

Crop Recommendation -Maximize agricultural yield by recommending appropriate crops

Data set link : <https://www.kaggle.com/datasets/siddharthss/crop-recommendation-dataset?resource=download>

About Dataset

Context

Precision agriculture is in trend nowadays. It helps the farmers to get informed decision about the farming strategy. Here, we present you a dataset which would allow the users to build a predictive model to recommend the most suitable crops to grow in a particular farm based on various parameters.**

Source

This dataset was build by augmenting datasets of rainfall, climate and fertilizer data available for India. Gathered over the period by ICFA, India.

Data fields

N - ratio of Nitrogen content in soil

P - ratio of Phosphorous content in soil

K - ratio of Potassium content in soil

temperature - temperature in degree Celsius

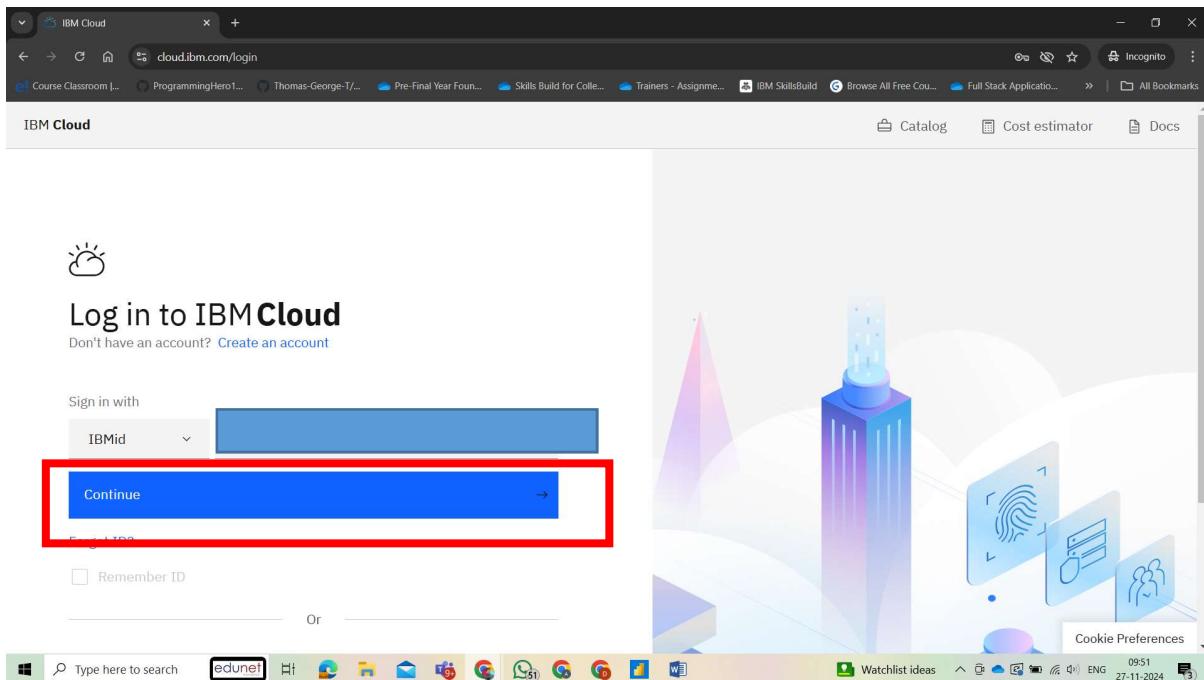
humidity - relative humidity in %

ph - ph value of the soil

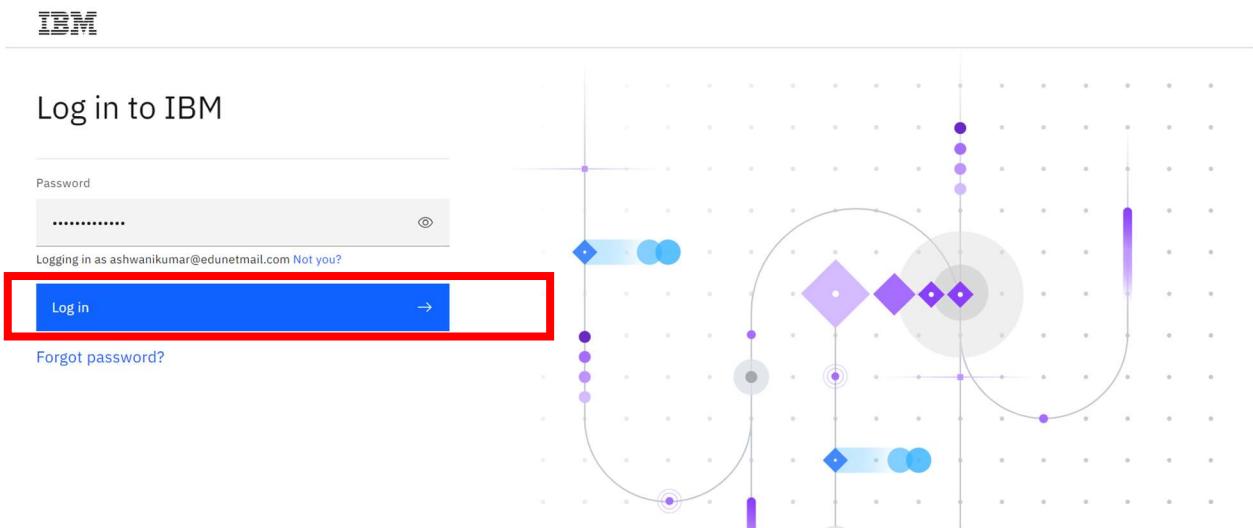
rainfall - rainfall in mm

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Step1 : Open IBM Cloud login page with this link [cloud.ibm.com](https://cloud.ibm.com/login), enter your Gmail and click on Continue



Step2 : Enter your IBM Academic portal password, Click on Login



Step3: This is IBM Cloud Dash board

The screenshot shows the IBM Cloud dashboard titled "Untitled". The top navigation bar includes "IBM Cloud", a search bar, "Catalog", "Manage", and a user account dropdown for "Ashwani Kumar's Acco...". On the right, there are icons for help, refresh, settings, notifications, and user profile. Below the title, there is a sidebar with icons for Build, Catalog, Manage, User access, and a list of pinned resources including DevOps, Classic Infrastructure, Code Engine, Kubernetes, OpenShift, Satellite, Security and Compliance, VMware, and VPC Infrastructure. The main content area features a "For you" section with cards for "Build", "Track emissions with Carbon Calculator", "Use Watson Assistant", "Get Started with Watson Studio", and "Build with Watson". At the bottom, tabs for "User access", "Manage users", "News" (selected), "View all", "Planned maintenance", and "View all" are visible.

Step4 : Click on Navigation menu, go to Resources list and clear all the resources

The screenshot shows the IBM Cloud dashboard with the navigation menu open. The "Resource list" option under the "Dashboard" category is highlighted with a red box. The main content area displays a table header for "Group", "Location", "Product", "Status", and "Tags". Below the header, there are several rows of data, each with a small icon and some text. The bottom right corner of the dashboard has a blue feedback button.

The screenshot shows the IBM Cloud Catalog interface. On the left, there is a sidebar with various service icons and a search bar at the top. The main area is a table with columns: Name, Group, Location, Product, Status, and Tags. The 'Name' column contains a search input field with the placeholder 'Filter by name or IP address...'. There are also filter dropdowns for 'Group', 'Location', 'Product', 'Status', and 'Tags'. The table lists several categories: Compute (0), Containers (0), Networking (0), Storage (0), Converged infrastructure (0), Enterprise applications (0), AI / Machine Learning (0), Analytics (0), Blockchain (0), Databases (0), and Developer tools (0+). A blue search icon is located in the bottom right corner of the table area.

Step5: Click on search icon and type “Watsonx.ai Studio”. Select Watson.ai Studio(Service).

The screenshot shows the IBM Cloud Catalog results for the search term "watsonx.ai Studio". The search bar at the top has "watsonx.ai Studio" typed into it. Below the search bar, a message says "0 resource results found". Underneath, there is a "Catalog Results" section with a "View all catalog results" link. A red box highlights the first result in the list: "watsonx.ai Studio Service". To the right of the search bar, there is a "Create resource" button. The main table below has columns: Name, Group, Location, Product, Status, and Tags. The "Name" column shows the service name with a small icon to its left. Other results listed include "watsonx Service", "Watsonx.ai SaaS with Assistant and Gover...", "AiSolved - Seekers Of Knowledge Meet AI ... Service", and "NeuralSeek Service". At the bottom of the page, there are links for "Search 'watsonx.ai Studio' in Support Cases" and "Search 'watsonx.ai Studio' in Docs".

