Accessible after import
Benefits	Reduces redundancy	Promotes code organization

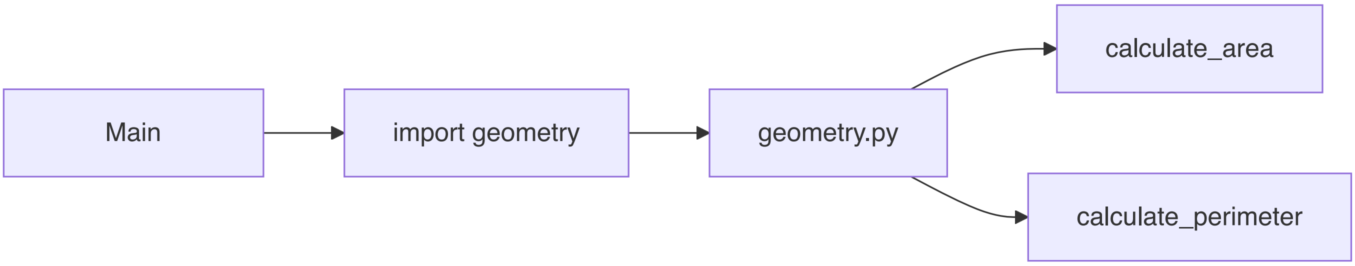
User-defined Function Example:

```
# Function definition
def calculate_area(length, width):
    """Calculate area of rectangle"""
    area = length * width
    return area

# Function call
result = calculate_area(5, 3)
print("Area:", result)  # Output: 15
```

User-defined Module Example:

```
# File: geometry.py
def calculate_area(length, width):
    return length * width

def calculate_perimeter(length, width):
    return 2 * (length + width)

# In another file
import geometry

area = geometry.calculate_area(5, 3)
print("Area:", area)  # Output: 15
```

Module Organization:



- **Function benefits**: Code reuse, modular design
- **Module benefits**: Organized code, namespace separation

Mnemonic: "FIR-MID" (Functions for Internal Reuse, Modules for Inter-file Distribution)

Question 4(c) [7 marks]

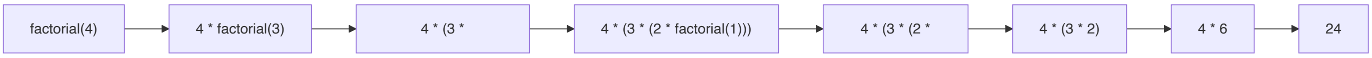
Write a Python code using user defined function to find the factorial of a given number using recursion.

Answer:

```
def factorial(n):
    """
    Calculate factorial of n using recursion
    n! = n * (n-1)!
    """
    # Base case: factorial of 0 or 1 is 1
    if n == 0 or n == 1:
        return 1

    # Recursive case: n! = n * (n-1)!
    else:
        return n * factorial(n-1)

# Get input from user
number = int(input("Enter a positive integer: "))
```

```python
# Check if input is valid
if number < 0:
    print("Factorial is not defined for negative numbers.")
else:
    # Calculate and display result
    result = factorial(number)
    print(f"Factorial of {number} is {result}")
```

Recursive Function Visualization:



- **Base case**: Stops recursion when n=0 or n=1
- **Recursive case**: Breaks problem into smaller subproblems

Mnemonic: "Factorial = Number times (Number minus one)!"

Question 4(a) OR [3 marks]

Explain math module with any three methods.

Answer:

The math module provides access to mathematical functions defined by the C standard.

Method	Description	Example
`math.sqrt()`	Square root	`math.sqrt(16)` returns 4.0
`math.pow()`	Power function	`math.pow(2, 3)` returns 8.0
`math.floor()`	Round down	`math.floor(4.7)` returns 4
`math.ceil()`	Round up	`math.ceil(4.2)` returns 5
`math.sin()`	Sine function	`math.sin(math.pi/2)` returns 1.0

Code Example:

```python
import math

# Square root
print("Square root of 25:", math.sqrt(25))  # Output: 5.0

# Power
print("2 raised to power 3:", math.pow(2, 3))  # Output: 8.0

# Constants
print("Value of pi:", math.pi)  # Output: 3.141592653589793
```

- **Mathematical operations**: Advanced math functions
- **Constants**: Mathematical constants like pi and e

Mnemonic: "SPT Math" (Square root, Power, Trigonometry in Math module)

Question 4(b) OR [4 marks]

Explain the concepts of global and local variables in Python.

