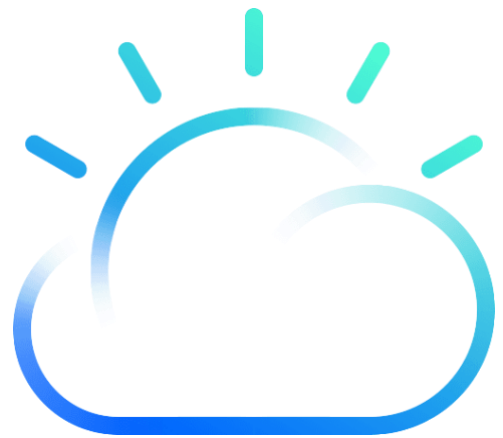


# Hands-on Lab



## Watson Studio

Decision Optimization

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# Introduction

**Watson Studio** provides you with the environment and tools to solve your business problems by collaboratively working with data. You can choose the tools you need to analyze and visualize data, to cleanse and shape data, to ingest streaming data, or to create, train, and deploy machine learning models.

This illustration shows how the architecture of Watson Studio is centered around the project. A project is where you organize your resources and work with data.

## Projects: work with data



With the **Decision Optimization** service, you invoke optimization engines and develop applications to solve complex problems in planning, scheduling, resource management, and other operational areas. You describe a situation as an optimization model, using your data and criteria, and Decision Optimization identifies the best solution. The service is based on a sophisticated analytics technology, called Prescriptive Analytics.

## Objective

In the following lab, you will learn:

- How to create a Watson Studio service in IBM Cloud
- How to create a Decision Optimization service in IBM Cloud
- How to import a Jupyter Notebook into a Watson Studio project and incorporate a Decision Optimization service to solve a business problem

## Pre-Requisites

- An E-mail address to sign up for an IBM Cloud account or use an existing account

# Steps

1. Log in to your IBM Cloud account
2. Create a Decision Optimization service
3. Create a Watson Studio service
4. Create a project in Watson Studio
5. Add an Apache Spark service
6. Copy a Jupyter Notebook
7. Incorporate the Decision Optimization service
8. Run the notebook to view results for a business problem
9. Next steps

## Step 1: Log in to IBM Cloud

Log in to your IBM Cloud account: <https://console.bluemix.net/>



Welcome to IBM Cloud, the home of 170+ unique services. Start building immediately.

Log in

Create a free account

Learn more:

[Pricing](#) [Catalog](#) [Docs](#) [Support](#) [Status](#)

Follow us on

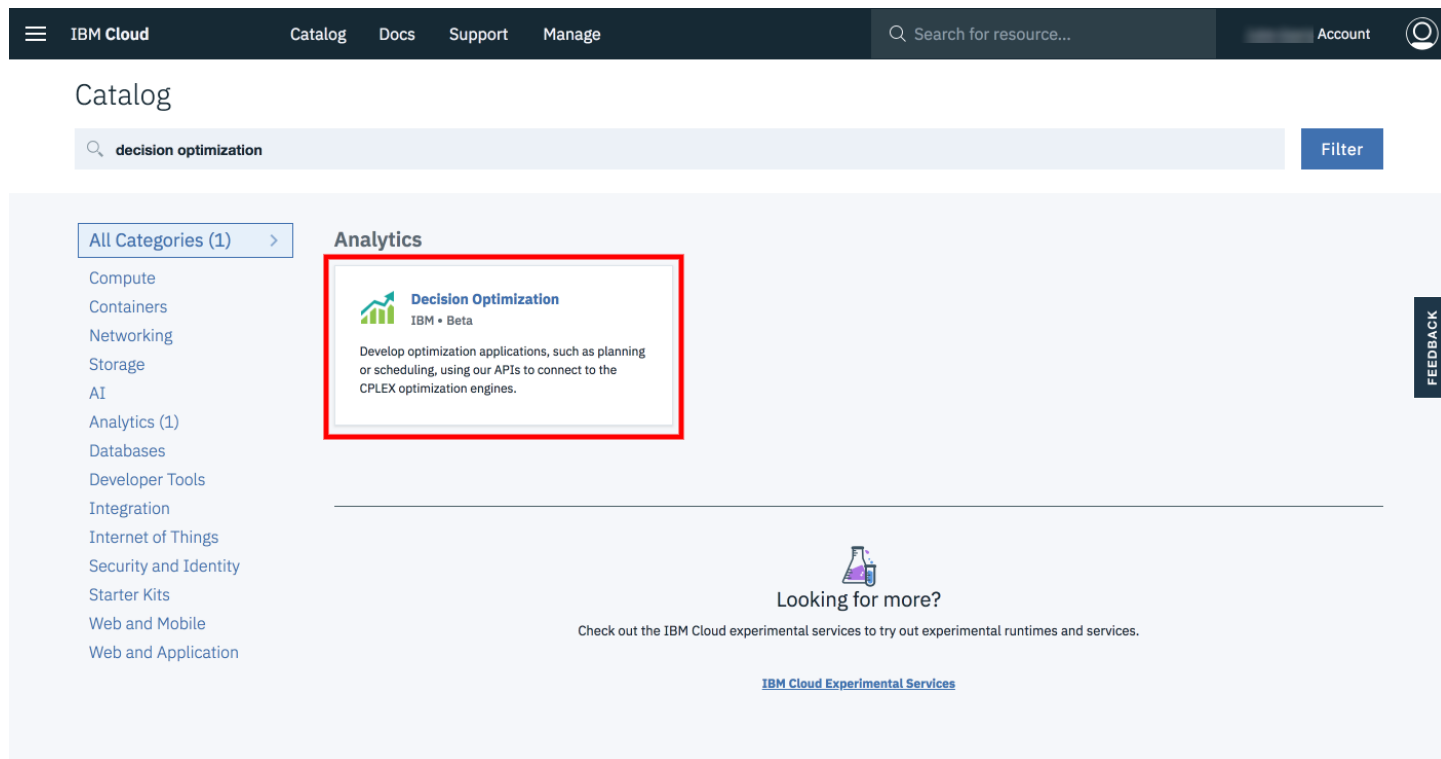


© Copyright IBM Corp. 2014, 2018. All rights reserved.

## Step 2: Create a Decision Optimization service

In this step you'll instantiate a Decision Optimization service to call from your notebook code to solve a business problem.

From the Catalog search for **decision optimization** and click on the **Decision Optimization** tile:



Specify the desired options or accept the defaults and click **Create\***:

*\*depending on your account type you may see Upgrade – if that is the case go ahead and click Upgrade to get a Pay-As-You-Go account or alternatively sign up for a free trial (<http://onboarding-oaas.docloud.ibmcloud.com/software/analytics/docloud/>)*

View all

## Decision Optimization

IBM • Beta

With the Decision Optimization service, you invoke optimization engines and develop applications to solve complex problems in planning, scheduling, resource management, and other operational areas. You describe a situation as an optimization model, using your data and criteria, and Decision Optimization identifies the best solution. The service is based on a sophisticated analytics technology, called Prescriptive Analytics. You can start with an application sample.

[View Docs](#) [Terms](#)

AUTHOR [IBM Decision Optimization](#)  
 PUBLISHED [08/22/2018](#)  
 TYPE [Service](#)  
 LOCATION [United Kingdom, US South](#)

**Service name:**  
Decision Optimization-wq

**Choose a region/location to deploy in:** US South

**Choose an organization:**

**Choose a space:** Projects

### Features

- **Benefit from the state-of-the-art optimization engines**  
Decision Optimization uses the market-leading CPLEX Optimizers to solve real-world optimization problems quickly and efficiently.
- **Simply connect with APIs**  
Use a Decision Optimization API to submit an optimization problem, including mathematical model and data, to the optimization engines. The API returns results to your application. APIs are available in REST, Java, Node.js, and Python.