Step6: Click on the check box and click on Create.

The screenshot shows the IBM Cloud Catalog interface. On the left, there's a sidebar with 'Create' and 'About' tabs, and a main panel for 'watsonx.ai Studio'. The main panel includes fields for 'Type' (Service), 'Provider' (IBM), 'Last updated' (11/26/2024), and 'Category' (AI / Machine Learning). It also has dropdowns for 'Select a location' (Sydney) and 'Select a pricing plan' (United States). Below these are tabs for 'Plan', 'Features and capabilities', and 'Pricing'. On the right, a 'Summary' panel shows the resource details: name (watsonx.ai Studio), location (Sydney), plan (Lite), service name (watsonx.ai Studio-tb), and resource group (Default). A large red box highlights the 'Create' button at the bottom right of the summary panel, which is preceded by a checkbox for accepting license agreements.

The screenshot shows the IBM Cloud Resource list. It displays a single resource named 'watsonx.ai Studio-tb' with status 'Active' and an 'Add tags' link. To the right are 'Details' and 'Actions' buttons. The main content area shows a 'Manage' section with a 'Getting started' tab selected, and a 'Page Not Found' message below it. A blue box highlights the 'Actions' button.

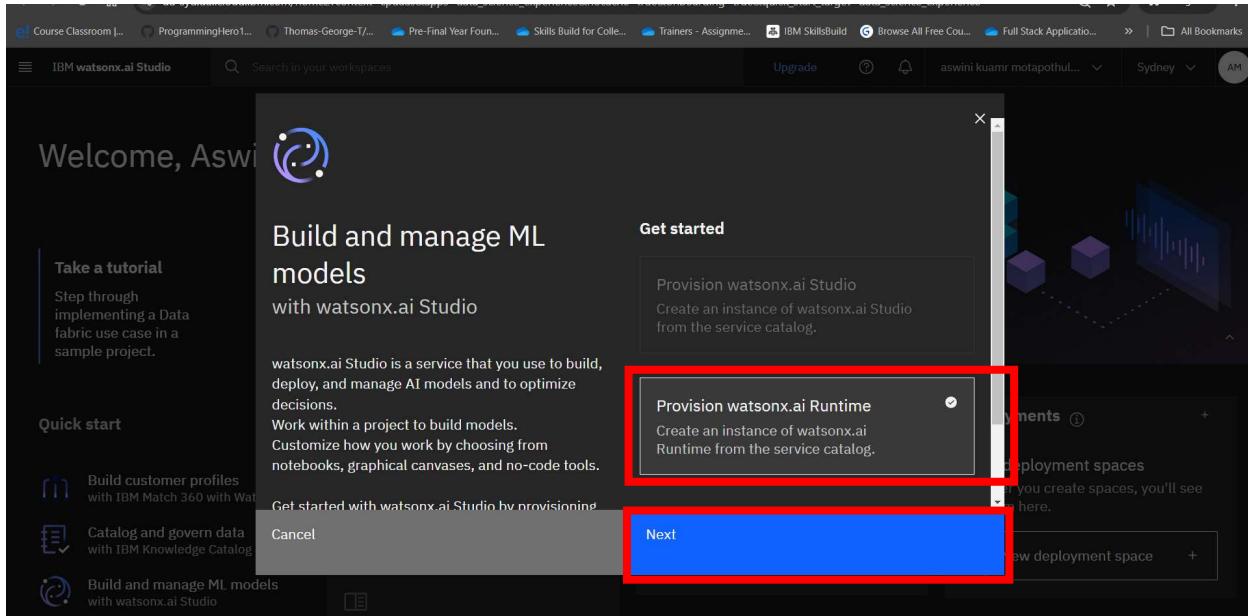
Step7: Click on the Manage and click on “Launch in “

The screenshot shows the IBM Cloud Service Details page for a service named "watsonx.ai Studio-tb". The top navigation bar includes "IBM Cloud", a search bar, and a "Manage" dropdown. Below the navigation, there's a "Details" tab and an "Actions" dropdown. The main content area features a "Data and watsonx" section with a description of building and deploying machine learning models. A large blue "Launch in" button is prominently displayed. The status bar at the bottom shows the URL as "au-syd.dal.cloud.ibm.com/registration/steptwo?context=cpdaas&apps=data_science_experience&sync_account_id=1788402170524ffabeb796a19d70017&redirectToAccountExists...".

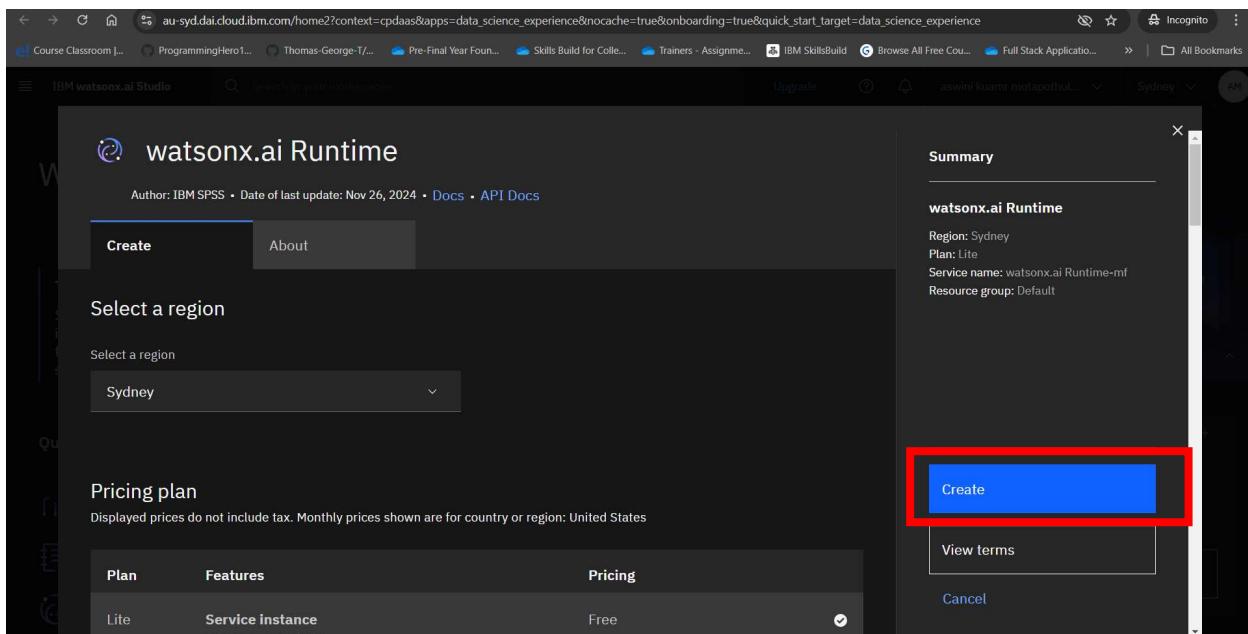
Company name should be college name

The screenshot shows the IBM Watsonx.ai Studio registration form. It asks for company information: "Provide your information to continue". There are fields for "Company name" (with a red box highlighting it), "Phone number" (with a red box highlighting the dropdown menu showing "+91"), and a "Continue" button. A note below the phone number field states: "IBM may use my contact data to keep me informed of products, services, and offerings: You can withdraw your marketing consent at any time by submitting an opt-out request. Also, you may unsubscribe from receiving marketing emails by clicking the unsubscribe link in each email. More information on our processing can be found in the [IBM Privacy Statement](#)".

