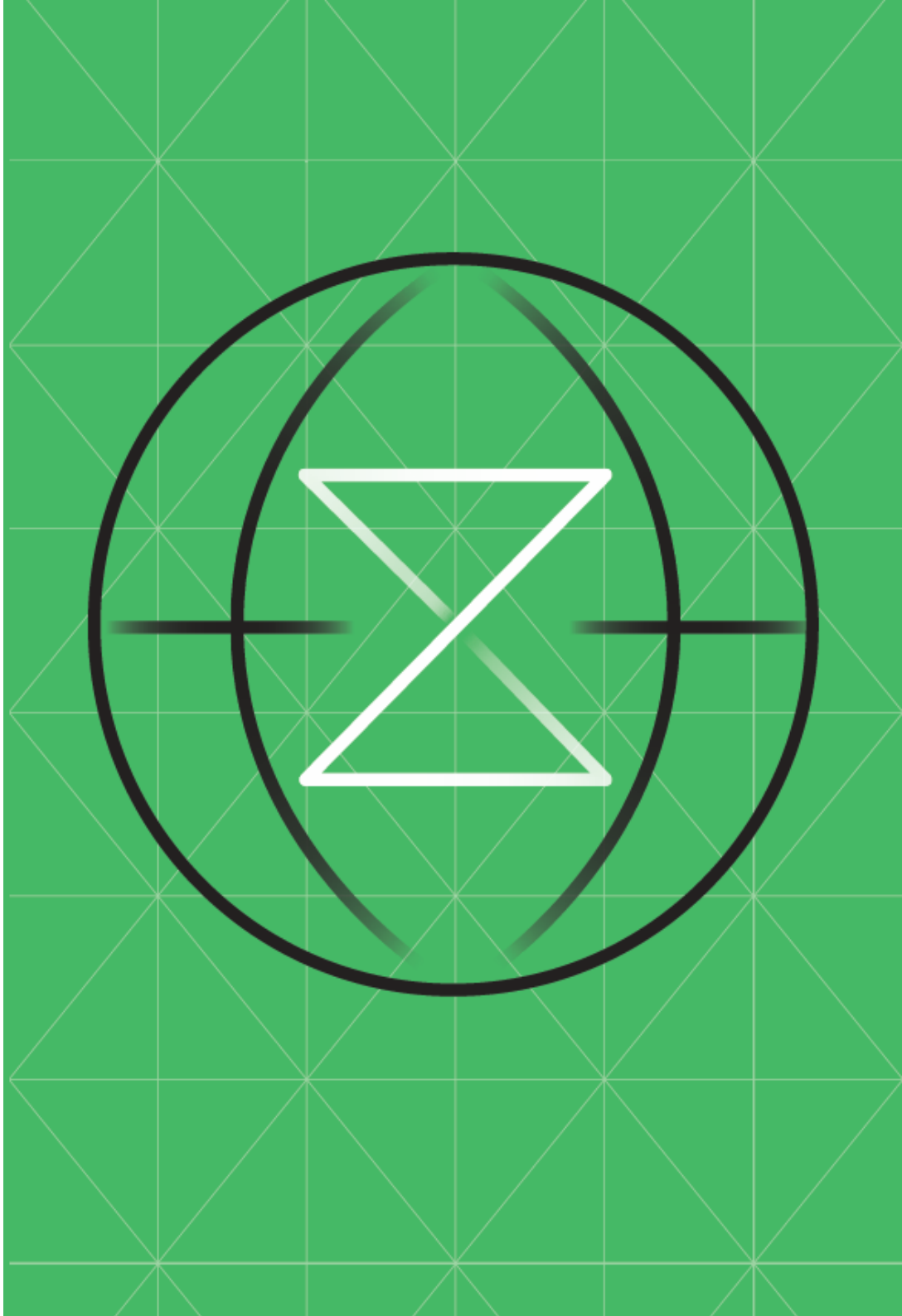
Extended

240226-0758

MLZ1

Machine Learning on IBM Z



Z Xplore

DIP YOUR TOE IN AI/ML

Build a scoring model on LinuxONE Community Cloud

The Challenge

In April 2022 IBM launched the z16 system, with the IBM Telum Processor – this includes technology for accelerating “inferencing” – executing real-time scoring and prediction services using live data. The path to creating these models can start anywhere that supports data science tools, and you will use the LinuxONE environment to build, train, and export such a model

Before You Begin

You will be using the same platform as the LNX1 and LNX2 challenges.