**Images**

Need Help? [Contact IBM Cloud Support](#)

Estimate Monthly Cost [Cost Calculator](#)

**Create**

The service will instantiate in a few moments. Click the **Service credentials** tab and then **New Credential** in the right-hand pane. In the modal that appears accept the default values and click **Add** to create API credentials for the service and take a note of them – you’ll need them for later use in your Jupyter Notebook:

Getting started

Manage

**Service credentials**

Connections

Data & Analytics /

## Decision Optimization-wq

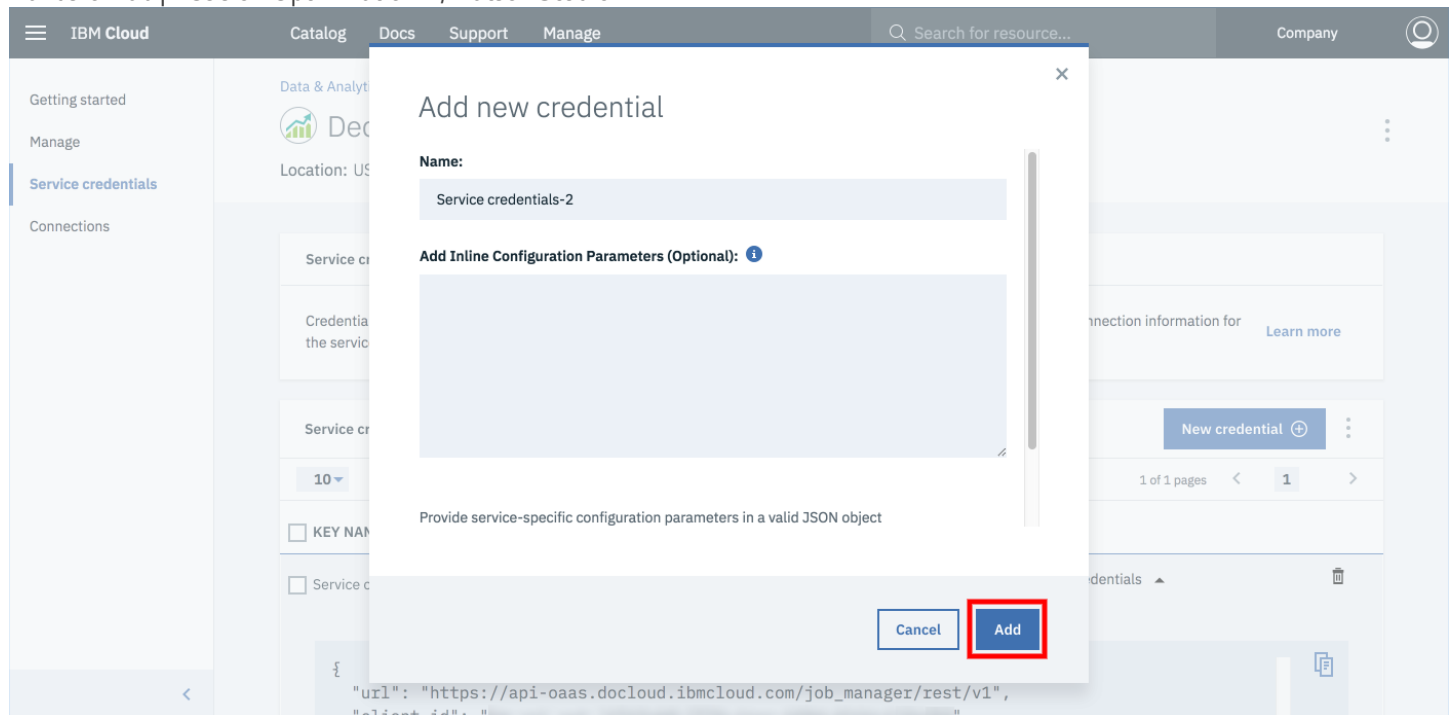
Location: US South Org: Space: Projects

**Service credentials**

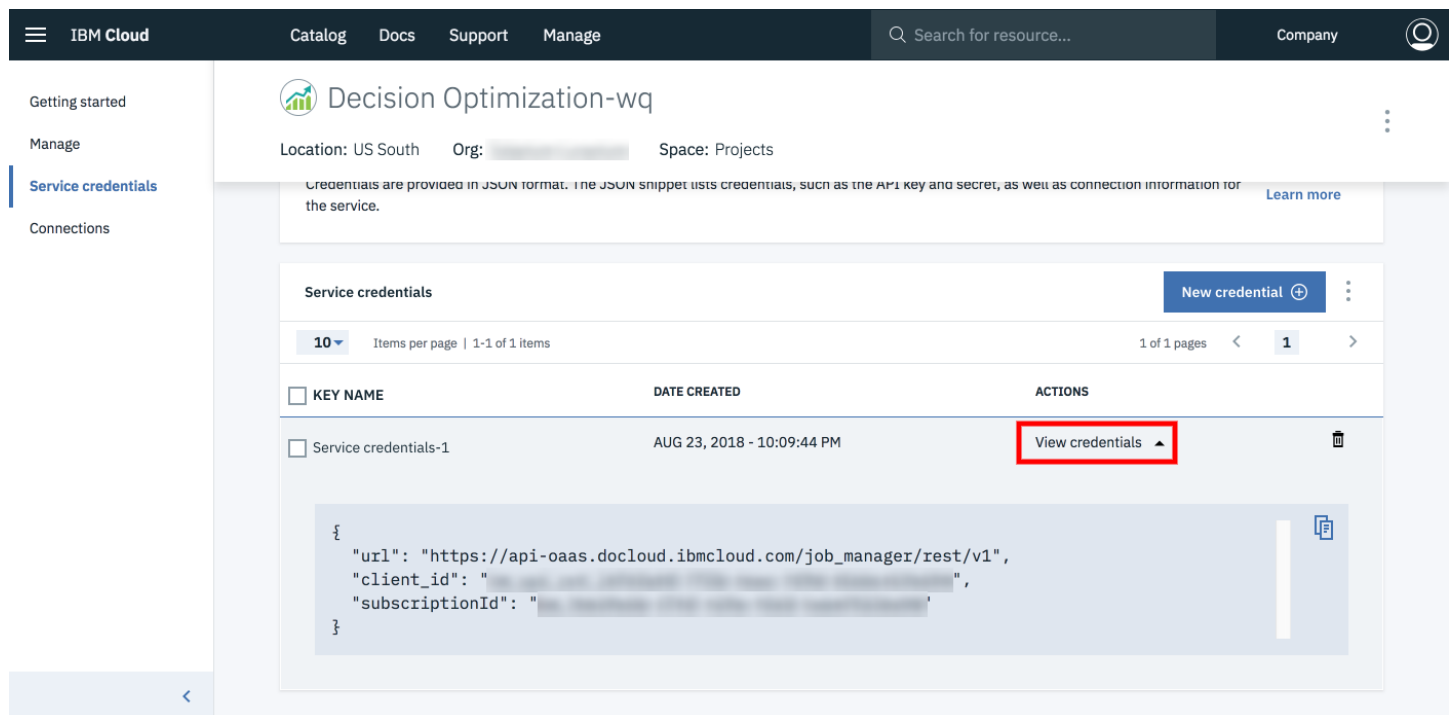
Credentials are provided in JSON format. The JSON snippet lists credentials, such as the API key and secret, as well as connection information for the service. [Learn more](#)

**Service credentials** **New credential**

Click **New credentials** to create a set of credentials for this instance



Click **View credentials** to see the credentials and save them for later use:

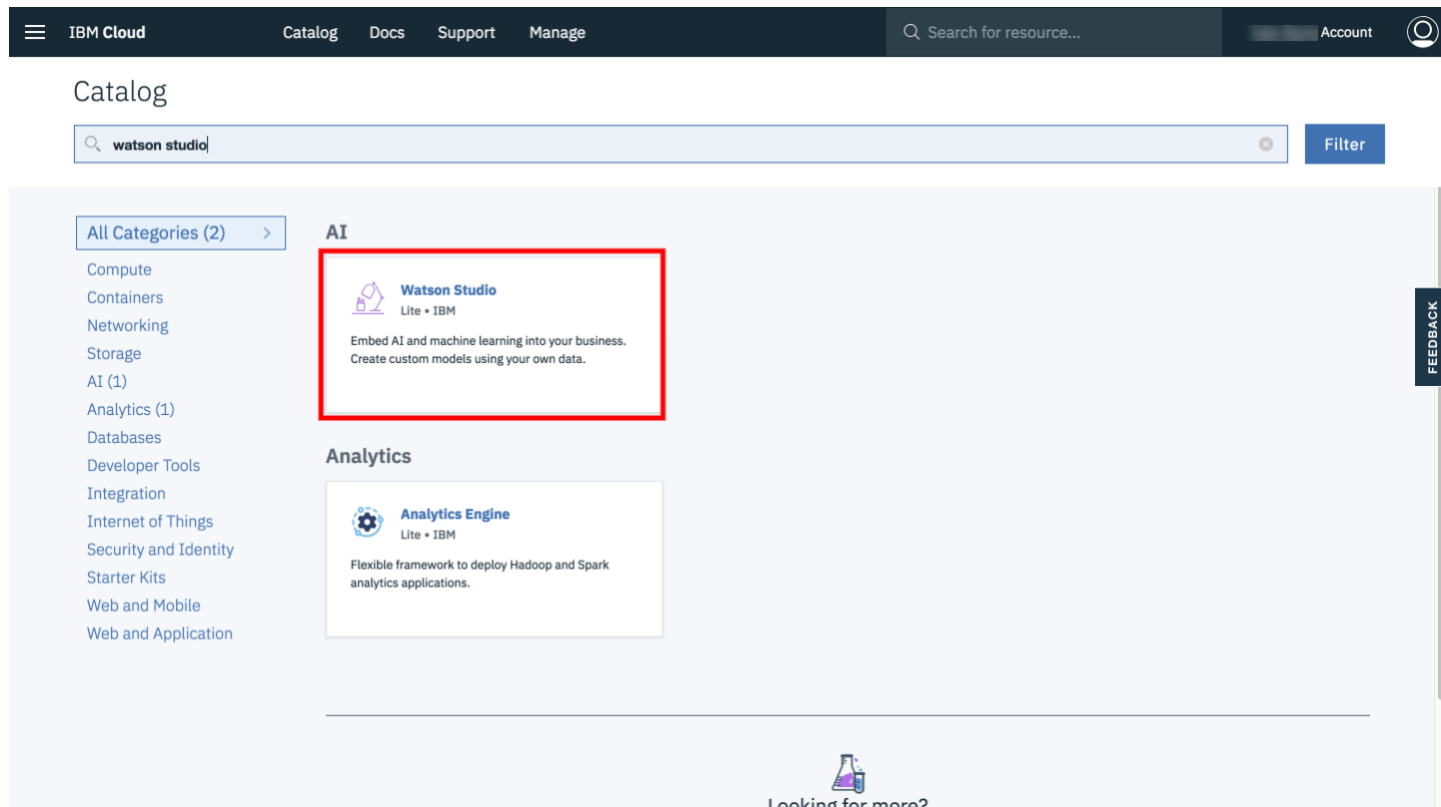




## Step 3: Create a Watson Studio service

In this step you'll instantiate a Watson Studio service – this is the integrated data science environment where you'll run code within a Jupyter Notebook to solve a business problem.

Go to the Catalog and search for **Watson Studio** and click on the **Watson Studio** tile:



Specify the desired options or accept the defaults and click **Create**:

← View all

## Watson Studio

Lite • IBM

Watson Studio democratizes machine learning and deep learning to accelerate infusion of AI in your business to drive innovation. Watson Studio provides a suite of tools and a collaborative environment for data scientists, developers and domain experts.

[View Docs](#) [Terms](#)

AUTHOR [IBM](#)  
PUBLISHED [08/22/2018](#)  
TYPE [Service](#)

**Service name:**  
Watson Studio-i6

**Choose a region/location to deploy in:**  
US South

**Select a resource group:** [?](#)  
default

### Features

- **Use what you know, learn what you don't**  
Start from a tutorial, start from a sample, or start from scratch. Tap into the power of the best of open source (RStudio, Jupyter Notebooks) and Watson services for flexible model creation. Use Python, R, or Scala. Stop downloading and configuring analysis environments and start getting insights.
- **Power on demand**  
Enterprise-scale features on demand. From data exploration and preparation, to enterprise-scale performance. Manage your data, your analytical assets, and your projects in a secured cloud environment.
- **Be a founding member**  
Take advantage of shared data sets, notebooks, models, and tutorials. Share your work with your team and your peers across job roles. Join a vibrant community of data
- **Collaborate for better outcomes**  
Work with your peers on projects to find better solutions together. Share your knowledge and your work easily with visualizations and code - and help fuel the advancement of

Need Help? [Contact IBM Cloud Support](#) [?](#) Estimate Monthly Cost [Cost Calculator](#)

**Create**

The service will instantiate and in a few moments the Watson Studio overview panel will appear. Click **Get Started** to launch the Watson Studio interface:

Manage

Plan

Watson /

## Watson Studio-i6

Resource Group: default Location: US South

# Watson Studio

Welcome to Watson Studio. Let's get started!

**Get Started**

[Documentation](#)  
From getting started to how to's — see what's available.

[Community](#)  
Check out our tutorials, articles, along with sample notebooks and data sets you can use to get going.

Specify the desired options in the modal that appears and then click **Continue**:

The screenshot shows the 'Select Organization and Space' dialog box in the IBM Watson Studio interface. The dialog has a title 'Select Organization and Space' and a subtitle 'Confirm your IBM Cloud organization and space information below. [Or create new organization and space](#)'. It contains four dropdown menus: 'Select IBM Cloud account', 'IBM Cloud Organization', 'IBM Cloud Space', and 'IBM Resource Group'. The 'IBM Resource Group' dropdown is currently set to 'default'. A red rectangle highlights the 'Continue' button at the bottom right of the dialog. In the background, the IBM Watson Studio header is visible with navigation links: IBM Watson, Projects, Community, Services, Manage, Support, Docs. On the right side of the header, there is a notification bell, 'No account selected', and a user profile icon labeled 'SL'. At the bottom right of the page, there is a yellow 'Let's talk' button and a 'Cookie Preferences' link.

Continue

Click Get Started:

The screenshot shows the 'Done!' dialog box in the IBM Watson Studio interface. The dialog has a title 'Done!' with a checkmark icon and a subtitle 'Your Watson apps are ready to use.' A red rectangle highlights the 'Get Started' button at the bottom right of the dialog. In the background, the IBM Watson Studio header is visible with navigation links: IBM Watson, Projects, Community, Services, Manage, Support, Docs. On the right side of the header, there is a notification bell, 'No account selected', and a user profile icon labeled 'SL'. At the bottom right of the page, there is a yellow 'Let's talk' button.

