Q1

a) Constructing a binary genetic algorithm for a complex problem involves several steps:

1. \*\*Problem Definition:\*\* Clearly define the problem you want to solve using the genetic algorithm.

2. \*\*Encoding:\*\* Decide on the representation of individuals in the population. In a binary genetic algorithm, this often means representing solutions as strings of binary digits (0s and 1s).

3. \*\*Initialization:\*\* Generate an initial population of individuals randomly or through heuristics. Each individual represents a potential solution encoded in binary strings.

4. \*\*Evaluation:\*\* Define a fitness function that quantifies how well an individual solves the problem. Evaluate the fitness of each individual in the population based on this function.

5. \*\*Selection:\*\* Select individuals from the population based on their fitness. Common methods include roulette wheel selection, tournament selection, or rank-based selection.

6. \*\*Crossover:\*\* Create new individuals (offspring) by combining genetic material from selected parents. For binary encoding, this often involves selecting crossover points and swapping segments of binary strings between parents.

7. \*\*Mutation:\*\* Introduce random changes in the offspring population to maintain genetic diversity. Flip or change certain bits in the binary strings based on a mutation probability.

8. \*\*Replacement:\*\* Decide how to replace individuals in the population with the new offspring. Strategies include generational replacement (replacing the entire population) or steady-state replacement (replacing a subset of the population).

9. \*\*Termination:\*\* Determine a stopping criterion, like reaching a maximum number of generations, achieving a certain fitness threshold, or stagnation in improvement.

10. \*\*Repeat:\*\* Iteratively perform steps 4 to 9 until the termination condition is met.

b) A single-layer perceptron requires a bias term to account for scenarios where all inputs are zero (or near zero). The bias allows the neuron to activate even when the inputs are not providing any signal. It essentially shifts the decision boundary away from the origin and enables the model to learn and represent patterns that don't pass through the origin. Without a bias term, the model might be constrained to pass through the origin, limiting its capacity to learn more complex patterns or data distributions that don't originate from the origin.

Q2

A screenshot of a math book

Description automatically generated

What is phase space

<https://en.wikipedia.org/wiki/Phase_space>

Q2.

a) = 0

b) stable 1d dynamic system

c) 2d system equribium, solve equation

d) P q coordinate axes

e) equation for isocline

eii) ode solver same phase space in isocline.

Q3.

a)exponential growth function

linear function with slope C

b) mathematic, queen based on linear+worker function

c) solved either way, mathematic or simulation to get optimal fitness

d) modeling mortality (check lecture), fits rate or logistic model (as simple as possible)

e)

Q4.

Simulation

a) computational cost, stochastic simulation model, loop over time, what are the condition, will it go extinct, survive will speciation, output not really look like the teacher

b) test stochastic model, function run 1000 times

c) density be the model?