Document Name	HOL – Azure Custom Vision Service v3.x
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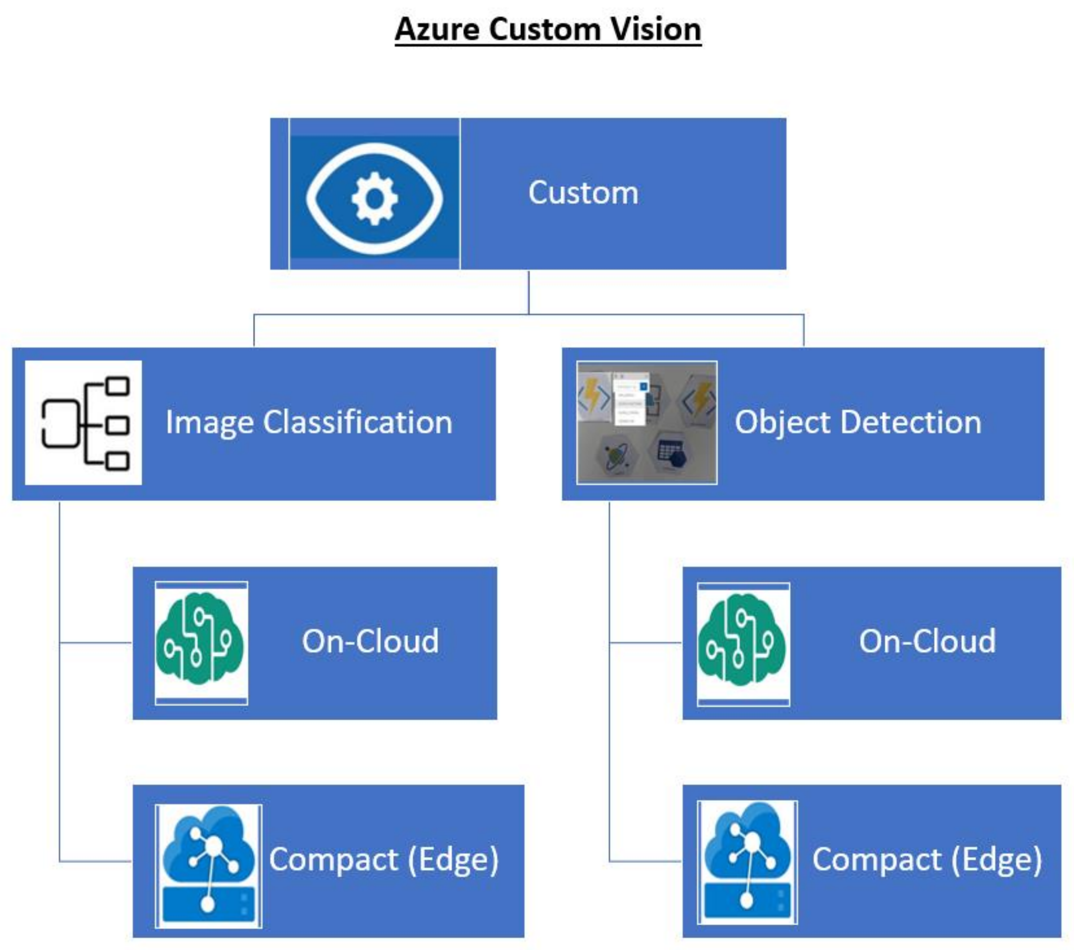
Reviewer	
Executive Summary	Azure Cognitive APIs enable the developers of all skill levels to add human intelligence in their applications. The services are designed for developers interested in pursuing DS/AI/ML skills and people who want to acquire the deep technical knowledge on the Cognitive APIs of Azure, despite not having Machine Learning expertise.
Purpose	This document is created to help you gain level 350 working knowledge on Azure Custom Vision Service. You will be able to explore each functionality offered by the service through the GUI Portal to train the model & REST APIs to observe the outcomes. We have also shared a sample dataset to replicate what we have used to create the content of this workshop. Once you complete these labs, you'll go from ***Zero to Hero*** on the respective Azure Cognitive service and should be able to *Demo, Develop and Deploy* your own custom use cases. The important thing to note here is that you don't need to refer any other documents to complete this workshop.
Intent of Guide	This workshop is designed to help you explore all the features of a service offered through their GUI Portal & APIs. The diagram shown in the beginning of the document is its functional Architecture; talking about the functionalities offered by the service in a flow. It also covers the Concepts, How-to and best practices about the service. This document is not intended to enable you with scenarios of deployment in production.

Service brief: Azure Custom Vision Service
Azure's Custom Vision service gives you access to build custom models for Image Classification & Object Detection using a no code or code first approach.

Diagram: Functional Architecture



Azure offers a separate Computer Vision service, that allows you to use pre-built models for Image Analysis & Object Detection. In case, you have a specific use case / requirements that may or may not be met by pre-built models, you can use the Custom Vision Service to create a custom model for your business.

Custom Vision models can be broadly classified into 2 categories :

1. Image Classification : This enables you to solve the classification problem pertaining to images. Using image classification, one can classify the images into 1 or more buckets by tagging the images. There are 2 types of classification problems -
   a. Multiclass Classification : Each image is associated with 1 tag
   b. Multilabel Classification : Each image can be associated with multiple tags
2. Object Detection : This enables you to detect objects present in an image by providing the bounding coordinates where they are present.

You can create & deploy the custom models in a no code approach using the GUI portal or in a code first approach using language specific SDKs or REST APIs. This workshop combines portal & REST API approach, for model building, training, testing, tuning and prediction.

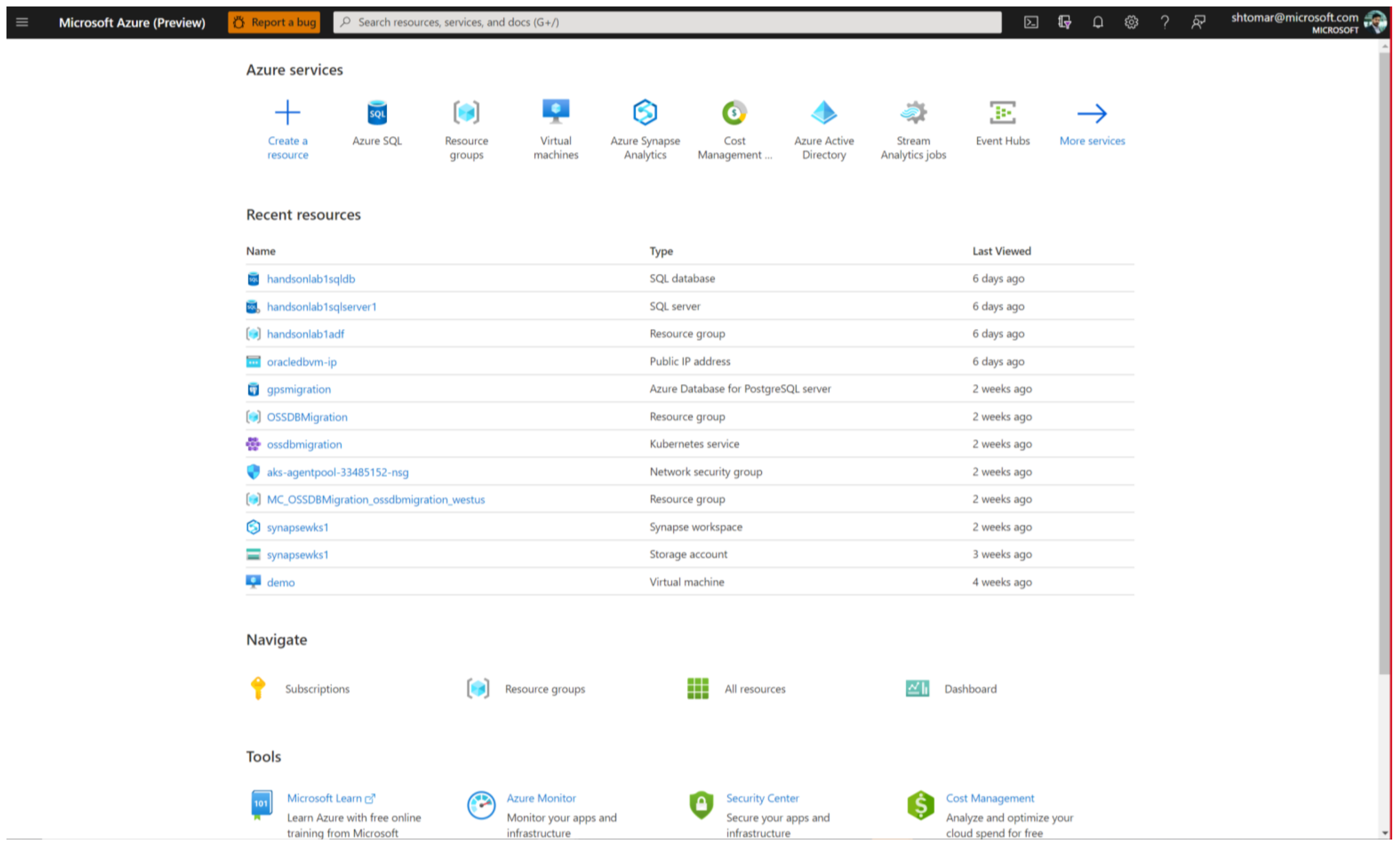
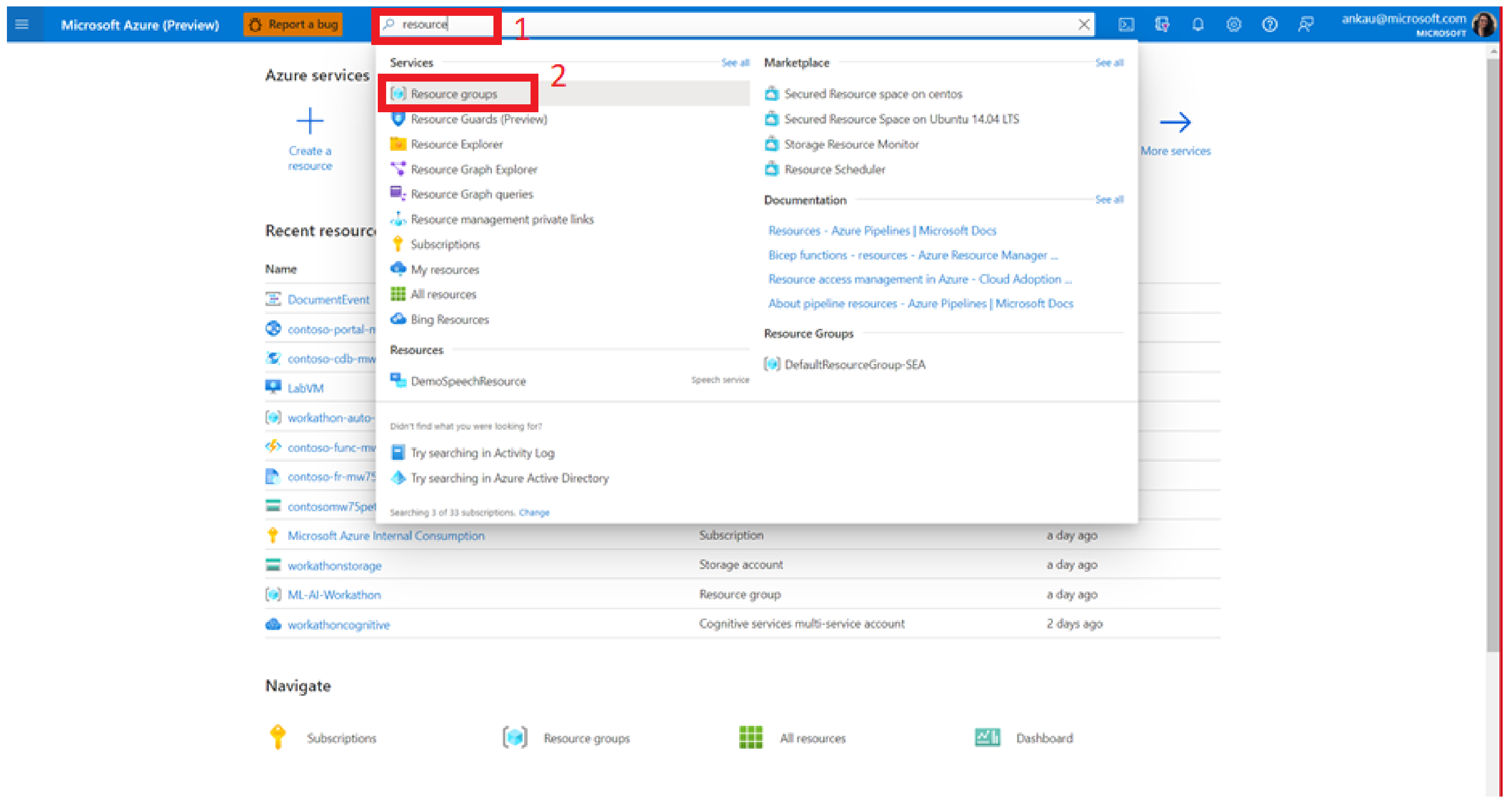
You can deploy the models on the cloud or on the edge.

Step by step hands on guide to go from *Zero to Hero*

Pre-requisites

- Download & Install Postman
    - Postman is a free tool which allows you to make API calls
    - You can download the desktop application or get started using the web version (Download Postman | Try Postman for Free)
- An active Azure Account
    - You can use your current Azure Subscription or get started by creating a free trial account (https://azure.microsoft.com/en-in/free)
- Download the data for training & testing images from the Data folder in Custom Vision Folder

Let's get started!

Screenshots	Steps & Significance
	Sign into your Azure Portal.
	<u>Create a Resource Group</u> Follow steps 1 & 2 to create a resource group.

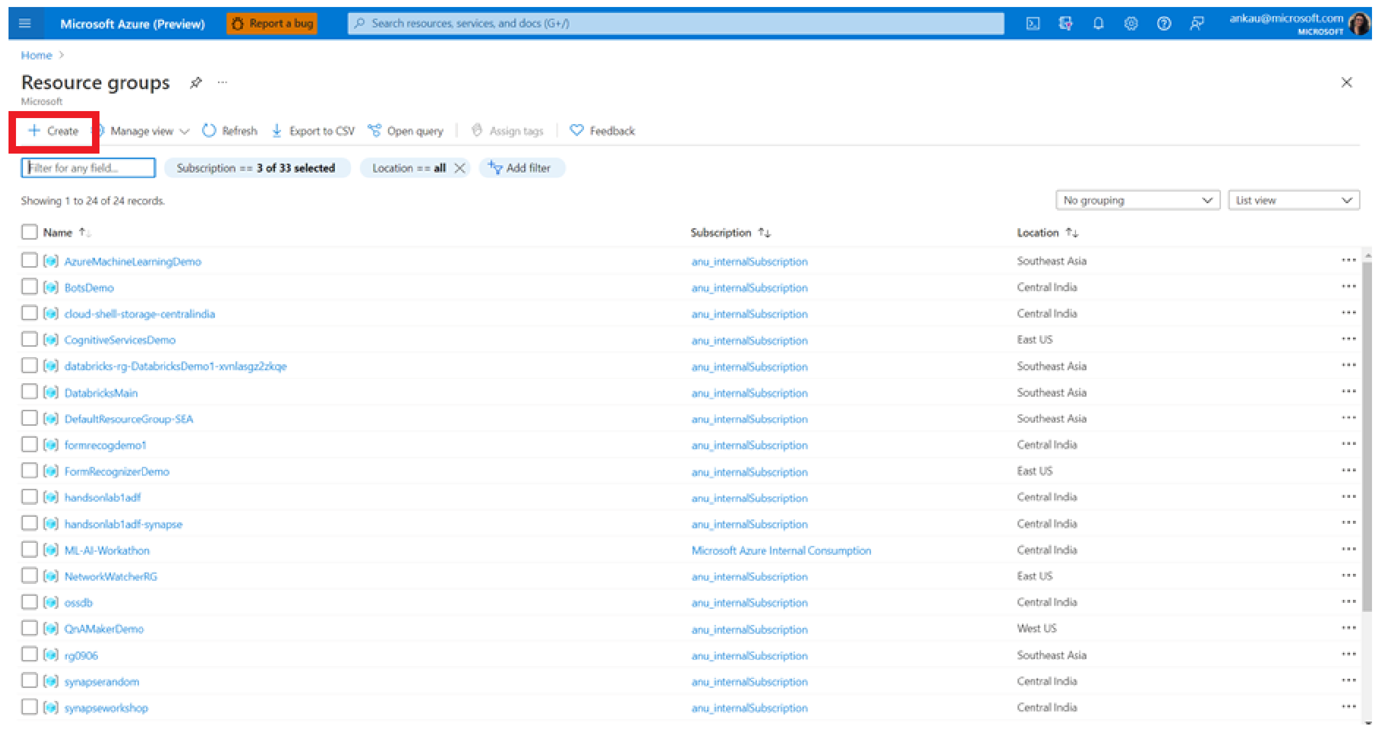
Recent resources

Name	Type	Last Viewed
handsonlab1sqldb	SQL database	6 days ago
handsonlab1sqlserver1	SQL server	6 days ago
handsonlab1adf	Resource group	6 days ago
oracledbvm-ip	Public IP address	6 days ago
gpsmigration	Azure Database for PostgreSQL server	2 weeks ago
OSSDBMigration	Resource group	2 weeks ago
ossdbmigration	Kubernetes service	2 weeks ago
aks-agentpool-33485152-nsg	Network security group	2 weeks ago
MC_OSSDBMigration_ossdbmigration_westus	Resource group	2 weeks ago
synapsewks1	Synapse workspace	2 weeks ago
synapsewks1	Storage account	3 weeks ago
demo	Virtual machine	4 weeks ago

Navigate
Subscriptions
Resource groups
All resources
Dashboard
Tools
Microsoft Learn
Learn Azure with free online training from Microsoft
Azure Monitor
Monitor your apps and infrastructure
Security Center
Secure your apps and infrastructure
Cost Management
Analyze and optimize your cloud spend for free

