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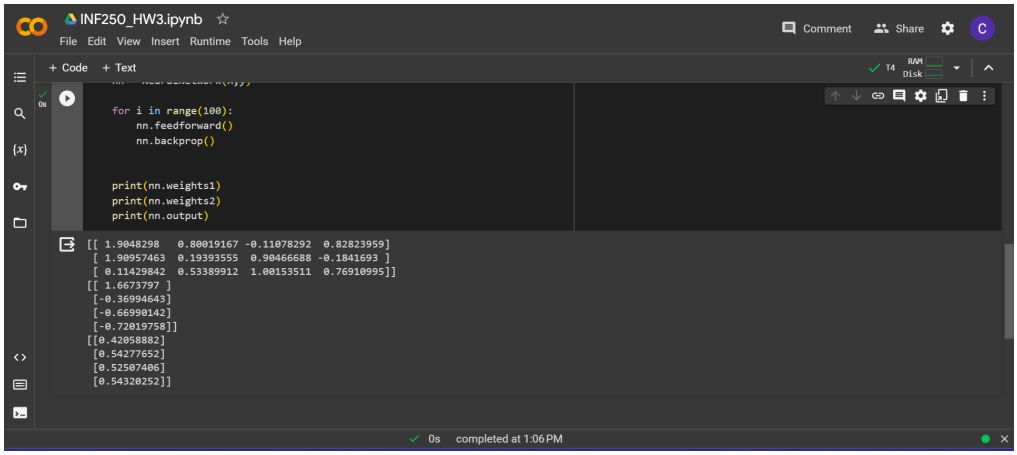
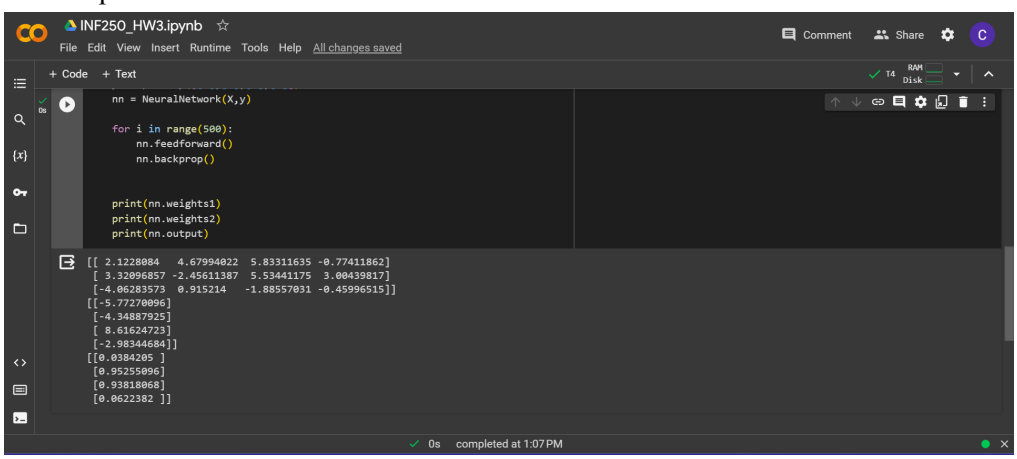
HW3: ML, Using Google's Colab, Verification "by hand," Teachable Machine

Q1

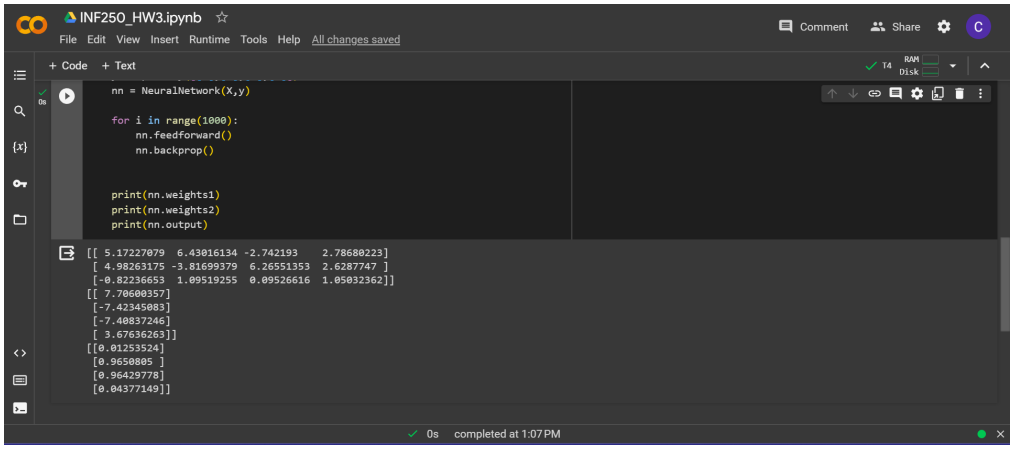
Backdrop 100 times:



Backdrop 500 times:



Backdrop 1000 times:



Backdrop 5000 times:

```
nn = NeuralNetwork(X,y)

for i in range(5000):
    nn.feedforward()
    nn.backprop()


print(nn.weights1)
print(nn.weights2)
print(nn.output)
```

```
[[ 3.79596152 -2.04690372  3.55892456  6.65194896]
 [ 2.70266873  2.55900056  2.52783082  7.16577672]
 [-5.0331172   2.14180634 -4.73202113 -3.19474024]]
[[-7.07100496]
 [-5.32154784]
 [-6.46903052]
 [11.19454632]]
[[0.011847  ]
 [0.98838852]
 [0.99294082]
 [0.00934226]]
```

