

CSIT110

# Fundamental Programming with Python

Class and Object 2

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# In this lecture

- Class and Object
  - Class method
  - Static method
- Problem solving with Class and Object

# Example

We want to build a program to let children practice mathematics.

- The program generates random questions of 4 types:
  - Addition question:  $5 + 7 = ?$
  - Subtraction question:  $25 - 3 = ?$
  - Multiplication question:  $4 \times 5 = ?$
  - Division question:  $20 / 10 = ?$
- The program checks the user answer and indicates the answer is correct or not

```
Welcome to cool math:
```

```
3 + 12 = 15
```

```
Correct
```

```
14 / 2 = 8
```

```
Incorrect
```

```
5 x 8 = 40
```

```
Correct
```

```
10 - 4 = q
```

```
Good bye!
```

# Designing the Class

Class `MathQuestion` has the following attributes:

- First number e.g. 4,
- Second number e.g. 6,
- Operation e.g. +,
- Solution e.g. 10

```
class MathQuestion:
    """
    Represents a question such as 4 + 6 = ?
    with the following attributes:
        number1: 1st number
        number2: 2nd number
        operation: +, -, x or /
        solution: the correct solution
    """

    def __init__(self, number1, number2, operation, solution):
        ...
```

# Designing the Class

```
class MathQuestion:

    def __init__(self, number1, number2, operation, solution):
        self.number1 = number1
        self.number2 = number2
        self.operation = operation
        self.solution = solution
```

```
# create question objects

question1 = MathQuestion(4, 6, "+", 10)
question2 = MathQuestion(17, 10, "-", 7)
question3 = MathQuestion(5, 3, "x", 15)
question4 = MathQuestion(35, 5, "/", 7)
```

# Special (dunder) method

```
class MathQuestion:

    def __str__(self):
        return f"{self.number1} {self.operation} {self.number2} = {self.solution}"
```

```
question1 = MathQuestion(4, 6, "+", 10)
question2 = MathQuestion(17, 10, "-", 7)
question3 = MathQuestion(5, 3, "x", 15)
question4 = MathQuestion(35, 5, "/", 7)

# test str
print(str(question1))
print(str(question2))
print(str(question3))
print(str(question4))
```

4 + 6 = 10
17 - 10 = 7
5 x 3 = 15
35 / 5 = 7

# Super (dunder) method

```
class MathQuestion:
```

```
    def __repr__(self):
```

```
        return f"MathQuestion({self.number1}, {self.number2}, '{self.operation}', {self.solution})"
```

```
question1 = MathQuestion(4, 6, "+", 10)
question2 = MathQuestion(17, 10, "-", 7)
question3 = MathQuestion(5, 3, "x", 15)
question4 = MathQuestion(35, 5, "/", 7)

# test repr
print(repr(question1))
print(repr(question2))
print(repr(question3))
print(repr(question4))
```

```
MathQuestion(4, 6, '+', 10)
MathQuestion(17, 10, '-', 7)
MathQuestion(5, 3, 'x', 15)
MathQuestion(35, 5, '/', 7)
```

Some information belong to individual object instance.  
Some other information is common to all objects of the same class.

**Instance attribute:** data belong to individual object instance.

**Class attribute:** data that is common to all objects of the same class.

## Instance method

- Deals with individual object instance attributes
- Automatically passes the object instance as the first parameter, usually named **self**



# Object instance method

```
class MathQuestion:
    def question_text(self):
        """
        Returns the question text (without the solution)
        """
        return f"{self.number1} {self.operation} {self.number2} = "
```

```
question1 = MathQuestion(4, 6, "+", 10)
question2 = MathQuestion(17, 10, "-", 7)
question3 = MathQuestion(5, 3, "x", 15)
question4 = MathQuestion(35, 5, "/", 7)

# test question_text()
print(question1.question_text())
print(question2.question_text())
print(question3.question_text())
print(question4.question_text())
```

4 + 6 =
17 - 10 =
5 x 3 =
35 / 5 =

# Object instance method

```
class MathQuestion:
    def check_answer(self, answer):
        """
        Returns true if the answer is equal to the solution
        """
        return answer == self.solution)

question1 = MathQuestion(4, 6, "+", 10)
question2 = MathQuestion(17, 10, "-", 7)
question3 = MathQuestion(5, 3, "x", 15)
question4 = MathQuestion(35, 5, "/", 7)

# test check_answer()
print(question1.check_answer(10))
print(question2.check_answer(1))
print(question3.check_answer(15))
print(question4.check_answer(2))
```

True  
False  
True  
False

# Static / Class Method

Some information belong to individual object instance.  
Some other information is common to all objects.