Microsoft Azure (Preview)
Report a bug
resource
1
ankau@microsoft.com
MICROSOFT
Services
See all
2
Resource groups
Resource Guards (Preview)
Resource Explorer
Resource Graph Explorer
Resource Graph queries
Resource management private links
Subscriptions
My resources
All resources
Bing Resources
Resources
DemoSpeechResource
Speech service
Marketplace
See all
Secured Resource space on centos
Secured Resource Space on Ubuntu 14.04 LTS
Storage Resource Monitor
Resource Scheduler
Documentation
See all
Resources - Azure Pipelines | Microsoft Docs
Bicep functions - resources - Azure Resource Manager ...
Resource access management in Azure - Cloud Adoption ...
About pipeline resources - Azure Pipelines | Microsoft Docs
Resource Groups
DefaultResourceGroup-SEA
Didn't find what you were looking for?
Try searching in Activity Log
Try searching in Azure Active Directory
Searching 3 of 33 subscriptions. Change
Azure services
Create a resource
More services
Recent resources

Name		
DocumentEvent		
contoso-portal-n		
contoso-cdb-mw		
LabVM		
workathon-auto-		
contoso-func-mw		
contoso-fr-mw75		
contosomw75pet		
Microsoft Azure Internal Consumption	Subscription	a day ago
workathonstorage	Storage account	a day ago
ML-AI-Workathon	Resource group	a day ago
workathoncognitive	Cognitive services multi-service account	2 days ago



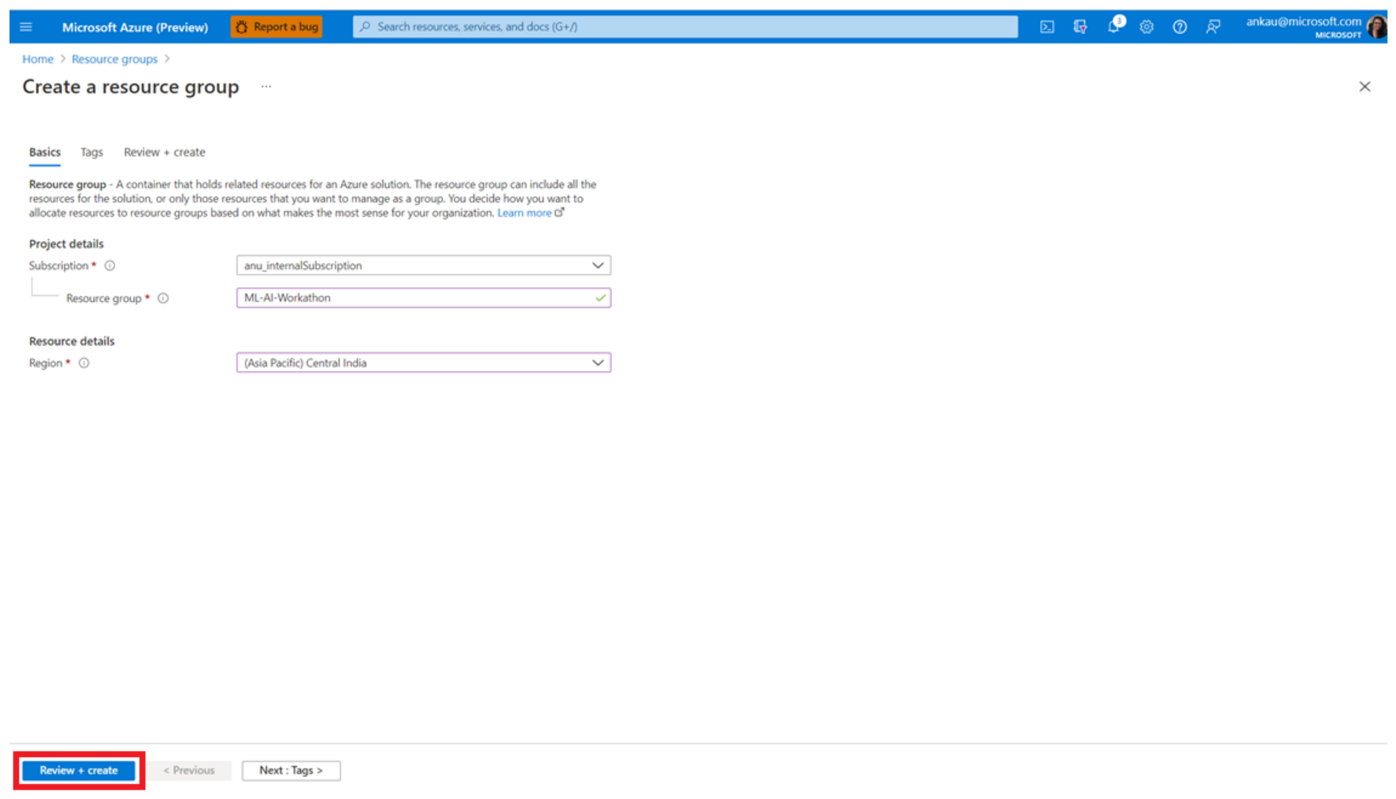
Resource groups

Microsoft

Showing 1 to 24 of 24 records.

Name	Subscription	Location
AzureMachineLearningDemo	anu_internalSubscription	Southeast Asia
BotsDemo	anu_internalSubscription	Central India
cloud-shell-storage-centralindia	anu_internalSubscription	Central India
CognitiveServicesDemo	anu_internalSubscription	East US
databricks-rg-DatabricksDemo1-xvnlasgz2zkqe	anu_internalSubscription	Southeast Asia
DatabricksMain	anu_internalSubscription	Southeast Asia
DefaultResourceGroup-SEA	anu_internalSubscription	Southeast Asia
formrecogdemo1	anu_internalSubscription	Central India
FormRecognizerDemo	anu_internalSubscription	East US
handsonlab1adf	anu_internalSubscription	Central India
handsonlab1adf-synapse	anu_internalSubscription	Central India
ML-AI-Workathon	Microsoft Azure Internal Consumption	Central India
NetworkWatcherRG	anu_internalSubscription	East US
ossdb	anu_internalSubscription	Central India
QnAMakerDemo	anu_internalSubscription	West US
rg0906	anu_internalSubscription	Southeast Asia
synapserandom	anu_internalSubscription	Central India
synapseworkshop	anu_internalSubscription	Central India

Click create to create a new resource group.



Create a resource group

Resource group - A container that holds related resources for an Azure solution. The resource group can include all the resources for the solution, or only those resources that you want to manage as a group. You decide how you want to allocate resources to resource groups based on what makes the most sense for your organization. Learn more

Project details

Subscription * : anu_internalSubscription

Resource group * : ML-AI-Workathon

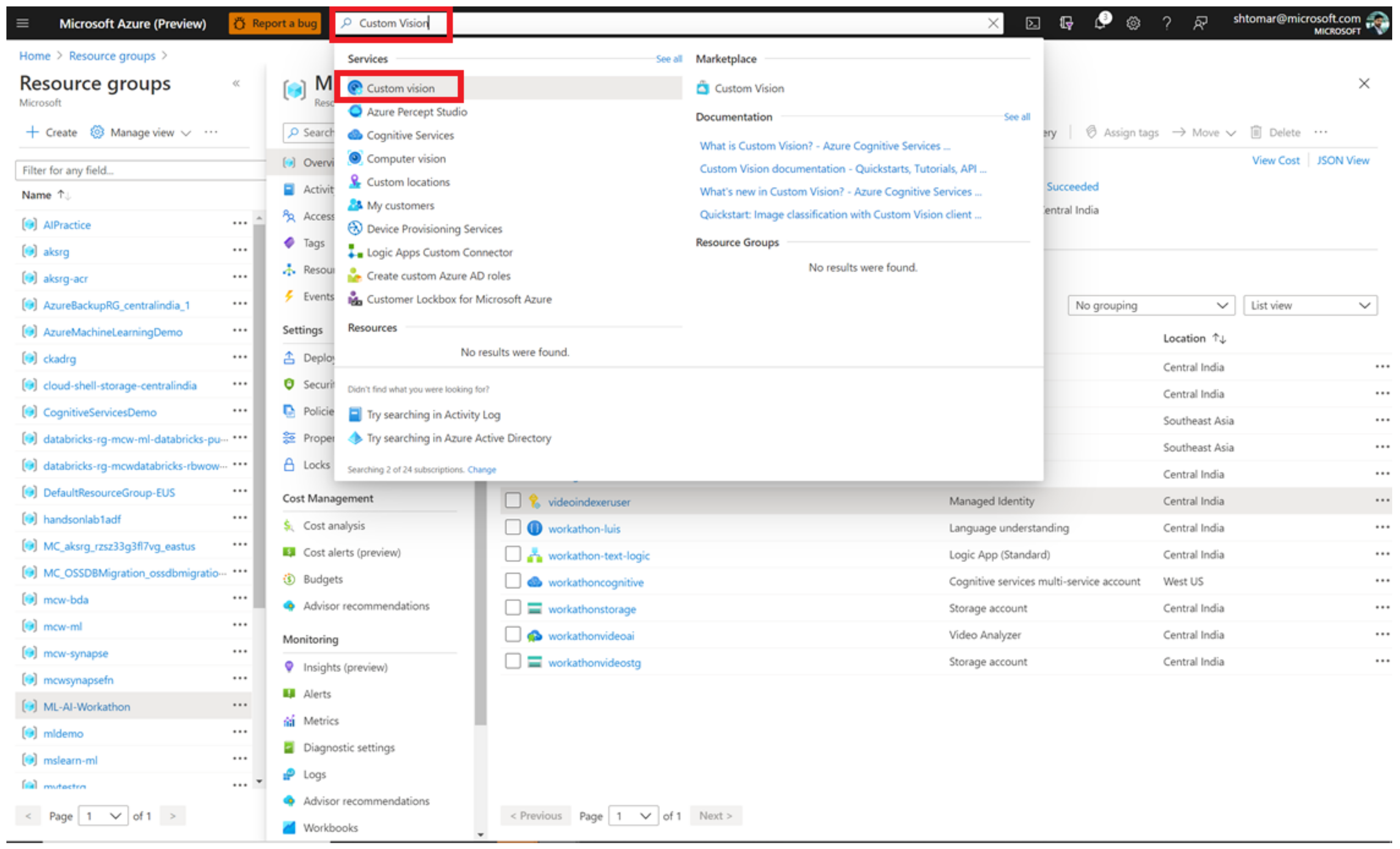
Resource details

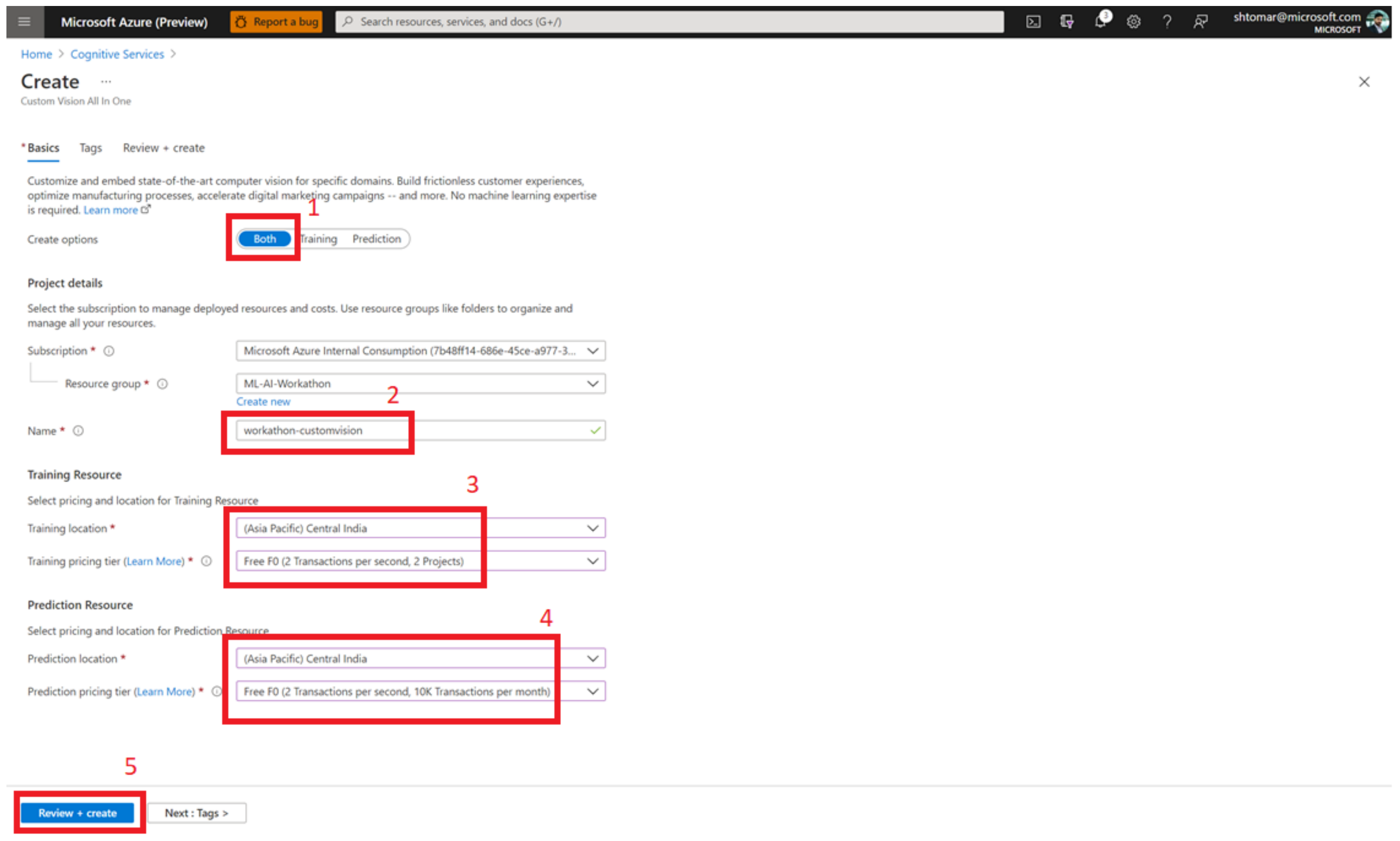
Region * : (Asia Pacific) Central India

Enter the details –

1. Subscription : Azure subscription in which you want to deploy the resource group
2. Resource Group : Name of your choice for the resource group
3. Region : Region where you want to deploy the resource group

Click Review + Create.


Microsoft Azure (Preview)
Report a bug
Custom Vision
Services
Custom vision
Azure Percept Studio
Cognitive Services
Computer vision
Custom locations
My customers
Device Provisioning Services
Logic Apps Custom Connector
Create custom Azure AD roles
Customer Lockbox for Microsoft Azure
Marketplace
Custom Vision
Documentation
What is Custom Vision? - Azure Cognitive Services ...
Custom Vision documentation - Quickstarts, Tutorials, API ...
What's new in Custom Vision? - Azure Cognitive Services ...
Quickstart: Image classification with Custom Vision client ...
Resource Groups
No results were found.
Resources
No results were found.
Try searching in Activity Log
Try searching in Azure Active Directory
Resource groups



Customize and embed state-of-the-art computer vision for specific domains. Build frictionless customer experiences, optimize manufacturing processes, accelerate digital marketing campaigns -- and more. No machine learning expertise is required. Learn more

Create options: [✓ Both] Training Prediction

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription *: Microsoft Azure Internal Consumption (7b48ff14-686e-45ce-a977-3...

Resource group *: ML-AI-Workathon

Name *: workathon-customvision

Training Resource

Select pricing and location for Training Resource

Training location *: (Asia Pacific) Central India

Training pricing tier (Learn More) *: Free F0 (2 Transactions per second, 2 Projects)

Prediction Resource

Select pricing and location for Prediction Resource

Prediction location *: (Asia Pacific) Central India

Prediction pricing tier (Learn More) *: Free F0 (2 Transactions per second, 10K Transactions per month)

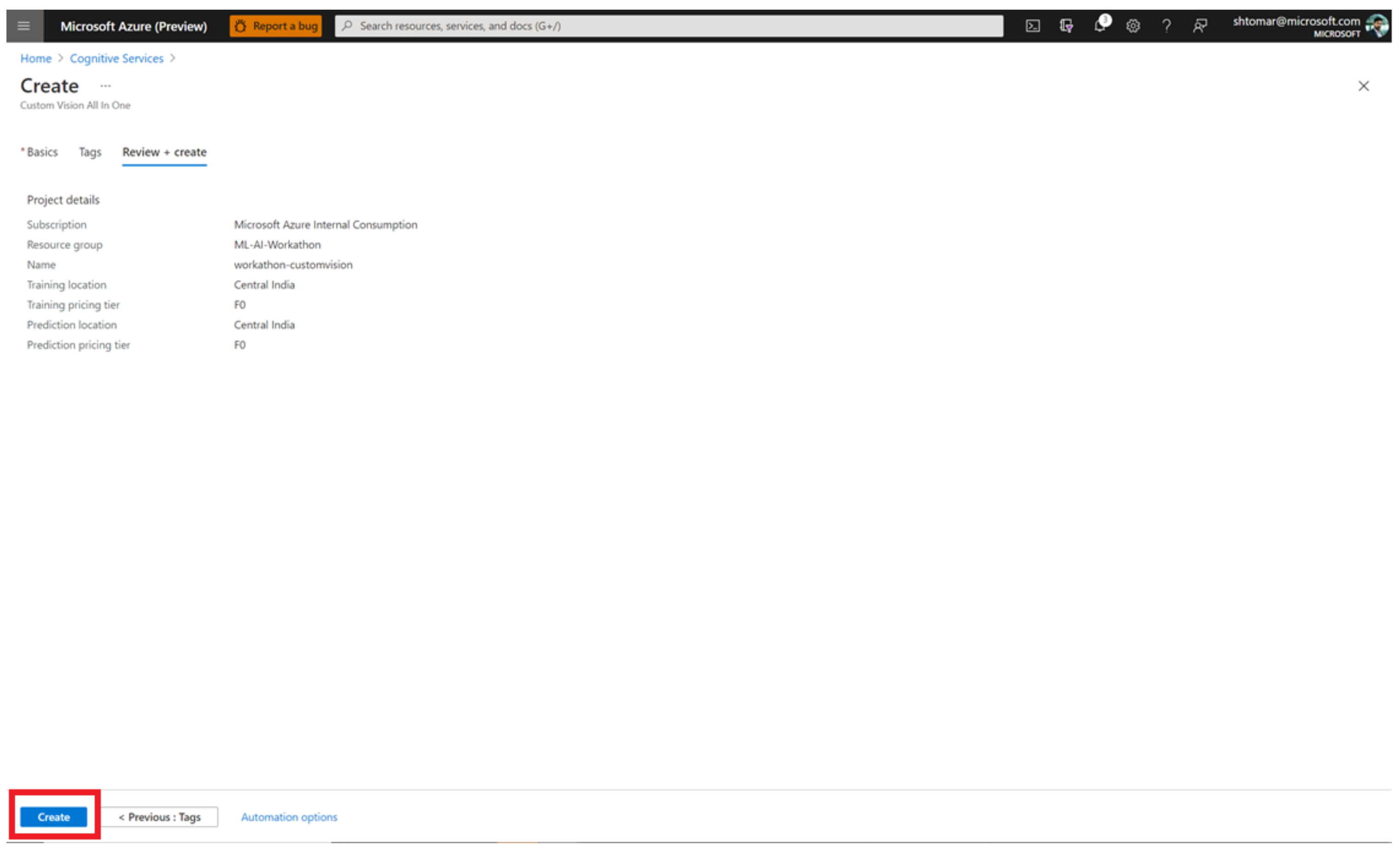
<u>Create a Custom Vision Service resource</u>

We are required to choose out of 3 resource type options on the Create custom service page, as shown in step 1 -

1. Training : Choosing this option will allow you to leverage this resource only to train a custom model. You will need a separate resource for Deployment & Prediction.
2. Prediction : Choosing this option will allow you to leverage this resource only for Deployment & Prediction of the trained model. You will need a separate resource to train a custom model.
3. Both : Choosing this option will allow you to spin up both resources at once, in the region of your choice. Hence, we are choosing this.

