# Welcome to CS 2100: Program Design and Implementation

Prof. Rasika Bhalerao

## Rasika Bhalerao, Ph.D.

- (Asst.) Teaching Professor
- Likes:
    - Rock climbing
    - Meditation
- Research areas:
    - Ethical tech
    - Practical/applied AI
    - CS Pedagogy

## In-class participation

Helps students to:

- connect with each other
- learn the material more deeply
- let the instructor know about their understanding.

It is also worth a portion of the grade.

Try it out: https://pollev.com/rasika

Log in with your Northeastern account
(May need to log out of other account)

## Poll: What motivates you? (Choose your top 3)

- Grades
- Learning
- Preparing for job / co-op interviews
- Doing well in the job / co-op
- Doing well in later courses
- Making friends
- Letter of recommendation from instructor
- Enjoying college life
- Addressing societal issues
- Health and well-being

In-class exercises are graded on completion, not correctness.

(And there is no "correct answer" for this poll.)

## Course Structure

- 3 lectures and 1 lab per week
- ~ weekly homework assignments
- Four quizzes and a final exam
- Office hours and the discussion board

## The AI Policy

- No AI coding assistants like Cursor, Windsurf, and Copilot
- No chat models like ChatGPT, Claude, or Gemini
- Exception: the AI overview that appears when using a search engine like Google. You may use it to look up documentation, errors, concepts, etc.
- Instructor may ask to meet with the student and have them explain their code

### Open ended poll: How do you feel about the AI policy?

## Resources

- Pawtograder (https://app.pawtograder.com)
  - Office hours
  - Discussion board
  - Starting assignments (homework and labs)
  - Checking grades
- Git / GitHub: Submitting assignments
- Lecture notes (https://neu-pdi.github.io/cs2100-public-resources)
- Textbook: "Python 3 Object Oriented Programming: Harness the Power of Python 3 Objects" by Dusty Phillips
  - we will not follow it exactly

## Code-level Design Practices (style guidlines)

### Why enforce a Style Guide?

- Any code that we write will be read by at least one other person (probably more)
    - Sometimes that "other person" is actually ourselves, years in the future, attempting to use our old code.
- Many employers require code to be verified by at least two other people before it is accepted into the code base
- Helps other people to easily contribute to our codebase
- TA needs to read it to grade it

We use the "official" Python style guide, PEP8: https://peps.python.org/pep-0008

## Style: Variable naming conventions

Names of variables, functions, and modules use `snake_case`: words in lowercase, separated by underscores (_).

## Pylint

Pylint (https://marketplace.visualstudio.com/items?itemName=ms-python.pylint) checks that our code follows the style guidelines.

Please set up the Pylint VSCode extension using the steps in the Setup Guide.

## Python code with types

Your classmate wants help finding a bug in their code:

```python
def get_area_of_rectangle(width, height):
    return width * height

width = '3'
height = 4

result = get_area_of_rectangle(width, height)

print(f'Area of a {width} by {height} rectangle: {result}')
```

Its output is `Area of a 3 by 4 rectangle: 3333`, which is false.

## Unconvinced? How about this code:

```python
num1 = input('Please enter a number: ')
num2 = input('Please enter another number: ')
print(num1 + num2)
```

It says that 3 + 5 is 35. We'll revisit that in a bit.

## Python:

- strongly typed language (variables have types)
- dynamically typed language (checks the types for consistency at run time, not compile time)

## We love Python, but...

this makes it hard for introductory learners, and hard to catch bugs in code generated by someone else.

## Python supports putting types in code

```python
def get_area_of_rectangle(width: int, height: int) -> int:
    return width * height

width: int = '3'
height: int = 4

result: int = get_area_of_rectangle(width, height)

print(f'Area of a {width} by {height} rectangle: {result}')
```

Python does not enforce the types. (The above code runs exactly the same as before, even after adding the types.)

So we use MyPy to enforce the type checking.

## MyPy

Please set up the MyPy VSCode extension using the steps in the Setup Guide.

Missing or mismatched types will be reported in the "Problems" tab every time you save or open a file:

- Mac: Cmd + Shift + M
- Windows: Ctrl + Shift + M

## MyPy

If MyPy is set up properly, then this code:

```python
def add(num1: int, num2) -> int:
    return num1 + num2

result: str = add(3, 'hi')

def func() -> int:
    pass
```

should result in three errors:

1. `num2` 's missing type
2. `add()` 's returning something other than the promised `int`
3. `result` 's value being an `int` when the variable type is `str`

If MyPy is set up properly, then this code:

```python
def add(num1: int, num2) -> int:
    return num1 + num2

result: str = add(3, 'hi')

def func() -> int:
    pass
```

If there is an error about `func()` missing a return, then the arg `--disable-error-code=empty-body` was not specified correctly in the settings.

## Back to the example where 3 + 5 is 35:

```
num1: int = input('Please enter a number: ')
num2: int = input('Please enter another number: ')
print(num1 + num2)
```

Adding the types for `num1` and `num2` prompted MyPy to remind us that the `input()` function returns a `str`, not an `int`.

## Functions require documentation and tests

Write tests to ensure our code works, but also to convince *others* that our code works.

