Question 1(a) [3 marks]

What is Dictionary? Explain with example.

Answer:

Dictionary એ Python માં key-value pairs નો collection છે જે mutable અને ordered હોય છે.

Table: Dictionary Properties

Property	Description
Mutable	Values ને change કરી શકાય છે
Ordered	Python 3.7+ માં insertion order maintain રહે છે
Indexed	Keys દ્વારા access કરાય છે
No Duplicates	Duplicate keys allow નથી

```
# Dictionary Example
student = {
    "name": "Raj",
    "age": 20,
    "course": "IT"
}
print(student["name"])  # Output: Raj
```

- **Key-Value Structure**: દરેક element માં key અને value હોય છે
- **Fast Access**: O(1) time complexity માં data access
- **Dynamic Size**: Runtime માં size વધારી-ઘટાડી શકાય છે

Mnemonic: "Dictionary = Key Value Treasure"

Question 1(b) [4 marks]

Explain Tuple Built-in functions and methods.

Answer:

Tuple માં limited built-in methods છે કારણ કે તે immutable છે.

Table: Tuple Methods

Method	Description	Example
count()	Element ની frequency return કરે છે	`t.count(5)`
index()	Element નું first index return કરે છે	`t.index('a')`
len()	Tuple નું length return કરે છે	`len(t)`
max()	Maximum value return કરે છે	`max(t)`
min()	Minimum value return કરે છે	`min(t)`

```
# Tuple Methods Example
numbers = (1, 2, 3, 2, 4, 2)
print(numbers.count(2))     # Output: 3
print(numbers.index(3))     # Output: 2
print(len(numbers))         # Output: 6
```

- **Immutable Nature**: Methods tuple ને modify નથી કરતા
- **Return Values**: બધા methods નવી values return કરે છે
- **Type Conversion**: tuple() function થી list ને tuple માં convert કરી શકાય

Mnemonic: "Count Index Length Max Min"

Question 1(c) [7 marks]

Write a python program to demonstrate set operations.

Answer:

Set operations mathematics ના set theory પર આધારિત છે.

Table: Set Operations

Operation	Symbol	Method	Description
Union	`|`	`union()`	બન્ને sets ના elements
Intersection	`&`	`intersection()`	Common elements
Difference	`-`	`difference()`	First set માંથી second ને minus
Symmetric Difference	`^`	`symmetric_difference()`	Unique elements only

```
# Set Operations Program
set1 = {1, 2, 3, 4, 5}
set2 = {4, 5, 6, 7, 8}

print("Set 1:", set1)
print("Set 2:", set2)
```

```python
# Union Operation
union_result = set1 | set2
print("Union:", union_result)

# Intersection Operation
intersection_result = set1 & set2
print("Intersection:", intersection_result)

# Difference Operation
difference_result = set1 - set2
print("Difference:", difference_result)

# Symmetric Difference
sym_diff_result = set1 ^ set2
print("Symmetric Difference:", sym_diff_result)

# Subset and Superset
set3 = {1, 2}
print("Is set3 subset of set1?", set3.issubset(set1))
print("Is set1 superset of set3?", set1.issuperset(set3))
```

- **Mathematical Operations**: Set theory ના operations implement કરે છે
- **Efficient Processing**: Duplicate elements automatically remove થાય છે
- **Boolean Results**: Subset/superset operations boolean return કરે છે

Mnemonic: "Union Intersection Difference Symmetric"

Question 1(c OR) [7 marks]

Write a python program to demonstrate the dictionaries functions and operations.

Answer:

Dictionary operations data manipulation માટે powerful tools પ્રદાન કરે છે.

Table: Dictionary Methods

Method	Description	Example
keys()	બધી keys return કરે છે	`dict.keys()`
values()	બધા values return કરે છે	`dict.values()`
items()	Key-value pairs return કરે છે	`dict.items()`
get()	Safe value retrieval	`dict.get('key')`
update()	Dictionary merge કરે છે	`dict.update()`

```python
# Dictionary Operations Program
```

```python
student_data = {
    "name": "Amit",
    "age": 21,
    "course": "IT",
    "semester": 2
}

print("Original Dictionary:", student_data)

# Accessing values
print("Student Name:", student_data.get("name"))
print("Student Age:", student_data["age"])

# Adding new key-value pair
student_data["city"] = "Ahmedabad"
print("After adding city:", student_data)

# Updating existing value
student_data.update({"age": 22, "semester": 3})
print("After update:", student_data)

# Dictionary methods
print("Keys:", list(student_data.keys()))
print("Values:", list(student_data.values()))
print("Items:", list(student_data.items()))

# Removing elements
removed_value = student_data.pop("semester")
print("Removed value:", removed_value)
print("Final Dictionary:", student_data)
```

- **Dynamic Operations**: Runtime માં keys અને values add/remove કરી શકાય
- **Safe Access**: get() method KeyError prevent કરે છે
- **Iteration Support**: keys(), values(), items() methods loop માટે useful

Mnemonic: "Get Keys Values Items Update Pop"

Question 2(a) [3 marks]

Distinguish between Tuple and List in Python.

Answer:

Table: Tuple vs List Comparison

Feature	Tuple	List
Mutability	Immutable (cannot change)	Mutable (can change)
Syntax	Parentheses `()`	Square brackets `[]`
Performance	Faster	Slower
Memory	Less memory	More memory
Methods	Limited (count, index)	Many methods available
Use Case	Fixed data	Dynamic data

- **Immutable Nature**: Tuple એકવાર create થયા પછી change થઈ શકતું નથી
- **Performance**: Tuple operations list કરતાં fast છે
- **Memory Efficient**: Tuple ઓછી memory વાપરે છે

Mnemonic: "Tuple Tight, List Light"

Question 2(b) [4 marks]

What is the dir() function in python? Explain with example.

Answer:

dir() function એ built-in function છે જે object ના attributes અને methods ની list return કરે છે.

Table: dir() Function Features

Feature	Description
Object Inspection	Object ના attributes show કરે છે
Method Discovery	Available methods list કરે છે
Namespace Exploration	Current namespace ના variables show કરે છે
Module Analysis	Module ના contents explore કરે છે

```
# dir() Function Example
# For string object
text = "Hello"
string_methods = dir(text)
print("String methods:", string_methods[:5])

# For list object
my_list = [1, 2, 3]
list_methods = dir(my_list)
print("List methods:", [m for m in list_methods if not m.startswith('_')][:5])
```

```
# For current namespace
print("Current namespace:", dir()[:3])

# For built-in functions
import math
print("Math module:", dir(math)[:5])
```

- **Interactive Development**: Objects ના capabilities જાણવા માટે useful
- **Debugging Tool**: Available methods quickly identify કરવા માટે
- **Learning Aid**: New libraries explore કરવા માટે helpful

Mnemonic: "Dir = Directory of Methods"

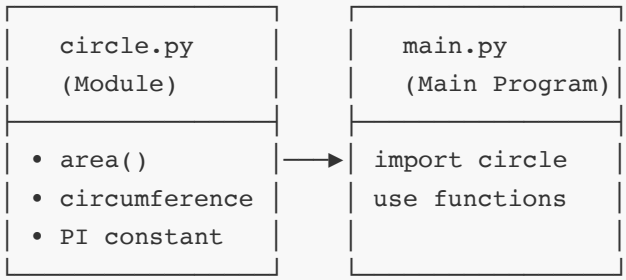
Question 2(c) [7 marks]

Write a program to define a module to find the area and circumference of a circle. Import module to another program.

Answer:

Module approach code reusability અને organization improve કરે છે.

Diagram: Module Structure



File 1: circle.py (Module)

```
# circle.py - Circle calculation module
import math

# Constants
PI = math.pi

def area(radius):
    """Calculate area of circle"""
    if radius < 0:
        return "Radius cannot be negative"
    return PI * radius * radius

def circumference(radius):
```

```
    """Calculate circumference of circle"""
    if radius < 0:
        return "Radius cannot be negative"
    return 2 * PI * radius

def display_info():
    """Display module information"""
    print("Circle Module - Version 1.0")
    print("Functions: area(), circumference()")
```

File 2: main.py (Main Program)

```
# main.py - Main program using circle module
import circle

# Get radius from user
radius = float(input("Enter radius: "))

# Calculate using module functions
circle_area = circle.area(radius)
circle_circumference = circle.circumference(radius)

# Display results
print(f"Circle with radius {radius}:")
print(f"Area: {circle_area:.2f}")
print(f"Circumference: {circle_circumference:.2f}")

# Display module info
circle.display_info()
```

- **Modular Design**: Functions ને separate file માં organize કરે છે
- **Reusability**: Module ને multiple programs માં use કરી શકાય
- **Namespace Management**: Module prefix થી function access કરાય છે

Mnemonic: "Import Calculate Display"

Question 2(a OR) [3 marks]

Explain Nested Tuple with example.

