Indian Institute of Technology, Indore

Computer Science & Engineering

CS 354N: Assignment - Hopfield Neural Network

Date: 01-04-2025

General Instructions:

- **File Naming Format:** Submit as `Assignment_10_yourRollno.pdf`.
- **Submission:** Only through Google Classroom.
- **Plagiarism:** Strictly prohibited.
- **Attempts:** Only one submission allowed before the deadline.
- **Deadline: 08-04-2025**.
- **Report Format:** Include procedure, code snippets, and results.

Task 1: Implement a Discrete Hopfield Neural Network

Develop a program to construct an Auto-Associative Neural Network using a Discrete Hopfield model. The network should store the patterns $(\mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1})$ and $(\mathbf{1}, \mathbf{1}, \mathbf{0}, \mathbf{0})$ using the **Hebbian learning rule**.

1. **Compute the Weight Matrix** based on the given stored patterns.
2. **Test the Network** with different input vectors:
   - **Input:** $(\mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{1})$ $\Rightarrow$ Observe the output.
   - **Input:** $(\mathbf{1}, \mathbf{1}, \mathbf{0}, \mathbf{0})$ $\Rightarrow$ Observe the output.
   - **Input:** $(\mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{0})$ $\Rightarrow$ Observe the output.

Task 2: Training the Hopfield Network

Write a program to train a Discrete Hopfield Network using Hebb rule to store the pattern $(\mathbf{1}, \mathbf{1}, \mathbf{1}, \mathbf{0})$ and evaluate its ability to recall stored patterns.

1. **Input:** $(\mathbf{1}, \mathbf{0}, \mathbf{0}, \mathbf{0})$ $\Rightarrow$ Observe the output.
2. **Input:** $(\mathbf{0}, \mathbf{0}, \mathbf{1}, \mathbf{0})$ $\Rightarrow$ Observe the output.
3. **Input:** $(\mathbf{0}, \mathbf{0}, \mathbf{0}, \mathbf{1})$ $\Rightarrow$ Observe the output.