CMPE287 Software Quality Assurance Testing
HW#3

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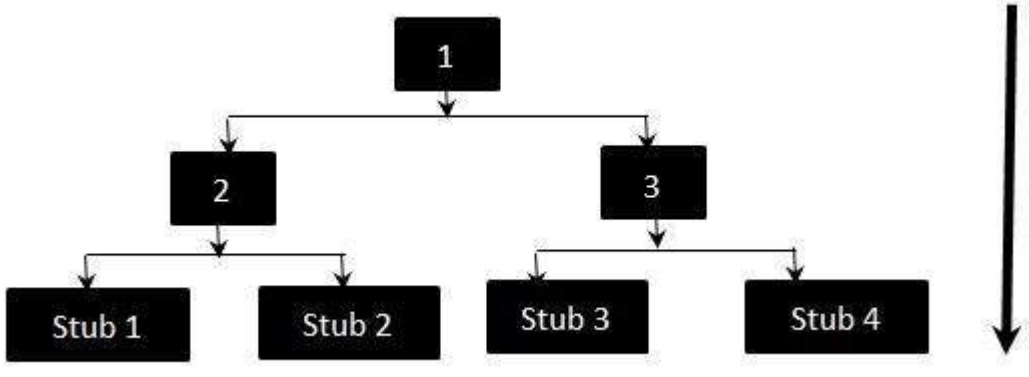
Question #1: Software Integration Testing

1. Questions about software integration based on a program structure:

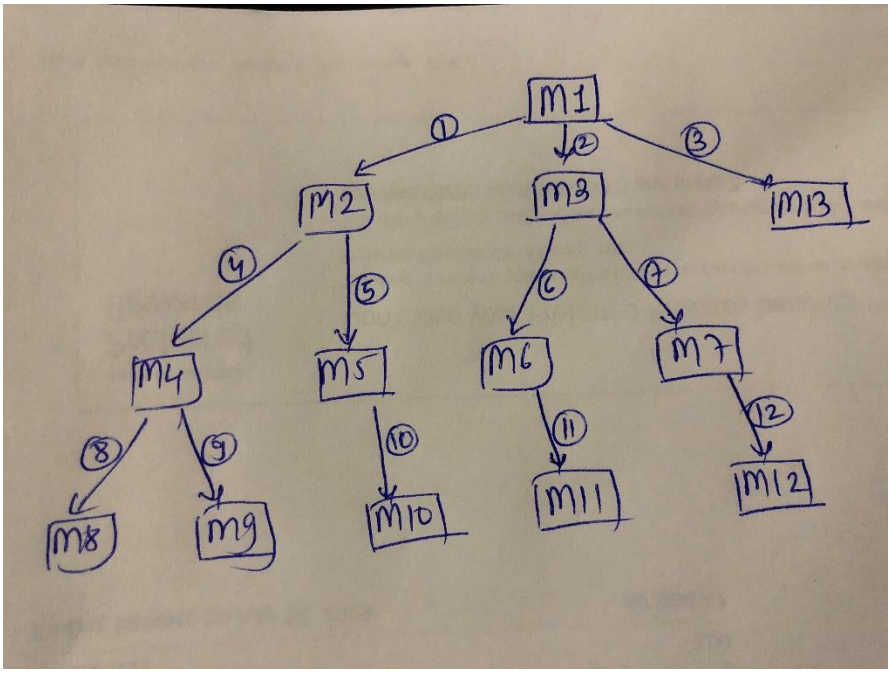
a) Explain the idea of the top-down integration approach.

Top-down is an approach to integration testing where testing is performed from top to bottom sequentially. This approach is adapted when, top-down approach is considered for development of the product. In this approach stubs are required to simulate lower level units, which is not available during the initial phase. It is like replacement for the units. Stub flow diagram is as follows-



[source: https://www.tutorialspoint.com/software_testing_dictionary/top_down_integration_testing.htm]

b) List an integration sequence using the top-down approach and its required test stubs (or drivers).



Top down approach
Integration Order - Breadth first (Left order)
IS - Integrated system
Mi* - Software stub for Mi

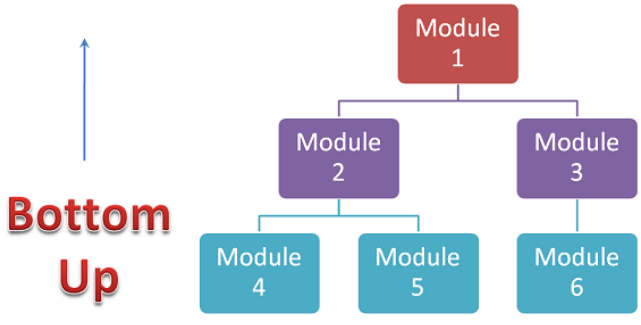
Sequence:
1. IS = M1 + M2 (Stubs : M3*, M4* , M5*, M13*)
2. IS = IS + M3 (Stubs : M4* , M5* , M6* , M7* , M13*)
3. IS = IS + M13 (Stubs : M4*, M5*, M6*, M7*)
4. IS = IS + M4 (Stubs : M5*, M6*, M7*, M8*, M9*)
5. IS = IS + M5 (Stubs : M6*, M7*, M8*, M9*, M10*)
6. IS = IS + M6 (Stubs : M7*, M8*, M9*, M10*, M11*)
7. IS = IS +M7 (Stubs : M8*, M9*, M10* , M11*, M12*)
8. IS = IS + M8 (Stubs :M9*, M10* , M11*, M12*)
9. IS = IS + M9 (Stubs : M10* , M11*, M12*)
10. IS = IS + M10 (Stubs : M11*, M12*)
11. IS = IS + M11 (Stubs : M12*)
12. IS = IS + M12 (No stub)

c) List the required total number of test stubs.
The required total number of test stubs are 11. They are as follows:
1. M3*
2. M4*
3. M5*
4. M6*
5. M7*
6. M8*
7. M9*
8. M10*
9. M11*

10. M12*
11. M13*

d) Explain the idea of the bottom-up integration approach.