Answer:

Nested Tuple એ tuple અંદર બીજા tuples હોય છે, જે hierarchical data structure બનાવે છે.

Table: Nested Tuple Features

Feature	Description
Multi-dimensional	2D અથવા 3D data structure
Immutable	બધા levels પર immutable
Indexing	Multiple square brackets વાપરીને access
Heterogeneous	Different data types store કરી શકાય

```
# Nested Tuple Example
student_records = (
    ("Raj", 20, ("IT", 2)),
    ("Priya", 19, ("CS", 1)),
    ("Amit", 21, ("IT", 3))
)

# Accessing nested elements
print("First student:", student_records[0])
print("First student name:", student_records[0][0])
print("First student course:", student_records[0][2][0])

# Iterating through nested tuple
for student in student_records:
    name, age, (course, semester) = student
    print(f"{name} - Age: {age}, Course: {course}, Sem: {semester}")
```

- **Data Organization**: Related data ને group કરવા માટે useful
- **Immutable Structure**: એકવાર create થયા પછી structure change થઈ શકતું નથી
- **Efficient Access**: Index-based fast access

Mnemonic: "Nested = Tuple Inside Tuple"

Question 2(b OR) [4 marks]

What is PIP? Write the syntax to install and uninstall python packages.

Answer:

PIP (Pip Installs Packages) એ Python package installer છે જે PyPI થી packages download અને install કરે છે.

Table: PIP Commands

Command	Syntax	Description
Install	`pip install package_name`	Package install કરે છે
Uninstall	`pip uninstall package_name`	Package remove કરે છે
List	`pip list`	Installed packages show કરે છે
Show	`pip show package_name`	Package info display કરે છે
Upgrade	`pip install --upgrade package_name`	Package update કરે છે

```
# PIP Command Examples (Terminal/Command Prompt માં run કરવા)

# Install a package
# pip install requests

# Install specific version
# pip install Django==3.2.0

# Uninstall a package
# pip uninstall numpy

# List all installed packages
# pip list

# Show package information
# pip show matplotlib

# Upgrade a package
# pip install --upgrade pandas

# Install from requirements file
# pip install -r requirements.txt
```

- **Package Management**: Third-party libraries easily manage કરી શકાય
- **Version Control**: Specific versions install કરી શકાય
- **Dependency Resolution**: Required dependencies automatically install થાય

Mnemonic: "PIP = Package Install Python"

Question 2(c OR) [7 marks]

Explain different ways of importing package. How are modules and packages connected to each other?

Answer:

Python માં imports ના વિવિધ ways છે જે code organization અને namespace management માટે important છે.

Diagram: Package Structure

```
MyPackage/
├── __init__.py
├── module1.py
├── module2.py
└── subpackage/
    ├── __init__.py
    └── module3.py
```

Table: Import Methods

Method	Syntax	Usage
Basic Import	`import module`	Full module name required
From Import	`from module import function`	Direct function access
Alias Import	`import module as alias`	Short name for module
Star Import	`from module import *`	Import all functions
Package Import	`from package import module`	Import from package

```python
# Different Import Ways

# 1. Basic Import
import math
result = math.sqrt(16)

# 2. From Import
from math import sqrt, pi
result = sqrt(16)
area = pi * 5 * 5

# 3. Alias Import
import numpy as np
array = np.array([1, 2, 3])

# 4. Star Import (not recommended)
from math import *
result = cos(0)

# 5. Package Import
from mypackage import module1
from mypackage.subpackage import module3

# 6. Relative Import (within package)
# from . import module1
# from ..parent_module import function
```

Module-Package Connection:

- **Modules**: Single .py files containing Python code
- **Packages**: Directories containing multiple modules with __init__.py
- **Namespace**: Packages create hierarchical namespace structure
- **init.py**: Makes directory a package and controls imports

Mnemonic: "Import From As Star Package"

Question 3(a) [3 marks]

Describe Runtime Error and Syntax Error. Explain with example.

Answer:

Table: Error Types Comparison

Error Type	When Occurs	Detection	Example
Syntax Error	Code parsing time	Before execution	Missing colon, brackets
Runtime Error	During execution	While running	Division by zero, file not found
Logic Error	Always	After execution	Wrong calculation logic

```
# Syntax Error Example
# print("Hello World"  # Missing closing parenthesis
# SyntaxError: unexpected EOF while parsing

# Runtime Error Examples
try:
    # ZeroDivisionError
    result = 10 / 0
except ZeroDivisionError:
    print("Cannot divide by zero")

try:
    # FileNotFoundError
    file = open("nonexistent.txt", "r")
except FileNotFoundError:
    print("File not found")
```

- **Syntax Errors**: Code run થવા પહેલા જ detect થાય છે
- **Runtime Errors**: Program execution દરમિયાન થાય છે
- **Prevention**: Exception handling runtime errors ને handle કરે છે

Mnemonic: "Syntax Before, Runtime During"

Question 3(b) [4 marks]

What is Exception handling in Python? Explain with example.

Answer:

Exception handling એ mechanism છે જે runtime errors ને gracefully handle કરે છે અને program crash થવાથી prevent કરે છે.

Table: Exception Handling Keywords

Keyword	Purpose	Description
try	Exception માં થઈ શકે એવો code	Risk code block
except	Exception handle કરવા માટે	Error handling block
finally	હંમેશા execute થાય	Cleanup code
else	Exception ન આવે તો	Success code block
raise	Manual exception raise કરવા	Custom error throwing

```
# Exception Handling Example
def safe_division(a, b):
    try:
        # Code that might raise exception
        result = a / b
        print(f"Division successful: {result}")

    except ZeroDivisionError:
        # Handle specific exception
        print("Error: Cannot divide by zero")
        result = None

    except TypeError:
        # Handle type errors
        print("Error: Invalid data types")
        result = None

    else:
        # Executes if no exception
        print("Division completed successfully")

    finally:
        # Always executes
        print("Division operation finished")

    return result

# Test the function
safe_division(10, 2)   # Normal case
```

```
safe_division(10, 0)   # Zero division
safe_division(10, "a") # Type error
```

- **Error Prevention**: Program crash થવાથી prevent કરે છે
- **Graceful Handling**: User-friendly error messages provide કરે છે
- **Resource Management**: finally block માં cleanup operations

Mnemonic: "Try Except Finally Else Raise"

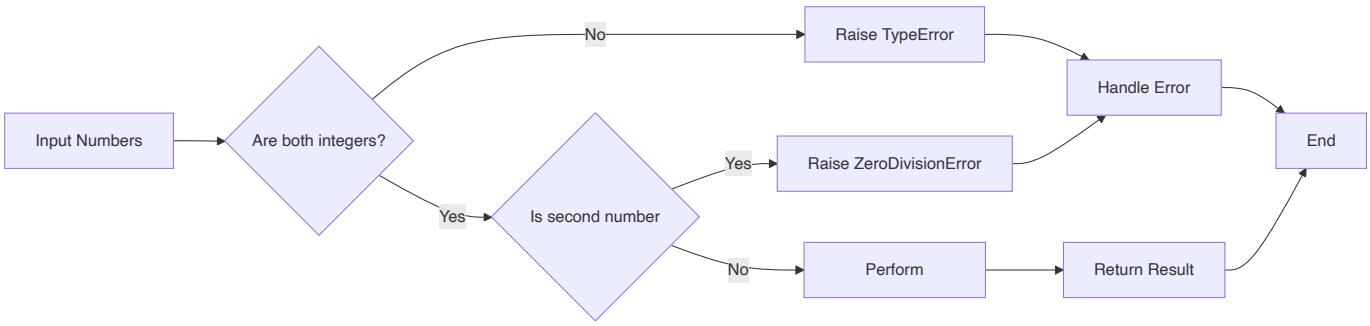
Question 3(c) [7 marks]

Create a function for division of two numbers, if the value of any argument is non-integer then raise the error or if second argument is 0 then raise the error.

Answer:

Custom exception handling function બનાવવું validation અને error control માટે important છે.