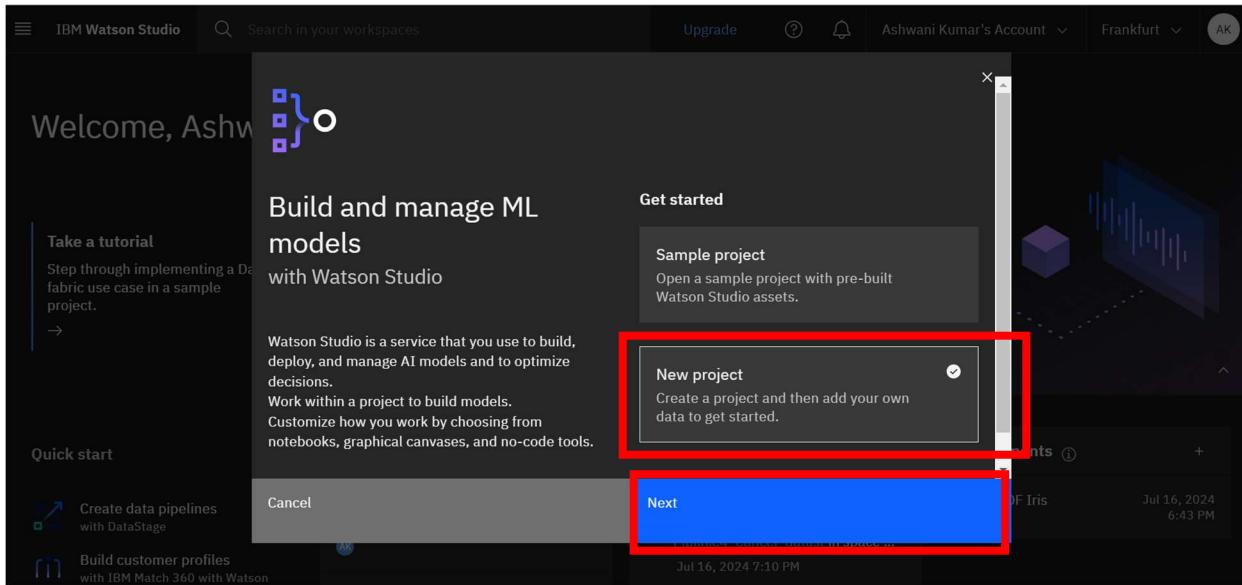
Step8: Select Provision Watson.ai Runtime and click on Next.



Step9 : Click on the Create.



Step10: Select New project and click on Next.



Step11: Enter project name and scroll a little.

A screenshot of the 'Create a project' dialog box. On the left, there's a sidebar with '+ New' selected, 'Local file', and 'Sample'. The main area is titled 'Define details' and contains fields for 'Name' (with placeholder 'Enter a name'), 'Description (optional)', and 'Tags (optional)'. A red box highlights the 'Name' input field.

Step12: Click on Add

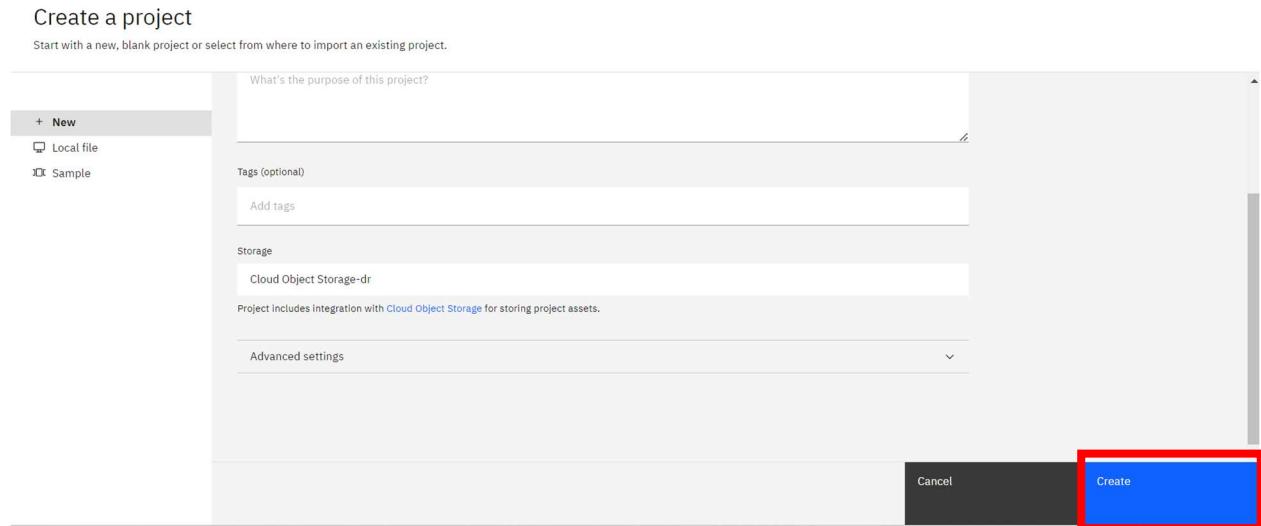
The screenshot shows a 'Create a project' interface. On the left, there's a sidebar with '+ New' options: 'Local file' and 'Sample'. The main area has a heading 'Define storage' with a red box around it. Inside, step 1 says 'Select storage service' with a red box around the 'Add' button. Step 2 says 'Refresh'. Below that, it says 'Project includes integration with Cloud Object Storage for storing project assets.' At the bottom right are 'Cancel' and 'Create' buttons.

Step13: Select Free plan(Second plan) , Click on Continue

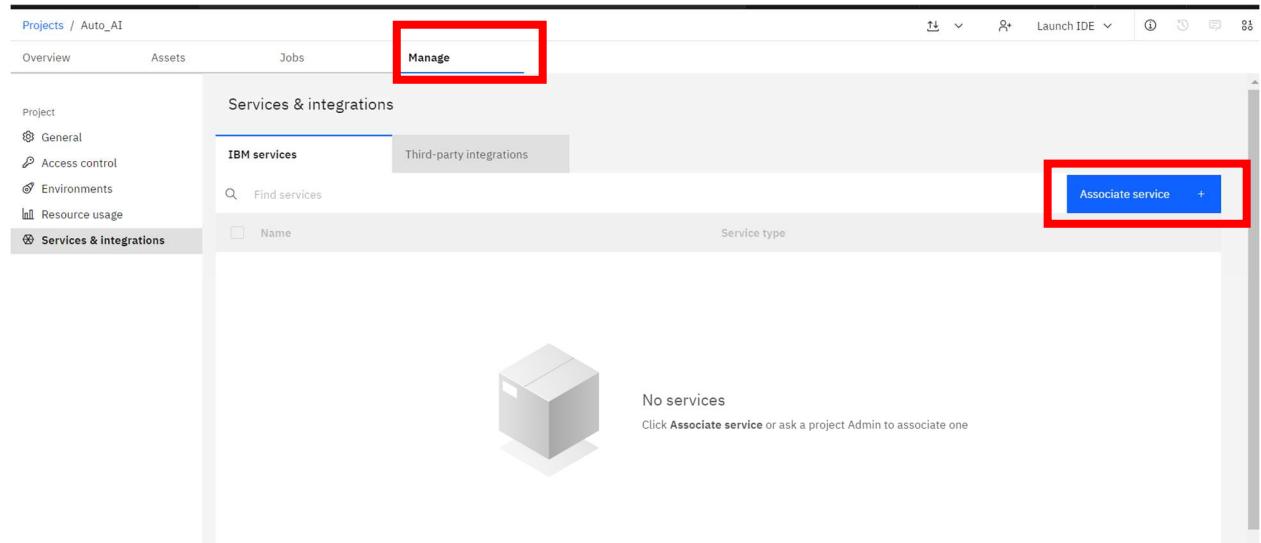
The screenshot shows the 'Cloud Object Storage' pricing page. It has a 'Services catalog /' header, a 'Cloud Object Storage' title, and a summary section on the right. The main content includes a 'Pricing plan' table and a 'Create' button highlighted with a red box. The table shows two plans: 'One Rate' and 'Lite(deprecated)'. The 'Lite(deprecated)' plan is marked as 'Free'.

Plan	Features	Pricing
One Rate	One Rate plan offers a flat monthly charge that includes capacity, and built-in allowances for outbound bandwidth and data access. It is best suited for active workloads with large amounts of outbound bandwidth as a percent of their storage capacity.	See pricing details
Lite(deprecated)	Lite plan instance is free to use for Storage capacity up to 25 GB per month. Lite plan instance is used for trial, and can be easily upgraded to Standard plan for unlimited scalability and full functionality. None Lite plan services are deleted after 30 days of inactivity.	Free

Step14: Click on the Refresh, click on the Create.



Step15: Click on the Manage and Associate the service.



