

## Genetic algorithm assignment

Suppose a genetic algorithm uses chromosomes of the form  $x = abcdefgh$  with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual  $x$  be calculated as:  $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$ .

and let the initial population consist of four individuals with the following chromosomes:  $x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$   $x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$   $x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$   $x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$

- a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.
- b) Perform the following crossover operations:
  - i) Cross the fittest two individuals using one-point crossover at the middle point
  - ii) Cross the second and third fittest individuals using a two-point crossover (points b and f).
- c) Suppose the new population consists of the six offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved?
- d) By looking at the fitness function and considering that genes can only be digits between 0 and 9 find the chromosome representing the optimal solution (i.e. with the maximum fitness). Find the value of the maximum fitness.