CS781 Quiz 0 (Autumn 2024)

Max marks: 10 **Duration: 20 mins**

- *The exam is open book and notes. However, you are not allowed to search on the internet or consult others over the internet for your answers.*
- *Be brief, complete and stick to what has been asked.*
- *Unless asked for explicitly, you may cite results/proofs covered in class without reproducing them.*
- ***If you need to make any assumptions, state them clearly.***
- ***Do not copy solutions from others. Penalty for offenders: FR grade.***

1. In this question, we will focus on two neurons n_1 and n_2 in a deep neural network N with ReLU activation functions. The pre-activation values of n_1 and n_2 are given by x_1 and x_2 respectively, and their post-activation values are given by y_1 and y_2 respectively.

   Assume I represents a 3-dimensional vector of inputs of N, and suppose we know that $A_{l,i}.I + b_{l,i} \leq x_i \leq A_{u,i}.I + b_{u,i}$, for $i \in \{1, 2\}$, where $A_{l,1} = [0.5, -0.5, 0.5]$, $A_{l,2} = [-0.5, 0.5, -0.5]$, $A_{u,1} = [0.7, 1, 0.3]$, $A_{u_2} = [-0.3, 0.9, 0.2]$, $b_{l,1} = b_{l,2} = 0.1$, $b_{u,1} = b_{u,2} = 0.2$.

   (a) *[7 marks]* Find the best lower and upper bounds you can on $(y_1 + y_2) - (x_1 + x_2)$, when $||I||_\infty \leq 1$.

   (b) *[3 marks]* Indicate what values of I achieve the bounds reported in your solution to the above sub-question.