09-11 - Math operations

# 1. Retrieval

# 2. Python Calculator (POGIL, 15 min)

In a Python Shell window, >>> is a *prompt* indicating that the interpreter is waiting for input. All text entered after the prompt will be executed immediately as Python code.

If you type a Python *expression* (code that results in a value) after the prompt, Python will show the value of that expression, similar to a calculator. You can use Python’s math module to perform more complex mathematical operations like logarithms and trigonometric operations.

**Do not type anything yet! Read the questions first!**

| Python code | Predicted output | Actual output |
| --- | --- | --- |
| 2 + 3 |  |  |
| 3 \* 4 + 2 |  |  |
| 3 \* 4 + 2.0 |  |  |
| 3(4 + 2) |  |  |
| 3 \* (4 + 2) |  |  |
| 5 / 10 |  |  |
| 5 / 10.0 |  |  |
| 5 / 9 |  |  |
| 2 \*\* 4 |  |  |
| abs(-2) \*\* 4 |  |  |
| math.pow(2, 4) |  |  |
| import math |  |  |
| math.pow(2, 4) |  |  |
| sqrt(4) |  |  |
| math.sqrt(4) |  |  |
| math.cos(0) |  |  |
| math.pi |  |  |
| math.sin(math.pi / 2) |  |  |

1. In the middle “Predicted output” column, write what value you expect will be displayed, based on your team’s experience using a calculator. If there are any lines you are not confident about, place an asterisk next to your predicted output.
2. Open a Python Shell on your computer. Type each Python expression at the prompt, one line at a time, and write the corresponding Python output in the third column above. If an error occurs, write what type of error it was (i.e., the first word of the last line of the error message).
3. What does the \*\* operator do?
4. Based on the Python code in the expressions table, identify four examples of:
   * Mathematical operators:
   * Mathematical functions:
5. For addition and multiplication to produce an output with a decimal value, what type of number must be part of the input? Provide justification for your team’s answer.
6. Does division follow the same rule as in the previous question? Provide justification for your team’s answer.
7. The output of the expressions table displayed three different errors. Explain the reason for each:
   * TypeError:
   * 1st NameError:
   * 2nd NameError:
8. Identify two differences between using a Python built-in function (e.g., abs) and a function from the math module.

# 3. Dividing Numbers (POGIL, 15 min)

| 9 / 4 | *evaluates to* | 2.25 |
| --- | --- | --- |
| 10 / 4 | *evaluates to* | 2.5 |
| 11 / 4 | *evaluates to* | 2.75 |
| 12 / 4 | *evaluates to* | 3.0 |
| 13 / 4 | *evaluates to* | 3.25 |
| 14 / 4 | *evaluates to* | 3.5 |
| 15 / 4 | *evaluates to* | 3.75 |
| 16 / 4 | *evaluates to* | 4.0 |

| 9 // 4 | *evaluates to* | 2 |
| --- | --- | --- |
| 10 // 4 | *evaluates to* | 2 |
| 11 // 4 | *evaluates to* | 2 |
| 12 // 4 | *evaluates to* | 3 |
| 13 // 4 | *evaluates to* | 3 |
| 14 // 4 | *evaluates to* | 3 |
| 15 // 4 | *evaluates to* | 3 |
| 16 // 4 | *evaluates to* | 4 |

| 9 % 4 | *evaluates to* | 1 |
| --- | --- | --- |
| 10 % 4 | *evaluates to* | 2 |
| 11 % 4 | *evaluates to* | 3 |
| 12 % 4 | *evaluates to* | 0 |
| 13 % 4 | *evaluates to* | 1 |
| 14 % 4 | \* |  |

evaluates to\* | 2 | | 15 % 4 | *evaluates to* | 3 | | 16 % 4 | *evaluates to* | 0 |

1. For each operator in the tables, identify the symbol and describe the type of numerical result.
2. If the result of the / operator were rounded to the nearest integer, would this be the same as the result of the // operator? Explain how the results in Table~A compare to Table~B.
3. If the table included more rows, list all numbers // 4 would evaluate to 2 and all the numbers // 4 would evaluate to 4.
4. Based on the results of Table~C, propose another number % 4 evaluates to 0, and explain what all these numbers have in common.
5. Consider the expressions in Table~C that evaluate to 1. How do the left *operands* in these expressions (i.e., 9, 13) differ from those that evaluate to 0?
6. Describe the reason for the repeated sequence of numbers (0, 1, 2, 3) for the result of % 4.
7. Imagine that you are given candy mints to divide evenly among your team members.
   * If your team receives 11 mints, how many mints would each student get, and how many are left over? Write a Python expression to compute each result.

* If your team receives 2 mints, how many mints would each student get, and how many are left over? Write a Python expression to compute this result.

1. Python has three division operators: “floor division”, “remainder”, and “true division”. Which operator (symbol) corresponds to each name?