'Squashing Bugs, Not Snakes': Co-creating a Python toolkit to develop students' programming proficiency



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INTRODUCTION & MOTIVATION

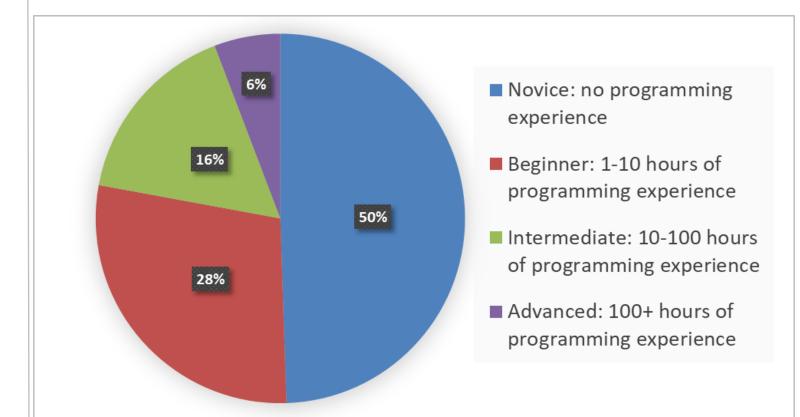
Feedback from first-year engineering students at QMUL revealed that they found programming rather difficult, particularly those without prior experience of it from their early education. Moreover, they felt that programming was taught very sparsely to engineers, leading to a lack of conceptual understanding, as it is not explained from the foundations of how a programming language works, making it hard to conceptualise.

Author: Muhie # Date: 21/05/24 # Explanation of the program: A program that finds fractions def get_valid_input(message, zero_check): valid_input = False while valid_input == False: user_input = int(input(message)) if zero_check == False: return user_input if user_input != 0: valid_input = True return user_input print("Invalid input, you cannot divide by zero, plese try again") numerator = get_valid_input("Welcome to the fraction calculator, " + "please enter the numerator", False) denomenator = get_valid_input("Please enter the denomenator", True) fraction = numerator/denomenator print(fraction)

Welcome to the fraction calculator, please enter the numerator 10 Please enter the denomenator 0 Invalid input, you cannot divide by zero, plese try again Please enter the denomenator 0 Invalid input, you cannot divide by zero, plese try again Please enter the denomenator 0 Invalid input, you cannot divide by zero, plese try again Please enter the denomenator 8 1.25

Module Survey (190 responses)

How would you describe your previous Python programming experience?



PROJECT AIMS

- To bridge the knowledge gap and create a 'level playing field' between students with varying levels of programming experience
- To help students avoid frustration by addressing common errors that beginners often make
- To build confidence by delivering • targeted practice questions that reinforce fundamental concepts
- To enhance students' problem-solving skills through a practice-oriented learning approach, in alignment with the QMUL Graduate Attributes framework

IMPLEMENTATION

Figure 22: Code with input validation

5.3 Creating infinite loops by forgetting to add a stopping condition (base case)

The simplest case where a user could accidentally create an infinite loop is through the use of the 'while' loop functions. An example case consists of using 'while True:', this statement in conjunction with the boolean True, makes it so the while loop runs infinitely until the loop is manually broken by the user. As shown below, a while statement and the condition a < b (which is always true), makes the loop run infinitely, since there is never a condition that causes the loop to break. For example:

Week 5: Getting familiar with numpy $\mathbf{2.6}$

1) Create a 3x2 matrix, initially filling it with zeros, then ask the user to input a value for each element in the matrix (the inputs should only be floats). You can make sure that the input type is correct by creating a separate method validate_inputs and rejects any rouge value. Finally, print out the matrix.

2) 3D rotations: Ask the user to input an XYZ point and then ask which axis the user would like to rotate around. Then output the rotated point to the screen.

For an anticlockwise rotation around the x-axis:

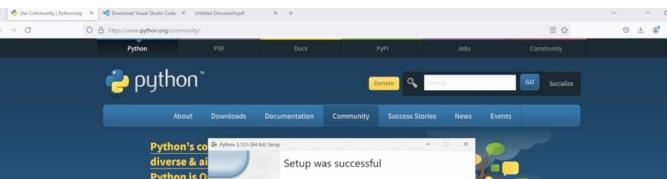
[1	0	0 -
0	cos(heta)	-sin(heta)
0	sin(heta)	cos(heta)

For an anticlockwise rotation around the y-axis:

$\int cos(\theta)$	0	$sin(\theta)$
0	1	0
$\lfloor -sin(\theta)$	0	cos(heta)

For an anticlockwise rotation around the z-axis:

$\cos(\theta)$	-sin(heta)	0
$sin(\theta)$	cos(heta)	0
0	0	1



STUDENT FEEDBACK

"The toolkit has lots of non-obvious but also obvious faults and mistake, which can be difficult to spot as a beginner and so it has been useful for me to see what I have been making mistakes on."

"I like that there are questions asking you to *identify where the errors are* as this is always a good skill to have when coding in general."

"It gives clear and detailed notes related to the mathematical topics which are covered in the course"

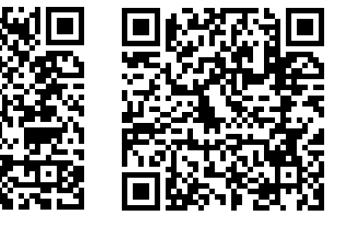
KEY FINDINGS OF STUDENT FEEDBACK

Student feedback was positively commented on how the toolkit design started from a foundational approach by addressing frequently made errors first.

Many of the respondents also highlighted that they would like additional resources covering different python libraries covered in the module such as numpy, matplotlib and pandas.

- **Co-creation** (staff-student partnership) of teaching toolkit resources
- **Components of toolkit:** •
 - Common errors handbook
 - Practice questions booklet
 - Video resources
- **Piloted** in a first-year undergraduate • applied mathematics module
- Embedded as an asynchronous, formative resource for students to use alongside course content

	Great software is sup exception. Our user b use of the language f beginner, the expert, knowledgebase.	Ş	documentation. At y or search for Python	rt with the <u>poline tutorial</u> and your terminal: type "py" to launch Python, in your Start menu. is release, or find more info about <u>using</u>			
	Getting Started New to the community? Here are some great places to get started:	python windows My experience	e with the	newsletter featuring curated news, articles, new releases, jobs, and	This is the place where Pythe	dln on	
	 Python FAQs Attend a Conference Diversity Statement Community Survey We want to be open about how we can improve transparency, provide the community with opportunities to interact with us, and be responsive to raised suggestions. 	Python community has been awesome. I have met some fantastic people through		articles, new releases, jobs, and more. Curated by Rahul Chaudhary every Thursday. Go to pythonweekly.com to sign up.	skills and network. Exchange technical publications, codin		
				PySlackers PySlackers is a community of Python enthusiasts centered aroun an open Slack team.	Go to the Python Developers Community on LinkedIn.		
	Contribute by filling out the Python Software Foundation Community			Go to pyslackers.com for more information and to join.	Libera.Chat hosts several cha Select an IRC client, register		
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Video

Playlists

Practice Questions Toolkit

Common Errors Toolkit

CONCLUSION AND FUTURE WORK

- Incorporate feedback and make necessary adjustments, including additional snippets and examples for future iterations
- Include more video/interactive resources to assist students who prefer different teaching styles
- Incorporate machine learning elements to cater for the second-year applied mathematics and data science module
- **Future dissemination** at QMUL Festival of Education and UK EERN conference in 2025



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