Backdrop 20000 times:

```
nn = NeuralNetwork(X,y)

for i in range(20000):
    nn.feedforward()
    nn.backprop()


print(nn.weights1)
print(nn.weights2)
print(nn.output)
```

```
[[ 7.59200533  4.34449507  5.28335212 -4.53237508]
 [-3.33893469  4.47633784  5.40971412  7.72371795]
 [ 0.02229893  0.14274579 -0.60847909  1.13742893]]
[[-10.55979748]
 [  7.16429051]
 [  8.89834933]
 [-10.55977457]]
[[0.00172387]
 [0.99325499]
 [0.99332958]
 [0.00835961]]
```

Pattern: It seems that with the increase of the input range for each backdrop to perform, the output values get closer and closer to those desired (ie. 0, 1, 1, 0). Empirically, this may be due to the fact that the NN learns with each iteration of the backdrop.

<u>Q2</u>

Below, there are 4 screenshots that include my calculations based on the NN weights, 001, 011, 101, 111 (in that exact order). The highlighted parts are my Y output:

W020=	-10.5598		X1=	0	-5.33876	W020 part		Total = W020 + W120 + W220 + W320		
W010=	7.592005		X2=	0				-6.36149		
W110=	-3.33893		X3=	1						
W210=	0.022299		0.022299	1 + e^=	1.977948			1+e^(total)=		0.001723817
W120=	7.164291		X1=	0	3.83738	W120 part				
W011=	4.344495		X2=	0						
W111=	4.476338		X3=	1						
W211=	0.142746		0.142746	1 + e^=	1.866974					
W220=	8.898349		X1=	0	3.135834	W220 part				
W012=	5.283352		X2=	0						
W112=	5.409714		X3=	1						
W212=	-0.60848		-0.60848	1 + e^=	2.837634					
W320=	-10.5598		X1=	0	-7.99594	W320 part				
W013=	-4.53238		X2=	0						
W113=	7.723718		X3=	1						
W213=	1.137429		1.137429	1 + e^=	1.320642					

W020=	-10.5598	X1=	0	-0.36964	W020 part	Total = W020 + W120 + W220 + W320		
W010=	7.592005	X2=	1			4.99221		
W110=	-3.33893	X3=	1					
W210=	0.022299	-3.31664	1 + e^=	28.56745		1+e^(total)=	0.993255164	
W120=	7.164291	X1=	0	7.094327	W120 part			
W011=	4.344495	X2=	1					
W111=	4.476338	X3=	1					
W211=	0.142746	4.619084	1 + e^=	1.009862				
W220=	8.898349	X1=	0	8.825805	W220 part			
W012=	5.283352	X2=	1					
W112=	5.409714	X3=	1					
W212=	-0.60848	4.801235	1 + e^=	1.00822				
W320=	-10.5598	X1=	0	-10.5583	W320 part			
W013=	-4.53238	X2=	1					
W113=	7.723718	X3=	1					
W213=	1.137429	8.861147	1 + e^=	1.000142				

W020=	-10.5598	X1=	1	-10.5546	W020 part	Total = W020 + W120 + W220 + W320	
W010=	7.592005	X2=	0			5.003406	
W110=	-3.33893	X3=	1				
W210=	0.022299	7.614304	1 + e^=	1.000493		1+e^(total)=	0.993329756
W120=	7.164291	X1=	1	7.084577	W120 part		
W011=	4.344495	X2=	0				
W111=	4.476338	X3=	1				
W211=	0.142746	4.487241	1 + e^=	1.011252			
W220=	8.898349	X1=	1	8.816124	W220 part		
W012=	5.283352	X2=	0				
W112=	5.409714	X3=	1				
W212=	-0.60848	4.674873	1 + e^=	1.009327			
W320=	-10.5598	X1=	1	-0.3427	W320 part		
W013=	-4.53238	X2=	0				
W113=	7.723718	X3=	1				
W213=	1.137429	-3.39495	1 + e^=	30.81305			

W020=	-10.5598	X1=	1	-10.415	W020 part	Total = W020 + W120 + W220 + W320	
W010=	7.592005	X2=	1			-4.77597	
W110=	-3.33893	X3=	1				
W210=	0.022299	4.27537	1 + e^=	1.013907		1+e^(total)=	0.008359395
W120=	7.164291	X1=	1	7.163374	W120 part		
W011=	4.344495	X2=	1				
W111=	4.476338	X3=	1				
W211=	0.142746	8.963579	1 + e^=	1.000128			
W220=	8.898349	X1=	1	8.897978	W220 part		
W012=	5.283352	X2=	1				
W112=	5.409714	X3=	1				
W212=	-0.60848	10.08459	1 + e^=	1.000042			
W320=	-10.5598	X1=	1	-10.4224	W320 part		
W013=	-4.53238	X2=	1				
W113=	7.723718	X3=	1				
W213=	1.137429	4.328772	1 + e^=	1.013184			

^It's noticeable that put together, the Y output values produced are close to the ones desired [0, 1, 1, 0], and they closely match the output given from the run with 20000 iterations (see last backdrop screenshot).

Q3

https://teachablemachine.withgoogle.com/models/52zJlgLlA/ ← link to my teachable model

https://drive.google.com/drive/folders/1FBqDXfgp6-77GsCnESeB3S4QAv8g3N5H?usp=sharing ← link to all the videos demonstrating the training process and final results **I will also include these videos as a .mov file in the zipped folder, as an alternative**