Name:

Problem	Points	Score
1	40	
2	30	
3	30	
Total	100	

Notes:

- (1) The exam is closed books and notes.
- (2) Please clearly indicate your answer to the problem.
- (3) Note that ungrammatical sentences, incoherent statements, or general illegible scratches will get zero credit.
- (4) If I can't read or follow your solution, it is wrong, and no partial credit will be awarded.

(40 pts) Problem No. 1: Derive a gradient descent algorithm to optimize the weights for the following function:

$$f(x) = w_0 + w_1 \log(x_1) + w_2 e^{x_2}$$

Explain your approach fully including any assumptions you make about the loss function, etc.

(30 pts) Problem No. 2: Design a neural network to represent the function shown in the table to the right. Clearly state any assumptions you make. The network need not be fully connected – you can modify the topology as you see fit. Try to make the network as simple as possible. (Hint: Think about the properties of an exclusive or gate.)

(30 pts) Problem No. 3: Consider two networks, one which functions as a classical "and" gate, and one which functions as a classical "or" gate:

A	В	C	F(A,B,C)
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

A	В	F(A,B)
0	0	0
0	1	0
1	0	0
1	1	1

A	В	F(A,B)
0	0	0
0	1	1
1	0	1
1	1	1

Design a second network that combines the outputs from the first two networks, and approximates the table shown. Explain your assumptions and justify your answer.

A	В	C	D	F(A,B,C,D)
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
1	0	0	0	0
1	1	0	0	0
1	1	1	1	1
1	0	0	1	0
0	1	1	1	1
1	1	1	0	1
0	1	1	1	1