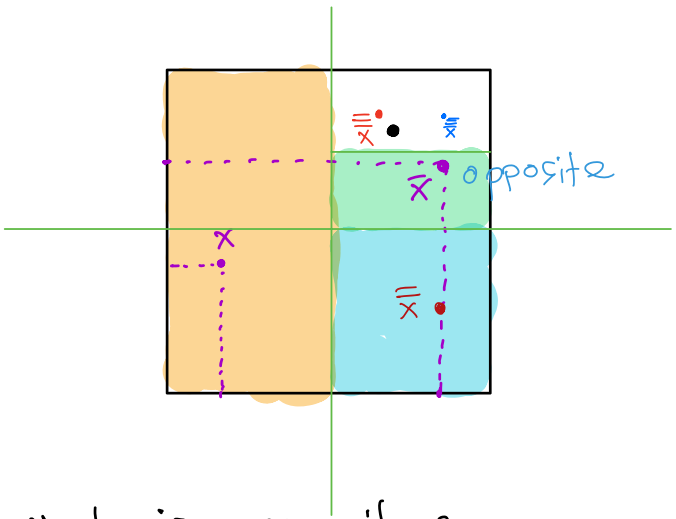
Other version of GAs

Differential Evolution (DEs)

Opposition-Based Learning

Idea- use opposites for better/faster learning/ optimization



What is opposite?

For any given $x \in [a,b]$, the opposite of x, $\breve{x}$ can be given as $\breve{x} = (a+b-x)$.

Idea of opposition based learning:

Given unknown function $f(x)$ with an evaluation function $g(x)$, for every x and its opposite $\breve{x}$, we continue with if $g(x) > g(\breve{x})$.

Ex: ANN w_i ... create $\breve{ANN}$ $\breve{w}_i$ ...

$\breve{w}_i = a + b - w_i$

continue working on the network with lowest error.

Problem: memory intensive

Perhaps meaningful at the very beginning.

RL Agent - Tabular implementation

$\bar{a}_1$ = a_3

Q	a_1	a_2	a_3	a_4
s_1				
s_2				
⋮				
s_i	r		$\bar{r}$	
⋮				
$\bar{s}_i$ = s_j	$\bar{r}$		r	
s_n				
⋮				

ex: a_1 = elevator up

$a_3 = \bar{a}_1$ = elevator down

Evolution ?

0	1	0	1	1	0	1

chromosome

↓ total mutation

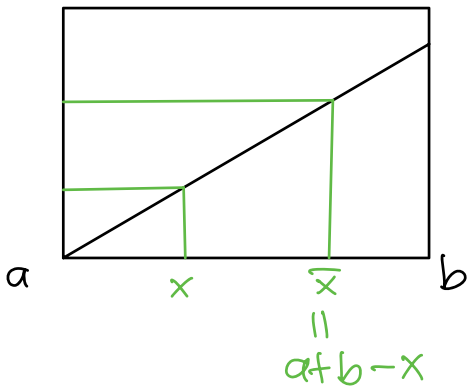
1	0	1	0	0	1	0

anti chromosome

↓ apply this on,

Opposition based Differential Evolution

What is opposition?



Linear : $\bar{x} = a + b - x, \quad x \in [a, b]$ — it gives lots of error

non linear: $\bar{x} = \{ x_i \mid y_i = y_{min} + y_{max} - y, \; y \in [y_{min}, y_{max}] \}$

How about randomness?

Scenario 1 : x_1 and x_2 (random gusses)

Scenario 2 : x_1 and $\bar{x}_1$

$g(x_1, \bar{x}_1) > g(x_1, x_2)$ with 12% higher probability

($x_1, \bar{x}_1$ negatively correlated)

GA application on Images

fitness function?

What is the task?

- segment the image

A segmented image is = binary image

↙

image with highest contrast

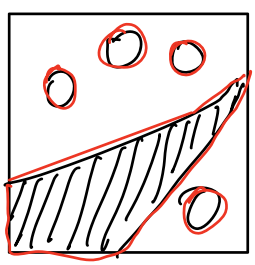
fitness = contrast(I) highest contrast prefered (white)

chromosomes ?

You need a function with parameters that change the contrast.

all pixels values

$$c(I) = \left(\frac{g_{ij} - min}{max - min} \right)^{\alpha} \qquad \alpha \in [0, 1]$$



river image

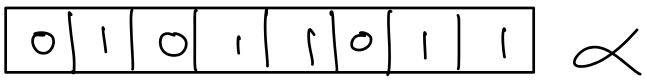
○ garbage

$$compactness = \frac{area}{(perimeter)^2}$$

highest compactness ⟶ ○

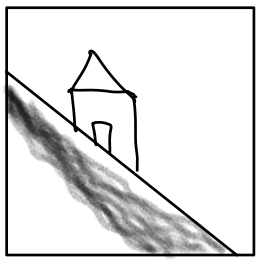
$$fitness = \left(\frac{g_{ij} - min}{max - min} \right)^{\alpha} + \underbrace{\frac{area}{(perimeter)^2}}_{compactness}$$

* compactness is very high just for the river.



Another advantage of GAs

Given another image



GA has to be rerun from scratch to optimize the fitness function again for new image.