



# WELCOME TO COMPSOC

WEEK 7 – INTRO TO MACHINE LEARNING

# WHAT CAN I DO WITH THIS INFORMATION?



- Rebuild Krapatoa (Let me know!)
- DIY Autonomous Vehicle w/Arduino, Raspberry Pi or similar (Lancaster University: Gerald Kotonya, Stephen Monk & others)
- Elden Ring playing robot (YouTube: Mike Boyd)
- Trackmania Reinforcement Learning (Youtube: Yosh)
- Deep Learning Institute Course (Nvidia)
- Your AI coursework
- AI Researcher
  - Meta
  - Microsoft
- Product Manager
  - Google
  - Tesco
- Research Assistant
  - Adobe
  - Arm
- Software Engineer
  - Amazon
  - Palantir



YOU WILL NOT KNOW EVERYTHING BY  
THE END OF TONIGHT

AND THAT'S OK, YOU'RE NOT SUPPOSED TO



# A BRIEF INTRO TO NEURAL NETWORKS



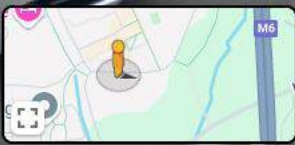


Search Google Maps

← **South Dr**  
Bairrigg, England

Google Street View

Jul 2016 [See more dates](#)



Google

Navigation controls including a compass, zoom in (+) and zoom out (-) buttons, and a street view pegman icon.



0,0,0	0,0,0	0,0,0	255,255,25	0,0,0	200,40,40	200,40,40	0,0,0	0,0,0
0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0
0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0
0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0
200,40,40	50,5,5	200,40,40	50,5,5	200,40,40	50,5,5	200,40,40	100,20,20	200,40,40
200,40,40	50,5,5	200,40,40	100,20,20	200,40,40	100,20,20	200,40,40	100,20,20	200,40,40
200,40,40	50,5,5	200,40,40	100,20,20	200,40,40	100,20,20	200,40,40	100,20,20	200,40,40
200,40,40	50,5,5	200,40,40	100,20,20	200,40,40	100,20,20	50,10,10	100,20,20	200,40,40
200,40,40	50,5,5	100,20,20	50,5,5	200,40,40	100,20,20	50,10,10	100,20,20	200,40,40
100,20,20	50,5,5	100,20,20	50,5,5	200,40,40	100,20,20	200,40,40	100,20,20	200,40,40
100,20,20	50,5,5	100,20,20	50,5,5	200,40,40	0,0,0	200,40,40	100,20,20	200,40,40
100,20,20	50,5,5	100,20,20	50,5,5	50,25,20	0,0,0	200,40,40	100,20,20	200,40,40
0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0
0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0
0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0	0,0,0
200,40,40	200,40,40	200,40,40	100,20,20	200,40,40	200,40,40	200,40,40	200,40,40	200,40,40
200,40,40	200,40,40	200,40,40	100,20,20	200,40,40	200,40,40	200,40,40	200,40,40	200,40,40
200,40,40	200,40,40	200,40,40	100,20,20	100,20,20	100,20,20	200,40,40	200,40,40	200,40,40





# CONVOLUTION

INPUT MAP

0	0	0	0	0	280	280	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
280	60	280	60	280	60	280	140	280	60
280	60	280	140	280	140	280	140	280	95
280	60	280	140	280	140	280	140	280	100
280	60	280	140	280	140	70	140	280	100
280	60	140	60	280	140	70	140	280	100
140	60	140	60	280	140	280	140	280	95
140	60	140	60	280	0	280	140	280	95
140	60	140	60	95	0	280	140	280	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
280	280	280	140	280	280	280	280	280	280
280	280	280	140	280	280	280	280	280	280
280	280	280	140	140	140	280	280	280	280
140	280	280	140	140	140	280	280	140	140
140	280	95	140	140	140	0	280	0	140
140	280	95	140	140	140	0	95	0	140

