Indraprastha Institute of Information Technology Delhi

CSE641 - Deep Learning

Assignment 01

Date: 23-01-2021 **Deadline: 01-02-2021, 11:59 AM**

Marks: 60

Instructions:

1. Use of any deep learning libraries is not allowed.
2. Each group member must do at least one of the following tasks. But all should know the working of all three tasks.
3. The assignment can be submitted in a group of maximum of three members. Group details can be found here.
4. For Plagiarism, institute policies will be followed strictly.
5. Extension policy as discussed in class can be found here. Spamming +1s on Classroom will lead to usage of your group's one extension.
6. Make sure to use Pickle or any other library to save all your trained models. There will not be enough time during the demo to retrain your model. This is a strict requirement. You must upload your best models on Classroom to reproduce your results during the demo. If you are not able to reproduce your results during the demo then no marks will be given.
7. You need to submit README.pdf, Code files (it should include both .py files and .ipynb files), Output.pdf, and models dumped after training.
8. Mention methodology, helper functions, preprocessing steps, any assumptions you may have, and contribution of each member in README.pdf.
9. Mention your sample outputs in the output.pdf.
10. You are advised to prepare a well-documented code file.
11. Submit code, models, readme, and output files in ZIP format with the following name: A1_Member1_Member2_Member3..zip
12. Use classroom discussion for any doubt.

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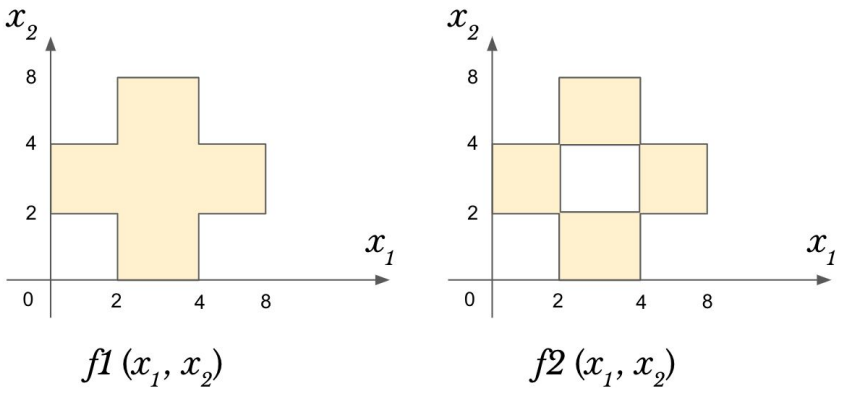
1. **Implement a perceptron training algorithm.** [9 + 6 + 5 points]
   a. Compute 2-variables AND, OR, and NOT (1-variable) operations and report the number of steps (number of weight-updates) required for the convergence.
   b. Draw the decision boundary at each step of learning.
   c. Prove that XOR can't be computed using PTA.
      i. How many minimum steps do you need to prove it? (Use PTA convergence theorem to verify it.)

2. **Using the Madaline learning algorithm compute the following two functions. Shaded regions are 1, rest are 0. Report the number of neurons for each case.**
   a. $f1\ (x_1, x_2)$ [10 points]
   b. $f2\ (x_1, x_2)$ [10 points]
   c. In comparison with $f1$, can you compute $f2$ in <= 2 more neurons? Justify and implement it. [No marks without justification] [5 points]

Note:

1. If you can compute (c), there is no need to do (b) separately. You'll get 15 points for it.
2. If Madaline doesn't work for any case, show your computations to justify it.



3. **Implement a single-neuron neural network to compute the following function $y = f(x)$. You can use the generalized delta rule for learning. If you think it's not possible, justify your claims properly.** [15 points]