

A satellite image of a tropical cyclone with a multi-colored eye (yellow, purple, blue, green) is centered on a grid of numbers. The numbers are in a light blue color and are arranged in a grid pattern across the entire image. The background is a grayscale satellite image of a tropical cyclone.

Using Genetic Algorithms to Estimate Tropical Cyclone Intensity

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About how old are they?

**Visual
characteristics**



**Usual
Estimates**

**Infant
(28 days-12
months)**

**Toddler
(12
months-23
months)**

**Child
(2 – 11 years)**

**Adolescents
(12-18 years)**

**Adults
(18+ years)**

**Visual characteristics help
us make estimates**

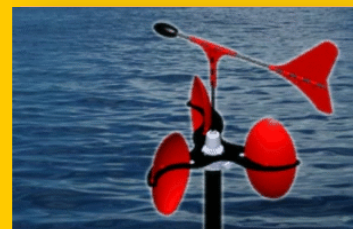
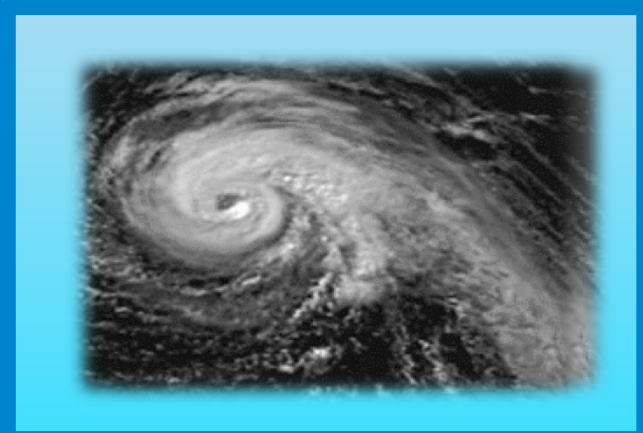
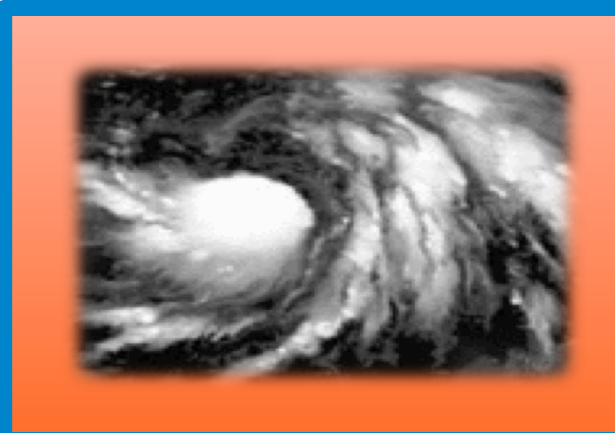
About how intense are they?



Vernon Dvorak

Visual characteristics

Usual Estimates



**Tropical Storm Wilma
(45-55
Knots)**



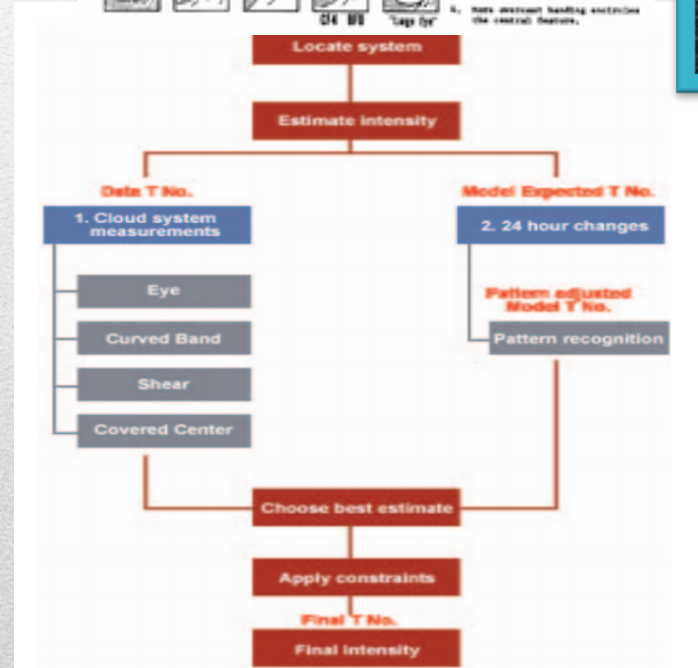
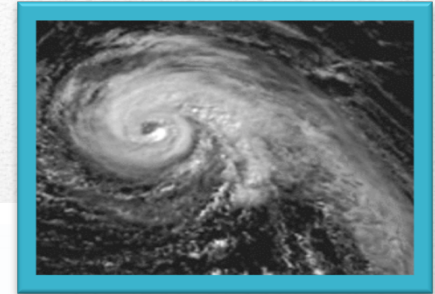
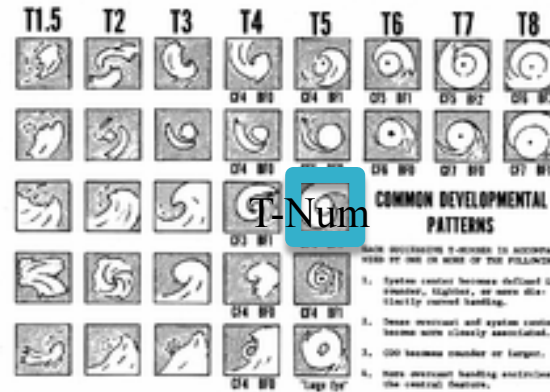
**Hurricane Jeanne
(90-102
Knots)**