FILTER

0	-1	0
-2	3	-2
0	-1	0

OUTPUT MAP

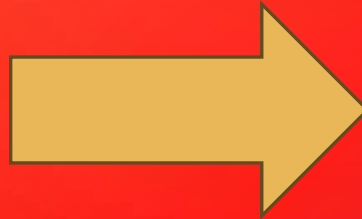
0	0	0	0	0	0	-280	-280	0	0
0	0	0	0	0	0	-560	280	280	-560
0	0	0	0	0	0	-280	-280	0	0
0	0	0	0	0	0	0	0	0	0
0	-280	-60	-280	-60	-280	-60	-280	-140	-280
-560	440	-1000	320	-1080	320	-1080	160	-840	160
-560	160	-1060	-120	-900	-280	-900	-280	-980	-190
-560	160	-1060	-120	-980	-280	-980	-70	-980	-200
-560	160	-1060	20	-900	-280	-560	-700	-560	-200
-560	300	-780	-240	-860	-120	-560	-700	-560	-200
-280	-120	-500	-100	-780	-120	-840	-70	-980	-190
-280	20	-500	-100	-780	345	-1260	0	-980	-190
-280	160	-440	40	-350	-115	-750	280	-840	280
0	-140	-60	-140	-60	-95	0	-280	-140	-280
0	0	0	0	0	0	0	0	0	0
0	-280	-280	-280	-140	-280	-280	-280	-280	-280
-560	0	-560	-280	-840	-280	-560	-560	-560	-560
-560	-280	-840	-560	-980	-420	-700	-840	-840	-840
-560	-140	-840	-560	-700	-560	-840	-560	-840	-700
-280	-560	-560	-375	-700	-420	-700	-280	-560	-700
-280	-420	-190	-930	-330	-420	-140	-1120	465	-980



## OUTPUT MAP

0	0	0	0	0	0	-280	-280	0	0
0	0	0	0	0	-560	280	280	-560	0
0	0	0	0	0	0	-280	-280	0	0
0	0	0	0	0	0	0	0	0	0
0	-280	-60	-280	-60	-280	-60	-280	-140	-280
-560	440	-1000	320	-1080	320	-1080	160	-840	160
-560	160	-1060	-120	-900	-280	-900	-280	-980	-190
-560	160	-1060	-120	-980	-280	-980	-70	-980	-200
-560	160	-1060	20	-900	-280	-560	-700	-560	-200
-560	300	-780	-240	-860	-120	-560	-700	-560	-200
-280	-120	-500	-100	-780	-120	-840	-70	-980	-190
-280	20	-500	-100	-780	345	-1260	0	-980	-190
-280	160	-440	40	-350	-115	-750	280	-840	280
0	-140	-60	-140	-60	-95	0	-280	-140	-280
0	0	0	0	0	0	0	0	0	0
0	-280	-280	-280	-140	-280	-280	-280	-280	-280
-560	0	-560	-280	-840	-280	-560	-560	-560	-560
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-560	-140	-840	-560	-700	-560	-840	-560	-840	-700
-280	-560	-560	-375	-700	-420	-700	-280	-560	-700
-280	-420	-190	-930	-330	-420	-140	-1120	465	-980