Bottom-up integration approach is used to analyse the risks in the software. The main advantages of this approach is, it is user friendly and provides high deployment coverage at the very early stage of SDLC. It is quite opposite of top-down approach. In this approach, each unit at lower level is tested with higher level modules until all modules are tested. In this approach instead of stubs, we use drivers for testing.



[source: https://www.guru99.com/integration-testing.html#8]

e) List an integration sequence using the bottom-up approach and its required test drivers.
Bottom up approach
Integration Order - Breadth first (Left order)
IS - Integrated system
Mi* - Software stub for Mi
Mi^ - Software driver for Mi

Sequence:
1. IS1 = M4 + M8 (Driver : M2^ and stub : M9*)
2. IS1 = IS1 + M9 (Driver : M2^)
3. IS2 = M5 + M10 (Driver : M2^)
4. IS1 = IS1 + M2 (Driver : M1^)
5. IS3 = IS1 + IS2 (Driver : M1^)
6. IS3 = IS3 + M1 (Stub: M3*, M13*)
7. IS4 = M6 + M11 (Driver: M3^)
8. IS4 = IS4 + M3 (Driver M1^, Stub M7*)
9. IS5 = M7 + M12 (Driver M3^)
10. IS6 = IS4 + IS5 (Driver M1^)
11. IS7 = IS3 + IS6 (stub M13*)
12. IS7 = IS7 + M13

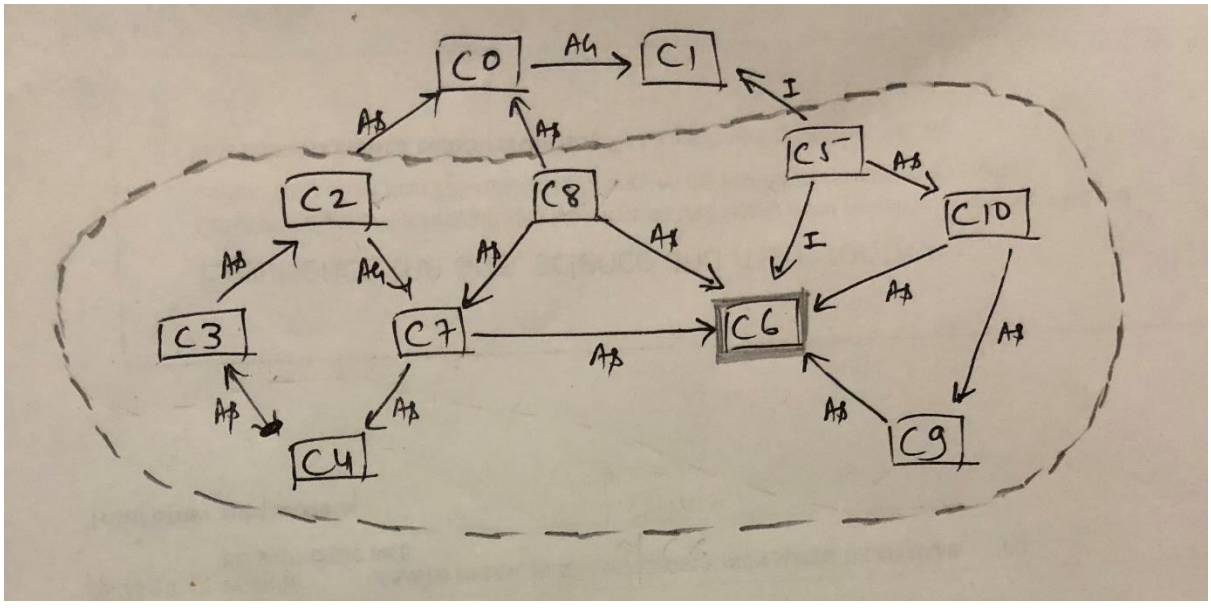
f) List the required total number of test drivers.
Total number of test drivers required is 3 : M1, M2, M3

Question #2: Questions about Software Regression Testing

a) What is the class test order based on the class diagram.

Level 1: C7
Level 2: C2, C8
Level 3: C3
Level 4: C4

b) Please show the class firewall of changing class 6



c) What are the possible affected classes by changing class 6?

C2, C3, C4, C5, C6, C7, C8, C9, C10

d) What are the re-integration links inside the class firewall?

Between C6 -> C5
Between C6 -> C8
Between C6 -> C9
Between C6 -> C10
Between C6 -> C7
Between C7 -> C2
Between C7 -> C3
Between C7 -> C4

Question #3: Testing a selected AI Mobile App (35%)

a) Present your AI-powered function requirements analysis using a tree model.

Selected intelligent mobile app: PHOTOMATH

Photomath is the camera calculator used to solve math problems. Photomath uses Artificial Intelligence technology to accurately predict the concepts to help students to clear their doubts by providing step by step explanations and with direct solutions. The main objective of this app to make learning easier. As the app is based on AI, it is getting better with time. This project aims at testing the application in every possible condition. In Photomath, AI function is reading and analysing an image. So the test requirement is based on image inputs. We are testing Photomath application on various types of image input and analyse the AI function. Following are some criteria on the basis of which, the application is being tested:

- Does the application is able to bifurcate between a math problem and other problems like science, history english etc
- Does the application able to understand handwritten problems with various kinds of hand-writing
- Does the application able to bifurcate between different topics of mathematics and provide relevant solution
- Does the application able to read the text in the image with different font style, font size, color
- Does the application works well on various available versions of iPhone and iPad
- Does the application provide relevant results if there is more than one problem captured in the frame
- Does the application able to detect noise
- Does the application able to work well in different light effects
- Does the application able to work well when problem is captured in different shooting angles
- Does the application able to work well with multiple languages
- Does the application able to work well if the problem captured too closely or from long distances
- How does the application react on blurry image
- How does the application react on invalid problems
- How does the application react with different backgrounds

