TASK 4 - DETECTION OF OBJECTS IN AN IMAGE USING COMPUTER VISION SDK

B PRIYANKAA

s224207694

priyayj2016@gmail.com

TASK OVERVIEW:

- Need to develop a model to detect different objects in images with the coordinates. It can be any image with different objects.
- Need to use the computer vision SDK to detect different objects on Azure.

  # TARGET GRADE : PASS(P)

What is Computer vision?

Computer vision means the usage of machines in order to understand both images and videos. It is a subfield to both Artificial Intelligence and Machine Learning as it uses both specialised methods and learning algorithms in order to have a better understanding of both the images and videos input files.

There are 8 capabilities of Computer Vision, They are:

1. Image Description: Analyse an image, evaluate the objects in the image and give a description of the image.
2. Feature Tagging: Based on objects that are recognised, tags are applied.
3. Image Categorization: Based on the images, that image is put into a category. For Example: Image of a cricket groud is put into **Sports** category.
4. Image Type Detection: This helps to identify if the image is a clip art or line drawing.
5. Color Scheme Detection: Find the dominant color in the background.
6. Content Moderation: To detect if there is any adult content in the image.
7. Object Detection: Find the common objects and return the coordinates of the bounding box.

8. Brand Detection: To find if there is a presence of any company logos in the image present.

Task Objective:

To develop a model using computer vision SDK to detect different objects in images with the coordinates. It can be any image with different objects.

1. IMPORTING THE NECCESSARY LIBRARIES:

In [1]:
```
# Importing the images using **IPython.display** library modules.


from IPython.display import Image as img
```

In [2]:
```
# CV Library - a package of modules that are designed to solve CV Problems.

# !pip install --upgrade azure-cognitiveservices-vision-computervision

# Pillow library: used for image processing.

#!pip install pillow

# dotenv library: This library is installed in order to give the credentials needed to
#!pip install python-dotenv
```

In [3]:
```
# To run the Azure Computer Vision Service:

from azure.cognitiveservices.vision.computervision import ComputerVisionClient

# To extract specific features from the image:

from azure.cognitiveservices.vision.computervision.models import VisualFeatureTypes

# To authenticate the client:

from msrest.authentication import CognitiveServicesCredentials

# To draw bounding boxes in images:

from PIL import Image, ImageDraw
import matplotlib.pyplot as plt

# To read the secret keys for Authentication:

import os
from dotenv import load_dotenv
```

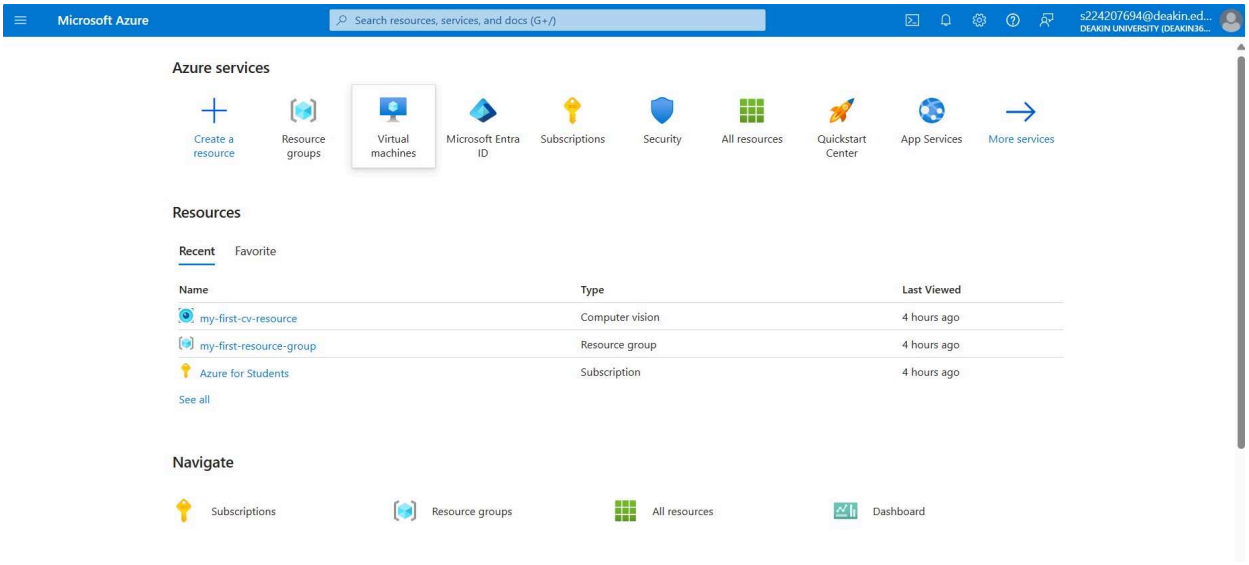
2. Creating a resource group on Azure portal:

1. Log in to the Azure portal using the credentials.

2. Here is the screenshot of the front page of the Azure portal. Azure for Students is the subscription with 100 credits developed by the university for the students to create the resource groups, workspace, develop and deploy the model and perform all the machine learning activities.

