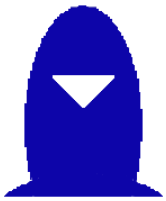
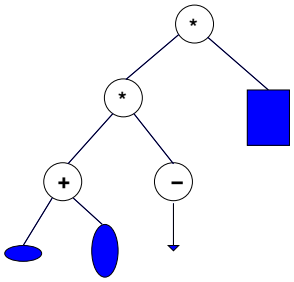
CEng 713 Evolutionary Computation, Homework 2

Due: 13th November 2005

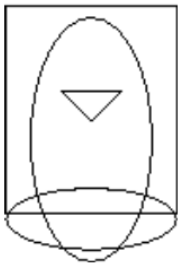
In this homework, you will have a genetic programming application that will try to match a geometric description on a rendered 2D image.



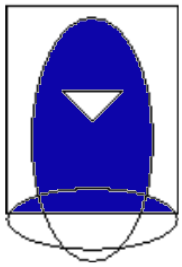
Rendered image



Tree of shapes



Shape borders



Shapes filled

There are only 3 operations are defined for shape composition:

- * Intersection operation combines the areas of shapes so that points only inside of the both operands will be in the new shape.
- + Union operation combines the areas of shapes so that points inside of the any operand will be in the new shape.
- - Negation operand produces a complement shape so that all points not inside of the operand will be in the new shape. Note that the difference `A - B` can be denoted as `A * (-B)`.

As terminals, you will have 3 basic shapes:

`rectagle(x1,y1,x2,y2)` A rectangle with the corners
`triangle(x1,y1,x2,y2,x3,y3)` A triangle with the corners
`ellipse(x1,y2,x2,y2,r1,r2)` An ellipse with given centers and radii.

All coordinates are integers in the range [0..255]. You have a 256×256 image and you will be given a sample of points with inside/outside information as inputs. Each individual will be a tree of geometric compositions. For the fitness evaluation, you will make inside/outside test for all sample points for the shape represented by the individual, and compare results with the input information. Also compactness (the number of nodes) of

the tree will be favored in fitness. However it should not be important than the accuracy. You can assume that the input images can be represented by composition of at most 20 basic shapes.
You can introduce additional terminals/non-terminals (i.e. geometric transformations) as long as they are convertible to existing sets. Input image information will be given as a text file consisting of triplets in each line:
$x \ y \ v$
Where v is either 0 or 1 denoting outside and inside respectively. Some input cases will be provided on the course web page.
You can use any variety of tree based encodings any evolutionary parameters, operators etc. as long as you explicitly state them. Also you can try some enhancement to improve performance. You can use galib tree encoding or other system like Open Beagle (`http://beagle.gel.ulaval.ca/index.html`), Beagle Puppy (a limited version of Open Beagle).
Please repeat your experiments for at least 10 times for each test data. Report your results with the following format:

Topic: Shape recognition with GP
Name surname: **Id:**

GP Parameters:

Population size:
Crossover/mutation rates:
Type of crossover/mutation:
Selection mechanism:
% of Elitism:
Maximum depth allowed: Additional alphabet elements and functions:

Any additional enhancement used:
Fitness function:

Results

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Figure 1: Generation vs best and average fitness (test case 1)

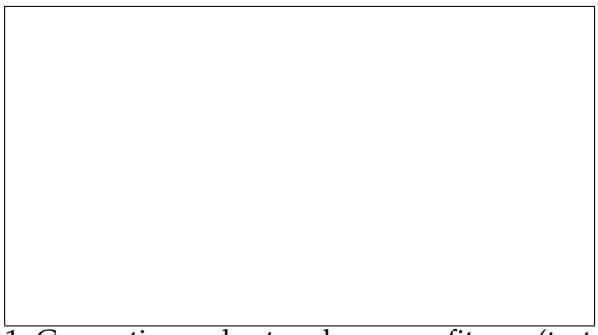

Figure 1: Generation vs best and average fitness (test case 2)

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