CMPE287 – Software Quality Assurance and Testing

Deliverable #2A – AI Test Modeling

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1. AI Function Test Requirement Analysis

1.1 Overview

Photo Math

Photo Math: Photo Math is an AI based educational mobile application owned and maintained by Google. It operates as a computer algebra system combined with an advanced optical character recognition system tailored for utilization with a smartphone's camera to scan and identify mathematical equations. Following the scanning process, the application proceeds to display methodical explanations directly on the screen.

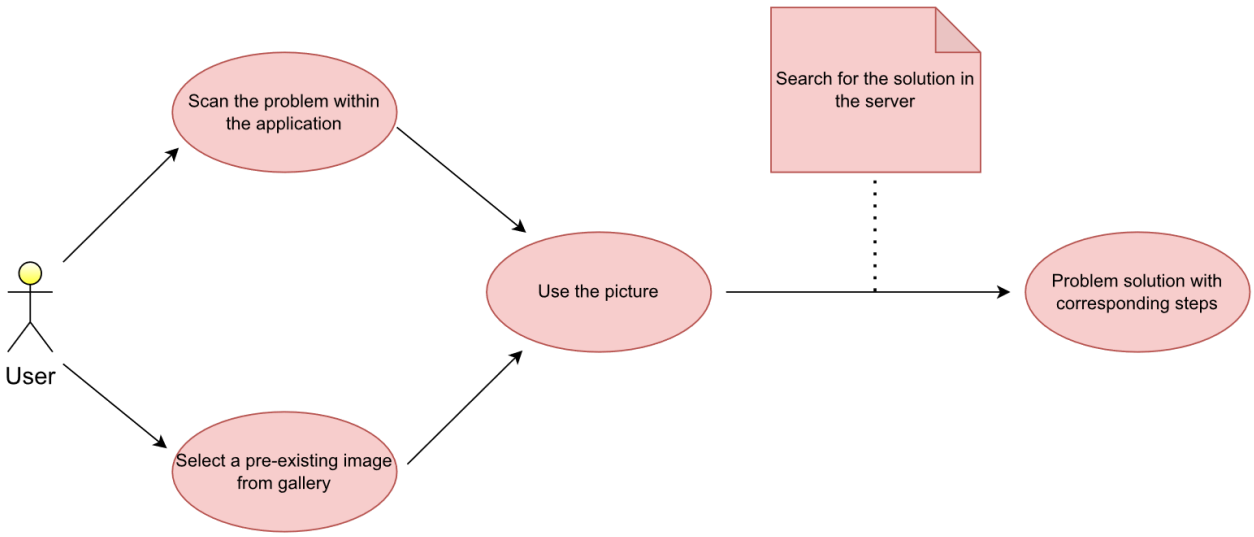


Figure 1.1– AI Function Scenario Diagram

1.2 AI Function Test Requirements

The primary divisions within artificial intelligence consist of machine learning (ML), natural language processing, and image recognition. To establish the criteria for testing the functionality of AI, we will assess whether the selected apps for testing incorporate these specific AI subcategories.

The AI feature we will investigate is Image Recognition. Here are the procedures for assessing this capability:

- Acquire the Image
- Evaluate the Input
- Produce the Outcome

1.3 AI Function Test Requirements Modeling

We are utilizing an AI testing tool to build models for AI function test requirements. This tool will assist us in constructing context trees as well as input and output classification trees. Our objective is to pinpoint the specific features and represent them within these trees. The main nodes within these trees are input, context, and output, which will be subdivided into subcategories based on the identified features. The terminal nodes, represented by leaf nodes, cannot be further divided into features. These leaf nodes represent distinct types of test cases that will undergo testing. The depth of each tree within the input, context, and output classifications is set at 3 levels.