In [5]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\AP1.jpg')
```

Out[5]:

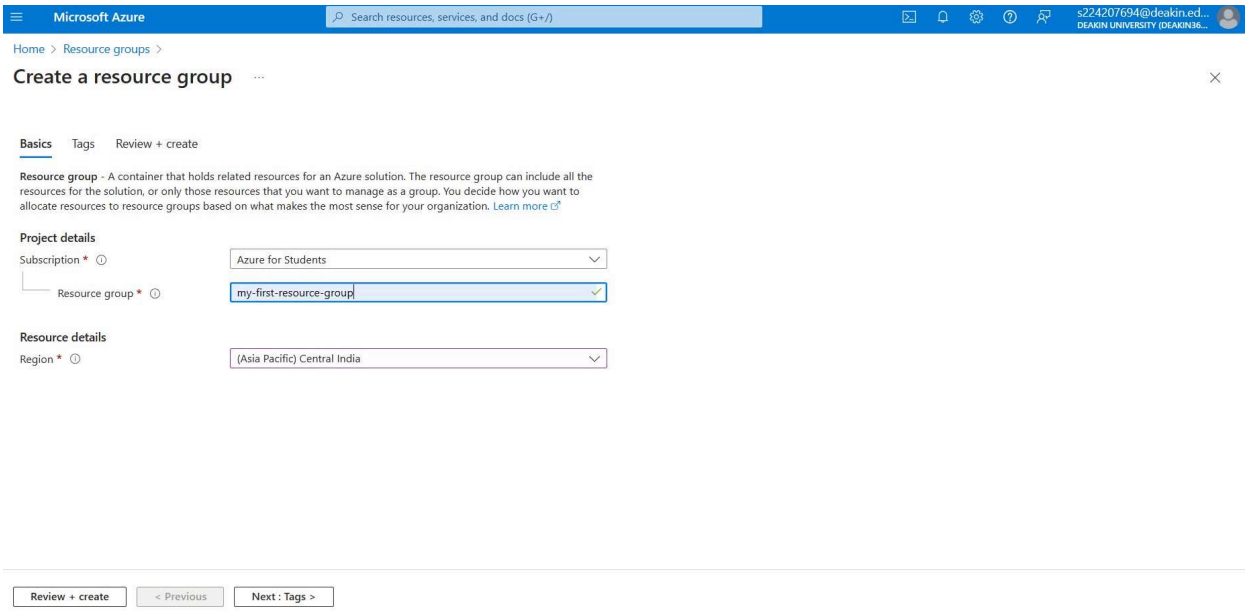


1. Click on the Resource-group icon available as seen in the below image.

2. The resource group name is given as “my-first-resource-group” and the Region is set to “Central-India”. Now “Review+Create” must be clicked.

In [6]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\RG1.jpg')
```

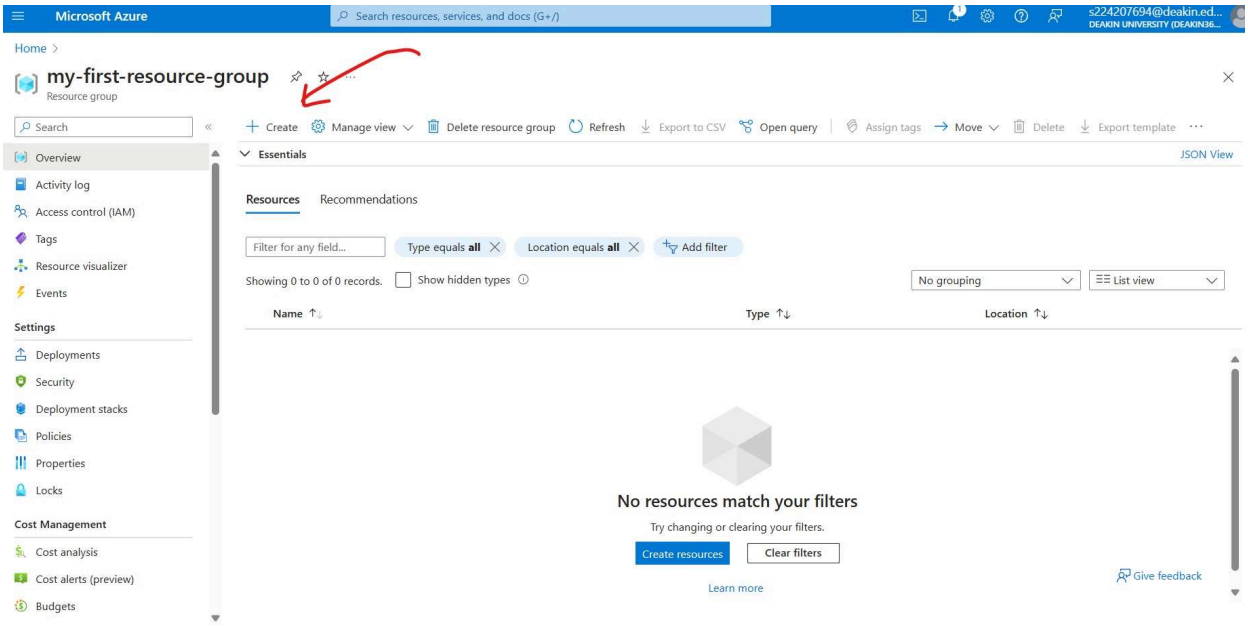
Out[6]:



1. So "Create" Button is clicked in order to choose "Computer Vision" from the MarketPlace.

In [7]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\RG2.jpg')
```

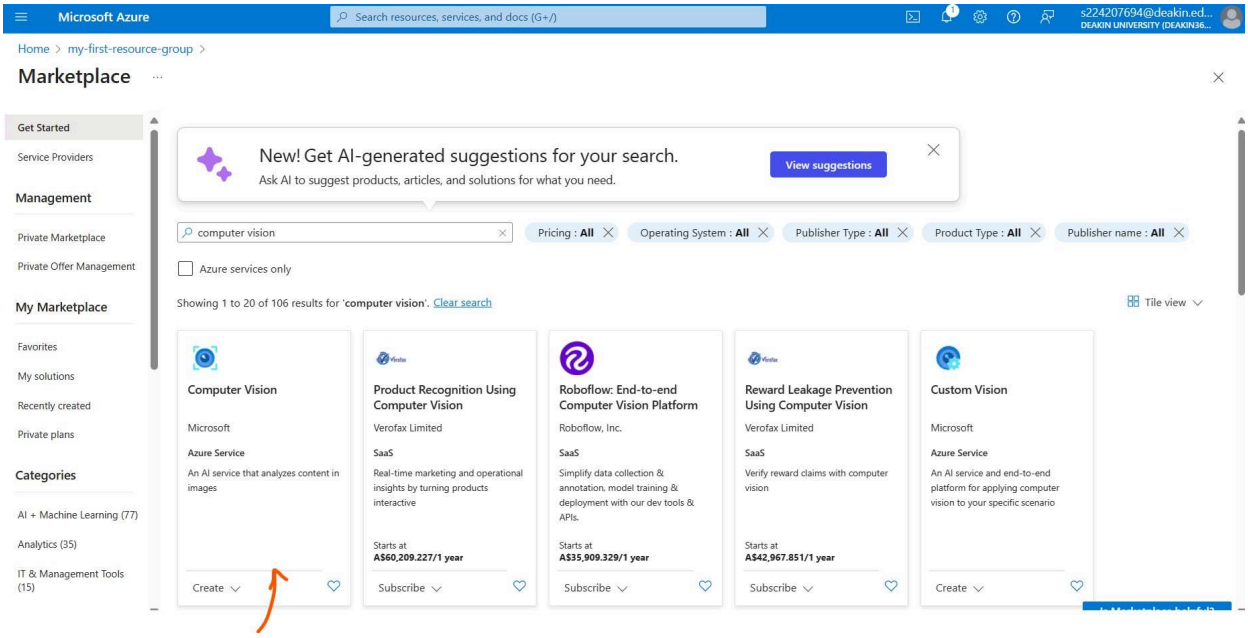
Out[7]:



1. "Computer Vision" option is chosen and create option is clicked.

In [8]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\CV1.jpg')
```

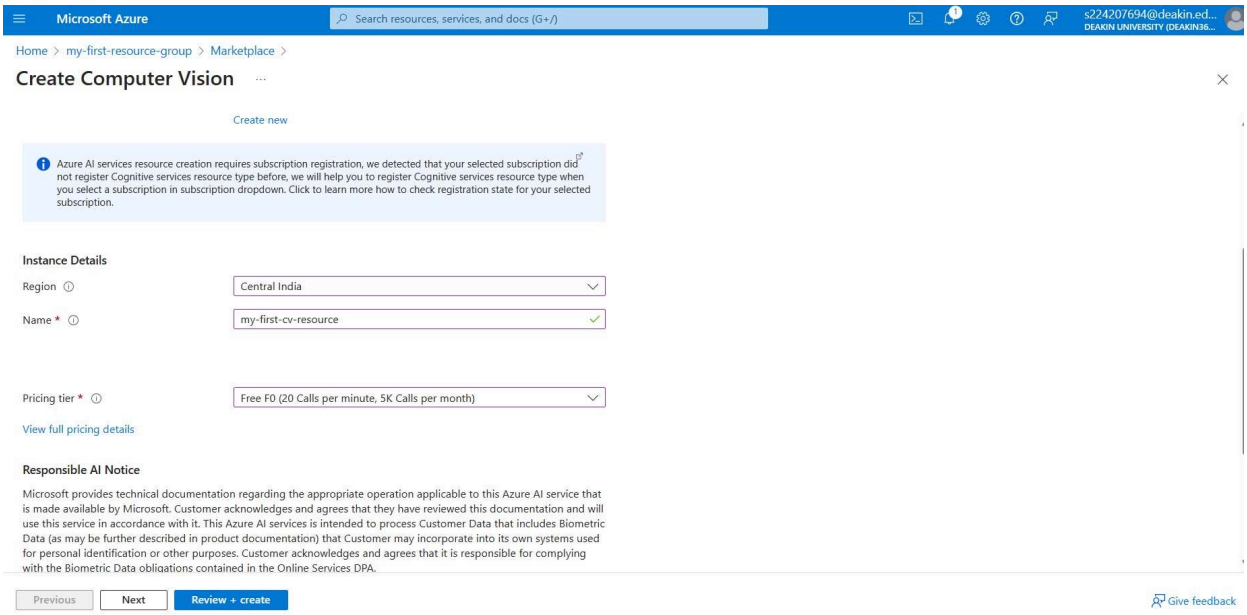
Out[8]:



1. Once **Create** button is clicked, then a name for CV workspace with a name “my-first-cv-resource” is given and the Region is set to “Central India”.

