Introduction:
RNA Structure Prediction & Design of Protein/Nucleic Acid Complexes

CS/CME/Biophys/BMI 371

Feb. 8, 2017
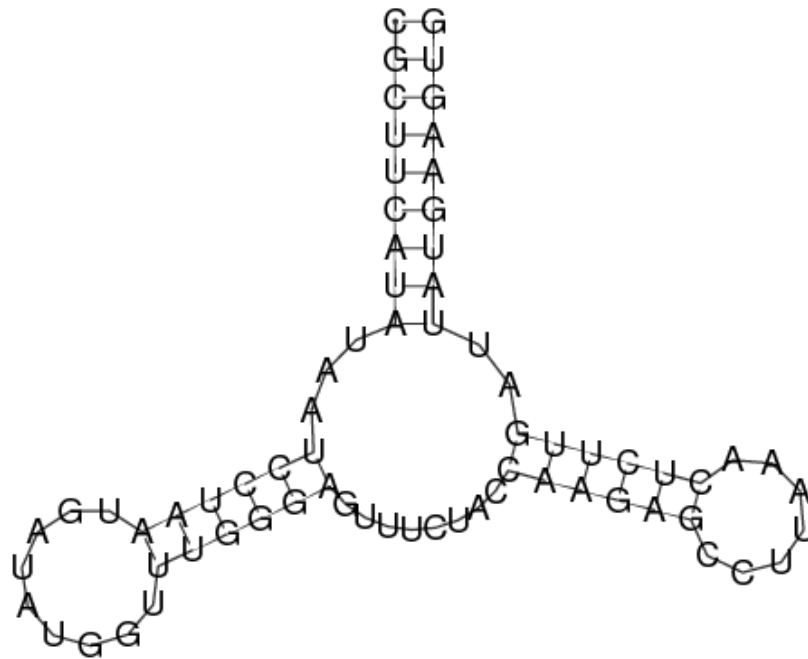
Ron Dror

Nucleic acid structure

- Most of the "machines" in the cell are protein-based

- Nucleic acids (DNA and RNA) act primarily as information carriers

- However, they're not just long threads. They can take on well-defined structure, which is important in two ways:

  – It influences gene expression (the extent to which proteins are produced from the DNA that codes for them)

  – Nucleic acids—especially RNAs—can also act as machines. (In fact, life may have originated this way.)

# Topic 1: Predicting RNA secondary structure

- For RNA "secondary structure" — that is, how the bases pair — is of great interest

http://www.tbi.univie.ac.at/~pkerp/forgi/_images/1y26_ss.png

Predicting secondary structure of RNA pseudo knots

- RNA secondary structure is typically predicted using dynamic programming algorithms that assume all loops are "nested"
- *Pseudoknots* violate this assumption
- One of Monday's paper proposes an algorithm to overcome this problem, incorporating information from SHAPE experiments (also used in EteRNA)

Typical secondary structure

Pseudoknot

http://www.tbi.univie.ac.at/~pkerp/forgi/_images/1y26_ss.png

Theimer and Feigon, Curr. Opin. Struct. Biol. 16:307-318 (2006)