Tropical System Intensity

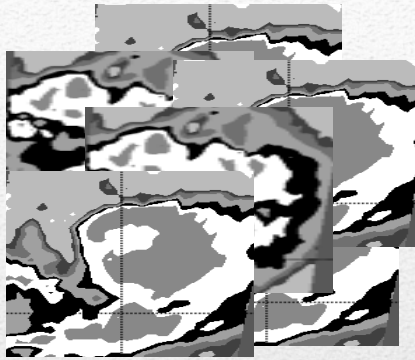
Dvorak T-Number and Corresponding Intensity[2]

	Wind Speed (knots)
1.0 - 1.5	25
2.0	30
2.5	35
3.0	45
3.5	55
4.0	65
4.5	77
5.0	90
5.5	102
6.0	115
6.5	127
7.0	140
7.5	155
8.0	170



The Dvorak Technique

Used tropical system Earl dataset as trainer



**GENETIC
ALGORITHM**

New Dataset

**GENETIC
ALGORITHM**

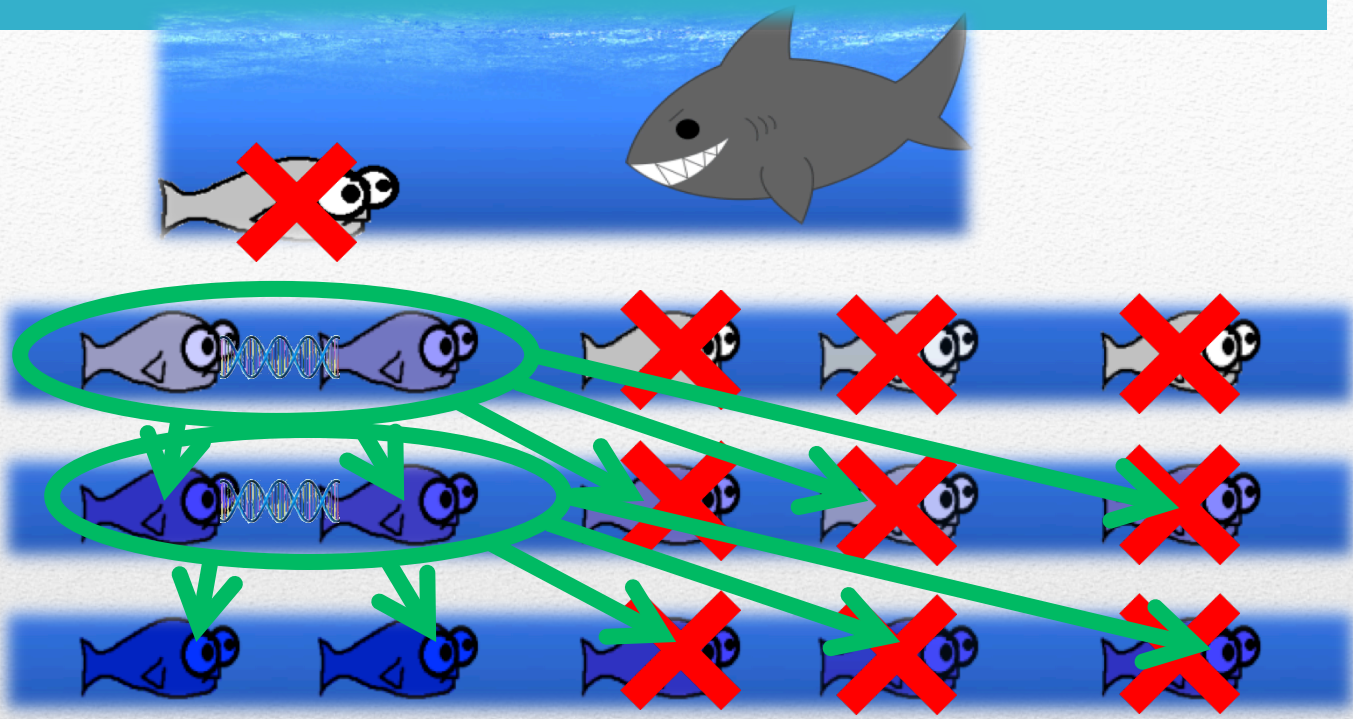
**GOOD
ESTIMATE**

The Genetic Algorithm

