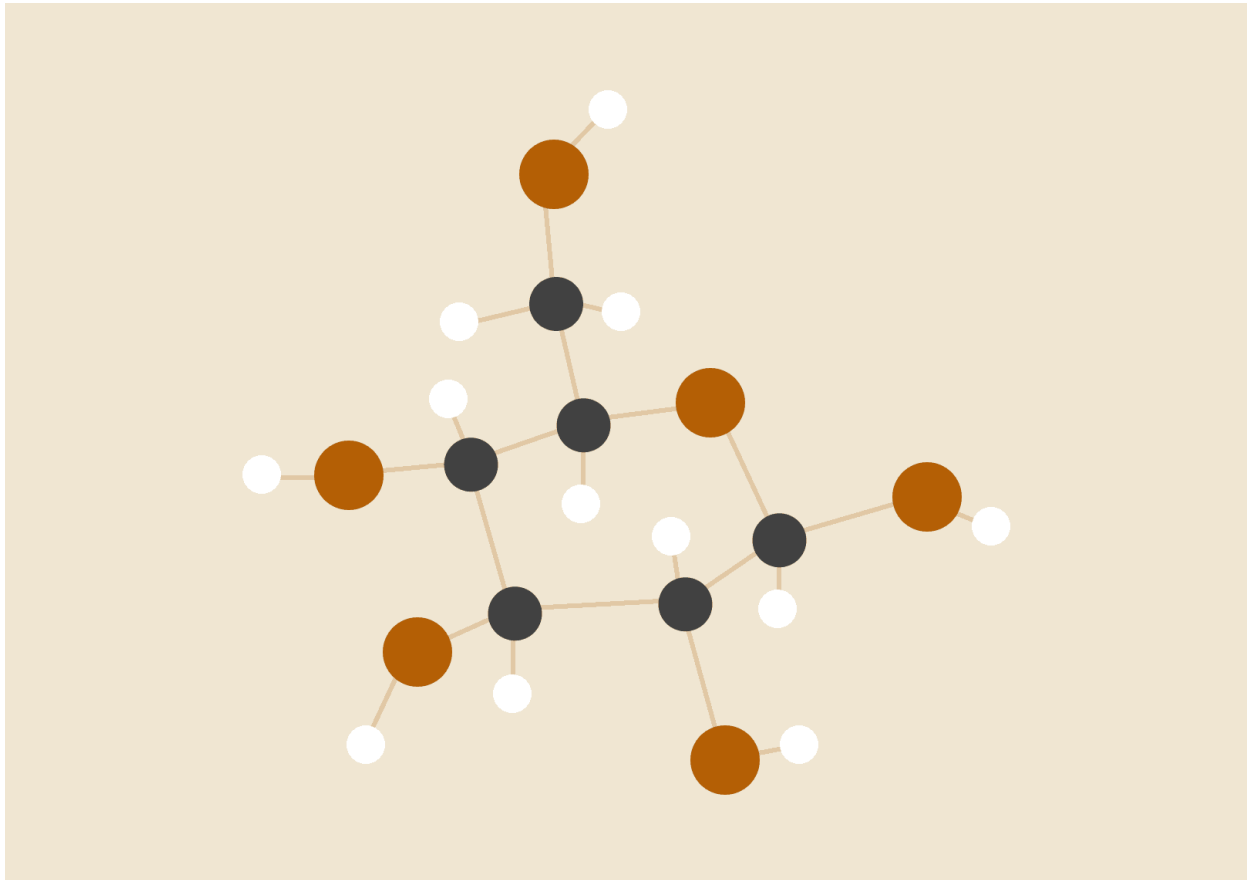# Fundamentals of Computational Biology

Question Bank

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06.02.2024
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UNIT - I

1. What do you understand by mathematical modeling? Explain with suitable examples.
2. In a fermentation unit where yeast is used for ethanol production, please find out the concentration of yeast cells after 48 hours of incubation, when the division time is given as 20 min. Please note that the initial cells were 4×10^3 in numbers?
3. Discuss the kinetics involved in product production and substrate decay.
4. For any enzyme kinetic reactions, please derive the expression for velocity of the reaction. Find out the velocity of reaction when Vmax and Km of the reaction are 1.1 and 0.25 respectively. Given substrate concentrations are 200mM, 70mM and 4mM.
5. Explain use of matrix algebra in solving linear equations? Please find out the number of bacterial cells after 24 hours of incubation, when the division time is given as 30 min. Please note that the initial cells were 100 in numbers?
6. What do you understand by bacterial growth kinetics? Derive mathematical equation explaining exponential phase.
7. Differentiate between dependent and independent variables with suitable examples.
8. What do you understand by mathematical modeling? Explain the different steps involved in it along with an example.
9. Discuss the different phases of bacterial growth along with the mathematical equations involved in it.
10. Discuss the kinetics involved in product production and substrate decay.