If you have an active registration and virtual server you can use that; otherwise, register for an account and create a new virtual server

Investment

Steps	Duration
14	90 minutes

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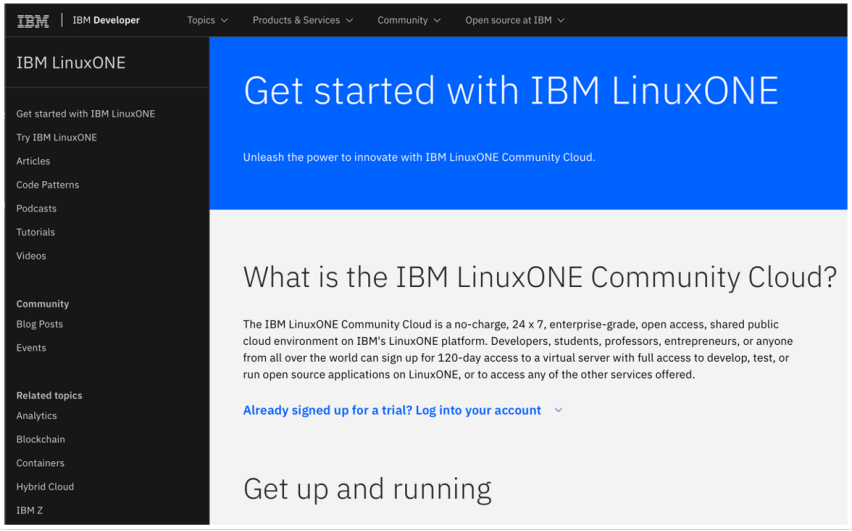
1 GET YOUR VIRTUAL MACHNE



You will have been to the Linux Community Cloud (L1CC) already if you have previously completed the LNX1 and/or LNX2 challenges. If it is all new to you, Then follow this link to request your own virtual system:

https://github.com/linuxone-community-cloud/technical-resources/blob/master/faststart/deploy-virtual-server.md

You will follow the instructions in this guide pretty closely, but please read ahead through steps 2-4 here, as they contain information specific to IBM Z Xplore.

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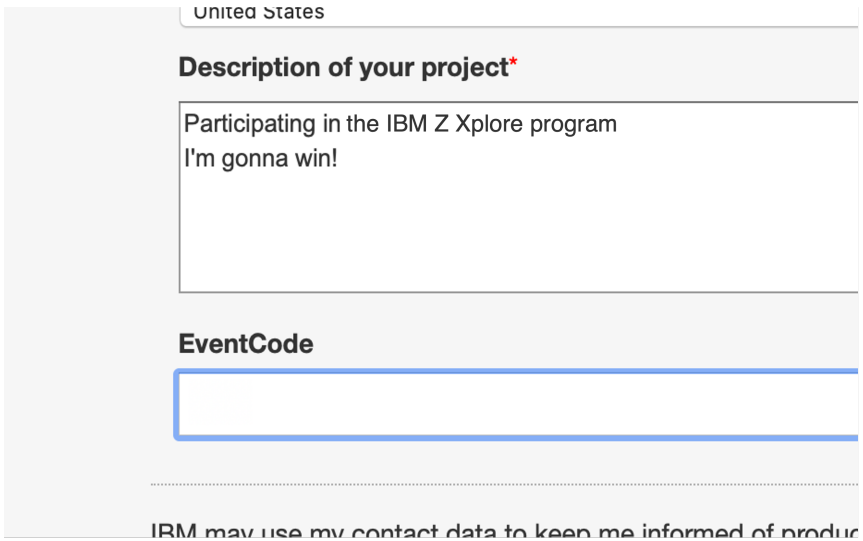
2 SET EVENT CODE



