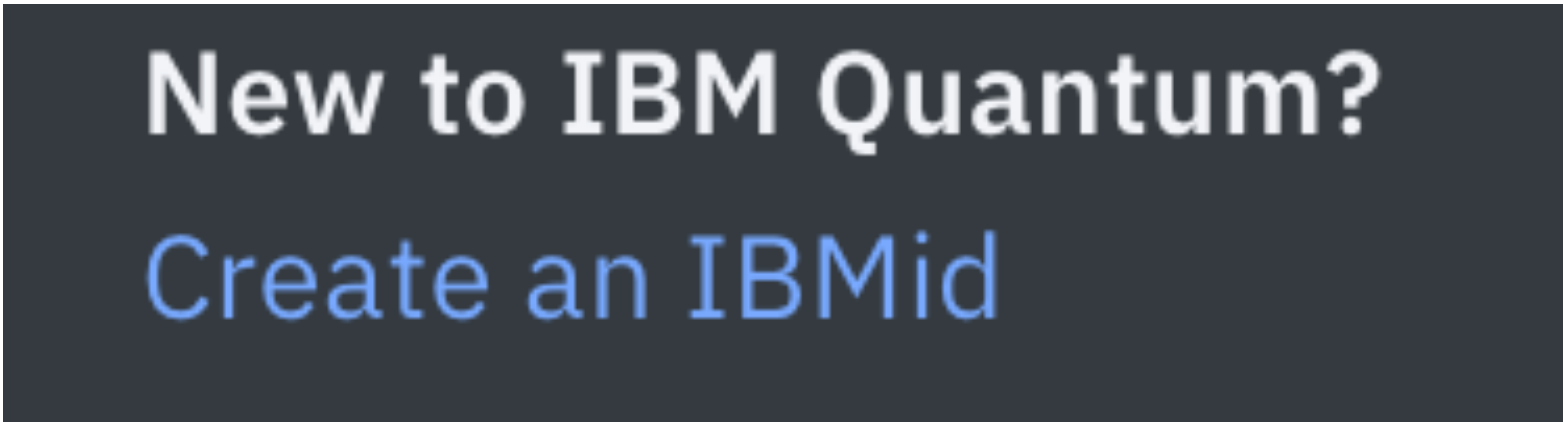


# Preparation for hands-on exercise

Go to <https://quantum.ibm.com/>

If you don't have IBM account, please follow the instructions to create an IBMid



New to IBM Quantum?  
Create an IBMid

Once you have the account, sign in to IBM Quantum

# IBM Quantum Platform

API Token

..... [refresh] [copy] [menu]

### Recent jobs

[View all](#)

0 Pending **6705** Completed jobs

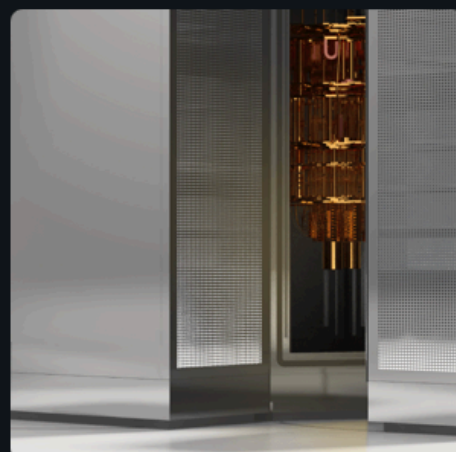
Job ID	Status	Created	Completed	Compute resource
cqdxtnjgepgg008fc860	Cancelled	About 12 hours ago	About 12 hours ago	ibm_cusco
cqdxk8xfejeg0085x230	Completed	About 13 hours ago	About 13 hours ago	ibm_cusco
cqdxearstagg008qrgs0	Completed	About 13 hours ago	About 13 hours ago	ibm_cusco
cqd7rpaxdecg008w5s1g	Cancelled	1 day ago	1 day ago	ibm_cusco
cqd4hfnxftxg00897bx0	Cancelled	1 day ago	1 day ago	ibm_cusco