In [9]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\CV2.jpg')
```

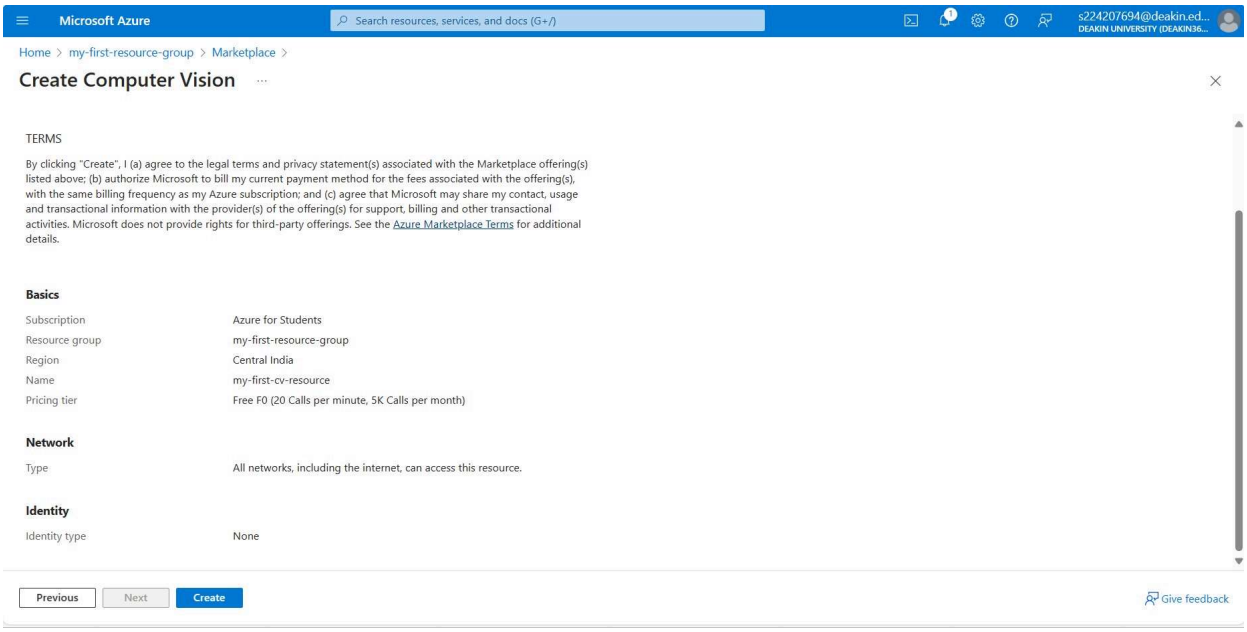
Out[9]:



1. The Pricing Tier is set to Free F0(20 calls per minute).
2. Once “Review+Create” is clicked and then “Create” is clicked, the deployment process begins and few minutes later, the process is over.

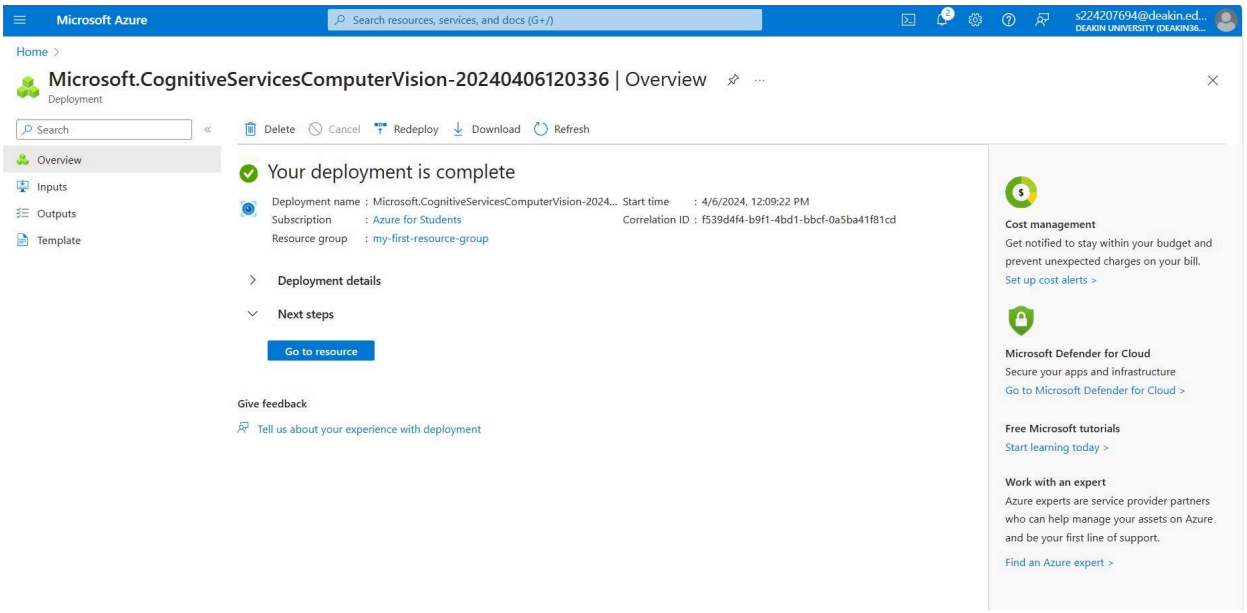
In [10]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\CV3.jpg')
```

Out[10]:



In [11]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\CV4.jpg')
```

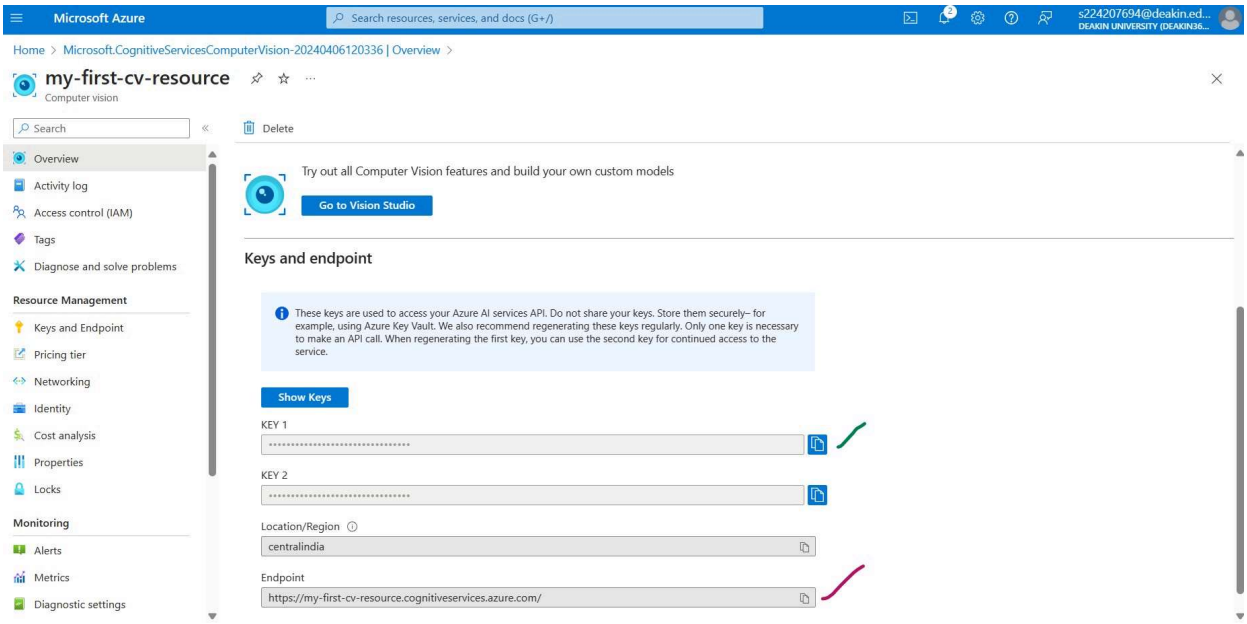
Out[11]:



1. Inside the "my-first-cv-resource", a key and endpoint is made after deployment.

In [12]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\CV-Key-and-endpoint.jpg')
```

Out[12]:



1. Those subscription_key (Key1) is copied and endpoint is copied onto the notepad for future use.

In [13]:
```
img('C:\\Users\\Priyankaa B\\TASK_4\\CV-Key-and-endpoint-2.jpg')
```

Out[13]:

3. Creating the subscription_key and endpoint variables:

In [14]:
```
subscription_key = os.environ.get("0b614e5025c44bf6b85644f178b4e523")
endpoint = os.environ.get("https://my-first-cv-resource.cognitiveservices.azure.com/")
```

A computervision client is made with the help of endpoint and subscription_key.

In [15]:
```
computervision_client = ComputerVisionClient("https://my-first-cv-resource.cognitivese
```

In [16]:
```
# Features like description, tags, categories, brands, objects, adult to be retrieved:

features = [VisualFeatureTypes.description,
            VisualFeatureTypes.tags,
            VisualFeatureTypes.categories,
            VisualFeatureTypes.brands,
            VisualFeatureTypes.objects,
            VisualFeatureTypes.adult]
```

4. First Image: An image of a group of people going on a trekking is given as a first input.

In [18]:
```
# Uploading Image to be analysed
image_file = 'C:\\Users\\Priyankaa B\\TASK_4\\TASK_4_INPUTS\\Trek.jpg'

# Viewing the image file
img(image_file)
```

Out[18]:

5. Reading the image as image data in order to retrieve the features like description, tags, categories, brands, objects, adult.

- The image is opened and mode is set as "rb" in order to read the image as image data and features are retrieved using the computervision_client.analyze_image_in_stream() function and it is stored into analysis variable.

In [19]:
```
# Get image analysis
with open(image_file, mode="rb") as image_data:
    # call the API.
    # The first argument in the function is the image to be analysed. The second argum
    # We will run the analysis once per image. Then, we will display each feature in a
    analysis = computervision_client.analyze_image_in_stream(image_data ,features)
```

Here computervision_client() is the API called with local image and features.

6. Image_Description:

- Based on reading the image and features collected, a description is made.
- For Example, this is an image of **"a group of people walking on a path through a forest"**.

In [20]:
```
# Get image description
if (len(analysis.description.captions) > 0):
    print("Describing the image: ")
    for caption in analysis.description.captions:
        print("Description: '{}' (confidence: {:.2f}%)".format(caption.text, caption.c
else:
    print('No description found.')
```

```
Describing the image:
Description: 'a group of people walking on a path through a forest' (confidence: 49.9
2%)
```

7. Image_Tagging:

- Based on the features extracted from the image, there are several objects identified by this **analysis.tags** statement.

In [21]:
```
# Get image tags
if (len(analysis.tags) > 0):
    print("These are the tags associated with the image:")
    for tag in analysis.tags:
        print(" -'{}' (confidence: {:.2f}%)".format(tag.name, tag.confidence * 100))
else:
    print("No image tags found")
```

```
These are the tags associated with the image:
 -'outdoor' (confidence: 99.89%)
 -'tree' (confidence: 98.86%)
 -'clothing' (confidence: 98.72%)
 -'hiking' (confidence: 98.31%)
 -'plant' (confidence: 96.66%)
 -'sky' (confidence: 95.23%)
 -'forest' (confidence: 95.13%)
 -'person' (confidence: 94.97%)
 -'backpack' (confidence: 89.37%)
 -'jungle' (confidence: 88.54%)
 -'people' (confidence: 85.07%)
 -'man' (confidence: 84.59%)
 -'nature' (confidence: 79.54%)
 -'grass' (confidence: 78.12%)
```

Inference Made:

- Here tags identified from the image are: Outdoor, tree, clothing, hiking, plant, sky, forest, person, backpack, jungle, people, man, nature, grass.