You might consider spinning resources separately in case you want to reuse a previously created resource for either Training or Prediction.
You could also train in 1 region & resource and choose to deploy to multiple Prediction resources in multiple regions, bases your use case.

Fill the details shown in step 2-4. Once done, click Review + Create.


Microsoft Azure (Preview)

Home > Cognitive Services >

Create

Custom Vision All In One

* Basics | Tags | Review + create

Project details

Subscription	Microsoft Azure Internal Consumption
Resource group	ML-AI-Workathon
Name	workathon-customvision
Training location	Central India
Training pricing tier	F0
Prediction location	Central India
Prediction pricing tier	F0

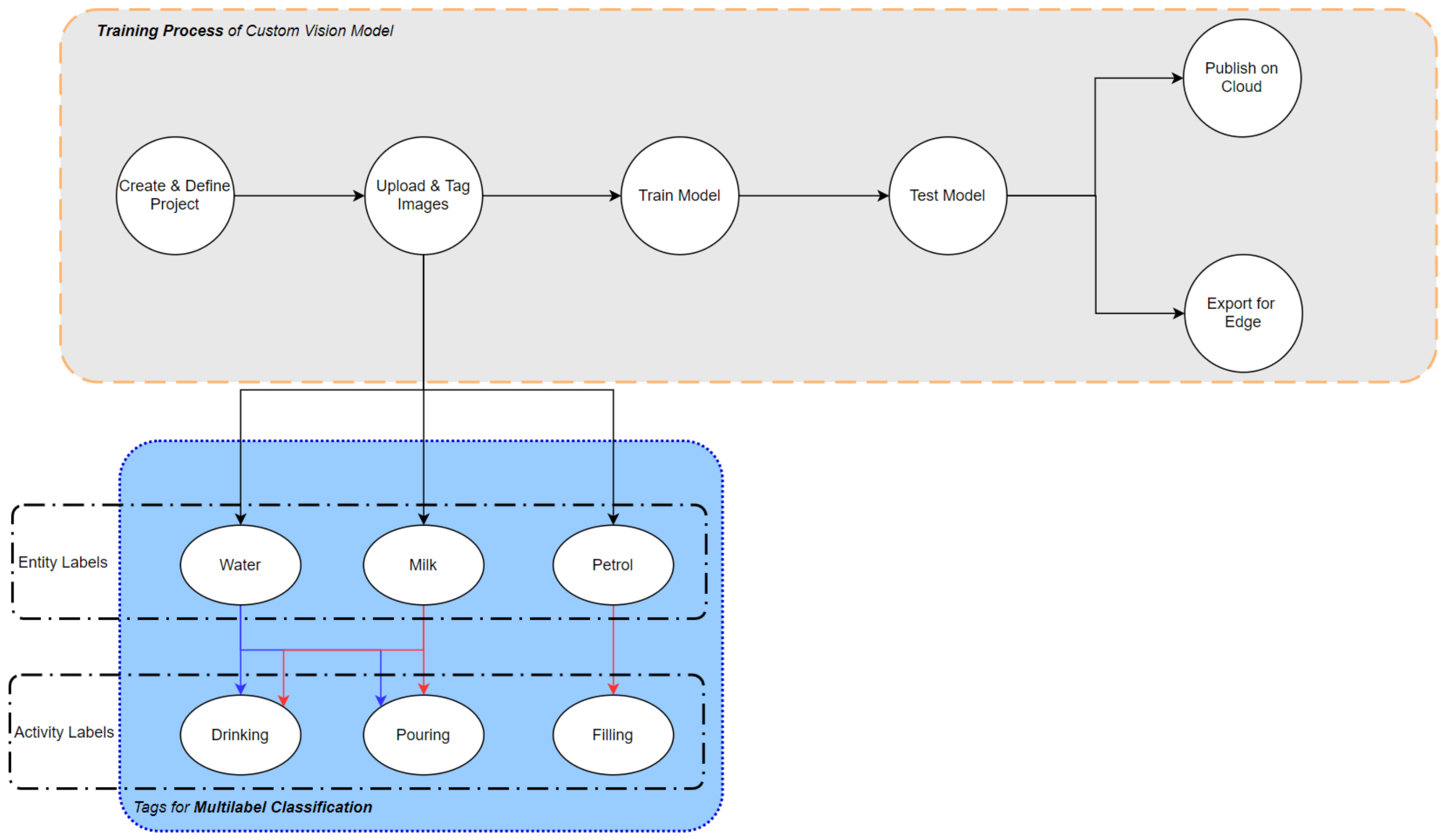
Verify the details and click Create.

Once provisioned, go back to the Resource group.
You will see 2 resources :

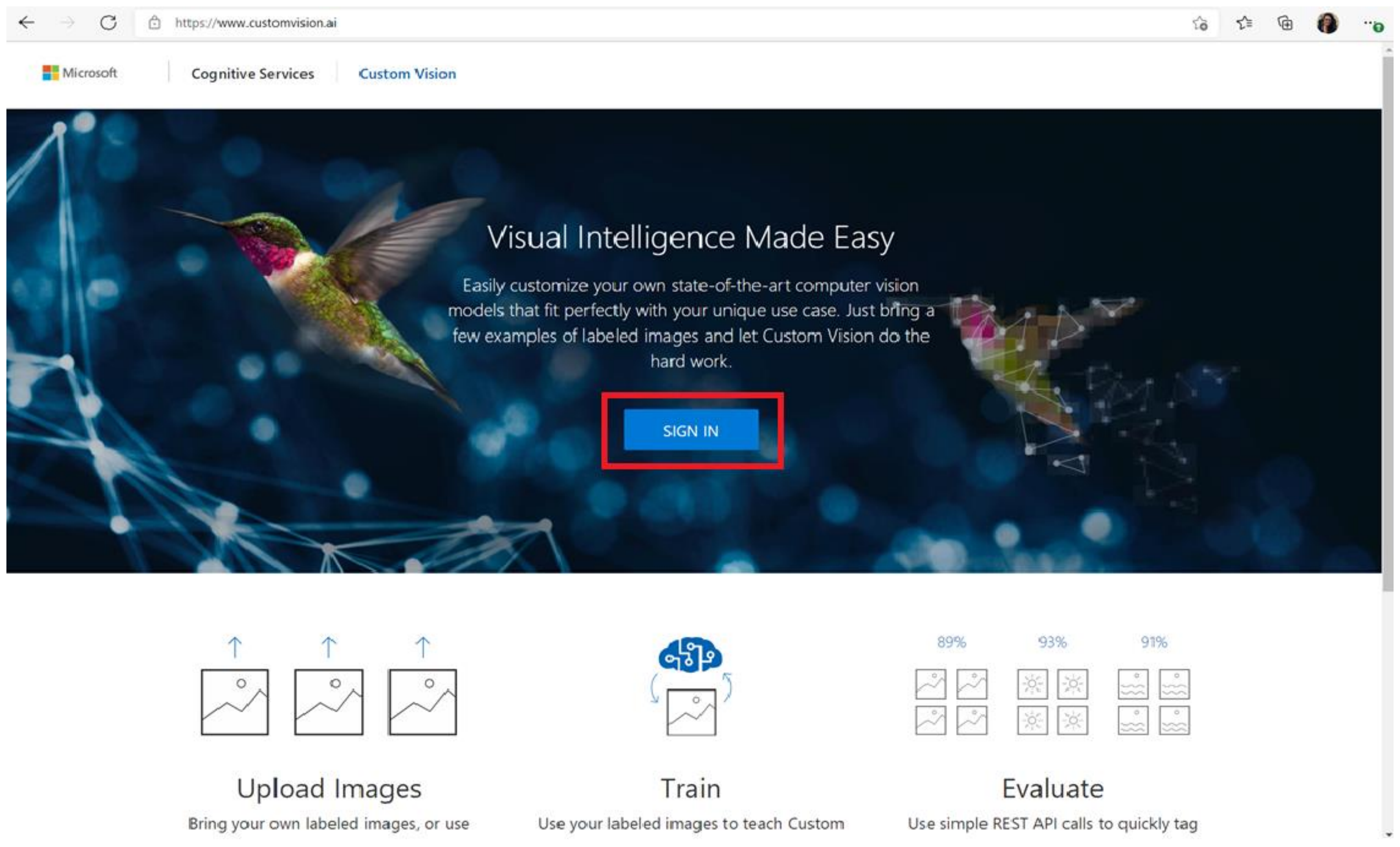
1. Workathon-customvision (This is the training resource)
2. Workathon-customvision-pred (This is the prediction resource)

Custom Model Training Workflow

In this workshop, you will be training a model using Custom Vision to perform multi label classification on any image.
You will begin with creating & defining a project in Custom Vision Portal. Once you have created a project, you will be uploading the images & tagging them as Entities & Activities mentioned in the blue box below.
In the diagram, Entities & Activities appear in a hierarchical format. However, this is just for your better understanding. When you create a multilabel project in Custom Vision, all tags will appear at the same level and not hierarchically. We will then train, test & publish / export the model for consumption in production.



Multilabel Classification simply means you can have multiple tags per image. For Eg : In an image with a person drinking water, we can tag that as Water (Entity) & Drinking (Activity).
Multilabel classification is an extension to Multiclass Classification (single tag per image). Hence, performing this workshop will cover the concepts of both.



Visual Intelligence Made Easy

Easily customize your own state-of-the-art computer vision models that fit perfectly with your unique use case. Just bring a few examples of labeled images and let Custom Vision do the hard work.

Upload Images

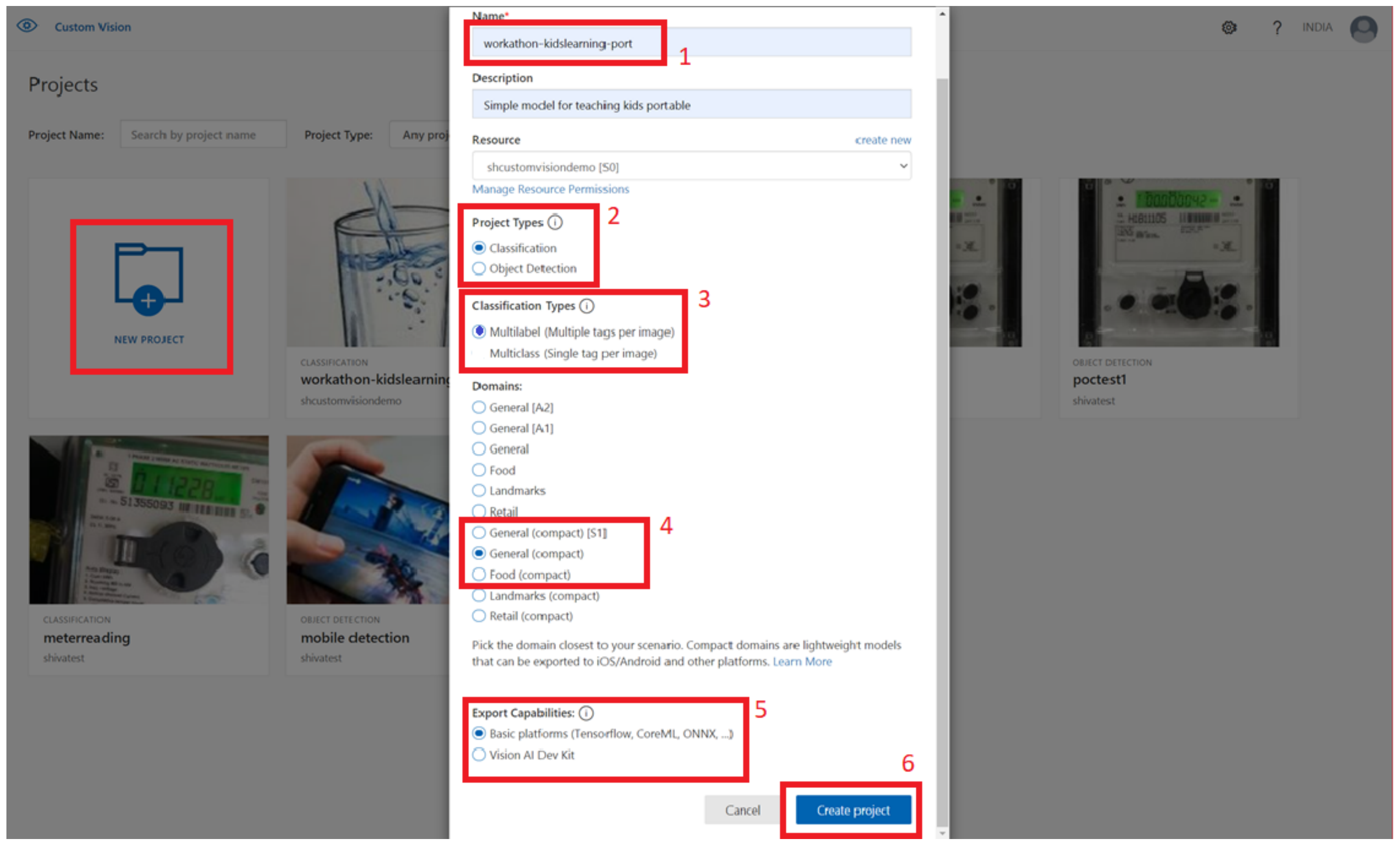
Bring your own labeled images, or use

Train

Use your labeled images to teach Custom

Evaluate

Use simple REST API calls to quickly tag



Name*: workathon-kidslearning-port

Description: Simple model for teaching kids portable

Resource: shcustomvisiondemo [S0] — create new

Manage Resource Permissions

Project Types: [✓ Classification] Object Detection

Classification Types: [✓ Multilabel (Multiple tags per image)] Multiclass (Single tag per image)

Domains: General [A2], General [A1], General, Food, Landmarks, Retail, General (compact) [S1], [✓ General (compact)], Food (compact), Landmarks (compact), Retail (compact)

Pick the domain closest to your scenario. Compact domains are lightweight models that can be exported to iOS/Android and other platforms. Learn More

Export Capabilities: [✓ Basic platforms (Tensorflow, CoreML, ONNX, ...)] Vision AI Dev Kit

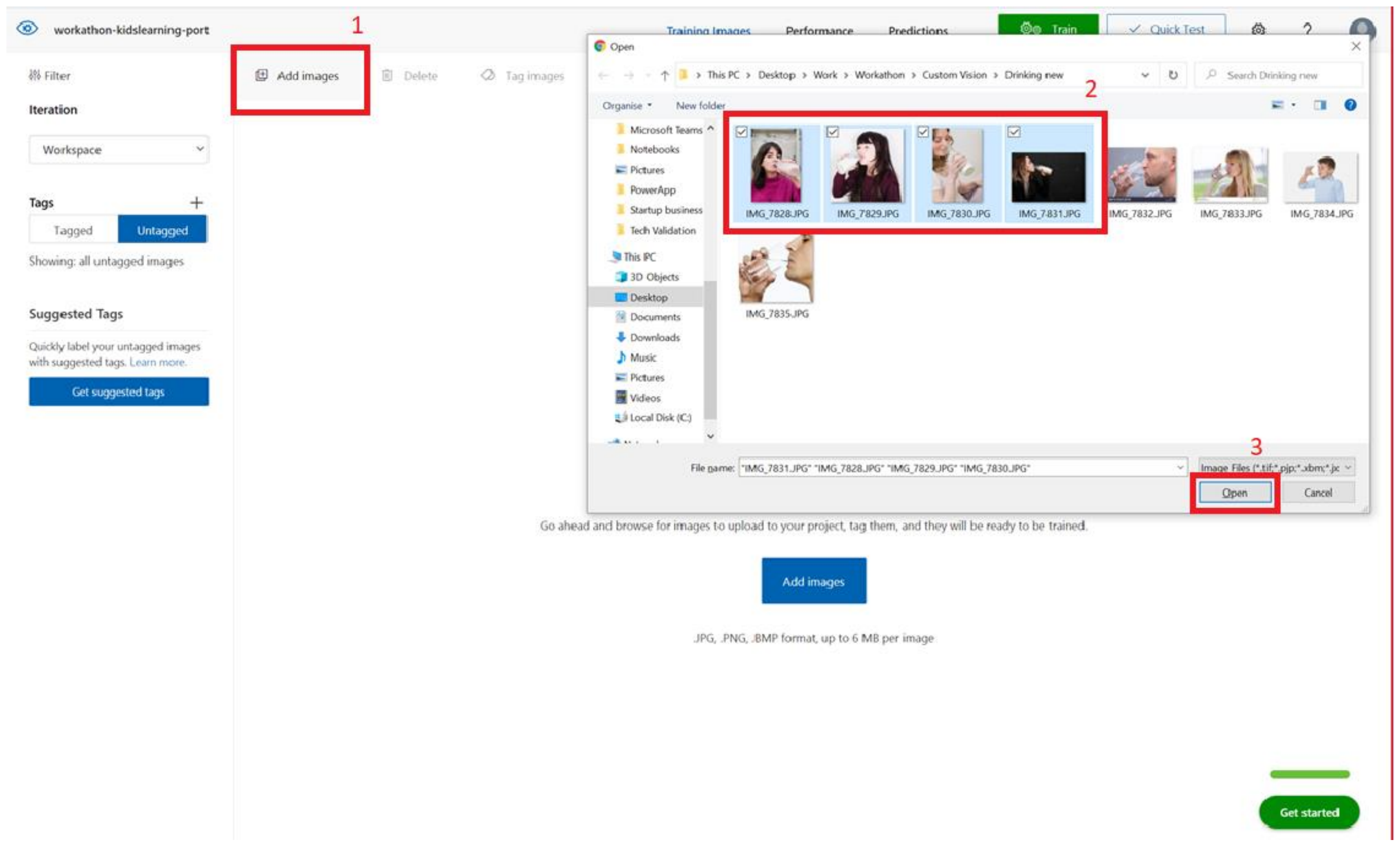
Cancel | Create project

Create a Custom Vision Multilabel Classification Project

1. Open the [Custom Vision Portal]
2. Sign in with Azure account
3. Enter the project details –
   a. Name of your choice
   b. Project type : Classification
   c. Classification type : Multiclass (Multiple tags per image)
   d. Domain : General (compact)
   e. Export Capabilities : Basic platforms
4. Click Create Project

Significance

1. Domains : General, Food, Retail, Landmarks etc. This allows you to select some pre-built models that lead to higher accuracy when trained with images from that domain. If your use case doesn't fit any of these domains, choose a General Domain.
2. Compact Models : Each of the available Domains have a corresponding compact model available as well. Selecting the compact models enables you to export these models to deploy them on edge. You can change to a compact domain later & retrain as well, however, it is recommended to select this before hand since there could be some difference in results between a compact vs non-compact domain.
3. Export capabilities : It allows you to choose a platform of your choice in which you would like to export.
   Click this to learn more.


