

Section A

a. What are the required AI services for this image classification. Explain the usage of each of the AI services. (2m)

These are the required AI services for image classification - Azure AI Cognitive Service (Computer Vision), Azure AI Vision Studio, Azure Machine Learning Workspace and Studio.

Azure AI Cognitive Service (Computer Vision) is for image analysis and classification. It provides the computational power required for hosting, training and deploying our AI custom vision model for classification of fruits. It integrates with Azure Vision Studio which is a UI interface to customize, train our model using labeled fruit images and deploy it without the need for extensive coding. Azure Machine Learning Workspace is to create a project to organize and manage our labelled dataset. It integrates with Azure Machine Learning Workspace which provides a UI interface to label our dataset easily with the correct label (cucumber, pear, carrot).

b. Outline the steps involved in creating and training a custom vision model in Azure Vision Studio.

(5m)

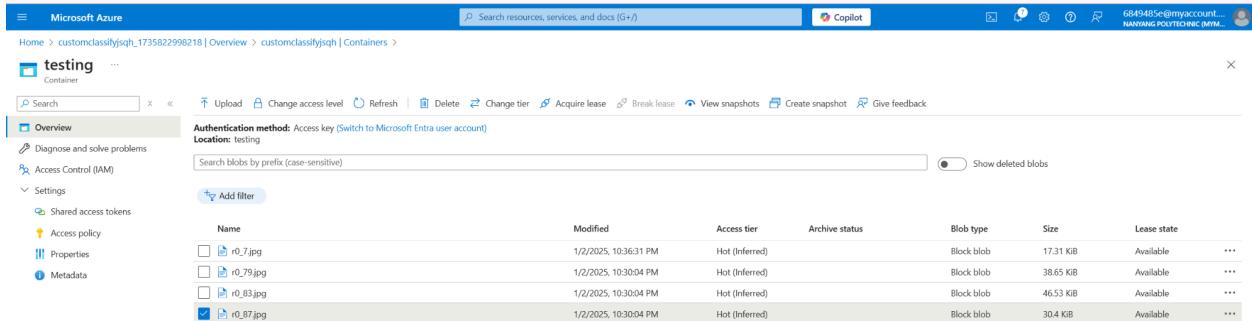
1. Provision Azure AI Cognitive multiservice account
2. Creating our Azure Blob Storage Account and upload our training images dataset into this storage account
3. Provision the Azure Machine Learning Workspace and using the Machine Learning Studio to help with the labelling of the training images dataset. Machine Learning Studio will generate a COCO file from the labelled training images.
4. Using the Azure Vision Studio to create a custom model, then configure the dataset section to pull the training images from the Azure Blob Storage Account and import the COCO file from the Machine Learning Studio.
5. The model is then trained for image classification of our fruits(cucumber, pear, carrot) using our labeled training images dataset.
6. After training is successful, the trained model performance is then reviewed.
7. Select testing images and use the trained model to make predictions. Predictions will be displayed in the form of probabilities that the image belongs to for each class.

c. Outline the steps involved in the COCO (Common Objects in Context) file. (2m)

1. Provision the Azure Machine Learning Workspace and using the Azure Machine Learning Studio to help with labelling the training images dataset, by assigning a single label to each image (cucumber, pear, carrot).
2. Machine Learning Studio will generate a COCO file which includes annotations and metadata for the labelled images.
3. Import the COCO file into Azure Vision Studio to use it for the training of the custom image classification model.

d. Integrate custom model into app (2m). You are required to show your python code.

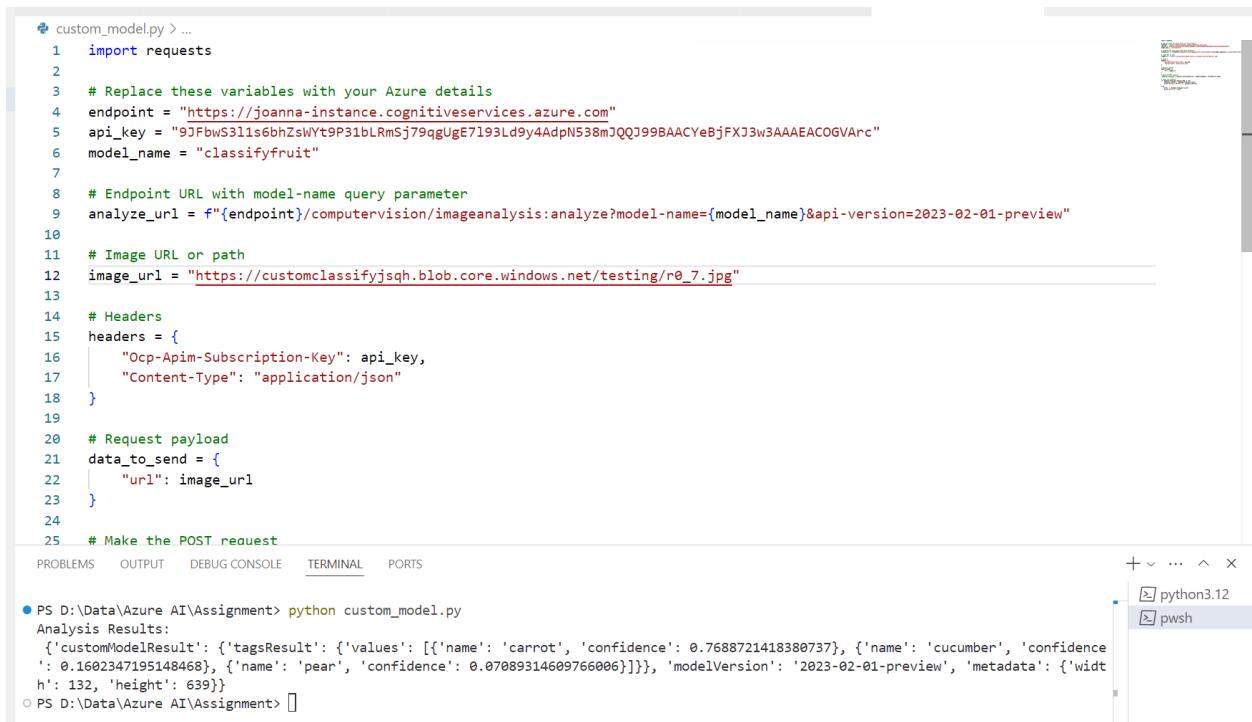
Refer to the python file attached in the zip “custom_model.py”. Test image is uploaded to Azure Storage container (*refer to Picture 1 below*) and the URL to access this test image is specified in the “image_url” in the python code. The code sends the image URL to the Azure custom trained model, “classifyfruit” via a REST API call. The model processes the test image and returns a response with predicted probabilities of each class(cucumber, pear, carrot) for the test image(*refer to the Picture 2, 3, 4, 5 below*)



The screenshot shows the Microsoft Azure Storage Container Overview page. At the top, there are navigation links for Home, Overview, and customclassifyjsqh. The main area displays a table of blobs. The columns are Name, Modified, Access tier, Archive status, Blob type, Size, and Lease state. There are four rows in the table:

Name	Modified	Access tier	Archive status	Blob type	Size	Lease state
r0_7.jpg	1/2/2025, 10:36:31 PM	Hot (Inferred)		Block blob	17.31 KB	Available
r0_79.jpg	1/2/2025, 10:30:04 PM	Hot (Inferred)		Block blob	38.65 KB	Available
r0_83.jpg	1/2/2025, 10:30:04 PM	Hot (Inferred)		Block blob	46.53 KB	Available
r0_87.jpg	1/2/2025, 10:30:04 PM	Hot (Inferred)		Block blob	30.4 KB	Available

