

Homework 1: ORF detection in R

Source: « Introduction to Computational Genomics, a case studies approach », Nello Cristianini and Matthew W. Hahn, Cambridge University Press, 2007

Open Reading frames: A (protein-coding) gene consists of stretches of (non-stop) codons that begins with a start codon and ends in a stop codon. However, only prokaryotic genes consist of single, continuous open-reading-frames (eukaryotic genes are interrupted by transcribed, but not translated, sequences called introns - the translated portions of the genes are referred to as exons). Because prokaryotic genes do not contain introns, gene finding can be simplified into a search for ORFs.

For this homework, we ask you to write a small program in R that finds ORFs in prokaryotic sequences. This program will have, at least, the sequence (in FASTA format) and a minimum length (in number of nucleotides) as input and will return the different ORFs as well as their position and their frame.

Algorithm: Given a DNA sequence s , a positive integer k , for each reading frame decompose the sequence into triplets, and find all the longest non-overlapping stretches of triplets starting with a start-codon and ending with a stop codon. Repeat also for the reverse complement of the sequence. Output all ORFs longer than the prefixed threshold k .

Execute your program on the mtDNA from the mouse (NC_005089). Note that the genetic code from mitochondria is slightly different from the standard one. In particular the one for those vertebrates has different start and stop codons, resulting in different ORFs: the codon TGA means stop in the universal code, but code for tryptophan in mtDNA; AGA and AGG code for arginine in the universal code and the stop codon in mtDNA; and ATA represents isoleucine in the universal code and methionine in mtDNA. (START : ATA, ATG & STOP : AGA, AGG, TAA, TAG)

- What fraction of the sequence represents (candidate) protein coding genes for $k = 200$?
- Try $k = 10, 50, 100, 300, 500$. How does this affect the number of ORFs you find ?