Step16: Click on the Watson.ai and click on Associate

The screenshot shows the 'Associate service' dialog in the IBM Watsonx.ai Studio. At the top, there are two tabs: 'Default' (selected) and 'Locations'. Below is a search bar labeled 'Find services'. A table lists services with columns: Name, Type, Plan, Location, Status, and Group. One row is selected, showing 'watsonx.ai Runtime-mf' as the name, 'watsonx.ai Runtime' as the type, 'Lite' as the plan, 'Sydney' as the location, 'Not associated' as the status, and 'Default' as the group. The 'Status' column contains a small icon of a diamond with a minus sign. At the bottom right of the dialog is a blue 'Associate' button, which is also highlighted with a red box.

Step17: Machine Learning service associated now click on the Overview.

The screenshot shows the 'Services & integrations' section in the IBM Watsonx.ai Studio. On the left, a sidebar lists 'Project', 'General', 'Access control', 'Environments', 'Resource usage', and 'Services & integrations...'. The 'Services & integrations...' item is selected and highlighted with a red box. In the main area, there are two tabs: 'IBM services (1)' (selected) and 'Third-party integrations'. Below is a search bar labeled 'Find services'. A table lists services with columns: Name and Service type. One row is selected, showing 'watsonx.ai Runtime-mf' as the name and 'watsonx.ai Runtime' as the service type. Both the 'Name' and 'Service type' columns have a small checkbox icon to their left. At the bottom right of the table area is a blue 'Associate service' button, which is also highlighted with a red box.

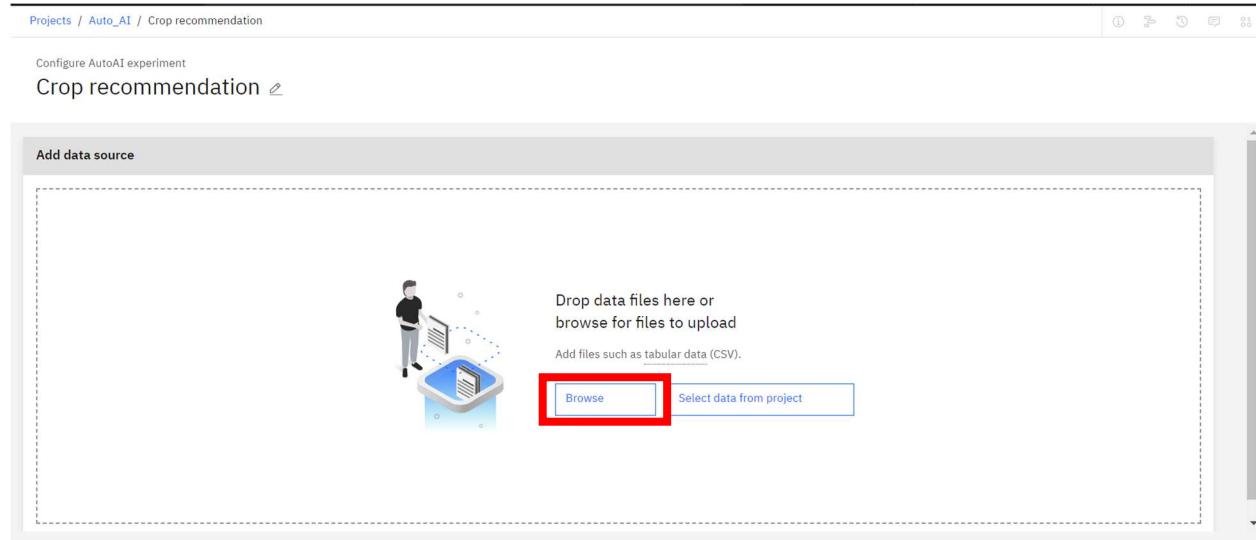
Step18: Click on “Build machine learning models automatically”

The screenshot shows the Watson Studio interface for a project named 'Auto_AI'. The top navigation bar includes 'Launch IDE' and other project management options. Below the header, there's a 'Start working' section with three main steps: 'Add users as collaborators', 'Add data to work with', and 'Build machine learning models automatically'. The third step is highlighted with a red box. The 'Assets' and 'Resource usage' sections are also visible.

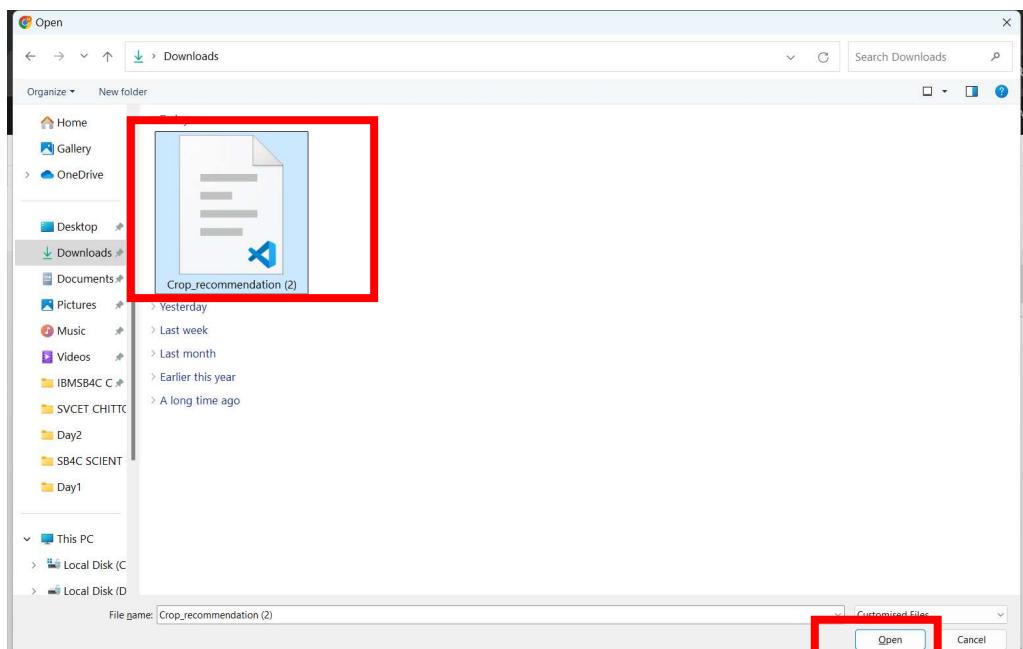
Step19: Enter the experiment name and click on Create

The screenshot shows the 'Define details' and 'Define configuration' sections of the AutoAI experiment creation dialog. In the 'Define details' section, the 'Name' field is populated with 'Crop recommendation' and has a red box around it. The 'Define configuration' section shows a 'Watson Machine Learning Service Instance' set to 'Watson Machine Learning-gb'. The 'Create' button at the bottom right is highlighted with a blue box.

Step20: Add the downloaded data set (Crop_recomondation.csv) with the help of Browse option



Step21: Select the data set and click on Open & click on create a user API Key



Configure AutoAI experiment

Crop_Auto_AI e

Autosaved: 11:10:10 AM

Add files such as tabular data (CSV).

Browse Select from project

Crop_recommendation.csv
Size: 146.52 KB

No user API key
To create an AutoAI machine learning experiment you must first [create a User API key](#). Then, click the [reload button](#).

Create a time series analysis?
Enable this option to predict future activity over a specified date/time range. Data must be structured and sequential. [Learn more](#)

<https://au-syd.dai.cloud.ibm.com/settings/user-api-key?context=cpdias>

Click on Create Key

Ashwani Kumar
ashwanikumar@edunetmail.com

Edit IBMid profile e

Profile Git integrations User API key

User API key

A user API key is required to authenticate runtime operations in IBM Watsonx.ai Studio.
Rotate keys as needed to create a new key and phase out the current key. [Learn more](#)