2. AI Test Modeling for Selected AI Features

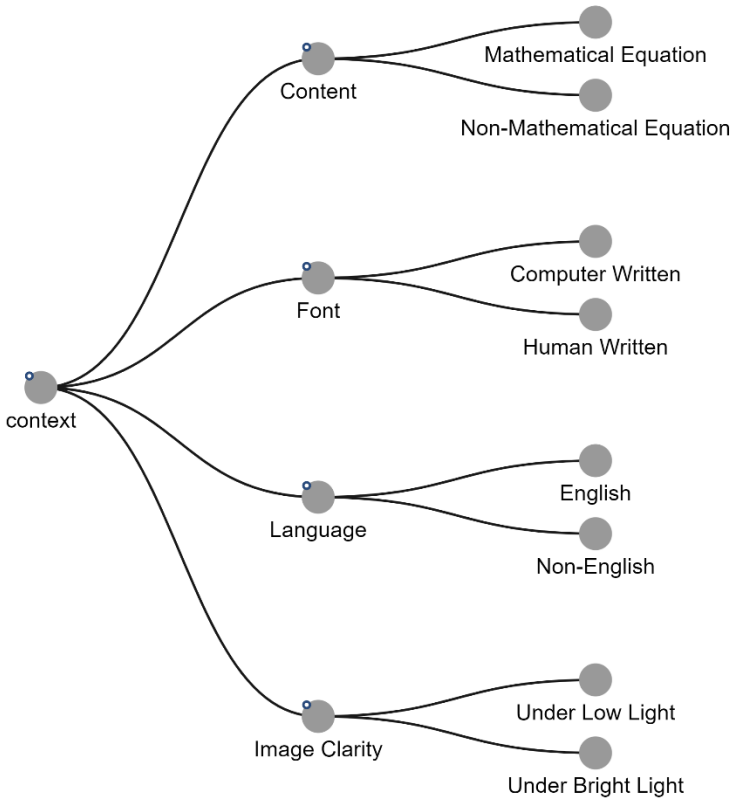
Image Recognition is the AI feature employed in Photomath application. Consequently, all the test cases conducted revolve around image inputs, and the specific AI function under test is Image Recognition. Numerous test cases, each involving distinct scenarios, are executed to evaluate the image recognition functionality of the Photomath application.

2.1 Context Modeling for each selected AI-powered Function/Feature

With respect to modeling the context for the selected AI feature (Image), we have categorized it into 4 types. We have content, font, language, and image clarity. Again, each of these categories is subdivided into two different categories. Content can be a Mathematical Equation, Non-Mathematical Equation. The font, on the other hand, can be

computer written or human written. Similarly, the language could be English or any language other than English. Finally, the image clarity can be good or bad.

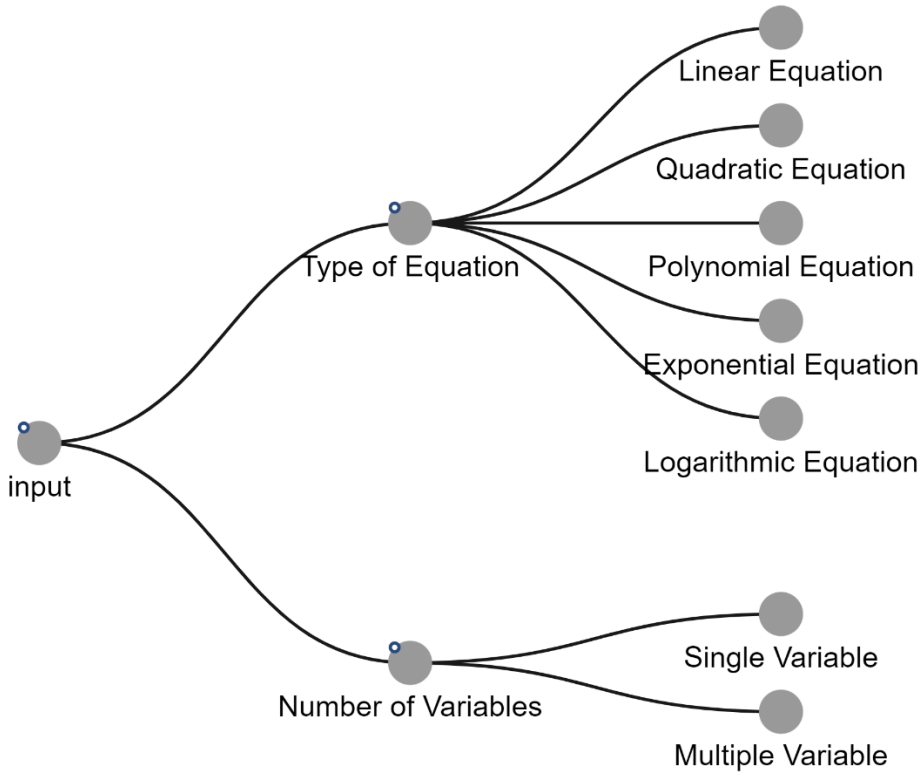
The following image shows the context modeling done using the AI Testing tool:



