

Development and Evaluation of an AI-Enhanced Python Programming Education System

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Outline:

- Introduction
- Design Process
- System Features
- Examples
- Conclusion

Problems:

- Difficulties to accommodate the diverse learning styles
- Challenges in online education involving interaction
- Reliability of multiple-choice quizzes due to guessing

Previous Solutions:



Khan
Academy



**And many more Online teaching
websites**

Limitations of Current Systems

- The system can only grade questions that it has been explicitly trained on.
- The system can only answer Python related questions.

Our Approach:

- The system is center around having a customized approach to education using AI
- AI-Enhanced Python Programming Education System
 - ❑ Integrate AI into individualized learning for asking questions
 - ❑ Have students give written answers and explanations
 - ❑ Have AI grade the questions and give feedback to the student for improvement

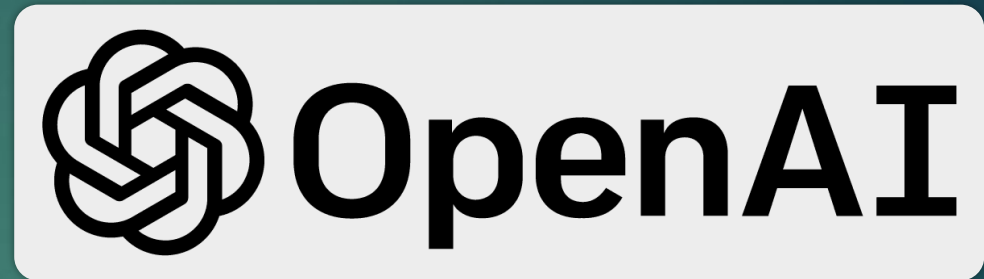
System Features:

- User asks Python-related questions
- Self-grading quiz with feedback
- Entrance exam that returns feedback for sections to review

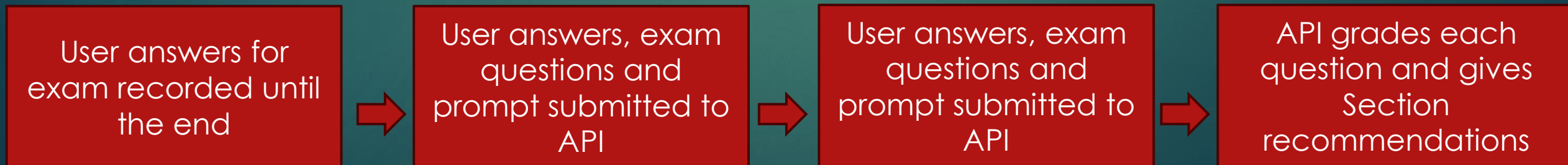
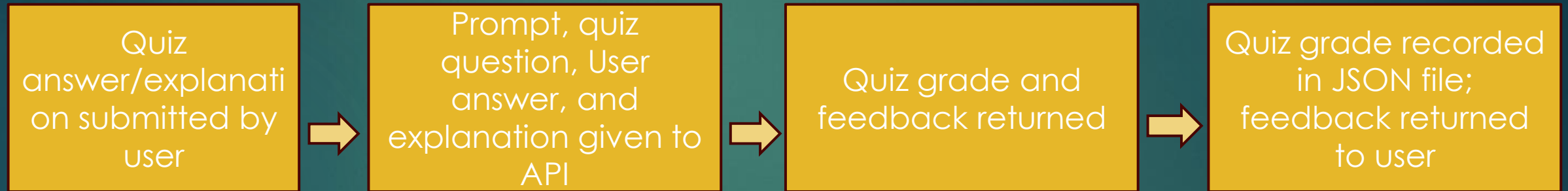
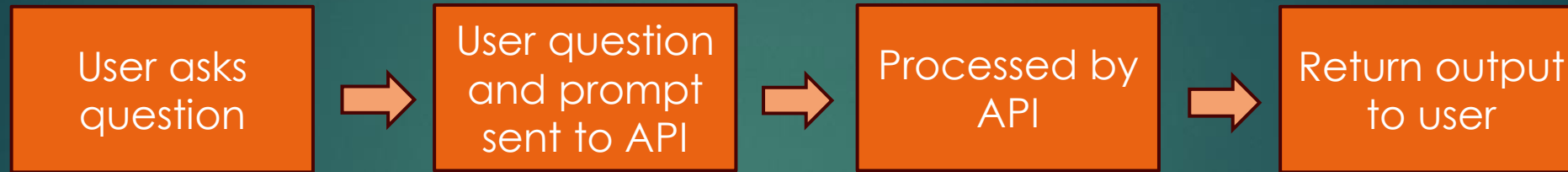
Design Process:

- The system's navigation is designed to be intuitive.
- Users are able to learn at their own pace
- Ask questions in real-time
- Have users answer questions with an explanation
- Have instantaneously graded questions with individualized feedback

Software Utilized:




System Diagram:



Entrance Exam

Home Dark Mode



Entrance Exam

This exam will assess your current Python knowledge and recommend parts of the course based on your performance.

