1 Introduction: Part 1

1.1 Problem Statement

What problem is your project trying to solve? Use non-technical jargon as much as possible. You may find the Problem Statement Worksheet helpful.

We will further the collective knowledge base of quantum computing and computer design by collectively contributing to the design and construction of a working quantum computer at ISU/Ames Lab over the next two semesters. This project will not conclude with us and will be carried on by future staff and students. We are doing so because quantum computing is a cutting edge technology, which offers opportunities to provide numerous advances in computational and scientific fields, and as a national lab and associated research university, Ames Lab and ISU's goals for furthering the state of science align with their construction of a quantum computer.

We will do this by subdividing and specializing into six sub-fields of quantum computer design with a focus on ion trap design and accumulating a knowledge base as we work. Robust communication and cross-educational sessions will be employed to ensure that along with our specializations, the knowledge necessary to address overall design concerns is accumulated across the entire team. Additionally, we have designated an integration specialist. Given the nature of our client, we will take guidance from them regarding the transition from research to development focus, at which point we will define our initial steps in construction in accordance with our research findings and available resources.

1.2 Intended Users and Uses

Who will use the product you create? Who benefits from or will be affected by the results of your project? Who cares that it exists? List as many users or user groups as are relevant to your project. For each user or user group, describe (1) key characteristics (e.g., a persona), (2) need(s) related to the project (e.g., a POV/needs statement), and (3) how they might use or benefit from the product you create. Please include any user research documentation, empathy maps, or other artifacts as appendices.

- **Ames Lab**
    1. **Characteristics:** homogenous employment; heterogeneous expertise & explicit goals connected to their background, existing proposals/fundings, etc.; Highly technical individuals, likely interested in details and implementation as much as final product;
    2. **Needs:** Development of new techniques in the design of a quantum computer/proof of concept for existing techniques, verbose documentation/explanation of work
    3. **How They Use / Benefit:** They will be able to conduct research and forward the current knowledge base on quantum computer design and computing, increasing the productive potential and prestige of the institution.
- **Iowa State University students and faculty**

    a. **Characteristics:** Large, diverse, and scholastic. A subset of students, likely in ECPE, Physics, ComSci, and related fields will be the most likely to be interested in this product. Within this subset, there are still wildly different areas of knowledge that will correspondingly result in different interests and concerns regarding our product. That said, they will all be technically inclined, though possibly to a lesser degree than the members of Ames Lab, and their access may be comparably limited.
    b. **Needs:** Access to quantum computing and/or quantum computer design starting at a possibly lower level of technical background than can be assumed of our other user base. This suggests the need for a full bodied "zero to hero" documentation structure.
    c. **How They Use / Benefit:** Involvement in the quantum computing domain - increases the prestige of the university and the real value offered to its associates through access/exposure to the computer and its design. **Students will have an expanded range of real world projects they can work on and take advantage of.** Will utilize knowledge and any components for furthering of our goal or for new discoveries
- **State-of-the art researchers:**
    a. **Characteristics:** Continuous drive for improvement, working on science projects. Very open and sharing for the benefit of everyone. Diverse ethnicities, cultural backgrounds, first-languages
    b. **Needs:** Perform high level calculations, Develop new solutions to current problems using new techniques and technologies developed by themselves or others
    c. **How They Use / Benefit:** Personal or group glory by using these concepts for further development in the field, enhanced knowledge in the field; Will utilize knowledge and any components for furthering of our goal or for new discoveries