CSE 527 Lecture15, Nov. 15, 2006
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Next four lectures on RNA.

Today motivate why RNA is important.

What is the most rapidly evolving human gene? Region would expect .25 mutations, has 18. Not coding for a protein. Why the evolutionary pressure.

RNA folds up to do something.

This gene is very specifically active in early states of brain development.

Origin of Life

Everything needs everything else (protein, DNA, RNA). How could all the interdependent complexity have originated? RNA can do everything, hence:

The "RNA World" Hypothesis: 1st life was RNA based.

DNA is more stable than RNA—better for information storage. Proteins are more flexible than RNA—Better for specific tasks. So RNA has been superceded for many tasks, but it was likely the original, and still is present in critical places (ribosomes, tRNA, etc.)

RNA Structure

Non-canonical pairs only occur in self folds of RNA, tend to occur if RNA has been modified.

Ribosomes

Ribosomes have an RNA core with Proteins attached. Also messenger RNA and transfer RNA.

RNA catalyses protein production. Goes back to RNA world hypothesis.

tRNA 3d Structure

At least 20 tRNAs—one for each amino acid. 61 different codons plus 3 stops. "Wobble" base pair can be exploited to decode multiple sequences, so in some organisms fewer that 61 kinds of tRNA (< 61 anti codons) suffice to decode all 61 codons.

tRNA – Alt. Representations

Can be drawn as a circle with lines connecting pairs. Lines do not cross. If lines cross it is called a pseudo knot. Algorithms we are going to discuss do not find pseudo knots—would be much slower if they did.

Classical RNAs

100s of amino acids 20 of which are coded for with codons. There is a 21st selenocysteine that appears sometimes. It is coded for with a stop codon that is changed with some context.

Semi-classical RNAs

Telomerase stabilizes ends of DNA

snoRNA provides templates

Recent Discoveries

Now lots of RNAs

Glycine Regulation

When glycine level is high, it binds to a protein transcription factor, that enables a gene that breaks down glycine—for a while.

Glycine Riboswitch

Regulates glycine without a protein. Break down enzyme is transcribed all the time. When glycine levels are low, a pair of riboswitchs turn off transcription mid way.

Methylation cycle

Gene Regulation

4 riboswitches regulate SAM

6S

First known in E.coli, recently found be in all bacteria. Traps RNA polymerase in times of scarce resources.

Followed Slides for a while

Comparative sequence analysis looks for changes in parings and compensating mutations with respect to anticipated structure.

Nussinov: Max Paring

Algorithms that account for pseudo knots have been proposed at something like n^4 or n^5.