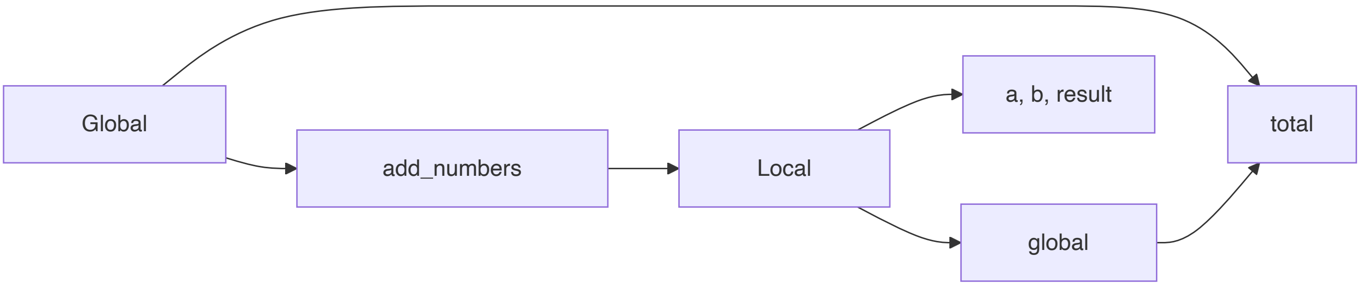
Answer:

Variable Type	Scope	Definition	Access
Local	Inside function	Defined within function	Only within the function
Global	Entire program	Defined outside functions	Anywhere in the program

Example:

```python
# Global variable
total = 0

def add_numbers(a, b):
    # Local variables
    result = a + b

    # Accessing global variable
    global total
    total += result

    return result

# Function call
sum_result = add_numbers(5, 3)
print("Sum:", sum_result)  # Output: 8
print("Total:", total)  # Output: 8
```

Variable Scope Diagram:



- **Global**: Accessible everywhere but needs `global` keyword to modify
- **Local**: Limited to function scope, freed after function execution

Mnemonic: "GLOBAL Goes Everywhere, LOCAL Lives in Functions"

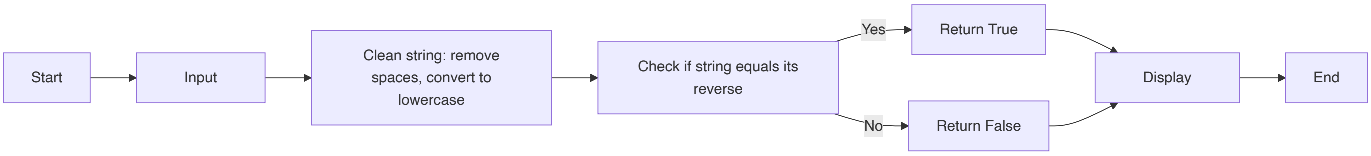
Question 4(c) OR [7 marks]

Create code with user defined function to check if given string is palindrome or not.

Answer:

```
def is_palindrome(text):
    """
    Check if a string is a palindrome.
    A palindrome reads the same forwards and backwards.
    """
    # Remove spaces and convert to lowercase
    cleaned_text = text.replace(" ", "").lower()

    # Check if the string equals its reverse
    return cleaned_text == cleaned_text[::-1]

def check_palindrome():
    # Get input from user
    input_string = input("Enter a string: ")

    # Check if it's a palindrome
    if is_palindrome(input_string):
        print(f"'{input_string}' is a palindrome!")
    else:
        print(f"'{input_string}' is not a palindrome.")

    # Examples for reference
    print("\nExamples of palindromes:")
    print("'radar' →", is_palindrome("radar"))
    print("'level' →", is_palindrome("level"))
    print("'A man a plan a canal Panama' →", is_palindrome("A man a plan a canal
Panama"))

# Run the function
check_palindrome()
```

