SENG 457/CSC 557
Lab 1: Hello Quantum World

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May 12, 2025

SENG 457/CSC557 Labs: Welcome!

- Engage in hands-on Qiskit/PennyLane programming sessions
- Participate in pen-and-paper exercises to practice concepts and notations in quantum computing
- Attendance contributes to the overall grade: 5% for undergraduates, 5% for graduate students

To-do list for today

- Install Anaconda Python, Qiskit, and PennyLane
- Run a sample Qiskit program on Jupyter notebooks
- Practice Circuit - Dirac - Matrix notations for one qubit
- Sign the attendance sheet!

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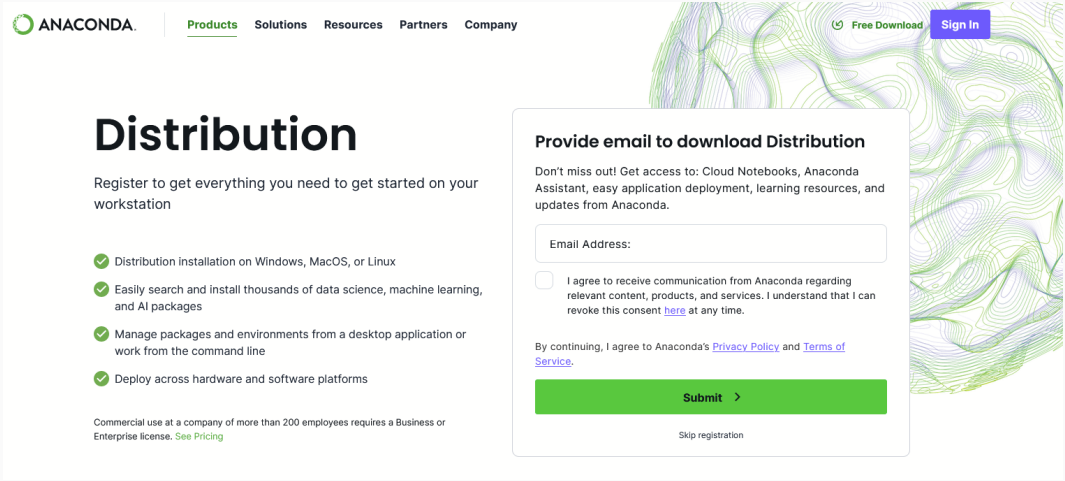
Programming tools

- Python 3.9 or newer (via Anaconda or standalone)
- Qiskit 2.0
- PennyLane 0.41.1

Anaconda Python

https://www.anaconda.com/download



Anaconda Python

- Accept the user agreement
- Choose the destination for your Anaconda Python installation
- Optional: If you do not have Python 3.9 or newer installed, you may register it as the default (second in Advanced Options)
- Install

Create an environment

- Open Anaconda Navigator or Anaconda Prompt
- (OR) Command line access: Add anaconda to your PATH to access it from the command line
- Create and activate the environment
  - `conda create -n ENV_NAME`
  - `conda activate ENV_NAME`

Install Qiskit[1]

- Type in the following:
  - `pip install qiskit`
  - `pip install qiskit --ibm-runtime`
  - `pip install qiskit [visualization]`
- Test your installation by importing Qiskit in a Python environment (e.g. a Jupyter Notebook):
  - `import qiskit`

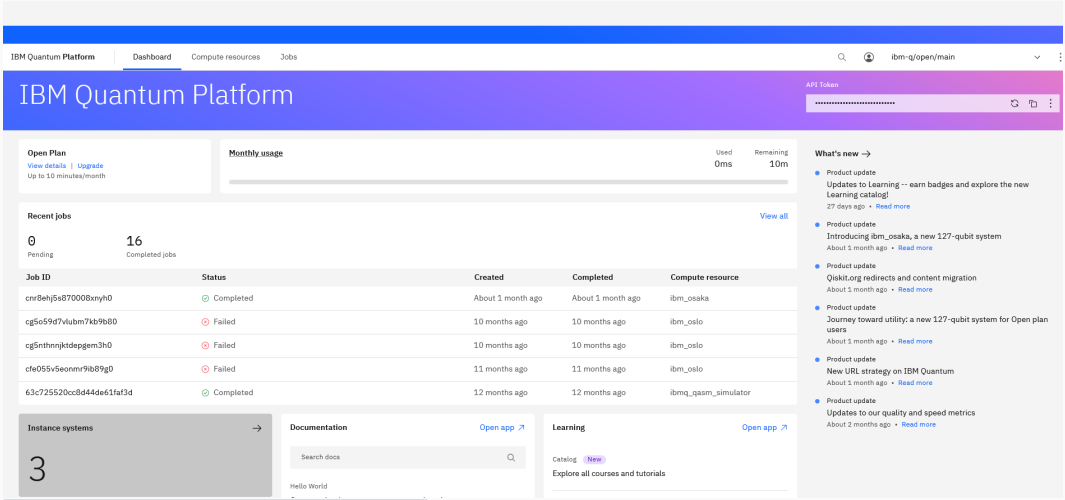
[1] https://docs.quantum.ibm.com/start/install

Install PennyLane[2]

- Type in `pip install pennylane --upgrade`
- Test your installation by importing PennyLane in a Python environment (e.g. a Jupyter Notebook):
  - `import pennylane as pl`

[2] https://pennylane.ai/install/

Access Qiskit on cloud[3]



[3]https://quantum.ibm.com/

Jupyter Notebooks

- Navigate to a directory where you want to save your files
- Type `jupyter notebook` or `jupyter lab` in the environment you just created
- A Jupyter notebook environment should open in your browser

Export Jupyter Notebooks as PDF[4]

Export to PDF with `nbconvert`:

- This requires `pyppeteer` and `Chromium` to be downloaded (open Anaconda as an administrator)
- Navigate to your environment and:
  - `pip install nbconvert[webpdf]`
  - For the first notebook download:
    `jupyter nbconvert --to webpdf --allow-chromium-download your-file.ipynb`
  - For subsequent downloads:
    `jupyter nbconvert --to webpdf --no-input your-file.ipynb`

[4] https://mljar.com/blog/jupyter-notebook-pdf/

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Hello Quantum World!

- Sample notebooks on Brightspace (under Content/Labs/Lab 1)

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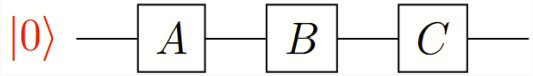
Draw the circuit corresponding to the following quantum state

- $X|0\rangle$
- $HX|0\rangle$
- $XH|-\rangle$

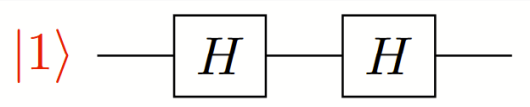
Represent the following with matrices (gates) and vectors (states)

- $X|0\rangle$
- $HX|0\rangle$
- $H|-\rangle$

Give the quantum state in dirac notation for:



What is the resulting quantum state for:



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