Diagram: Function Flow




```
def safe_integer_division(num1, num2):
    """
    Divide two numbers with validation
    Raises TypeError if arguments are not integers
    Raises ZeroDivisionError if second argument is 0
    """

    # Check if both arguments are integers
    if not isinstance(num1, int):
        raise TypeError(f"First argument must be integer, got {type(num1).__name__}")

    if not isinstance(num2, int):
        raise TypeError(f"Second argument must be integer, got {type(num2).__name__}")

    # Check for zero division
    if num2 == 0:
        raise ZeroDivisionError("Cannot divide by zero")

    # Perform division
    result = num1 / num2
```

```
    return result

# Test the function with different cases
def test_division():
    test_cases = [
        (10, 2),      # Valid case
        (15, 3),      # Valid case
        (10, 0),      # Zero division error
        (10.5, 2),    # Non-integer first argument
        (10, 2.5),    # Non-integer second argument
        ("10", 2),    # String argument
    ]

    for num1, num2 in test_cases:
        try:
            result = safe_integer_division(num1, num2)
            print(f"{num1} ÷ {num2} = {result}")

        except TypeError as e:
            print(f"Type Error: {e}")

        except ZeroDivisionError as e:
            print(f"Zero Division Error: {e}")

        except Exception as e:
            print(f"Unexpected Error: {e}")

        print("-" * 40)

# Run tests
test_division()
```

- **Input Validation**: Arguments ના type અને value check કરે છે
- **Custom Errors**: Specific exceptions raise કરે છે
- **Error Messages**: Clear અને descriptive error messages

Mnemonic: "Validate Type, Check Zero, Divide Safe"

Question 3(a OR) [3 marks]

Describe any five built-in exceptions in Python.

Answer:

Table: Built-in Exceptions

Exception	Cause	Example
ValueError	Invalid value for operation	`int("abc")`
TypeError	Wrong data type	`"hello" + 5`
IndexError	Index out of range	`list[10]` when list has 5 elements
KeyError	Dictionary key not found	`dict["nonexistent"]`
FileNotFoundError	File does not exist	`open("missing.txt")`

```
# Built-in Exceptions Examples

# 1. ValueError
try:
    number = int("not_a_number")
except ValueError:
    print("ValueError: Invalid conversion")

# 2. TypeError
try:
    result = "Hello" + 5
except TypeError:
    print("TypeError: Cannot add string and integer")

# 3. IndexError
try:
    my_list = [1, 2, 3]
    value = my_list[5]
except IndexError:
    print("IndexError: List index out of range")
```

- **Automatic Detection**: Python automatically raises these exceptions
- **Specific Handling**: દરેક exception નો specific purpose છે
- **Inheritance**: બધા exceptions BaseException class થી inherit થાય છે

Mnemonic: "Value Type Index Key File"

Question 3(b OR) [4 marks]

Explain try, except and finally terms with syntax.

Answer:

Exception handling ના blocks નો specific purpose અને execution order છે.

Table: Exception Handling Blocks

Block	Purpose	Execution	Mandatory
try	Risky code	First	Yes
except	Error handling	If exception occurs	At least one
else	Success code	If no exception	No
finally	Cleanup code	Always	No

Syntax Structure:

```
try:
    # Code that might raise exception
    risky_code()
except ExceptionType1:
    # Handle specific exception
    handle_error1()
except ExceptionType2:
    # Handle another exception
    handle_error2()
else:
    # Code runs if no exception
    success_code()
finally:
    # Code always runs
    cleanup_code()
```

Practical Example:

```
def file_operation(filename):
    file_handle = None
    try:
        # Risky operation
        file_handle = open(filename, 'r')
        content = file_handle.read()
        print("File read successfully")

    except FileNotFoundError:
        print("File not found error")

    except PermissionError:
        print("Permission denied")

    else:
        print("File operation completed successfully")

    finally:
        # Cleanup - always executes
        if file_handle:
            file_handle.close()
```

```
            print("File closed")

# Test the function
file_operation("test.txt")
```

- **Exception Flow**: try → except/else → finally
- **Multiple Handlers**: Multiple except blocks allowed
- **Guaranteed Execution**: finally block હંમેશા run થાય છે

Mnemonic: "Try Exception Else Finally"

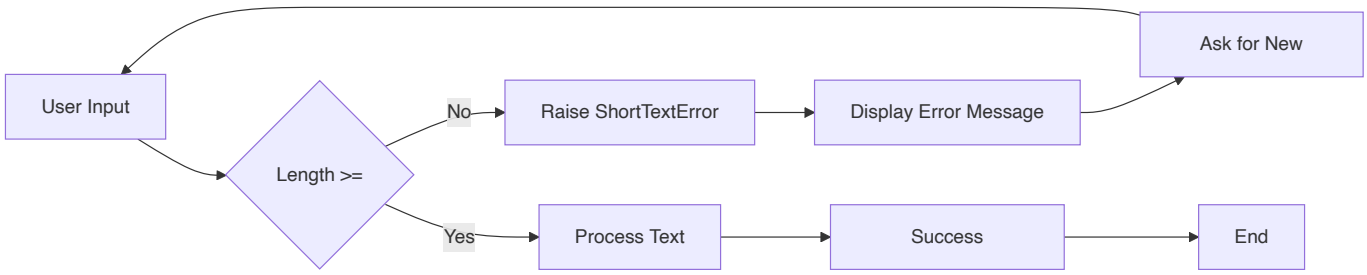
Question 3(c OR) [7 marks]

Write a user defined exception that could be raised when the text entered by a user consists of less than 10 characters.

Answer:

User-defined exceptions custom validation logic implement કરવા માટે powerful tool છે.

Diagram: Custom Exception Flow




```
# User-defined Exception Class
class ShortTextError(Exception):
    """Custom exception for text that is too short"""

    def __init__(self, text_length, minimum_length=10):
        self.text_length = text_length
        self.minimum_length = minimum_length
        message = f"Text is too short! Length: {text_length}, Required: {minimum_length}"
        super().__init__(message)

def validate_text_length(text):
    """
    Validate text length and raise exception if too short
    """
    if len(text) < 10:
        raise ShortTextError(len(text))
    return True

def process_user_text(text):
```

```
    """
    Process text after validation
    """
    try:
        validate_text_length(text)
        print(f"✓ Text accepted: '{text}'")
        print(f"Text length: {len(text)} characters")
        return text.upper()  # Process the text

    except ShortTextError as e:
        print(f"❌ {e}")
        return None

def interactive_text_input():
    """
    Interactive function to get valid text from user
    """
    while True:
        try:
            user_input = input("Enter text (minimum 10 characters): ")

            # Validate text length
            if len(user_input) < 10:
                raise ShortTextError(len(user_input))

            print(f"✓ Valid text entered: '{user_input}'")
            break

        except ShortTextError as e:
            print(f"❌ Error: {e}")
            retry = input("Try again? (y/n): ")
            if retry.lower() != 'y':
                print("Operation cancelled.")
                break

# Test different scenarios
def test_custom_exception():
    test_texts = [
        "Hi",                   # Too short (2 chars)
        "Hello",                # Too short (5 chars)
        "Short",                # Too short (5 chars)
        "This is valid text",   # Valid (19 chars)
        "Perfect length text"   # Valid (20 chars)
    ]

    print("Testing Custom Exception:")
    print("=" * 40)

    for text in test_texts:
        result = process_user_text(text)
        if result:
            print(f"Processed: {result}")
```

```
        print("-" * 30)

# Run tests
test_custom_exception()

# Uncomment to test interactive input
# interactive_text_input()
```

Additional Features:

```
# Enhanced Custom Exception with more features
class TextValidationError(Exception):
    """Enhanced text validation exception"""

    def __init__(self, text, error_type, details=None):
        self.text = text
        self.error_type = error_type
        self.details = details

        if error_type == "short":
            message = f"Text too short: {len(text)} chars (min: 10)"
        elif error_type == "empty":
            message = "Text cannot be empty"
        elif error_type == "spaces":
            message = "Text contains only spaces"
        else:
            message = f"Text validation failed: {error_type}"

        super().__init__(message)

def advanced_text_validation(text):
    """Advanced text validation with multiple checks"""
    if not text:
        raise TextValidationError(text, "empty")

    if text.isspace():
        raise TextValidationError(text, "spaces")

    if len(text.strip()) < 10:
        raise TextValidationError(text, "short")

    return True
```

- **Custom Logic**: Application-specific validation rules implement કરી શકાય
- **Inheritance**: Exception class ને inherit કરીને custom exceptions બનાવાય
- **Detailed Information**: Exception object માં additional data store કરી શકાય

Mnemonic: "Custom Exception = Class Inherit Raise"

Question 4(a) [3 marks]

Write five points on difference between Text File and Binary File.