1
2
3
workathon-kidslearning-port
Add images
Delete
Tag images
Training Images
Performance
Predictions
Train
Quick Test
Filter
Iteration
Workspace
Tags
Tagged
Untagged
Showing: all untagged images
Suggested Tags
Quickly label your untagged images with suggested tags. Learn more.
Get suggested tags
Open
This PC > Desktop > Work > Workathon > Custom Vision > Drinking new
IMG_7828.JPG
IMG_7829.JPG
IMG_7830.JPG
IMG_7831.JPG
IMG_7832.JPG
IMG_7833.JPG
IMG_7834.JPG
IMG_7835.JPG
File name: "IMG_7831.JPG" "IMG_7828.JPG" "IMG_7829.JPG" "IMG_7830.JPG"
Open
Cancel
Go ahead and browse for images to upload to your project, tag them, and they will be ready to be trained.
Add images
.JPG, .PNG, .BMP format, up to 6 MB per image
Get started

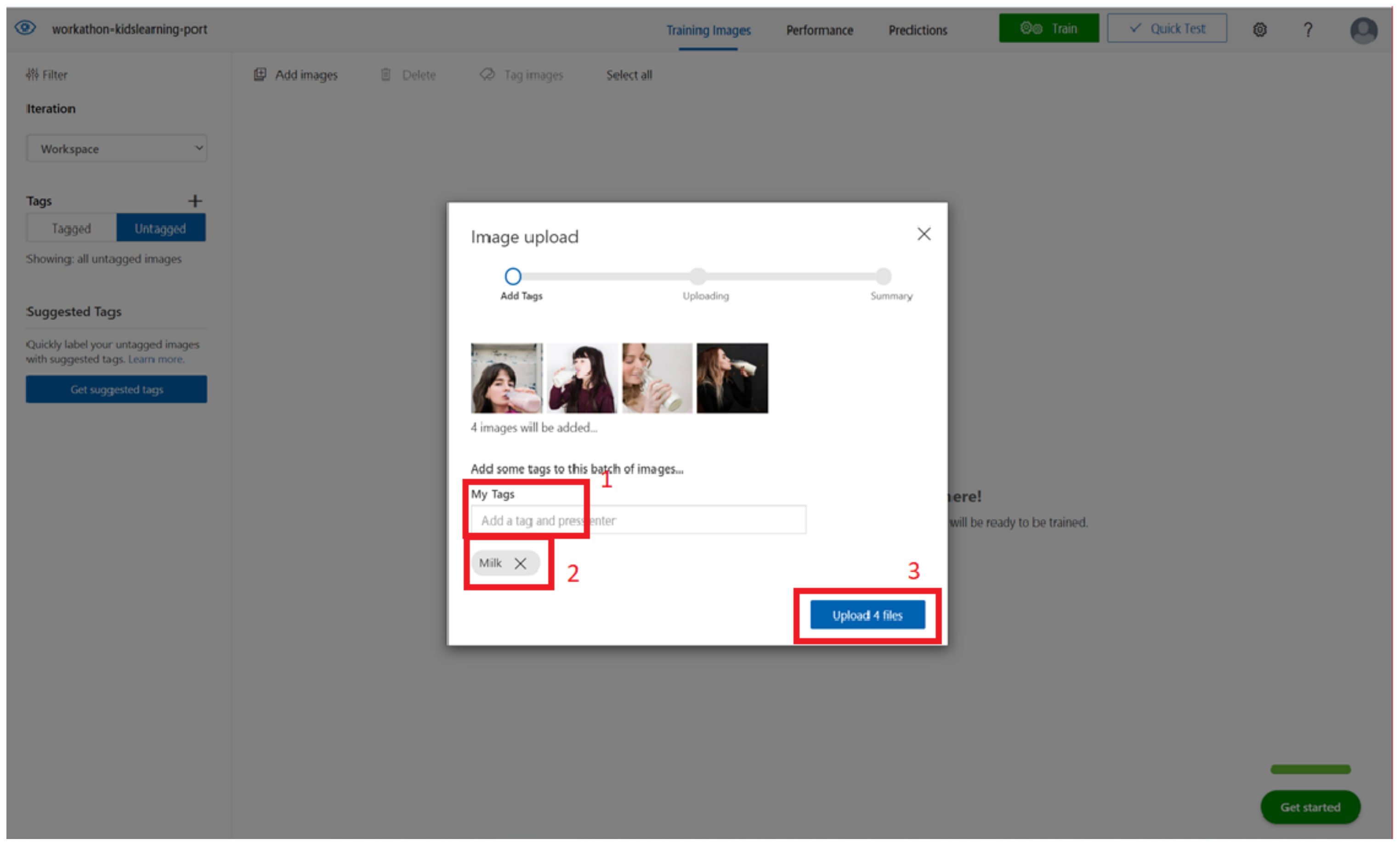


Image upload
Add Tags
Uploading
Summary
4 images will be added...
Add some tags to this batch of images...
1
My Tags
Add a tag and press enter
Milk
2
3
Upload 4 files
Select all
Get started

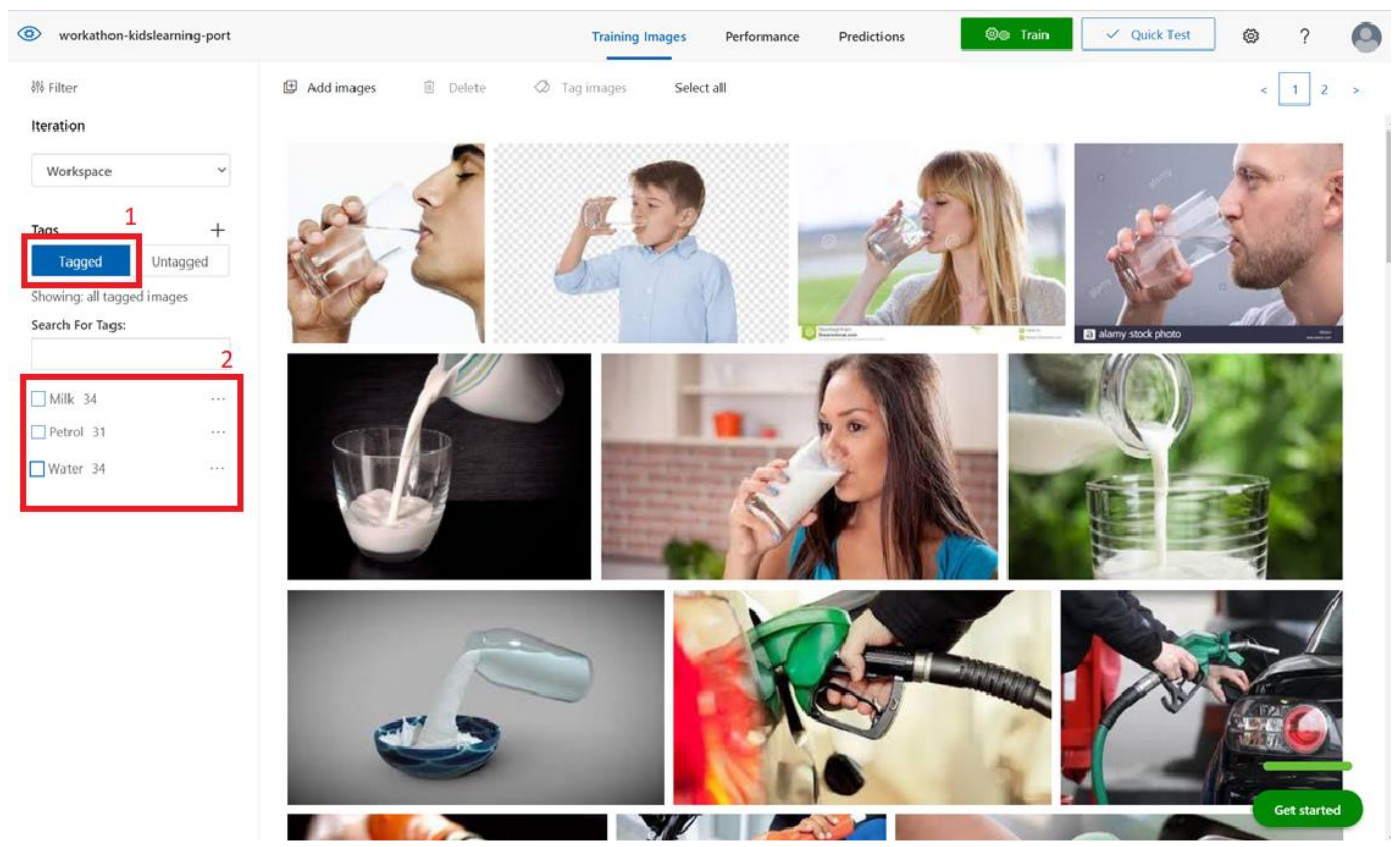
Adding Images for training

In this step, we will add images for training.
Follow the steps as highlighted.

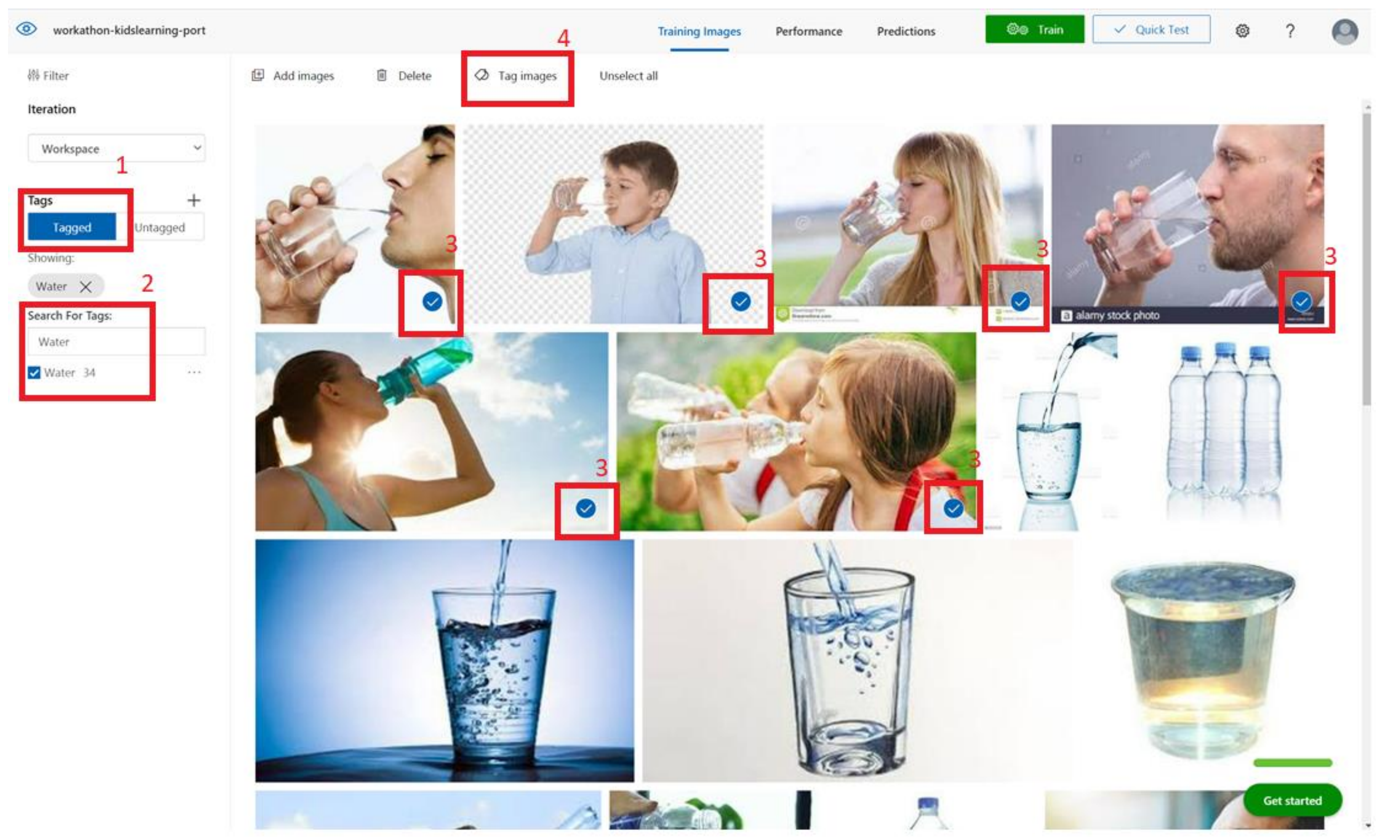
We will first tag images as Milk, Water & Petrol.

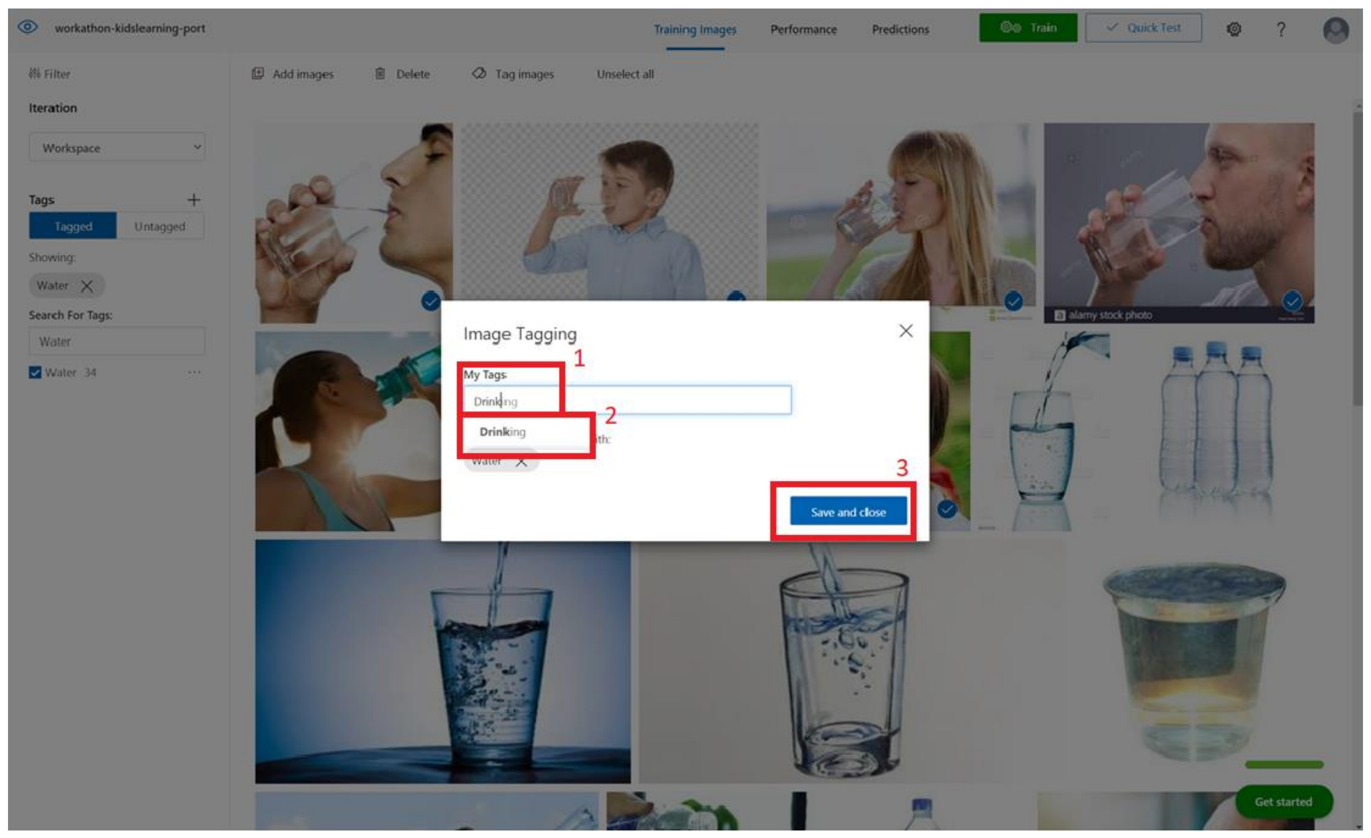
Select images for 1 tag at a time since the tag you will apply (as shown in below image) will apply to all the chosen images.
Repeat the step for other tags as well.

