

## Activity: Arithmetic

### Team Roles (10 min)

Decide who will be what role for today's activity. List the names of your team members next to their role.

|                           |
|---------------------------|
| Manager:                  |
| Spokesperson:             |
| Quality Control/Recorder: |
| Process Analyst:          |

If you have only three people, one may serve as both manager and spokesperson. If you have five team members, then assign two people to process analyst.

### Questions

1. What are some advantages to working in groups?
2. What are some disadvantages to working in groups?
3. What is the difference between a group and a team? Come up with a precise answer.
4. Manager: invite each person to explain their role to the team.

## Model 1: Dividing Numbers (10 min)

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

|           |                     |      |
|-----------|---------------------|------|
| 9.0 / 4.0 | <i>evaluates to</i> | 2.25 |
| 10. / 4.  | <i>evaluates to</i> | 2.5  |
| 11 / 4.0  | <i>evaluates to</i> | 2.75 |
| 12. / 4   | <i>evaluates to</i> | 3.0  |
| 13 / 4.0  | <i>evaluates to</i> | 3.25 |

### Questions

5. In the first table, which number(s) divided by 4 evaluate to 3? What is significant about the number of answers you have written down?

6. How do the answers in the first table differ from the mathematically correct answers?

7. To the right of the second table, round each answer to the closest integer. How do those values compare to what you see in the first table?

8. Complete the table:

|          |                     |  |
|----------|---------------------|--|
| 14. / 4. | <i>evaluates to</i> |  |
| 14. / 4  | <i>evaluates to</i> |  |
| 14 / 4.  | <i>evaluates to</i> |  |
| 14 / 4   | <i>evaluates to</i> |  |

9. Dividing numbers with fractional parts (known as **floating-point** numbers) gives you different results from dividing two integers. In the previous question:

- a) Which rows evaluate to an integer?
- b) Which rows evaluate to a floating-point number?

10. Imagine you are writing a Java program that requires division.

- a) What must be true about the **operands** (the numbers around the **operators**) for you to get the mathematically correct answer?
- b) Does it need to be true for *both* operands?

### Model 2: The % Operator (10 min)

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

|        |                     |   |
|--------|---------------------|---|
| 9 % 4  | <i>evaluates to</i> | 1 |
| 10 % 4 | <i>evaluates to</i> | 2 |
| 11 % 4 | <i>evaluates to</i> | 3 |
| 12 % 4 | <i>evaluates to</i> | 0 |
| 13 % 4 | <i>evaluates to</i> | 1 |
| 14 % 4 | <i>evaluates to</i> | 2 |
| 15 % 4 | <i>evaluates to</i> | 3 |
| 16 % 4 | <i>evaluates to</i> | 0 |

### Questions

11. Which numbers % 4 evaluate to 0 in the table above? If the table were extended to include more rows, which other numbers % 4 would evaluate to 0?

12. Look at the expressions in the second table that evaluate to 1. How do the left operands in these expressions (9, 13, 17) differ from those that evaluate to 0?

13. List three numbers % 5 that will evaluate to 0 and three numbers % 5 that will evaluate to 2.

14. Evaluate the following Java expressions:

$18 \% 4$

$19 \% 4$

$19 \% 5$

$19 \% 6$

15. Describe what the % operator does. How are the / and % operators related?

16. “Twenty-nine days” means the same thing as “Four weeks and one day”. If **days** is a Java integer variable containing some number of days, develop expressions for:

- The number of weeks in `days` (4 in the example above).
- The number of days that are left over. (1 in the example above).

### Model 3: Order of Operations (10 min)

The Java language defines a specific order of execution for math and other operations. For example, multiplication and division take precedence over addition and subtraction. Using parentheses, you can override the order of operations. The following table lists some Java operators from highest precedence to lowest precedence.

|                                    |       |
|------------------------------------|-------|
| Parenthesis                        | ( )   |
| Unary (positive or negative signs) | + -   |
| Multiplicative                     | * / % |
| Additive                           | + -   |
| Assignment                         | =     |

For the following questions, assume you have these two variables:

```
int x;  
double y;
```

### Questions

17. What operator has the lowest precedence? Why do you think Java is designed that way?
  
18. Give the order of operations in the Java expression: `x = 5 * -3;`
  - a) First operator to be executed:
  - b) Second operator:
  - c) Third operator:
  
19. Give the order of operations in the Java expression: `y = 9 / 2;`
  - a) First operator to be executed:
  - b) Second operator:
  
20. Based on your answer to the previous question, explain why the variable `y` will be changed to 4.0 (and not 4 or 4.5).

21. Rewrite the assignment for y so that it will be set correctly to 4.5. (Hint: you'll need to recall what you learned about division in Model 1.)

22. Number each of the operators in the following expression in the order that they will be executed:

$$y = 3.0 / 2 * 3 + 10 / 3 * 2$$

23. What will be contained in y after this expression is executed?

### **Group Reflection (5 min)**

Process Analyst: Lead a short discussion on how your team performed during today's activities. Discuss what went well and what could be improved next time. Complete the Report Form included in your folder.

Everyone: Review the job description on your role card. Evaluate privately on how well you performed in your role. You do not need to record your answer.

### **Acknowledgements**

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## Challenge/Homework

When describing the duration of some event we could say:

**“The class lasted 1 hour, 20 minutes and 13 seconds.”**

Or, we could say:

**“The class lasted 4813 seconds.”**

The two statements express the same idea in two different ways.

It is possible to convert from one representation to the other using arithmetic operators. The following example shows how we can convert from hours/minutes/seconds to seconds:

```
int totalSeconds;
int hours;
int minutes;
int seconds;

hours = 1;
minutes = 20;
seconds = 13;

totalSeconds = hours * 3600 + minutes * 60 + seconds;
```

This works because there are 3600 seconds in an hour and 60 seconds in a minute.

Your goal is to determine appropriate Java expressions for performing this conversion in the other direction: from the total number of seconds to the equivalent number of hours minutes and seconds:

```
int totalSeconds;
int hours;
int minutes;
int seconds;

totalSeconds = 4813;

hours = ??????;
minutes = ??????;
seconds = ??????;
```

Each ?????? should be replaced with an expression involving `totalSeconds`.