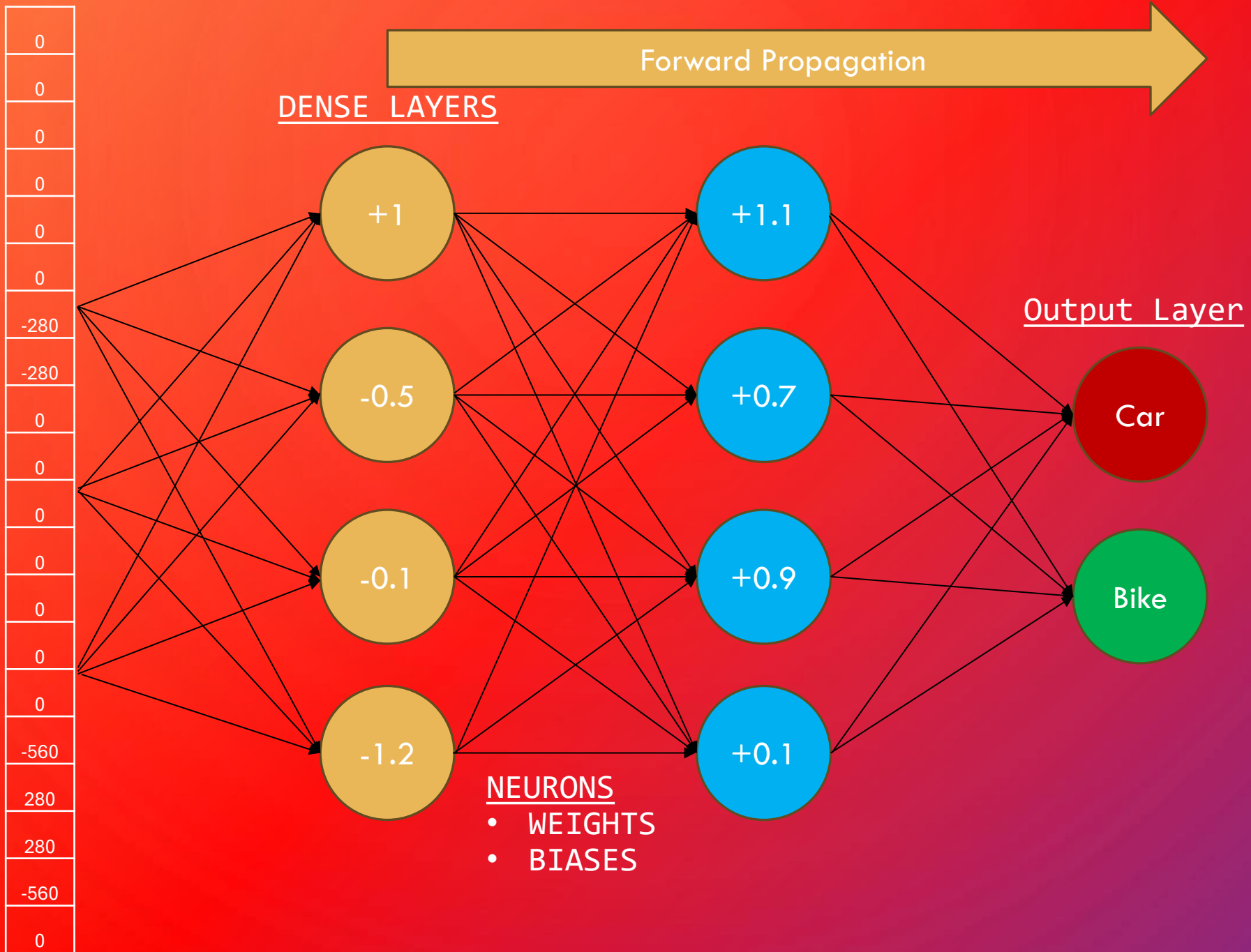
## FLATTENING



## FEATURE VECTOR

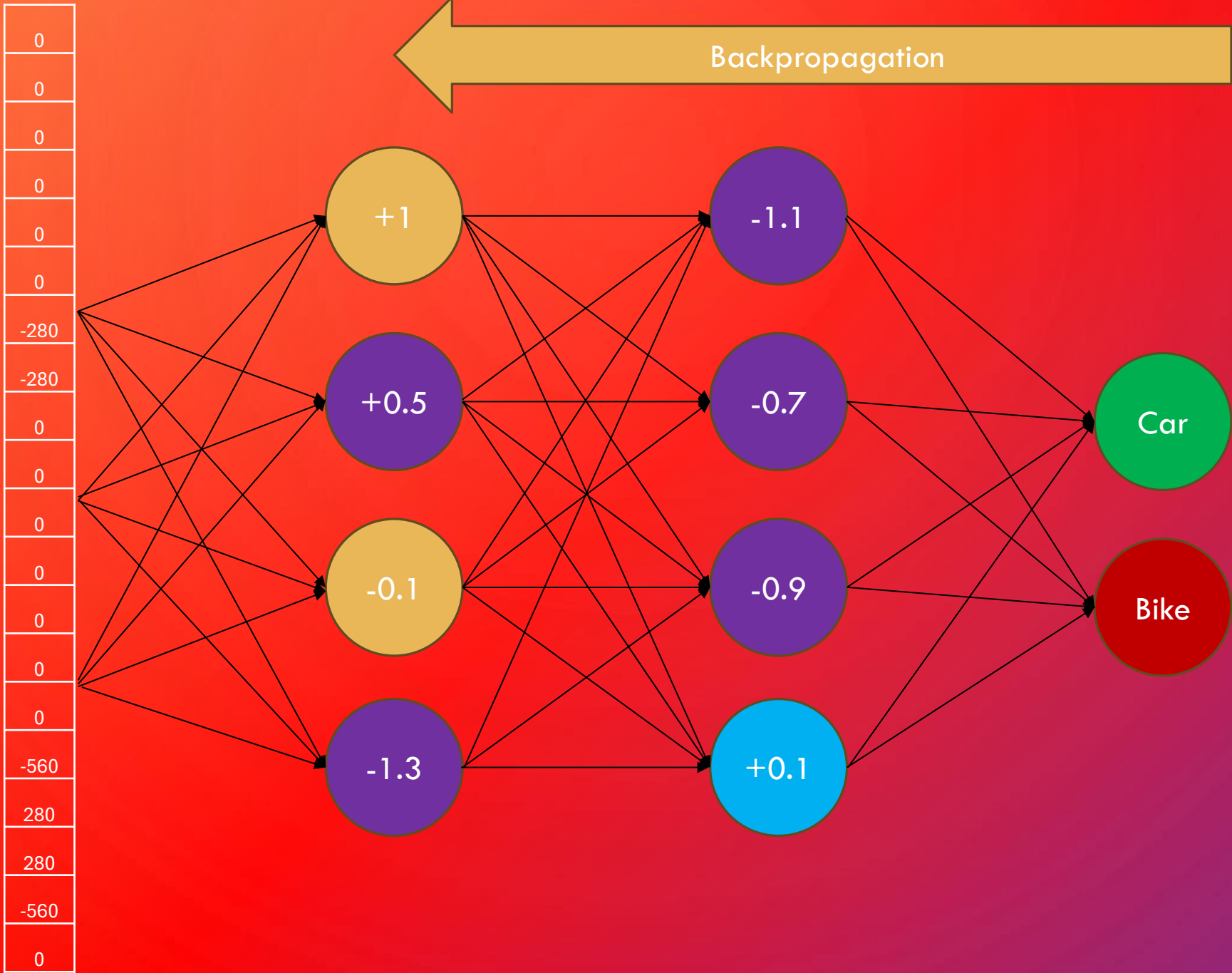
0	0	0	0	0	0	0	-280	-280	0	0	0	0	0	0	0	-560	280	280	-560	0
---	---	---	---	---	---	---	------	------	---	---	---	---	---	---	---	------	-----	-----	------	---