Palindrome Testing Process:


Start
Input
Clean string: remove spaces, convert to lowercase
Check if string equals its reverse
Yes
Return True
No
Return False
Display
End

- **String cleaning**: Removes spaces, converts to lowercase
- **Comparison**: Checks against reversed string
- **Example palindromes**: "radar", "madam", "A man a plan a canal Panama"

Mnemonic: "Clean, Reverse, Compare"

Question 5(a) [3 marks]

Define class and object with example.

Answer:

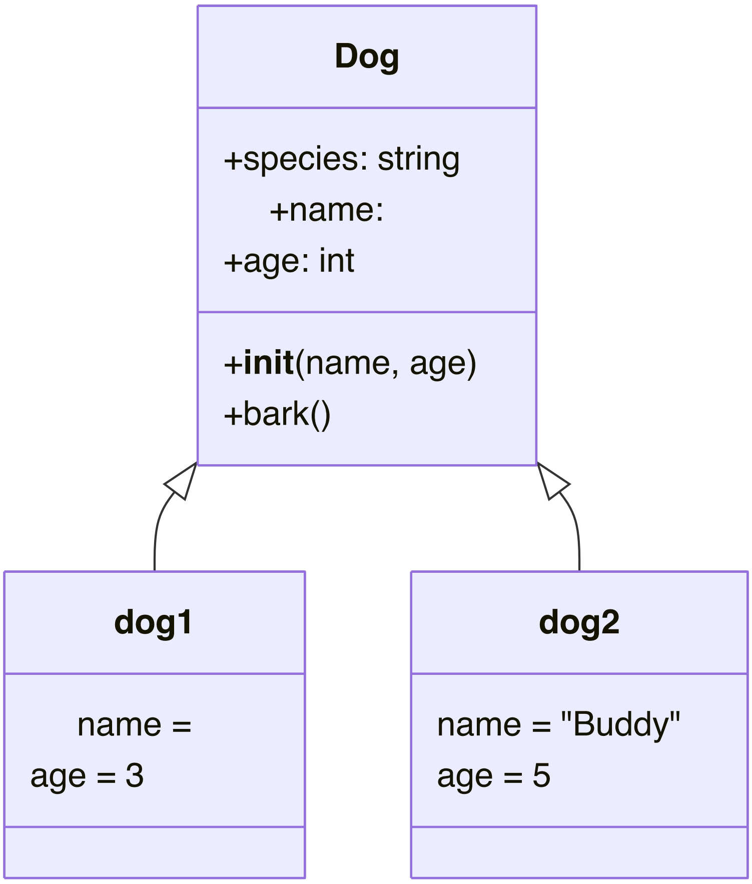
Class: A blueprint for creating objects that defines attributes and methods.

Object: An instance of a class with specific attribute values.

Code Example:

```python
# Class definition
class Dog:
    # Class attribute
    species = "Canis familiaris"

    # Constructor (initializes instance attributes)
    def __init__(self, name, age):
        self.name = name
        self.age = age

    # Instance method
    def bark(self):
        return f"{self.name} says Woof!"

# Creating objects (instances)
dog1 = Dog("Rex", 3)
dog2 = Dog("Buddy", 5)

# Accessing attributes and methods
print(dog1.name)  # Output: Rex
print(dog2.species)  # Output: Canis familiaris
print(dog1.bark())  # Output: Rex says Woof!
```

Class-Object Relationship:



- **Class**: Template with attributes and methods
- **Object**: Concrete instance with specific values

Mnemonic: "CAMBO" (Classes Are Molds, Build Objects)

Question 5(b) [4 marks]

Classify constructor. Explain any one in detail.