GENERATION 1

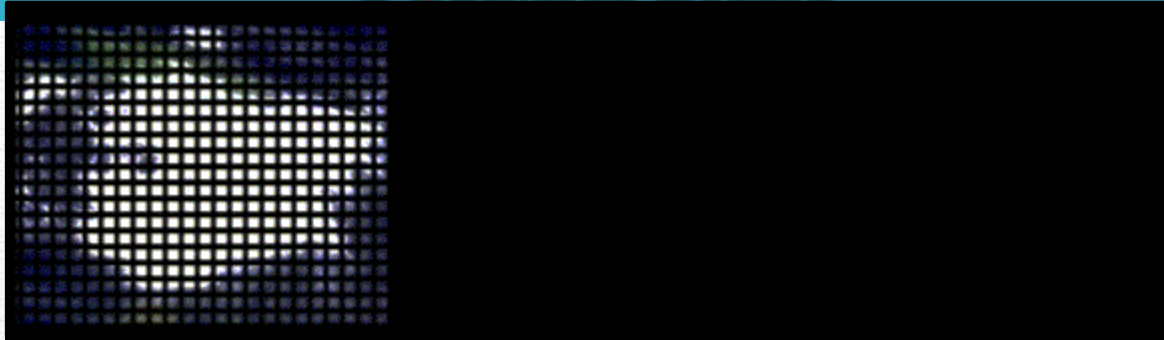
GENERATION 2

GENERATION 3



Evolution illustration

FORMAT DATA

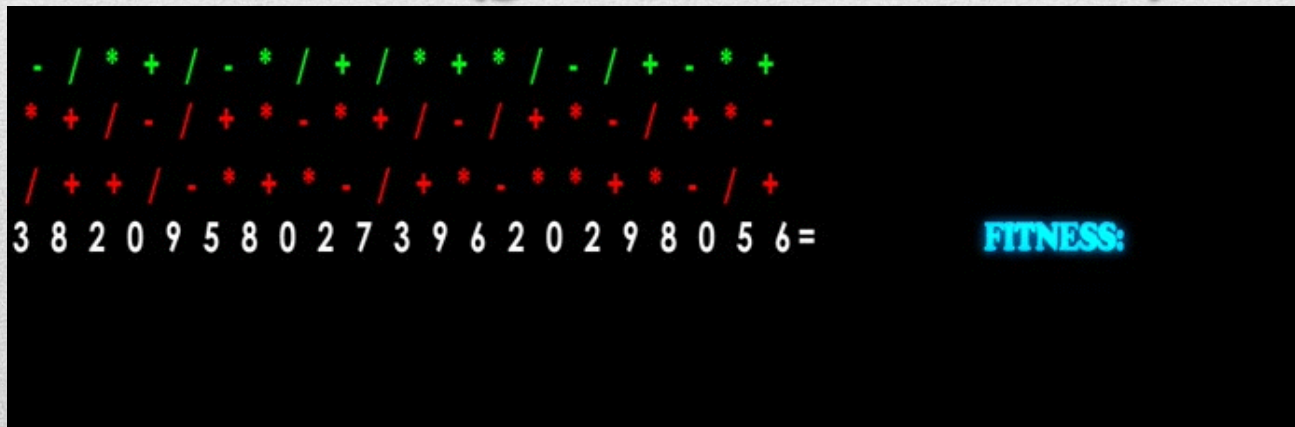


GENOME



$$3/8+2+0/9.5*8+0*2.7/3+9*6.2*0*2+9*8.0/5+6 = \text{T-Num}$$

$$\text{FITNESS} = |\text{generated value} - \text{TNum}|$$



- / * + / - * / + / * + * / - / + - * +
* + / - / + * - * + / - / + * - / + * -
/ + + / - * + * - / + * - * + * - / +
3 8 2 0 9 5 8 0 2 7 3 9 6 2 0 2 9 8 0 5 6 =

