



WQC HACKATHON KICKOFF

March 8th, 2024

Welcome!

To the first ever WQC Hackathon



Introduction to WQC

- Founded in 2023 by Jack, Emma & Nico
- Includes members across a broad range of faculties, with a shared interest in the evolution of quantum computing technologies

Mission: Educate & inspire university students about the diverse applications of quantum computing technologies through team problem-solving.





Goals for Hackathon

1. Participants gain a foundational understanding of D-Wave Software
2. Participants reflect critically on the applications of quantum computing to business operations and logistics management
3. Regardless of technical competency, students collaborate to tackle challenging problems creatively
4. Have fun & bond with teammates!



Weekend Overview

Friday, March 8th

- Opening Ceremony
- Case released
- Time to work on the case

Saturday, March 9th

- Time to work on the case

Sunday, March 10th

- Time to work on the case
- Submit deliverable by 5:00 PM
- Presentations from 5:00-7:00 PM in the ACEB Atrium
- Winner announced



Communication

- DISCORD!!!
 - Join using this [link](#)
 - Case & Resources
 - Feel free to use the chat-room for questions or comments!
- Email
 - Case
 - khill223@uwo.ca



Resources

- This slideshow!
- 8 min video explaining how to configure D-Wave to your computer (ESSENTIAL)
- Research paper completed by D-Wave proposing algorithm to bike sharing rebalancing using quantum computing
- Introduction to using hybrid D-Wave solvers
- Introduction to developing QUBO's
- Ocean and Objective slides
- Ocean and Constraint slides
- + More (available once the case has been released)

All will be in the Resources channel on Discord!



Breakout Rooms & Extra Help

Breakout Rooms available
on Saturday from 8:00 AM
- 8:00 PM:

- ◆ ACEB 2450
- ◆ ACEB 2439
- ◆ ACEB 2445 (after 4 PM)
- ◆ ACEB 2448
- ◆ ACEB 3450
- ◆ ACEB 4450

Get extra help from
WQC Execs:

- ◆ ACEB 2445
- ◆ 9:00 AM - 1:00 PM &
1:45 PM - 4:00 PM on
Saturday
- ◆ Or, use the discord
chat-room!



Guidelines

- Submit Deliverable by 5pm on Sunday (March 10th) via email to khill223@uwo.ca
- Deliverable format:
 - 1 PowerPoint Slide Deck summarizing findings & recommendations from each question
 - Microsoft Excel File
 - D-Wave File
- Important: Watch Video on Process of Installing D-Wave Software



Judges



Nicolas Folz

HBA1/Software
Engineering Student



Amer Sabsabi

Structural Engineering
PhD Student



Jack Freeman

HBA1/Software
Engineering Student



Prizes

WINNER:

- ◆ \$400 shopping spree!
- ◆ Coffee chat with Jason Yang from Deloitte's AI Team or Dave Turk



RUNNER-UP:

- ◆ \$200 shopping spree!
- ◆ Coffee chat with WQC Executives



Basics of Quantum Computing



What is a Qubit?

- ◆ Basic unit of quantum information, similar to a bit in a classical computer
- ◆ Unlike a classical bit, qubits can exist outside of the standard 0 or 1
- ◆ Superposition allows qubits to exist in a state of both 1 and 0 simultaneously



Superposition

- Ability of a qubit to exist in multiple states at once
- In computing, these states are 0 or 1
- Consider a spinning coin, which is neither heads nor tails while spinning, but can be considered in a 'superposition'





Entanglement

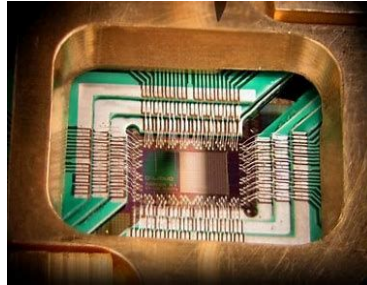
- ◆ Two or more quantum particles become interconnected
- ◆ State of one of the particles instantly influences the state of the other
- ◆ In computing, allows us to perform complex calculations far more efficiently



Different Types of Quantum Computers

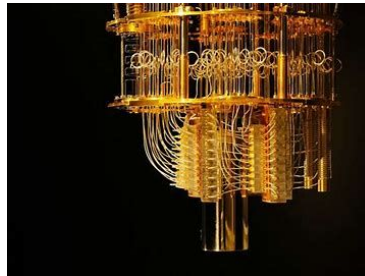
D-Wave

- **Type of Quantum Computer:** Quantum annealing machines
- **Qubits:** 5000+
- **Architecture:** More to come
- **Applications:** Specific optimization problems



IBM

- **Type of Quantum Computer:** Gate-model quantum computers
- **Qubits:** 433
- **Applications:** Designed for a wide range of applications



Xanadu

- **Type of Quantum Computer:** Focus on photonic quantum computers which use particles of light (photons) as qubits
- **Qubits:** 53 ish
- **Architecture:** Leverages the unique properties of photons for quantum information processing
- **Applications:** Machine learning and quantum simulation





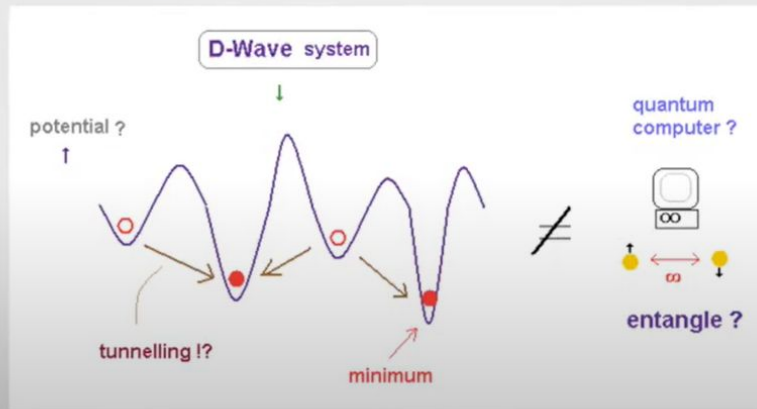
Why D-Wave Software?

1. Most commercially scalable for optimization problems
2. Easiest for developers (you don't need 8 PHD's!)
3. Access to Quantum Cloud services

4..... It's Canadian!

What is Quantum Annealing?

Annealing - optimize solutions to problems by quickly searching over a space and finding the global minimum which becomes the solution



1. CPU needs to follow along the whole function until minimum is found
2. Using the QPU and leveraging superposition we can skip from minimum to minimum until the lowest is found (quantum tunneling)

Travelling Salesman Problem Example



Helpful Tips

1. Use Microsoft Excel to solve questions 1 & 2 (however, feel free to use other softwares if preferred)
2. Use the WQC Exec Team as a resource to answer questions regarding software, case content, and quantum problems
3. Split up tasks and work as a team. Have some team members learning D-Wave's software while others complete the first two Excel tasks
4. Utilize resources provided and those provided on the D-Wave Leap platform

Questions?

Good luck to all groups!