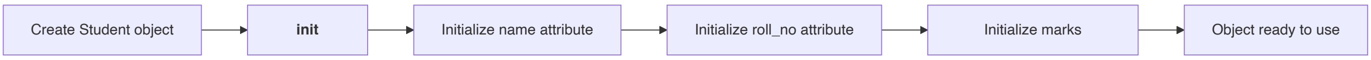
Answer:

Constructor Type	Description	When Used
Default constructor	Created by Python if none defined	Simple class creation
Parameterized constructor	Takes parameters to initialize	Customized object creation
Non-parameterized constructor	Takes no parameters	Basic initialization
Copy constructor	Creates object from existing object	Object duplication

Parameterized Constructor Example:

```python
class Student:
    # Parameterized constructor
    def __init__(self, name, roll_no, marks):
        self.name = name
        self.roll_no = roll_no
        self.marks = marks

    def display(self):
        print(f"Name: {self.name}, Roll No: {self.roll_no}, Marks: {self.marks}")

# Creating objects with parameters
student1 = Student("Alice", 101, 85)
student2 = Student("Bob", 102, 78)

# Displaying student information
student1.display()  # Output: Name: Alice, Roll No: 101, Marks: 85
student2.display()  # Output: Name: Bob, Roll No: 102, Marks: 78
```

Constructor Flow:



- **Purpose**: Initialize object attributes
- **Self parameter**: Reference to the instance being created
- **Automatic call**: Called when object is created

Mnemonic: "PICAN" (Parameters Initialize Constructor And Name)

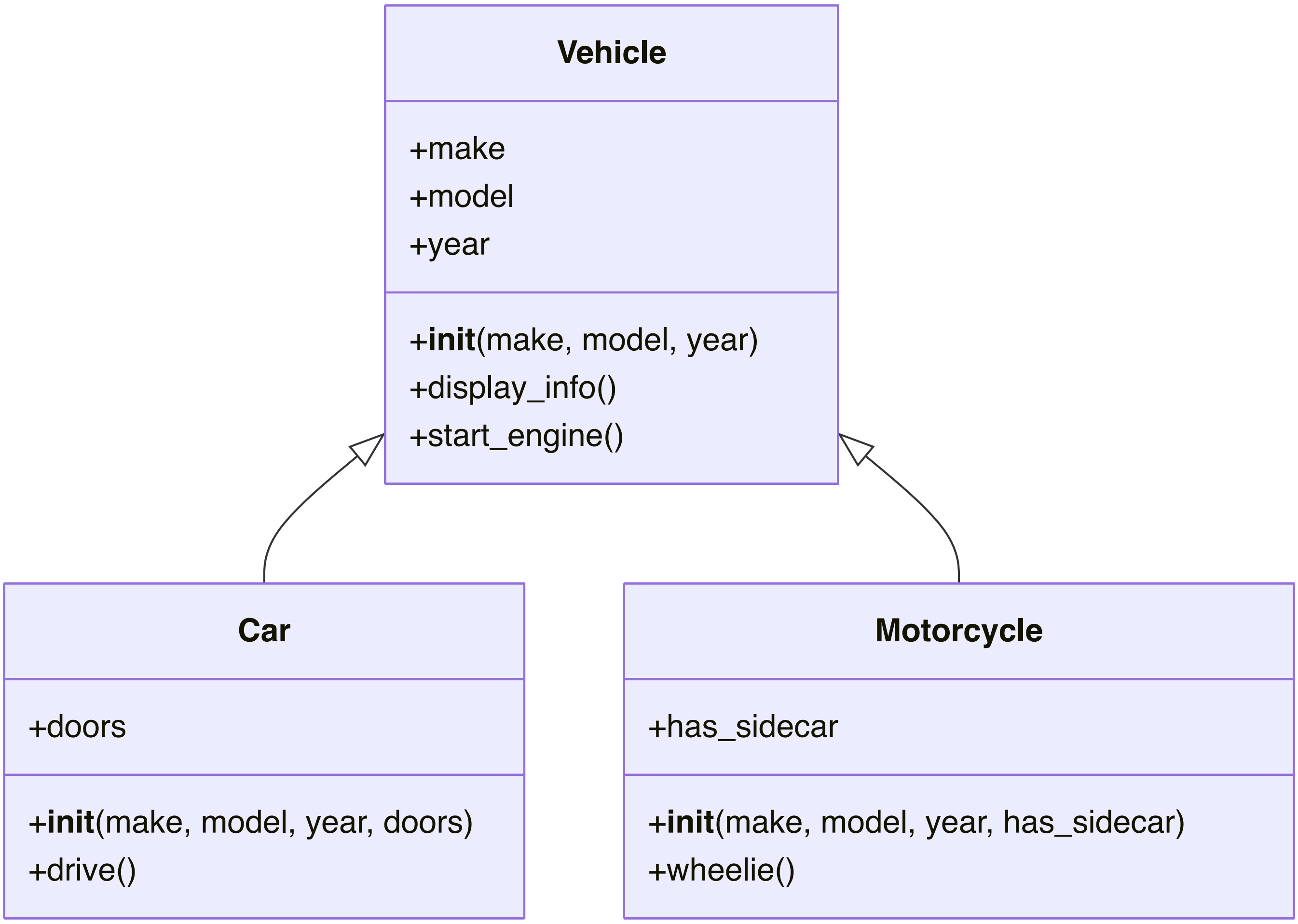
Question 5(c) [7 marks]