← Backpropagation





# A BRIEF INTRO TO GENETIC ALGORITHMS



GENERATION 0



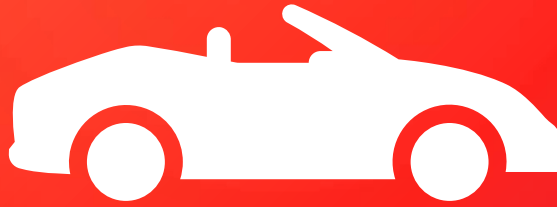
POPULATION



GENERATION 0



3



4



2

NORMALISE THE VALUES

$$\text{NORMVAL} = \frac{(N - N_{min})}{(N_{max} - N_{min})}$$

GENERATION 0



0.5



1



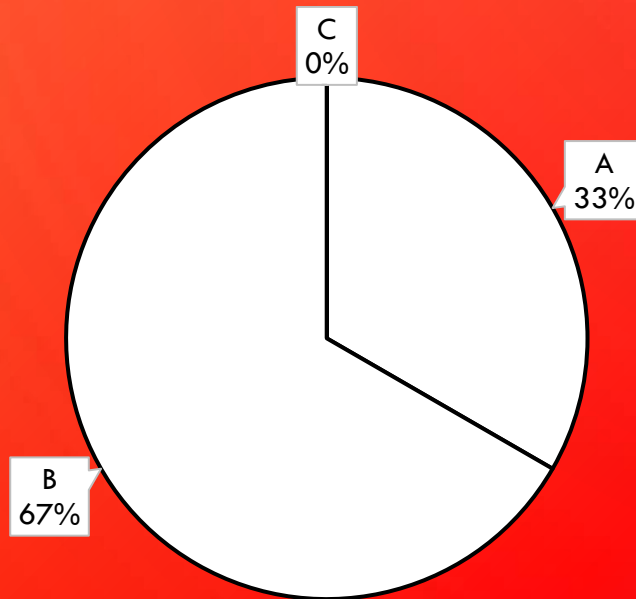
0



## SELECTION METHOD



## ROULETTE WHEEL



## CUMULATIVE PROBABILITIES

$$0.5 + 1 + 0 = 1.5$$

$$A = \frac{0.5}{1.5} = 0.33$$

$$B = \frac{1.5}{1.5} = 1.00$$

## GENERATE RANDOM NUMBER

```
IF(R < 0.33){  
  SELECT A  
}  
ELSE{  
  SELECT B  
}
```

SELECTION METHOD



TOURNAMENT



ROUND 1

A VS B

B IS HIGHER

B WINS

ROUND 2

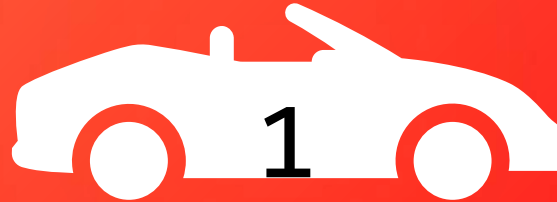
B VS C

B IS HIGHER

B WINS

FATALITY

## SELECTION METHOD



## LINEAR RANKING



## ASSIGN RANKS

$$A = 1$$

$$B = 2$$

$$C = 3$$

## ASSIGN PROBABILITIES

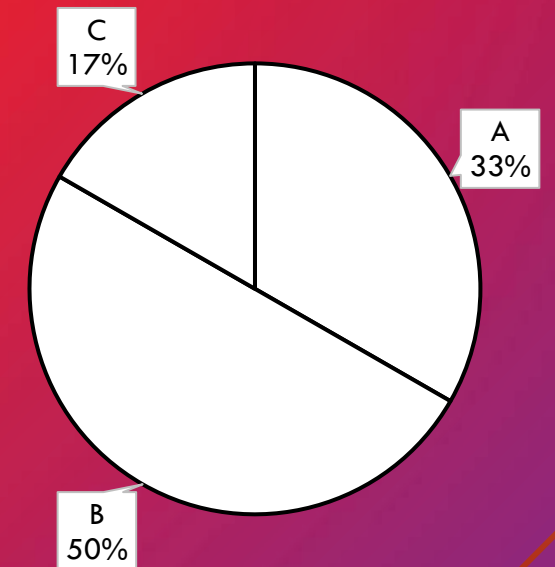
$$Prank = \frac{2(\#Ranks - Rank\# + 1)}{\#Ranks(\#Ranks + 1)}$$