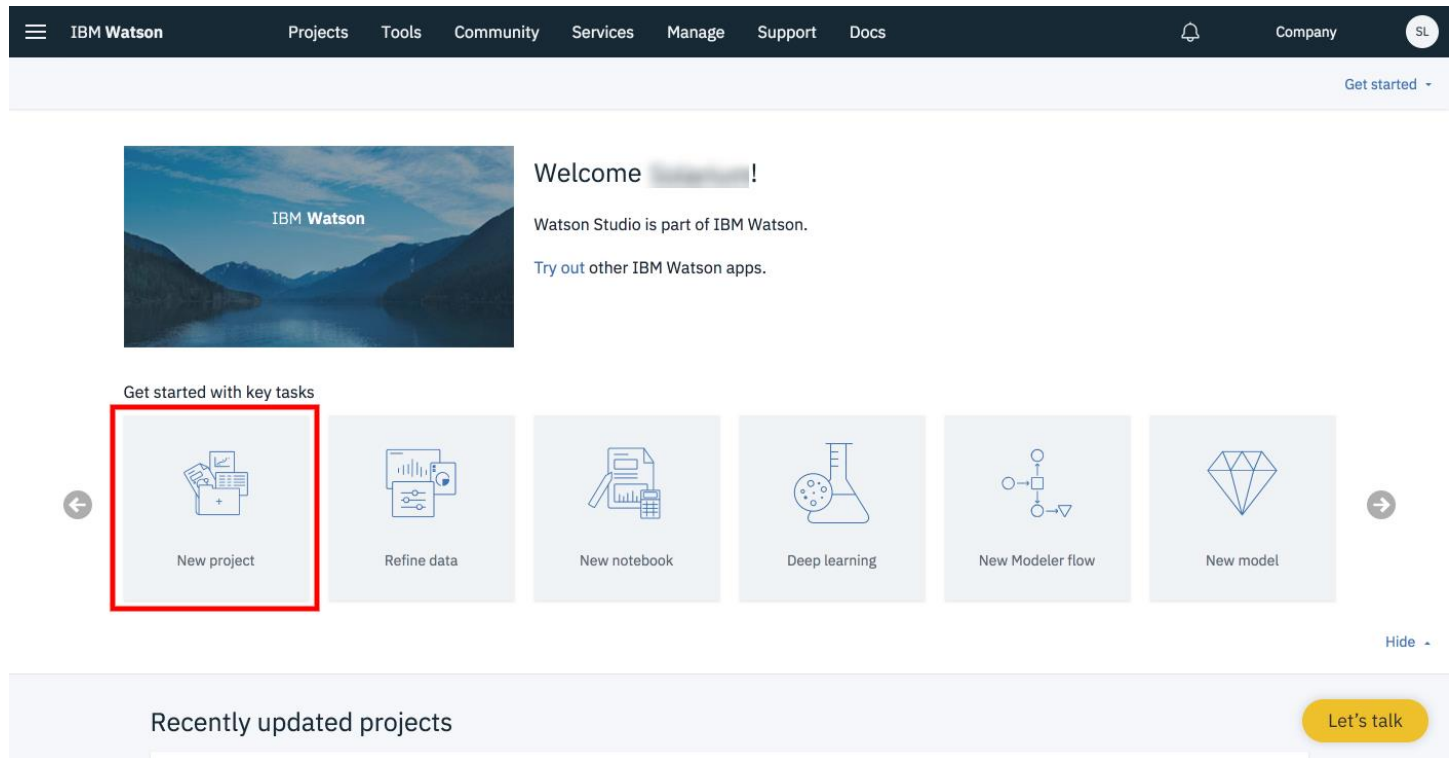
Get Started

The landing view for Watson Studio will appear. Continue on to the next step to create a project.

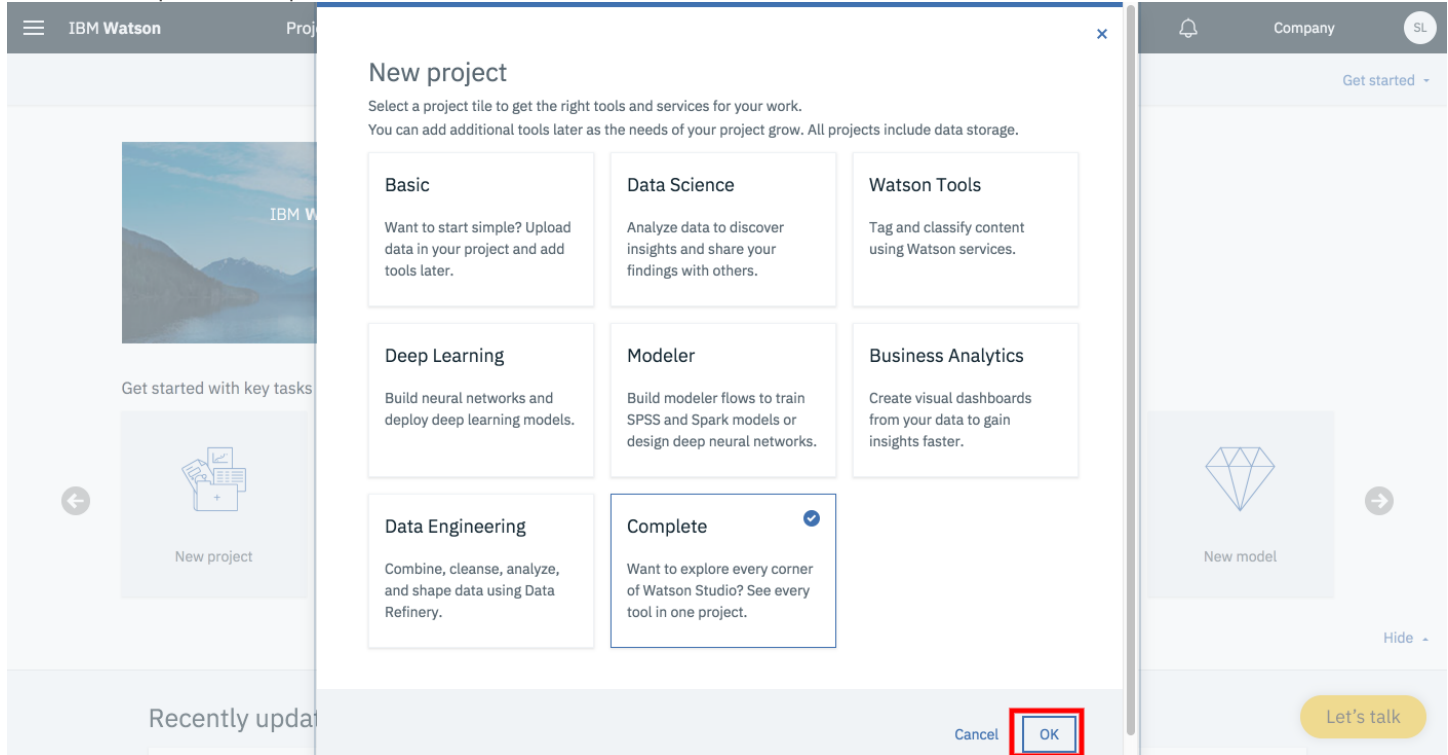
## Step 4: Create a project in Watson Studio

In this step you'll create a project within Watson Studio – projects serve as a unifying unit of governance for your work within this data science environment.

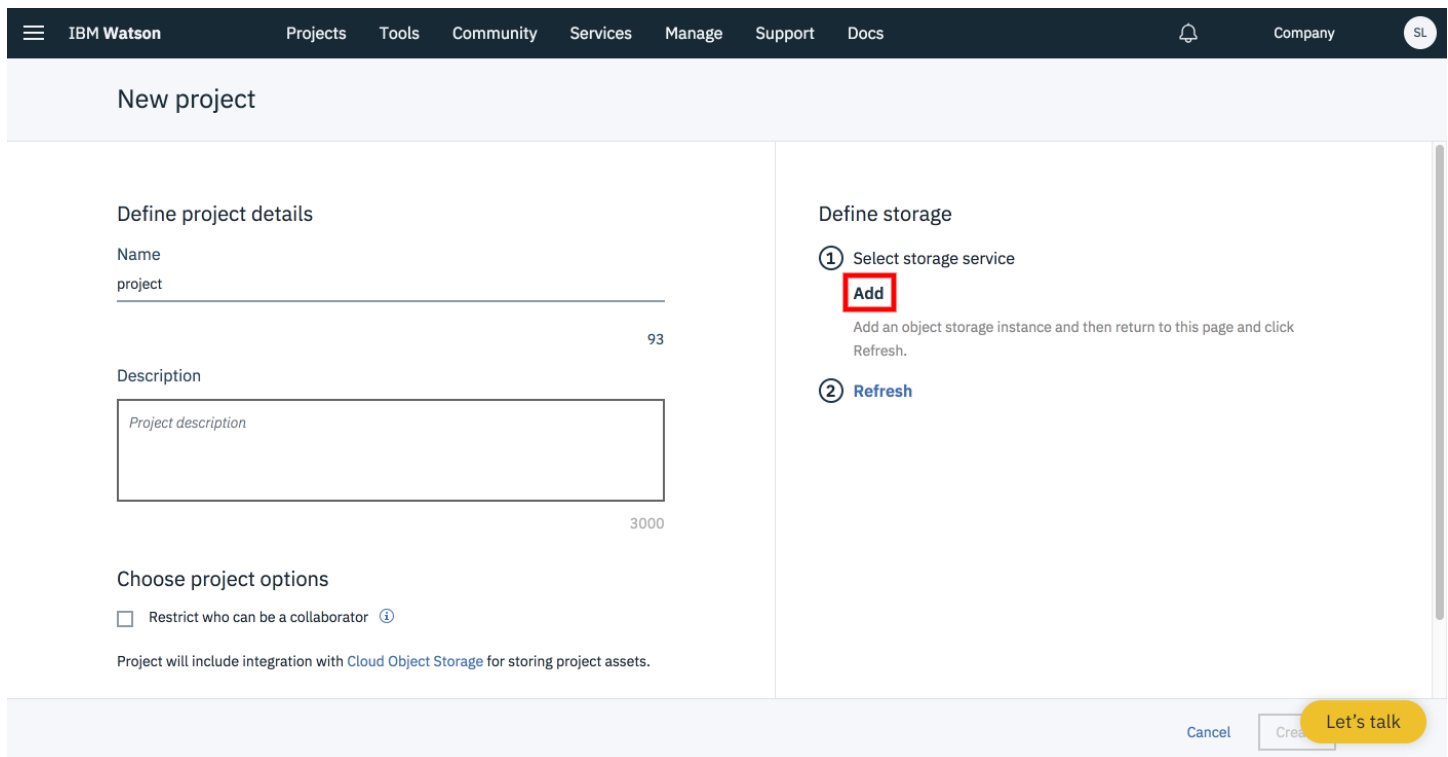
Click **New project**:



Select **Complete** in the New project modal and then **OK**:



In the New project screen that appears you'll need to specify a project Name and then click **Add** within the right-hand Define storage panel to add an instance of Object Storage for use with your Watson Studio environment. The Object Storage instance is where Watson Studio will store your data assets:



The Cloud Object Storage page appears in a new browser tab. Select the **Lite** plan and then click **Create**:

## Cloud Object Storage

Existing New

### Cloud Object Storage

IBM Cloud Object Storage is a highly scalable cloud storage service, designed for high durability, resiliency and security. Store, manage and access your data via our self-service portal and RESTful APIs. Connect applications directly to Cloud Object Storage use other IBM Cloud Services with your data.

#### Features

##### Storage for the IBM Cloud

IBM Cloud Object Storage provides unstructured data storage for cloud applications. Libraries and SDKs support a common set of S3 API functions for connecting new applications to scalable cloud storage and integrating your data into other services on the IBM Watson and Cloud Platform.

##### IAM Policies - Bucket level access management

IBM Identity and Access Management (IAM) integration allows for granular access control at the bucket level using role-based policies.

##### Encryption management

All data is encrypted at-rest and in-flight by default. Keys are automatically managed by default, but can optionally be self-managed or managed using IBM Key Protect\*. (\*Key Protect is only available for buckets created in the US South (Dallas) and EU GB (London) regions.)

##### Regional and Cross Region resiliency options

Select the best resiliency option for your data. Choose "Cross Region" to store unstructured data across three regions, or choose "Regional" resiliency to store your data within a single region.

##### Data storage classes for Active, Less Active, Archive and Dynamic workloads

Choose storage classes for frequently accessed data, occasionally accessed data and long-term data retention with Standard, Vault, and Cold Vault. Or, choose Flex class for dynamic data access needs that fluctuate month to month.

##### Lite and pay-as-you-go plans

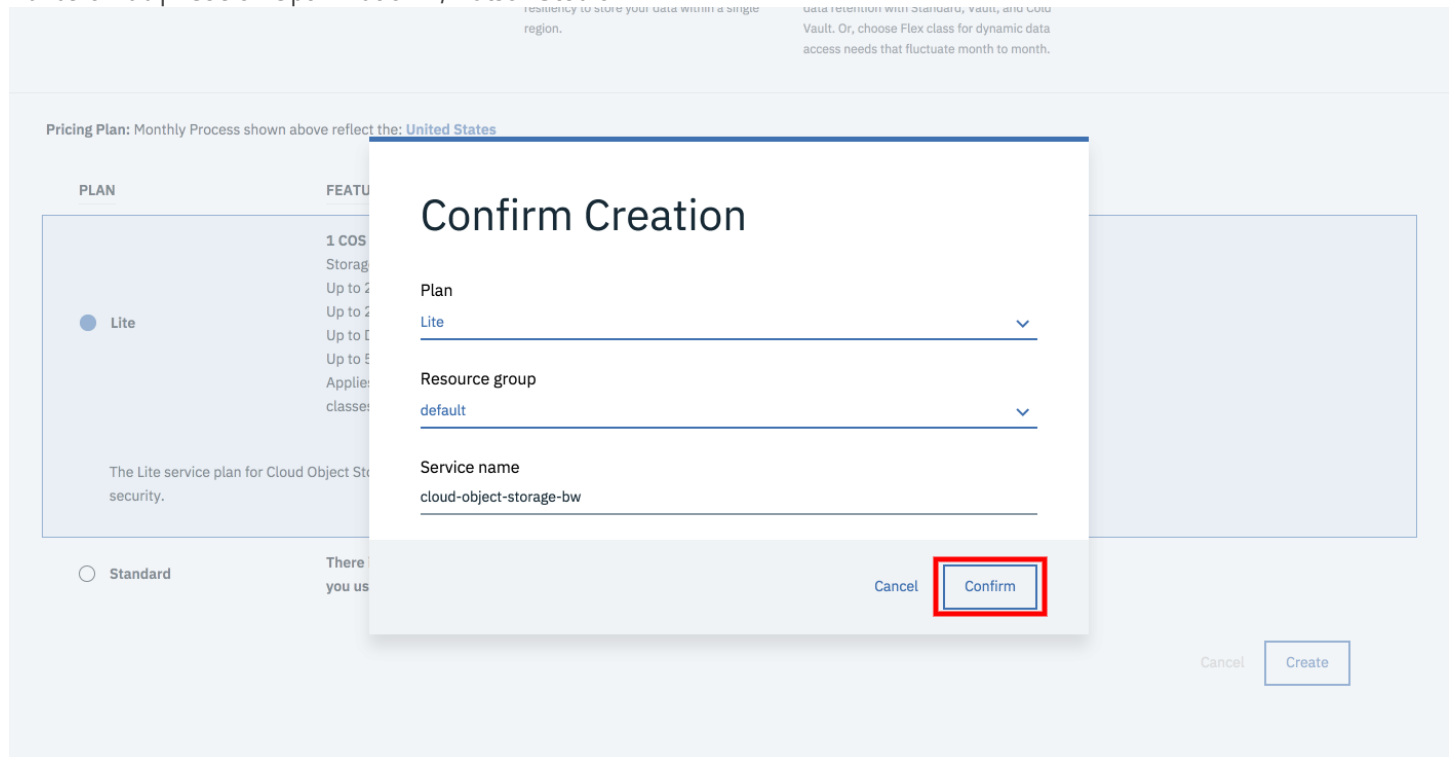
Pricing Plan: Monthly Process shown above reflect the: [United States](#)

| PLAN                                  | FEATURES  | PRICING |
|---------------------------------------|---|---------|
| <input checked="" type="radio"/> Lite | <b>1 COS Service Instance</b><br>Storage up to 25 GB/mo.<br>Up to 20,000 GET requests/mo.<br>Up to 2,000 PUT requests/mo.<br>Up to Data Retrieval 10 GB/mo.<br>Up to 5GB Public Outbound<br>Applies to aggregate total across all storage bucket classes<br><br>The Lite service plan for Cloud Object Storage includes Regional and Cross Regional resiliency, flexible data classes, and built in security. | Free    |
| <input type="radio"/> Standard        | There is no minimum fee, so you pay only for what you use.  | -       |

