

# 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 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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