Picture 1: Test images uploaded into Storage Container



```
custom_model.py > ...
1 import requests
2
3 # Replace these variables with your Azure details
4 endpoint = "https://joanna-instance.cognitiveservices.azure.com"
5 api_key = "93FbwS31s6bhZsWt9P31bLrmSj79qgUgE7l93Ld9y4AdpN538mJQ0J99BAACYebjFXJ3w3AAAEACOGVArc"
6 model_name = "classifyfruit"
7
8 # Endpoint URL with model-name query parameter
9 analyze_url = f'{endpoint}/computervision/imageanalysis:analyze?model-name={model_name}&api-version=2023-02-01-preview'
10
11 # Image URL or path
12 image_url = "https://customclassifyjsqh.blob.core.windows.net/testing/r0_7.jpg"
13
14 # Headers
15 headers = {
16     "Ocp-Apim-Subscription-Key": api_key,
17     "Content-Type": "application/json"
18 }
19
20 # Request payload
21 data_to_send = {
22     "url": image_url
23 }
24
25 # Make the POST request
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS + ⌂ ... ^ x
PS D:\Data\Azure AI\Assignment> python custom_model.py
Analysis Results:
{"customModelResult": {"tagsResult": {"values": [{"name": "carrot", "confidence": 0.7688721418380737}, {"name": "cucumber", "confidence": 0.1602347195148468}, {"name": "pear", "confidence": 0.07089314609766006}], "modelVersion": "2023-02-01-preview", "metadata": {"width": 132, "height": 639}}}
PS D:\Data\Azure AI\Assignment>
```

Picture 2: Test Image R07 Response Result

```

custom_model.py > ...
1 import requests
2
3 # Replace these variables with your Azure details
4 endpoint = "https://joanna-instance.cognitiveservices.azure.com"
5 api_key = "9JFbwS3l1s6bhZsWt9P31bLrmSj79qgUgE7l93Ld9y4AdpN538mJQQJ99BAACYeBjFXJ3w3AAAEACOGVArC"
6 model_name = "classifyfruit"
7
8 # Endpoint URL with model-name query parameter
9 analyze_url = f"{endpoint}/computervision/imageanalysis:analyze?model-name={model_name}&api-version=2023-02-01-preview"
10
11 # Image URL or path
12 image_url = "https://customclassifyjsqh.blob.core.windows.net/testing/r0_79.jpg"
13
14 # Headers
15 headers = {
16     "Ocp-Apim-Subscription-Key": api_key,
17     "Content-Type": "application/json"
18 }
19
20 # Request payload
21 data_to_send = {
22     "url": image_url
23 }
24
25 # Make the POST request

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```

PS D:\Data\Azure AI\Assignment> python custom_model.py
Analysis Results:
{'customModelResult': {'tagsResult': {'values': [{'name': 'cucumber', 'confidence': 0.9998186230659485}, {'name': 'pear', 'confidence': 0.00011635332339210436}, {'name': 'carrot', 'confidence': 6.5013838692995e-05}]}, 'modelVersion': '2023-02-01-preview', 'metadata': {'width': 288, 'height': 918}}
○ PS D:\Data\Azure AI\Assignment> []

```

Picture 3: Test Image R079 Response Result

```

custom_model.py > ...
1 import requests
2
3 # Replace these variables with your Azure details
4 endpoint = "https://joanna-instance.cognitiveservices.azure.com"
5 api_key = "9JFbwS3l1s6bhZsWt9P31bLrmSj79qgUgE7l93Ld9y4AdpN538mJQQJ99BAACYeBjFXJ3w3AAAEACOGVArC"
6 model_name = "classifyfruit"
7
8 # Endpoint URL with model-name query parameter
9 analyze_url = f"{endpoint}/computervision/imageanalysis:analyze?model-name={model_name}&api-version=2023-02-01-preview"
10
11 # Image URL or path
12 image_url = "https://customclassifyjsqh.blob.core.windows.net/testing/r0_83.jpg"
13
14 # Headers
15 headers = {
16     "Ocp-Apim-Subscription-Key": api_key,
17     "Content-Type": "application/json"
18 }
19
20 # Request payload
21 data_to_send = {
22     "url": image_url
23 }
24
25 # Make the POST request

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```

PS D:\Data\Azure AI\Assignment> python custom_model.py
Analysis Results:
{'customModelResult': {'tagsResult': {'values': [{'name': 'cucumber', 'confidence': 0.9998842477798462}, {'name': 'pear', 'confidence': 7.983647810760885e-05}, {'name': 'carrot', 'confidence': 3.5854878660757095e-05}]}, 'modelVersion': '2023-02-01-preview', 'metadata': {'width': 319, 'height': 762}}
○ PS D:\Data\Azure AI\Assignment> []

```

Picture 4: Test Image R083 Response Result

```

custom_model.py > ...
1 import requests
2
3 # Replace these variables with your Azure details
4 endpoint = "https://joanna-instance.cognitiveservices.azure.com"
5 api_key = "93Fbw5311s6bhZsWt9P31bLrmSj79qgUgE7193Ld9y4AdpN538mJQJ99BAAACYeBjFXJ3w3AAAAEACOGVArc"
6 model_name = "classifyfruit"
7
8 # Endpoint URL with model-name query parameter
9 analyze_url = f"{endpoint}/computervision/imageanalysis:analyze?model-name={model_name}&api-version=2023-02-01-preview"
10
11 # Image URL or path
12 image_url = "https://customclassifyjsqh.blob.core.windows.net/testing/r0_87.jpg"
13
14 # Headers
15 headers = {
16     "Ocp-Apim-Subscription-Key": api_key,
17     "Content-Type": "application/json"
18 }
19
20 # Request payload
21 data_to_send = {
22     "url": image_url
23 }
24
25 # Make the POST request

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```

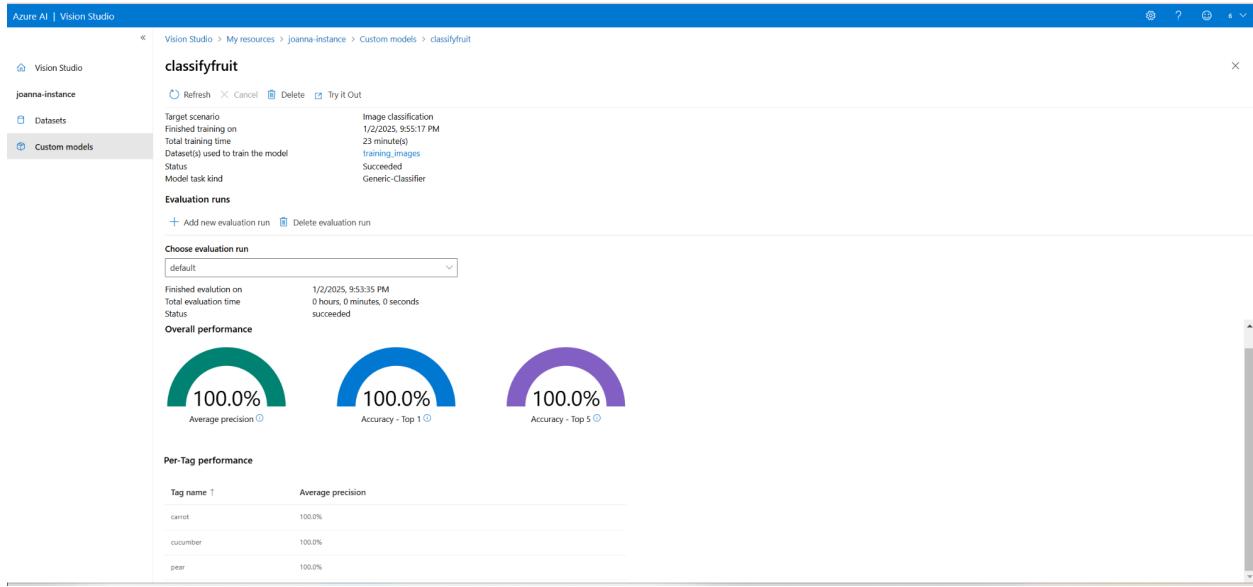
PS D:\Data\Azure AI\Assignment> python custom_model.py
Analysis Results:
{'customModelResult': {'tagsResult': {'values': [{'name': 'carrot', 'confidence': 0.9995935559272766}, {'name': 'cucumber', 'confidence': 0.00029747214284725487}, {'name': 'pear', 'confidence': 0.00010909107368206605}]}, 'modelVersion': '2023-02-01-preview', 'metadata': {'width': 185, 'height': 663}}

```

Picture 5: Test Image R087 Response Result

e. Include a screenshot showing the performance of your trained model, along with an explanation of the results. (2 marks)

The performance of the trained model is shown below(*Picture 6*). The accuracy and precision for each class (carrot, cucumber, pear) are 100%. This model managed to correctly classify all the images in the training dataset. However, the model performance reflected is only based on part of the training dataset as there is no evaluation set used during the training. This indicates that the model's performance might be overestimated. To get a more accurate assessment of the model's performance, test images are uploaded. These test images are not part of the training dataset, allowing us to evaluate how well the model is able to predict correctly based on unseen data. The prediction results of these test images shown below, show a more reliable measure of the model's performance below(*Refer to Picture 7,8,9,10*).



