BIOINFORMATICS

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What is Bioinformatics?

- Interdisciplinary research area to manage and analyze biological data using computational techniques.
What is Bioinformatics?

Bioinformatics

Computational Techniques
- Data Mining
- Machine Learning
- Mathematical Model
- Statistical Model

Biological Data
- Genome
- Proteome
- Transcriptome
- Interactome

Knowledge

Biomedical Applications
- Functional Characterization
- Disease Diagnosis
- Drug Development
Stage 1.
Sequence Analysis

- Gene sequencing
- Sequence alignment
- Homolog search
- Motif finding
Computational Biology

Stage 1. Sequence Analysis

- Gene sequencing
- Sequence alignment
- Homolog search
- Motif finding

Stage 2. Structure Analysis

- Protein folding
- Homolog search
- Protein docking
- Function prediction
Human Genome Project

- **Goal**
  - Identification of complete human genome
  - Mapping the genes from a functional standpoint

- **History**
  - Began in 1990 by NIH
  - An initial draft was released in 2001

- **Participation**
  - International Consortium was founded by hundreds of universities and research centers from US, UK, Germany, France, Japan, Canada, China, New Zealand, India, and so on.
Computational Biology

Stage 1. Sequence Analysis

- Gene sequencing
- Sequence alignment
- Homolog search
- Motif finding

Stage 2. Structure Analysis

- Protein folding
- Homolog search
- Protein docking
- Function prediction
Functional Genomics

Stage 1. Sequence Analysis
- Gene sequencing
- Sequence alignment
- Homolog search
- Motif finding

Stage 2. Structure Analysis
- Protein folding
- Homolog search
- Protein docking
- Function prediction

Stage 3. Genome Analysis
- Function prediction
- Gene clustering
- Disease classification
Systems Biology

Stage 1. Sequence Analysis
- Gene sequencing
- Sequence alignment
- Homolog search
- Motif finding

Stage 2. Structure Analysis
- Protein folding
- Homolog search
- Protein docking
- Function prediction

Stage 3. Genome Analysis
- Function prediction
- Gene clustering
- Disease classification

Stage 4. Network Analysis
- Network modeling
- Function prediction
- Pathway identification
- Module detection
Personalized Medicine

- Customized medical treatment
  - examination of genetic variation
  - understanding of the roles of genes in disease
Why Bioinformatics at Baylor?

- Bioinformatics Program in Baylor
  - Bachelor of Science in Informatics (BSI), majoring in Bioinformatics
  - First undergraduate program nationally (1999). Continues to occupy a very unique niche.
  - There is an increasing need to train individuals at the intersection of computer science, biology (genetics), biochemistry, mathematics, and statistics.
  - Two faculty members, Dr. Erich Baker and Dr. Young-Rae Cho
  - Approximately 40-50 majors.
Why Bioinformatics at Baylor?

- **Requirements**
  - Computer Science: 32 credit hours
  - Biology: 20 credit hours
  - Chemistry: 17 credit hours
  - Bioinformatics: 12 credit hours
    - Genomics & Bioinformatics
    - Introduction to Computational Biology
    - Capstone Bioinformatics Design Project
  - General Electives: 0 credit hours
Why Bioinformatics at Baylor?

- Research
- Bioinformatics Applications
- Databases / Algorithms
- Genetics
- Statistics / Systems Programming
- Biochemistry
- Mathematics / Computer Programming
- Evolutionary Biology
- Graduate / Industry
- Undergraduate
What can I do with this degree?

- **Graduate Schools (75%)**
  - Bioinformatics
  - Professional schools
  - Life science
  - Computer science

- **Industry (25%)**
  - Bioinformatics (pharmaceutical research)
  - Computer science
  - Life science
Bioinformatics Career & Salary Outlook

Molecular modelers and bioinformatics software developers can obtain between $60,000 and $100,000. The outlook for careers in bioinformatics is good, as the increasing trend in science is towards taking a multidisciplinary approach to solving biological problems. All of these career fields should see faster than average growth over the next five to seven years. However, competition for such jobs is expected to be high, and the best opportunities will be for candidates with post-graduate degrees.
Research Topics at Baylor

- **Dr. Erich Baker**
  - *Shewanella* Knowledgebase: integrating technology across disciplines and between laboratories. (DoE)
  - PTSD: managing data created by the center of excellence for traumatic brain injury. (DoD/VA)
  - Ontological Discovery Environment: identifying empirically created ontologies from primary biological sources. (NIH)

- **Dr. Young-Rae Cho**
  - Biological network modeling and analysis
  - Genomic and proteomic functional characterization
  - Disease-related pathway and drug target identification
Reference

- http://www.ecs.baylor.edu/bioinformatics/