

CIS 419 – Homework 4

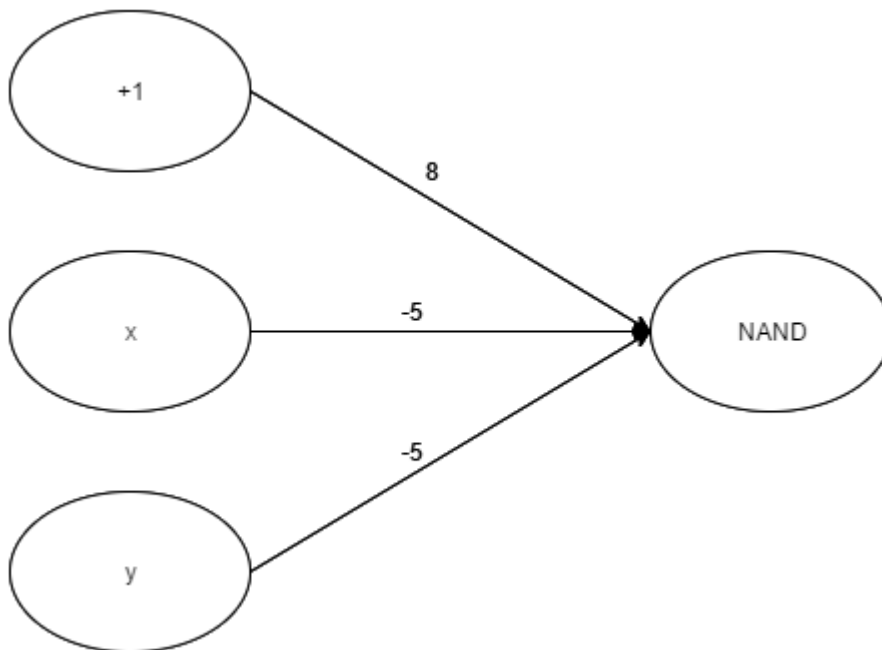
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Problem 1

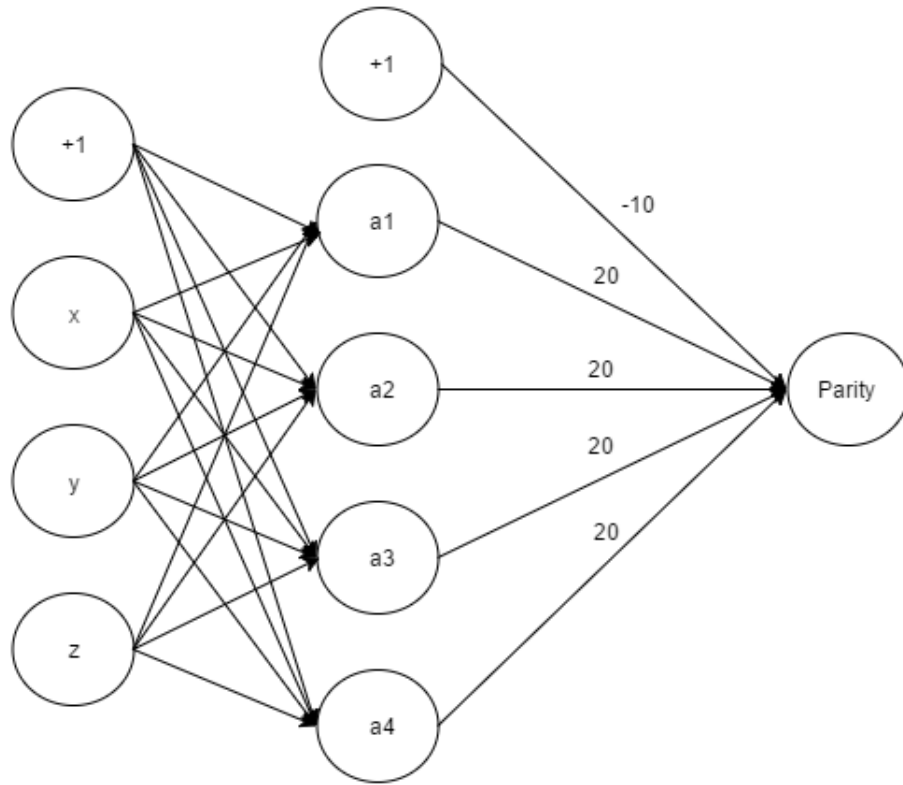
For each of the logical functions below, draw the neural network that computes the function, and give a truth table showing the inputs, the value of the logical function, and the output of the neural network verifying that the neural network is correct. Show your work for the computations of the neural network's output.