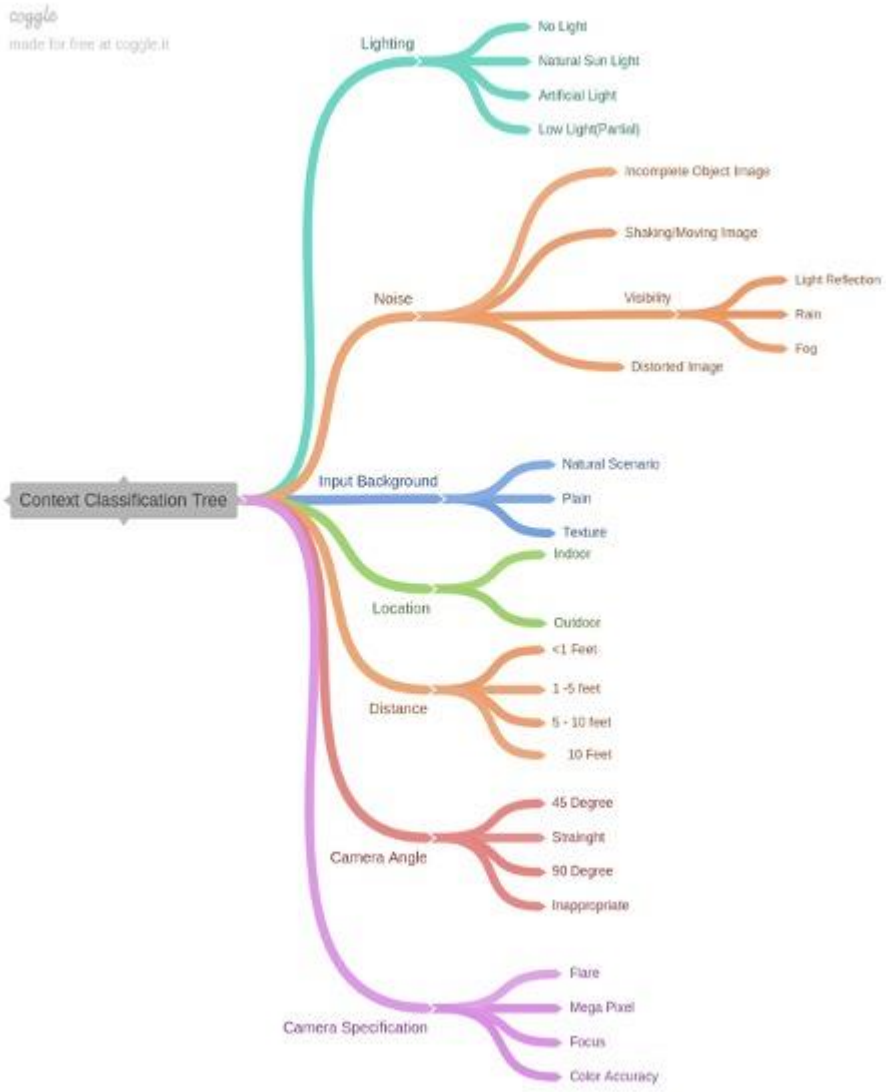
AI Function Testing Methods With The Necessary Criteria: AI functions are the key points of Photomath application. So, once the AI testing of these features is done, we can say almost testing is finished. Understandability, correctness, relevance, consistency, and timeliness are the five main factors behind the quality of any AI based application. All the possible scenarios must be tested of an application before it is delivered. It should be tested by end user's point of view. Scenario based testing is one of the black-box testing methods which make sure the capability of the application. Following is a table showing some criteria on the basis of which application will be tested:

	Understandability	Correctness	Relevance	Consistency	Timeliness
True or False mathematical statements/ equations					
Multiple choice questions with one or more answers					

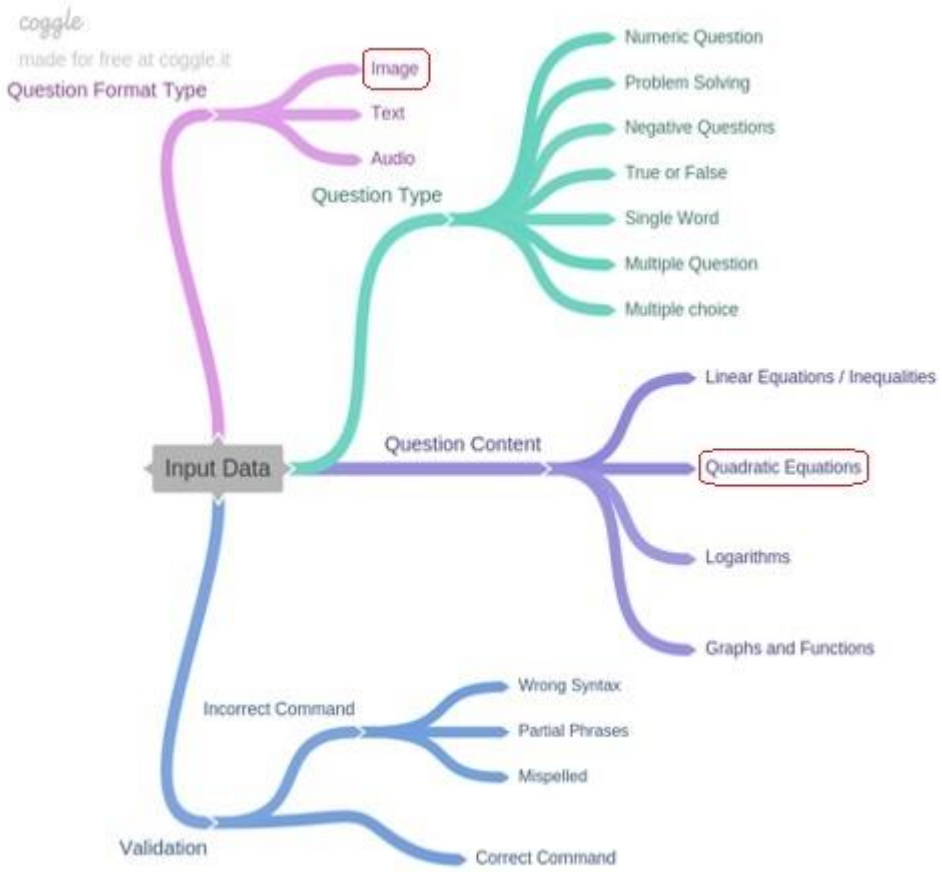
Multiple questions in a single click					
Essay problems					

b) Conduct AI test modeling in the following steps:

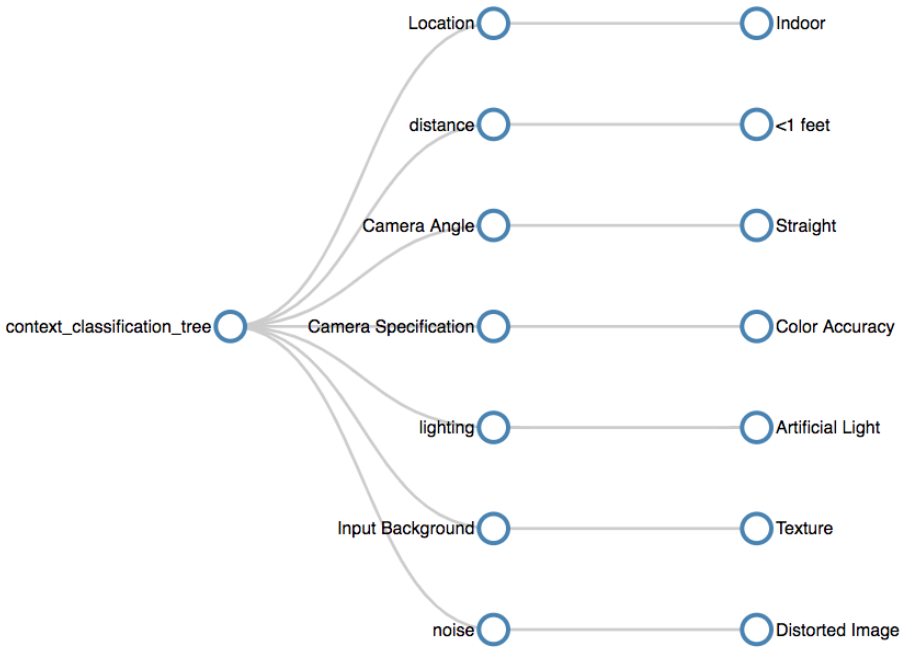
a. Identify and present classified contexts of your selected AI-powered function in a classified context tree model.