Develop and explain a python code to implement hierarchical inheritance.

Answer:

```python
# Base class
class Vehicle:
    def __init__(self, make, model, year):
        self.make = make
        self.model = model
        self.year = year

    def display_info(self):
        return f"{self.year} {self.make} {self.model}"

    def start_engine(self):
        return "Engine started!"

# Derived class 1
class Car(Vehicle):
    def __init__(self, make, model, year, doors):
        # Call parent class constructor
        super().__init__(make, model, year)
        self.doors = doors

    def drive(self):
        return "Car is being driven!"

# Derived class 2
class Motorcycle(Vehicle):
    def __init__(self, make, model, year, has_sidecar):
        # Call parent class constructor
        super().__init__(make, model, year)
        self.has_sidecar = has_sidecar

    def wheelie(self):
        if not self.has_sidecar:
            return "Performing wheelie!"
        else:
            return "Cannot perform wheelie with sidecar!"

# Create objects
car = Car("Toyota", "Corolla", 2023, 4)
motorcycle = Motorcycle("Honda", "CBR", 2024, False)

# Use methods from parent class
print(car.display_info())  # Output: 2023 Toyota Corolla
print(motorcycle.start_engine())  # Output: Engine started!

# Use methods from specific classes
print(car.drive())  # Output: Car is being driven!
print(motorcycle.wheelie())  # Output: Performing wheelie!
```

Hierarchical Inheritance Diagram:



- **Base class**: Common attributes/methods for all vehicles
- **Derived classes**: Specialized behaviors for specific vehicle types
- **Method inheritance**: Child classes inherit parent class methods

Mnemonic: "Parents Share, Children Specialize"

Question 5(a) OR [3 marks]

What is the init method in Python? Explain its purpose with a suitable example.

Answer:

The `__init__` method is a special method (constructor) in Python classes that is automatically called when an object is created.

Purpose:

1. Initialize object attributes
2. Set up the initial state of the object
3. Execute code that must run when object is created

Example:

```
class Rectangle:
    def __init__(self, length, width):
        # Initialize attributes
        self.length = length
        self.width = width
        self.area = length * width  # Calculated attribute

        # Print confirmation message
        print(f"Rectangle created with dimensions {length}x{width}")

    def display(self):
        return f"Rectangle: {self.length}x{self.width}, Area: {self.area}"

# Create rectangle objects
rect1 = Rectangle(5, 3)  # __init__ called automatically
rect2 = Rectangle(10, 2)  # __init__ called automatically

# Display information
print(rect1.display())
print(rect2.display())
```

- **Automatic execution**: Called when object is created
- **Self parameter**: References the current instance
- **Multiple parameters**: Can accept any number of arguments

Mnemonic: "ASAP" (Attributes Set At Production)

Question 5(b) OR [4 marks]

Classify methods in Python class. Explain any one in detail.