The Activity labels (Drinking, Pouring, Filling) will be done in the next step since they will reuse these images and we don't need to add any other images.



Once you are done adding images and creating tags for Milk, Water & Petrol, you should get a view as shown in the image.





Setting labels for Activity Tags

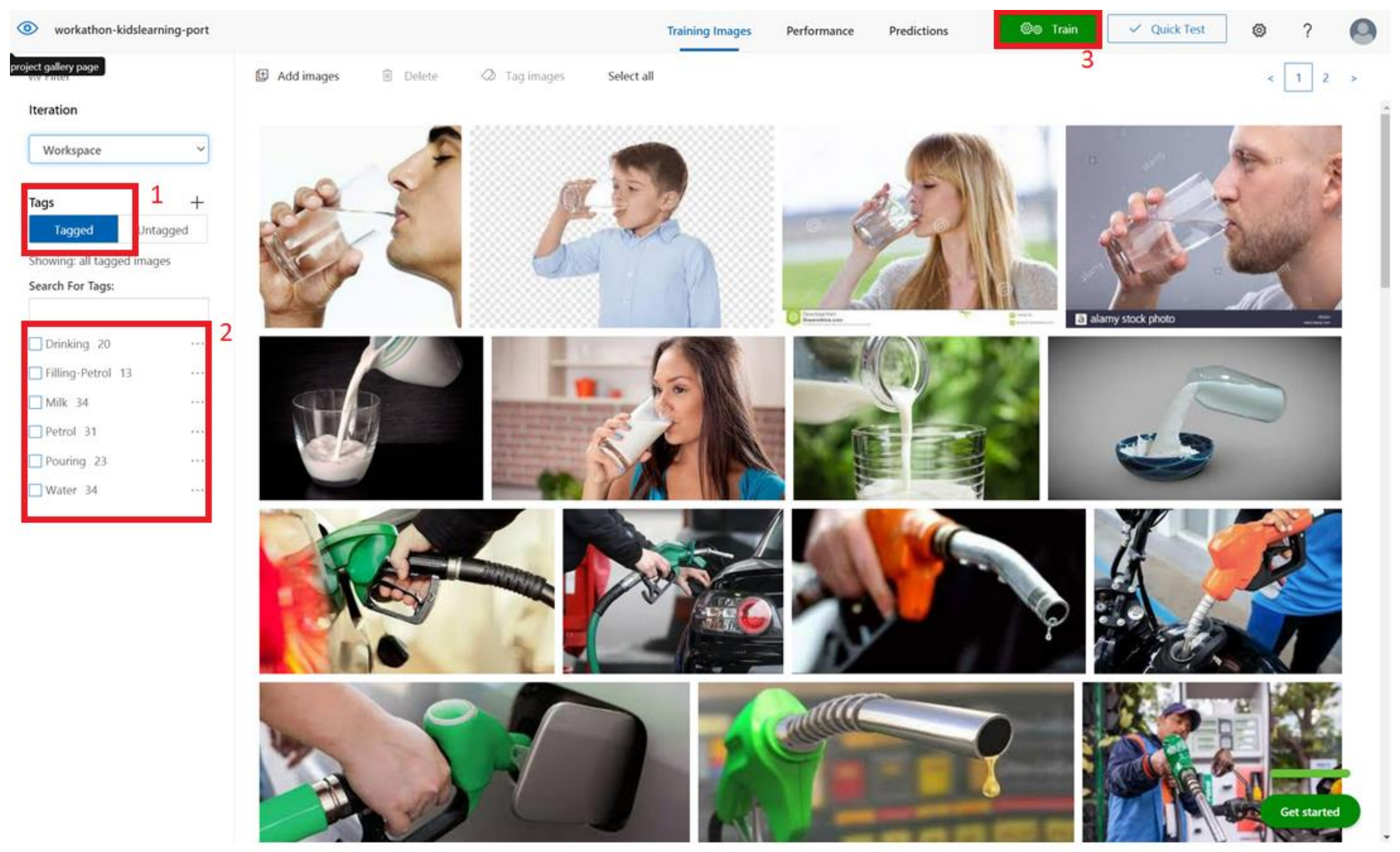
For the 2nd hierarchy of classification – Drinking, Pouring, Filling – follow these steps as highlighted.

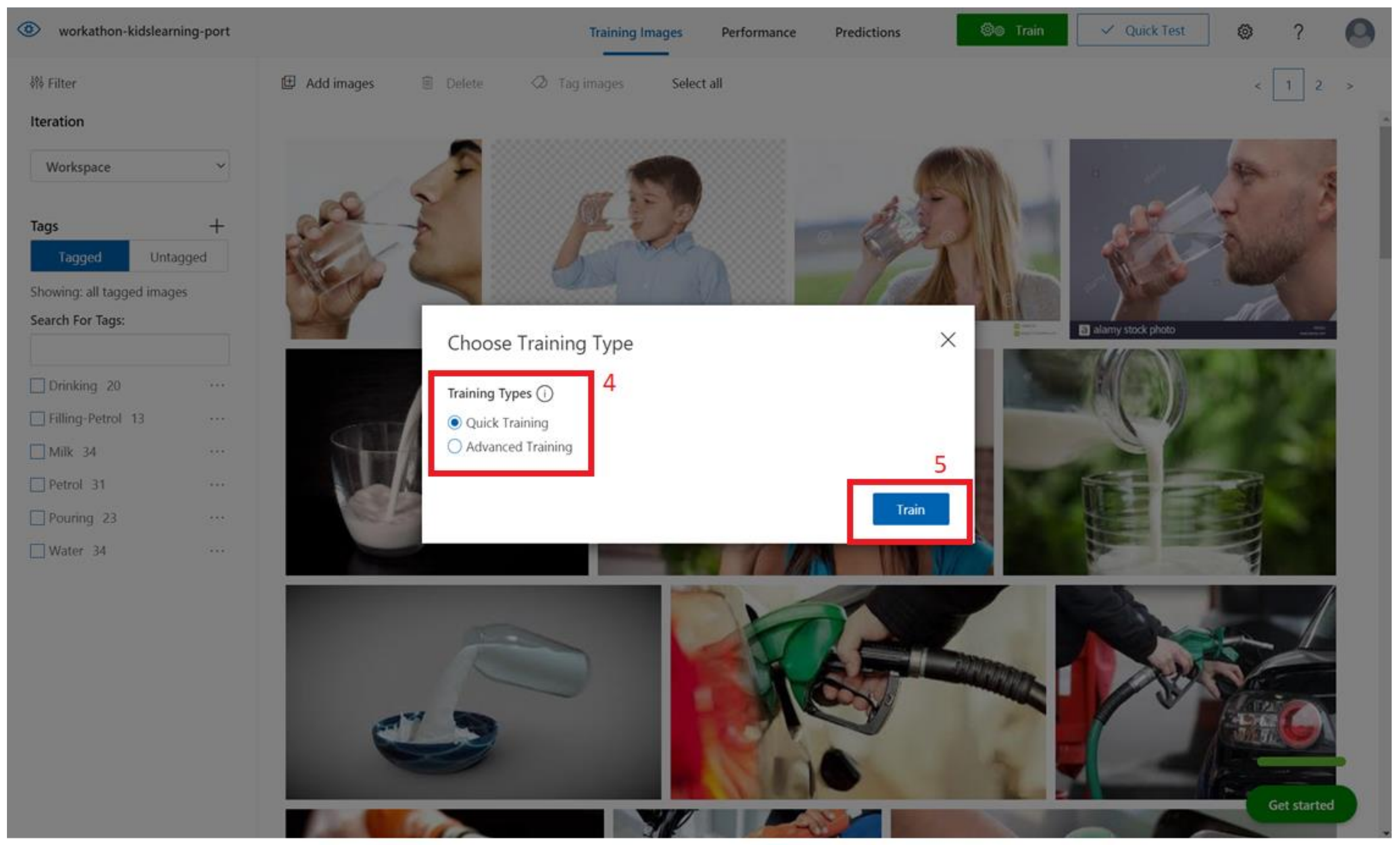
For instance, for tagging images from Water label that depict Drinking :

1. Make sure you are on the Tagged images tab (step 1)
2. Filter images to Water so it's easier to find images (step 2)
3. Select all the images that depict drinking (step 3)
4. Click on tag images (step 4)
5. Add drinking tag (as shown in image below)
6. Click Save & Close

Similarly, repeat the above steps for other multi-tagging :

Pouring in Water images (Filter on water & set Tag as Pouring)
Pouring in Milk images (Filter on milk & set Tag as Pouring)
Drinking for Milk images (Filter on milk & set Tag as Drinking)
Filling in Petrol images (Filter on Petrol & set Tag as Filling)





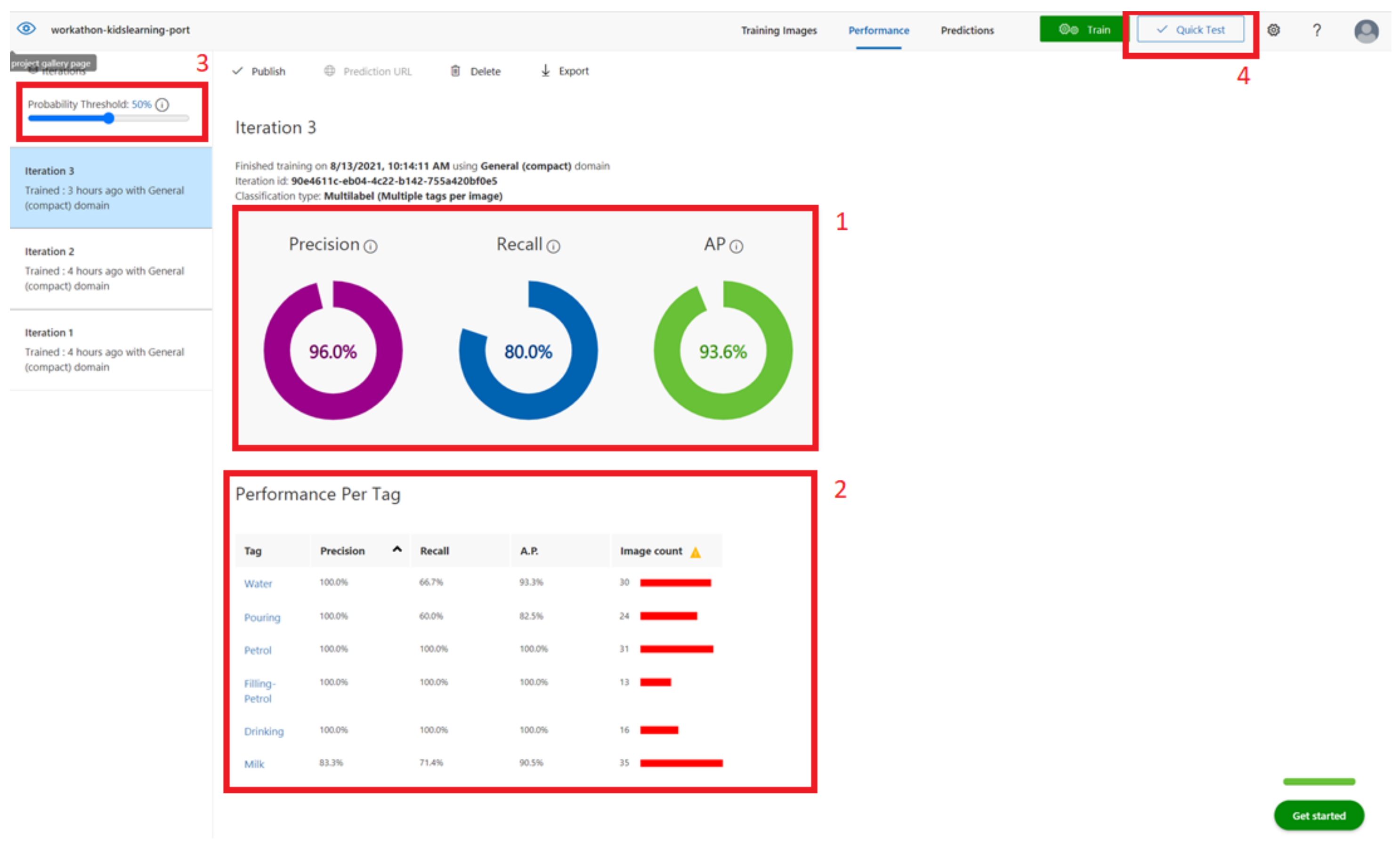
<u>Training the Model</u>

Once you have tagged all images , you'll see the outcome as shown (Step 1,2)

Click the Train the button, to train your custom model (Step 3)

Select Quick Training (Step 4)
We are selecting Quick Training in the interest of time & resources. In a production scenario, you might also want to try out Advanced Training since this will result in higher accuracy.

Click Train.



Probability Threshold: 50%

Iteration 3
Trained : 3 hours ago with General (compact) domain

Iteration 2
Trained : 4 hours ago with General (compact) domain

Iteration 1
Trained : 4 hours ago with General (compact) domain

Iteration 3

Finished training on **8/13/2021, 10:14:11 AM** using **General (compact)** domain
Iteration id: **90e4611c-eb04-4c22-b142-755a420bf0e5**
Classification type: **Multilabel (Multiple tags per image)**

Precision 96.0%
Recall 80.0%
AP 93.6%

Performance Per Tag

Tag	Precision	Recall	A.P.	Image count
Water	100.0%	66.7%	93.3%	30
Pouring	100.0%	60.0%	82.5%	24
Petrol	100.0%	100.0%	100.0%	31
Filling-Petrol	100.0%	100.0%	100.0%	13
Drinking	100.0%	100.0%	100.0%	16
Milk	83.3%	71.4%	90.5%	35

<u>Observe Model Training Outcome & Metrics</u>

Once your model is trained, you will get the outcome as shown.
The Precision, Recall & AP metrics measure the performance of your model in different aspects, basis which you can decide how to further tune your model.

Precision is the metrics that tells out of all the images the model labelled as particular tag, how many it labelled correctly.
Eg : In the test set, if it labelled 5 images as water & 4 were actually water, the precision is 80%.
This doesn't mean there were only 5 images of water, there could be more as well that the model didn't catch. For precision, we are just concerned with the ones the model said to be water.

$$Precision = \frac{True\ Positive(TP)}{True\ Positive(TP) + False\ Positive(FP)}$$

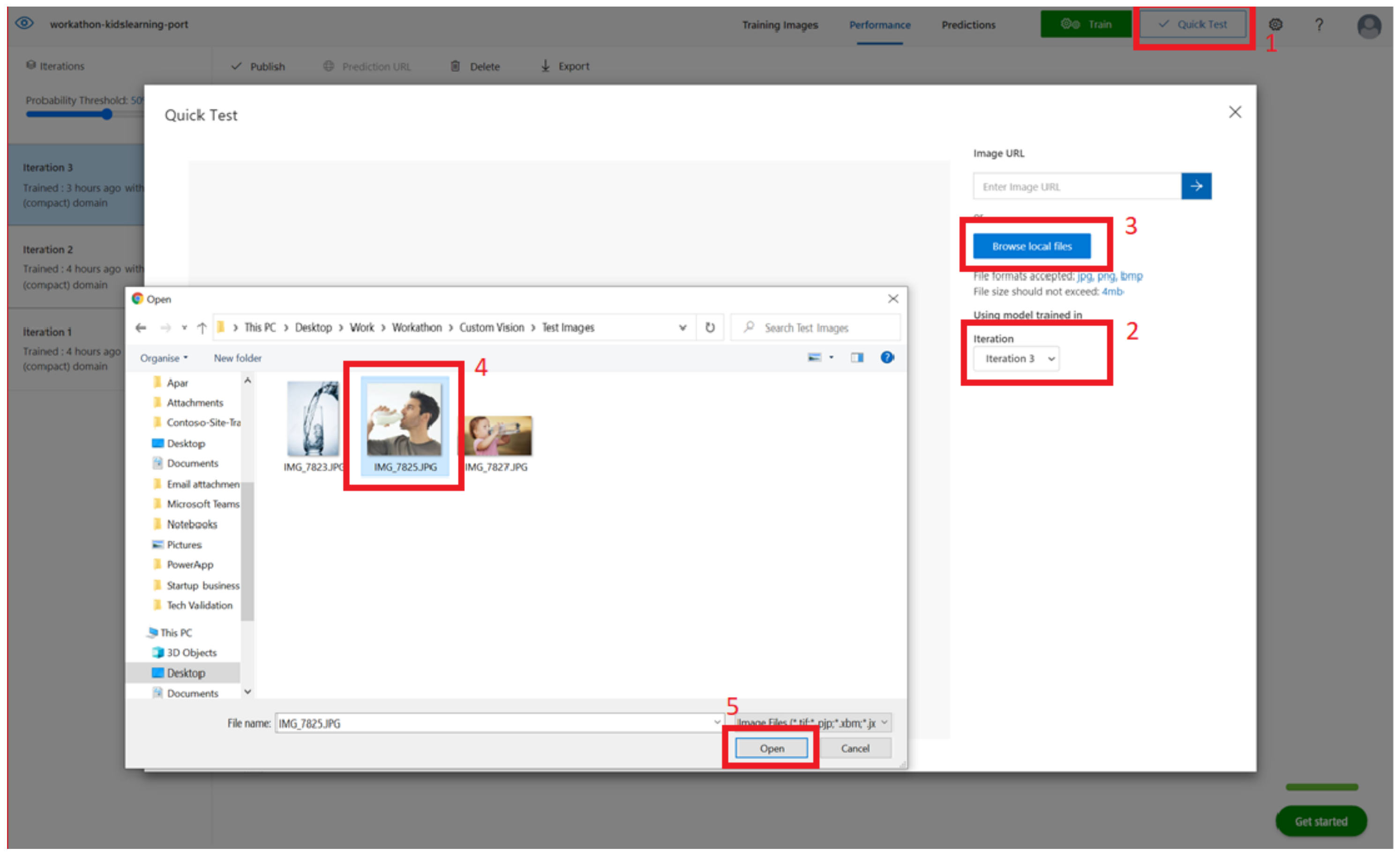
Recall is the metrics that tells out of all the images that belong to a particular tag, how many the model was able to identify.
Eg : In the test set, if there were 8 images of water & it could identify 6, the recall would be 75%.
This doesn't mean the model identified just 6 images as water. It could have identified images belonging to other tags (milk, petrol) as water, however, we are just concerned with water images that it correctly identified.

