22BIO211: Intelligence of Biological Systems - 2

Lab Sheet 4

1. Solve the following Rosalind Challenge : https://rosalind.info/problems/ba4b/and upload the 'strand' page.

Find Substrings of a Genome Encoding a Given Amino Acid String

There are three different ways to divide a DNA string into codons for translation, one starting at each of the first three starting positions of the string. These different ways of dividing a DNA string into codons are called reading frames. Since DNA is double-stranded, a genome has six reading frames (three on each strand).

We say that a DNA string Pattern encodes an amino acid string Peptide if the RNA string transcribed from either Pattern or its reverse complement Pattern translates into Peptide.

Peptide Encoding Problem

Find substrings of a genome encoding a given amino acid sequence.

Given: A DNA string Text and an amino acid string Peptide.

Return: All substrings of Text encoding Peptide (if any such substrings exist).

Sample Dataset

ATGGCCATGGCCCCCAGAACTGAGATCAATAGTACCCGTATTAACGGGTGA

MA

Sample Output

ATGGCC

GGCCAT

ATGGCC

2. Generate the Theoretical Spectrum of a Cyclic Peptide

The theoretical spectrum of a cyclic peptide Peptide, denoted Cyclospectrum(Peptide), is the collection of all of the masses of its subpeptides, in addition to the mass 0 and the mass of the entire peptide. We will assume that the theoretical spectrum can contain duplicate elements.

Generating Theoretical Spectrum Problem

Generate the theoretical spectrum of a cyclic peptide.

Given: An amino acid string Peptide.

Return: Cyclospectrum(Peptide).

Sample Dataset

LEQN

Sample Output

0 113 114 128 129 227 242 242 257 355 356 370 371 484

3. Find a Cyclic Peptide with Theoretical Spectrum Matching an Experimental Spectrum

Given an ideal experimental spectrum, find a cyclic peptide whose theoretical spectrum matches the experimental spectrum.

Given: A collection of (possibly repeated) integers *Spectrum* corresponding to an ideal experimental spectrum.

Return: Every amino acid string *Peptide* such that *Cyclospectrum*(*Peptide*) = *Spectrum* (if such a string exists).

Algorithm : Brute Force

4. Find a Cyclic Peptide with Theoretical Spectrum Matching an Experimental Spectrum

Given an ideal experimental spectrum, find a cyclic peptide whose theoretical spectrum matches the experimental spectrum.

Given: A collection of (possibly repeated) integers *Spectrum* corresponding to an ideal experimental spectrum.

Return: Every amino acid string *Peptide* such that *Cyclospectrum*(*Peptide*) = *Spectrum* (if such a string exists).

Algorithm : Branch and Bound