Syllabus: QNT 480: Quantum Computing Capstone

Course Title: QNT 480: Quantum Computing Capstone

Semester: Fall 2024

Instructor: Dr. Sarah Parker

Email: sparker@asu.edu

Office: SANCA 270B, The Polytechnic School, ASU

Office Phone: (480) 727-5900

Office Hours: Mondays 2:00-4:30 PM OR by appointment

Class Time & Place: Monday or Wednesday 3:00-4:15 PM in SANCA 275

Course Description:

This capstone course explores the application of quantum computing to solve complex problems. Students will design, implement, and test a quantum algorithm or system that addresses a specific challenge in the field. The course includes the development of a project proposal, algorithm design, quantum implementation, and presentation of findings through a report and at the Innovation Showcase.

Course Objectives:

Design and implement a quantum algorithm to solve a complex problem.

Conduct simulations and performance analysis of quantum systems.

Optimize the quantum algorithm for efficiency and accuracy.

Effectively present the project at the Innovation Showcase.

Learning Outcomes:

Gain expertise in quantum computing algorithms and systems.

Develop practical skills in quantum algorithm design and optimization.

Improve communication skills through written reports and presentations.

Enhance the ability to manage quantum computing projects from conception to completion.

Group Project and Required Subtasks:

The group project for this course will involve the development and implementation of a quantum algorithm or quantum system to solve a complex problem. The project will be broken down into the following subtasks:

1. **Project Proposal (Week 3):**

   - Create a proposal outlining the quantum problem being addressed, the proposed quantum solution, and the anticipated impact. Include a timeline and assign roles to team members.

2. **Algorithm Design and Simulation (Weeks 4-6):**

   - Design the quantum algorithm or system, and develop a simulation to test its functionality in a classical environment before implementation on a quantum computer.

3. **Quantum Implementation (Weeks 7-10):**

   - Implement the quantum algorithm on a quantum computing platform. Test and refine the algorithm to ensure it meets the project's objectives.

4. **Performance Analysis and Optimization (Weeks 11-12):**

   - Analyze the performance of the quantum algorithm, identify areas for optimization, and make necessary improvements.

5. **Final Report and Presentation (Weeks 13-15):**

   - Document the entire development process, including design decisions, challenges, and outcomes in a final report.

   - Prepare a presentation and poster for the Innovation Showcase that highlights the key aspects of the project.

Groups are expected to collaborate closely, meeting regularly to discuss progress and resolve any issues. Instructor check-ins will be scheduled to provide guidance and feedback.

Evaluation:

Class meetings (5): 20 points

Individual meetings (3): 12 points

Project Proposal: 10 points

Algorithm Design and Simulation: 15 points

Quantum Implementation: 18 points

Performance Analysis and Optimization: 10 points

Final Report: 10 points

Presentation: 5 points

Poster: 10 points

Total: 100 points

Course Policies:

Attendance and Participation: Regular attendance and active participation are crucial for success in this course. Students are expected to attend all scheduled class meetings and individual sessions. If a student is unable to attend a class, they should inform the instructor in advance and arrange to complete any missed work.

Academic Integrity: All students must adhere to ASU's academic integrity policy. Any form of academic dishonesty, including plagiarism, will be reported and may result in severe penalties, including a failing grade for the course.

Accommodations: Students with disabilities or special needs should contact the ASU Disability Resource Center to arrange appropriate accommodations and notify the instructor as soon as possible.

Important Dates:

Class Week 1: Introductions & Project Brainstorming (Aug 26)

Individual Meeting #1: Discuss Ideas and Readings (Sep 4)

Class Week 2: Proposal Presentation & Group Feedback (Sep 18)

Individual Meeting #2: Proposal Feedback & Methods Discussion (Oct 2)

Class Week 3: Revised Proposal Presentation & CERTT Tour (Oct 23)

Individual Meeting #3: Data Analysis & Progress Review (Nov 13)

Class Week 4: Professional Development & Project Discussion (Nov 27)

Innovation Showcase: Final Presentations & Poster Display (Dec 6)