Introduction to Bioinformatics
CSC 314

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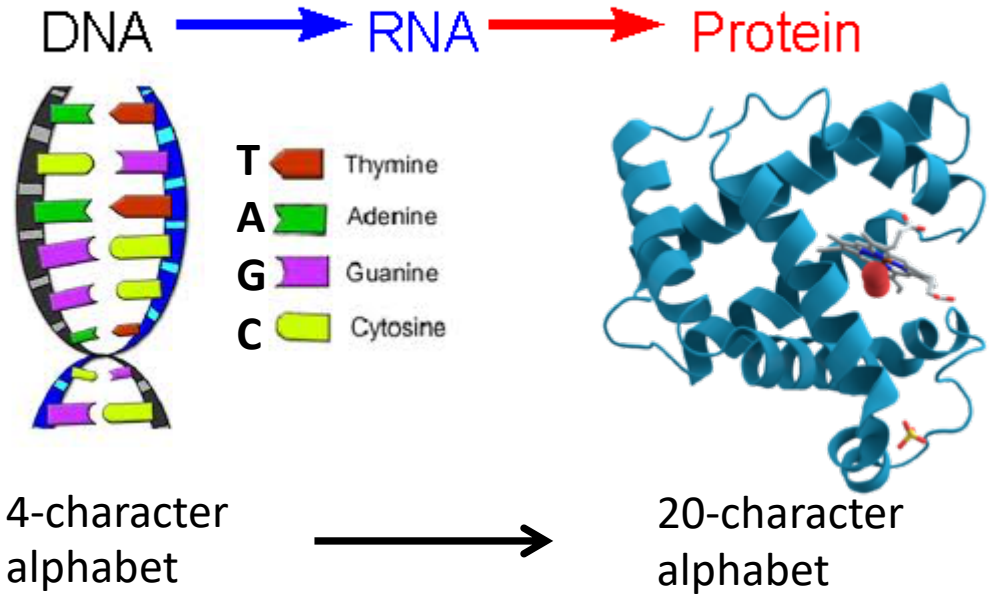
Course notes: https://gdancik.github.io

What is bioinformatics

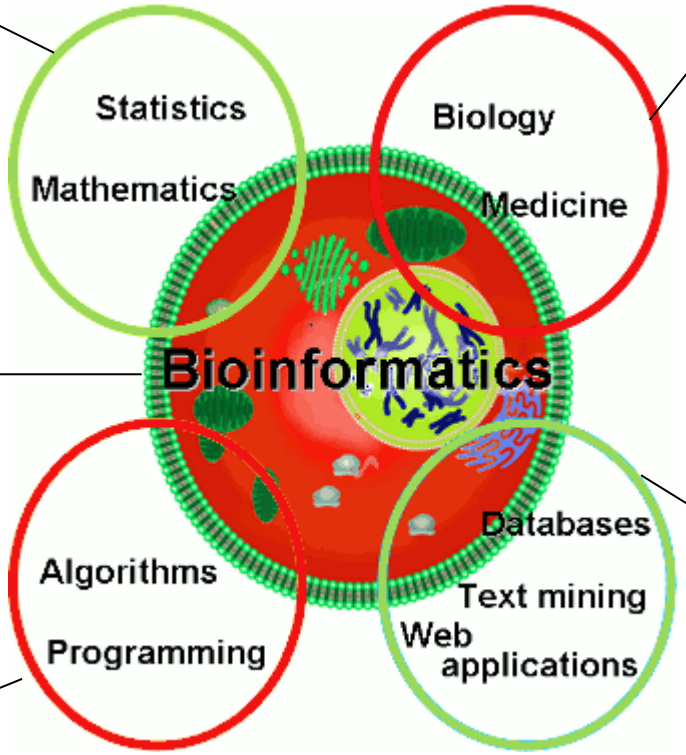
- Bioinformatics:
  - Biology + information
  - the study and utilization of methods for storing, retrieving and analyzing biological data



- How much information:
  - Human genome: 3 billion nucleotides
  - ~20,000 genes
    - many more when considering “junk DNA” and alternative splicing
  - >10 million sites of DNA variation
  - Countless possible interactions between DNA, RNA, and proteins