Each function's documentation must include:

- All parameters
- Any returns
- Any errors or exceptions that might be raised

Formatting the documentation properly makes it show up in official places like `str.__doc__` and `help(str)`.

```python
def get_area_of_rectangle(width: int, height: int) -> int:
    """Returns the area of a rectangle.

    Parameters
    ----------
    width : int
        The width of the rectangle
    height : int
        The height of the rectangle

    Returns
    -------
    int
        The area of the rectangle

    Raises
    ------
    ValueError
        If width or height is negative
    """
    if (width < 0 or height < 0):
        raise ValueError("Rectangle dimensions cannot be negative")
    return width * height
```

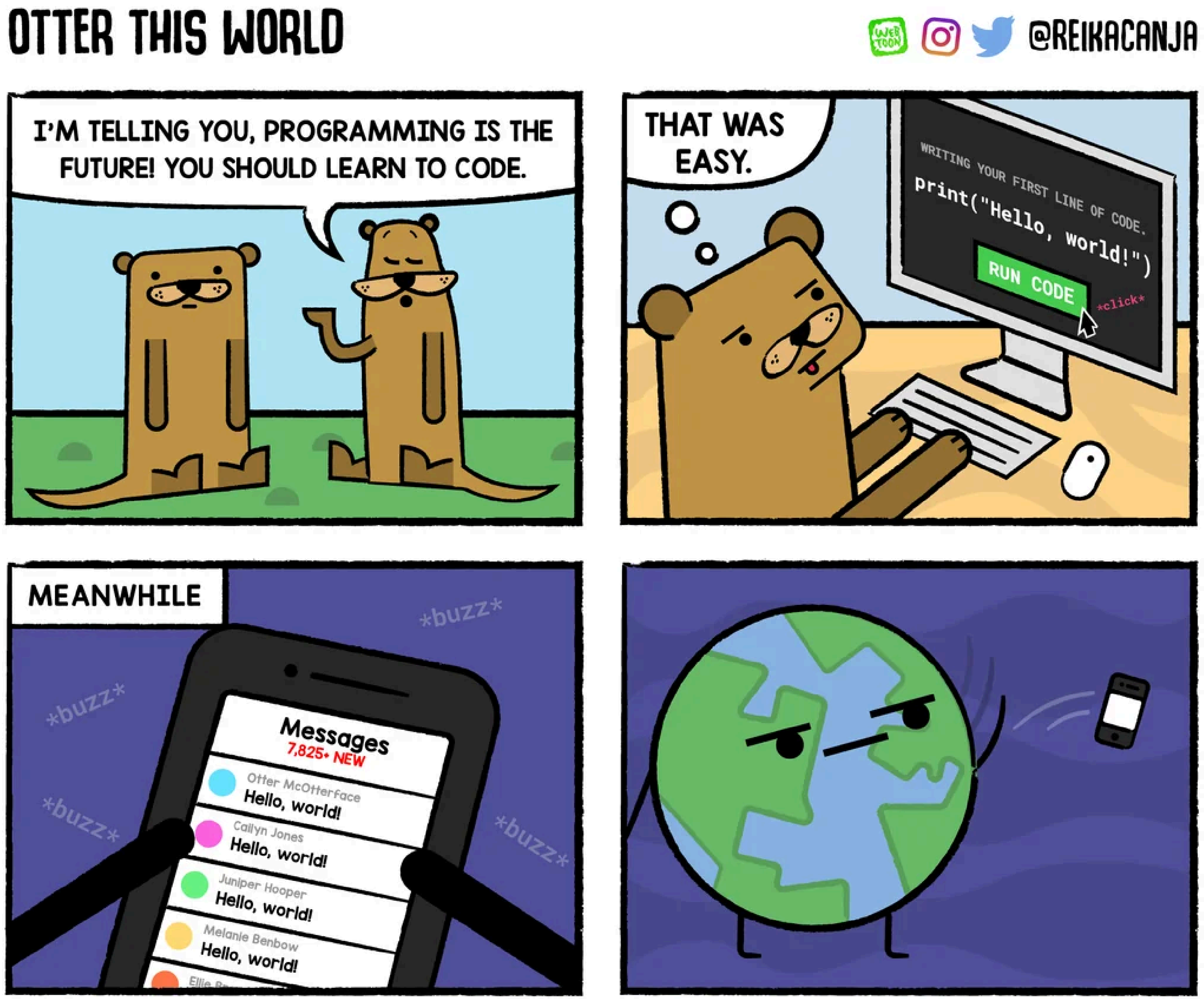
(Same file, continued)

```python
class TestArea(unittest.TestCase):
    """Tests for the function get_area_of_rectangle(width: int, height: int) -> int"""

    def test_3_by_4(self) -> None:
        """3 by 4 rectangle"""
        self.assertEqual(12, get_area_of_rectangle(3, 4))

    def test_negative_area(self) -> None:
        """Make sure it raises a ValueError for a negative width"""
        with self.assertRaises(ValueError):
            get_area_of_rectangle(-1, 4)


if __name__ == '__main__':
    unittest.main()
```

## Why Python?

### It's popular

- Employers
- Interviews
- Hundreds of thousands of public Python packages
- Popular among data scientists, web developers, game developers, machine learning engineers, and many others
- Many online resources for learning Python



Source: https://www.reddit.com/r/ProgrammerHumor/comments/64s93u/hello_world_oc

## Poll:

1. What is your main takeaway from today?

2. What would you like to revisit next time?

Source: https://www.reddit.com/r/ProgrammerHumor/comments/64s93u/hello_world_oc