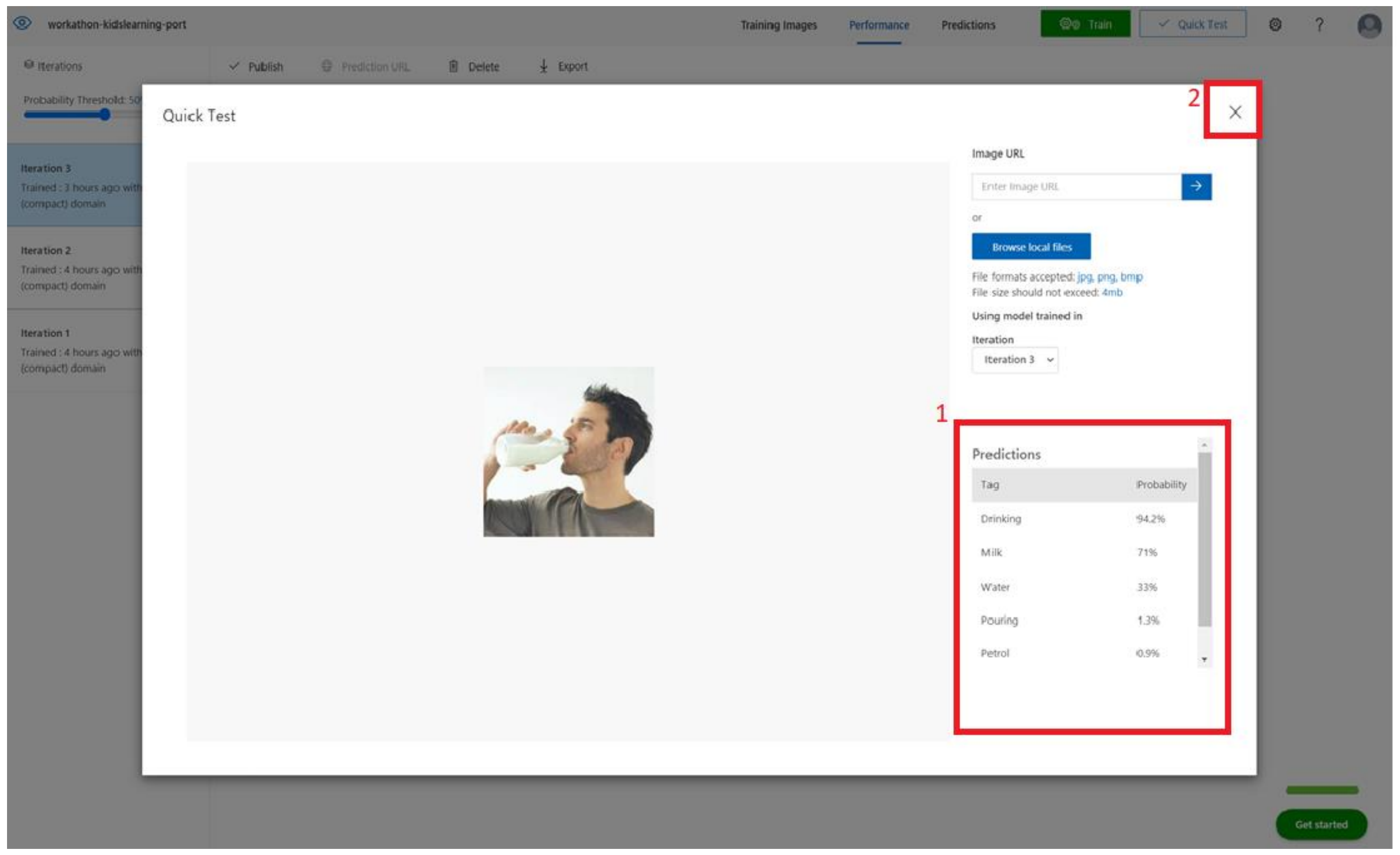
$$Recall = \frac{True\ Positive(TP)}{True\ Positive(TP) + False\ Negative(FN)}$$

AP is a measure of model performance that summarises the Precision & Recall at different threshold. This is threshold agnostic, hence, changing threshold will not affect AP.

Probability Threshold (step 3) : This is the level of confidence that a prediction needs to have to be considered correct.
Observe the changes in the 3 metrics on changing the threshold slider.
Increasing the threshold will increase Precision but decrease recall. Since now model will label as image as X only if it is super sure, thereby, reducing False Positive & increasing False Negatives.
Similarly, decreasing the threshold will increase Recall but decrease Precision. Since now model will label as image as X even if it is not so sure, thereby, increasing False Positive & decreasing False Negatives.

Now go back & read the definition of Precision & Recall. We're sure you'll have a better understanding now.




workathon-kidslearning-port
Training Images
Performance
Predictions
Train
Quick Test
Iterations
Publish
Prediction URL
Delete
Export
Probability Threshold: 50
Iteration 3
Trained : 3 hours ago with (compact) domain
Iteration 2
Trained : 4 hours ago with (compact) domain
Iteration 1
Trained : 4 hours ago with (compact) domain
Quick Test
2
Image URL
Enter Image URL
or
Browse local files
File formats accepted: jpg, png, bmp
File size should not exceed: 4mb
Using model trained in
Iteration
Iteration 3
1
Get started

Predictions

Tag	Probability
Drinking	94.2%
Milk	71%
Water	33%
Pouring	1.3%
Petrol	0.9%

<u>Testing the model</u>

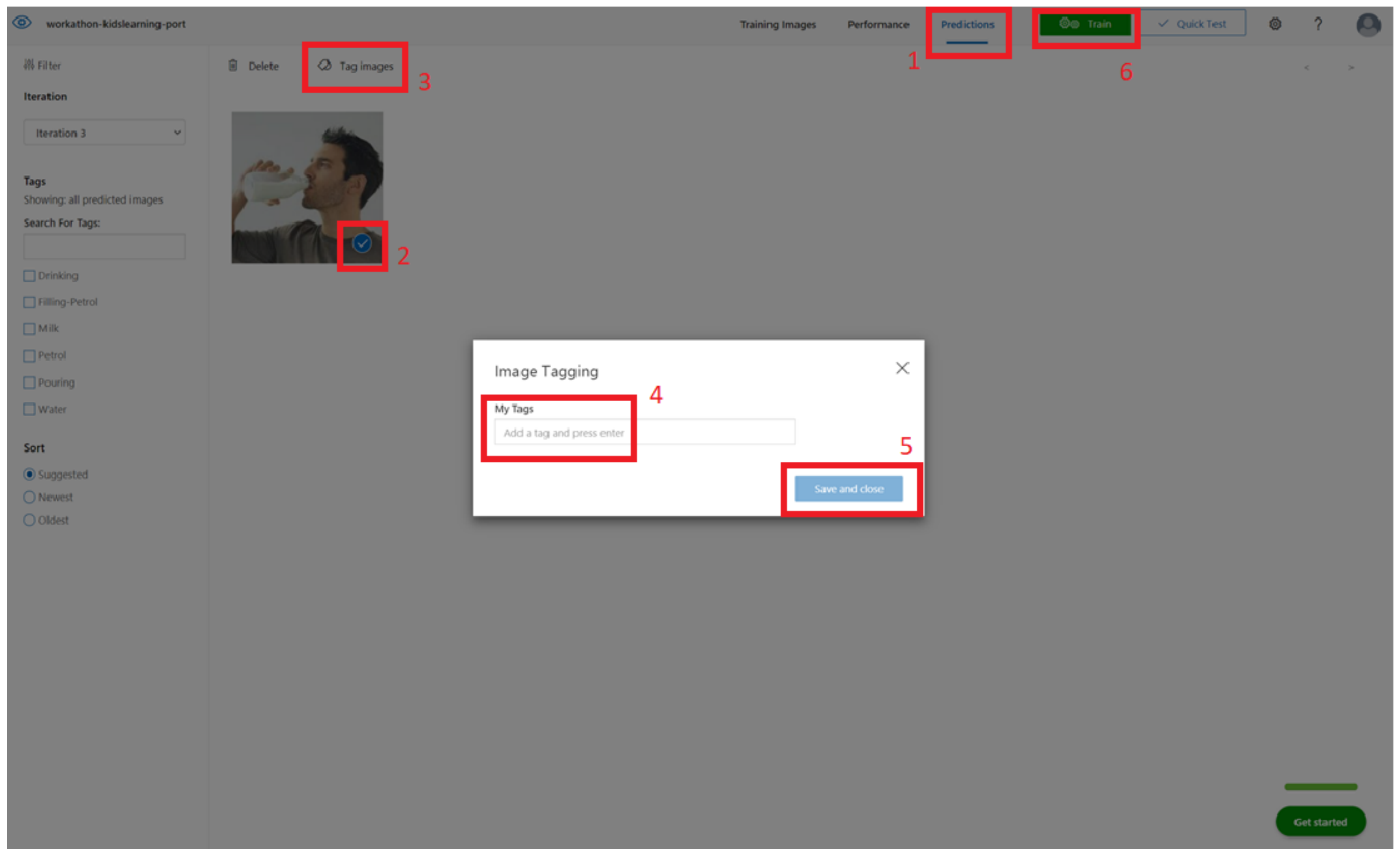
Once you have trained the model, you can test it for new images from within the portal itself.

Follow the steps as highlighted:

1. Select quick test tab
2. Select the iteration you want to test (This is important if you have multiple iterations trained. By default, it will pick the latest iteration)
3. Browse local images or provide accessible URLs
4. Click Open.

Once you have selected the image, observe the results & tags predicted and the corresponding probability.
If the results are not as expected or probability confidence is low, you might want to upload more images to the model & retrain.

Any image you test will be available for you to tag & retrain the model. We will see this in the next step.



Adding tested images to model & retraining

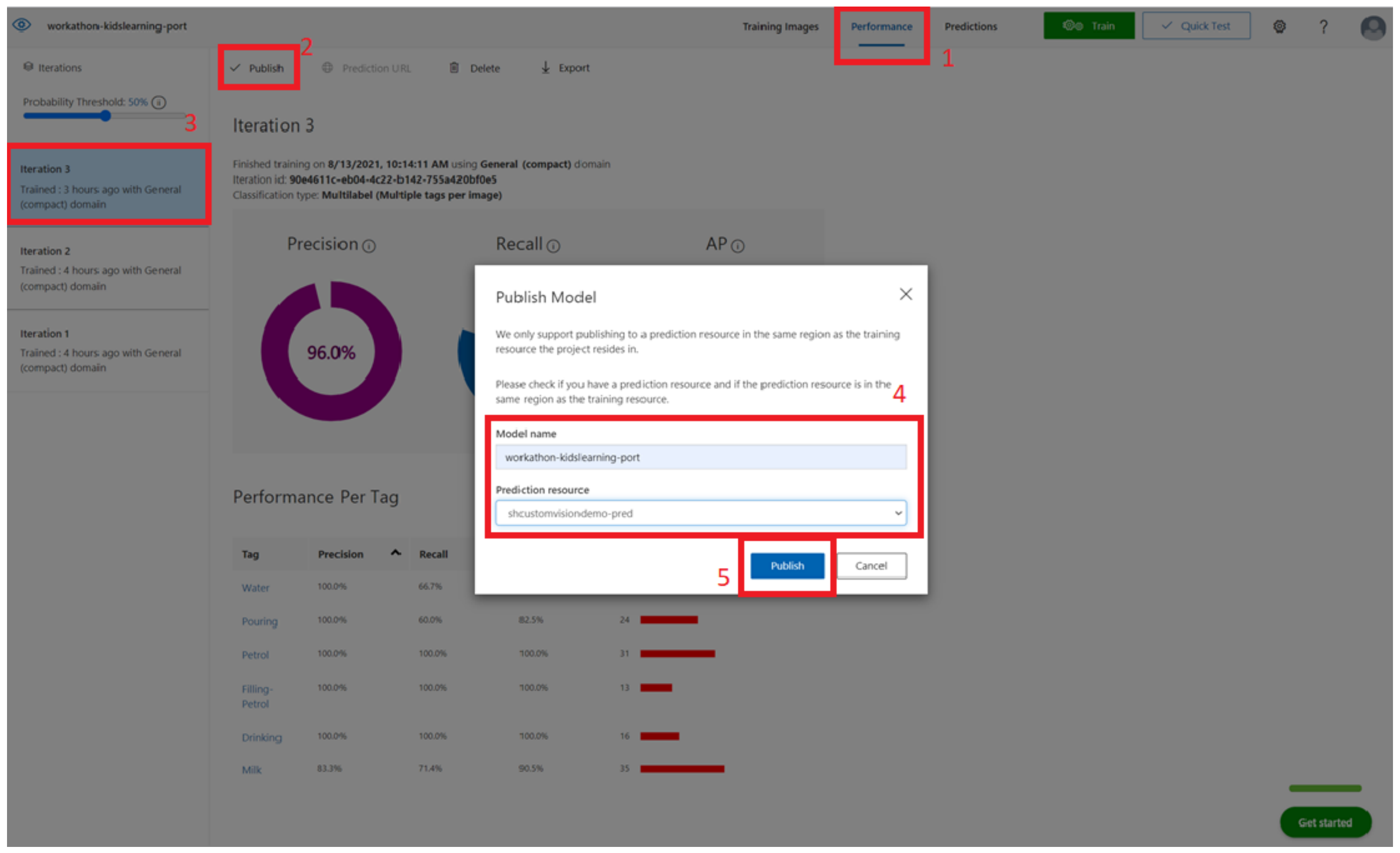
Once you have tested a couple of images in the step above, switch to the Prediction tab as shown in step 1.

Any image you tested in the above step will appear here.

Select all images (step 2) to which you want to apply the same tag and select Tag image (step 3).
Mention the tag you want to apply & click Save and Close (Step 4,5).

Once you have performed steps 2 through 5 for different tags that you want to apply, select Train.

If you want to apply multiple tags to the same image, after applying the first tag, you will have to go to the Training Images section and apply the tags as we applied earlier.



Publish Model

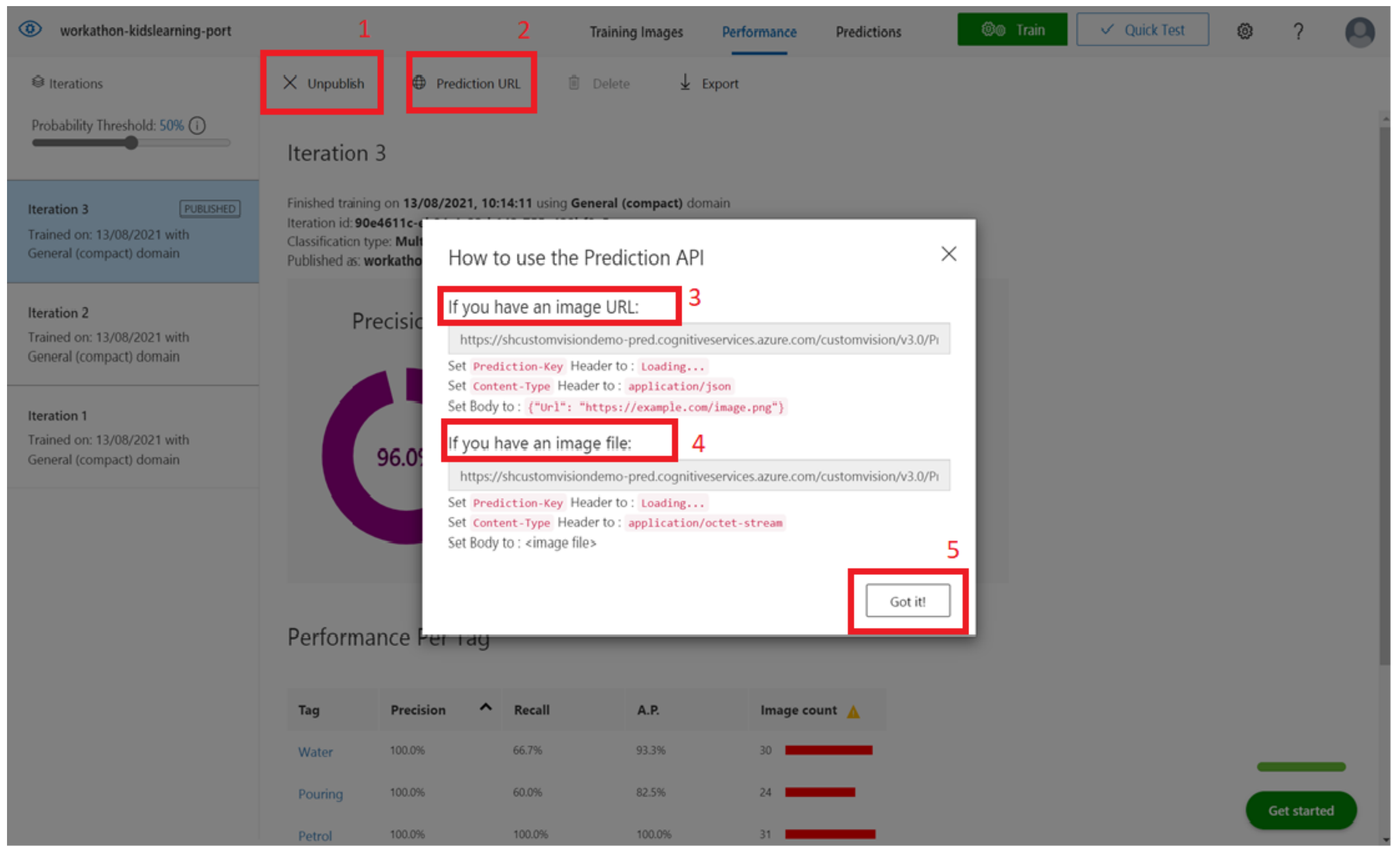
We only support publishing to a prediction resource in the same region as the training resource the project resides in.

