Programming Homework 10

CS540

August 2, 2019

1 Instruction

Please submit your output files and code on Canvas → Assignments → P10. Please do not put code into zip files and do not submit data files. The homework can be submitted within 2 weeks after the due date on Canvas without penalty (50 percent penalty after that).

Please add a file named "comments.txt", and in the file, you must include the instructions on how to generate the output, for example:

- Data files required: train.csv, test.csv. Run: main.jar.
- Data folder required: data/train1.png ... data/train100.png . Compile and Run: main.java.

2 Details

All the requirements are listed on the course website. The following is only an example workflow to solve the problem.

1. Use an integer array to store the pipe heights. Let h_t represent the height of the pipe at location t.
2. Randomly generate 100 integer or boolean arrays (of length 100) to represent the actions of the 100 birds. For example, if 1 represents a mouse click and 0 represents no mouse click, then you can initialize bird i, time t action by:

$$a_{it} = \begin{cases} 1 & \text{with probability } \dfrac{1}{3} \\ 0 & \text{with probability } \dfrac{2}{3} \end{cases}$$

3. Compute the score of each bird by keep adding 1 while the bird does not hit the pipe (strictly below h_t or strictly above $h_t + 2$) or go out of the map (strictly below 0 or strictly above 10). Here z_{it} is the position of the bird i at time t and s_i the score of bird i.

$$z_{it} = \sum_{t'=1}^{t} \left(a_{it'} \cdot x - (1 - a_{it'}) \cdot y \right), \text{ with } x = 2, y = 1, \text{ for example}$$

$$s_i = \min_t \left\{ z_{it} \in [0, 10] \text{ and } z_{it} \in [h_t, h_t + 2] \text{ if } h_t \neq 0 \right\}$$

4. Compute the reproduction probability of bird i.

$$p_i = \frac{s_i}{\sum_{i'=1}^{100} s_{i'}}$$

5. Generate 50 pairs of random parents for crossover according the p_i. Use CDF Inversion (see HW5). There are many ways to crossover, try uniform crossover and 1 point crossover before or around the position when one of the birds die. For example, if you choose to crossover birds i and i' at the point $s = \min\{s_i - \varepsilon, s_{i'} - \varepsilon\}$, say $\varepsilon = 1$, then the children will be b_i and $b_{i'}$ with:

$$b_{it} = \begin{cases} a_{it} & \text{if } t < s \\ a_{i't} & \text{if } t \geqslant s \end{cases}$$

$$b_{i't} = \begin{cases} a_{i't} & \text{if } t < s \\ a_{it} & \text{if } t \geqslant s \end{cases}$$

   You can try $\varepsilon = 0, 1, 2, 3, ...$ and compare the performance. You can choose a random $\varepsilon \in \{0, 1, 2, ...\}$ every time too.

6. Mutate by updating each action a_{it} (from 1 to 0 or 0 to 1) with a very small probability, say 0.01.

$$b_{it} = \begin{cases} b_{it} & \text{with probability } \approx 1 \\ 1 - b_{it} & \text{with probability } \approx 0 \end{cases}$$

7. Replace the population a_i by b_i. Keep track of s_i and repeat until average s_i does not improve.