Answer:

Table: Text File vs Binary File

Feature	Text File	Binary File
Content	Human-readable characters	Binary data (0s and 1s)
Encoding	Character encoding (UTF-8, ASCII)	No character encoding
Opening Mode	'r', 'w', 'a'	'rb', 'wb', 'ab'
File Size	Generally larger	Generally smaller
Platform	Platform dependent	Platform independent

```
# Text vs Binary File Examples
# Text file example
with open("sample.txt", "w") as f:
    f.write("Hello World")

# Binary file example
with open("sample.bin", "wb") as f:
    f.write(b'\x48\x65\x6c\x6c\x6f')
```

- **Readability**: Text files editor માં read કરી શકાય, binary files special software જોઈએ
- **Portability**: Binary files different platforms પર easily transfer થાય
- **Processing**: Text files string operations માટે, binary files exact data storage માટે

Mnemonic: "Text Human, Binary Machine"

Question 4(b) [4 marks]

Write a program to read the data from a file and separate the uppercase character and lowercase character into two separate files.

Answer:

File processing માં character-based operations common requirements છે.

Table: File Operations

Operation	Method	Purpose
Read	`read()`	Complete file content
Write	`write()`	Write string to file
Character Check	`isupper()`, `islower()`	Character case detection
File Handling	`with open()`	Safe file operations

```python
def separate_case_characters(input_file, upper_file, lower_file):
    """
    Read file and separate uppercase/lowercase characters
    """
    try:
        # Read from input file
        with open(input_file, 'r') as infile:
            content = infile.read()

        # Separate characters
        uppercase_chars = ""
        lowercase_chars = ""

        for char in content:
            if char.isupper():
                uppercase_chars += char
            elif char.islower():
                lowercase_chars += char

        # Write to uppercase file
        with open(upper_file, 'w') as upfile:
            upfile.write(uppercase_chars)

        # Write to lowercase file
        with open(lower_file, 'w') as lowfile:
            lowfile.write(lowercase_chars)

        print(f"✓ Characters separated successfully!")
        print(f"Uppercase characters: {len(uppercase_chars)}")
        print(f"Lowercase characters: {len(lowercase_chars)}")

    except FileNotFoundError:
        print(f"Error: File '{input_file}' not found")
    except Exception as e:
        print(f"Error: {e}")

# Create sample input file
def create_sample_file():
    sample_text = """Hello World! This is a SAMPLE Text file.
It contains UPPERCASE and lowercase Characters.
Python Programming is FUN and Educational."""
```

```
    with open("input.txt", "w") as f:
        f.write(sample_text)
    print("Sample input file created: input.txt")

# Main execution
create_sample_file()
separate_case_characters("input.txt", "uppercase.txt", "lowercase.txt")

# Display results
print("\nFile Contents:")
print("-" * 30)

try:
    with open("uppercase.txt", "r") as f:
        print(f"Uppercase file: {f.read()}")

    with open("lowercase.txt", "r") as f:
        print(f"Lowercase file: {f.read()}")
except FileNotFoundError:
    print("Output files not found")
```

- **Character Processing**: દરેક character ની case individually check કરાય છે
- **File Safety**: with statement automatic file closing ensure કરે છે
- **Error Handling**: File operations માં proper exception handling

Mnemonic: "Read Separate Write"

Question 4(c) [7 marks]

Describe dump() and load() method. Explain with example.

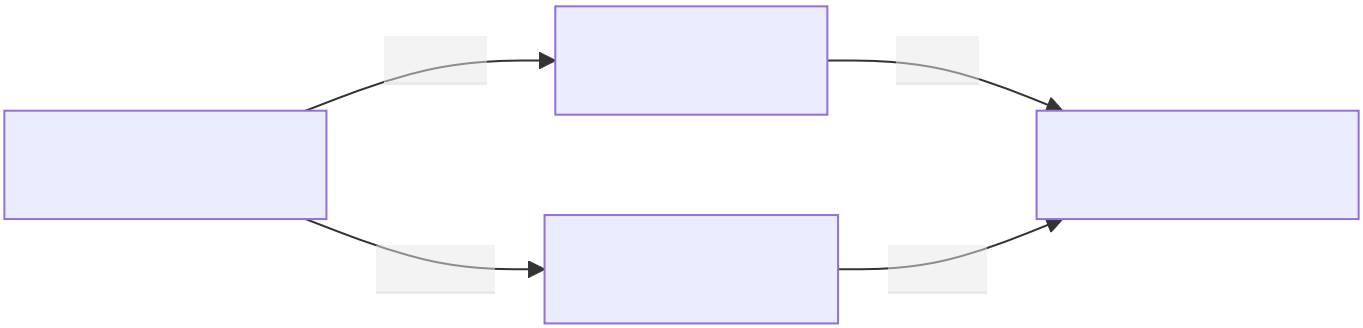
Answer:

dump() અને load() methods pickle module ના part છે જે object serialization માટે વાપરાય છે.

Table: Pickle Methods

Method	Purpose	File Mode	Description
dump()	Serialize object to file	'wb'	Object ને binary file માં store કરે
load()	Deserialize object from file	'rb'	File માંથી object retrieve કરે
dumps()	Serialize to bytes	N/A	Object ને bytes માં convert કરે
loads()	Deserialize from bytes	N/A	Bytes માંથી object બનાવે

Diagram: Serialization Process



```python
import pickle

# Example with different data types
def demonstrate_pickle():
    # Sample data to serialize
    student_data = {
        'name': 'Raj Patel',
        'age': 20,
        'grades': [85, 92, 78, 96],
        'subjects': ('Math', 'Python', 'Database'),
        'is_active': True
    }

    class Student:
        def __init__(self, name, roll_no):
            self.name = name
            self.roll_no = roll_no

        def __str__(self):
            return f"Student: {self.name} (Roll: {self.roll_no})"

    # Create objects
    student_obj = Student("Priya Shah", 101)
    data_list = [student_data, student_obj, [1, 2, 3, 4, 5]]

    # DUMP - Serialize objects to file
    print("=== DUMP Operation ===")
    try:
        with open('student_data.pkl', 'wb') as f:
            pickle.dump(data_list, f)
        print("✓ Data successfully dumped to student_data.pkl")

        # Also demonstrate dumps()
        serialized_bytes = pickle.dumps(student_data)
        print(f"✓ Data serialized to bytes: {len(serialized_bytes)} bytes")

    except Exception as e:
        print(f"❌ Dump error: {e}")

    # LOAD - Deserialize objects from file
    print("\n=== LOAD Operation ===")
```

```
    try:
        with open('student_data.pkl', 'rb') as f:
            loaded_data = pickle.load(f)

        print("✓ Data successfully loaded from student_data.pkl")
        print("\nLoaded Data:")
        print("-" * 20)

        # Display loaded data
        for i, item in enumerate(loaded_data):
            print(f"Item {i+1}: {item}")
            print(f"Type: {type(item)}")
            print()

        # Also demonstrate loads()
        deserialized_data = pickle.loads(serialized_bytes)
        print(f"✓ Data deserialized from bytes: {deserialized_data}")

    except FileNotFoundError:
        print("❌ Pickle file not found")
    except Exception as e:
        print(f"❌ Load error: {e}")

# Advanced example with custom class
def advanced_pickle_example():
    class BankAccount:
        def __init__(self, account_no, holder_name, balance):
            self.account_no = account_no
            self.holder_name = holder_name
            self.balance = balance
            self.transactions = []

        def deposit(self, amount):
            self.balance += amount
            self.transactions.append(f"Deposit: +{amount}")

        def withdraw(self, amount):
            if self.balance >= amount:
                self.balance -= amount
                self.transactions.append(f"Withdraw: -{amount}")
            else:
                print("Insufficient balance")

        def __str__(self):
            return f"Account {self.account_no}: {self.holder_name} - Balance: ₹
{self.balance}"

    # Create and use account
    account = BankAccount("12345", "Amit Kumar", 5000)
    account.deposit(1500)
    account.withdraw(800)
```

```
    print("=== Advanced Pickle Example ===")
    print(f"Original: {account}")
    print(f"Transactions: {account.transactions}")

    # Serialize account object
    with open('bank_account.pkl', 'wb') as f:
        pickle.dump(account, f)

    # Load account object
    with open('bank_account.pkl', 'rb') as f:
        loaded_account = pickle.load(f)

    print(f"Loaded: {loaded_account}")
    print(f"Loaded transactions: {loaded_account.transactions}")

    # Verify object functionality
    loaded_account.deposit(200)
    print(f"After new deposit: {loaded_account}")

# Run demonstrations
demonstrate_pickle()
print("\n" + "="*50 + "\n")
advanced_pickle_example()
```

Benefits and Limitations:

```
# Benefits
benefits = [
    "Complete object state preservation",
    "Works with complex nested objects",
    "Maintains object relationships",
    "Fast serialization/deserialization"
]

# Limitations
limitations = [
    "Python-specific format",
    "Security risks with untrusted data",
    "Version compatibility issues",
    "Not human-readable"
]

print("Benefits:", benefits)
print("Limitations:", limitations)
```

- **Object Persistence**: Python objects ને file માં permanently store કરી શકાય
- **Complete State**: Object ની complete state including methods preserve થાય છે
- **Binary Format**: Efficient storage પણ human-readable નથી

Mnemonic: "Dump Store, Load Restore"

Question 4(a OR) [3 marks]

List different types of file modes provided by python for file operations and explain their uses.