a) NAND of two binary variables



x	y	$NAND$
0	0	$8 + 0 + 0 \Rightarrow 1$
0	1	$8 + 0 - 5 \Rightarrow 1$
1	0	$8 - 5 + 0 \Rightarrow 1$
1	1	$8 - 5 - 5 \Rightarrow 0$

b) Parity of three binary variables

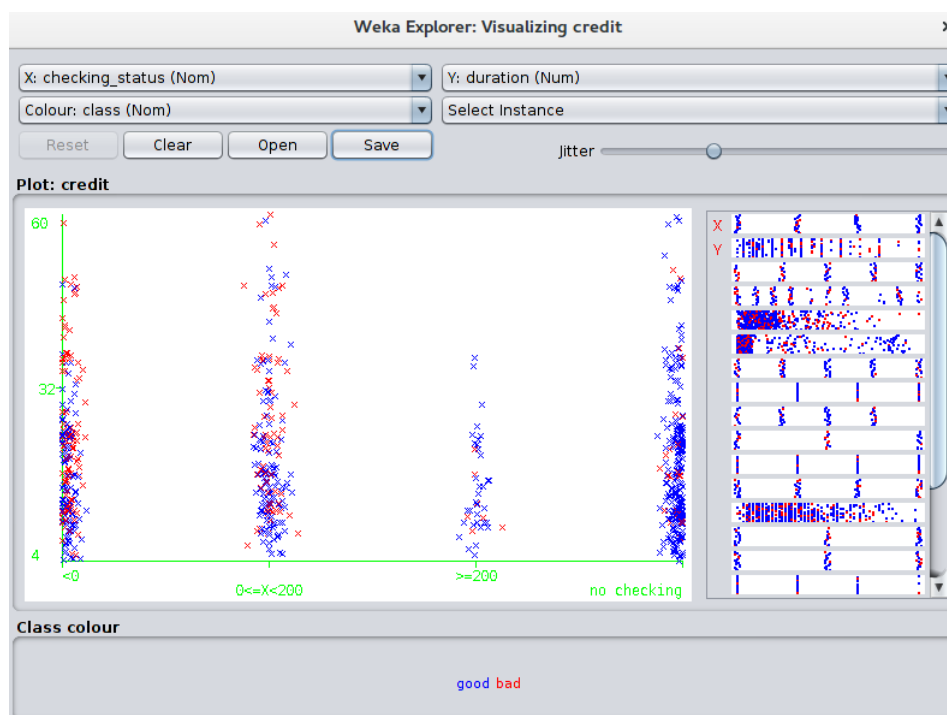


x	y	z	$a1$	$a2$	$a3$	$a4$
0	0	0	$-10 + 0 + 0 + 0$	$-10 + 0 + 0 + 0$	$-10 + 0 + 0 + 0$	$-20 + 0 + 0 + 0$
0	0	1	$-10 + 0 + 0 + 15$	$-10 + 0 + 0 + -10$	$-10 + 0 + 0 + -10$	$-20 + 0 + 0 + 7$
0	1	0	$-10 + 0 + -10 + 0$	$-10 + 0 + 15 + 0$	$-10 + 0 + -10 + 0$	$-20 + 0 + 7 + 0$
0	1	1	$-10 + 0 + -10 + 15$	$-10 + 0 + 15 + -10$	$-10 + 0 + -10 + -10$	$-20 + 0 + 7 + 7$
1	0	0	$-10 + -10 + 0 + 0$	$-10 + -10 + 0 + 0$	$-10 + 15 + 0 + 0$	$-20 + 7 + 0 + 0$
1	0	1	$-10 + -10 + 0 + 15$	$-10 + -10 + 0 + -10$	$-10 + 15 + 0 + -10$	$-20 + 7 + 0 + 7$
1	1	0	$-10 + -10 + -10 + 0$	$-10 + -10 + 15 + 0$	$-10 + 15 + -10 + 0$	$-20 + 7 + 7 + 0$
1	1	1	$-10 + -10 + -10 + 15$	$-10 + -10 + 15 + -10$	$-10 + 15 + -10 + -10$	$-20 + 7 + 7 + 7$