Create a key +

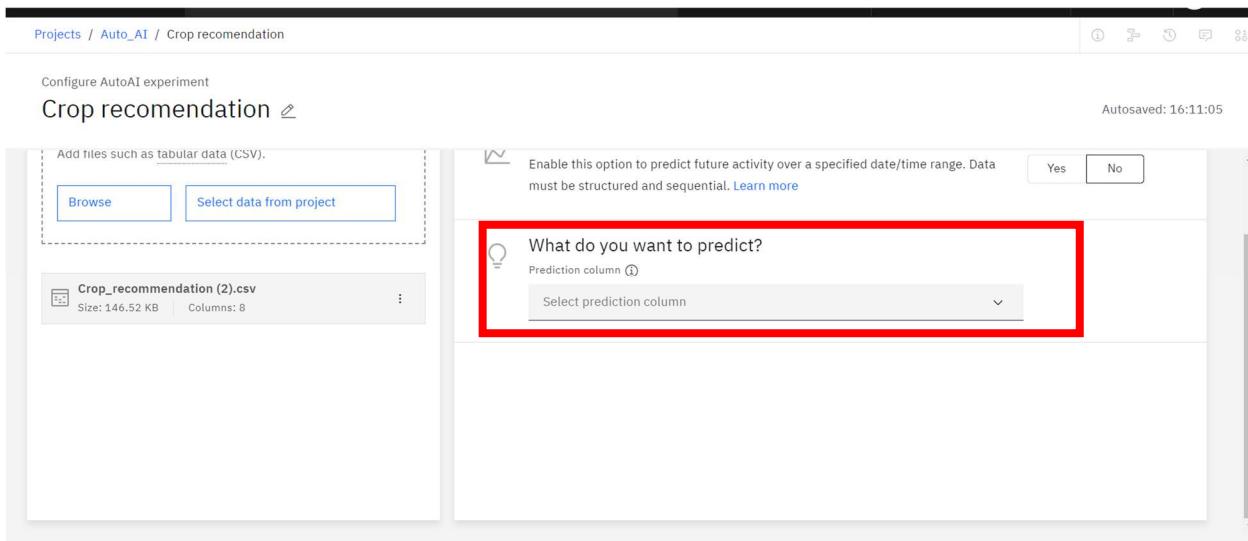
API Key created , click on browser reload button of this page

The screenshot shows the IBM Watson AI Studio interface. At the top, there's a navigation bar with links like 'Course Classroom...', 'ProgrammingHero1...', 'Thomas-George-T...', etc., and a search bar. Below the navigation is a header bar with 'IBM watsonx.ai Studio', 'Search in your workspaces', 'Upgrade', a help icon, a notification icon, 'Ashwani Kumar's Account', 'Sydney', and a user profile icon. The main content area is titled 'Configure AutoAI experiment' and 'Crop_Auto_AI'. On the left, there's a section for adding files with 'Browse' and 'Select from project' buttons. A file named 'Crop_recommendation.csv' is listed with a size of 146.52 KB. On the right, there's a yellow warning box stating 'No user API key' with instructions to create one and reload the page. Below it is a section titled 'Create a time series analysis?' with a 'Yes' and 'No' button. The URL at the bottom of the page is https://au-syd.dai.cloud.ibm.com/settings/user-api-key?context=cpdaas.

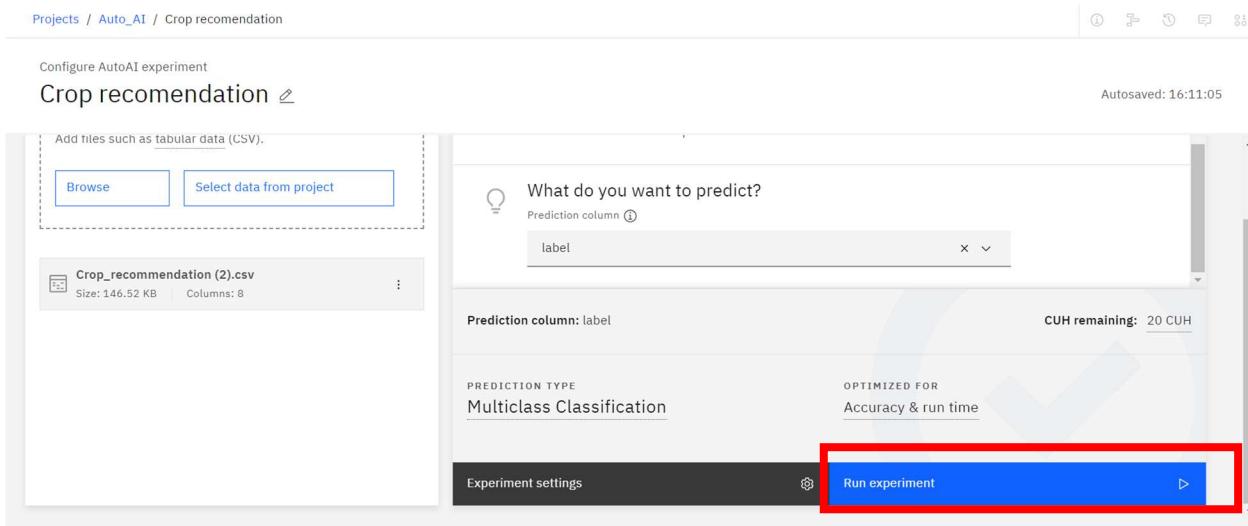
Step22: Data set is loaded. In create a time series analysis? You can choose No option

This screenshot shows the same interface as the previous one, but with a red box around the 'No' button under the 'Create a time series analysis?' section. Another red box highlights the uploaded CSV file 'Crop_recommendation (2).csv' in the left panel. The URL at the bottom is https://au-syd.dai.cloud.ibm.com/settings/user-api-key?context=cpdaas.

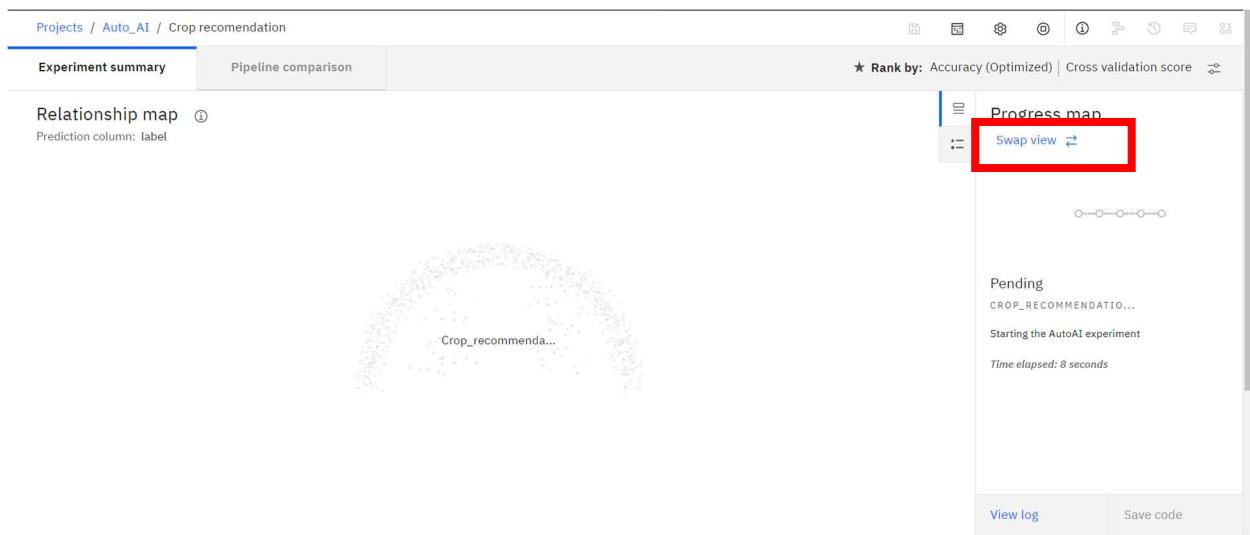
Step23 : Choose prediction column.



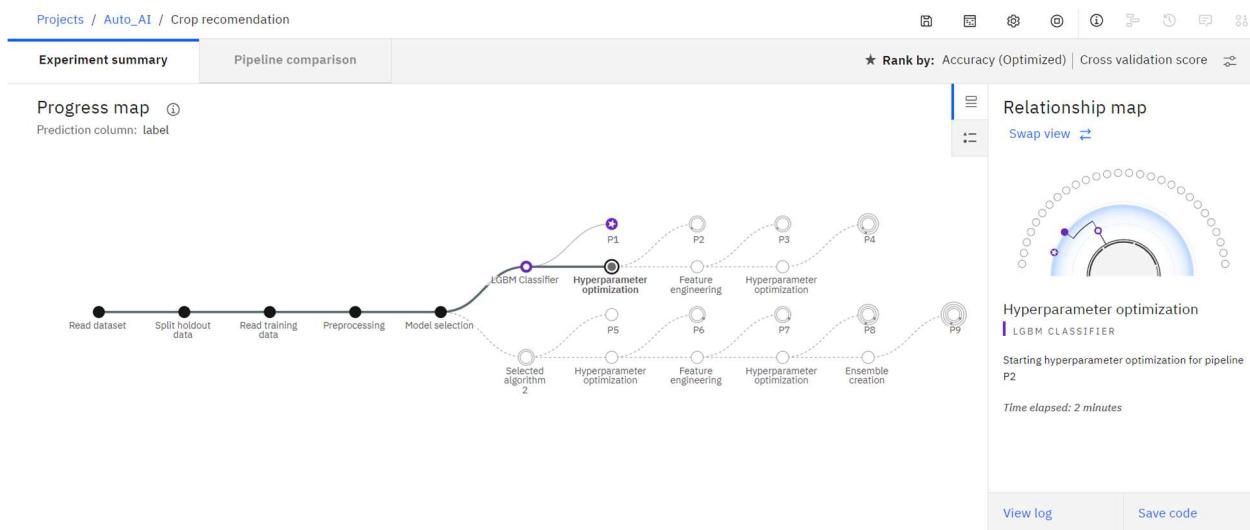
Step24: Now click on the Run experiment



Step25: Auto AI experiment is running. Now click on swap view



Step26: Pipelines are building.