### What's new →

- Product update  
Update to Qiskit Runtime Primitives  
12 days ago • [Read more](#)
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Updates to Learning -- earn badges and explore the new Learning catalog!  
3 months ago • [Read more](#)
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12



### Simulators →

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Graphically build circuits



IBM Quantum Lab  
Develop quantum experiments



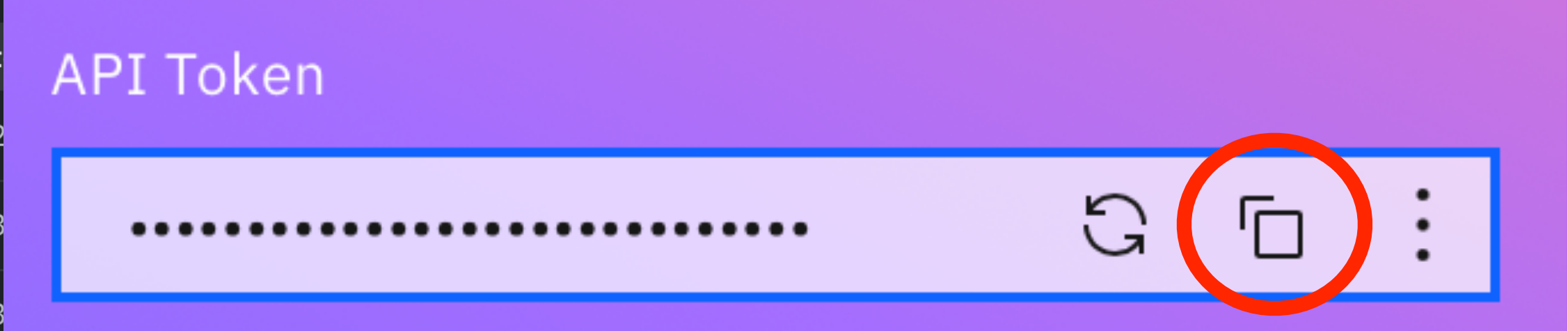
# IBM Quantum Platform



## Recent jobs

0 Pending 6705 Completed jobs

Job ID	Status	Created	Completed
cqdxtnjgepgg008fc860	Cancelled	About 12 hours ago	About 12 hours ago
cqdxk8xfejeg0085x230	Completed	About 13 hours ago	About 13 hours ago
cqdxearstagg008qrgs0	Completed	About 13 hours ago	About 13 hours ago
cqd7rpaxdecg008w5s1g	Cancelled	1 day ago	1 day ago
cqd4hfnxftxg00897bx0	Cancelled	1 day ago	1 day ago



In case you need your API token, you can copy it here

No need to do that if you use only IBM Quantum Lab (next page)

Instance systems →

12

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New URL strategy on IBM Quantum

3 months ago • Read more

# IBM Quantum Platform

API Token

..... 🔁 📄 ⋮

## Recent jobs

[View all](#)

0 Pending 6705 Completed jobs

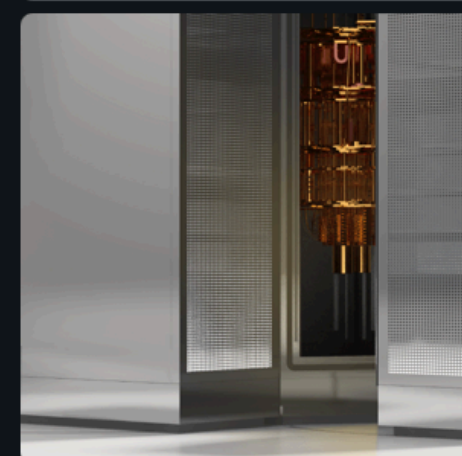
Job ID	Status	Created	Completed	Compute resource
cqdxtnjgepgg008fc860	Cancelled	About 12 hours ago	About 12 hours ago	ibm_cusco
cqdxk8xfejeg0085x230	Completed	About 13 hours ago	About 13 hours ago	ibm_cusco
cqdxearstagg008qrgs0	Completed	About 13 hours ago	About 13 hours ago	ibm_cusco
cqd7rpaxdecg008w5s1g	Cancelled	1 day ago	1 day ago	ibm_cusco
cqd4hfnxftxg00897bx0	Cancelled	1 day ago	1 day ago	ibm_cusco

