1. **Main objectives and scope of the assignment**

Implement Hopfield Networks and explore its capabilities, capacity and limitations

# 2 Methods

The programming language used was Python.

# 3 Results and discussion

# 3.1 Convergence and attractors

x1d and x3d converge towards stored patterns, but x2d does not converge toward x2.

There are 14 attractors in the network.

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| (1) [-1 -1 -1 -1 -1 1 -1 -1]  (2) [-1 -1 -1 -1 1 -1 -1 -1]  (3) [-1 -1 1 -1 -1 1 -1 1]  (4) [-1 -1 1 -1 1 -1 -1 1]  (5) [-1 -1 1 -1 1 1 -1 1]  (6) [-1 1 -1 -1 -1 1 -1 -1]  (7) [-1 1 1 -1 -1 1 -1 1]  (8) [-1 1 1 -1 1 -1 -1 1]  (9) [ 1 -1 -1 1 1 -1 1 -1]  (10) [ 1 1 -1 1 -1 1 1 -1]  (11) [ 1 1 -1 1 1 -1 1 -1]  (12) [ 1 1 -1 1 1 1 1 -1]  (13) [ 1 1 1 1 -1 1 1 1]  (14) [ 1 1 1 1 1 -1 1 1] |

We created three input patterns which have 5 bit errors, compared with x1, x2 and x3. When the starting pattern is very dissimilar to the stored ones, the recalled patterns cannot converge towards stored patterns.

# 3.2 Sequential Update

The three patterns are stable.

For P10, the network can complete a degraded pattern through the synchronous update, but not for P11.

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| 手机屏幕的截图  描述已自动生成 | 图片包含 游戏机, 钟表  描述已自动生成 |

Figure 1: Recalled patterns p10 (left) and p11 (right) with synchronous update

For Random Sequential Update, p10 converged to p1. For Original Sequential Update, p10 converged to a spurious pattern.

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| 手机屏幕的截图  描述已自动生成 | 图片包含 游戏机, 钟表, 画  描述已自动生成 | 手机屏幕的截图  描述已自动生成 |
| 手机屏幕的截图  描述已自动生成 | 手机屏幕的截图  描述已自动生成 | 手机屏幕的截图  描述已自动生成 |

Figure 2: Random Sequential Update for p10 (Every 1024 Iteration)

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| 图片包含 游戏机, 钟表  描述已自动生成 | 图片包含 游戏机, 钟表  描述已自动生成 |

Figure 3: Original Sequential Update for p10 (Every 1024 Iteration)