Here **confidence** means the degree of certainity of a Computer Vision Algorithm in its predictions.

- From the image, the algorithm has confidence of predicting girls as 'people' - 85.07%.

8. Image_Category:

- Based on the image, it is segregated as indoor or outdoor.
- With the help of **analysis.categories** feature obtained from the image_data, the confidence is also printed.
- Here since its a Trekking image, it is found to be outdoor category.

In [22]:
```python
# Get image categories
if (len(analysis.categories) > 0):
    print("Categories:")
    landmarks = []
    for category in analysis.categories:
        # Print the category
        print(" -'{}' (confidence: {:.2f}%)".format(category.name, category.score * 10
        if category.detail:
            # Get landmarks in this category
            if category.detail.landmarks:
                for landmark in category.detail.landmarks:
                    if landmark not in landmarks:
                        landmarks.append(landmark)

    # If there were landmarks, list them
    if len(landmarks) > 0:
        print("Landmarks:")
        for landmark in landmarks:
```

```
            print(" -'{}' (confidence: {:.2f}%)".format(landmark.name, landmark.confid
else:
    print("Unable to find image categories.")
```

```
Categories:
 -'outdoor_' (confidence: 0.78%)
```

9. Object_Detection:

- With the help of **analysis.objects** feature obtained from the image_data, the confidence is also printed.
- Image is given as input and drawn.
- Image is taken as a rectangle and Based on these x, y , w, h variables, a bounding box is drawn.
- The output file is stored as "objects_present.jpg" file.

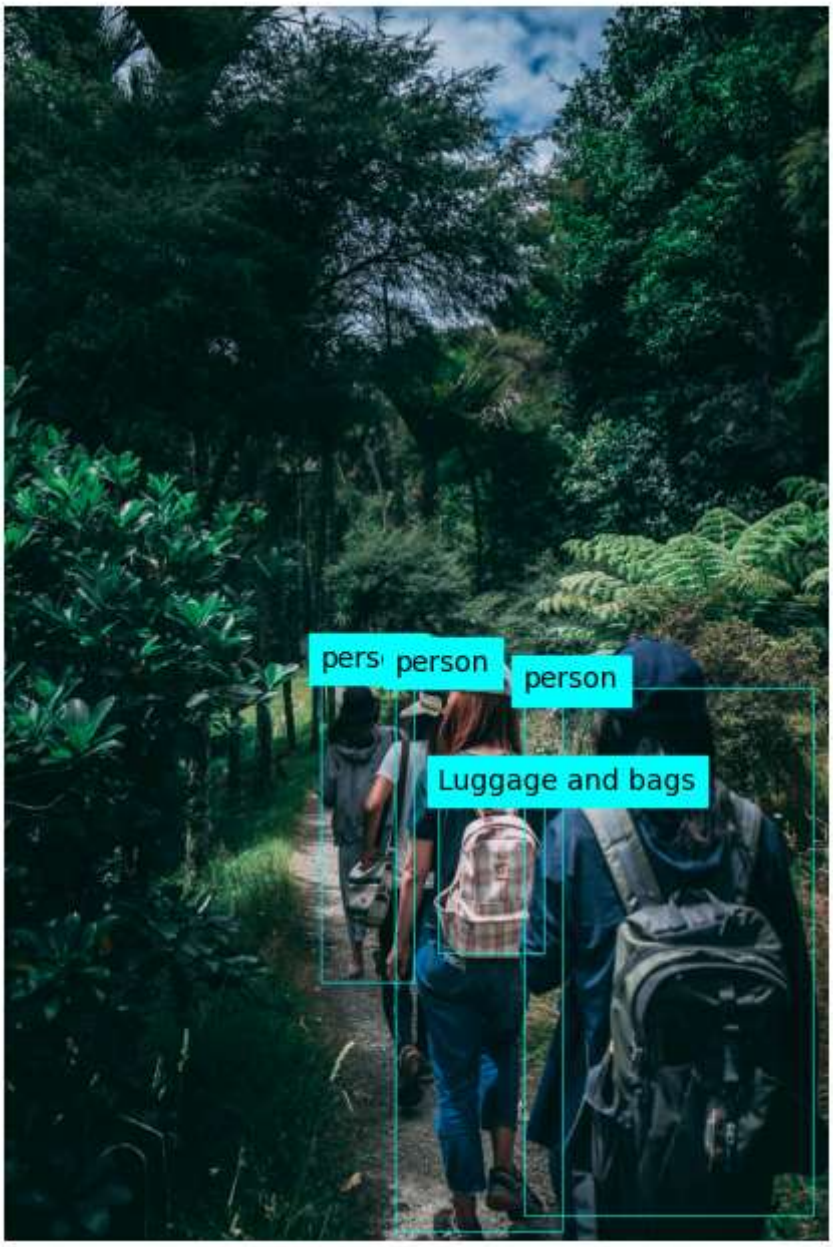
In [23]:
```
'''
Object Detection - This is done to locate objects, identifies them, and draws bounding
'''
print("===== Object Detection =====")
# Get objects in the image
if len(analysis.objects) > 0:
    print("Objects in image:")

    # Prepare image for drawing
    fig = plt.figure(figsize=(8, 8))
    plt.axis('off')
    image = Image.open(image_file)
    draw = ImageDraw.Draw(image)
    color = 'cyan'
    for detected_object in analysis.objects:
        # Print object name
        print(" -{} (confidence: {:.2f}% at location {}, {}, {}, {})".format(detected_
        detected_object.rectangle.y, detected_object.rectangle.y + detected_object.rec


        # Draw object bounding box
        r = detected_object.rectangle
        bounding_box = ((r.x, r.y), (r.x + r.w, r.y + r.h))
        draw.rectangle(bounding_box, outline=color, width=3)
        plt.annotate(detected_object.object_property,(r.x, r.y), backgroundcolor=color
    # Save annotated image
    plt.imshow(image)

    # Save the annotated image in a new file for future reference
    outputfile = 'objects_present.jpg'
    fig.savefig(outputfile)
    print('  Results saved in', outputfile)
else:
    print('No objects found in the image.')
```

```
===== Object Detection =====
Objects in image:
 -Luggage and bags (confidence: 51.80% at location 1053, 1311, 1903, 2302)
 -person (confidence: 73.70% at location 768, 995, 1605, 2373)
 -person (confidence: 86.40% at location 948, 1355, 1616, 2979)
 -person (confidence: 58.20% at location 1261, 1963, 1656, 2940)
  Results saved in objects.jpg
```