4

Topic 2: Design of DNA structures

- DNA has been used previously to design "origami" shapes
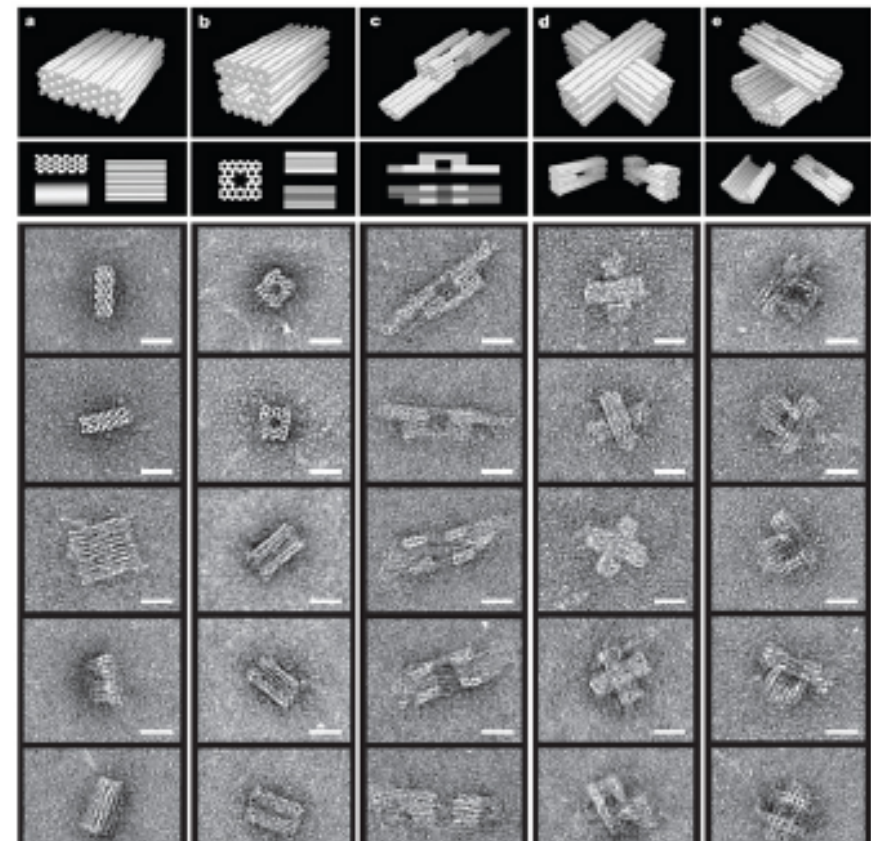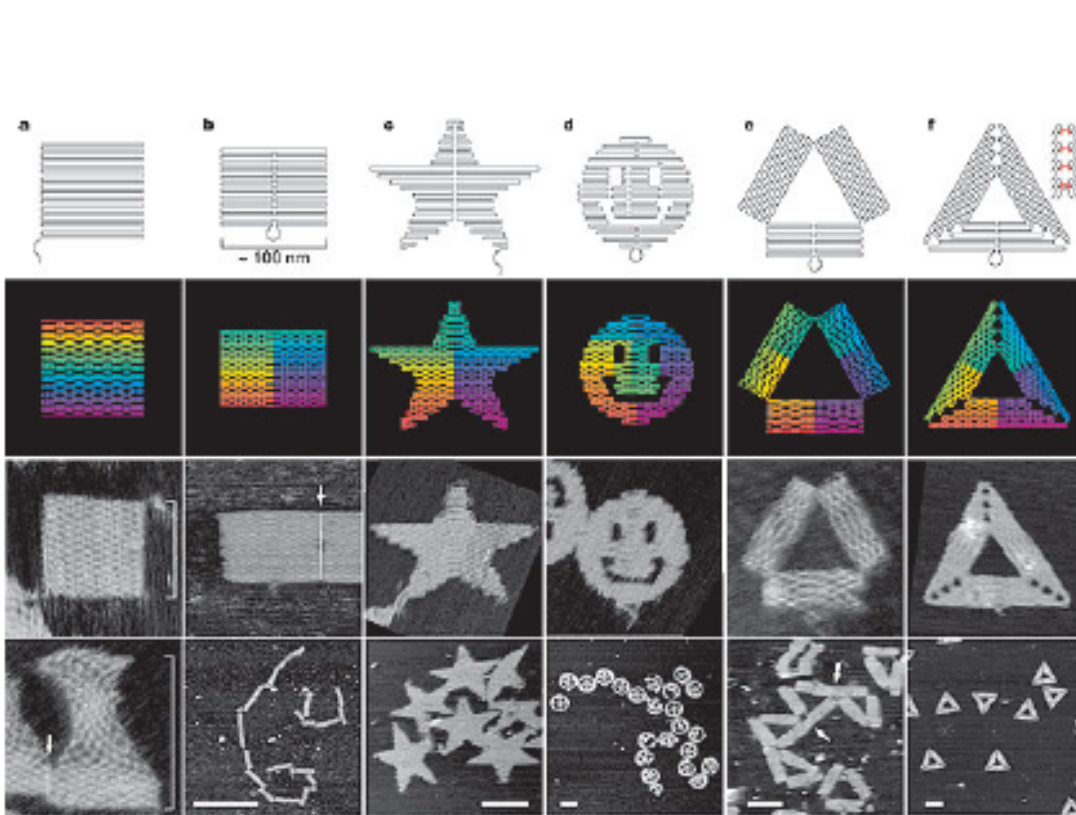
PWK Rothemund. Nature 440, 272-302 (2006).
SM Douglas et al. Nature 459, 414-418 (2009).

Designing a DNA–protein complex

- One of Monday's papers describes design of a self-assembling "wire" including repeating protein and DNA units

Mou et al., Nature 525:230-233 (2015)