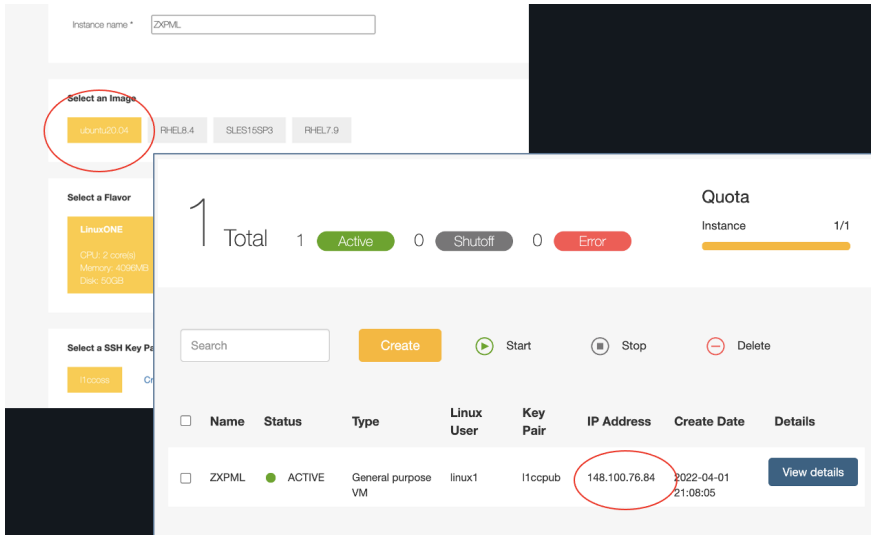
First this challenge, if you are registering with L1CC for the first time – please fill in

`IBMZXPLORE`

for the event code to help us with capacity planning for future use.

If you have an existing L1CC account, don't worry – there is nowhere for you to add the code!

3 SELECT UBUNTU OS



There are a number of Linux Distributions available for Z hardware, including SUSE Linux Enterprise Server (SLES) and Red Hat Enterprise Linux (RHEL). For these challenges, we'll be using the latest **ubuntu** version possible, so make sure you select that here.

Note: Instructions in this challenge for installing additional software will assume you have an ubuntu virtual server.

Select the Virtual Servers menu option to view your server. Take a note of the IP Address of your server – you will need this for logging in to the server and for the Machine Learning container. And note it make take **5-10 minutes** for the virtual server to become available.

4 SSH KEY MANAGEMENT

Good news! you may be able to use the terminal built right into VSCode to ssh into your LinuxONE instance.

Once the machine has started and you've downloaded your `.pem` file (keep that in a safe place), `chmod` it to `600` so no one else can see it.
If you can't, then please follow the instructions and use PuTTy.

Then use an `ssh` command similar to the one above to log in. You'll use `-i` to point it to your pem file. It will ask you if you want to continue (Yes), and then you're in!

This step can be tricky, so take your time.

5 PREPARE THE WAY

To use this system for Machine Learning, you will need a container runtime environment – we will first install and activate a Docker service.

Run the following commands:

```
curl -fsSL https://test.docker.com -o test-docker.sh
```

```
WARNING: Adding a user to the "docker" group will grant the ability to run
         containers which can be used to obtain root privileges on the
         docker host.
         Refer to https://docs.docker.com/engine/security/security/#docker-daemon-attack-surface
         for more information.
```

```
sudo sh test-docker.sh
sudo usermod -aG docker $USER; newgrp docker
sudo systemctl start docker
exec bash
```

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6 BRING ON THE CONTAINERS

Now docker is active, you will need to set up the firewall to allow access to the docker container when it is active.

