Homework Assignment #22 Key

Genetic Algorithms (10 points)

Suppose you want to discover the best combination of attributes for pizza. Using the genetic algorithm paradigm (use crossover and mutation), walk through and discuss **two** evolutionary iterations of a scenario starting from an initial population of **4** pizzas. Describe necessary assumptions about representation, genetic operators, selection approach, survival, etc. Show your best pizza after two iterations. Note that:

- The features are crust type, amount of cheese, sauce type, and # of pepperonis.
- You should provide 4 actual initial pizzas (genomes) with an appropriate feature representation.
- Assume you are provided a fitness function (e.g. a CS student) that will test any combination of these features and return a fitness measure.

Here is an example solution:

My feature assumptions:
Crust type can be Thin, Stuffed, or Thick
Amount of cheese is by weight in ounces (real valued)
Sauce type is red, white, or BBQ
Pepperoni is a positive integer >= 0
Fitness is a value between 0 and 10

Initial Random Pizzas and their fitness

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
1	Thin	5.8	Red	0	2
2	Thick	18	BBQ	50	5
3	Stuffed	15	White	60	6
4	Thin	22	Red	100	8

For crossover I choose parents by roulette wheel (higher fitness has higher probability of being chosen). The crossover spot is random. I choose 2 parents each time thus creating two new children.

In this round I assume parents 2 and 4 are chosen with a crossover split in the middle. This creates two new Pizzas which when tested have the following fitness values.

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
Child 1	Thick	18	Red	100	4
Child 2	Thin	22	BBQ	50	5

I choose 1 pizza randomly for mutation and mutate one feature. Assume it is Pizza 3 with mutation (# pepperonis) and fitness as follows:

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
3 Mutated	Stuffed	15	White	45	3

Now my new population has 7 pizzas.

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
1	Thin	5.8	Red	0	2
2	Thick	18	BBQ	50	5
3	Stuffed	15	White	60	6
4	Thin	22	Red	100	8
Child 1	Thick	18	Red	100	4
Child 2	Thin	22	BBQ	50	5
3 Mutated	Stuffed	15	White	45	3

I need to remove 3 pizzas which I do randomly and inversely proportional to their fitness. Assume I delete pizzas 1, 2, and Child 1 leaving me with the new population of

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
1	Stuffed	15	White	60	6
2	Thin	22	Red	100	8
3	Thin	22	BBQ	50	5
4	Stuffed	15	White	45	3

Now I do one more round. Assume I crossover 1 and 2 with the crossover happening between Crust and Cheese. Assume I mutate Pizza 4 (crust type). Following would be my new population with fitness values.

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
1	Stuffed	15	White	60	6
2	Thin	22	Red	100	8
3	Thin	22	BBQ	50	5
4	Stuffed	15	White	45	3
Child 1	Stuffed	22	Red	100	7
Child 2	Thin	15	White	60	9
4 Mutated	Thick	15	White	45	5

I probabilistically Pizzas 1, 4, and 4 mutated leaving the following four of which Pizza 4 is the current best with a fitness of 9.

Pizza #	Crust	Cheese	Sauce	# Pepperoni	Fitness
1	Thin	22	Red	100	8
2	Thin	22	BBQ	50	5
3	Stuffed	15	Red	100	7
4	Thin	22	White	60	9