$$A = 0.333$$

$$B = 0.500$$

$$C = 0.167$$

## BACK TO THE CASINO





SELECTION METHOD



ELITISM

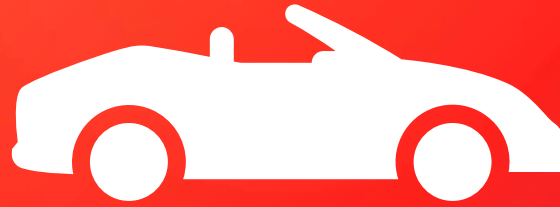
WE ONLY CARE ABOUT THE BEST

GENERATION 0



ctrl + c

GENERATION 1



MUTATE



ctrl

+

v



MUTATE



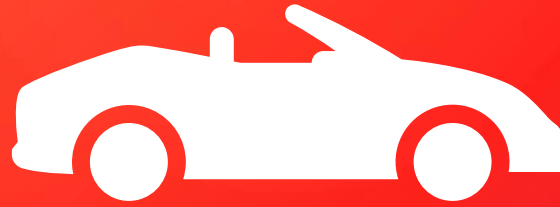
GENERATION 1



GENERATION 1



5



4



8

GENERATION 1



0.25



0



1

GENERATION 1



ctrl + c



GENERATION 2



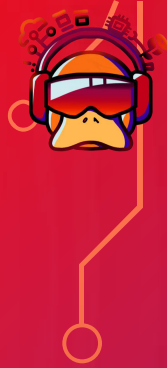
ctrl

+

v



LET IT COOK



GENERATION 1000



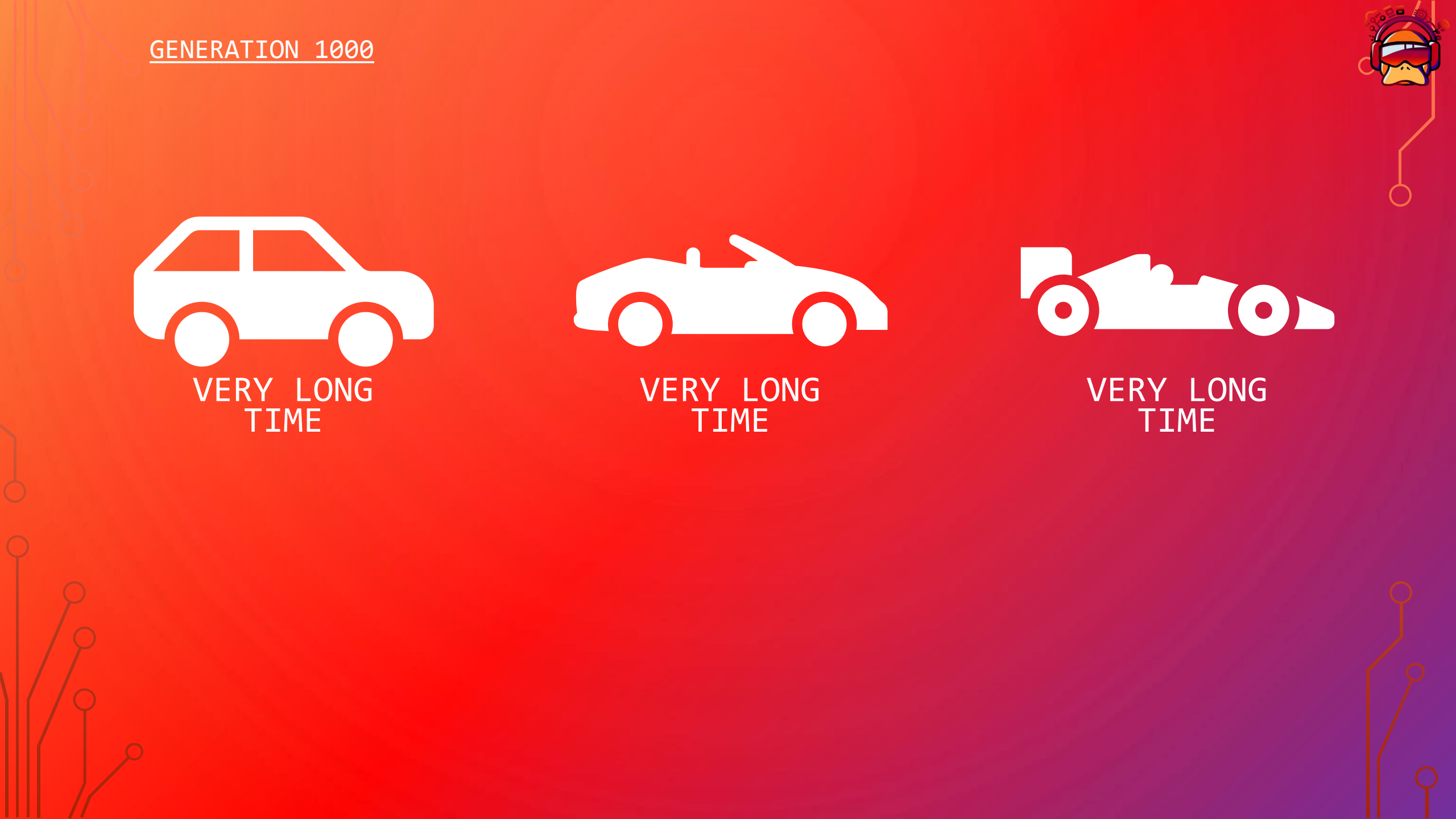
VERY LONG  
TIME



VERY LONG  
TIME



VERY LONG  
TIME





YOU HAVEN'T SPOKEN ABOUT  
CROSS OVER OR TIME COMPLEXITY!

You're right, I haven't





LET'S TEACH CARS HOW TO DRIVE  
THEMSELVES!

[GITHUB.COM/LUCOMPSOC/CSSSELFDRIVINGCAR](https://github.com/LUCOMPSOC/CSSSELFDRIVINGCAR)



# COMING UP!

THIS SUNDAY:.....GAMING WITH LUGES

NEXT WEEK:.....INTRO TO DISTRIBUTED SYSTEMS

WEEK 10:.....BY ELECTION & EOT DINNER



**GOOD LUCK!!!**

**WHAT'S A NEURAL NETWORKS FAVOURITE WORKOUT?**

**WEIGHTLIFTING!**