Step27: This is the pipeline leader board. In this Pipeline2 is the top performer.

The screenshot shows a Pipeline leaderboard in a software interface. The top navigation bar includes 'Projects / Auto_AI / Crop recommendation' and various icons. Below the navigation is a header with tabs: 'Experiment summary' (selected), 'Pipeline comparison', and 'Pipeline leaderboard'. The 'Pipeline leaderboard' tab is currently active, indicated by a downward arrow icon. The main area displays a table with the following data:

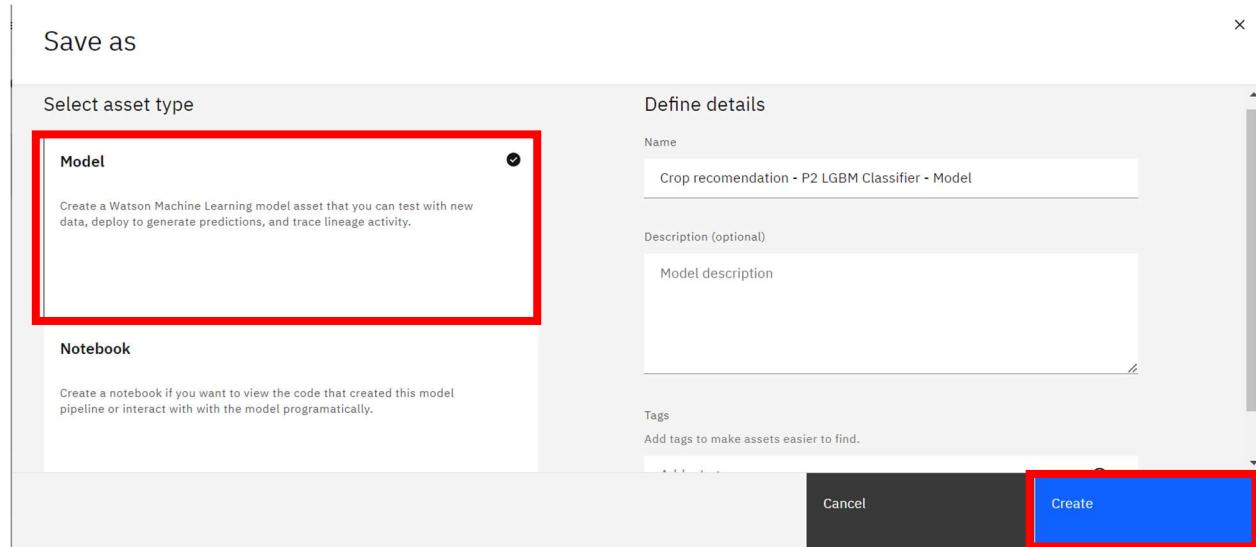
Rank	↑	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★ 1		Pipeline 2	LGBM Classifier	0.991	HPO-1	00:02:53
2		Pipeline 1	LGBM Classifier	0.989	None	00:00:08
3		Pipeline 4	LGBM Classifier	0.988	HPO-1 FE HPO-2	00:22:58
4		Pipeline 3	LGBM Classifier	0.988	HPO-1 FE	00:18:27
5		Pipeline 8	Logistic Regression	0.988	HPO-1 FE HPO-2	00:02:48
6		Pipeline 7	Logistic Regression	0.983	HPO-1 FE	00:01:23

Step28: Now we can save this model. Click on the Save as

The screenshot shows the same Pipeline leaderboard interface as the previous step, but with a red box highlighting the 'Save as' button for Pipeline 2. The table data is identical to the previous screenshot:

Rank	↑	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★ 1		Pipeline 2	LGBM Classifier	0.991	HPO-1	00:02:53
2		Pipeline 1	LGBM Classifier	0.989	None	00:00:08
3		Pipeline 4	LGBM Classifier	0.988	HPO-1 FE HPO-2	00:22:58
4		Pipeline 3	LGBM Classifier	0.988	HPO-1 FE	00:18:27
5		Pipeline 8	Logistic Regression	0.988	HPO-1 FE HPO-2	00:02:48
6		Pipeline 7	Logistic Regression	0.983	HPO-1 FE	00:01:23

Step29: Choose Model asset and click on Create



Step30: The mode saved successfully and click on view in project

The screenshot shows the 'Pipeline leaderboard' in IBM Watson Studio. The table lists six pipelines, each with its rank, name, algorithm, accuracy, enhancements, and build time. A green toast notification at the top right of the table area says 'Saved model successfully. Crop recommendation - P2 LGBM Classifier - Model was successfully saved to Auto AI.' A red box highlights the 'View in project' link within this message.

Rank	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
1	Pipeline 2	LGBM Classifier	0.991	HPO-1	00:02:53
2	Pipeline 1	LGBM Classifier	0.989	None	00:00:08
3	Pipeline 4	LGBM Classifier	0.988	HPO-1 FE HPO-2	00:22:58
4	Pipeline 3	LGBM Classifier	0.988	HPO-1 FE	00:18:27
5	Pipeline 8	Logistic Regression	0.988	HPO-1 FE HPO-2	00:02:48
6	Pipeline 7	Logistic Regression	0.983	HPO-1 FE	00:01:23

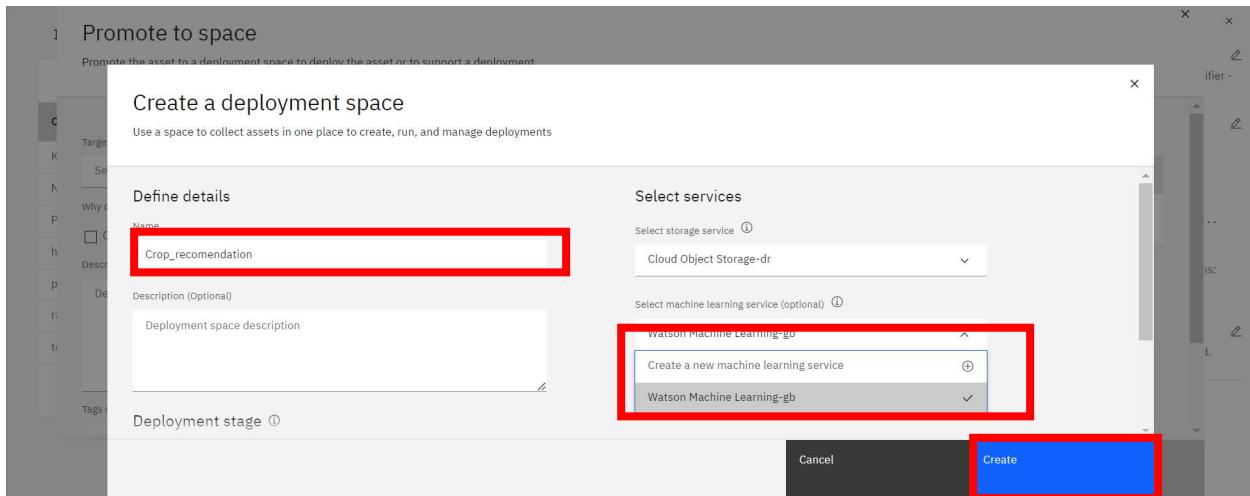
Step31: Click on promote in deployment space

The screenshot shows the IBM Watson Studio interface. In the top navigation bar, there is a 'Promote to deployment space' button with a red box drawn around it. To the left, there is an 'Input Schema' section with a table showing columns K, N, P, humidity, ph, rainfall, and temperature, each with a type of "double". To the right, there is an 'About this asset' panel with details like Name: Crop recommendation - P2 LGBM Classifier - Model, Description: No description provided, Asset Details: Type: wml-hybrid_0.1, Model ID: 554a7d56-f222-4ce3-817..., Software specification: hybrid_0.1, and Tags: Add tags to make assets easier to find. Last modified: 1 min ago by Ashwani Kumar.