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## Instance systems →

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- Hello World  
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## Learning [Open app ↗](#)

Catalog New  
Explore all courses and tutorials

- IBM Quantum Composer  
Graphically build circuits
- IBM Quantum Lab**  
Develop quantum experiments

**We use IBM Quantum Lab for hands-on**

# Server not running

Your server is not running. Would you like to start it?

Launch Server

New file +

Filter files by name

Lab files /

Name ▲

Last Modified

This space will be empty

File Edit View Run Kernel Tabs Settings Help

Launcher

Notebook



Qiskit v1.0.0 (ipykernel)



Get started with Grover's



Qiskit v1.0.0 (ipykernel)

Console

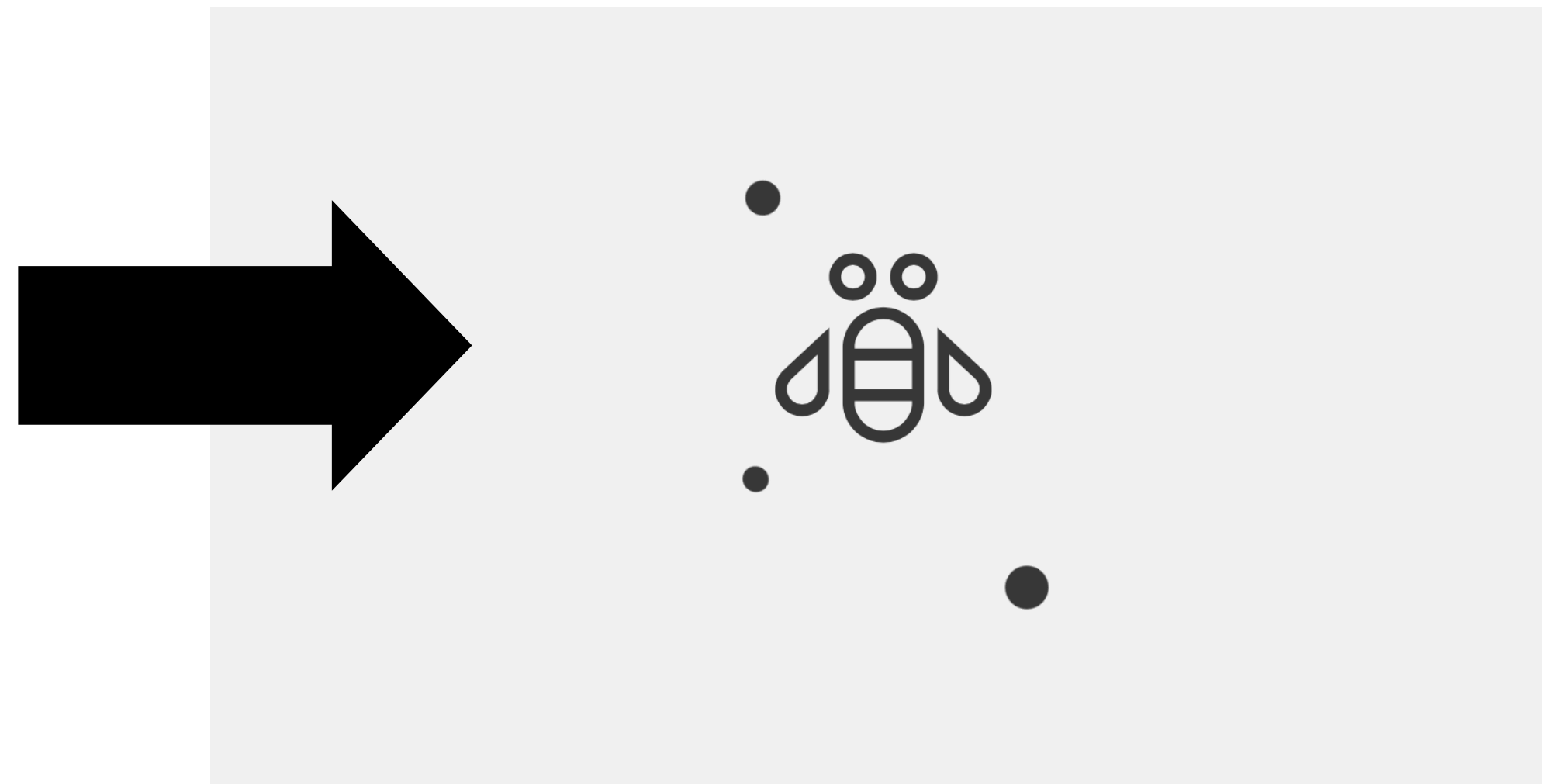


Qiskit v1.0.0 (ipykernel)

At the beginning of the lecture, please click the link below, that will upload the hands-on materials to IBM Quantum Lab

<https://cern.ch/aertr>

After clicking on the link, you will see...



# The page like this should appear

The screenshot displays the IBM Quantum Learning Lab interface. At the top, the navigation bar includes 'IBM Quantum Learning', 'Home', 'Catalog', 'Network', 'Composer', and 'Lab' (which is currently selected). On the right side of the navigation bar, there is a search icon, a user profile icon, and the text 'ibm-q/open/main'. Below the navigation bar is a menu with options: 'File', 'Edit', 'View', 'Run', 'Kernel', 'Tabs', 'Settings', and 'Help'. The main workspace is divided into two panes. The left pane is a file explorer showing a directory structure under 'Lab files / kmi-school-2024 /'. It contains a table with columns 'Name' and 'Last Modified'. The right pane is the 'Launcher' area, which shows a 'kmi-school-2024' workspace. Under the 'Notebook' section, there are three buttons: 'Qiskit v1.0.0 (ipykernel)', 'Get started with Grover's', and 'Qiskit v1.0.0 (ipykernel)'. Under the 'Console' section, there is one button: 'Qiskit v1.0.0 (ipykernel)'.

IBM Quantum Learning | Home | Catalog | Network | Composer | Lab | Search | User Profile | ibm-q/open/main

File | Edit | View | Run | Kernel | Tabs | Settings | Help

Launcher +

kmi-school-2024

Notebook

Qiskit v1.0.0 (ipykernel) | Get started with Grover's | Qiskit v1.0.0 (ipykernel)

