**Pattern Recognition Using Hebb’s Rule** [jj2196@nyu.edu](mailto:jj2196@nyu.edu)

Joby Joy

**Observations:**

**Pattern C:**

Misclassification counts by flipping K pixels:

{

1: 0,

2: 0,

3: 0,

4: 70,

5: 546,

6: 1890,

7: 3830,

8: 5055,

9: 4585,

10: 2947,

11: 1365,

12: 455,

13: 105,

14: 15,

15: 1

}

Misclassification counts by using K undetermined pixels:

{

1: 0,

2: 0,

3: 0,

4: 0,

5: 0,

6: 0,

7: 0,

8: (8, array([0, 1, 0, 1, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1])),

9: (63, array([0, 0, 0, 1, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1])),

10: (210, array([0, 0, 0, 0, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1])),

11: (385, array([0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 1, 0, -1, 0, 1])),

12: (420, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, -1, 0, 1])),

13: (273, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 1])),

14: (98, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1])),

15: (15, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]))

}

**Pattern X:**

Misclassification counts by flipping K pixels:

{

1: 0,

2: 0,

3: 0,

4: 70,

5: 546,

6: 1890,

7: 3830,

8: 5055,

9: 4585,

10: 2947,

11: 1365,

12: 455,

13: 105,

14: 15,

15: 1

}

Misclassification counts by using K undetermined pixels:

{

1: 0,

2: 0,

3: 0,

4: 0,

5: 0,

6: 0,

7: 0,

8: (8, array([0, 1, 0, 1, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1])),

9: (63, array([0, 0, 0, 1, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1])),

10: (210, array([0, 0, 0, 0, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1])),

11: (385, array([0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 1, 0, -1, 0, 1])),

12: (420, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, -1, 0, 1])),

13: (273, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 0, 1])),

14: (98, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1])),

15: (15, array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]))

}

**Comparison table for Misclassification Pattern C and Pattern X**:

**Flipped Pixels**

|  |  |  |
| --- | --- | --- |
| **K** | **Pattern C** | **Pattern X** |
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| **4** | **70** | **70** |
| 5 | 546 | 546 |
| 6 | 1890 | 1890 |
| 7 | 3830 | 3830 |
| 8 | 5055 | 5055 |
| 9 | 4585 | 4585 |
| 10 | 2947 | 2947 |
| 11 | 1365 | 1365 |
| 12 | 455 | 455 |
| 13 | 105 | 105 |
| 14 | 15 | 15 |
| 15 | 1 | 1 |

**Undetermined Patterns**

|  |  |  |
| --- | --- | --- |
| **K** | **Pattern C** | **Pattern X** |
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |
| 8 | 8 | 8 |
| 9 | 63 | 63 |
| 10 | 210 | 210 |
| 11 | 385 | 385 |
| 12 | 420 | 420 |
| 13 | 273 | 273 |
| 14 | 98 | 98 |
| 15 | 15 | 15 |

**For Undermined Pixels the pattern at which misclassification occurs:**

Pattern C:

K=8 [0, 1, 0, 1, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1]

Pattern X:

K=8 [0, 1, 0, 1, 0, 0, -1, 0, -1, 0, 1, 0, -1, 0, 1]

These subsequent patterns wherein the first pattern in the set yields a misclassification is observed to be the same for Pattern X and Y.

This experiment allows us to conclude that the behavior in the misclassification for pattern X and C are the same using the Hebb’s rule for a Neural Network that can classify between two patterns.

This also helps us in yielding the conclusion for undermined pixel that is corruption in the patterns also yields the same results for pattern C and X.