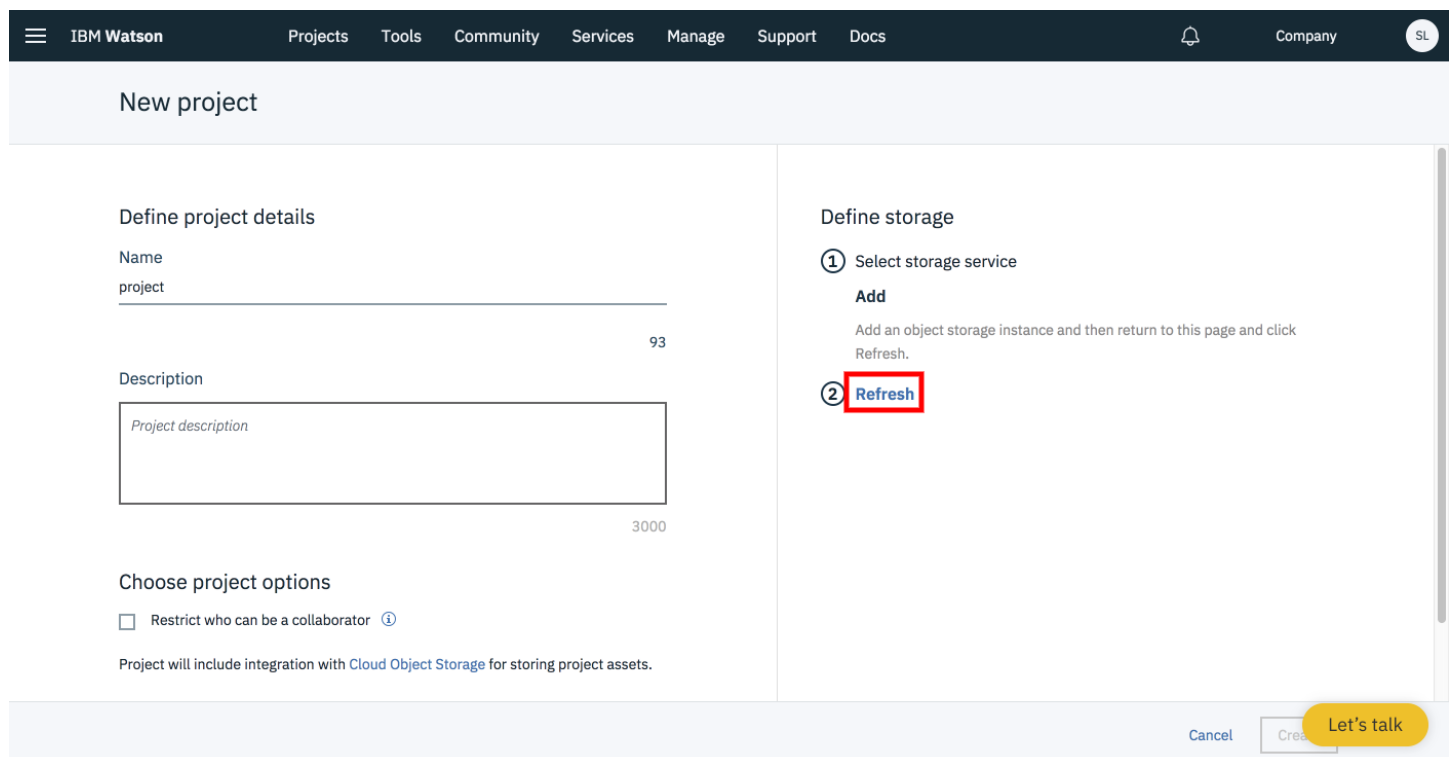
Cancel

Create

Click **Confirm** in the Confirm Creation modal that appears:



The tab should automatically close. In the New project view click the **Refresh** button:



The Object Storage instance will appear specified as the Storage value. Click **Create** to create the project:

IBM Watson

ProjectsToolsCommunityServicesManageSupportDocs

CompanySL

## New project

### Define project details

Name

project

93

Description

Project description

3000

### Choose project options

☐ Restrict who can be a collaborator ⓘ

Project will include integration with [Cloud Object Storage](#) for storing project assets.

### Storage

cloud-object-storage-bw

Cancel

Create

You'll now see the landing page for the new project:

IBM Watson

ProjectsToolsCommunityServicesManageSupportDocs

CompanySL

My Projects / project

+ Add to project

InfoRefreshHelpGridShare

OverviewAssetsEnvironmentsBookmarksDeploymentsAccess ControlSettings

project

Last Updated:

[Readme](#)

0Assets

0Bookmarks

1Collaborators

#### Date created

#### Description

No description available

#### Storage

0% of 25 GB used

#### Collaborators

[View all \(1\)](#)

SL Admin

#### Bookmarks

[View all \(0\)](#)

#### Recent activity

Alerts related to this project will show here when the project is active.

Let's talk



## Step 5: Add an Apache Spark service

In this step you'll add an Apache Spark service for use as a runtime for solving a business problem specified in the notebook you'll copy in the next step.

Click the **Settings** tab for your project and then scroll down to the Associated services section. Click **Add service** and select **Spark**:

The screenshot shows the IBM Watson Studio interface. At the top is a dark navigation bar with the IBM Watson logo and tabs for Projects, Tools, Community, Services, Manage, Support, and Docs. Below this is a breadcrumb trail 'My Projects / project' and a '+ Add to project' button. The main content area is divided into sections: 'Associated services', 'Access tokens', and 'Connect to a GitHub repository'. The 'Associated services' section has a table with columns NAME, SERVICE TYPE, PLAN, and ACTION. Below the table is a message: 'You don't have any Associated services yet.' To the right of this section is a '+ Add service' button with a dropdown menu. The dropdown menu is open, showing options: Amazon EMR Spark, IBM Analytics Engine, Spark (highlighted with a red box), Streaming Analytics, Dashboard, and Watson. The 'Access tokens' section has a table with columns NAME, ROLE, CREATED, LAST USED, and ACTIONS, with a message: 'You don't have any Access tokens yet.' The 'Connect to a GitHub repository' section has a text input field for 'Repository URL' with a placeholder 'https://github.com/owner/repository-name', a 'Connect' button, and a 'Let's talk' button.

In the Apache Spark page that appears select **Lite** for the Plan and then click **Create**:

## Apache Spark

Existing New

### Apache Spark

Apache Spark is an open source cluster computing framework optimized for extremely fast and large scale data processing, which you can access via the newly integrated notebook interface IBM Analytics for Apache Spark. You can connect to your existing data sources or take advantage of the on-demand big data optimization of Object Storage. Spark plans are based on the maximum number of executors available to process your analytic jobs. Executors exist only as long as they're needed for processing, so you're charged only for processing done.

### Features

#### Incredibly Fast

Apache Spark delivers 100x the performance of Apache Hadoop for certain workloads because of its advanced in-memory computing engine.


#### Easy to Use and Powerful

Apache Spark's Streaming and SQL programming models backed by MLlib and GraphX make it incredibly easy for developers and data scientists to build apps that exploit machine learning and graph analytics. Because the service is 100% compatible with Apache Spark, developers can build their apps and run them against the IBM managed service to benefit from operational, maintenance, and hardware excellence.

#### Convenient Data Storage

Object Storage enables a convenient way to upload your data from a file for immediate use by your Spark instance. You can set up Object Storage directly from the Spark service interface.

Pricing Plan: Monthly Process shown above reflect the: [United States](#)

| PLAN   | FEATURES          | PRICING |
|--|-------------------|---------|
|  Lite | 2 Spark Executors | Free    |
| An entry level plan to run programs using up to 2 Spark executors                      |                   |         |

Cancel

Create

Specify the desired values in the Confirm Creation modal that appears and then click **Confirm**:

### Apache Spark

Apache Spark is an open source cluster computing framework optimized for extremely fast and large scale data processing, which you can access via the newly integrated notebook interface. You can connect to your data sources or take advantage of the on-demand big data storage. Spark plans are based on the maximum number of executors available to process your analytic jobs. As long as they're needed for processing, so you're not paying for processing done.

### Features

Interface TPM

Incredibly Fast

Easy to Use and Powerful

Convenient Data Storage

Pricing Plan: Monthly Process shown above reflects

| PLAN                                  | FEATURES          |
|---------------------------------------|-------------------|
| <input checked="" type="radio"/> Lite | 2 Spark executors |

An entry level plan to run programs using

## Confirm Creation

Organization:

Plan  
Lite

Space  
Projects

Service name  
spark-it

Cancel Confirm

Cancel Create

You are now ready to add a notebook to your project.

## Step 6: Copy a Jupyter Notebook

In this step you'll copy an existing public Jupyter Notebook into your project.