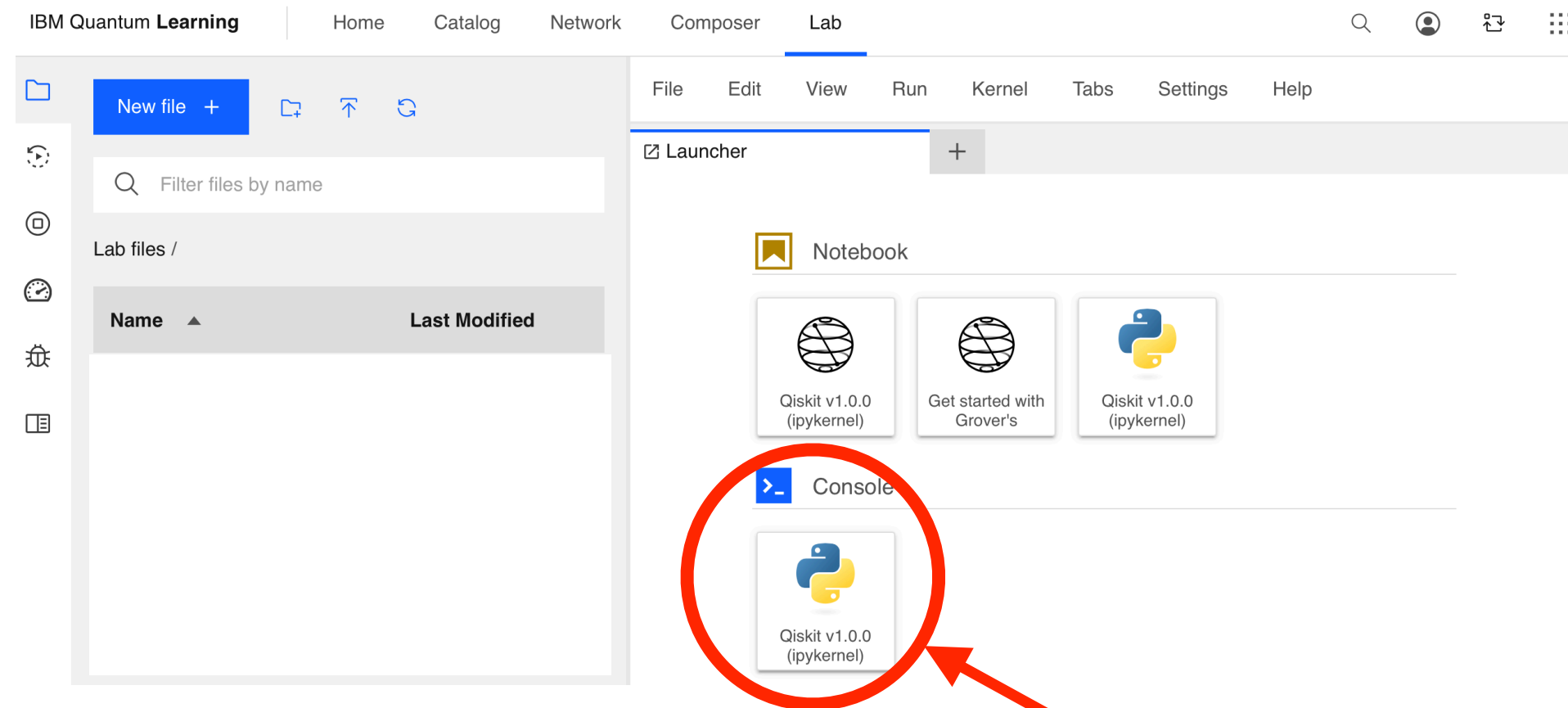
Console

Qiskit v1.0.0 (ipykernel)