Answer:

Table: Python File Modes

Mode	Type	Description	Pointer Position
'r'	Text Read	Read only, file must exist	Beginning
'w'	Text Write	Write only, creates/overwrites	Beginning
'a'	Text Append	Write only, creates if not exist	End
'x'	Text Create	Create new file, fails if exists	Beginning
'rb'	Binary Read	Read binary data	Beginning
'wb'	Binary Write	Write binary data	Beginning
'ab'	Binary Append	Append binary data	End
'r+'	Text Read/Write	Read and write, file must exist	Beginning
'w+'	Text Write/Read	Write and read, creates/overwrites	Beginning

```
# File Modes Examples
import os

# Create sample file for demonstration
with open('demo.txt', 'w') as f:
    f.write("Original content\nLine 2\nLine 3")

# Read mode ('r')
with open('demo.txt', 'r') as f:
    content = f.read()
    print("Read mode:", content)

# Append mode ('a')
with open('demo.txt', 'a') as f:
    f.write("\nAppended line")

# Read+Write mode ('r+')
with open('demo.txt', 'r+') as f:
    f.seek(0)  # Go to beginning
    f.write("Modified")

print("File modes demonstrated successfully")
```

- **Safety**: 'x' mode prevents accidental file overwriting
- **Efficiency**: Binary modes faster for non-text data
- **Flexibility**: Combined modes allow both read and write operations

Mnemonic: "Read Write Append Create Binary Plus"

Question 4(b OR) [4 marks]

Describe readline() and writeline() functions of the file.

Answer:

Note: Python માં `writeline()` function exist નથી. Correct function `writelines()` છે.

Table: Line-based File Functions

Function	Purpose	Return Type	Usage
readline()	Read single line	String	Sequential line reading
readlines()	Read all lines	List of strings	Complete file as list
writelines()	Write multiple lines	None	Write list of strings
write()	Write single string	Number of chars	Basic writing

```
def demonstrate_line_functions():
    # Create sample file with multiple lines
    lines_to_write = [
        "First line of text\n",
        "Second line of text\n",
        "Third line of text\n",
        "Fourth line without newline"
    ]

    print("=== WRITELINES() Demonstration ===")
    # Write multiple lines using writelines()
    with open('sample_lines.txt', 'w') as f:
        f.writelines(lines_to_write)
    print("✓ Multiple lines written using writelines()")

    print("\n=== READLINE() Demonstration ===")
    # Read lines one by one using readline()
    with open('sample_lines.txt', 'r') as f:
        line_count = 0
        while True:
            line = f.readline()
            if not line:  # End of file
                break
            line_count += 1
```

```
            print(f"Line {line_count}: {line.strip()}")

    print(f"Total lines read: {line_count}")

    print("\n=== READLINES() Demonstration ===")
    # Read all lines at once using readlines()
    with open('sample_lines.txt', 'r') as f:
        all_lines = f.readlines()

    print("All lines as list:")
    for i, line in enumerate(all_lines, 1):
        print(f"  [{i}] {repr(line)}")

    # Practical example: Processing file line by line
    print("\n=== Practical Example ===")
    student_data = [
        "Raj,20,IT\n",
        "Priya,19,CS\n",
        "Amit,21,EC\n",
        "Sneha,20,IT\n"
    ]

    # Write student data
    with open('students.txt', 'w') as f:
        f.writelines(student_data)

    # Read and process line by line
    print("Student Information:")
    with open('students.txt', 'r') as f:
        while True:
            line = f.readline()
            if not line:
                break

            # Process each line
            parts = line.strip().split(',')
            if len(parts) == 3:
                name, age, course = parts
                print(f"  {name} (Age: {age}, Course: {course})")

# Run demonstration
demonstrate_line_functions()

# File pointer behavior example
def file_pointer_demo():
    print("\n=== File Pointer Behavior ===")

    with open('sample_lines.txt', 'r') as f:
        print(f"Initial position: {f.tell()}")

        line1 = f.readline()
        print(f"After readline(): position {f.tell()}")
```

```
        print(f"Read: {repr(line1)}")

        line2 = f.readline()
        print(f"After second readline(): position {f.tell()}")
        print(f"Read: {repr(line2)}")

file_pointer_demo()
```

- **Sequential Access**: readline() sequential manner માં lines read કરે છે
- **Memory Efficient**: Large files માટે readline() memory-efficient છે
- **List Operations**: writelines() list of strings ને efficiently write કરે છે

Mnemonic: "Read Line, Write Lines"

Question 4(c OR) [7 marks]

Write a python program to demonstrate seek() and tell() methods.

Answer:

seek() અને tell() methods file pointer manipulation માટે વાપરાય છે.

Table: File Pointer Methods

Method	Purpose	Parameters	Return Value
tell()	Current position	None	Integer (byte position)
seek()	Move pointer	offset, whence	New position
whence=0	From beginning	Default	Absolute position
whence=1	From current	Relative	Current + offset
whence=2	From end	End relative	End + offset

Diagram: File Pointer Movement

```
File: "Hello World"
      ^             ^          ^
   Position 0   Position 6  Position 11 (EOF)

seek(0)    -> Move to beginning
seek(6)    -> Move to position 6
seek(-5,2) -> Move 5 positions before end
```

```
def demonstrate_seek_tell():
    # Create sample file with known content
    sample_text = "Hello Python Programming World!"
```

```
    with open('pointer_demo.txt', 'w') as f:
        f.write(sample_text)

    print("=== File Pointer Demonstration ===")
    print(f"File content: '{sample_text}'")
    print(f"File length: {len(sample_text)} characters")
    print()

    with open('pointer_demo.txt', 'r') as f:
        # Initial position
        print(f"1. Initial position: {f.tell()}")

        # Read some characters
        first_part = f.read(5)  # Read "Hello"
        print(f"2. After reading '{first_part}': position {f.tell()}")

        # Move to specific position
        f.seek(6)  # Move to position 6 (start of "Python")
        print(f"3. After seek(6): position {f.tell()}")

        # Read from new position
        next_part = f.read(6)  # Read "Python"
        print(f"4. Read '{next_part}': position {f.tell()}")

        # Move relative to current position (only in binary mode for positive offset)
        # Let's demonstrate absolute positioning
        f.seek(0)  # Go to beginning
        print(f"5. After seek(0): position {f.tell()}")

        # Move to end of file
        f.seek(0, 2)  # 0 offset from end (position 2 = end)
        print(f"6. After seek(0,2) - end of file: position {f.tell()}")

        # Move backwards from end
        f.seek(-6, 2)  # 6 positions before end
        print(f"7. After seek(-6,2): position {f.tell()}")

        # Read remaining content
        remaining = f.read()
        print(f"8. Read remaining '{remaining}': position {f.tell()}")

def practical_seek_tell_example():
    print("\n=== Practical Example: File Editor Simulation ===")

    # Create a file with structured data
    data_lines = [
        "NAME:John Doe\n",
        "AGE:25\n",
        "CITY:Mumbai\n",
        "PHONE:9876543210\n",
        "EMAIL:john@example.com\n"
```

```
    ]

    with open('person_data.txt', 'w') as f:
        f.writelines(data_lines)

    # Demonstrate finding and modifying specific data
    with open('person_data.txt', 'r+') as f:  # Read+Write mode
        # Find and display all positions
        positions = {}

        while True:
            pos = f.tell()
            line = f.readline()
            if not line:
                break

            field = line.split(':')[0]
            positions[field] = pos
            print(f"Field '{field}' starts at position {pos}")

        print(f"\nFile positions: {positions}")

        # Modify specific field (AGE)
        if 'AGE' in positions:
            f.seek(positions['AGE'])
            print(f"\nMoving to AGE field at position {f.tell()}")

            # Read current line
            current_line = f.readline()
            print(f"Current line: {current_line.strip()}")

            # Calculate position to overwrite
            f.seek(positions['AGE'])
            new_age_line = "AGE:26\n"  # Same length as original
            f.write(new_age_line)
            print(f"Updated AGE field")

    # Verify changes
    print("\nUpdated file content:")
    with open('person_data.txt', 'r') as f:
        print(f.read())

def binary_seek_tell_demo():
    print("\n=== Binary File Seek/Tell Demo ===")

    # Create binary file
    binary_data = b'\x48\x65\x6c\x6c\x6f\x20\x57\x6f\x72\x6c\x64'  # "Hello World"

    with open('binary_demo.bin', 'wb') as f:
        f.write(binary_data)

    with open('binary_demo.bin', 'rb') as f:
```

```
        print(f"Binary file size: {len(binary_data)} bytes")

        # Demonstrate all seek modes in binary
        print(f"Initial position: {f.tell()}")

        # Read first 5 bytes
        first_bytes = f.read(5)
        print(f"Read first 5 bytes: {first_bytes} at position {f.tell()}")

        # Seek relative to current position (works in binary mode)
        f.seek(1, 1)  # Move 1 byte forward from current
        print(f"After seek(1,1): position {f.tell()}")

        # Seek from end
        f.seek(-3, 2)  # 3 bytes before end
        print(f"After seek(-3,2): position {f.tell()}")

        # Read remaining
        remaining_bytes = f.read()
        print(f"Remaining bytes: {remaining_bytes}")

# Run all demonstrations
demonstrate_seek_tell()
practical_seek_tell_example()
binary_seek_tell_demo()

# Cleanup
import os
try:
    os.remove('pointer_demo.txt')
    os.remove('person_data.txt')
    os.remove('binary_demo.bin')
    print("\nDemo files cleaned up")
except:
    pass
```