Picture 6: Performance of Trained Model

f. Include a screenshot showing the performance of your testing image, along with an explanation of the results. (2 marks)

The prediction results for the four test images, with the probabilities for each class (carrot, cucumber, pear) indicated for each image shown below (*Picture 7,8,9,10*).

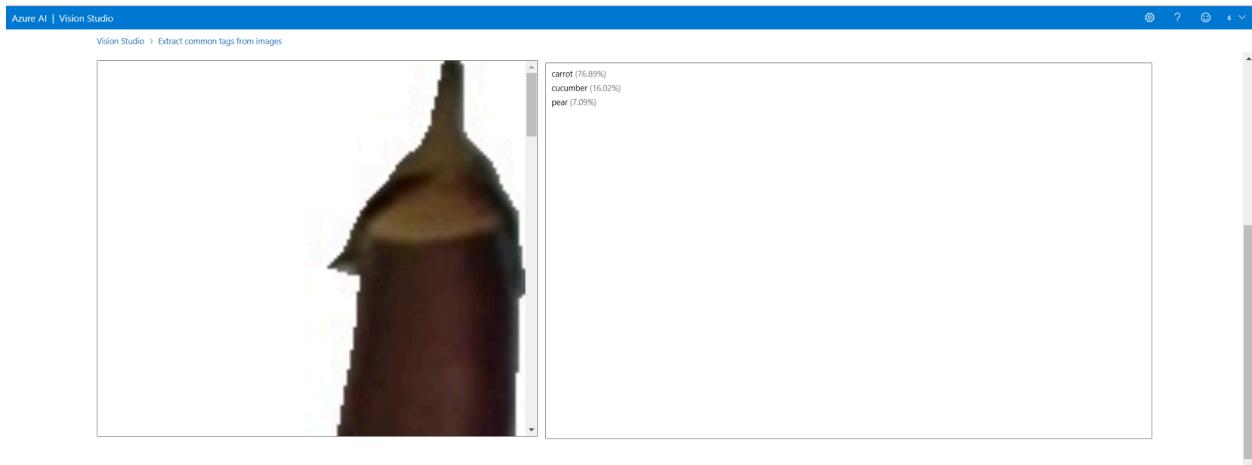
For the image r07(*Picture 7*), the test image is an egg plant and does not belong to any of the classes. The model predicted that it is a carrot with a high probability of 76.89%. This showed that the model is not good in identification of images that are not part of the three classes, as indicated by the high probability that the model assigned to the image. The model could have probably learned certain features in the image that resembled the carrot class even though the image does not belong to it. In an ideal situation when the image does not fit any of the trained classes(carrot, cucumber, pear), the model should show lower probabilities across all classes indicating that it is uncertain of which class it belongs to. The model confidently classified the eggplant as a carrot shows that it struggles to handle out-of-class data and the performance on such images is unreliable. Hence, to overcome this limitation, the model should be retrained with a more diverse and representative dataset of the three classes to improve its performance. Additionally, we could also set a confidence threshold to classify the image as “unknown” if it falls below the threshold to handle such cases more effectively.

For the image r079(*Picture 8*) and 083(*Picture 9*), the test images are cucumber. The model predicted the image correctly that it is a cucumber with a high probability of 99.98% and 99.99%. This means the model is performing well in identifying images that belong to the cucumber class as seen by its high confidence in prediction.

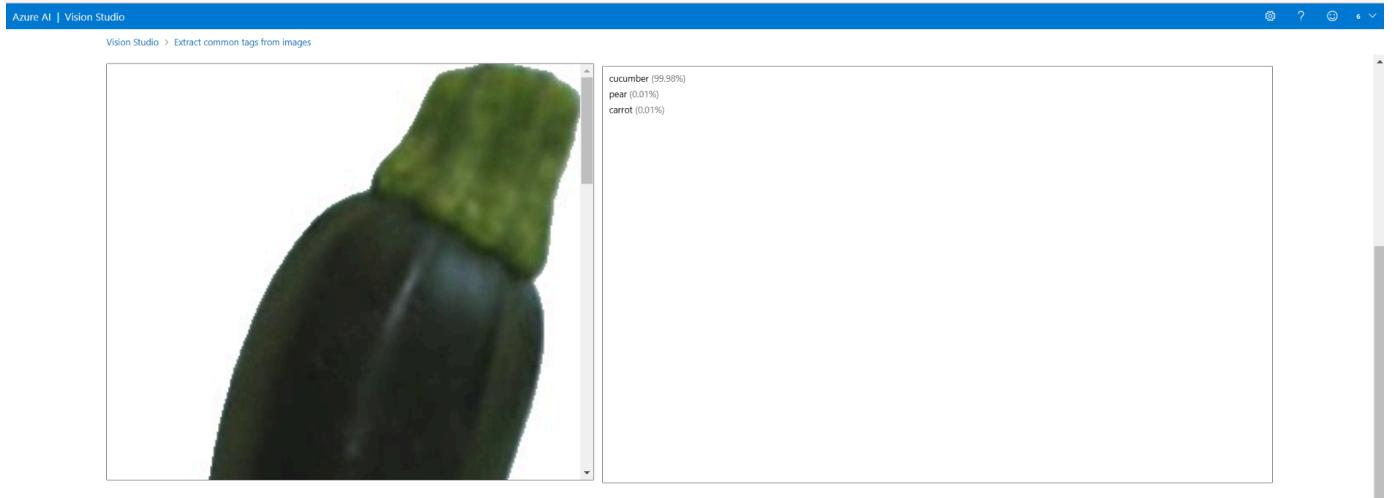
For the image r087(*Picture 10*), the test image is a carrot. The model predicted the image correctly that it is a carrot, with a high probability of 99.96%. This means that the model is

performing well in identifying images that belong to carrot, as seen by its high confidence in prediction.

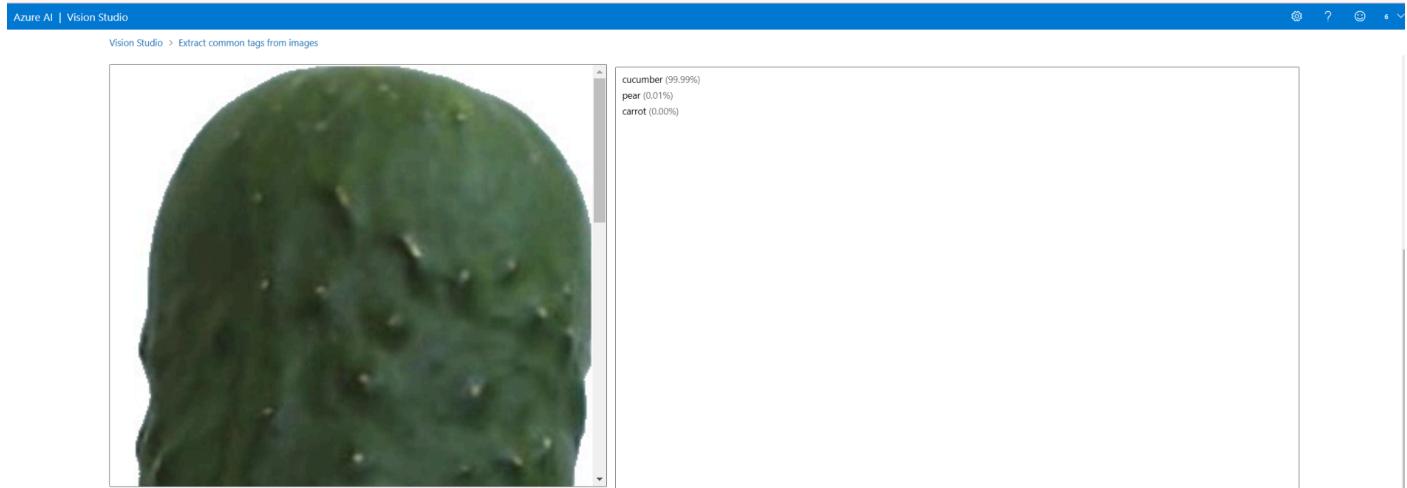
There is no test image for the pear class provided. This limits the ability for us to assess the model's performance on this particular class. Hence, it would be good if we could include a test image for pear to provide a more complete evaluation of the model's ability to classify pears accurately.