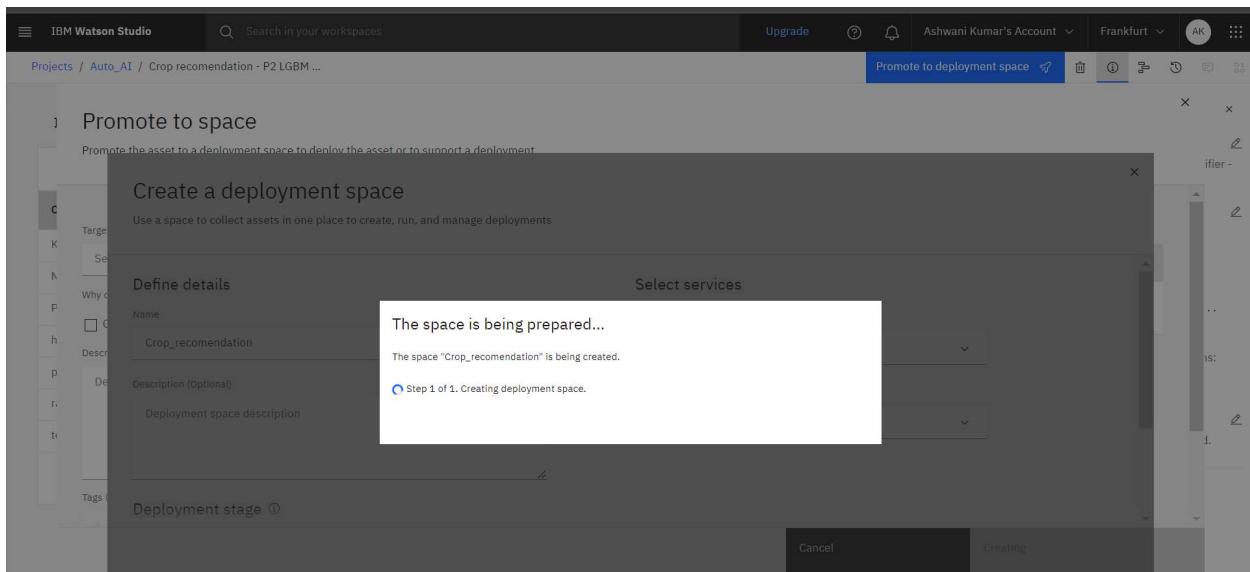
Step32: Create the new deployment space.

The screenshot shows the 'Promote to space' dialog box. It has a 'Target space' section where 'Create a new deployment space' is highlighted with a red box. Below it is a dropdown menu with 'Auto AI OF Iris'. There is also a 'Description (Optional)' field and a 'Description of assets' field. On the right, there is a 'Selected assets (1)' table with one item: 'Crop recommendation - P2 LGBM Cla...' (Model, Current, Queued). At the bottom, there are 'Cancel' and 'Promote' buttons.

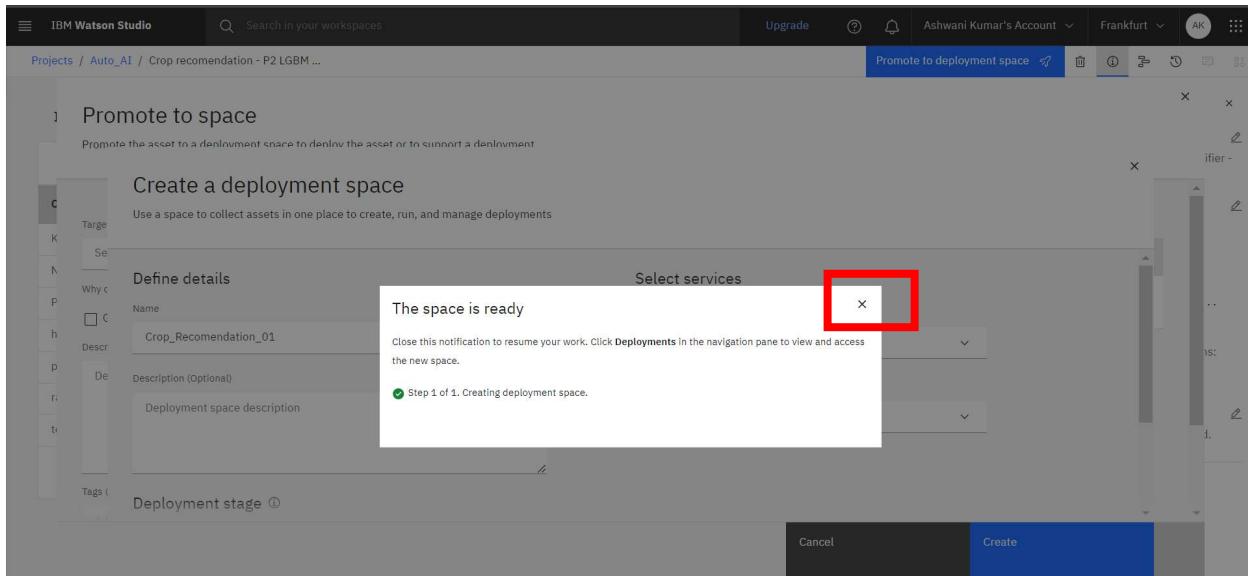
Step33: Give the deployment space name and select machine learning service , click on Create



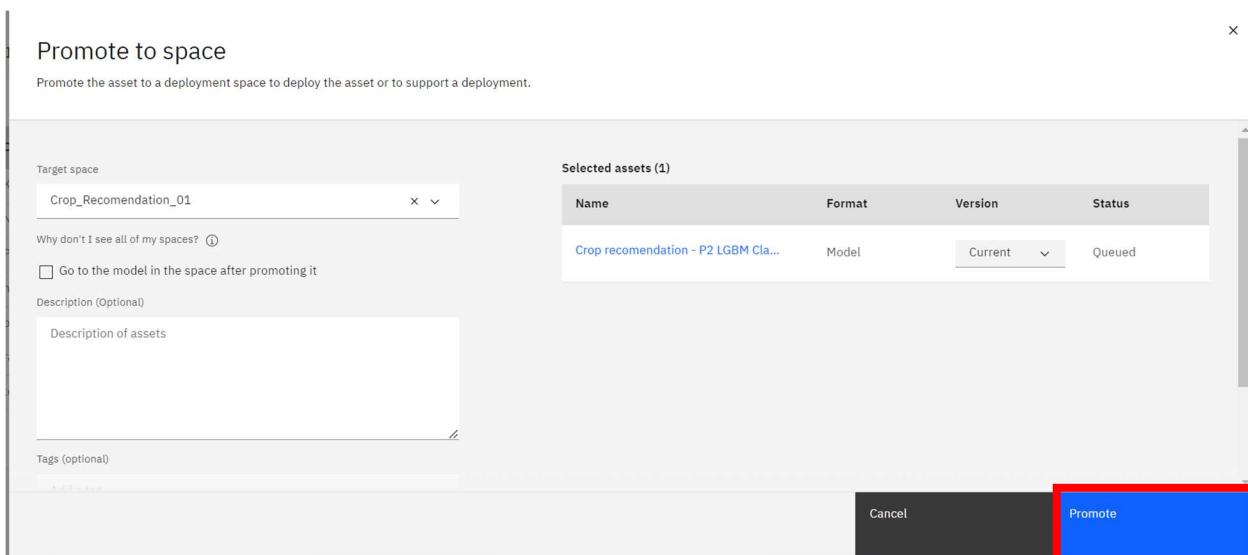
Step34: it's preparing the deployment space.