Enter: Name#idNumber

Start

Home Dark Mode

Specific Sections to Review:

Chapter 2:

- Section 2.2
- Section 2.4

Home

Home Dark Mode

Question 13: What will the output be for this code snippet if temperature is 85?

```
1
2 temperature = 85
3 if temperature > 90:
4     print("It's very hot")
5 elif temperature > 70:
6     print("It's warm")
7 else:
8     print("It's cool")
```

Answer:

It's warm

Explanation:

85 is not greater than 90, but is greater than 70. So, the code which executes if temperature is greater than 90 is skipped, but the code which executes if it's greater than 70 is executed.

Back Next

Quiz

Question 1:

Question: What will this code output?

```
print("tacos"+"and"+"cheese")
```

Answer: tacoandcheese

Answer Grade: 80/100

Explanation: it concatenates the strings into a single string and prints the result into the terminal.

Explanation Grade: 80/100

Question 2:

Question: What will this code output if entered correctly in a Python interpreter?

What does the code do?

```
print(type(4))
```

Answer:

Answer Grade: 100/100

Explanation: the code gets the type of the number 4 and then prints the results into the terminal

Explanation Grade: 100/100

Question 3:

Question: What type will "x" be?

```
x=27/3  
print(type(x))
```

Answer: 9.0

Answer Grade: 80/100

Explanation: This is because division always returns a float in python so the answer will be 9 but because it needs to be a float it will return 9.0

Explanation Grade: 80/100

Question 4:

Question: What will this code output?

```
print(17//2)
```

Answer:

Answer Grade: 0/100

Explanation: this is floor division, so the answer removes everything after the . then returns the result.

Explanation Grade: 80/100

Question 5:

Question: What will this code output?

```
print(2**4)
```

Answer: 16

Answer Grade: 100/100

Explanation: 2 to the power of 4 is 16

Explanation Grade: 100/100

Average Grades:

Average Answer Grade: 72/100

Average Explanation Grade: 88/100

Home

Feedback:

Your answer "tacoandcheese" is almost correct. The code will output "tacosandcheese" with an "s" at the end of "taco".

Your explanation is clear and provides a good understanding of what the code does. It correctly mentions that the code concatenates the strings into a single string and prints the result. Just a minor typo in the user answer. Well done!

Next

User asking questions

The screenshot shows a Python learning interface with a dark green header containing 'Home', 'Next', and 'Dark Mode' (with a toggle switch). Below the header, there is a code editor with the following code:

```
cost=4.5
print(name + " is " + str(age) + " years old.")
```

The output of this code is displayed in a light gray box: "Mollie is 25 years old." Below the output, there is a text prompt: "Try creating a variable, and tying it with another. Then printing it out." This is followed by another code editor window titled "main.py" with the following code:

```
1 days_until_vacation=67
2 print(days_until_vacation)
```

Below the code editor, there is a section titled "Number types" with a sub-section for "Integer". The text under "Integer" reads: "Computers process data values that represent different types of informa".

Overlaid on the right side of the interface is a chat window with a dark green background and rounded corners. It contains the following text:

User: what does the map function do in python?
Assistant: The `map()` function in Python applies a specific function to each item in an iterable (such as a list) and returns a new iterator that yields the results. It allows you to process and transform each item in a collection without using a loop. The syntax for `map()` is

At the bottom of the chat window, there is a text input field with the placeholder "Ask your question...", a "Send" button, and a "Close" button.

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Fine Tuning

- The fine-tuning involved changes to the prompt, including grading before recommending sections, providing detailed reasoning for each section, and instructing the AI to double-check results.
- These changes yielded great results.
- To ensure accuracy, we considered adding “Refer” at the start of each section when providing reasoning, due to the system’s second self-check before output.

Question 18:

Output: "5\n4\n3\n2\n1"

(Refer to Chapter 4, Section 4.1 or Chapter 2, Section 2.2 depending on Reasoning)

Reasoning:

If a student understands the -= operator but is unclear about how it works within a loop, direct them to Chapter 4, Section 4.1, which focuses on while loops.

