## Natural Computing

## Selection

## Question 1

*(Hint: use a Spreadsheet Application such as MS-Excel for Question 1)*

1.  Given a population of ten Polar Bears with the following fitness values {4.0, 3.0, 7.0, 3.0, 2.0, 2.0, 1.0, 4.0, 5.0, 4.0} (Note: larger fitness values are best):

    1.1.  What is the average fitness of the population?

    1.2.  Calculate the probability of each Polar Bear to become a parent.

    1.3.  What is the sum of all the probabilities?

    1.4.  Convert each probability to a percentage.

    1.5.  Draw an illustration of the Roulette Wheel used to select from these Polar Bears (Hint: Graph a Pie-Chart).

    1.6.  Temporarily modify some of the fitness values and observe the effect on the Roulette Wheel. For example, What are the implications of a population with fitness values {6.0, 6.0, 7.0, 6.0, 6.0, 7.0, 7.0, 7.0, 6.0, 7.0}?

## Question 2

1.  Draw a figure of the Roulette Wheel converted to a line diagram. (Hint: the start point of the line has the value 0.0 and the end point of the line has value 1.0).

2.  Download, compile & execute the java implementation of a Roulette Wheel Selection algorithm (RouletteWheel.java) from http://ncra.ucd.ie/ COMP30290/selection/selection.zip (Hint: *read* the README.txt file)

3.  In your own words describe how the Roulette Wheel Selection algorithm works.

4.  Adapt the code to also calculate & print out

    4.1.  the average fitness of the population

    4.2.  the best fitness value of the population

    4.3.  the worst fitness value of the population

## Question 3

1.  Given the Roulette Wheel Selection code from Question 2 and the following population of Polar Bear fitness values {4.0, 1.0, 7.0, 5.0, 4.0, 5.0, 2.0, 3.0, 5.0, 5.0}:

    *(Hint: adapt the Spreadsheet from Question 1)*

    1.1.  Calculate the probability of each Polar Bear being selected and store the values in a text file with one value per line. (Hint: The sum of all the fitness values should be equal to 1.0)

    1.2.  Use the Roulette Wheel Selection code from Q.II to select five pairs of Polar Bears as parents (Aside: each pair would produce two children, so in our simple Evolutionary Algorithm all the parents die when they reproduce and are replaced with their children. The population size remains constant at ten).

    1.3.  Calculate the expected count of each Polar Bear being selected as a parent (i.e., Divide the Fitness of each Polar Bear by the Average Fitness of the population).

    1.4.  Does the expected count of each individual approximately correspond with the Actual number of each Polar actually selected? (Aside: you should observe that the fitter Polar Bears get more copies).