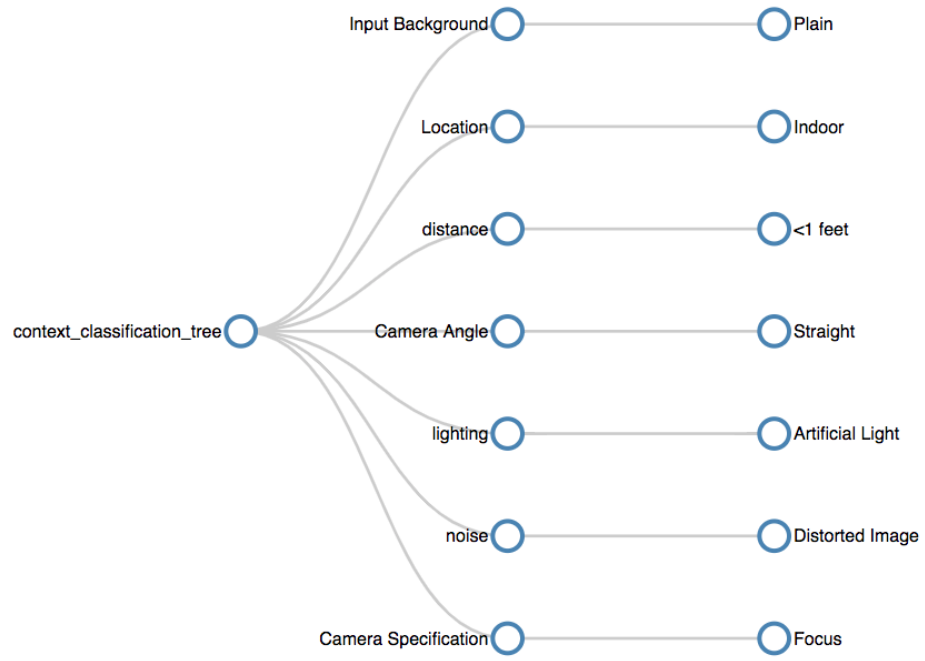


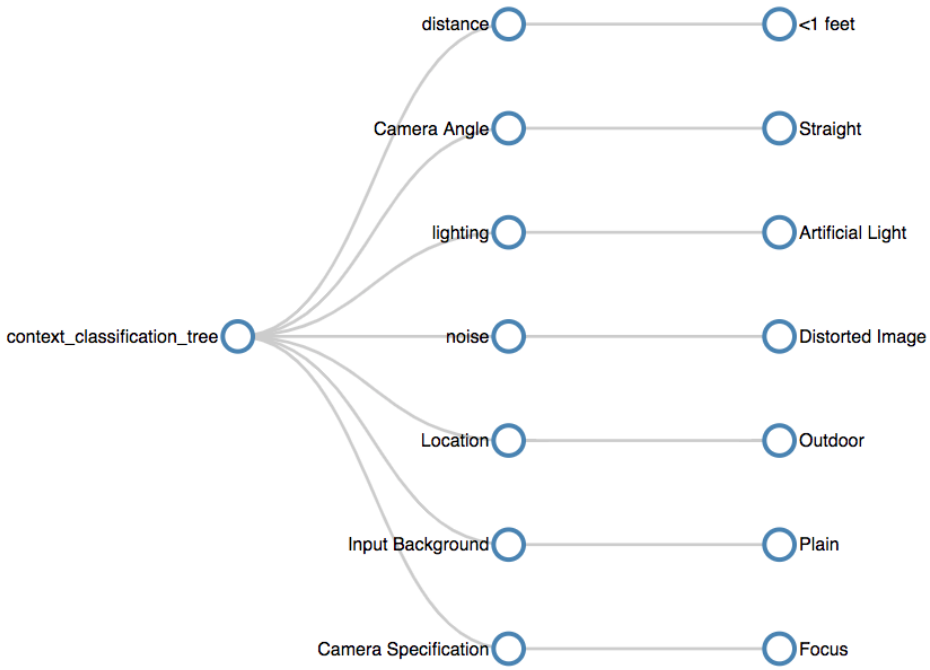
b. Identify and present classified inputs for your selected AI-powered function in a classified input model

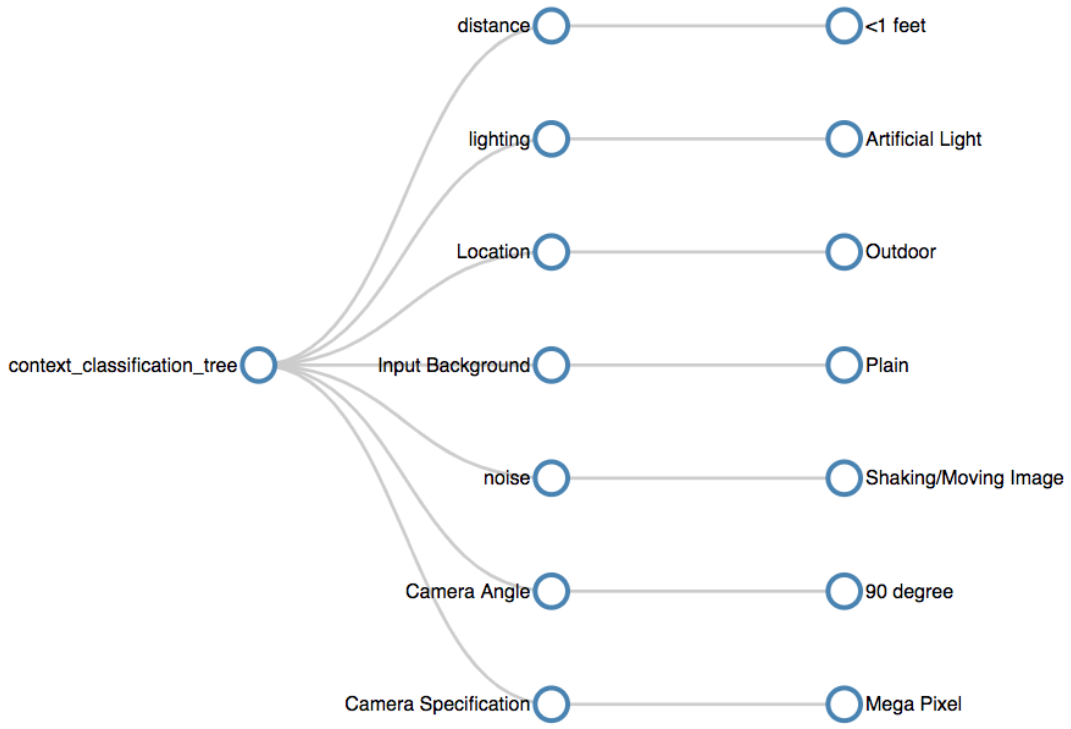


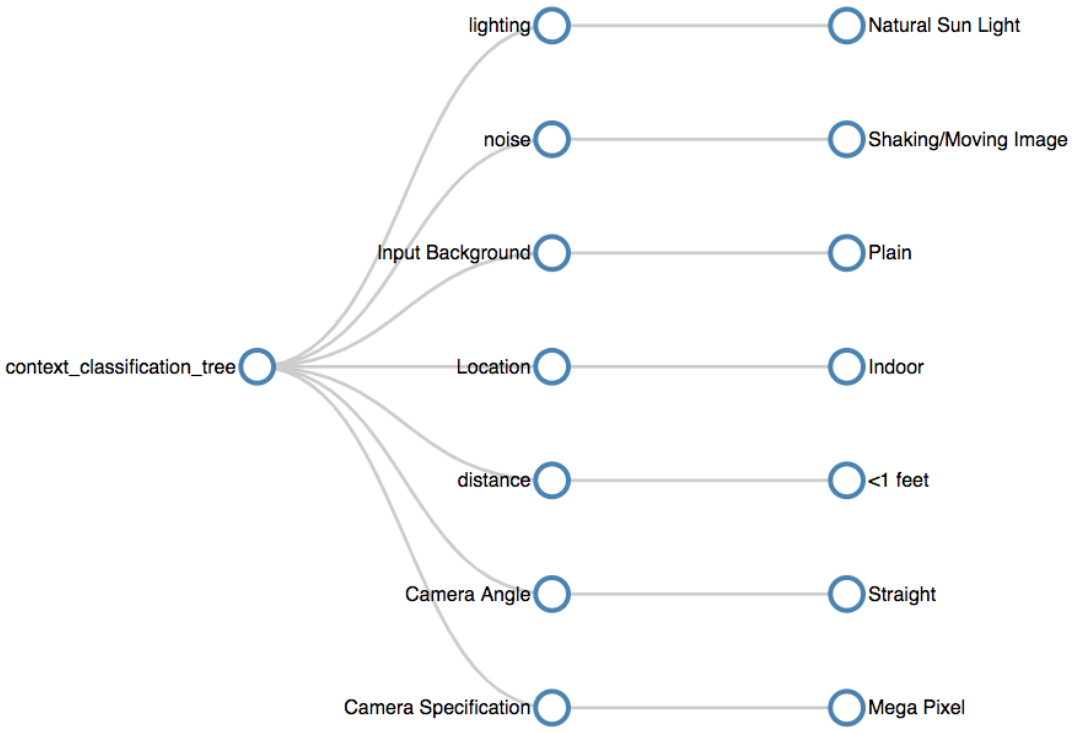
c. Identify and present 5 classified sample spanning trees for your context classification tree model using a decision table



