introduction

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1 Definitions

- **Data structure** is a systematic way of organizing and accessing data.
- An **algorithm** is a step-by-step procedure for performing some task in a finite amount of time.

2 Motivations

- **Algorithms are fundamental to all areas of Computing**
  - Algorithms are the backbone of computer science.
    * Operating Systems
    * Networking
    * Cyber Security
  - Algorithms and the computational perspective (the "computational lens") has also been fruitfully applied to other areas, such as
    * physics (e.g. quantum computing),
    * economics (e.g. algorithmic gametheory), and
    * biology (e.g. for studying evolutions, as a surprisingly efficient algorithm that searches the space of genotypes).

- **Algorithms are useful**
- Much of the progress that has occurred in tech/industry is due to the dual developments of improved hardware (a la "Moore's Law")
- In fact, the faster computers get, the bigger the discrepancy is between what can be accomplished with fast algorithms vs what can be accomplished with slow algorithms.
- Industry needs to continue developing new algorithms for the problems of tomorrow, and you can help contribute.

- **Algorithms are fun!**
- The design and analysis of algorithms requires a combination of creativity and mathematical precision.
- It is both an art and a science, and hopefully at least some of you will come to love this combination.

3 Algorithms and Programs

- It is important that you do not mix up these two concepts.

- An algorithm algorithm is an **abstract concept** to solve a given problem.

- In contrast, a program is a **concrete** implementation of an algorithm.

- In order to implement an algorithm as a program we have to cover every detail, be it trivial or not.

- On the other hand, to specify an algorithm it is often sufficient to describe just the interesting aspects.

- The rest can then be filled in by a competent programmer.

- Therefore, a `specification` of an algorithm often **abstracts** from minor details.

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