A few simple commands:

`docker ps` to check that docker is running as expected:

```
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
```

```
sudo iptables -I INPUT -p tcp --dport 38888 -j ACCEPT
```

This exposes the port **38888** to the outside world; and the following command will save the setting across restarts of your virtual server.

```
sudo bash -c "iptables-save > /etc/iptables/rules.v4"
```

7 START THE IMAGE

Now docker is active, and the connection port is allowed through the firewall, you can bring in the Machine Learning experience container and get ready to run it.

The container image is stored in an L1CC repository (also known as a registry). To pull the image into your docker environment, you need to authenticate.

```
docker login -u l1cc registry.linuxone.cloud.marist.edu
```

You will be prompted for a password – enter `LinuxONE` (note NOT **LinuxONE** – see the difference?)

```
WARNING! Your password will be stored unencrypted in /home/linux1/.docker/config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
```

Now you can launch the container instance with this handy command:

```
docker run -p 38888:8888 --name notebook --rm \
    -v /home/linux1/jupyter:/home/jovyan/shared     \
    -d registry.linuxone.cloud.marist.edu/jupyterlab-image-s390x:latest \
     jupyter lab --ServerApp.token='IBMZXPLORE'
```

```
Unable to find image 'registry.linuxone.cloud.marist.edu/jupyterlab-image-s390x:latest' locally
latest: Pulling from jupyterlab-image-s390x
0019aa8d746a: Pull complete
e32119a70bac: Extracting [==============================================>    ]  314.7MB/339.6MB
29e1aea6097d: Download complete
6cbc7f9dd8fb: Download complete
```

8 LET'S GO!

```
linux1@zxpml:~$ docker ps
CONTAINER ID   IMAGE                                                               COMMAND
          CREATED          STATUS         PORTS
                                           NAMES
cb3161d195c7   registry.linuxone.cloud.marist.edu/jupyterlab-image-s390x:latest   "/usr/bin/tini
-g --…"   10 seconds ago   Up 7 seconds   0.0.0.0:38888->8888/tcp, :::38888->8888/tcp   notebook
linux1@zxpml:~$
linux1@zxpml:~$ ip address | grep "global enc1000"
    inet 148.100.76.84/22 brd 148.100.79.255 scope global enc1000
linux1@zxpml:~$
```

Run the command

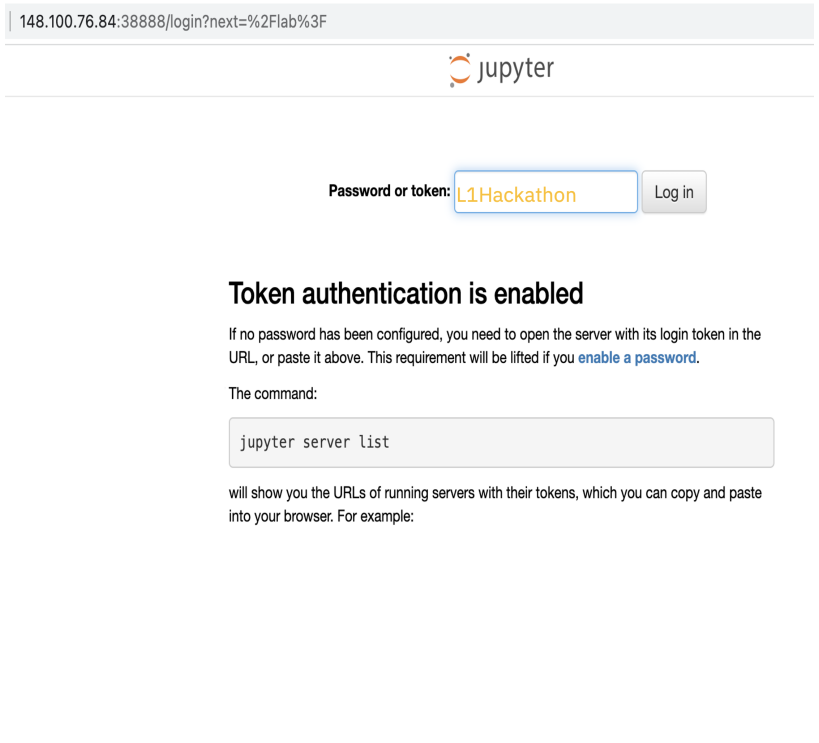
```
docker ps
```

to make sure the container is active. You can see that the tcp port 38888 is active.