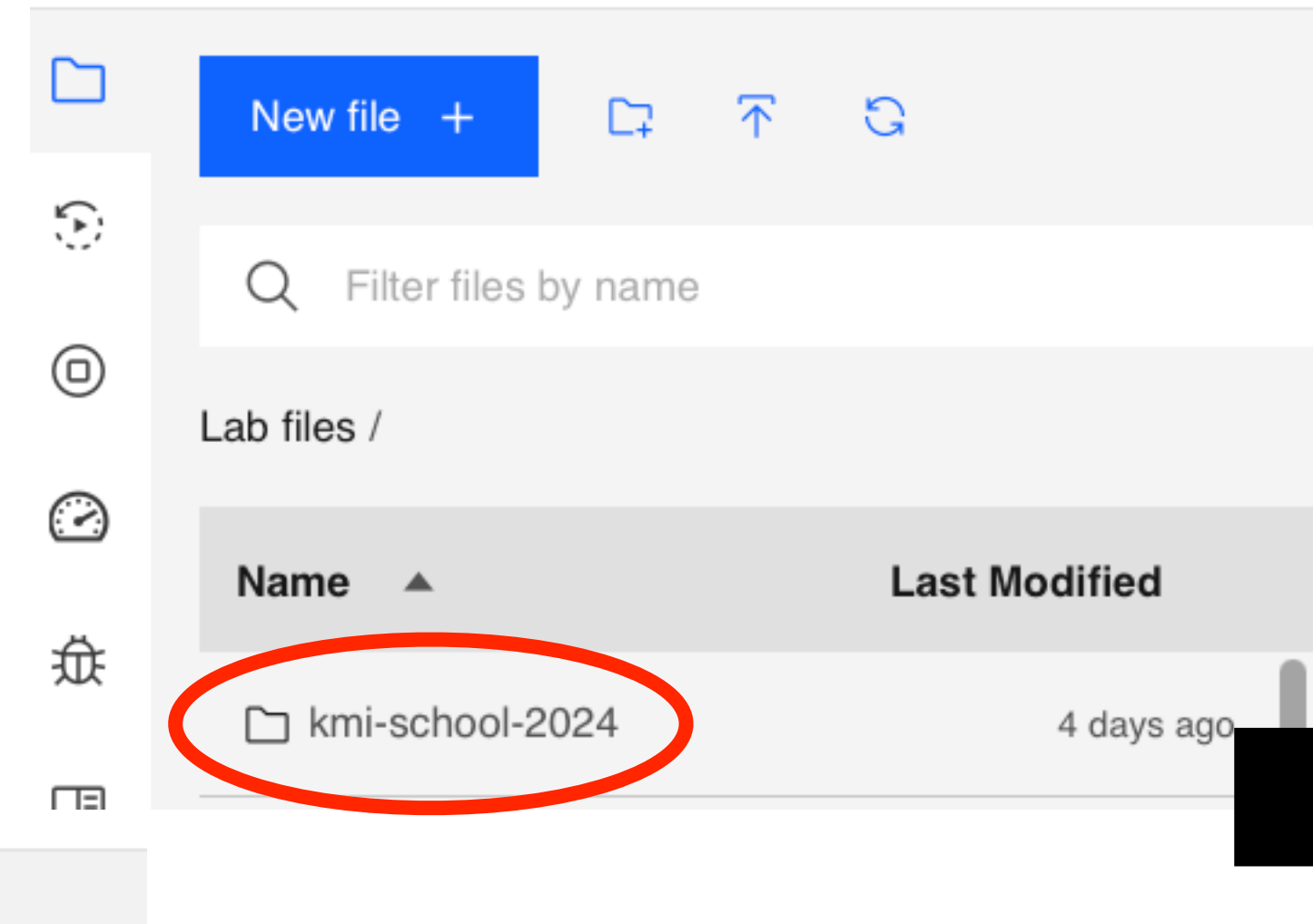
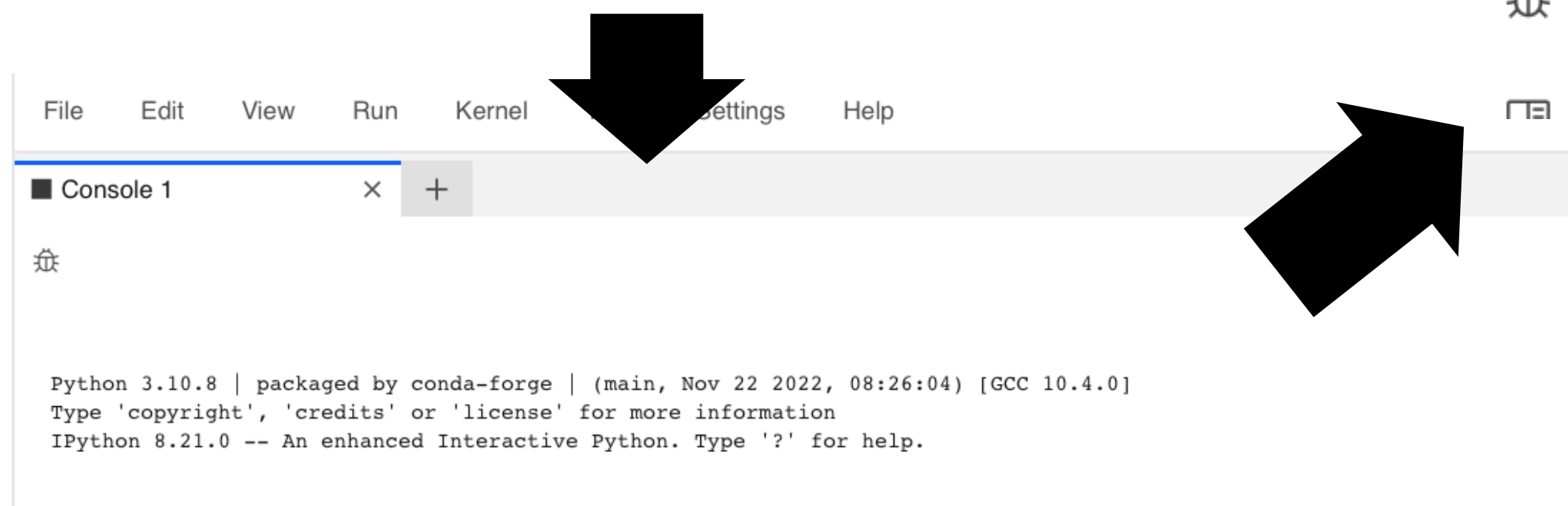
Name	Last Modified
data	4 days ago
ds	4 days ago
hepqpr	4 days ago
qc_workbook	4 days ago
hands-on-preparation.pdf	11 minutes ago
Lec1.ipynb	19 hours ago



