Lesson 5: Arithmetic expressions

Introduction

This lesson has been designed to ensure that learners understand the rules of operator precedence when evaluating arithmetic expressions. They will be reminded of BIDMAS, before investigating code that uses various arithmetic expressions. This lesson will prepare them for the next lesson, where they will begin to use conditions in programming.

Learning objectives

- Evaluate arithmetic expressions using rules of operator precedence (BIDMAS)
- Write and use expressions that use arithmetic operators (add, subtract, multiply, real division, integer division, MOD, to the power)
- Assign expressions to variables

Key vocabulary

Arithmetic expression, BIDMAS, MOD/modulo, integer division, real division, operators

Preparation

Subject knowledge:

You will need to be aware of how PEMDAS is used to determine the rules of operator precedence. You should also know how to use the following in Python code:

- MOD
- To the power (exponentiation)
- Integer division
- Real division

You will need:

- Slides
- Split my bill: A2 worksheet and solutions
- A2 starter file (https://replit.com/@awade05/splitmybill#main.py)
- Feedback journal: worksheet

You may also need:

- A2 modify program solution
- Make solution

Assessment opportunities

The starter activity is an opportunity to use peer instruction to see what learners have remembered from their math lessons about PEMDAS.

The 'Using operators in Python' activity includes three peer instruction questions that should be used to check learner understanding of integer division and modulo.

'Split my bill' is a PRIMM activity. Model answers have been provided to help learners self- or peer-assessment, or they can be used for teacher assessment.

Misconception

Modulo is used to store the discarded values after the decimal point. E.g `number = 10%3` would evaluate as `number = 0.3333333`.

Outline plan

Please note that the slide deck labels the activities in the top right-hand corner to help you navigate the lesson.

Starter activity (Slides 2–12) 8 mins	**Arithmetic expressions - what value is being held?** Present learners with the expression `number = 10-2+2*5` and ask them to choose from four possible answers to decide what value is being held by `number`. The correct answer is 18. The other three were distractors that learners might think are the answer if they have misunderstood the concept of PEMDAS from their math lessons. Use peer instruction as a way to get learners to work together to form an answer. Learners should be given a short amount of time to develop their answer, which they could write on a mini whiteboard. Alternatively, you could use clickers or cards with A, B, C, D on them. After their initial answer, ask learners with each response to explain what led them to that answer. Once each option has been discussed, ask learners to choose again before revealing the correct answer (18). During your discussion, a learner may have already reminded the class of BIDMAS and order of precedence. It is important to note that some learners may think that you need to add before you subtract because this is how PEMDAS is written. However, the add and subtract are interchangeable and the expression should be solved from left to right. Slides 3–12 explain this.

Activity 1 (Slides 14–24) 15 mins	**Using operators in Python** Introduce learners to the operators used in Python to create arithmetic expressions. They will be familiar with most of them, but integer division and modulo will possibly be new to them. The slides will give them an introduction to integer division and modulo with example code. You may wish for learners to try these code snippets out themselves, but this will be covered in the next activity. **Note:** If you or your learners are typing this directly into the shell (interactive prompt), then the print is no longer needed and it will be quicker to show more examples. It is important to note that when integer division // is used in Python with real/float numbers it will evaluate as a real number. Learners don't need to know this at this point, but they might come across issues later on where this can then be introduced. Some learners find the concept of modulo confusing because they have the misconception that it will store the discarded values after the decimal point. For example, they think that `number = 10%3` will evaluate as `number = 0.33333`. It is important that they understand that modulo is used to calculate the remaining whole value. The counters on slide 19 should help to correct/avoid this misconception. Slides 22 to 24 include three **peer instruction** questions that should be used to check learner understanding of integer division and modulo.

Activity 2 (Slide 25) 25 mins	**The split my bill app - A PRIMM activity** Learners will be using the PRIMM approach to investigate a program that has been created to work out how a bill could be split between friends. The investigation task allows learners to think about how each line of code works and how the lines relate to each other. The investigation tasks assess new learning whilst also visiting prior learning on data types and data validation techniques. The modified task has been designed to get learners to write their own arithmetic expression based on three separate expressions. Learners can use their knowledge of BIDMAS to help them write an accurate expression. It also gives them opportunities to test their work. The modified task also allows learners to check how much they remembered about try and except. They are asked to incorporate this into the code to make it more robust. Finally, present the learners with a task. Ask them to create a program that is similar to 'Split my bill', but this time they will be splitting a pizza between friends. They will need to use their new knowledge of integer division and mod to create a program that will split the pizza evenly and reveal how many slices will be remaining. An explorer task has been provided where learners are asked to incorporate both apps together to work out the cost per person of the pizza. Model answers have been provided for the 'Split my bill' worksheet. There is also a sample solution

	(https://replit.com/@awade05/splitmybillmodifysolution#main.py) of the modified tasks. There is also a sample solution to the make task.(https://replit.com/@awade05/makepizza)
Plenary (Slide 26) 5 mins	**Learning partner feedback** Throughout this unit there will be opportunities for learners to share their progress and challenges with a learning partner. You may want to establish these now and use the same person for the whole unit, or you may wish to vary the partners as you go along. Give the learners some time to reflect on their solutions to the task with their learning partner. They must discuss: ● Did you meet the requirements? ● Did you try the explorer task? ● What errors did you encounter and how did you overcome them? ● How could you improve your program? Learners should record their feedback using the feedback journal.

Homework	**Optional:** Complete the ‘Split my pizza’ app for homework. Improve it based on feedback.