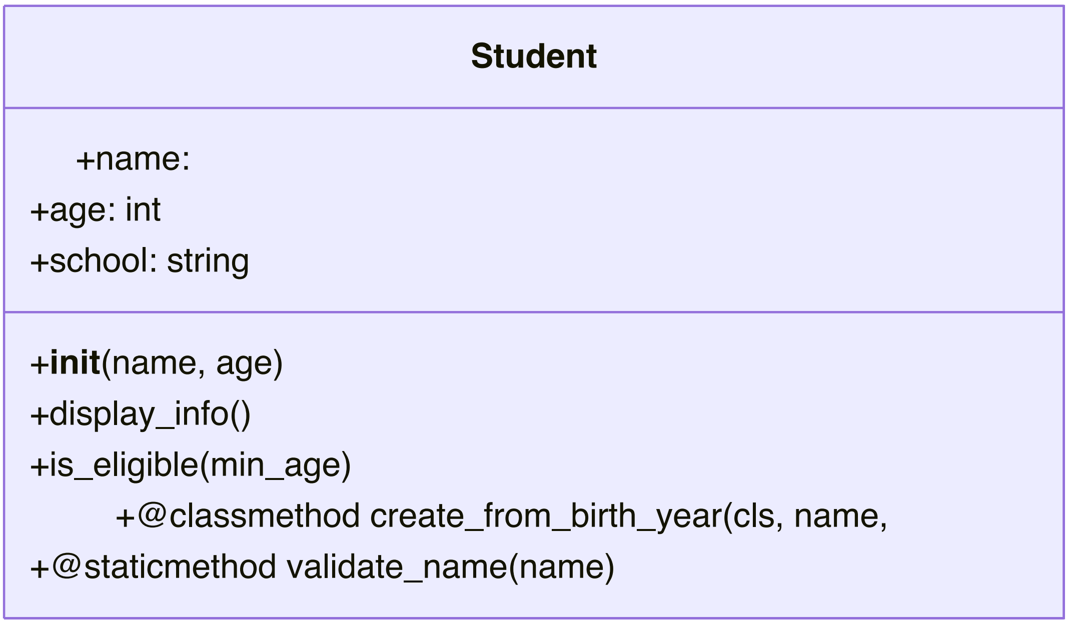
Answer:

Method Type	Description	Definition
Instance Method	Operates on object instance	Regular method with `self`
Class Method	Operates on class itself	Decorated with `@classmethod`
Static Method	Doesn't need class or instance	Decorated with `@staticmethod`
Magic/Dunder Method	Special built-in methods	Surrounded by double underscores

Instance Method Example:

```
class Student:
    # Class variable
    school = "ABC School"

    def __init__(self, name, age):
        # Instance variables
        self.name = name
        self.age = age

    # Instance method - operates on instance
    def display_info(self):
        return f"Name: {self.name}, Age: {self.age}, School: {self.school}"

    # Instance method with parameter
    def is_eligible(self, min_age):
        return self.age >= min_age

# Create object
student = Student("John", 15)

# Call instance methods
print(student.display_info())  # Output: Name: John, Age: 15, School: ABC School
print(student.is_eligible(16))  # Output: False
```

Method Classification:



- **Instance methods**: Access and modify object state
- **Self parameter**: Reference to the instance
- **Object-specific**: Results depend on the instance state

Mnemonic: "SIAM" (Self Is Always Mentioned in instance methods)

Question 5(c) OR [7 marks]