- **File Navigation**: seek() arbitrary position પર move કરવા માટે વાપરાય છે
- **Position Tracking**: tell() current position track કરવા માટે useful છે
- **File Editing**: Specific locations પર data modify કરવા માટે જરૂરી

Mnemonic: "Tell Position, Seek Destination"

Question 5(a) [3 marks]

Draw Circle and rectangle shapes using Turtle and fill them with red color.

Answer:

Turtle graphics module માં shapes draw કરવા અને fill કરવા માટે specific methods છે.

Table: Turtle Shape Methods

Method	Purpose	Example
circle()	Draw circle	`turtle.circle(50)`
forward()	Move forward	`turtle.forward(100)`
right()	Turn right	`turtle.right(90)`
begin_fill()	Start filling	`turtle.begin_fill()`
end_fill()	End filling	`turtle.end_fill()`
fillcolor()	Set fill color	`turtle.fillcolor("red")`

```python
import turtle

def draw_filled_shapes():
    # Create screen and turtle
    screen = turtle.Screen()
    screen.title("Filled Shapes with Turtle")
    screen.bgcolor("white")
    screen.setup(800, 600)

    # Create turtle object
    painter = turtle.Turtle()
    painter.speed(3)

    # Draw filled circle
    print("Drawing filled circle...")
    painter.penup()
    painter.goto(-150, 0)  # Move to left side
    painter.pendown()

    painter.fillcolor("red")
    painter.begin_fill()
    painter.circle(80)  # Radius = 80
    painter.end_fill()

    # Draw filled rectangle
    print("Drawing filled rectangle...")
    painter.penup()
    painter.goto(50, 50)  # Move to right side
    painter.pendown()

    painter.fillcolor("red")
    painter.begin_fill()

    # Draw rectangle (100x80)
    for _ in range(2):
        painter.forward(100)
```

```
            painter.right(90)
            painter.forward(80)
            painter.right(90)

        painter.end_fill()

        # Add labels
        painter.penup()
        painter.goto(-150, -120)
        painter.write("Red Circle", align="center", font=("Arial", 14, "normal"))

        painter.goto(100, -50)
        painter.write("Red Rectangle", align="center", font=("Arial", 14, "normal"))

        # Hide turtle and display result
        painter.hideturtle()
        print("Shapes drawn successfully!")

        # Keep window open
        screen.exitonclick()

# Run the program
draw_filled_shapes()
```

- **Fill Process**: begin_fill() અને end_fill() વચ્ચે drawn shape automatically fill થાય છે
- **Color Setting**: fillcolor() method fill color set કરે છે
- **Shape Drawing**: Geometric shapes માટે specific turtle movements

Mnemonic: "Begin Fill Draw End"

Question 5(b) [4 marks]

Explain the various inbuilt methods to change the direction of the Turtle.

Answer:

Table: Turtle Direction Methods

Method	Parameters	Description	Example
right()	angle	Turn right by degrees	`turtle.right(90)`
left()	angle	Turn left by degrees	`turtle.left(45)`
setheading()	angle	Set absolute direction	`turtle.setheading(0)`
towards()	x, y	Point towards coordinates	`turtle.towards(100, 50)`
home()	none	Return to center, face east	`turtle.home()`

```
import turtle
```

```
def demonstrate_direction_methods():
    screen = turtle.Screen()
    screen.setup(600, 600)
    screen.title("Turtle Direction Methods")

    t = turtle.Turtle()
    t.speed(2)
    t.shape("turtle")

    # 1. right() method
    t.write("1. right(90)", font=("Arial", 10, "normal"))
    t.forward(50)
    t.right(90)
    t.forward(50)

    # 2. left() method
    t.penup()
    t.goto(-100, 100)
    t.pendown()
    t.write("2. left(45)", font=("Arial", 10, "normal"))
    t.forward(50)
    t.left(45)
    t.forward(50)

    # 3. setheading() method
    t.penup()
    t.goto(100, 100)
    t.pendown()
    t.write("3. setheading(180)", font=("Arial", 10, "normal"))
    t.setheading(180)  # Face west
    t.forward(50)

    # 4. towards() method
    t.penup()
    t.goto(-100, -100)
    t.pendown()
    target_x, target_y = 100, -100
    t.write("4. towards(100,-100)", font=("Arial", 10, "normal"))
    angle = t.towards(target_x, target_y)
    t.setheading(angle)
    t.goto(target_x, target_y)

    # 5. home() method
    t.write("5. home()", font=("Arial", 10, "normal"))
    t.home()  # Return to center and face east

    t.hideturtle()
    screen.exitonclick()

demonstrate_direction_methods()
```

- **Relative Turns**: right() અને left() current direction થી relative turn

- **Absolute Direction**: setheading() absolute compass direction set કરે
- **Smart Pointing**: towards() specific coordinates તરફ point કરે

Mnemonic: "Right Left Set Towards Home"

Question 5(c) [7 marks]

Write a python program to draw a rainbow using Turtle.

Answer:

Rainbow drawing માં multiple colored arcs અને proper positioning જરૂરી છે.