**Instance attribute:** data belonging to individual object instances.

**Class attribute:** data that is common to all objects.

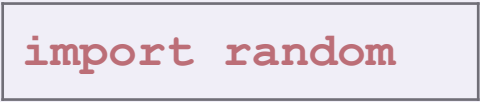
## Static / Class method:

- Does NOT deal with individual object instance attributes
- Class method: automatically pass the class as the first parameter we use `cls` to differentiate it.
- Static method: no automatic parameter passing

# Static Method

```
class MathQuestion:
    @staticmethod
    def generate_question_add():
        """
        Generate a random addition question
        """
        operation = "+"
        number1 = random.randint(0, 20)
        number2 = random.randint(0, 20)
        solution = number1 + number2

        return MathQuestion(number1, number2, operation, solution)
```



```
# testing generate add question
add_question = MathQuestion.generate_question_add()

print(str(add_question))
print(add_question.question_text())
print(add_question.check_answer(-77))
```

12 + 6 = 18  
12 + 6 =  
False

# Static Method

```
class MathQuestion:
    @staticmethod
    def generate_question_subtract():
        """
        Generate a random addition question
        """
        operation = "-"
        solution = random.randint(0, 20)
        number2 = random.randint(0, 20)
        number1 = solution + number2

        return MathQuestion(number1, number2, operation, solution)
```

```
# testing generate subtract question
subtract_question = MathQuestion.generate_question_subtract()

print(str(subtract_question))
print(subtract_question.question_text())
print(subtract_question.check_answer(-77))
```

19 - 3 = 16 19 - 3 = False
----------------------------------

# Static Method

```
class MathQuestion:
    @staticmethod
    def generate_question_multiply():
        """
        Generate a random addition question
        """
        operation = "x"
        number1 = random.randint(0, 10)
        number2 = random.randint(0, 10)
        solution = number1 * number2

        return MathQuestion(number1, number2, operation, solution)
```

```
# testing generate multiply question
multiply_question = MathQuestion.generate_question_multiply()

print(str(multiply_question))
print(multiply_question.question_text())
print(multiply_question.check_answer(-77))
```

2 x 5 = 10
2 x 5 =
False

# Static Method

```
class MathQuestion:
    @staticmethod
    def generate_question_divide():
        """
        Generate a random division question
        """
        operation = "/"
        solution = random.randint(0, 10)
        number2 = random.randint(1, 10)
        number1 = solution * number2

        return MathQuestion(number1, number2, operation, solution)
```

```
# testing generate divide question
divide_question = MathQuestion.generate_question_divide()

print(str(divide_question))
print(divide_question.question_text())
print(divide_question.check_answer(-77))
```

14 / 2 = 7  
14 / 2 =  
False

# Static Method

```
class MathQuestion:
    @staticmethod
    def generate_question():
        """
        Generate a random question
        """
        question_type = random.randint(1, 4)

        if (question_type == 1):
            question = MathQuestion.generate_question_add()
        elif (question_type == 2):
            question = MathQuestion.generate_question_subtract()
        elif (question_type == 3):
            question = MathQuestion.generate_question_multiply()
        else:
            question = MathQuestion.generate_question_divide()

        return question
```



# Static Method

```
class MathQuestion:
    @staticmethod
    def generate_question():
        """
        Generate a random question
        """
        ...
        return question
```

```
# testing generate random question
random_question1 = MathQuestion.generate_question()
print(str(random_question1))

random_question2 = MathQuestion.generate_question()
print(str(random_question2))
```

$16 - 7 = 9$ $4 \times 5 = 20$
-----------------------------------

# Class Method

```
class MathQuestion:
    @staticmethod
    def generate_question_add():
        operation = "+"
        number1 = random.randint(0, 20)
        number2 = random.randint(0, 20)
        solution = number1 + number2
        return MathQuestion(number1, number2, operation, solution)
```

```
class MathQuestion:
    @classmethod
    def generate_question_add(cls):
        operation = "+"
        number1 = random.randint(0, 20)
        number2 = random.randint(0, 20)
        solution = number1 + number2
        return cls(number1, number2, operation, solution)
```

↓ Re-write using class method

# The main program

```
print("Welcome to cool math:")

while True:
    question = MathQuestion.generate_question() # generate a random question

    prompt = question.question_text() # get the question text, use as prompt

    user_input = input(prompt + "(q to quit)") # ask for solution or quit

    if(user_input == "q"): # check if student wants to quit
        print("Good bye!")
        break
    # user don't want to quit - translate string to integer for answer
    answer = int(user_input)
    correct = question.check_answer(answer) # check if answer is correct
    if(correct):
        print("Correct")
    else:
        print("Incorrect")
```

# The main program - output

```
Welcome to cool math:
```

```
3 + 12 = 15
```

```
Correct
```

```
14 / 2 = 8
```

```
Incorrect
```

```
5 x 8 = 40
```

```
Correct
```

```
10 - 4 = q
```

```
Good bye!
```

Any questions?