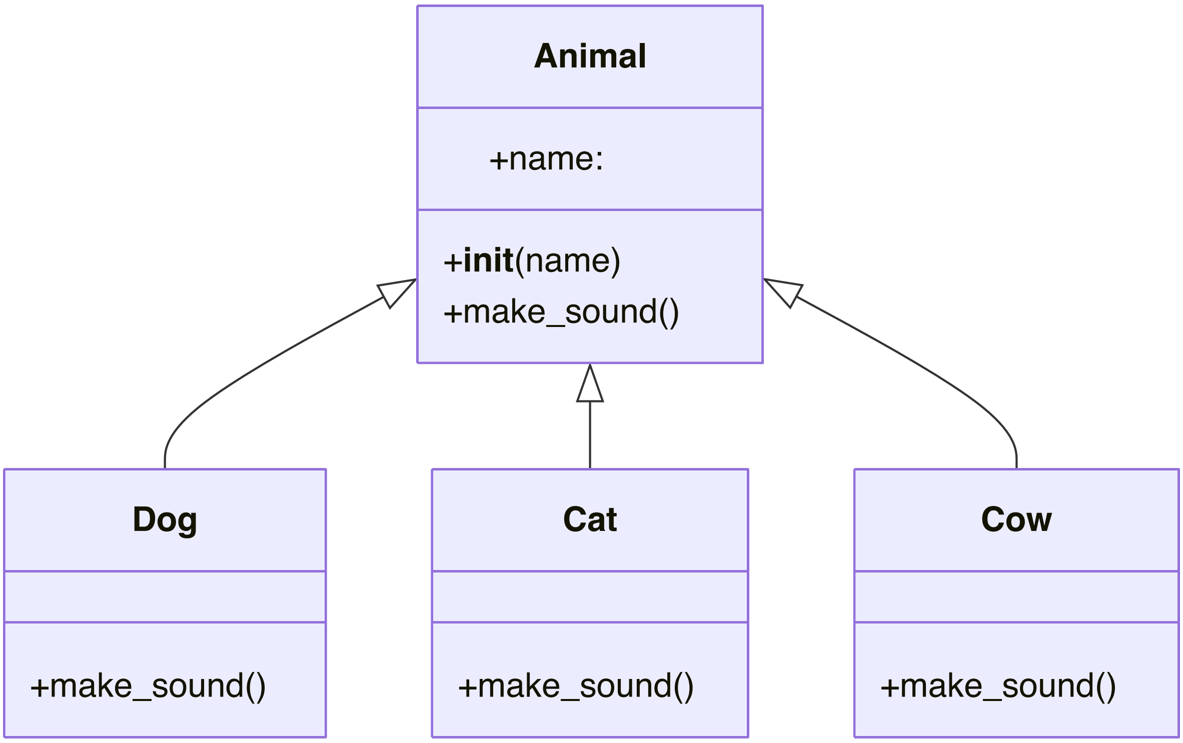
Develop a Python code for Polymorphism and explain it.

Answer:

```
# Base class
```

```python
class Animal:
    def __init__(self, name):
        self.name = name

    def make_sound(self):
        # Generic sound - will be overridden by subclasses
        return "Some generic sound"

# Derived class 1
class Dog(Animal):
    def make_sound(self):
        # Override base class method
        return "Woof!"

# Derived class 2
class Cat(Animal):
    def make_sound(self):
        # Override base class method
        return "Meow!"

# Derived class 3
class Cow(Animal):
    def make_sound(self):
        # Override base class method
        return "Moo!"

# Function using polymorphism
def animal_sound(animal):
    # Same function works for any Animal subclass
    return animal.make_sound()

# Create objects of different classes
dog = Dog("Rex")
cat = Cat("Whiskers")
cow = Cow("Daisy")

# Demonstrate polymorphism
animals = [dog, cat, cow]
for animal in animals:
    print(f"{animal.name} says: {animal_sound(animal)}")

# Output:
# Rex says: Woof!
# Whiskers says: Meow!
# Daisy says: Moo!
```

Polymorphism Diagram:



- **Method overriding**: Subclasses implement their own versions
- **Single interface**: Same method name for different behavior
- **Flexibility**: Code works with any class in the hierarchy
- **Dynamic binding**: Correct method called based on object type

Mnemonic: "Same Method, Different Behavior"