Diagram: Rainbow Structure

```
    Red (outer)
   Orange
  Yellow
 Green
Blue
Indigo
Violet (inner)
```

```python
import turtle

def draw_rainbow():
    # Screen setup
    screen = turtle.Screen()
    screen.title("Beautiful Rainbow")
    screen.bgcolor("lightblue")
    screen.setup(800, 600)

    # Turtle setup
    rainbow_turtle = turtle.Turtle()
    rainbow_turtle.speed(8)
    rainbow_turtle.pensize(8)

    # Rainbow colors (ROYGBIV)
    colors = ["red", "orange", "yellow", "green", "blue", "indigo", "violet"]

    # Rainbow parameters
    start_radius = 200
    radius_decrease = 15
    start_y = -150

    print("Drawing rainbow...")

    # Draw each color arc
    for i, color in enumerate(colors):
        # Set color
```

```
        rainbow_turtle.pencolor(color)

        # Calculate current radius
        current_radius = start_radius - (i * radius_decrease)

        # Position turtle for semi-circle
        rainbow_turtle.penup()
        rainbow_turtle.goto(-current_radius, start_y)
        rainbow_turtle.pendown()
        rainbow_turtle.setheading(0)  # Face east

        # Draw semi-circle (180 degrees)
        rainbow_turtle.circle(current_radius, 180)

        print(f"Drew {color} arc with radius {current_radius}")

    # Add clouds at ends
    draw_clouds(rainbow_turtle)

    # Add sun
    draw_sun(rainbow_turtle)

    # Add text
    rainbow_turtle.penup()
    rainbow_turtle.goto(0, -250)
    rainbow_turtle.pencolor("black")
    rainbow_turtle.write("🌈 Beautiful Rainbow 🌈", align="center",
                         font=("Arial", 16, "bold"))

    rainbow_turtle.hideturtle()
    print("Rainbow completed!")

    screen.exitonclick()

def draw_clouds(turtle_obj):
    """Draw clouds at both ends of rainbow"""
    turtle_obj.pensize(3)
    turtle_obj.pencolor("white")
    turtle_obj.fillcolor("lightgray")

    # Left cloud
    cloud_positions = [(-250, -100), (250, -100)]

    for x, y in cloud_positions:
        turtle_obj.penup()
        turtle_obj.goto(x, y)
        turtle_obj.pendown()
        # Draw cloud using multiple circles
        turtle_obj.begin_fill()
        for i in range(3):
            turtle_obj.circle(20)
            turtle_obj.left(120)
```

```
        turtle_obj.end_fill()

def draw_sun(turtle_obj):
    """Draw sun in corner"""
    turtle_obj.penup()
    turtle_obj.goto(300, 200)
    turtle_obj.pendown()
    turtle_obj.pencolor("orange")
    turtle_obj.fillcolor("yellow")

    # Draw sun body
    turtle_obj.begin_fill()
    turtle_obj.circle(30)
    turtle_obj.end_fill()

    # Draw sun rays
    turtle_obj.pensize(2)
    for angle in range(0, 360, 45):
        turtle_obj.setheading(angle)
        turtle_obj.forward(45)
        turtle_obj.backward(45)

# Alternative rainbow with gradient effect
def draw_gradient_rainbow():
    screen = turtle.Screen()
    screen.title("Gradient Rainbow")
    screen.bgcolor("skyblue")
    screen.setup(800, 600)

    t = turtle.Turtle()
    t.speed(0)
    t.pensize(5)

    # Color variations for gradient effect
    rainbow_colors = [
        "#FF0000", "#FF4500", "#FFD700", "#32CD32",
        "#0000FF", "#4B0082", "#8B00FF"
    ]

    # Draw rainbow with varying thickness
    for i, color in enumerate(rainbow_colors):
        t.pencolor(color)
        t.pensize(12 - i)  # Decreasing thickness

        radius = 150 - (i * 10)
        t.penup()
        t.goto(-radius, -100)
        t.pendown()
        t.setheading(0)
        t.circle(radius, 180)

    t.hideturtle()
```

```
    screen.exitonclick()

# Run the rainbow programs
print("Choose rainbow type:")
print("1. Standard Rainbow")
print("2. Gradient Rainbow")

choice = input("Enter choice (1 or 2): ")
if choice == "2":
    draw_gradient_rainbow()
else:
    draw_rainbow()
```

- **Color Sequence**: ROYGBIV (Red Orange Yellow Green Blue Indigo Violet) નો proper order
- **Radius Management**: દરેક arc નો radius gradually decrease કરાય છે
- **Positioning**: Proper positioning માટે penup/pendown અને goto methods

Mnemonic: "ROYGBIV Arc Radius Position"

Question 5(a OR) [3 marks]

Draw a diagram of turtle screen and explain all 4 quadrants of x and y coordinates.

Answer:

Diagram: Turtle Coordinate System

```
                    +Y
                     |
                     |
        II           |           I
    (-x,+y)          |       (+x,+y)
                     |
-X -----|-----|-----|-----|----- +X
       -200  -100    0   100  200
                     |
        III          |          IV
    (-x,-y)          |       (+x,-y)
                     |
                     |
                    -Y

Default Screen: 400x300 pixels
Center: (0, 0)
```

Table: Coordinate Quadrants

Quadrant	X Value	Y Value	Description	Example
I	Positive (+)	Positive (+)	Top-right	(100, 50)
II	Negative (-)	Positive (+)	Top-left	(-100, 50)
III	Negative (-)	Negative (-)	Bottom-left	(-100, -50)
IV	Positive (+)	Negative (-)	Bottom-right	(100, -50)

```
import turtle

def demonstrate_coordinate_system():
    screen = turtle.Screen()
    screen.title("Turtle Coordinate System")
    screen.setup(600, 500)
    screen.bgcolor("white")

    t = turtle.Turtle()
    t.speed(3)
    t.shape("turtle")

    # Draw coordinate axes
    t.pencolor("gray")
    t.pensize(2)

    # X-axis
    t.penup()
    t.goto(-250, 0)
    t.pendown()
    t.goto(250, 0)

    # Y-axis
    t.penup()
    t.goto(0, -200)
    t.pendown()
    t.goto(0, 200)

    # Mark center
    t.penup()
    t.goto(0, 0)
    t.dot(8, "red")
    t.write("(0,0)", font=("Arial", 12, "normal"))

    # Demonstrate each quadrant
    quadrants = [
        (100, 100, "I", "red"),     # Quadrant I
        (-100, 100, "II", "blue"),  # Quadrant II
        (-100, -100, "III", "green"), # Quadrant III
        (100, -100, "IV", "orange")   # Quadrant IV
    ]
```

```
    for x, y, quad_name, color in quadrants:
        t.pencolor(color)
        t.penup()
        t.goto(x, y)
        t.pendown()
        t.dot(10, color)
        t.write(f"Q{quad_name}\n({x},{y})", align="center",
                font=("Arial", 10, "bold"))

    t.hideturtle()
    screen.exitonclick()

demonstrate_coordinate_system()
```

- **Origin**: (0,0) screen ના center પર આવેલું છે
- **Positive Direction**: X-axis right તરફ, Y-axis up તરફ positive
- **Navigation**: goto(x, y) method specific coordinates પર move કરે છે

Mnemonic: "Right Up Positive, Left Down Negative"

Question 5(b OR) [4 marks]

Describe various turtle screen methods to change the background color, title, screensize and shapesize.

Answer:

Table: Turtle Screen Methods

Method	Purpose	Parameters	Example
bgcolor()	Set background color	color name/hex	`screen.bgcolor("blue")`
title()	Set window title	string	`screen.title("My Program")`
setup()	Set screen size	width, height	`screen.setup(800, 600)`
screensize()	Set canvas size	width, height	`screen.screensize(400, 300)`
shapesize()	Set turtle size	stretch_wid, stretch_len	`turtle.shapesize(2, 3)`

```
import turtle

def demonstrate_screen_methods():
    # Create screen object
    screen = turtle.Screen()

    # 1. Title Method
    screen.title("Screen Methods Demonstration")
    print("✓ Title set to: 'Screen Methods Demonstration'")

    # 2. Background Color Method
```

```
    screen.bgcolor("lightgreen")
    print("✓ Background color set to: lightgreen")

    # 3. Setup Method (window size)
    screen.setup(width=800, height=600)
    print("✓ Window size set to: 800x600 pixels")

    # 4. Screen Size Method (canvas size)
    screen.screensize(canvwidth=400, canvheight=300)
    print("✓ Canvas size set to: 400x300")

    # Create turtle to demonstrate shapesize
    demo_turtle = turtle.Turtle()
    demo_turtle.speed(3)

    # 5. Shape Size Method
    demo_turtle.shape("turtle")
    demo_turtle.shapesize(stretch_wid=3, stretch_len=2, outline=3)
    print("✓ Turtle shape size: width=3x, length=2x, outline=3")

    # Demonstrate different background colors
    colors = ["lightblue", "lightyellow", "lightpink", "lightcoral"]

    for i, color in enumerate(colors):
        screen.bgcolor(color)
        demo_turtle.write(f"Background: {color}",
                          font=("Arial", 14, "normal"))
        demo_turtle.forward(50)
        demo_turtle.right(90)
        screen.ontimer(lambda: None, 1000)  # Wait 1 second

    # Reset to final state
    screen.bgcolor("white")
    demo_turtle.penup()
    demo_turtle.goto(0, -50)
    demo_turtle.write("Screen Methods Demo Complete!",
                      align="center", font=("Arial", 16, "bold"))

    demo_turtle.hideturtle()
    screen.exitonclick()

def advanced_screen_customization():
    """Advanced screen customization example"""
    screen = turtle.Screen()

    # Advanced setup with all parameters
    screen.setup(width=0.8, height=0.8, startx=100, starty=50)
    screen.title("🦕 Advanced Turtle Graphics 🦕")
    screen.bgcolor("#2E8B57")  # Sea Green

    # Custom color palette
    screen.colormode(255)  # Enable RGB mode
```

```
    # Create multiple turtles with different sizes
    turtles = []
    shapes = ["turtle", "circle", "square", "triangle"]
    sizes = [(1, 1), (2, 1), (1, 2), (3, 3)]
    colors = [(255, 0, 0), (0, 255, 0), (0, 0, 255), (255, 255, 0)]

    for i in range(4):
        t = turtle.Turtle()
        t.shape(shapes[i])
        t.shapesize(sizes[i][0], sizes[i][1])
        t.color(colors[i])
        t.penup()
        t.goto(-150 + i*100, 0)
        turtles.append(t)

        # Label each turtle
        t.write(f"{shapes[i]}\n{sizes[i]}",
               align="center", font=("Arial", 10, "normal"))

    # Add instructions
    instruction_turtle = turtle.Turtle()
    instruction_turtle.hideturtle()
    instruction_turtle.penup()
    instruction_turtle.goto(0, -100)
    instruction_turtle.color("white")
    instruction_turtle.write("Different turtle shapes and sizes",
                             align="center", font=("Arial", 16, "bold"))

    screen.exitonclick()

# Run demonstrations
print("Running Screen Methods Demo...")
demonstrate_screen_methods()

print("\nRunning Advanced Customization...")
advanced_screen_customization()
```

- **Window vs Canvas**: setup() window size, screensize() canvas size control કરે છે
- **Color Modes**: bgcolor() color names અથવા hex values accept કરે છે
- **Shape Scaling**: shapesize() turtle appearance ને scale કરે છે

Mnemonic: "Title Background Setup Size Shape"

Question 5(c OR) [7 marks]

Write a python program to draw a star, triangle and octagon using turtle.