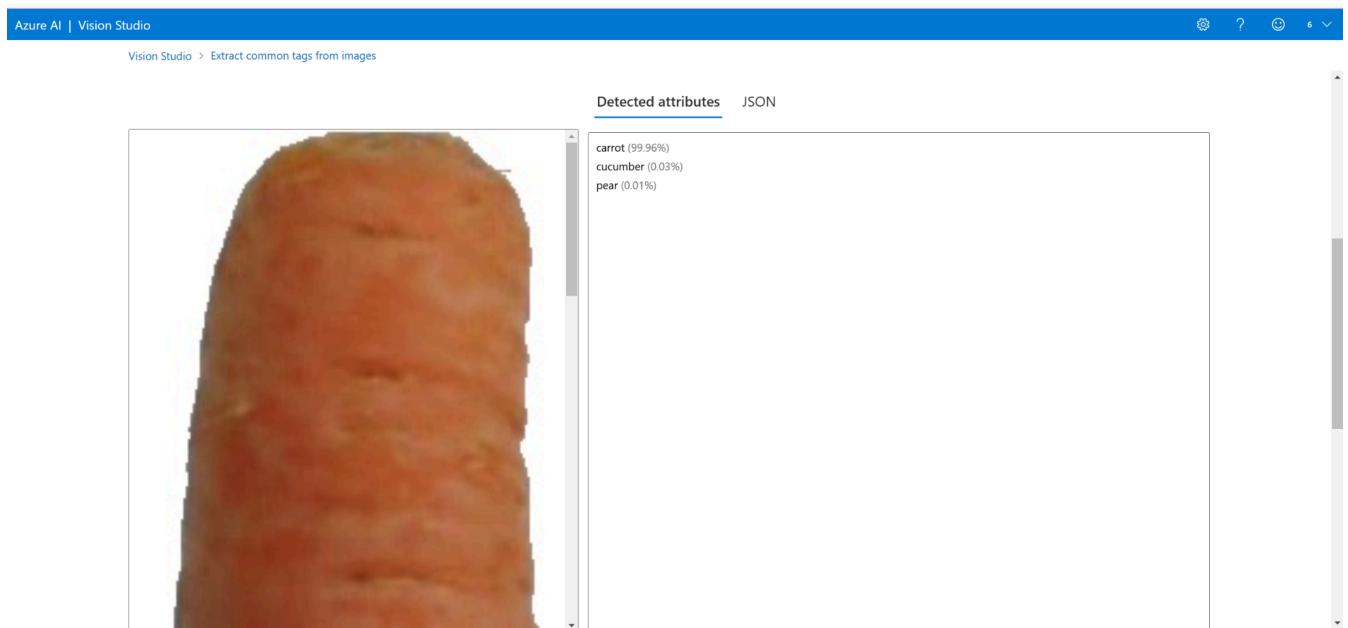
Picture 7: Model's predictions based on the test image r07



Picture 8: Model's predictions based on the test image r079



Picture 9: Model's predictions based on the test image r083



Picture 10: Model's predictions based on the test image r087

Section B: Natural Language Processing

Part A: Build a chatbot in English (15 marks)

1. Write a brief description of what your company is selling here. (3m)

Our company, Asian Frank, specializes in selling a wide range of food products that is catered to our diverse tastes of customers across Asia.

Our main goal is to deliver high quality and authentic Asian flavours to our customers, making it easy for everyone to cook at home and recreate traditional dishes in their own kitchens.

We offer the following products:

- **Ready-to-Cook Meal Kit:** Pre-measured ingredients like rice, noodle, sauces, spices to help prepare Asian dishes like Laksa, Prawn Noodle, Thai Curry and Butter Chicken.
- **Authentic Sauce:** A diverse range of essential Asian sauce, including Fish Sauce, Soy Sauce, Chili Paste, Chili Powder, Asam Sauce and Chili Crab sauce

2. List some of the common questions that your chatbot will help to offload from your customer service colleagues. Please include at **least 10 questions and answers** in an excel (3m).

Refer to the Q&A excel for the list of common questions. I have also listed it out here for easy reference.

Question Number	Question	Answer
1	Is there a way to track my order?	You can track your order through the tracking line that is sent to your email.
2	How much is the shipping cost?	Our delivery charges are waived for orders of \$100 and above, a %\$5 fee applies for orders below \$100. Additional fees may apply for specific delivery time slot during peak period. For more details, please refer to the the FAQ section.
3	Can I change the delivery date?	You may change your delivery date by informing us at least 24 hours before the scheduled delivery.
4	Do you offer discounts for bulk purchases?	Yes, we offer discounts for orders above \$100. For more details, refer to the discount page.
5	Are your products halal certified?	Yes, most of our products are halal certified.
6	What is your return policy?	Returned items must be in original packaging with proof of purchase within 7 days of the date delivered.
7	What payment methods do you accept?	We accept payment via Visa, Mastercard and American Express.
8	How can I contact customer service?	You can email us at support@asianfrank.com or call our hotline at 1234 5678.
9	I have discovered missing/damaged items in my delivery order. What should I do?	We apologize for the inconvenience. You can email us at support@asianfrank.com or call our hotline at 1234 5678.
10	Can I modify my order after payment?	Orders cannot be modified after purchase has been made. Please review your orders carefully before check out.
11	How are my items packaged for delivery?	Our products are carefully packed and shipped to ensure that they arrive in great condition. Dry products are stored in a cool, dry place. For items that require to be kept cold are shipped with appropriate cooling measures to

		maintain the proper temperature and preserve freshness of the product.
12	Can I cancel my order?	You can cancel your order within 24 hrs by contacting our hotline at 1234 5678.

3. What are the required AI services for this chatbot. Explain the usage of each of the AI services. (2m)

These are the required AI services for this chatbot - Azure AI Language Service and Azure Language Studio.

Azure AI Language Service provides the backend capabilities for natural language processing, enabling the chatbot to understand and process the user queries. It interprets the text and generates the response to the user's questions. It integrates with the Azure Language Studio which is a UI interface to allow users to easily create a knowledge Q&A knowledge base, train and test the chatbot's performance before deployment.

4. Create a knowledge base in language studio. You are required to import the excel file created in PartA-Q2. Please provide the screenshot for the QnA pairs. (3m)

The knowledge base was created in Azure Language Studio by creating a question answering project and then importing the excel file created in PartA-Q2 (*Picture 11 below*).

Additional follow up prompt was added, "What if I did not receive the email or am having trouble tracking", for the question "Is there a way to track my order?" (*Picture 12 below*). The Q&A pairs in the knowledge base can be seen (*Picture 13 and 14 below*).

The screenshot shows the 'Manage sources' page in Azure Language Studio. At the top, there are navigation links: 'Language Studio' > 'Custom question answering' > 'LearnFAQ - Manage sources'. Below this is a header with 'Manage sources' and several action buttons: '+ Add source', 'Edit name', 'Refresh URL', 'Delete', '1 items in list', 'Filter', and a 'Source type' dropdown set to 'file'. A table lists the imported source: 'Source name' is 'Learn FAQ Page', 'Unstructured' is 'No', and 'Source type' is 'file'. The source name is also highlighted in blue.