2.2 AI-powered function input classifications

With respect to the input modeling, we have categorized it into two variants. One is related to the type of equation, and other is regarding the number of variables used. The type of equation is again subcategorized into 5 different categories. They are, Linear Equation, Quadratic Equation, Polynomial Equation, Exponential Equation, Logarithmic Equation. Finally, the number of variables could be single variable inputs or multi-variable inputs.

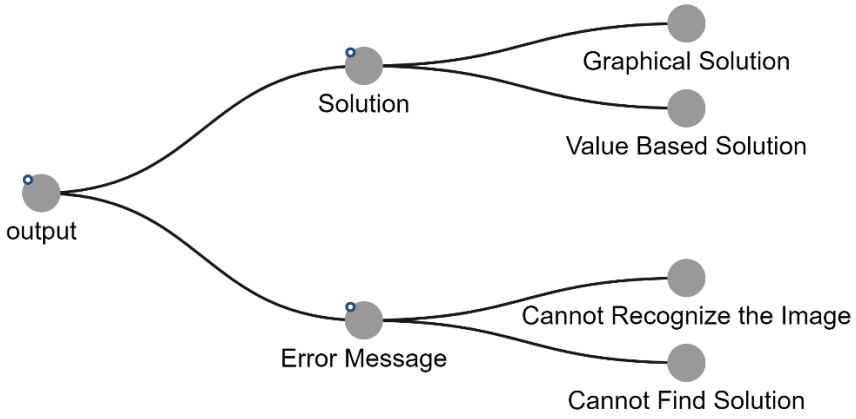
The following image shows the input modeling done using the AI Testing tool



2.3 AI-powered function output/event/action classifications

With respect to the output modeling, we have categorized it into two variants. One is related to the solution, and other is regarding the error message given. The solution is again subcategorized into 2 different categories. We can have Graphical-based solution and value-based solution. Finally, the error message could have ‘cannot recognize the image’ message or ‘cannot find the solution’ message.