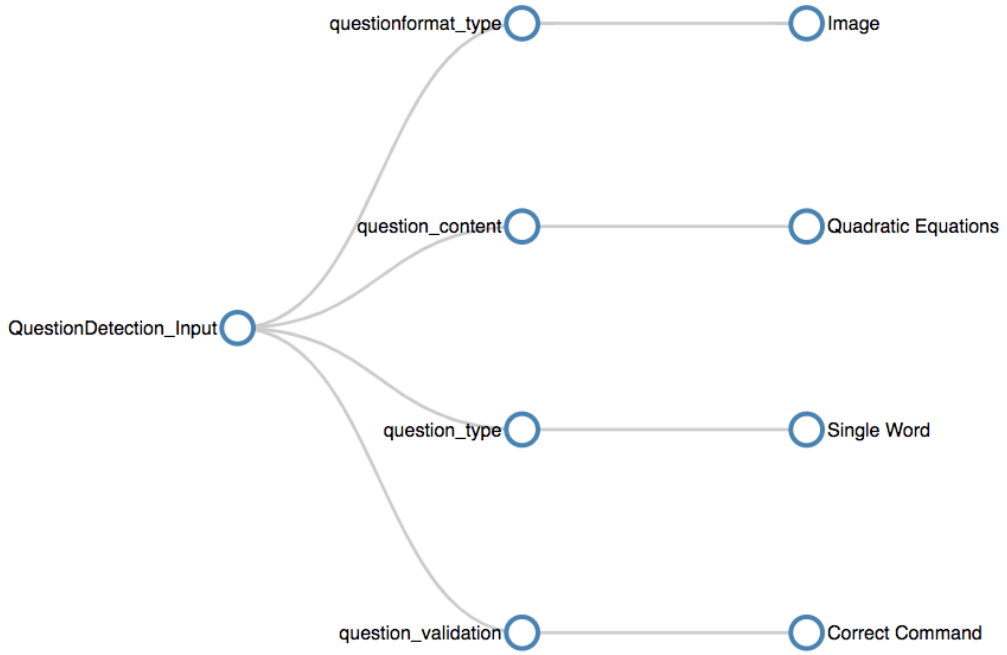

context_classification_tree
Input Background
Plain
Location
Indoor
distance
<1 feet
Camera Angle
Straight
lighting
Artificial Light
noise
Distorted Image
Camera Specification
Focus

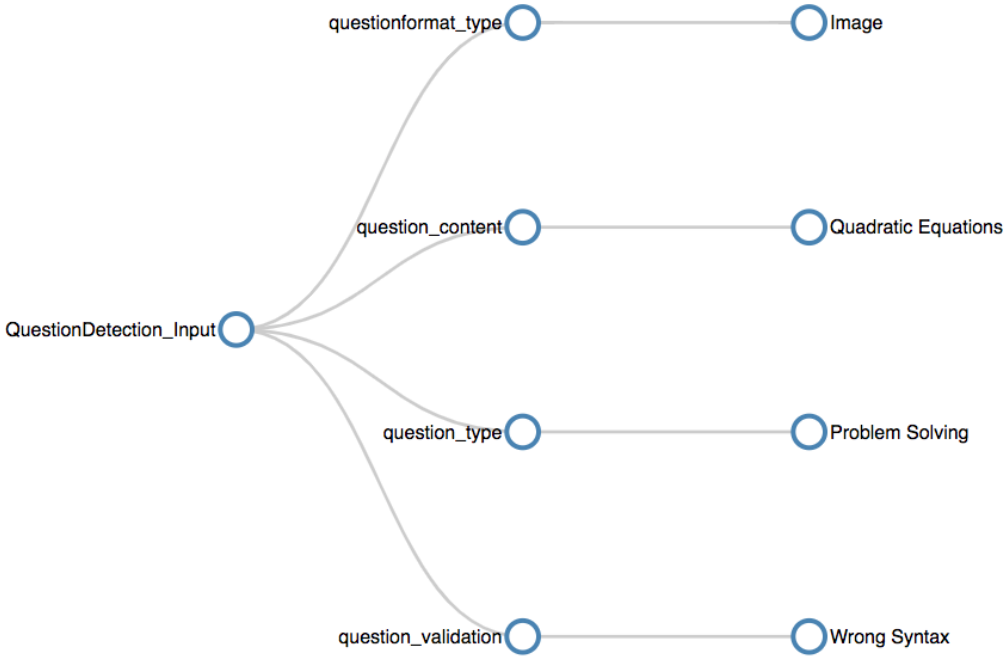

context_classification_tree
distance
<1 feet
Camera Angle
Straight
lighting
Artificial Light
noise
Distorted Image
Location
Outdoor
Input Background
Plain
Camera Specification
Focus





d. Identify and present 5 classified sample spanning trees for your input classification tree model using a decision table


QuestionDetection_Input
questionformat_type
Image
question_content
Quadratic Equations
question_type
Single Word
question_validation
Correct Command


QuestionDetection_Input
questionformat_type
Image
question_content
Quadratic Equations
question_type
Problem Solving
question_validation
Wrong Syntax