Picture 11: Importing the excel file as a source to the knowledge base

Edit knowledge base

0 unstructured sources and 1 structured sources. [View sources](#)

Is there a way to track my order?

Source: Q&A Excel.xlsx

Answer

You can track your order through the tracking link that is sent to your email.

Alternate questions (1)

Add an alternate question when there are multiple ways the same question can be asked. Alternate questions should be as semantically dissimilar as possible and should not exceed 10 alternate questions.

Add alternate question

Follow up prompts (1)

Add follow up prompt when a user would want more information after receiving an answer. Prompts link to a new or existing question pair. [Learn more about prompts](#)

Add follow up prompt

Metadata (1)

Follow-up prompt

Text displayed in the prompt to the user:

What if I did not receive the email or am having trouble tracking

Answer: If you did not receive the email or having trouble tracking, feel free to provide your order number here and we will assist you further.

Show only in contextual flow?

A context only prompt cannot be queried directly. The user will only see it after the answer to the parent question is returned. [Learn more about context](#)

Show in contextual flow only

Add prompt **Cancel**

Picture 12: Additional Follow up prompt for the question “Is there a way to track my order?”

Edit knowledge base

0 unstructured sources and 1 structured sources. [View sources](#)

I have discovered missing/damaged items in my delivery order. What should I do?

Source: Q&A Excel.xlsx

Answer

We apologize for the inconvenience. You can email us at support@asianfrank.com or call our hotline at 1234 5678.

Alternate questions (1)

Add an alternate question when there are multiple ways the same question can be asked. Alternate questions should be as semantically dissimilar as possible and should not exceed 10 alternate questions.

Add alternate question

Follow up prompts (0)

Add follow up prompts to connect question answer pairs for multi-turn conversations. This connection allows the client application to provide a top answer and provides more questions for the user to select if needed. You can view all the connections to a question answer pair by selecting view context tree.

Add follow up prompt

Metadata (1)

Picture 13: Q&A Pair imported into the knowledge base

The screenshot shows the Azure AI Language Studio interface. On the left, there's a sidebar with icons for Home, Projects, and Data. The main area is titled "Edit knowledge base". It displays a list of "Question answer pairs (13)" and "Synonyms (0)". A search bar at the top right says "Search pairs". Below the search bar, there's a list of questions and their answers:

- You may change your delivery date by informing us at least 24 hours before the scheduled delivery.**
- Do you offer discounts for bulk purchases?**
- Are your products halal certified?**
- What is your return policy?**
- What payment methods do you accept?**
- How can I contact customer service?**
- I have discovered missing/damaged items in my delivery order. What should I do?**
- Can I modify my order after payment?**
- How are my items packaged for delivery?**
- Can I cancel my order?**

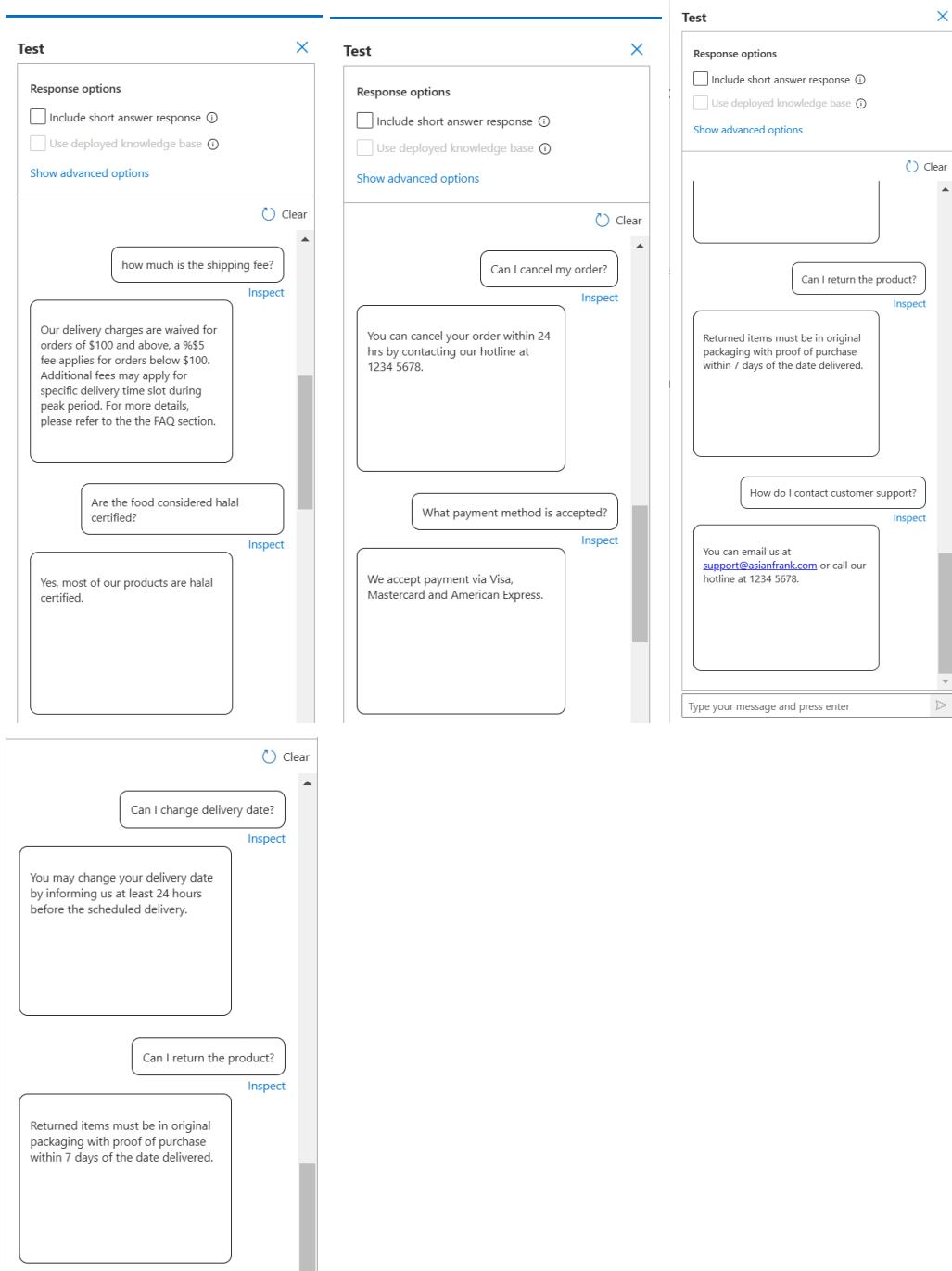
On the right side of the interface, there are sections for "Edit knowledge base", "Edit answer", "Add alternate question", "Follow up prompts", and "Metadata". There are also buttons for "Enable rich text" and "Show context tree". The top right corner shows the user's email address: 684945Se@myaccount.nyp.edu.sg and the date: October 19, 2023.

Picture 14: Q&A Pair imported into the knowledge base

5. Test and publish the chatbot. You are required to show the necessary screenshot with at least 5 dialog scenarios. (4m)

To test the chatbot, the test feature was used in the Azure Language Studio (*Picture 15*). The knowledge base was then published(*Picture 16*) and accessed using Azure SDK for Python (*Picture 17*).

A question answering app was developed and configured using Visual Studio Code. When typing the question in the integrated terminal, the app will send API calls via the SDK to query the knowledge base, and then return a response in the form of an answer (*Picture 18 and 19*).