The following image shows the output modeling done using the AI Testing tool



2.4 AI-powered function classification decision tables

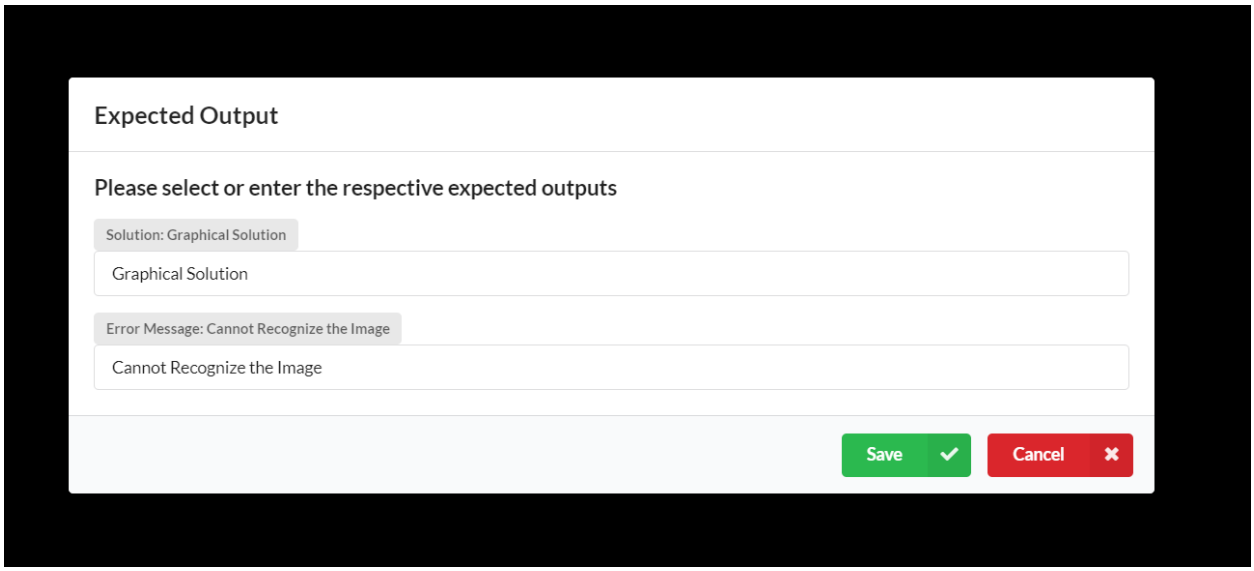
A 3D Decision table is generated from the AI testing tool by the utilizing the above context, input, and output modeling trees.

3. AI Function Test Cases with Inputs/Expected Outputs

3.1 AI-powered function test sets

As you can see in the above 3D decision table, we have “undefined” in the output section of the decision table. This is because we have not yet defined the expected outputs in the tool.

The following snippet shows how we modified the expected output:



After changing the expected outputs of all the test cases, we have the following modified 3D decision table shown in various angles.

id	Error Message	Solution
1	Cannot Recognize the Image	Graphical Solution
2	Cannot Find Solution	Graphical Solution
3	Cannot Recognize the Image	Value Based Solution
4	Cannot Find Solution	Value Based Solution
5	Cannot Find Solution	Graphical Solution
6	Cannot Recognize the Image	Value Based Solution
7	Cannot Find Solution	Graphical Solution
8	Cannot Recognize the Image	Graphical Solution
9	Cannot Find Solution	Value Based Solution
10	Cannot Find Solution	Value Based Solution

id	Number of Variables	Type of Equation
1	Single Variable	Linear Equation
2	Multiple Variable	Logarithmic Equation
3	Multiple Variable	Linear Equation
4	Single Variable	Quadratic Equation
5	Multiple Variable	Quadratic Equation
6	Single Variable	Polynomial Equation
7	Multiple Variable	Polynomial Equation
8	Single Variable	Exponential Equation
9	Multiple Variable	Exponential Equation
10	Single Variable	Logarithmic Equation

id	Number of Variables	Type of Equation
1	Single Variable	Linear Equation
2	Multiple Variable	Logarithmic Equation
3	Multiple Variable	Linear Equation
4	Single Variable	Quadratic Equation
5	Multiple Variable	Quadratic Equation
6	Single Variable	Polynomial Equation
7	Multiple Variable	Polynomial Equation
8	Single Variable	Exponential Equation
9	Multiple Variable	Exponential Equation
10	Single Variable	Logarithmic Equation

The AI testing tool has generated testcases based on the given 3 tree models. The following series of snippets depict the generated testcases.

Project Name: MathScanner Function Name: MathImageScanner

Test Cases

Enter a keyword and press enter...