FITNESS:

The Genetic Algorithm

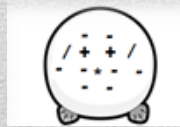
GENERATION 1



GENERATION 2



GENERATION 3

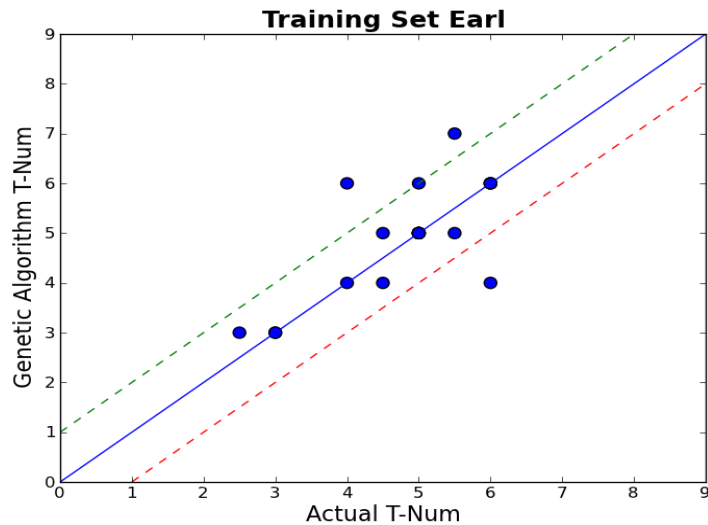


382095802739620298056

New Dataset

GOOD ESTIMATE

Genetic Algorithm illustration



No. of Images: 21

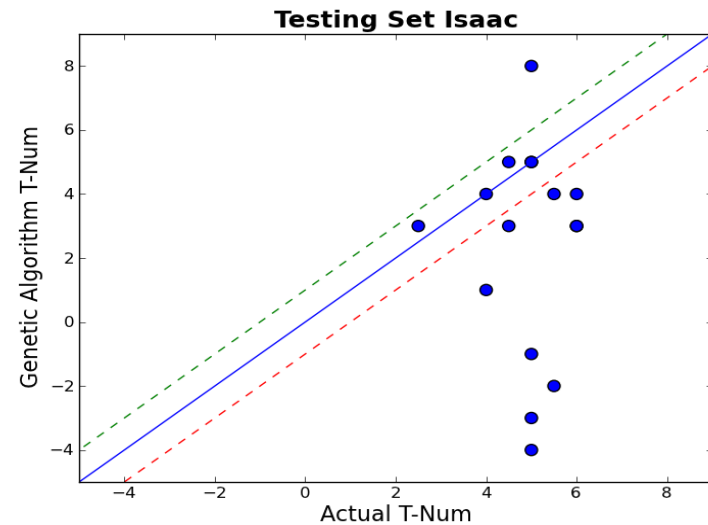
Initial Average Fitness: 4.29

Final Average Fitness: 0.4

Learning Time: Approx. 4 days

Execution Time: Less than 20 seconds

R-squared: 0.53



No. of Images: 18

Average Fitness: 3.4

Execution Time: Less than 20 seconds

R-squared: 0.04

