Dept. of Computer Science and Engineering, Graduate
National Sun Yat-sen University
Bioinformatics, Final Exam., June 27, 2007, 18:30—20:30

Part I

(1) Comparing the similarities and differences between prokaryotic and eukaryotic cells. (10%)

(2) DNA replication, transcription and translation are essential processes of living cells. Choose one of the processes and describe it. (10%)

(3) Polymerase chain reaction is a widely used experiment. What is it? What are the components included in the PCR? How to perform it? (15%)

Part II

(4) The KMP algorithm is one of efficient algorithms for solving the string matching problem. In the algorithm, one should first calculate the prefix function f of the pattern string $P_1P_2...P_m$. $f(j)$ of P_j is defined as the largest $k < j$ such that $P_{1,k} = P_{j-k+1,j}$, where $P_{i,j} = P_iP_{i+1}...P_j$.

(a) Suppose the pattern string is P="ATCACATCATCA". Please give the value of the prefix function on each position. (6%)

(b) Suppose the text string is S="GATCGATCACATCATCACGA" (20 letters). Please illustrate the KMP algorithm for finding P in S by using the prefix function. (9%)

(5) (a) The degree of each node in an unrooted evolution tree is 3. Suppose that the number of leaf nodes is n. Prove that $NE(n)=2n-3$, where $NE(n)$ denotes the number of edges in the tree.(5%)

(b) Suppose that there are n leaf nodes in an unrooted evolution tree. Prove that $TU(n) = (2n-5)(2n-7)...1$, where $TU(n)$ represents the number of possible unrooted trees. (5%)

(6) Explain the primary, secondary, tertiary structures of a protein. Explain the ab inito method and homology modeling for predicting protein structures. (10%)

Part III

(7) What are the six goals of the human genome projects? (6%)

(8) In pharmacogenomics, how the polymorphisms of drug metabolizing and receptor genes affect one individual's responses (14%)?

(9) What are homologous genes? (5%)

(10) What is a Morkov chain and hidden Morkov model (HMM), please give two examples of appliciations in bioinformatics. (10%)