		Input Feature		Context Feature				Expected Output		Image Input	Upload
	id	Number of Variables	Type of Equation	Content	Font	Image Clarity	Language	Error Message	Solution		
	1	Single Variable	Linear Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Recognize the Image	Graphical Solution		Upload
	2	Multiple Variable	Linear Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Recognize the Image	Value Based Solution		Upload
	3	Single Variable	Quadratic Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Find Solution	Value Based Solution		Upload
	4	Multiple Variable	Quadratic Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Find Solution	Graphical Solution		Upload
	5	Single Variable	Polynomial Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Recognize the Image	Value Based Solution		Upload
	6	Multiple Variable	Polynomial Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Find Solution	Graphical Solution		Upload
	7	Single Variable	Exponential Equation	Mathematical Equation	Computer Written	Under Low Light	English	Cannot Recognize the Image	Graphical Solution		Upload

11	Single Variable	Linear Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Recognize the Image	Graphical Solution		Upload
12	Multiple Variable	Linear Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Recognize the Image	Value Based Solution		Upload
13	Single Variable	Quadratic Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Find Solution	Value Based Solution		Upload
14	Multiple Variable	Quadratic Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Find Solution	Graphical Solution		Upload
15	Single Variable	Polynomial Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Recognize the Image	Value Based Solution		Upload
16	Multiple Variable	Polynomial Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Find Solution	Graphical Solution		Upload
17	Single Variable	Exponential Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Recognize the Image	Graphical Solution		Upload
18	Multiple Variable	Exponential Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Find Solution	Value Based Solution		Upload
19	Single Variable	Logarithmic Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Find Solution	Value Based Solution		Upload
20	Multiple Variable	Logarithmic Equation	Mathematical Equation	Computer Written	Under Bright Light	English	Cannot Find Solution	Graphical Solution		Upload

« ‹ 1 2 3 4 5 ... 8 › » Select rows per page Import Data Export Testcases Data Generation Data Augmentation

Project Name: MathScanner Function Name: MathImageScanner

Test Cases

Enter a keyword and press enter...

		Input Feature		Context Feature				Expected Output		Image Input	Upload
	id	Number of Variables	Type of Equation	Content	Font	Image Clarity	Language	Error Message	Solution		
	141	Single Variable	Linear Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Recognize the Image	Graphical Solution		Upload
	142	Multiple Variable	Linear Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Recognize the Image	Value Based Solution		Upload
	143	Single Variable	Quadratic Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Find Solution	Value Based Solution		Upload
	144	Multiple Variable	Quadratic Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Find Solution	Graphical Solution		Upload
	145	Single Variable	Polynomial Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Recognize the Image	Value Based Solution		Upload
	146	Multiple Variable	Polynomial Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Find Solution	Graphical Solution		Upload
	147	Single Variable	Exponential Equation	Non-Mathematical Equation	Human Written	Under Low Light	Non-English	Cannot Recognize the Image	Graphical Solution		Upload

151	Single Variable	Linear Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Recognize the Image	Graphical Solution		Upload
152	Multiple Variable	Linear Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Recognize the Image	Value Based Solution		Upload
153	Single Variable	Quadratic Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Find Solution	Value Based Solution		Upload
154	Multiple Variable	Quadratic Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Find Solution	Graphical Solution		Upload
155	Single Variable	Polynomial Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Recognize the Image	Value Based Solution		Upload
156	Multiple Variable	Polynomial Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Find Solution	Graphical Solution		Upload
157	Single Variable	Exponential Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Recognize the Image	Graphical Solution		Upload
158	Multiple Variable	Exponential Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Find Solution	Value Based Solution		Upload
159	Single Variable	Logarithmic Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Find Solution	Value Based Solution		Upload
160	Multiple Variable	Logarithmic Equation	Non-Mathematical Equation	Human Written	Under Bright Light	Non-English	Cannot Find Solution	Graphical Solution		Upload