Results

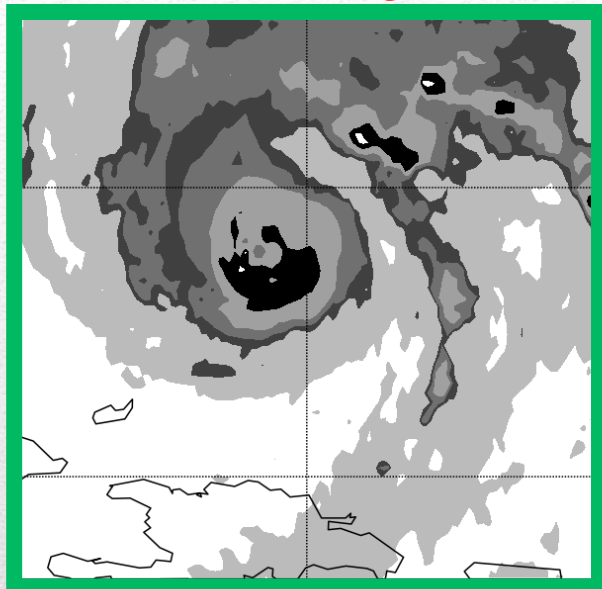
X Isaac

X Earl



Discussion

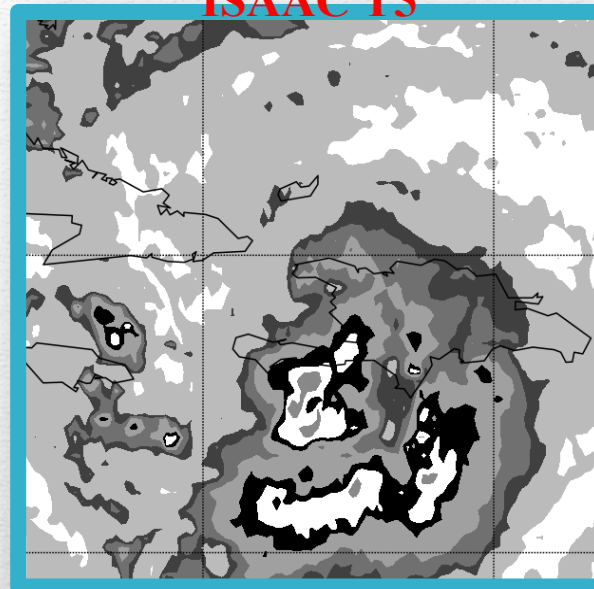
EARL T5



GA: T-5




ISAAC T5



GA: T-8

Discussion



more datasets:
(last five years)
variety could give better results

more computational power (when learning):
Learns faster

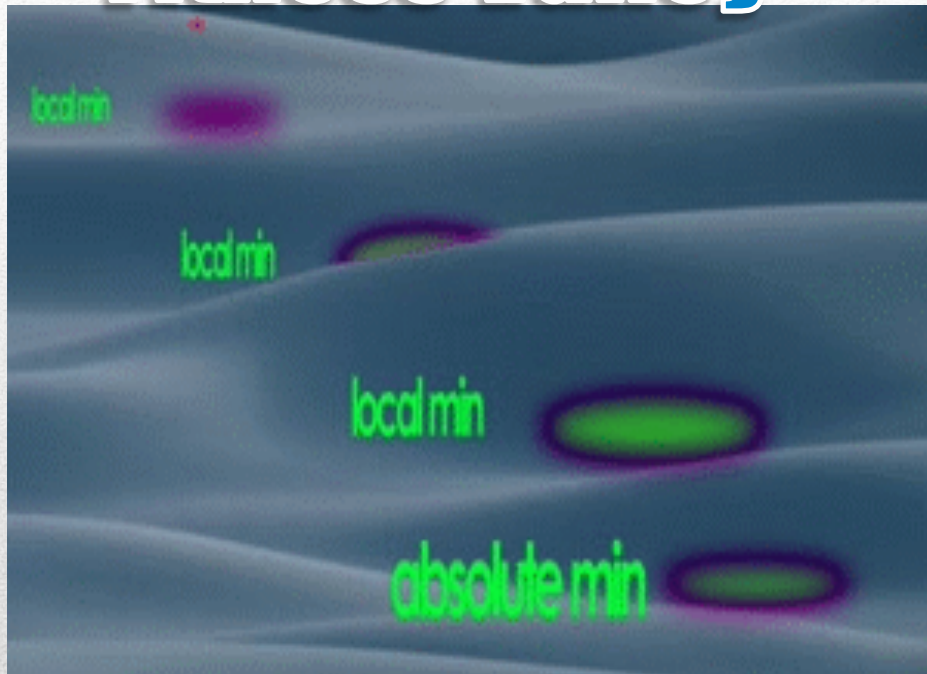
Future Improvements



THE END



Fitness Valley



Parameters

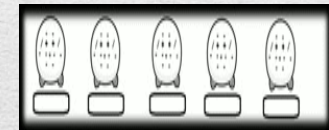
MATING PROBABILITY



MUTATION PROBABILITY



SURVIVAL RATE



POPULATION SIZE



Local Minimum Problem