Bioinformatics is interdisciplinary

Calculus
Biostatistics



Biology
Genetics
Chemistry
Physics

Applied bioinformatics
Methods in bioinformatics
Genomic data analysis

Computer programming
(Python/Biopython)
Computer algorithms
(Dynamic programming)

Database design
Database applications
Database searching

Source: http://www.amberbio.com/

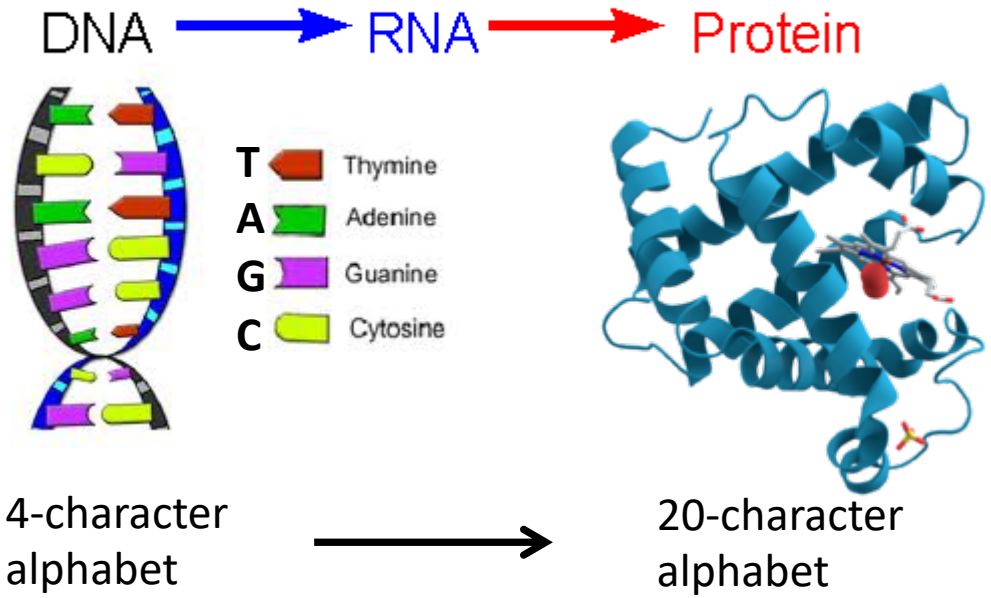
What is this?

```
public class helloWorld {
    public static void main(String[] args) {
            System.out.println("Hello World!");
    }
}
```

Bioinformatics is an information science

- Computer code is a *set of instructions* that tells a computer how to process data and output results
- The genetic code is also a set of instructions, that tells a cell how to produce a molecule (RNA/protein) from DNA
  - Information flows from DNA → RNA → protein
  - The DNA information determines the structure/function of RNA and protein

Central Dogma of Molecular Biology



- The function of a protein can be predicted from its DNA or protein sequence
- Just like Java is a language for computers, genetics is the language of life (DNA is the alphabet)
  - This is a fundamental concept in bioinformatics

Intro to Genetics (Genetics 101)

- What are genes?
  - http://www.youtube.com/watch?v=ubq4eu_TDFc
  - Genes are part of what molecule?
  - How many possible bases (characters) are found in DNA?
  - How are genes organized?
  - How many *pairs* of chromosomes do humans have?
- What are SNPs?
  - http://www.youtube.com/watch?v=tJjXpiWKMyA
  - What is the human genome?
  - What is a SNP?

Intro to Genetics (Genetics 101)

- Where do your genes come from?
  - http://www.youtube.com/watch?v=-Yg89GY61DE
  - Where do your genes come from?
  - What are homologous chromosomes?
  - What determines your sex?

Bioinformatics Preview

- Let's look briefly at the genome of SARS-Cov2, the virus that causes COVID-19:
  - https://www.ncbi.nlm.nih.gov/nuccore/NC_045512
  - This is a preview and will make much more sense by the end of the semester