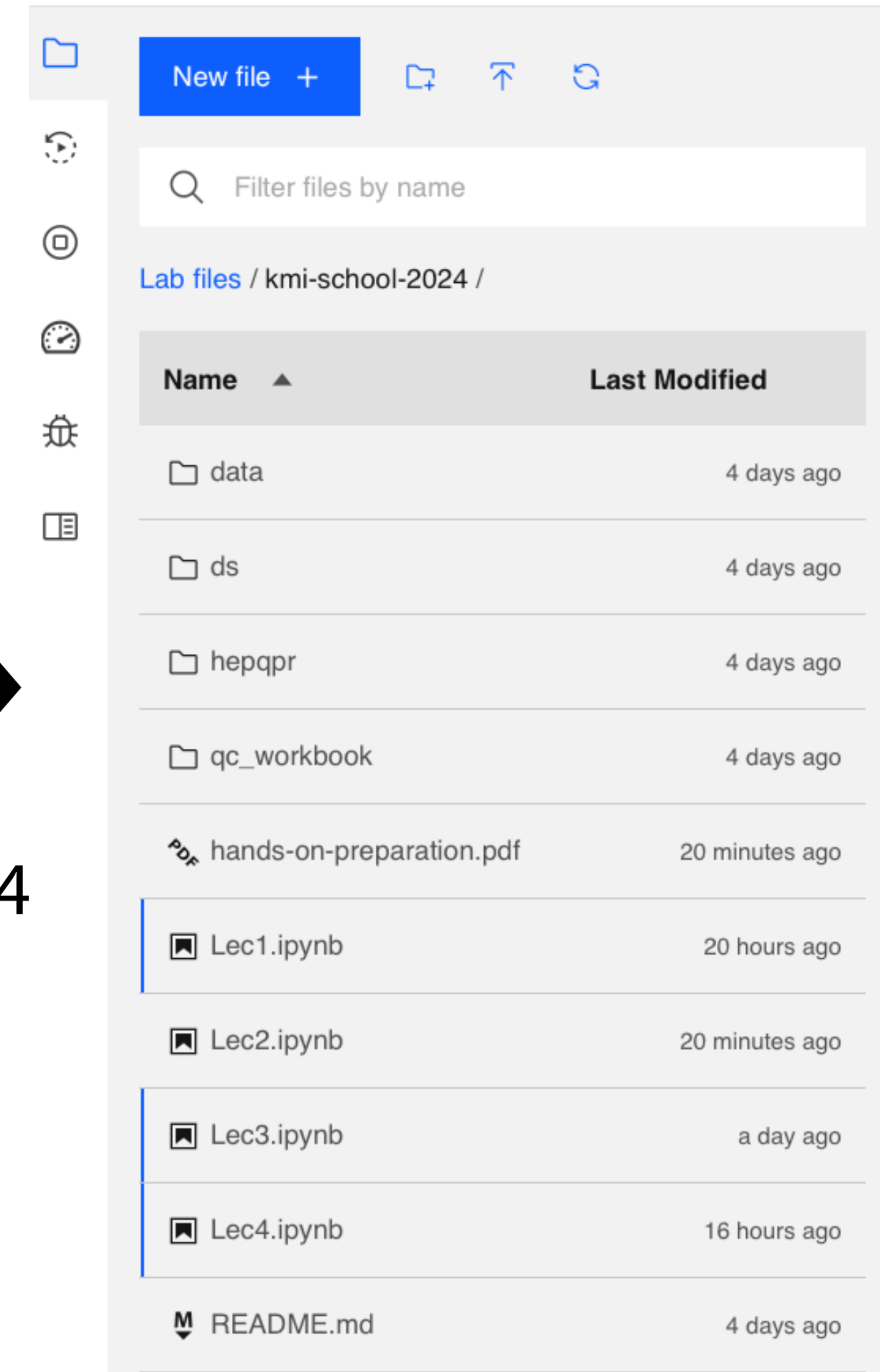
# If this does not work for you, you can try the following