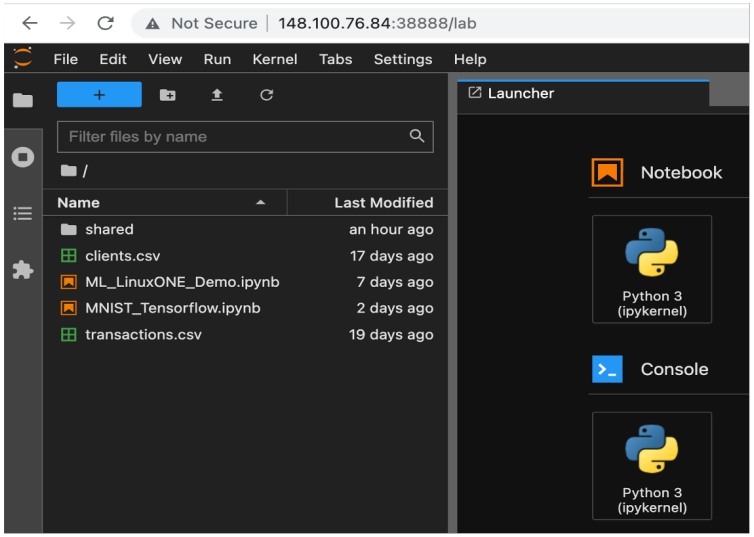
Remember the bit at the end of the `docker run` command? **IBMZXPLORE** is the "password" you will need to access the web interface to the Machine Learning environment.

Now open a browser connection to :

http://{your-server-address}:38888/



9 JUPYTER LAB LIVE



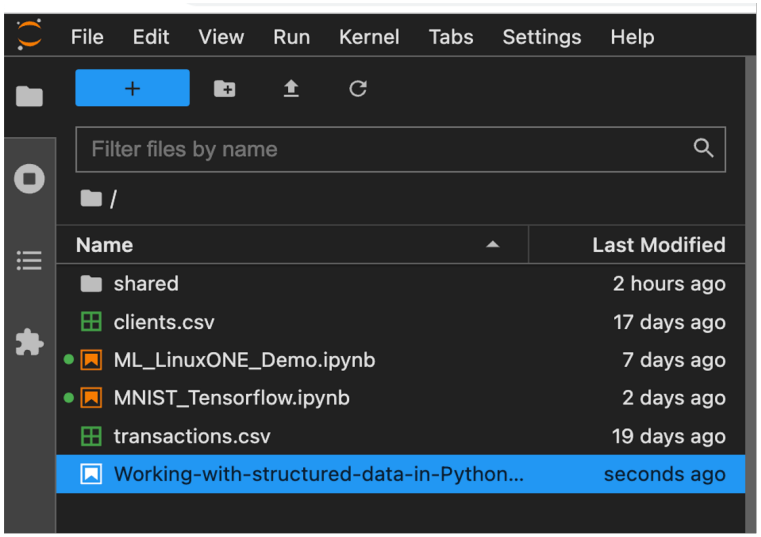
Congratulations! You now have access to your personal data science laboratory. It supports a selection common and popular tools and frameworks:

- Python
- Pandas
- Keras
- TensorFlow
- PyTorch
- Numpy
- SciKit learn
- MatPlotlib

You will find some sample data and lab exercises in the home directory view.

If this is all entirely new to you, try out a data analysis notebook to get familiar with how notebooks work, and how to progressively “slice and dice” the data.