Navigate to the Community by clicking the **Community** tab within the top menu bar. The Community is a resource of tutorials, articles, sample notebooks, and data sets to get you quickly up and running with Watson Studio. Once there apply the **Notebook** filter and type **decision optimization** in the search bar to narrow the results further:

The screenshot shows the IBM Watson Studio Community interface. The top navigation bar includes 'IBM Watson', 'Projects', 'Tools', 'Community' (selected), 'Services', 'Manage', 'Support', and 'Docs'. A search bar in the top right contains 'decision optimization'. On the left sidebar, under 'All filters', the 'Notebook' filter is selected. The main content area displays 'Search results (8)' with a 'Sort by: Most Related' dropdown. Six notebook tiles are visible, each with a title, author (IBM), date (Mar 20, 2018), and topic. The tiles are: 'Finding optimal locations of new store using...', 'House Building with worker skills', 'Maximize oil company profits', 'Model a Golomb Ruler', 'Sudoku', and 'The Nurse Assignment Problem'. A 'Let's talk' button is in the bottom right corner.

| Tile Title                                      | Author | Date         | Topic                | Interactions         |
|---|--------|--------------|----------------------|----------------------|
| Finding optimal locations of new store using... | IBM    | Mar 20, 2018 | Economy & Business   | 12 likes, 1 bookmark |
| House Building with worker skills               | IBM    | Mar 20, 2018 | Society              | 5 likes, 1 bookmark  |
| Maximize oil company profits                    | IBM    | Mar 20, 2018 | Economy & Business   | 28 likes, 1 bookmark |
| Model a Golomb Ruler                            | IBM    | Mar 20, 2018 | Science & Technology |                      |
| Sudoku  | IBM    | Mar 20, 2018 | Leisure              |                      |
| The Nurse Assignment Problem                    | IBM    | Mar 20, 2018 | Health               |                      |

Scroll down and select the **Use decision optimization to schedule league...** tile:

The screenshot shows the IBM Watson Studio Community interface. At the top is a navigation bar with links: IBM Watson, Projects, Tools, Community, Services, Manage, Support, Docs, a notification bell, Company, and a user profile icon (SL). Below the navigation bar is a 'Create new' button. The main content area displays a grid of notebooks. The first row includes 'Economy & Business' (12 likes), 'Society' (5 likes), and 'Economy & Business' (28 likes). The second row includes 'Model a Golomb Ruler' (5 likes), 'Sudoku' (7 likes), and 'The Nurse Assignment Problem' (7 likes). The third row includes 'The Unit Commitment Problem' (9 likes) and the notebook 'Use decision optimization to schedule league...' which is highlighted with a red rectangular box. This highlighted notebook has 9 likes and is categorized under 'Leisure'. A 'Let's talk' button is visible in the bottom right corner of the notebook grid. At the bottom of the page are links for Blog, Docs, Contact, Privacy, and Terms of Use.

An overview of the notebook will appear. Click the **Copy** icon in the top right-hand corner to copy the notebook to your project:

The screenshot shows the overview page for the notebook 'Use decision optimization to schedule league games'. The top navigation bar is identical to the previous screenshot. Below the navigation bar, the notebook title is displayed. To the right of the title are icons for bookmark, likes (9), a 'Copy' icon (highlighted with a red box), share, and download. The main content area includes a description: 'This tutorial includes everything you need to set up decision optimization engines, build mathematical programming models, and arrive at a good working schedule for a sports league's games.' It also lists metadata: TOPIC: Leisure, LAST UPDATED: Mar 20, 2018, CREATED: Mar 02, 2017, and PUBLISHER: IBM. A 'Sign Up' button is present. Below this is a section titled 'Use Decision Optimization to help a sports league schedule its games' with a detailed description of the tutorial's goals and prerequisites. It mentions that the notebook is part of 'Prescriptive Analytics for Python' and requires a valid subscription to 'Decision Optimization on Cloud'. A 'Table of contents' section lists two links: 'Describe the business problem' and 'How decision optimization (prescriptive analytics) can help'. A 'Let's talk' button is in the bottom right corner.

The New Notebook view will appear. Select the previously-created spark instance from the **Select runtime** drop-down and click **Create Notebook**:

IBM Watson Projects Tools Community Services Manage Support Docs Company SL

My Projects / New Notebook

New notebook: Use decision optimization to schedule league games

Project  
project

Add the notebook to an existing project.

Select runtime\* Includes notebook environments ⓘ  
spark-it

Associate this notebook with the runtime service of your choice.

Cancel Create Notebook

The copied notebook will appear in your project. This notebook contains code that models a decision optimization problem around scheduling a league of games:

IBM Watson Projects Tools Community Services Manage Support Docs Company SL

My Projects / project / Use decision optimization to sche...

File Edit View Insert Cell Kernel Help Not Trusted | Python 2 with Spark 2.1

Want to do more?  
Try out this notebook with your free trial of IBM Watson Studio. Sign Up

### Use Decision Optimization to help a sports league schedule its games

This tutorial includes everything you need to set up decision optimization engines, build mathematical programming models, and arrive at a good working schedule for a sports league's games.

When you finish this tutorial, you'll have a foundational knowledge of *Prescriptive Analytics*.

This notebook is part of [Prescriptive Analytics for Python](#).

It requires a valid subscription to **Decision Optimization on Cloud**. Try it for free [here](#).

This notebook runs on Python 2 with Spark 2.1.

Table of contents:

- Describe the business problem
- How decision optimization (prescriptive analytics) can help
- Use decision optimization
  - Step 1: Download the library
  - Step 2: Set up the engines
  - Step 3: Model the Data

## Step 7: Incorporate the Decision Optimization service

In this step you'll insert your Decision Optimization credentials into the appropriate cell within the notebook in order to make use of your Decision Optimization instance.

Scroll down to cell 2 of the notebook and enter your Decision Optimization credentials on the appropriate lines as specified by the comments:

The screenshot shows the IBM Watson Studio interface. The top navigation bar includes 'IBM Watson', 'Projects', 'Tools', 'Community', 'Services', 'Manage', 'Support', 'Docs', a notification bell, 'Company', and a user profile icon labeled 'SL'. Below this is a breadcrumb trail: 'My Projects / project / Use decision optimization to sche...'. The main toolbar contains icons for file operations, a 'Run' button, and a 'Format' dropdown menu set to 'Code'. The notebook content is divided into two sections:

**Step 2: Set up the prescriptive engine**

- Subscribe to the [Decision Optimization on Cloud solve service](#).
- Get the service URL and your personal API key (Client\_id) and enter your credentials here:

Below the instructions is a code cell labeled 'In [2]:'. The code is as follows:

```
from docplex.cp.model import *
SVC_URL = "" #ENTER YOUR URL HERE
SVC_KEY = "" #ENTER YOUR KEY (Client_id) HERE
```

The code cell is highlighted with a red rectangular box.

**Step 3: Model the data**

In this scenario, the data is simple. There are eight teams in each division, and the teams must play each team in the division once and each team outside the division once.

Use a Python module, *Collections*, which implements some data structures that will help solve some problems. *Named tuples* helps to define meaning of each position in a tuple. This helps the code be more readable and self-documenting. You can use named tuples in any place where you use tuples.

In this example, you create a *namedtuple* to contain information for points. You are also defining some of the parameters.