Picture 15: Test feature used in Azure AI Language Studio to test for different dialog scenarios

The screenshot shows the Azure AI Language Studio interface. At the top, there's a banner for 'Try new features in Azure AI Studio' with a note about Fast Translation and other Speech features. Below the banner, the navigation path is 'Language Studio > Custom question answering > LearnFAQ - Deploy knowledge base'. The main title is 'Deploy knowledge base'. A sub-section titled 'Deploy knowledge base and create a bot in a few clicks.' is shown. There are two buttons: 'Deploy' and 'Get prediction URL'. A green success message says 'Your knowledge base is now deployed. You can get your prediction URL or create a bot.' Below this, the 'Knowledge base status' section displays the following details:

State	Deployment Date	Location	Resource
Deployed	1/2/2025	eastus	ChatbotLanguage/joanna
Deployment Time	1:48:18 AM	Tier	Free (F0)

Picture 16: Knowledge base deployed

This screenshot shows the 'Get prediction URL' dialog box overlaid on the main Language Studio interface. The dialog has a title 'Get prediction URL' and a sub-instruction 'Use these sample requests as a starting point to call your model's endpoint'. It contains a 'Prediction URL' field with the value 'https://chatbotlanguagejoanna.cognitiveservices.azure.com/language/:query-k...'. Below it is a 'Sample request' code block containing a curl command. The main Language Studio interface in the background shows the same deployed knowledge base status as Picture 16.

Picture 17: Obtain the project name and deployment name from the prediction URL for the API endpoint for the knowledge base

The screenshot shows a Microsoft Visual Studio Code interface. On the left is the Explorer sidebar with a tree view of files: env, Multilanguage_Translation.py, Additional_Feature.py, and SectionBQS.py. The Multilanguage_Translation.py file is open in the main editor area. The code imports dotenv, os, and AzureKeyCredential from azure.core.credentials, and QuestionAnsweringClient from azure.ai.language.questionanswering. The terminal tab at the bottom shows three command-line entries: 'python SectionBQS.py', 'python SectionBQS.py', and 'python SectionBQS.py'. The output pane displays five dialogue scenarios from a Q&A Excel.xlsx source. Each scenario includes a question, an answer, a confidence score, and the source file.

```

1  from dotenv import load_dotenv
2  import os
3
4  # Import namespaces
5  from azure.core.credentials import AzureKeyCredential
6  from azure.ai.language.questionanswering import QuestionAnsweringClient
7

PS D:\Data\Azure AIAssignment> python SectionBQS.py
PS D:\Data\Azure AIAssignment> python SectionBQS.py
PS D:\Data\Azure AIAssignment> python SectionBQS.py

Question:
How much is the shipping fee?
ore details, please refer to the the FAQ section.
Confidence: 0.9487
Source: Q&A Excel.xlsx

Question:
Are the food considered halal certified?
Yes, most of our products are halal certified.
Confidence: 0.924
Source: Q&A Excel.xlsx

Question:
Can I cancel my order?
You can cancel your order within 24 hrs by contacting our hotline at 1234 5678.
Confidence: 1.0
Source: Q&A Excel.xlsx

Question:
What payment method is accepted?
We accept payment via Visa, Mastercard and American Express.
Confidence: 0.9229
Source: Q&A Excel.xlsx

Question:
How do I contact customer support?
You can email us at support@asianfrank.com or call our hotline at 1234 5678.
Confidence: 0.9342
Source: Q&A Excel.xlsx

Question:

```

Picture 18: Integrated terminal where chatbot is tested showing the different dialogue scenarios using Python SDK

Question:
Can I change delivery date?
You may change your delivery date by informing us at least 24 hours before the scheduled delivery.
Confidence: 0.98
Source: Q&A Excel.xlsx

Question:
Can I return the product?
Returned items must be in original packaging with proof of purchase within 7 days of the date delivered.
Confidence: 0.626
Source: Q&A Excel.xlsx

Picture 19: Integrated terminal where chatbot is tested showing the different dialogue scenarios using Python SDK

Part B: Build a chatbot in Multilanguage (15 marks)

By using the knowledge base that you generated in Part A. You are required to build your chatbot in at least 1 other Asian language. Your chatbot should be able to read in others language and return the answer in the same language.

1. State and explain what are the two benefits of generating a multilingual chatbot for your business? (2m)

By having a multilingual chatbot, it will enable chatbot to be able to interact with a wider customer base in different Asian regions. This chatbot can easily communicate with customers who speak in various languages, and answer all their questions. With a more border customer base to address the customer questions, this could ultimately increase sales for the company.

Additionally, the chatbot allows customers from different regions to ask for help anytime. Furthermore as the company does not have resources to engage third party translators, implementing this multilingual chatbot can significantly reduce the cost, hence making it a more cost effective solution for the company.

Having a multilingual chatbot will also provide improved customer experience. Customers who are not very familiar with English can interact in their preferred language with the chatbot. This helps the customer to feel confident and familiar when asking their questions through the chatbot and then receiving an answer in their preferred language. With the ease of using chatbot in their preferred language, this can provide a better customer user experience, where customers are more likely to refer their friends or family members to buy products from the company due to the ease of communication. Hence, increasing the company's reputation and revenue.

2. What are the extra AI services required for this Multilanguage chatbot. Assumption: The AI services that generated in Part A are still applicable. (2m)

Azure AI Translator is required for this multilingual chatbot. Azure AI Translator can be integrated into the question and answering app code that we created earlier on in Section B, Part A Question 5. The Azure AI Translator first detects the language of the user's query. It then translates the user's question to English, which then can be queried in the existing English knowledge base that was created in Section B, Part A. The response is generated in English and the Azure AI translator will then translate the response back to the user's original language before displaying it in the chatbot. This ensures that the user can interact with the multilingual chatbot in their preferred language.

3. Explain the procedure on how you could generate the Multilanguage chatbot with minimum cost. (3m)

The chatbot will be integrated with the question and answering app code earlier on in Section B, Part A Question 5. The code will be added on with the Azure AI Translation feature. When the user submits a query, the Azure AI Translator first detects the language of the query and then translates it into English. The translated question, which is now in English, will be queried against the existing English knowledge base that was created earlier on in Section B, Part A. The response generated from the knowledge base will be displayed in the chatbot if the user's query was in English. However, if the user's query was in another language, the Azure AI Translator will translate the response back to the user's original language before displaying it in the chatbot.

This approach helps to minimize cost, as it eliminates the need to develop and maintain a separate knowledge base for each language. There is also no need to manually input the translation language into the knowledge base, which is very tedious. By translating for the input and the output, we ensure that the chatbot can serve customers in multiple languages while

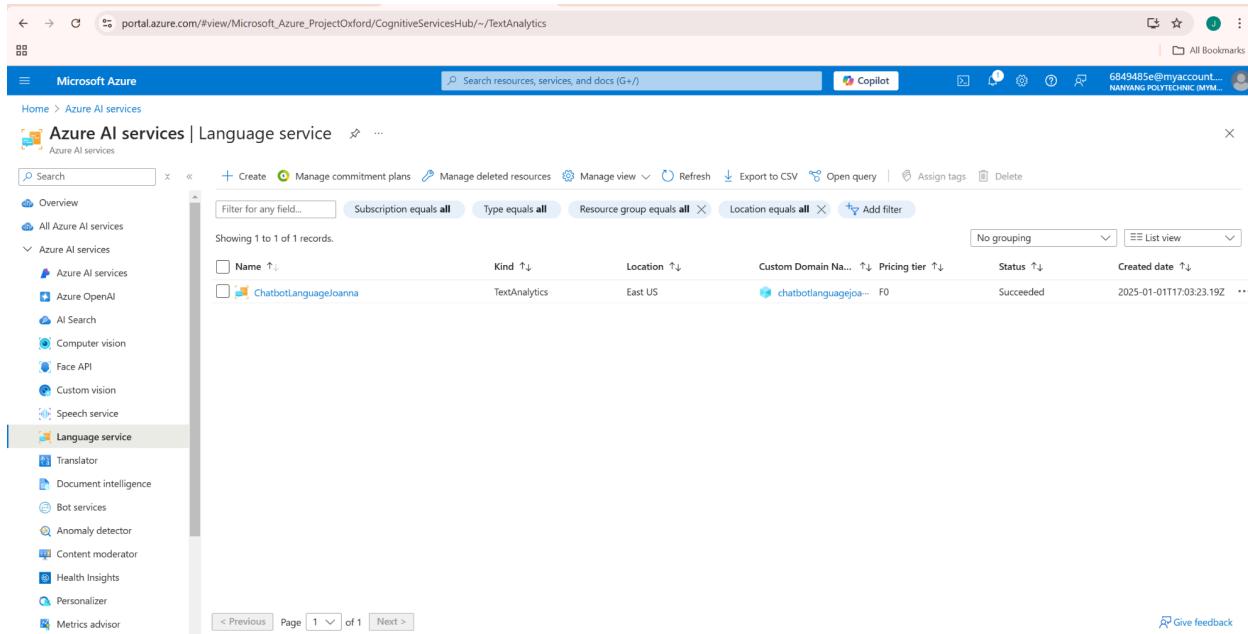
reusing the existing knowledge base, hence, it is considered as a cost effective and scalable solution.