Inference Made:

1. The model draws a bounding box of a person with co-ordinates of 768, 995, 1605, 2373.
2. The model draws a bounding box of the Luggages and Bags with co-ordinates of 1053, 1311, 1903, 2302.

10. Color Detection: This gives an idea of the dominant colour present in the image.

- The image is taken as input with read mode.
- The color feature is taken and stored on to **local_image_features.**
- dominant_color_background() using this, the dominant color is found to be **BLACK**.

In [25]:
```
# Detect Color: To detect the different aspects of its color scheme in a local image.

print("===== Detect Color =====")
# Open local image
local_image = open(image_file, "rb")
# Select visual feature(s) you want
local_image_features = ["color"]
# Call API with local image and features
detect_color_results_local = computervision_client.analyze_image_in_stream(local_image

# Print results of the color scheme detected
print("Getting color scheme of the local image: ")
print("Is black and white: {}".format(detect_color_results_local.color.is_bw_img))
print("Accent color: {}".format(detect_color_results_local.color.accent_color))
print("Dominant background color: {}".format(detect_color_results_local.color.dominant
print("Dominant foreground color: {}".format(detect_color_results_local.color.dominant
print("Dominant colors: {}".format(detect_color_results_local.color.dominant_colors))
print()
```

```
===== Detect Color =====
Getting color scheme of the local image:
Is black and white: False
Accent color: 0C2622
Dominant background color: Black
Dominant foreground color: Black
Dominant colors: ['Black']
```

12. Brand Detection:

- This feature "analysis.brands" is taken as imput.
- Name of the brand and confidence of the brand is found.

In [27]:
```
# Detect brands: example detects brands in a local image.

print("===== Detect brands =====")

# Get brands in the image
if (len(analysis.brands) > 0):
    print("Brands: ")
    for brand in analysis.brands:
        print(" -'{}' (confidence: {:.2f}%)".format(brand.name, brand.confidence * 100
```

```
else:
    print("No brands detected in image.")
```

```
===== Detect brands =====
No brands detected in image.
```

Second Image: An image of a apple laptop kept on table is taken as a second input.

In [28]:
```
image_file2 = 'C:\\Users\\Priyankaa B\\TASK_4\\TASK_4_INPUTS\\Apple_Products.jpg'


# Viewing the image file
img(image_file2)
```

Out[28]:

1. Reading the image as image data in order to retrieve the features like description, tags, categories, brands, objects, adult.

- The image is opened and mode is set as "rb" in order to read the image as image data and features are retrieved using the computervision_client.analyze_image_in_stream() function and it is stored into analysis variable.

In [29]:
```
# Get image analysis
with open(image_file2, mode="rb") as image_data:
    # call the API.
    # The first argument in the function is the image to be analysed. The second argum
```

```
    # We will run the analysis once per image. Then, we will display each feature in a
    analysis = computervision_client.analyze_image_in_stream(image_data ,features)
```

2. Image_Description:

- Based on reading the image and features collected, a description is made.
- For Example, this is an image of **"a laptop on a table"**.

In [30]:
```
# Get image description
if (len(analysis.description.captions) > 0):
    print("Describing the image: ")
    for caption in analysis.description.captions:
        print("Description: '{}' (confidence: {:.2f}%)".format(caption.text, caption.c
else:
    print('No description found.')
```

```
Describing the image:
Description: 'a laptop on a table' (confidence: 61.17%)
```

3. Image_Tagging:

- Based on the features extracted from the image, there are several objects identified by this **analysis.tags** statement.

In [31]:
```
# Get image tags
if (len(analysis.tags) > 0):
    print("These are the tags associated with the image:")
    for tag in analysis.tags:
        print(" -'{}' (confidence: {:.2f}%)".format(tag.name, tag.confidence * 100))
else:
    print("No image tags found")
```

```
These are the tags associated with the image:
 -'laptop' (confidence: 98.43%)
 -'indoor' (confidence: 97.69%)
 -'computer' (confidence: 93.59%)
 -'mac' (confidence: 91.40%)
 -'table' (confidence: 91.11%)
 -'gadget' (confidence: 89.58%)
 -'sitting' (confidence: 88.75%)
 -'furniture' (confidence: 87.21%)
 -'electronic device' (confidence: 86.05%)
 -'wall' (confidence: 79.74%)
 -'floor' (confidence: 73.24%)
 -'apple' (confidence: 68.75%)
 -'wooden' (confidence: 59.45%)
```

Inference Made:

- Here tags identified from the image are: Indoor, laptop, computer, mac, table, furniture, floor, wooden.