UNIT - II

1. What do you understand by cancer spread? In brief please explain the cell cycle of a cancer cell.
2. With suitable examples, describe the ODE model building and its importance?
3. Explain the Lotka-Volterra model in detail. Also write the mathematics expression for prey and predator concentrations by using appropriate constants.
4. In detail explain the concept of infectious disease spread. Please discuss the SIR

and SIS models with examples and mathematical expressions.

5. Explain the mathematical mode associated with cancer spread?

6. Derive the ODE expression for each component of the following reaction. Please note that the product formation step is an enzymatic process (use enzyme kinetics while modeling the last step).

$$S_1 + S_2 \overset{k1}{\underset{k2}{\leftrightarrow}} [S_1 S_2] \overset{k3}{\underset{k4}{\leftrightarrow}} [P_1 P_2] \overset{k5}{\to} P_1 + P_2$$
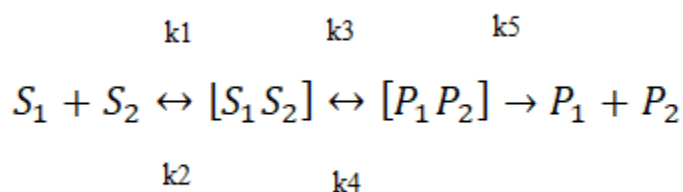
7. Explain population dynamics. Also write the mathematics expression for prey and predator concentrations by using appropriate constants.

8. Define vaccines. How can its efficacy be predicted?

9. What do you understand by population dynamics? Discuss predator-prey model in detail.

10. Discuss the various models used to study the cycle of infectious diseases.

11. What do you understand about cancer? How it spreads, Explain the mechanism, What are the different models associated with it.

UNIT - III

1. Write short notes on graph theory.

2. What are the different graphs used to represent biological data, explain with suitable examples. Discuss surface and heat plot in detail.

3. Write down the different steps used for plotting graphs in Python and Google Sheets. What are the different commands used to add axis title, scale, changing colour using Python and Google Sheets?

4. What are the different types of graphs used for representing biological data? Which one is most appropriate type of graph to study population dynamics?

5. Write short notes on different distribution plots.

6. Write detailed notes on different plots used in computational biology.

7. Write down the script for plotting following graphs.
    a) Scatter plot
    b) Bar plot
    c) Surface plot
    d) Heatmaps

UNIT - IV

1. Write detailed notes about different fluid properties.
2. In detail, please describe the process of cellular respiration process. Write mathematical equations associated with respiration.
3. In detail, please describe the circulatory system in humans.
4. What do you understand by streamline and turbulent flow?
5. What is the difference between breathing and respiration?
6. In detail, please describe the process of cellular respiration. In brief explain the fick's law of diffusion and mathematical expression associated with fick's law.
7. In details, please describe the circulatory system in humans. What do you understand by streamline and turbulent flow?
8. State continuity equation and find out the exit velocity of a fluid flowing in pipe when the diameter is reduced from 100mm to 80mm. Given that velocity of fluid at entry point is 0.6 m/s
9. What do you understand by respiration? Discuss briefly.
10. Discuss the mechanism involved in any one biochemical reaction with suitable example.
11. Discuss the different models used to study fluid flow along with mathematical relations.
12. Define Fick's law of diffusion. What do you understand by simulation?

UNIT - V

1. Define molecular switches. Explain with suitable examples.
2. What do you understand by flux balance analysis? Explain in detail, how it is done?
3.   What is mutation? How is it studied in the population? Explain.
4. What do you understand by molecular switch? Provide appropriate examples.
5. Explain what a mutation is and its role in evolution. Also, how mutational studies are performed in a population.

6. What do you understand by flux balance analysis? What is the use of flux balance analysis? Give an appropriate example of how one can formulate and solve the flux balance.
7. Explain the relevance of molecular switches.
8. What do you mean by mutations? State different theories associated with mutational theories of evolution?
9. With appropriate example, explain the flux balance analysis in computational biology.
10. In detail explain the mutational theory of evolution.
11. What do you understand by evolution? Briefly explain the different theories of evolution.