Please check if you have a prediction resource and if the prediction resource is in the same region as the training resource.

Model name: workathon-kidslearning-port

Prediction resource: shcustomvisiondemo-pred

Publish Cancel



How to use the Prediction API

If you have an image URL:

https://shcustomvisiondemo-pred.cognitiveservices.azure.com/customvision/v3.0/Pr

Set `Prediction-Key` Header to : `Loading...`
Set `Content-Type` Header to : `application/json`
Set Body to : `{"Url": "https://example.com/image.png"}`

If you have an image file:

https://shcustomvisiondemo-pred.cognitiveservices.azure.com/customvision/v3.0/Pr

Set `Prediction-Key` Header to : `Loading...`
Set `Content-Type` Header to : `application/octet-stream`
Set Body to : <image file>

Got it!

<u>Publishing the Model to Production</u>

When you have done a couple of iterations (Train, test, tune, retrain) and are satisfied with the final iteration, you can publish the model so that it will available for real time predictions.

Follow the highlighted steps:

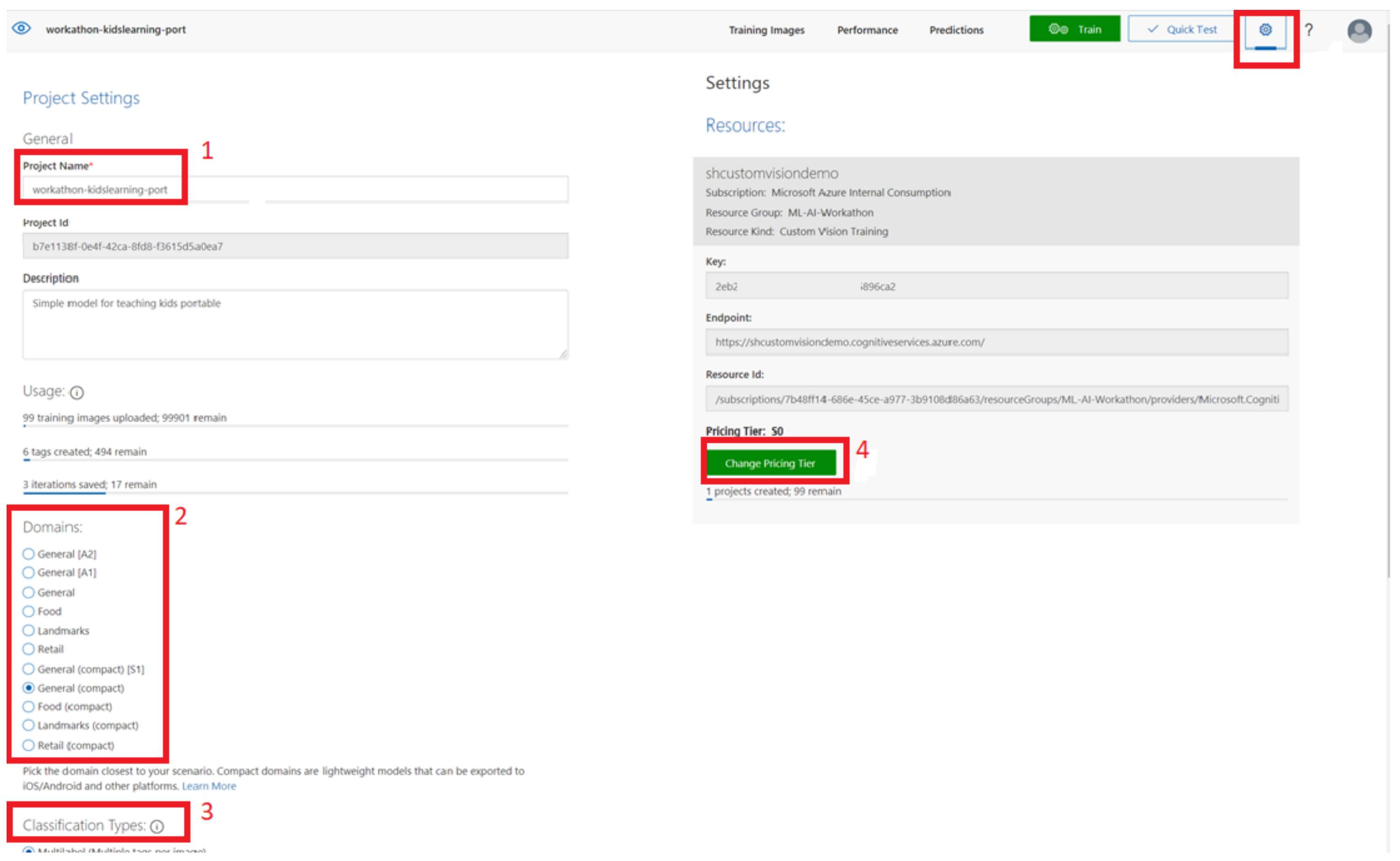
1. Go to the Performance tab
2. Select Publish
3. Make sure you have selected the right iteration
4. Provide the Model name and Prediction resource (this is the resource we provisioned in the beginning of the workshop : Workathon-customvision-pred)
5. Select Publish

Once published, you will see the option has changed from Publish to Unpublish.

Click the Prediction URL.
Observe you get 2 options to use this in production scenario

1. Provide input as image URL
2. Provide input as image File

We will test this using the REST API in Postman in a later step.



Project Settings

General

Project Name*: workathon-kidslearning-port

Project Id: b7e1138f-0e4f-42ca-8fd8-f3615d5a0ea7

Description: Simple model for teaching kids portable

Usage:
99 training images uploaded; 99901 remain
6 tags created; 494 remain
3 iterations saved; 17 remain

Domains:
- General [A2]
- General [A1]
- General
- Food
- Landmarks
- Retail
- General (compact) [S1]
- [✓ General (compact)]
- Food (compact)
- Landmarks (compact)
- Retail (compact)

Pick the domain closest to your scenario. Compact domains are lightweight models that can be exported to iOS/Android and other platforms. Learn More

Classification Types:
[✓ Multilabel (Multiple tags per image)]

Settings

Resources:

shcustomvisiondemo
Subscription: Microsoft Azure Internal Consumption
Resource Group: ML-AI-Workathon
Resource Kind: Custom Vision Training

Key: 2eb2 [redacted] i896ca2

Endpoint: https://shcustomvisiondemo.cognitiveservices.azure.com/

Resource Id: /subscriptions/7b48ff14-686e-45ce-a977-3b9108d86a63/resourceGroups/ML-AI-Workathon/providers/Microsoft.Cogniti

Pricing Tier: S0

Change Pricing Tier

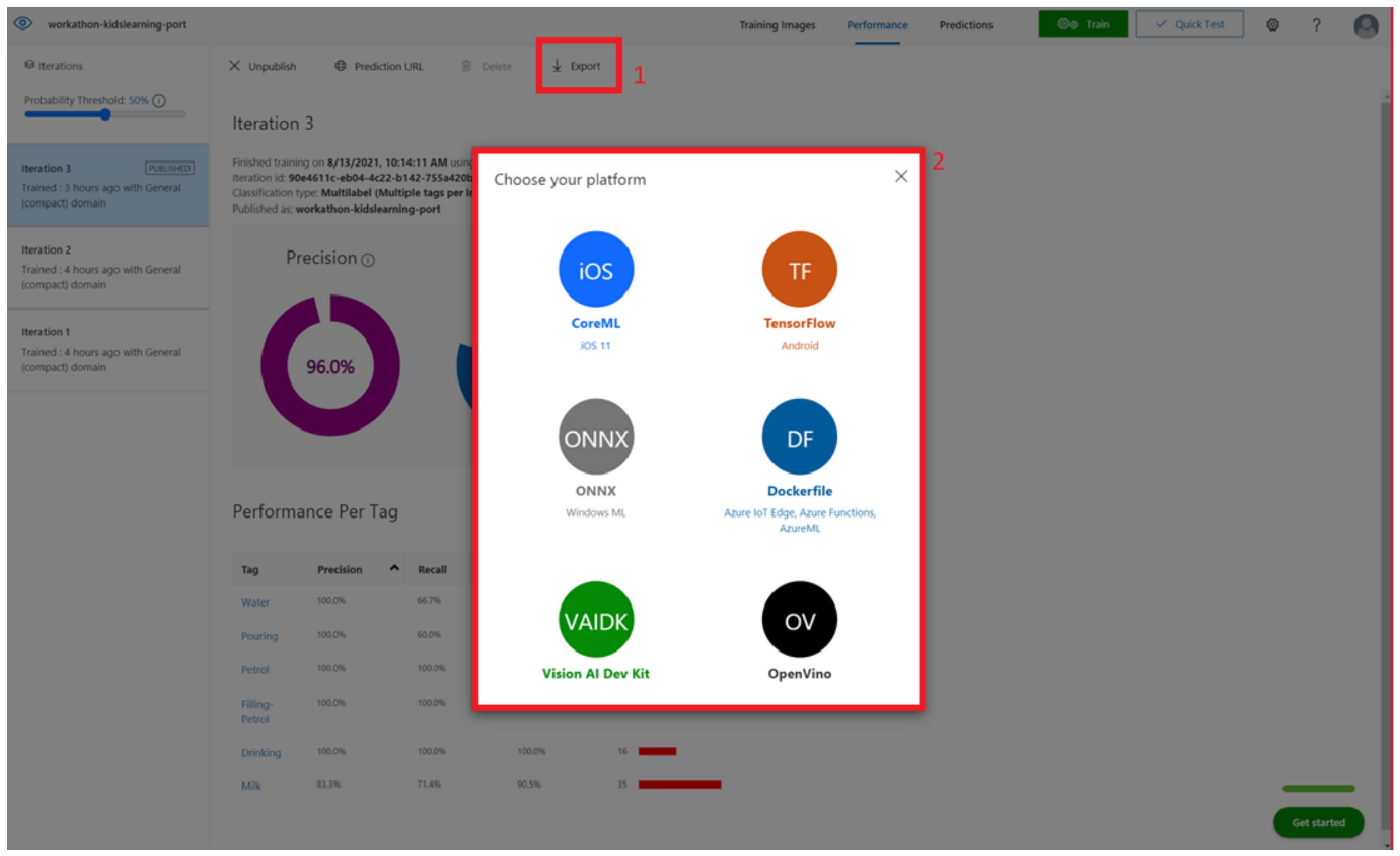
1 projects created; 99 remain

Model & Service Management

Model details can be found in the settings tab.

Some of the details & settings can be changed from this page, such as:
1. Project name & description.
2. Project Domain (You can try different iterations with different domains and see how the performance varies)
3. Classification type (You can switch between multiclass & multilabel)
4. Pricing Tier (in case you started off with free tier and now want to switch to Pay-as-you-Go)

You can also fetch other details such as Project ID, Key, Endpoint etc



Probability Threshold: 50%

Iteration 3 PUBLISHED
Trained : 3 hours ago with General (compact) domain

Iteration 2
Trained : 4 hours ago with General (compact) domain

Iteration 1
Trained : 4 hours ago with General (compact) domain

Iteration 3

Finished training on 8/13/2021, 10:14:11 AM usin
Iteration id: 90e4611c-eb04-4c22-b142-755a420b
Classification type: Multilabel (Multiple tags per i
Published as: workathon-kidslearning-port

Performance Per Tag

Tag	Precision	Recall		
Water	100.0%	66.7%		
Pouring	100.0%	60.0%		
Petrol	100.0%	100.0%		
Filling-Petrol	100.0%	100.0%		
Drinking	100.0%	100.0%	100.0%	16
Milk	83.3%	71.4%	90.5%	35

Choose your platform

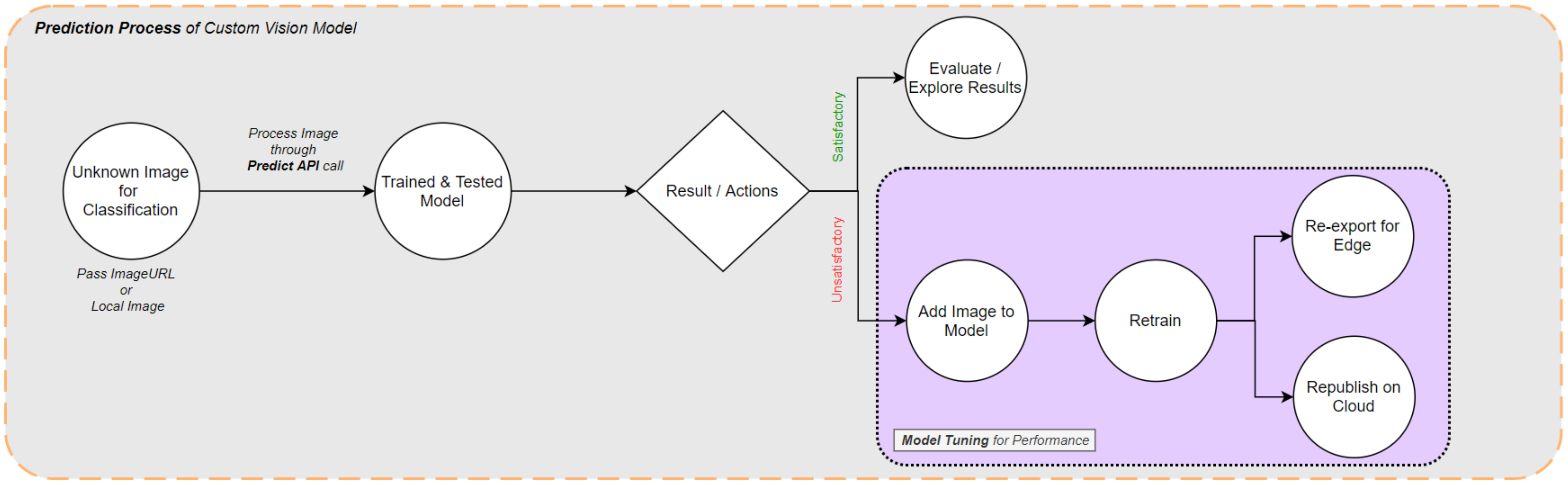
- iOS — CoreML — iOS 11
- TF — TensorFlow — Android
- ONNX — ONNX — Windows ML
- DF — Dockerfile — Azure IoT Edge, Azure Functions, AzureML
- VAIDK — Vision AI Dev Kit
- OV — OpenVino

Exporting the model

In the beginning of the workshop, we mentioned we will be selecting the compact model for general domain.
This is where the significance of choosing a compact model comes into play. You can now export the model to run offline in your application or on edge devices.

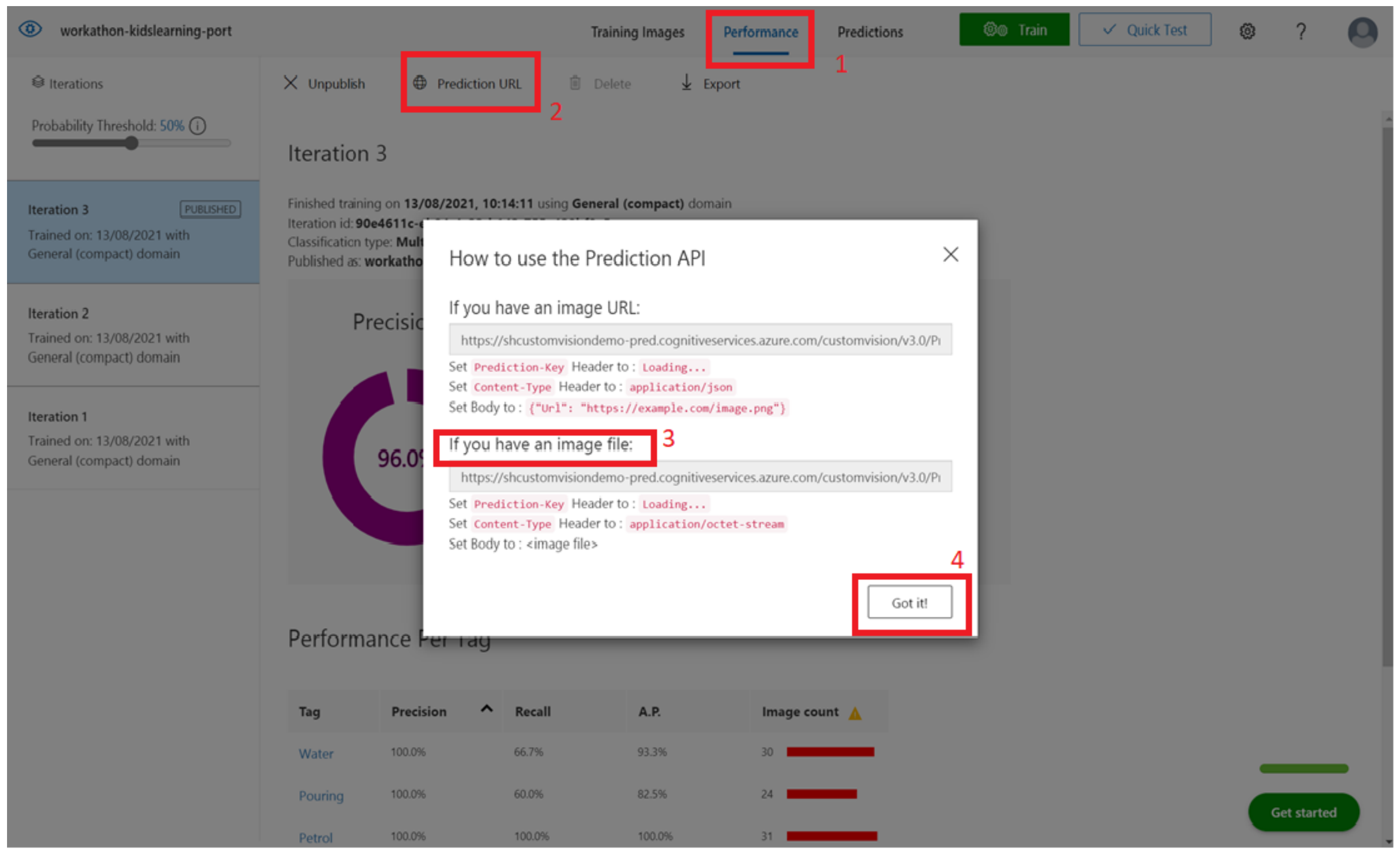
Select Export (Step 1) & choose the appropriate format for your use case.
Artefacts such as model code, required package files etc will be downloaded.