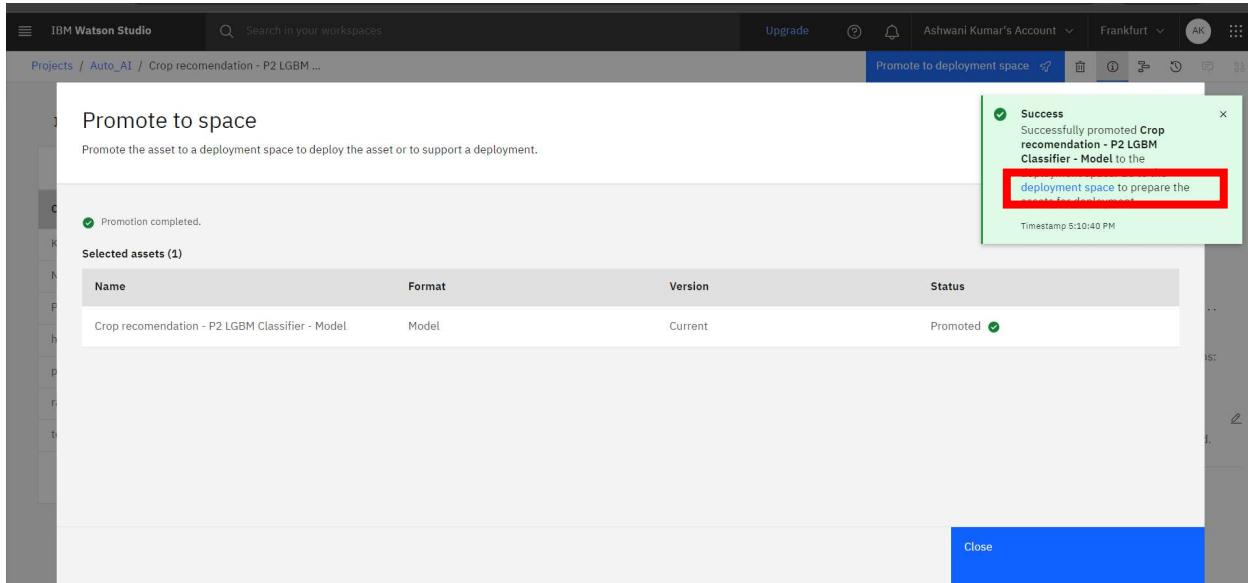
Step35: Now the space is ready , close the dialog box



Step36: Click on the promote.



Step37: it's promoted and click on deployment space.



Step38: Click on the Asset name.

A screenshot of the IBM Watson Studio interface, specifically the 'Assets' tab under 'Deployments'. The title bar shows 'IBM Watson Studio', a search bar, and account information for 'Ashwani Kumar's Account' and 'Frankfurt'. The main area displays the asset 'Crop_Recommendation_01'. The 'Assets' tab is selected. On the left, there are filters for 'Asset types' (Models) and 'Find assets'. The main table lists one asset: 'Crop recommendation - P2 LGBM Classifier - Model' (Model). This row is highlighted with a red box. The table columns include 'Name' and 'Last modified'. The 'Last modified' column shows '1 minute ago' and 'Ashwani Kumar (You)'. A blue 'Import assets' button is located at the top right of the asset list. The URL 'https://eu-de.dataplatform.cloud.ibm.com/ml-runtime/models/80db0d8d-fb7d-4839-9b74-03a6f81fabc6?space_id=fe92a6f8-55ca-4541-8a56-3fc47cca306&context=crdapp' is visible at the bottom of the page, along with a page number '1 of 1 pages'.

Step39: Click on the New deployment

The screenshot shows the IBM Watson Studio interface. At the top, there's a navigation bar with 'IBM Watson Studio', a search bar, and account information for 'Ashwani Kumar's Account'. Below the navigation bar, the URL 'Deployments / Crop_Recommendation_01 / Crop recommendation - P2 LGBM Classifier - Model' is visible. The main area is titled 'Deployments' and contains a table with columns: Name, Type, Status, Tags, and Last modified. A large button labeled 'New deployment' is highlighted with a red box. To the right of the table, there's a sidebar titled 'About this asset' with sections for Name, Description, Asset Details, Tags, and Source asset details. The 'Name' section shows 'Crop recommendation - P2 LGBM Classifier - Model'. The 'Description' section says 'No description provided.' The 'Asset Details' section includes 'Type: wml-hybrid_0.1', 'Model ID: 80dbde8d-tb7d-48...', 'Software specification: hybrid_0.1', and 'Hybrid pipeline software specifications: autoai-kb_rt24.1-py3.11'. The 'Tags' section has a note 'Add tags to make assets easier to find.' The 'Source asset details' section shows 'Last modified 2 minutes ago by Ashwani Kumar' and 'Created on Aug 10, 2024 by Ashwani Kumar'.

Step40: select deployment type and give the deployment name. Click on the Create.

The screenshot shows a 'Create a deployment' dialog box. At the top, it says 'Create a deployment'. Below that, 'Define details' is shown. Under 'Associated asset', it lists 'Crop recommendation - P2 LGBM Classifier - Model'. The 'Deployment type' section has two options: 'Online' (selected) and 'Batch'. The 'Online' option is described as 'Run the model on data in real-time, as data is received by a web service.' The 'Batch' option is described as 'Run the model against data as a batch process.' A 'Name' field is filled with 'Crop_Recommendation', which is also highlighted with a red box. Below the name field is a 'Serving name' field with a placeholder '(1)'. At the bottom, there are 'Cancel' and 'Create' buttons, with the 'Create' button highlighted with a red box.

Step41: Model is deployed.

The screenshot shows the IBM Watson Studio interface. The top navigation bar includes 'IBM Watson Studio', 'Search in your workspaces', 'Upgrade', 'Ashwani Kumar's Account', 'Frankfurt', and a three-dot menu. Below the header, the URL 'Deployments / Crop_Recomendation_01 / Crop recommendation - P2 LGBM Classifier - Model' is visible. The main content area has tabs for 'Deployments' (which is selected) and 'Model details'. The 'Deployments' tab shows a table with one row: 'Crop_Recommendation' (Type: Online, Status: Deployed, Last modified: 26 seconds ago by Ashwani Kumar). A red box highlights this row. To the right, there is a sidebar titled 'About this asset' with sections for Name, Description, Asset Details, Tags, and Source asset details. The 'Name' section shows 'Crop recommendation - P2 LGBM Classifier - Model'. The 'Asset Details' section provides technical details like Type: wml-hybrid_0.1, Model ID: 80dbbd8d-fb7d-48..., and Software specification: hybrid_0.1. The 'Tags' section allows adding tags to make assets easier to find. The 'Source asset details' section shows the last modified time as 6 minutes ago by Ashwani Kumar and the creation date as Aug 10, 2024 by Ashwani Kumar. At the bottom, pagination controls show 'Items per page: 20' and '1 of 1 pages'.

Step42: Now click on Test to predict with new values.

The screenshot shows the 'Test' tab of the deployment details. The top navigation bar is identical to the previous screenshot. The main area is titled 'Enter input data' with tabs for 'Text' (selected) and 'JSON'. Below this, instructions say 'Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.' There are buttons for 'Download CSV template', 'Browse local files', and 'Search in space'. A large table grid is present, with the first row labeled as 'N (double)', 'P (double)', 'K (double)', 'temperature (double)', 'humidity (double)', 'ph (double)', and 'rainfall (double)'. The table has 5 rows numbered 1 to 5. A note at the bottom left says '0 rows, 7 columns'. On the right side of the table, there is a 'Predict' button. The top right corner of the interface has icons for delete, edit, copy, etc.

Step43: Enter the new values and click on predict

The screenshot shows the 'Enter input data' section of the Watson Studio interface. A red box highlights the first row of a CSV table, which contains the following data:

	N (double)	P (double)	K (double)	temperature (double)	humidity (double)	ph (double)	rainfall (double)
1	30	79	75	18.820	16.10748	8.204862	89.73119
2							
3							
4							
5							
6							
7							

Below the table, it says '1 row, 7 columns'. To the right of the table is a blue 'Predict' button, which is also highlighted with a red box.

Step44: It's predicted label name with 99% confidence.

The screenshot shows the 'Prediction results' section of the Watson Studio interface. On the left, there is a large purple circle with the number '1' in the center, indicating '1 Record'. Below this, there is a legend with a purple square labeled 'chickpea' and a small bar chart showing a distribution. The main area displays a table of prediction results:

	Prediction	Confidence
1	chickpea	99%
2		
3		
4		
5		
6		
7		
8		
9		
10		

To the right of the table is a blue 'Download JSON file' button, which is highlighted with a red box.