10 TRAINING WHEELS



Download the starter notebook from

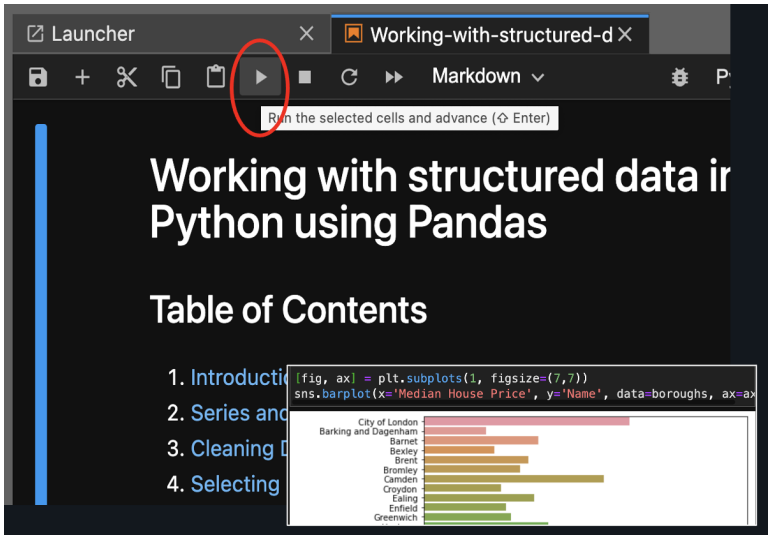
[Developer.ibm.com Pandas Sample]

This uses Python, a very popular analytics library called **Pandas**, and the matplotlib visualization package.

Once downloaded to your workstation/laptop, click the “upload” arrow below the jupyter lab menu bar, and select the notebook you just downloaded (it should have a filetype of “**.ipynb**”)

Double-click on the “Working-with-structure..” file to launch the notebook session.

11 NOTEBOOK ACTIONS



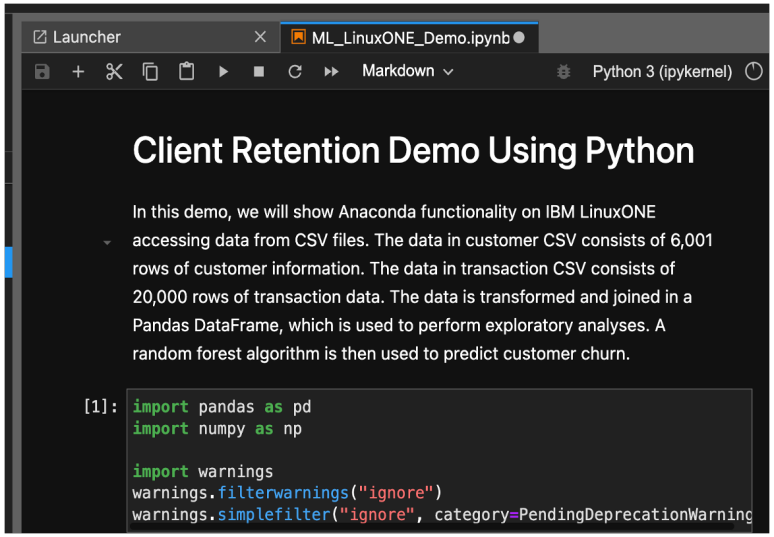
Notebooks are designed to mix instructional/informational text and pictures with executable code. To step through each section in turn, click the highlighted “play” triangle on the menu bar.

Try stepping through the descriptions and the python code, and you will see data being imported, analyzed, chopped, reshaped, and visualized.

Check out the other menu bar options and experiment.

Once you’ve seen the visualizations – charts and plots – close the notebook and get ready for creating an inference model.