x	y	z	$a1$	$a2$	$a3$	$a4$	$Parity$
0	0	0	0	0	0	0	$-10 + 0 + 0 + 0 + 0 + 0 \Rightarrow 0$
0	0	1	1	0	0	0	$-10 + 20 + 0 + 0 + 0 \Rightarrow 1$
0	1	0	0	1	0	0	$-10 + 0 + 20 + 0 + 0 \Rightarrow 1$
0	1	1	0	0	0	0	$-10 + 0 + 0 + 0 + 0 \Rightarrow 0$
1	0	0	0	0	1	0	$-10 + 0 + 0 + 20 + 0 \Rightarrow 1$
1	0	1	0	0	0	0	$-10 + 0 + 0 + 0 + 0 \Rightarrow 0$
1	1	0	0	0	0	0	$-10 + 0 + 0 + 0 + 0 \Rightarrow 0$
1	1	1	0	0	0	1	$-10 + 0 + 0 + 0 + 20 \Rightarrow 1$

Problem 2

What features best represent this data set?



Checking Status versus Duration best visualized this dataset as depicted by the picture above. I used the CfsSubsetEval attribute evaluator with a BestFirst search method to find these two features. I used a CfsSubsetEval as it evaluates the worth of the attributes by the predictive ability of each feature combined with the degree of redundancy. I also used several other attribute evaluator methods that produced the same result.

Problem 3

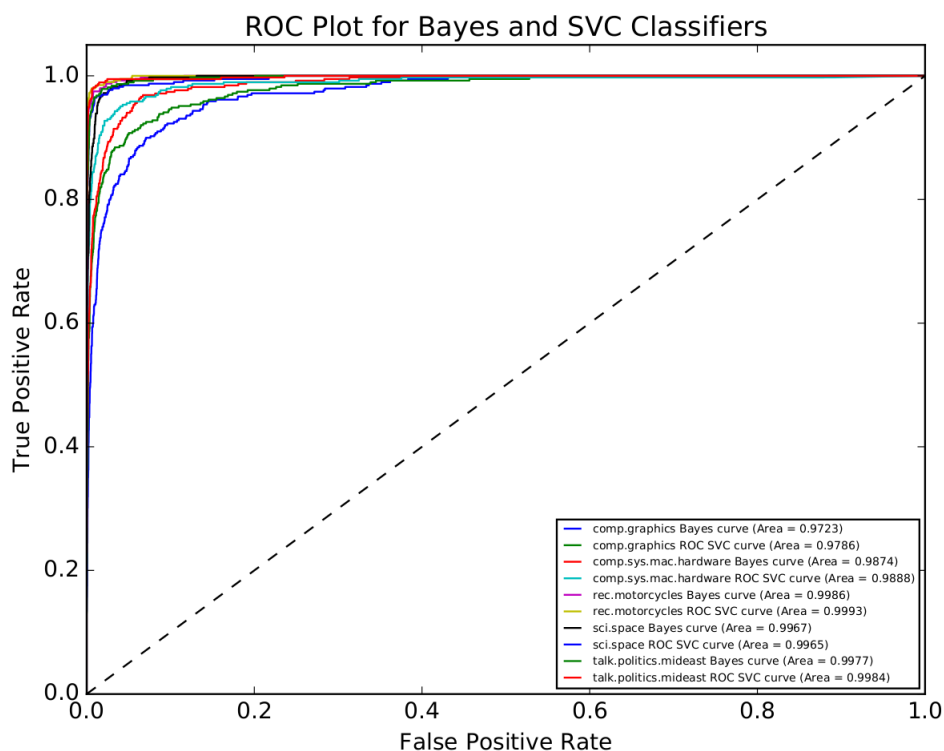
Which classifier is better?

SVM with a cosine similarity kernel is better than the Multinomial Naive Bayes. The SVM outperformed Multinomial Naive Bayes in every category for both the test and training set. As shown below:

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Bayes Training Time:  0.21513
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Bayes Train Accuracy Score:  0.959165635496
Bayes Train Precision Score:  0.963001641562
Bayes Train Recall Score:  0.94971825651
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Bayes Test Accuracy Score:  0.819437068508
Bayes Test Precision Score:  0.841965329356
Bayes Test Recall Score:  0.803871775123
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SVC Training Time:  27.084629
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SVC Train Accuracy Score:  0.996199398975
SVC Train Precision Score:  0.996194255998
SVC Train Recall Score:  0.996127608867
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SVC Test Accuracy Score:  0.846255974509
SVC Test Precision Score:  0.848552735505
SVC Test Recall Score:  0.839373845703
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Problem 4

Neural Network Training

To achieve a training accuracy of 95.5% I used a learning rate of 3.0, a regularization parameter of 0.001 with 1000 epochs.