Custom Model Prediction Workflow



Prediction Process of Custom Vision Model
Unknown Image for Classification
Pass ImageURL or Local Image
Process Image through Predict API call
Trained & Tested Model
Result / Actions
Satisfactory
Evaluate / Explore Results
Unsatisfactory
Add Image to Model
Retrain
Re-export for Edge
Republish on Cloud
Model Tuning for Performance

Once you have trained the model, you can leverage it for production scenarios & predict images in real time. Over time, as you predict more and more images, if your model is not performing in the most optimal way, you might also want to leverage those images to further retrain the model. In the below steps, we will predict an image using the REST API Endpoint for the deployed model and add it to the training set.



Iteration 3 — Trained on: 13/08/2021 with General (compact) domain

Iteration 2 — Trained on: 13/08/2021 with General (compact) domain

Iteration 1 — Trained on: 13/08/2021 with General (compact) domain

Finished training on **13/08/2021, 10:14:11** using **General (compact)** domain
Iteration id: **90e4611c-**
Classification type: **Mul**
Published as: **workatho**

How to use the Prediction API

If you have an image URL:

https://shcustomvisiondemo-pred.cognitiveservices.azure.com/customvision/v3.0/Pı

Set `Prediction-Key` Header to : `Loading...`
Set `Content-Type` Header to : `application/json`
Set Body to : `{"Url": "https://example.com/image.png"}`

If you have an image file:

https://shcustomvisiondemo-pred.cognitiveservices.azure.com/customvision/v3.0/Pı

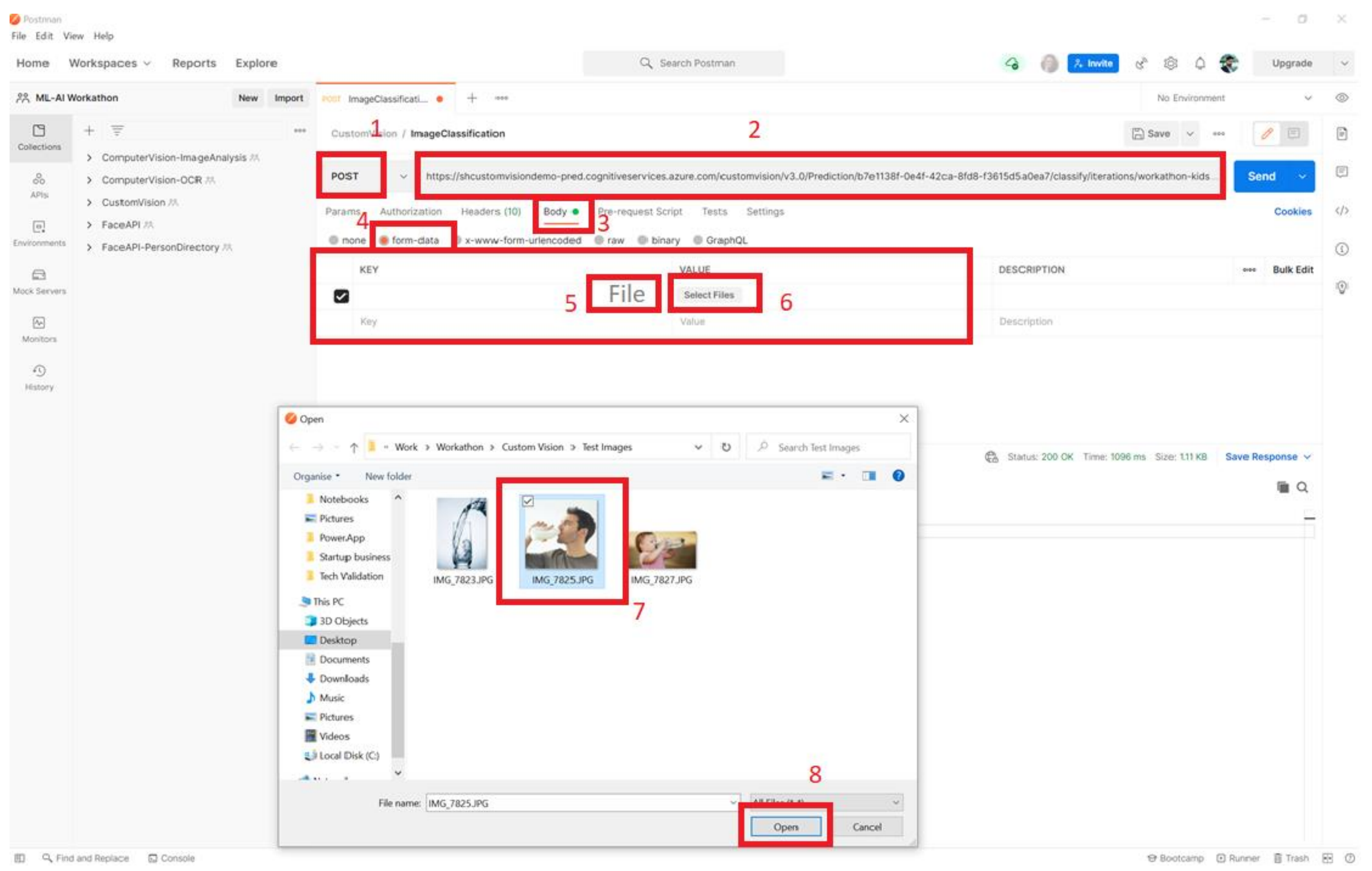
Set `Prediction-Key` Header to : `Loading...`
Set `Content-Type` Header to : `application/octet-stream`
Set Body to : <image file>

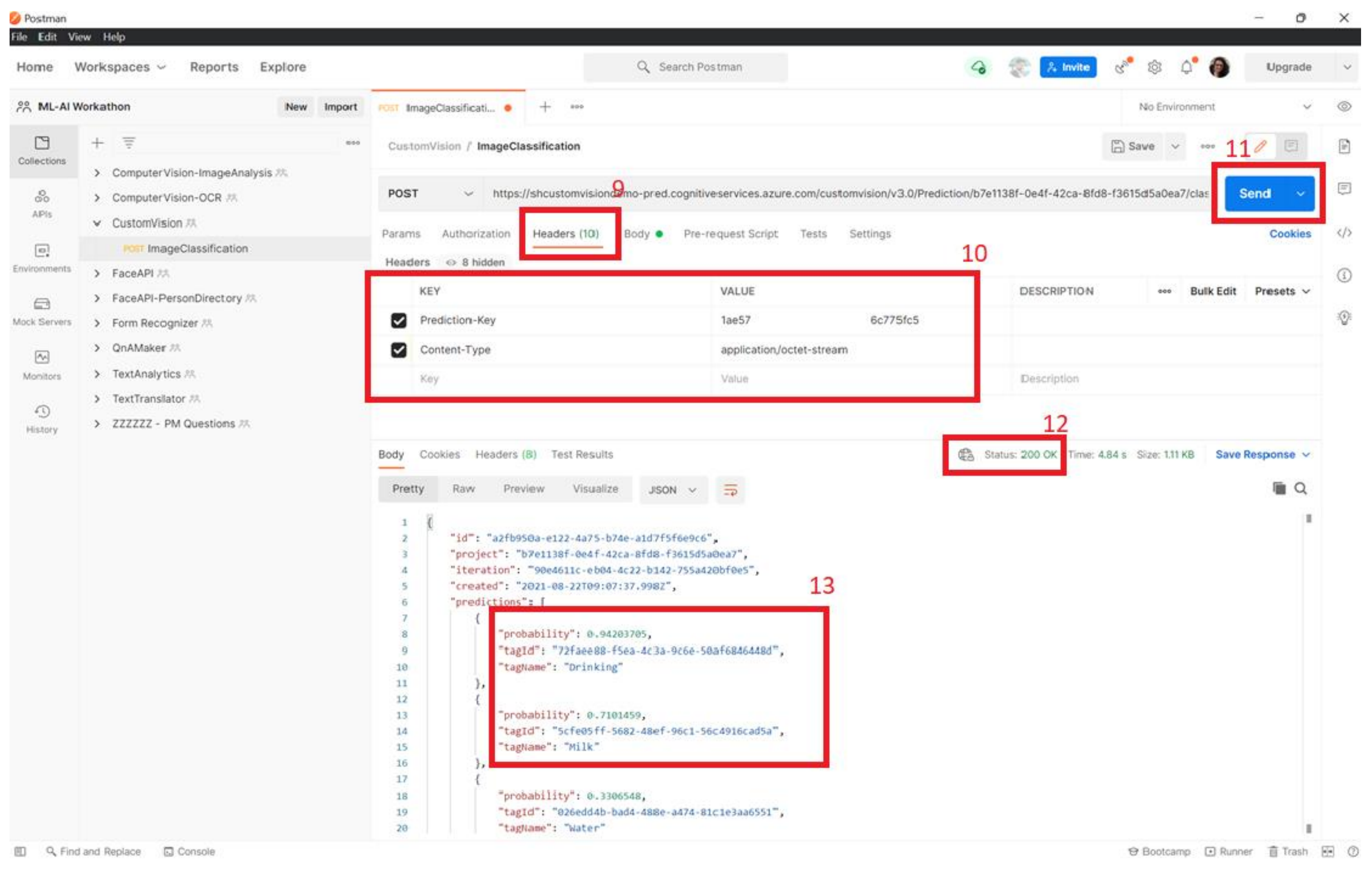
Performance Per Tag

Tag	Precision	Recall	A.P.	Image count
Water	100.0%	66.7%	93.3%	30
Pouring	100.0%	60.0%	82.5%	24
Petrol	100.0%	100.0%	100.0%	31

Classify a new image using your custom model (Using REST APIs in Postman)

From the Performance tab (step 1), select Prediction URL and copy the Endpoint & Headers as shown in step 3.


1
2
3
4
5
6
7
8
POST
https://shcustomvisiondemo-pred.cognitiveservices.azure.com/customvision/v3.0/Prediction/b7e1138f-0e4f-42ca-8fd8-f3615d5a0ea7/classify/iterations/workathon-kids...
Send
Body
form-data
File
Select Files
IMG_7823.JPG
IMG_7825.JPG
IMG_7827.JPG
File name: IMG_7825.JPG
Open
Cancel


9
10
11
12
13
POST
https://shcustomvisiondemo-pred.cognitiveservices.azure.com/customvision/v3.0/Prediction/b7e1138f-0e4f-42ca-8fd8-f3615d5a0ea7/clas
Send
Headers (10)

KEY	VALUE
Prediction-Key	1ae57 6c775fc5
Content-Type	application/octet-stream

Status: 200 OK Time: 4.84 s Size: 1.11 KB

```
{
    "id": "a2fb950a-e122-4a75-b74e-a1d7f5f6e9c6",
    "project": "b7e1138f-0e4f-42ca-8fd8-f3615d5a0ea7",
    "iteration": "90e4611c-eb04-4c22-b142-755a420bf0e5",
    "created": "2021-08-22T09:07:37.998Z",
    "predictions": [
        {
            "probability": 0.94203705,
            "tagId": "72faee88-f5ea-4c3a-9c6e-50af6846448d",
            "tagName": "Drinking"
        },
        {
            "probability": 0.7101459,
            "tagId": "5cfe05ff-5682-48ef-96c1-56c4916cad5a",
            "tagName": "Milk"
        },
        {
            "probability": 0.3306548,
            "tagId": "026edd4b-bad4-488e-a474-81c1e3aa6551",
            "tagName": "Water"
```

<u>Fire the Prediction API call using Postman</u>

We will be using Postman to predict a local image. You can use Postman desktop app or web client.

URL : Paste the URL you copied in the above step.

Body :
Select form-data (step 4)
Select file from drop down (step 5)
Browse & select image file you want to predict (step 6-8)

You should also try exploring with different local images & URLs (make sure to change the body & Headers accordingly).

Headers :
Ocp-Apim-Subscription-Key : Paste the key copied in above step
Content-Type : application/octet-stream

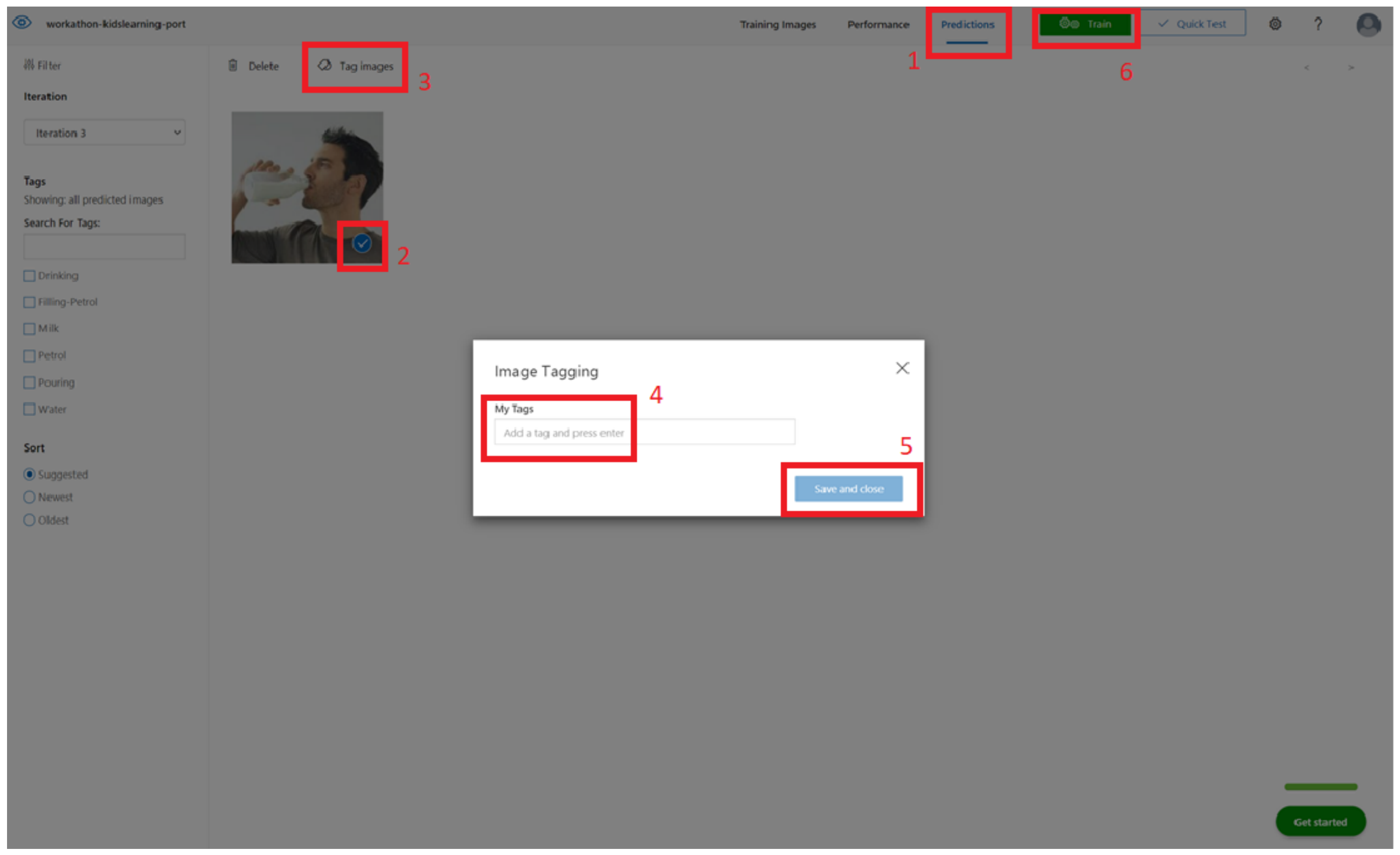
<u>Significance of input & output</u>

1. {{endpoint}} , {{key}} : Values being picked from global variables

2. Ocp-Apim-Subscription-Key : This is the Azure Cognitive service key, that will authenticate the request.
   Content-Type : This refers to the input type that you provide in the body, for eg application/octet-stream allows you to enter body in image format. Change the content-type based on input you provide.

3. After you execute the call, observe the status returned, as shown in step 10. This should reflect 200 OK.

4. Observe the predictions section in the JSON output as shown in step 13.



Any image that you make predictions on will be uploaded to your project.

The way we tagged these images and retrained the model earlier, you can follow the steps to repeat the same.

In a production scenario, you can do this activity periodically when you collect a good bunch of images and retrain the model to improve performance.

<u>HOMEWORK</u>

In this workshop, we have explored Image Classification model. We would recommend to you try creating a custom Object Detection Model.
HINT

1. Collect the data set, Create object tags & Tag images
2. Train & test the model, Publish the model
3. Predict on a new image using REST APIs

<u>Additional recommended resources</u>

Service Name	Category	Links
Custom Vision	Programming Language	.Net, Java, Python, Node.js, Go
	Tiers	Free (not for production), Standard
	Pricing	https://azure.microsoft.com/en-us/pricing/details/cognitive-services/custom-vision-service/
	Limits	https://docs.microsoft.com/en-us/azure/cognitive-services/custom-vision-service/limits-and-quotas
	Language Support	Not Applicable
	Sample Apps	Sample Skills, Food Recognizer (ONNX), Video Feed Analysis (OpenCV – IoT), Rock Paper Scissor
	Regional Availability & Support	https://azure.microsoft.com/en-us/global-infrastructure/services/?products=cognitive-services&regions=all
	SLAs for Cognitive Services	https://azure.microsoft.com/en-in/support/legal/sla/cognitive-services/v1_1/
	Compliance & Certificates	https://azure.microsoft.com/en-us/support/legal/cognitive-services-compliance-and-privacy/
	Cognitive Services Updates	https://azure.microsoft.com/en-us/updates/?product=cognitive-services

<u>Security best practices</u>

1. Azure Cognitive Services security
2. Networking
3. Authentication
4. Key Management
5. Data loss prevention
6. Azure security baseline
7. Regulatory Compliance controls

Responsible AI being a part of best practices, we encourage you to read this.

Custom Vision Documentation

Training API & error link
Prediction API & error link