MO640 - Computational Biology

Open-Ended Exam 1 - March 26th, 2015

Question 1 (2.0 points)

1. Cite three amino acids.

2. Find the reverse complement of the following sequence:

   AACAAATGGCACTAGCTGCCTTTCAAGCTCTCGGT

3. Enzyme *EcoRI* cuts DNA in the pattern `G|AATTC`. Consider a DNA molecule represented by the below:

   ATGGAATTCCGCATCCTTCACTG

   Compute the number of nucleotides in each part as this DNA molecule is cut *EcoRI*. Don't forget to consider both strands of each piece.

Question 2 (2.0 points)

1. Draw the graph represented by the following adjacency lists:

   ```
   1:  3, 2, 5
   2:
   3:  4, 2
   4:  5, 1, 2
   5:  3, 2
   ```
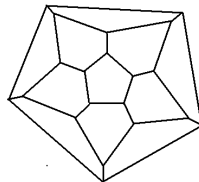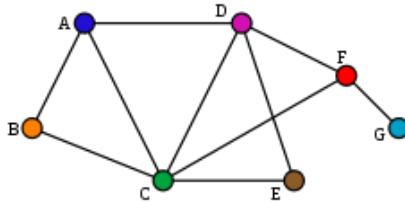
2. Find a Hamiltonian cycle in the graph below:

3. Color the vertices of the following graph so that adjacent vertices get distinct colors. Use as few colors as possible.

Question 3 (1.0 points) Find all optimal global alignments between the following sequences:

```
ATTC
ATGGA
```

Use a scoring scheme where matches score $+1$, mismatches score -1 and spaces score -2.

Question 4 (5.0 points) Two DNA sequences A and B with length 80 differ in 15 positions, with 8 of them being transversions and 5 transitions. Admitting that their evolution follows the Kimura two-parameter model, find the transition and transversion rates multiplied by elapsed time.

For reference, we reproduce here the Kimura formulas for the probabilities of transitions and transversions given the transition and transversion rates α and β:

$$\text{Pr(transition)} = \frac{1}{4} - \frac{1}{2}e^{-2(\alpha+\beta)\Delta t} + \frac{1}{4}e^{-4\beta\Delta t}$$
$$\text{Pr(transversion)} = \frac{1}{2} - \frac{1}{2}e^{-4\beta\Delta t}$$

Good luck!