Additionally, the code is structured in a way such that it minimizes the API calls for translation. It checks if the user's query is detected to be in English, then there is no need for translation, so the response from the knowledge base can be directly displayed in the chatbot. This reduces the number of API calls for translation, hence reducing the cost incurred by the Azure AI Translator service when implementing this multilingual chatbot.

4. Test and implemented the above chatbot. Please include the necessary screenshot for the generated cognitive service. You are required to submit the generated code in zip file. (2m).

The existing Azure AI Language Service (*Picture 20*) and knowledge base created in Azure Language Studio(*Picture 21*) created in Section B, Part A was reused. The Azure AI Translator Service was provisioned (*Picture 22*) and the API endpoint region and key(*Picture 23*) was obtained so as to make API calls for translation using our code.

Refer to the python file attached in the zip “Multilanguage_Translation.py”. The multilingual chatbot was tested by typing questions in the integrated terminal in different languages (Chinese, Malay and Tamil). It can be seen that the chatbot is able to accept the user's query in these different languages and provide the correct response back in the same language that the user queried in(*Picture 24 and Picture 25*).



Name	Kind	Location	Custom Domain Name	Pricing tier	Status	Created date
chatbotlanguagejoanna	TextAnalytics	East US	chatbotlanguagejoanna	F0	Succeeded	2025-01-01T17:03:23.19Z

Picture 20: Existing AI Language Service created in Section B, Part A

The screenshot shows the Azure Language Studio interface. At the top, there's a banner for 'Try new features in Azure AI Studio' and a message about AI Speech tools. The main area is titled 'Edit knowledge base' and shows a list of 'Question answer pairs (13)'. One pair is selected, displaying a question 'What if I did not receive the email or am having trouble tracking' and its answer: 'If you did not receive the email or having trouble tracking, feel free to provide your order number here and we will assist you further.' Below this, there are several other questions listed:

- Is there a way to track my order?**: 'You can track your order through the tracking link that is sent to your email.'
- How much is the shipping cost?**: 'Our delivery charges are waived for orders of \$100 and above, a 1% fee applies for orders below \$100. Additional fees may apply for specific delivery time slot and during peak period. For more details, please refer ...'
- Can I change the delivery date?**: 'You may change your delivery date by informing us at least 24 hours before the scheduled delivery.'
- Do you offer discounts for bulk purchases?**: 'Yes, we offer discounts for orders above \$100. For more details, refer to the discount page.'
- Are your products halal certified?**: 'Yes, most of our products are halal certified.'
- What is your return policy?**: 'Returned items must be in original packaging with proof of purchase within 7 days of the date delivered.'
- What payment methods do you accept?**: 'We accept payment via Visa, Mastercard and American Express.'

Picture 21: Existing knowledge base in Azure Language Studio created in Section B, Part A

The screenshot shows the 'Azure AI services | Translator' blade in the Azure portal. The left sidebar lists various AI services, with 'Translator' currently selected. The main area displays a table of resources:

Name	Kind	Location	Custom Domain Name	Pricing tier	Status	Created date
jtranslator	TextTranslation	East US	jtranslator	F0	Succeeded	2025-01-01T18:13:16.48Z

At the bottom right, there's a 'Give feedback' button.

Picture 22: Provisioned Azure Translator Service

The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes the Microsoft Azure logo, a search bar, and a user profile icon. The current page is 'jstranslator | Keys and Endpoint' under the 'Azure AI services | Translator' category. On the left, there's a sidebar with navigation links like Home, Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource Management, Security, Monitoring, Automation, Help, and a lock icon. The main content area has a heading 'jstranslator | Keys and Endpoint'. Below it are two buttons: 'Regenerate Key!' and 'Regenerate Key?'. A note about key security is displayed: 'These keys are used to access your Azure AI services API. Do not share your keys. Store them securely, for example, using Azure Key Vault. We also recommend regenerating these keys regularly. Only one key is necessary to make an API call. When regenerating the first key, you can use the second key for continued access to the service.' A 'Show Keys' button is present. The 'Keys and Endpoint' tab is selected, showing 'KEY 1' and 'KEY 2' fields, both of which are masked with dots. The 'Location/Region' dropdown is set to 'eastus'. Below this, there are tabs for 'Web API' and 'Containers'. A note under 'Web API' says: 'Use the below endpoints while using the Web API. To force the request to be handled by a specific geography, specify here.' Two examples are provided: 'Text Translation' with the URL <https://api.cognitive.microsofttranslator.com/> and 'Document Translation' with the URL <https://translator.cognitiveservices.azure.com/>.

