

Test 1 will be Thursday (Oct. 4) in class. The test will cover chapters 1, 2, 3, and sections 4.1-4.3. The test will be open book and notes. Test 1 Topics are listed below.

### **Chapter 1. Introduction**

General definition of Bioinformatics

### **Chapter 2. Algorithms and Complexity**

What is an algorithm.

The Change Problem and algorithms: Greedy, BruteForceChange (Backtracking), Dynamic Programming

Correct vs. Incorrect Algorithms

Recursive Algorithms; Iterative vs. Recursive;

Fibonacci

Fast vs. Slow algorithms

Asymptotic Complexity Functions: Big-O, omega, and theta notations

You should be able to analyze an algorithm and determine its big-O and theta notations.

Algorithm Design Techniques: Exhaustive search, Branch-and-Bound Algorithms, Greedy

Algorithms, Dynamic Programming, Divide-and-Conquer Algorithms, Machine Learning, and Randomized Algorithms

Tractable vs. Intractable Problems; *NP*-Complete problems

### **Chapter 3. Molecular Biology Primer**

Cells: general composition, Prokaryotes vs. Eukaryotes, signaling pathways

Terminology: genome, gene, proteins, amino acids, genotype, phenotype, nucleic acid

Genetic Molecules: DNA (nucleotide bases (A, T, C, G)), RNA, Proteins

DNA structure, base pairs and hydrogen bonding, orientation, reverse complement

DNA Replication: DNA polymerase

RNA role in cell

Central dogma: transcription, translation, RNA polymerase, ribosomes

Codons: amino acid encodings, read frames,

Transcription process in Prokaryotes vs. Eukaryotes

Eukaryotic genes: intron, exons, splicing, alternative splicing

Translation (elongation) process: tRNA, rRNA, mRNA, anticodon,

Regulation of protein production: regulatory region, untranslated regions, start codon, stop codon, transcription factor, regulatory factor

Protein Structure and function: primary, secondary, tertiary, quaternary

Amino acid R-groups and their properties: polar/nonpolar, hydrophobic/hydrophilic

Chemistry Review: elements, atoms, neutron, proton, electron, isotopes, ions

Quantum numbers, chemical reactivity, covalent bonding, valence

Electronegativity, polar bonds and hydrogen bonding, hydrophilic, and hydrophobic

Molecular Biology Tools: restriction enzyme digests, blunt ends and sticky ends,

cloning, PCR reaction, DNA sequencing methods, gel electrophoresis, probe, hybridization, microarray (DNA chip)

### **Chapter 4. Exhaustive Search** (ONLY Sections 4.1-4.3 are on this test)

Terms: restriction mapping, complete and partial digests, multiset, partial digest problem (PDP)

PDP algorithms: BruteForcePDP, AnotherBruteForcePDP, PartialDigest (backtracking)

You should be able to trace and answer questions about these algorithms