

Math 127, **Homework # 2**

due: Thursday, February 15

- (1) Write a short essay (\leq one page) about the **genetic code**. Define the terms **codon** and **codon bias**. What is a **stop codon** ?
- (2) The HMM for the occasionally dishonest casino is specified by 1296 homogeneous polynomials $p_{\tau_1\tau_2\tau_3\tau_4}$ in twelve unknowns $\theta_{\bullet\bullet}, \theta'_{\bullet\bullet}$. For which sequence of dice roll observations $\tau_1\tau_2\tau_3\tau_4$ is the number of terms in the monomial expansion of $p_{\tau_1\tau_2\tau_3\tau_4}$ maximal resp. minimal.
- (3) Compute (e.g. using MATLAB or Mathematica) the dimension of the vector space (over the field of real numbers) spanned by the 1296 coordinate polynomials $p_{\tau_1\tau_2\tau_3\tau_4}$ of the occasionally dishonest casino model.
- (4) Prove Proposition 2.4 on page 46 in the ASCB book.
- (5) Let G be the undirected graph on five nodes with adjacency matrix

$$D_G = \begin{pmatrix} 0 & 3 & 7 & \infty & 11 \\ 3 & 0 & 8 & 4 & 2 \\ 7 & 8 & 0 & 1 & 5 \\ \infty & 4 & 1 & 0 & 20 \\ 11 & 2 & 5 & 20 & 0 \end{pmatrix}$$

Compute the tropical matrix powers $D_G^2, D_G^3, D_G^4, D_G^5$ and D_G^6 . Also compute the tropical determinant of the 5×5 -matrix D_G . Explain what the results of your computations mean.

- (6) Explain (in your own words) the proof of Remark 2.31 on page 68 in the ASCB book. Give several examples which illustrate this statement.
- (7) On Monday, February 12 at 8:00pm, **Arnold Levine** of IAS Princeton will give a public lecture at the Berkeley Repertory Theatre on “*The Evolution of Influenza Viruses in the 20th and 21st Centuries*”, and on Tuesday, February 13 at 3:00pm, he’ll speak at MSRI on “*DNA/RNA Sequence Complexity: The Entropy Distribution of Viruses and Bacteria*”. See www.msri.org for details. Attend (at least) one of these two lectures and write a brief report (\leq one page) on its content, highlighting what you see as the main insights presented by the speaker.