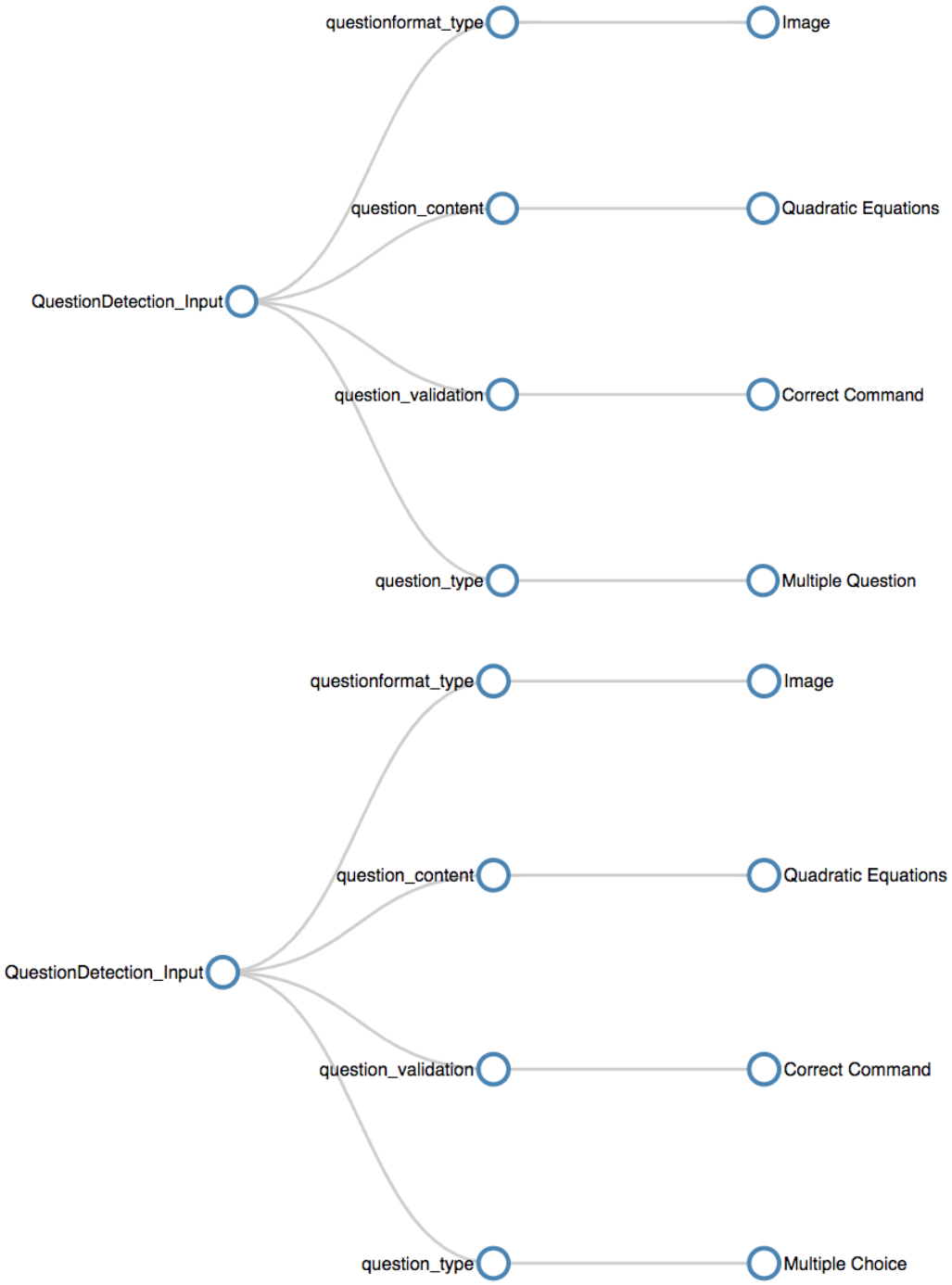

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Image
question_content
Quadratic Equations
QuestionDetection_Input
question_validation
Correct Command
question_type
Multiple Question
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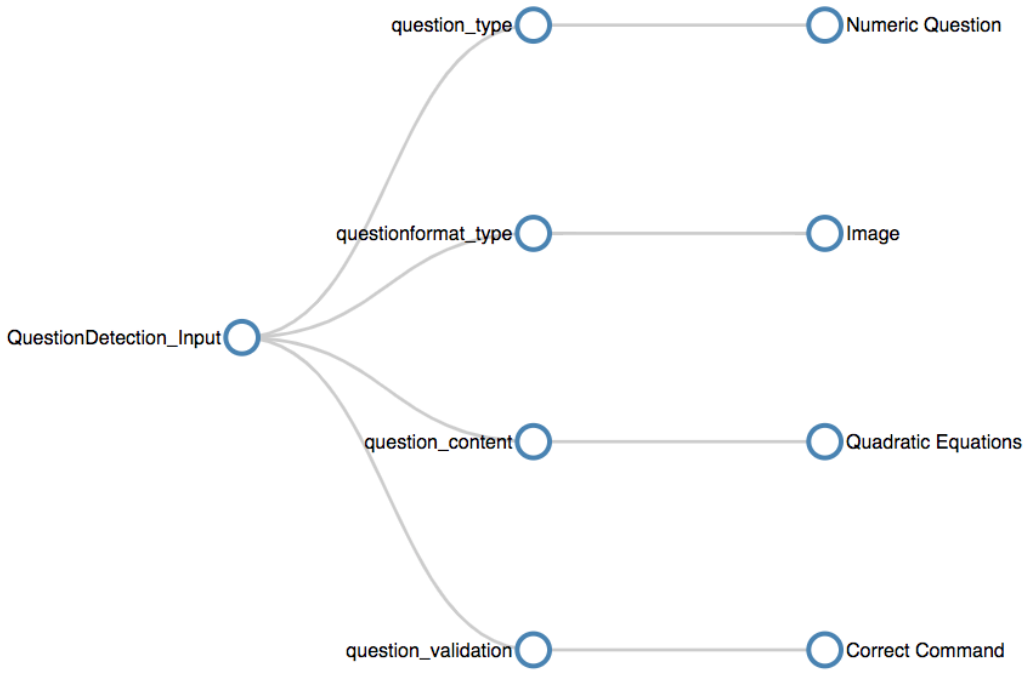
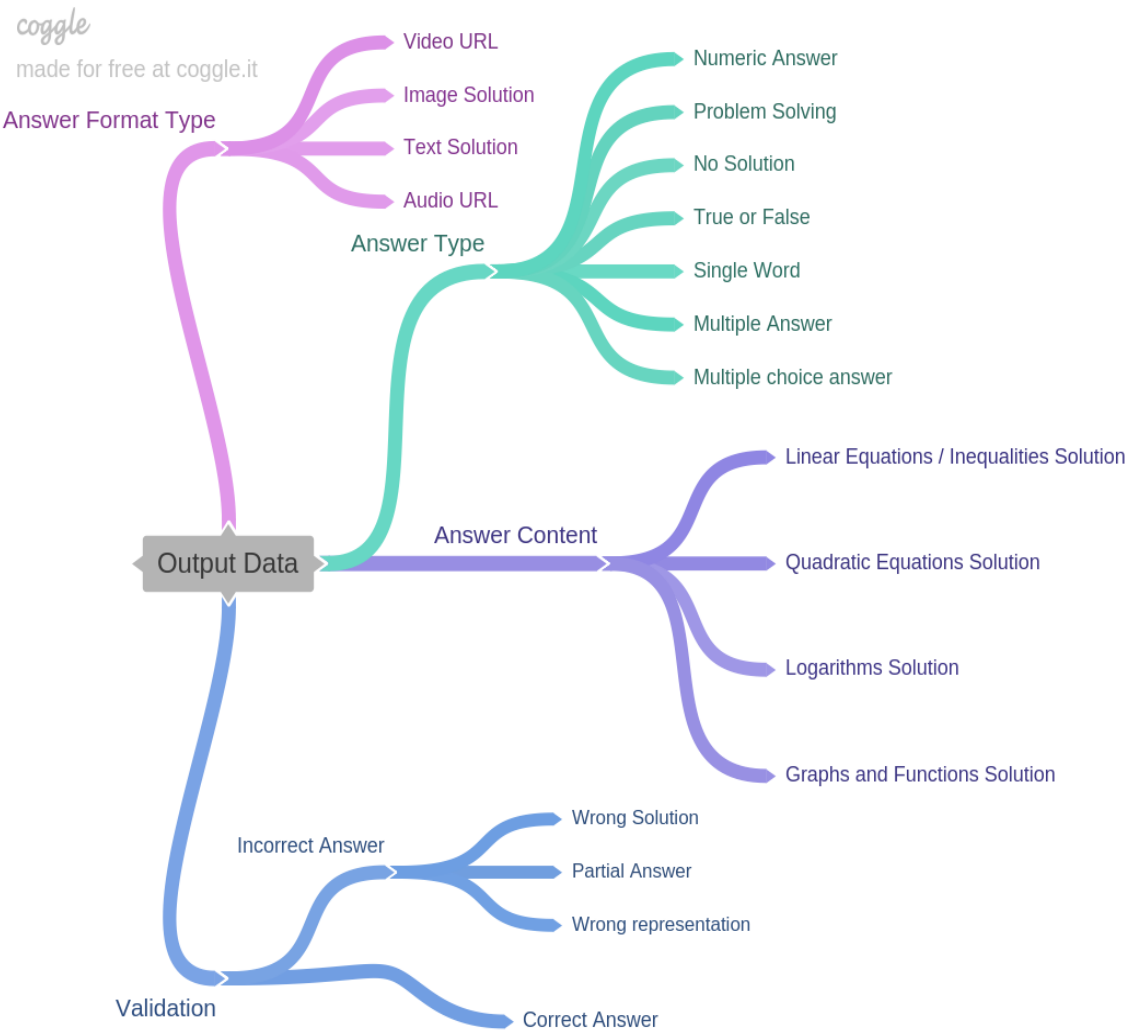
question_content
Quadratic Equations
QuestionDetection_Input
question_validation
Correct Command
question_type
Multiple Choice



e. Identify and present a classified output tree using a tree model.



c) Using a 3-D classification decision table to show the outputs and actions/events for the mapping between the two group of spanning trees.

RULE	QUESTION_TYPE	QUESTION_CONTENT	QUESTION_VALIDATION	QUESTIONFORMAT_TYPE	YBSU9CFV	SMOMXL5A	SR4FGBSQ	V6RZO8CR	PSNASCIY	FFVBDIXC	15MMC9O6	PMKIBM1K	CEDG4DXW	CREVZDAA	QFJKX0MV
Rule - 12	Negative Questions	Quadratic Equations	Partial Phrases	Image											T
Rule - 13	Single Word	Quadratic Equations	Correct Command	Image											
Rule - 14	Multiple Choice	Quadratic Equations	Correct Command	Image											

ATTRIBUTES	ATTRVAL	YBSU9CFV	CWQBUGIT	VGL5RGIZ	SMOMXL5A	SR4FGBSQ	V6RZO8CR	ZNONAPSO	PSNASCIY	FFVBDIXC	15MMC9O6	PMKIBM1K
distance	<1 feet	X	X	X	X	X	X	X	X	X	X	X
	1-5 feet											
noise	Distorted Image	X	X									
	Shaking/Moving Image			X			X	X	X	X	X	X
	Incomplete Object Image				X	X						
Camera Angle	Straight	X	X	X	X	X		X	X	X	X	
	Inappropiate						X					
	90 degree											X
lighting	Artificial Light	X	X	X	X		X		X		X	
	Low Light					X						
	Natural Sun Light							X		X		X
	No Light											
Input Background	Texture	X		X		X			X	X		
	Plain		X		X		X	X			X	
	Natural Scenario											X
	Focus	X	X		X	X			X	X	X	