Here **confidence** means the degree of certainity of a Computer Vision Algorithm in its predictions.

- From the image, the algorithm has confidence of predicting **laptop** as 'electronic device' - 86.05%.

4. Image_Category:

- Based on the image, it is segregated as indoor or outdoor.
- With the help of **analysis.categories** feature obtained from the image_data, the confidence is also printed.
- Here since its a Laptop image, it is found to be abstract category.

In [32]:
```
# Get image categories
if (len(analysis.categories) > 0):
    print("Categories:")
    landmarks = []
    for category in analysis.categories:
        # Print the category
        print(" -'{}' (confidence: {:.2f}%)".format(category.name, category.score * 10
        if category.detail:
            # Get landmarks in this category
            if category.detail.landmarks:
                for landmark in category.detail.landmarks:
                    if landmark not in landmarks:
                        landmarks.append(landmark)

    # If there were landmarks, list them
    if len(landmarks) > 0:
        print("Landmarks:")
        for landmark in landmarks:
            print(" -'{}' (confidence: {:.2f}%)".format(landmark.name, landmark.confic
else:
    print("Unable to find image categories.")
```

```
Categories:
 -'abstract_' (confidence: 0.78%)
 -'others_' (confidence: 7.81%)
```

5. Object_Detection:

- With the help of **analysis.objects** feature obtained from the image_data, the confidence is also printed.
- Image is given as input and drawn.
- Image is taken as a rectangle and Based on these x, y , w, h variables, a bounding box is drawn.
- The output file is stored as "brands_image.jpg" file.

Here computervision_client() is the API called with local image and features.

In [33]:
```
## Detect brands: This example detects brands in a local image. If any brands are foun
print("===== Detect brands =====")
# Open local image
local_image_type = open(image_file2, "rb")
# Select visual feature(s) you want
local_image_features = ["brands"]


# Call API with local image and features
detect_type_results_local = computervision_client.analyze_image_in_stream(local_image_
# Get brands in the image
if (len(detect_type_results_local.brands) > 0):
    print("Brands: ")

    fig = plt.figure(figsize=(8, 8))
    plt.axis('off')
    image = Image.open(image_file2)
    draw = ImageDraw.Draw(image)
    color = 'cyan'
    for brand in detect_type_results_local.brands:
       # Prepare image for drawing
        print(" -'{}' (confidence: {:.2f}% at location {}, {}, {}, {})".format(brand.r
        brand.confidence * 100, brand.rectangle.x, brand.rectangle.x + brand.rectangle
        brand.rectangle.y, brand.rectangle.y + brand.rectangle.h))
        # Draw object bounding box
        r =  brand.rectangle
        bounding_box = ((r.x, r.y), (r.x + r.w, r.y + r.h))
        draw.rectangle(bounding_box, outline=color, width=3)
        plt.annotate(brand.name,(r.x, r.y), backgroundcolor=color)
    # Save annotated image
    plt.imshow(image)

    # Save the annotated image in a new file for future reference
    outputfile = 'brands_image.jpg'
    fig.savefig(outputfile)
    print('  Results saved in', outputfile)
else:
  print("No brands detected.")
```

```
===== Detect brands =====
Brands:
 -'Apple' (confidence: 83.50% at location 2807, 3146, 1582, 1961)
  Results saved in brands_image.jpg
```

Inference Made:

- Image of a Apple laptop is printed with its bounding box values, (2807, 3146, 1582, 1961) and confidence of 83.50%.

6. Color Detection: This gives an idea of the dominant colour present in the image.

- The image is taken as input with read mode.
- The color feature is taken and stored on to **local_image_features.**
- dominant_color_background() using this, the dominant color is found to be **GREY**.

In [36]:
```
# Detect Color: To detect the different aspects of its color scheme in a local image.

print("===== Detect Color =====")
# Open local image
local_image = open(image_file2, "rb")
# Select visual feature(s) you want
local_image_features = ["color"]
# Call API with local image and features
detect_color_results_local = computervision_client.analyze_image_in_stream(local_image

# Print results of the color scheme detected
print("Getting color scheme of the local image: ")
print("Is black and white: {}".format(detect_color_results_local.color.is_bw_img))
print("Accent color: {}".format(detect_color_results_local.color.accent_color))
```

```
print("Dominant background color: {}".format(detect_color_results_local.color.dominant
print("Dominant foreground color: {}".format(detect_color_results_local.color.dominant
print("Dominant colors: {}".format(detect_color_results_local.color.dominant_colors))
print()
```

```
===== Detect Color =====
Getting color scheme of the local image:
Is black and white: False
Accent color: A6252E
Dominant background color: Grey
Dominant foreground color: White
Dominant colors: ['White', 'Grey', 'Black']
```

7. Brand Detection:

- This feature "analysis.brands" is taken as imput.
- Name of the brand and confidence of the brand is found.

In [37]:
```
# Detect brands: example detects brands in a local image.

print("===== Detect brands =====")

# Get brands in the image
if (len(analysis.brands) > 0):
    print("Brands: ")
    for brand in analysis.brands:
        print(" -'{}' (confidence: {:.2f}%)".format(brand.name, brand.confidence * 100
else:
    print("No brands detected in image.")
```

```
===== Detect brands =====
Brands:
 -'Apple' (confidence: 83.50%)
```

Inference Made:

The brand: Apple is found from the Apple Laptop Image present with confidence 83.50%.