Open a terminal window from here



Double click on kmi-school-2024



```
[ ]: !git clone https://github.com/kterashi/kmi-school-2024.git
```

Type in `!git clone https://github.com/kterashi/kmi-school-2024.git` and Shift+Enter

IBM Quantum Learning | Home | Catalog | Network | Composer | Lab

File | Edit | View | Run | Kernel | Tabs | Settings | Help

Lab files / kmi-school-2024 /

Name	Last Modified
data	3 days ago
ds	3 days ago
hepqpr	3 days ago
qc_workbook	3 days ago
Lec1.ipynb	3 hours ago
Lec3.ipynb	12 hours ago

Hands-on Exercise (1)

```
[1]: # Import everything
import sys
import numpy as np
import matplotlib.pyplot as plt
from IPython.display import Math
from qiskit import QuantumCircuit, QuantumRegister, ClassicalRegister, transpile
#from qiskit.tools.monitor import job_monitor
from qiskit_aer import AerSimulator
from qiskit_ibm_provider import IBMProvider, least_busy

sys.path.append('/home/jovyan/kmi-school-2024')
from qc_workbook.show_state import statevector_expr
```

Jupyter notebook for hands-on:  
**Lec1-5.ipynb** for 5 lectures

Double-click to open in the right window



New file +



🔍 Filter files by name

Lab files / kmi-school-2024 /

Name ▲

Last Modified

data

3 days ago

ds

3 days ago

hepqpr

3 days ago

qc\_workbook

3 days ago

Lec1.ipynb

3 hours ago

Lec3.ipynb

12 hours ago

File

Edit

View

Run

Kernel

Tabs

Settings

Help

Lec1.ipynb



Markdown ▾



Qiskit v1.0.0 (ipykernel) ○

## Hands-on Exercise (1)

```
[1]: # Import everything
import sys
import numpy as np
import matplotlib.pyplot as plt
from IPython.display import Math
from qiskit import QuantumCircuit, QuantumRegister, ClassicalRegister, transpile
#from qiskit.tools.monitor import job_monitor
from qiskit_aer import AerSimulator
from qiskit_ibm_provider import IBMProvider, least_busy

sys.path.append('/home/jovyan/kmi-school-2024')
from qc_workbook.show_state import statevector_expr
```

To process code in a cell:  
Select the cell and click on ▶  
or Shift+Enter

If you restart the kernel, all processed information is lost, so you have to start from the beginning

# Quantum Computing Workbook

We have been preparing an English version of Quantum Computing Workbook developed by ICEPP

Go to <https://utokyo-icepp.github.io/qc-workbook/en>



Several topics still missing in English version  
Working in progress...



Japanese version:

<https://utokyo-icepp.github.io/qc-workbook>