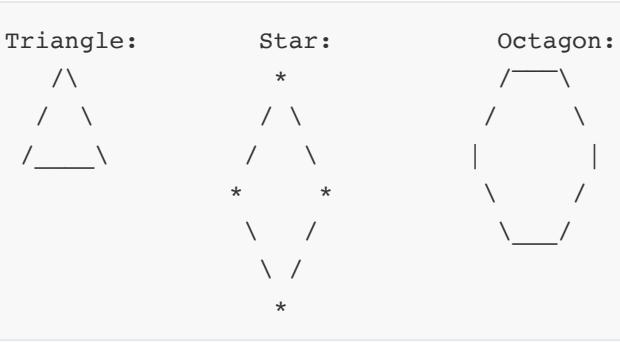
Answer:

Geometric shapes drawing માં angles અને sides ની proper calculation જરૂરી છે.

Table: Shape Properties

Shape	Sides	External Angle	Internal Angle	Turn Angle
Triangle	3	120°	60°	120°
Star (5-point)	5	144°	36°	144°
Octagon	8	45°	135°	45°

Diagram: Shape Construction




```python
import turtle
import math

def draw_geometric_shapes():
    # Screen setup
    screen = turtle.Screen()
    screen.title("Geometric Shapes: Star, Triangle, Octagon")
    screen.bgcolor("black")
    screen.setup(900, 600)

    # Turtle setup
    artist = turtle.Turtle()
    artist.speed(6)
    artist.pensize(3)

    # Shape 1: Triangle
    draw_triangle(artist, -250, 100, 80, "cyan")

    # Shape 2: Five-pointed Star
    draw_star(artist, 0, 100, 80, "yellow")

    # Shape 3: Octagon
    draw_octagon(artist, 250, 100, 60, "magenta")

    # Add labels
    add_labels(artist)

    artist.hideturtle()
```

```
    print("All shapes drawn successfully!")
    screen.exitonclick()

def draw_triangle(turtle_obj, x, y, size, color):
    """Draw an equilateral triangle"""
    print(f"Drawing triangle at ({x}, {y})")

    turtle_obj.penup()
    turtle_obj.goto(x, y)
    turtle_obj.pendown()
    turtle_obj.color(color)
    turtle_obj.fillcolor(color)

    turtle_obj.begin_fill()
    for _ in range(3):
        turtle_obj.forward(size)
        turtle_obj.left(120)  # External angle for triangle
    turtle_obj.end_fill()

def draw_star(turtle_obj, x, y, size, color):
    """Draw a five-pointed star"""
    print(f"Drawing star at ({x}, {y})")

    turtle_obj.penup()
    turtle_obj.goto(x, y)
    turtle_obj.pendown()
    turtle_obj.color(color)
    turtle_obj.fillcolor(color)

    turtle_obj.begin_fill()
    for _ in range(5):
        turtle_obj.forward(size)
        turtle_obj.right(144)  # 144° turn for 5-pointed star
    turtle_obj.end_fill()

def draw_octagon(turtle_obj, x, y, size, color):
    """Draw a regular octagon"""
    print(f"Drawing octagon at ({x}, {y})")

    turtle_obj.penup()
    turtle_obj.goto(x, y)
    turtle_obj.pendown()
    turtle_obj.color(color)
    turtle_obj.fillcolor(color)

    turtle_obj.begin_fill()
    for _ in range(8):
        turtle_obj.forward(size)
        turtle_obj.right(45)  # 360°/8 = 45° for octagon
    turtle_obj.end_fill()

def add_labels(turtle_obj):
```

```
    """Add labels for each shape"""
    turtle_obj.color("white")

    labels = [
        (-250, 30, "Triangle\n3 sides\n120° turns"),
        (0, 30, "Star\n5 points\n144° turns"),
        (250, 30, "Octagon\n8 sides\n45° turns")
    ]

    for x, y, text in labels:
        turtle_obj.penup()
        turtle_obj.goto(x, y)
        turtle_obj.write(text, align="center", font=("Arial", 12, "normal"))

def draw_advanced_shapes():
    """Advanced version with animations and multiple variations"""
    screen = turtle.Screen()
    screen.title("Advanced Geometric Shapes")
    screen.bgcolor("navy")
    screen.setup(1000, 700)

    artist = turtle.Turtle()
    artist.speed(8)
    artist.pensize(2)

    # Animated triangle variations
    triangle_sizes = [40, 60, 80]
    triangle_colors = ["red", "orange", "yellow"]

    for i, (size, color) in enumerate(zip(triangle_sizes, triangle_colors)):
        x = -300 + i * 30
        y = 200 - i * 20
        draw_triangle(artist, x, y, size, color)

    # Animated star variations
    star_sizes = [30, 50, 70, 90]
    star_colors = ["pink", "lightblue", "lightgreen", "gold"]

    for i, (size, color) in enumerate(zip(star_sizes, star_colors)):
        angle = i * 90
        x = 150 + math.cos(math.radians(angle)) * 80
        y = 100 + math.sin(math.radians(angle)) * 80

        artist.penup()
        artist.goto(x, y)
        artist.setheading(angle)
        artist.pendown()
        artist.color(color)
        artist.fillcolor(color)

        artist.begin_fill()
        for _ in range(5):
```

```
            artist.forward(size)
            artist.right(144)
        artist.end_fill()

    # Octagon pattern
    for i in range(3):
        size = 40 + i * 15
        color_intensity = 0.3 + i * 0.2
        draw_octagon(artist, -100, -100 + i * 80, size,
                     (color_intensity, 0, color_intensity))

    # Mathematical information
    artist.penup()
    artist.goto(0, -250)
    artist.color("white")
    artist.write("Geometric Shapes - Mathematical Properties",
                 align="center", font=("Arial", 16, "bold"))

    artist.goto(0, -280)
    artist.write("Triangle: Sum of angles = 180°, Star: 36° points, Octagon: Sum =
1080°",
                 align="center", font=("Arial", 12, "normal"))

    artist.hideturtle()
    screen.exitonclick()

def calculate_shape_properties():
    """Calculate and display mathematical properties"""
    shapes_info = {
        "Triangle": {
            "sides": 3,
            "internal_angle": 180 * (3-2) / 3,
            "external_angle": 360 / 3,
            "sum_of_angles": 180 * (3-2)
        },
        "Star (5-point)": {
            "points": 5,
            "point_angle": 36,
            "turn_angle": 144,
            "total_rotation": 720
        },
        "Octagon": {
            "sides": 8,
            "internal_angle": 180 * (8-2) / 8,
            "external_angle": 360 / 8,
            "sum_of_angles": 180 * (8-2)
        }
    }

    print("\n" + "="*50)
    print("GEOMETRIC SHAPES - MATHEMATICAL PROPERTIES")
    print("="*50)
```

```
    for shape, props in shapes_info.items():
        print(f"\n{shape}:")
        for prop, value in props.items():
            print(f"  {prop.replace('_', ' ').title()}: {value}°" if 'angle' in prop else
f"  {prop.replace('_', ' ').title()}: {value}")

# Run the programs
print("Choose drawing mode:")
print("1. Basic Shapes")
print("2. Advanced Shapes with Variations")

choice = input("Enter choice (1 or 2): ")

if choice == "2":
    draw_advanced_shapes()
else:
    draw_geometric_shapes()

# Display mathematical properties
calculate_shape_properties()
```

- **Angle Calculation**: દરેક shape માટે correct turn angles ની calculation જરૂરી
- **Fill Technique**: begin_fill() અને end_fill() વચ્ચે shape automatically fill થાય
- **Mathematical Foundation**: Geometry ના principles આધારે shapes construct થાય

Mnemonic: "Triangle 120, Star 144, Octagon 45"