CSCE 636: Deep Learning (Spring 2024)
Assignment #5

Due 11:59PM on 05/01/2024

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1. You need to submit a report in PDF to Canvas. You should NOT submit your code.
2. Your PDF report should include (1) answers to the non-programming part, and (2) results and analysis of the programming part.
3. Please name your PDF report "HW#_FirstName_LastName.pdf" and submit to Canvas directly.
4. All students are highly encouraged to typeset their reports using Word or LaTeX. In case you decide to hand-write, please make sure your answers are clearly readable in scanned PDF.
5. Unlimited number of submissions are allowed and the latest one will be timed and graded.
6. Please read and follow submission instructions. No exception will be made to accommodate incorrectly submitted files/reports.
7. Please start your submission to Canvas at least 15-30 minutes before the deadline, as there might be latency. We do NOT accept E-mail submissions.

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1. (50 points) Consider the same example setting that we discussed in class, but the observations now become:

   Green Red Red Red Blue Blue

   (a) (20 points) Derive the update rules for $\hat{\mu}_1$ and $\hat{\mu}_2$.

   (b) (10 points) Implement the update rules and run numerical simulations. Report your simulation results, possibly using different initializations.

   (c) (20 points) Intuitively derive the values of $\hat{\mu}_1$ and $\hat{\mu}_2$ based on discussions in class and match them with your simulation results.

2. (50 points + 20 bonus points) Consider the same example setting that we discussed in class, but now the sample has N balls, with N_g green, N_b blue and N_r red, $(N_g + N_b + N_r = N)$. In (a), (b), (c), you can assume $N_g \leq \frac{N}{2}$ and $N_b \leq \frac{N}{2}$.

   (a) (20 points) Derive the update rules for $\hat{\mu}_1$ and $\hat{\mu}_2$.

   (b) (10 points) Implement the update rules and run numerical simulations. Report your simulation results using different values of N_g, N_b, N_r, and possibly different initializations. Verify that your simulations ultimately converge to

   $$\hat{\mu}_1 = \frac{N - 2N_g}{N}, \quad \hat{\mu}_2 = \frac{N - 2N_b}{N}, \tag{1}$$

   if $N_g \leq \frac{N}{2}$ and $N_b \leq \frac{N}{2}$.

(c) (20 points) Intuitively explain why Equation (1) is true.

(d) (20 bonus points) Resolve the cases when $N_g > \frac{N}{2}$ and/or $N_b > \frac{N}{2}$ and repeat the steps in (a), (b), (c).