Below the text is a code cell labeled 'In [3]:'. The code is as follows:

```
# Teams in 1st division
TEAM_DIV1 = ["Baltimore Ravens", "Cincinnati Bengals", "Cleveland Browns", "Pittsburgh Steelers", "Houston Texans",
             "Indianapolis Colts", "Jacksonville Jaguars", "Tennessee Titans", "Buffalo Bills", "Miami Dolphins",
             "New England Patriots", "New York Jets", "Denver Broncos", "Kansas City Chiefs", "Oakland Raiders",
             "San Diego Chargers"]

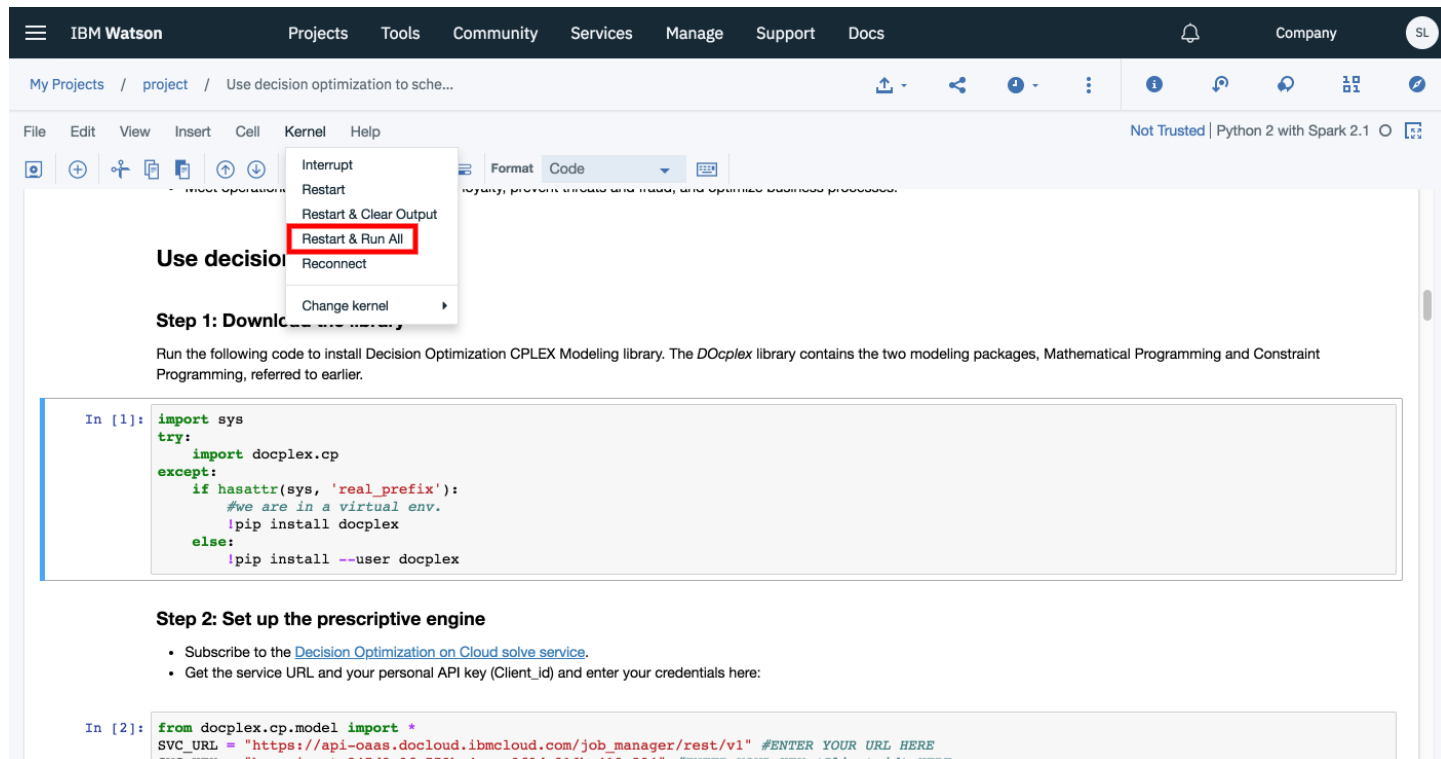
# Teams in 2nd division
TEAM_DIV2 = ["Chicago Bears", "Detroit Lions", "Green Bay Packers", "Minnesota Vikings", "Atlanta Falcons",
             "Carolina Panthers", "New Orleans Saints", "Tampa Bay Buccaneers", "Dallas Cowboys", "New York Giants",
             "Philadelphia Eagles", "Washington Redskins", "Arizona Cardinals", "San Francisco 49ers",
             "Seattle Seahawks", "St. Louis Rams"]
```

Now you're finally ready to run a decision optimization problem to solve a business problem!

## Step 8: Run the notebook

In this step you'll run the notebook cells and see the outputs to solve a business problem.

In the **Kernel** menu select **Restart & Run All** to run all cells of the notebook:



The screenshot shows the IBM Watson Studio web interface. At the top, there's a navigation bar with 'IBM Watson' and various menu items like 'Projects', 'Tools', 'Community', 'Services', 'Manage', 'Support', and 'Docs'. Below this, a breadcrumb trail shows 'My Projects / project / Use decision optimization to sche...'. The main toolbar includes 'File', 'Edit', 'View', 'Insert', 'Cell', 'Kernel', and 'Help'. The 'Kernel' menu is open, displaying options: 'Interrupt', 'Restart', 'Restart & Clear Output', 'Restart & Run All' (highlighted with a red box), 'Reconnect', and 'Change kernel'. The notebook content is visible in the background, showing a title 'Use decision...', a section 'Step 1: Downl...', and a code cell with Python code for installing the docplex library. Below that is 'Step 2: Set up the prescriptive engine' with instructions to subscribe to a service and get API credentials. A second code cell is partially visible at the bottom.

```
In [1]: import sys
try:
    import docplex.cp
except:
    if hasattr(sys, 'real_prefix'):
        #we are in a virtual env.
        !pip install docplex
    else:
        !pip install --user docplex
```

**Step 2: Set up the prescriptive engine**

- Subscribe to the [Decision Optimization on Cloud solve service](#).
- Get the service URL and your personal API key (Client\_id) and enter your credentials here:

```
In [2]: from docplex.cp.model import *
SVC_URL = "https://api-oas.doccloud.ibmcloud.com/job_manager/rest/v1" #ENTER YOUR URL HERE
CVC_KEY = "ba api key 2722a8f-777b-4a8a-8f8d-816a410a58d1" #ENTER YOUR KEY (Client_id) HERE
```

Confirm the run by clicking **Restart and Run All Cells**:



The screenshot shows the IBM Watson Studio interface. At the top is a dark navigation bar with the IBM Watson logo and various menu items: Projects, Tools, Community, Services, Manage, Support, and Docs. On the right of this bar are a notification bell, a 'Company' link, and a user profile icon labeled 'SL'. Below the navigation bar is a breadcrumb trail: 'My Projects / project / Use decision optimization to sche...'. The main workspace contains a Jupyter notebook with a menu bar (File, Edit, View, Insert, Cell, Kernel, Help) and a toolbar with icons for adding, deleting, and running cells. A modal dialog is open in the center, titled 'Restart kernel and re-run the whole notebook?'. The dialog text asks: 'Are you sure you want to restart the current kernel and re-execute the whole notebook? All variables and outputs will be lost.' At the bottom of the dialog are two buttons: 'Continue Running' and 'Restart and Run All Cells', with the latter highlighted by a red rectangle. The notebook content includes a code cell with Python code for installing 'docplex' and a text cell with instructions for setting up the prescriptive engine, including links to the 'Decision Optimization on Cloud solve service' and instructions to get the service URL and API key.

IBM Watson

Projects Tools Community Services Manage Support Docs

My Projects / project / Use decision optimization to sche...

File Edit View Insert Cell Kernel Help

Not Trusted | Python 2 with Spark 2.1

Restart kernel and re-run the whole notebook?

Are you sure you want to restart the current kernel and re-execute the whole notebook? All variables and outputs will be lost.

Continue Running Restart and Run All Cells

**Use decision optimization**

**Step 1: Download the library**

Run the following code to install Decision Optimization on Cloud solve service, referred to earlier.

```
In [1]: import sys
try:
    import docplex.cp
except:
    if hasattr(sys, 'real_prefix'):
        #we are in a virtual env.
        !pip install docplex
    else:
        !pip install --user docplex
```

**Step 2: Set up the prescriptive engine**

- Subscribe to the [Decision Optimization on Cloud solve service](#).
- Get the service URL and your personal API key (Client\_id) and enter your credentials here:

```
In [2]: from docplex.cp.model import *
SVC_URL = "https://api-oas.doccloud.ibmcloud.com/job_manager/rest/v1" #ENTER YOUR URL HERE
SVC_KEY = "bm api key 34743a8f-772b-4aaa-8f8d-91f6a18a58d4" #ENTER YOUR KEY (Client_id) HERE
```

Watch as each cell executes in the notebook. The end result is the solving of a decision optimization problem.

## Step 9: Next steps

Congratulations! You've now completed this lab and have successfully run a notebook in Watson Studio that makes use of the Decision Optimization service to solve a business problem. This is just the tip of the iceberg in terms of what you can accomplish with Watson Studio and Decision Optimization for your business. For more information on how to incorporate these tools to realize value for your business please consult the links found below:

<https://console.bluemix.net/docs/services/DecisionOptimization/DecisionOptimization.html>

<https://developer.ibm.com/doccloud/documentation/doccloud/>

<https://developer.ibm.com/doccloud/>

<https://dataplatform.cloud.ibm.com/docs/content/getting-started/overview-ws.html>

<https://dataplatform.cloud.ibm.com/docs/content/DO/DOinDSX.html>