12 CLIENT CHURN PREDICTION

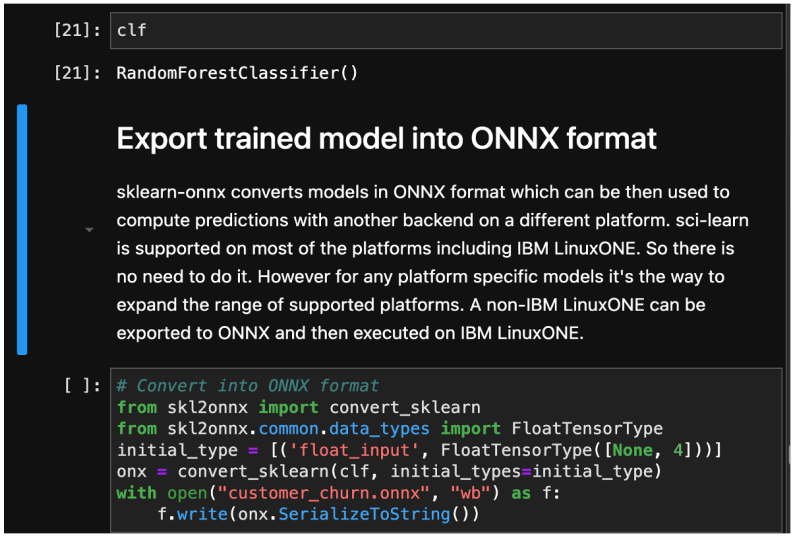


This notebook analyzes the “**transactions.csv**” sample dataset, defines and trains a predictor for how likely a customer is to leave the company, based on lots of customer transaction history.

You will see a similar notebook “flow” to that in the previous starter notebook – both based on the Data Science Method DSM - https://developer.ibm.com/blogs/following-the-data-science-methodology

Step through again to see how the analysis progresses until you reach the “**Export trained model into ONNX format**” step

13 WHY DO WE DO THIS?



The reason for all the analysis, and predictor generation?

Ultimately, we are looking to create an executable model that can be used to predict an outcome on a new set of data – like a new customer transaction. In this case, you can create and export the predictor “model” which can be loaded into an “inferencing service”.

The ONNX model format is an open format for transferring models between systems – when you run this step, you create an exportable model.

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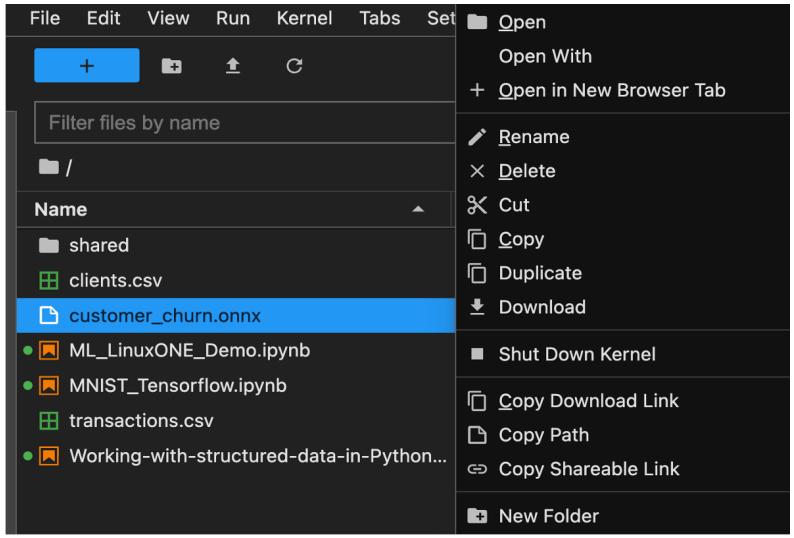
14 READY FOR PRODUCTION



See the new file **customer_churn.onnx** ? Right/command-click to open the action menu and click “Download”. Use the command

```
docker stop notebook
```

to shut down the container.

Back in on your workstation/laptop, use the scp or sftp command to copy the ONNX file you just downloaded and upload it into your USS home directory. Now locate and submit the validation job - **CHKMLZ1** member of **ZXP.PUBLIC.JCL** .

Now you’re ready to work in creating a real-time prediction service based on ONNX models running in the IBM Online Scoring engine

Nice job - let’s recap	Next up …
You have created a data science environment to process historical data, generated predictors for handling new data, and created an exported model that can be transferred to a “production” runtime and be used for live scoring/predicting.	Take your model and turn it into a live scoring service. You will use the IBM Watson Machine Learning for Z Community Edition, also known as Online Scoring.

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