Picture 23: API Key and Region was obtained from the Azure Translator Service

```
13     detected_result = detected_language.language
14
15     # Get response from Q&A model
16     response = ai_client.get_answers(question=translated_question,
17                                     project_name=ai_project_name,
18                                     deployment_name=ai_deployment_name)
19
20     if not response.answers:
21         print("No answers found.")
22         continue
23
24
25     # We only want the highest confidence answer
26     top_answer = response.answers[0].answer
27
28
29     # Output the answer in the same language that the user entered
30     if detected_result != 'en':
31         translated_answer = [InputTextItem(text=top_answer)]
32         translated_answer_output = client.translator.translate(content=translated_answer, to=[detected_result])
33
34     # We only want to retain the highest confidence translated answer.
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

PS D:\Data\Azure AI\Assignment> python Multilanguage_Translation.py

Question:
运费是多少?
Answer: 100 美元及以上的订单免除运费，低于 100 美元的订单收取 5% 的费用。在高峰期，特定送货时间段可能需要支付额外费用。有关更多详细信息，请参阅常见问题部分。

Question:
Adakah makanan tersebut dianggap halal?
Answer: Ya, sebagian besar produk kami bersertifikat halal.

Question:
我可以取消我的订单吗?
Answer: 您可以在 24 小时内拨打我们的热线 1234 5678 取消订单。

Question:
可以接受哪种付款方式?
Answer: 我们接受通过 Visa, Mastercard 和 American Express 付款。

Picture 24: Integrated terminal where chatbot is tested showing the different dialogue scenarios in different languages (Chinese, Malay, Tamil) using Python SDK

Question:
我可以退货吗?
Answer: 退回的物品必须在交货之日起 7 天内保持原包装并附有购买凭证。

Question: வடத்தினப்பார் சுவையை நன்கொறி துப்பகீல்தா?
Answer: நிர்வாக support@asianfrank.com என்கூல்களுக்கு மின்கூல்துறை பொம்புல்து எச்சர் டப் பிளா 1234 5678 என்கூல்களுக்கும்

Question: பிள்ளைரித் துடிமை மற்றுமா?
Answer: தப்பியிலிப்பட்ட பிள்ளைரிக்க கற்றார்கள் 24 மாத நிற்கின் மனு என்கிறது சுதாமல்கூமரித் துடிமை மற்றும்

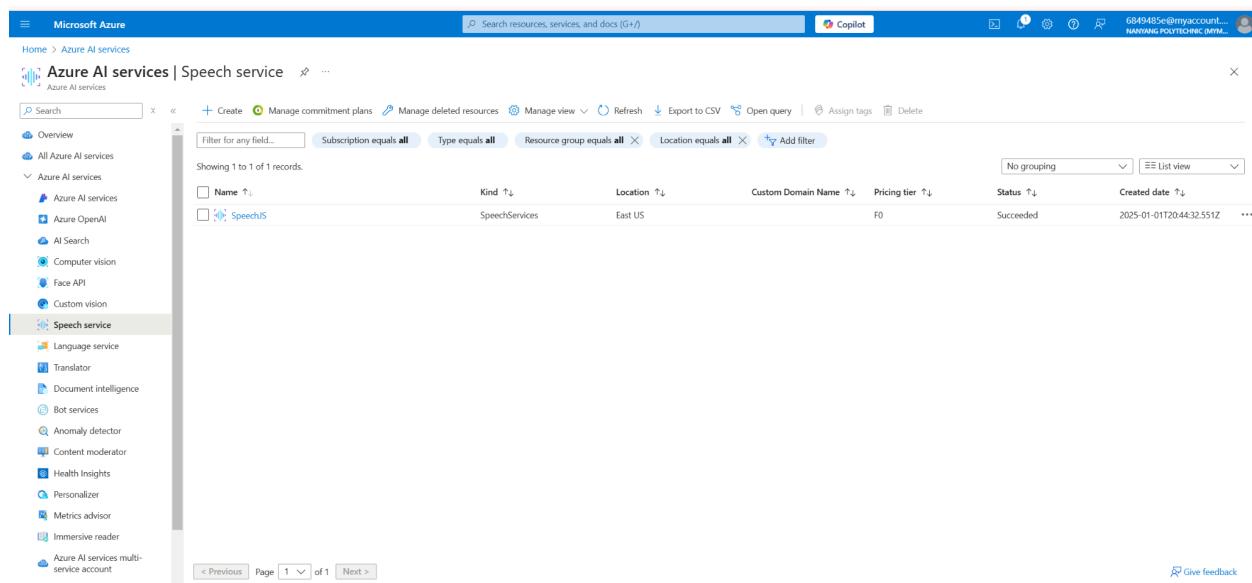
Picture 25: Integrated terminal where chatbot is tested showing the different dialogue scenarios in different languages (Chinese, Malay, Tamil) using Python SDK

5. You can improve your assignment by expanding the code in Part A and B to include some additional features. (6m)

The multilingual chatbot was enhanced by adding on two key features, Speech to Text and Text to Speech. The Speech Service was provisioned and the API endpoint region and key(*Picture 26*) was obtained so as to make API calls for speech recognition and speech synthesis using our code(*Picture 27*).

Refer to the python file attached in the zip “Additional_Feature.py”. The chatbot will prompt the user “Would you like to use voice input? (yes/no)”. If the user typed yes, then the user will speak into the default microphone by asking their question in any language, then the **Speech to Text** functionality in the code will transcribe their question in the form of speech to text format. This text format is then passed into the Azure Translator to first detect the language of the question in text format and then translate it into English. The translated question which is in English will be queried against the existing English knowledge base that was created earlier on in Section B, Part A. The response generated from the knowledge base will be displayed in the chatbot if the user’s query was in English, and the **Text to Speech** functionality in the code will help to convert the response in text format to speech format as an audio stream and the response will be read aloud in English voice (“en-US-AriaNeural”) However, if the user’s query was in another language, the Azure AI Translator will translate the response back to the user’s original language before displaying it in the chatbot. The **Text to Speech** functionality in the code will help to convert the response in text format to speech format as an audio stream and the response will be read aloud in Malay, Tamil, Chinese voice (“ms-MY-YasminNeural”, “ta-SG-VenbaNeural” and “zh-CN-XiaoxiaoNeural”)(*Picture 28*).

The screenshot below also shows if the user chooses not to query in speech but prefers to type in text format, the chatbot will respond back in text format only (*Picture 29 and Picture 30*).



The screenshot shows the Microsoft Azure portal interface. The top navigation bar includes 'Microsoft Azure', 'Search resources, services, and docs (G+)', 'Copilot', and a user profile. The main content area is titled 'Azure AI services | Speech service'. On the left, a sidebar lists various Azure AI services, with 'Speech service' currently selected. The main pane displays a table with one record:

Name	Kind	Location	Custom Domain Name	Pricing tier	Status	Created date
SpeechTS	SpeechServices	East US		F0	Succeeded	2025-01-01T20:44:32.551Z

At the bottom, there are navigation links for '< Previous', 'Page 1 of 1', and 'Next >'. The bottom right corner has a 'Give feedback' link.

Picture 26: Provisioned Speech Service

The screenshot shows the 'SpeechJS | Keys and Endpoint' page in the Microsoft Azure portal. The left sidebar has a 'Keys and Endpoint' section selected. The main area displays two API keys, both labeled 'KEY 1' and 'KEY 2', with their values shown as long strings of characters. Below the keys, there is a 'Location/Region' field set to 'eastus' and an 'Endpoint' field showing the URL 'https://eastus.api.cognitive.microsoft.com/'. A note at the top of the page cautions against sharing the keys securely.

Picture 27: API Key and Region was obtained from the Azure Speech Service

The screenshot shows a Jupyter Notebook interface with several files listed in the Explorer pane: '.env', 'Additional_Feature.py', 'Multilanguage_Translation.py', and 'text_to_speech'. The 'Additional_Feature.py' file is open in the code editor, showing Python code for speech-to-text conversion. The code includes imports, environment variable loading, and a function definition. The terminal pane below shows the execution of the script and its interaction with the user, displaying speech recognition results in multiple languages (Chinese, Malay, Tamil) and their corresponding text outputs.

```

20     def speech_to_text():
21         print('Speak now...')
22
23         # Start speech recognition
24         speech = speech_recognizer.recognize_once_async().get()
25
26         print(speech)
27
28
29         if speech.reason == ResultReason.NoMatch:
30             print("Speech recognition failed: " + speech.reason.name)
31         elif speech.reason == ResultReason.SpeechTimedOut:
32             print("Speech timed out")
33         else:
34             print("Speech recognized: " + speech.text)
35
36         return speech.text
37
38
39 if __name__ == '__main__':
40     speech_to_text()

```

Picture 28: Integrated terminal where chatbot is tested showing the user speaking into the microphone in different language(Chinese, Malay, Tamil) and the response is read aloud and displayed as text in the same language that the user queried in using Python SDK

The screenshot shows the VS Code interface with the terminal tab active. The terminal window displays a Python script named `Additional_Feature.py`. The script contains code for speech-to-text conversion and a user interaction loop. The output pane shows the following interaction:

```

PS D:\Data\Azure AI\Assignment> python Additional_Feature.py
Would you like to use voice input? (yes/no): no
Please enter your question: Is there discount?
Answer: Yes, we offer discounts for orders above $100. For more details, refer to the discount page.
Please enter your question: I have discovered missing items in my order, what should I do?
Answer: We apologize for the inconvenience. You can email us at support@asianfrank.com or call our hotline at 1234 5678.
Please enter your question: Is there a way to track my order?
Answer: You can track your order through the tracking link that is sent to your email.
Please enter your question: 

```

Picture 29: Integrated terminal where chatbot is tested where the no voice input was chosen, then user will have to type in the question and the chatbot will display the response in text format only

The screenshot shows the VS Code interface with the terminal tab active. The terminal window displays a Python script named `Additional_Feature.py`. The script contains code for getting speech voice and a user interaction loop. The output pane shows the following interaction:

```

PS D:\Data\Azure AI\Assignment> python Additional_Feature.py
Would you like to use voice input? (yes/no): no
Please enter your question: ada diskau?
Answer: Ya, kami menawarkan diskau untuk pesanan melebihi $100. Untuk maklumat lanjut, rujuk halaman diskau.
ms
Please enter your question: 普通話嗎?
Answer: 普通話嗎?
Please enter your question: 

```

Picture 30: Integrated terminal where chatbot is tested where the no voice input was chosen, then user will have to type in the question and the chatbot will display the response in text format only