If a student understands looping mechanisms but is not familiar with the -= operator, refer them to Chapter 2, Section 2.2.

If both areas are unclear, they should study both sections for better understanding of loops and augmented assignments.

Results



For the Entrance Exam, the initial testing after being ran yielded 20/30 times being accurate and consistent.



After fine tuning the system, results changed from 20/30 to being 28/30.



The system ran the quiz 30 times, returning consistent results for questions 1, 2, 4, and 5. However, question 3 had inaccurate feedback twice.

Final Thoughts/Conclusion



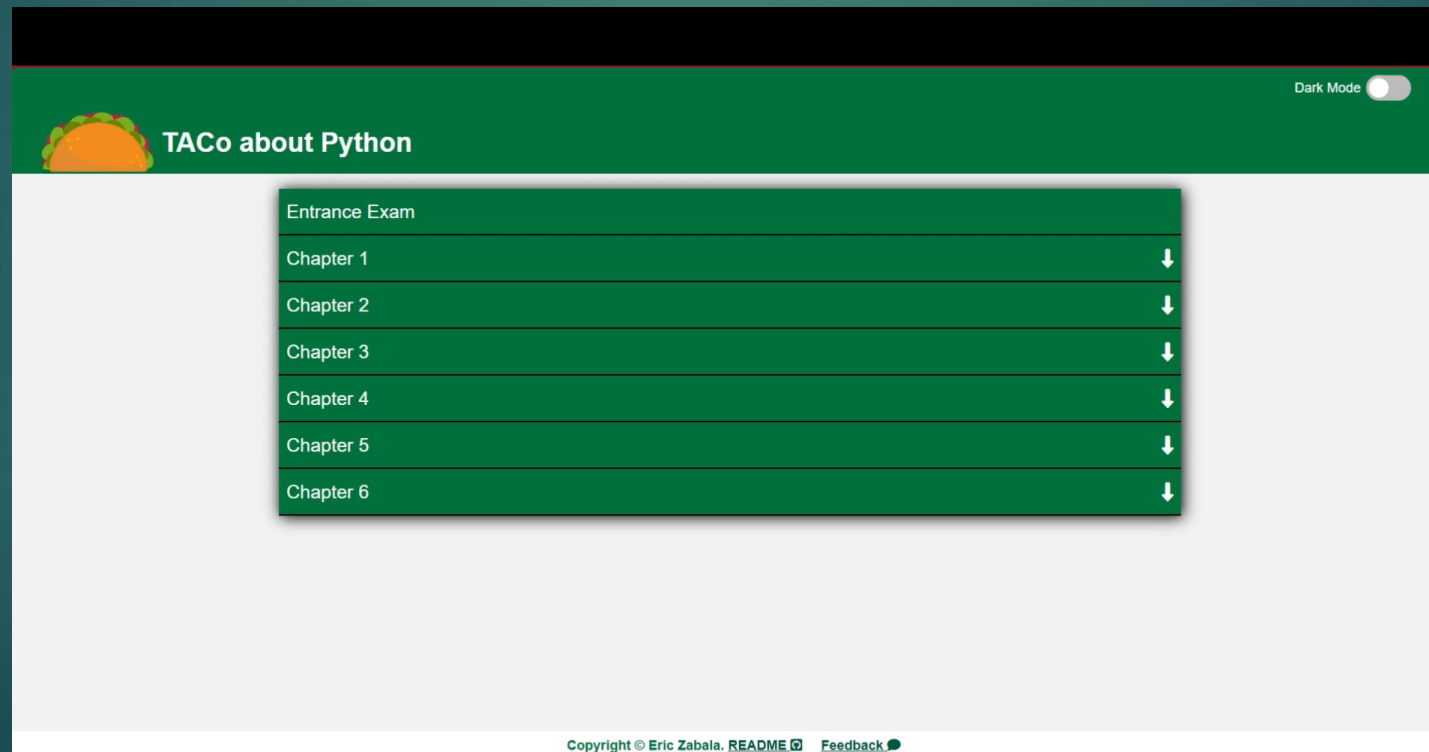
The AI-powered system enhances learning with interactive quizzes, real-time feedback, and a Chatbot for Python-related queries.



The system needs further refinement to address inconsistencies and expand course content before wide-scale deployment.


Demo:

- Here is a demonstration of the app.



Questions?

Dark Mode



TACo about Python

- Entrance Exam
- Chapter 1 ↓
- Chapter 2 ↓
- Chapter 3 ↓
- Chapter 4 ↓
- Chapter 5 ↓
- Chapter 6 ↓

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