

**과제 #1 Perceptron 구현**

컴퓨터과학부

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권은진

1. 과정
   1. 입력 배열의 크기를 입력받는다.
   2. weight 과 theta 값을 결정하기 위한 랜덤값의 범위를 입력받는다.
   3. 연산에 필요한 모든 값을 초기화한 후, learning 을 수행한다.
   4. learning 을 수행할 때마다, 시도횟수, 틀린 개수, 각 입력값에 대해 x1,x2 의 함수를 출력한다.
   5. 모든 입력값에 대해 출력값이 AND Gate 의 출력값과 동일하다면, 퍼셉트론을 구현하는데 사용된 theta 및 weight 그리고 모든 입/출력값을 출력한다.
2. 결과 1 (입력 배열 크기: 3)
   1. 첫번째 시도

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| Input Dimension (> 2): 3  Input Random Range (min, max): -1 1  Function: x2 = 0.268298 x1 -0.0467129  Function: x2 = 0.268298 x1 -0.0467129  Function: x2 = 0.268298 x1 -0.0467129  Function: x2 = 0.268298 x1 -0.0467129  Try Count: 1, Wrong Count: 2  Function: x2 = -1.43056 x1 -3.14759  Function: x2 = -1.43056 x1 -3.14759  Function: x2 = -1.43056 x1 -3.14759  Function: x2 = -1.43056 x1 -3.14759  Try Count: 2, Wrong Count: 1  …  Function: x2 = -0.811058 x1 + 0.839984  Function: x2 = -0.811058 x1 + 0.839984  Function: x2 = -0.811058 x1 + 0.839984  Function: x2 = -0.811058 x1 + 0.839984  Try Count: 10, Wrong Count: 1  **Function: x2 = -1.39171 x1 + 2.33472**  **Function: x2 = -1.39171 x1 + 2.33472**  **Function: x2 = -1.39171 x1 + 2.33472**  **Function: x2 = -1.39171 x1 + 2.33472**  **Try Count: 11, Wrong Count: 0**  ALL PASS Above 4 function  --------------------------------------------------------  Theta Value : 0.335103  Weights : 1.07924, 0.775479, 1.47542  [Input Fixed Value]  x1 : 0.0, 0.0, 1.0, 1.0  x2 : 0.0, 1.0, 0.0, 1.0  x3: -1, -1, -1, -1  x2\*w2 = theta - sum - x1\*w1  [Output 1]  left term : 0  right term : 1.81052  [Output 2]  left term : 0.775479  right term : 1.81052  [Output 3]  left term : 0  right term : 0.731283  [Output 4]  left term : 0.775479  right term : 0.731283  -------------------------------------------------------- |

* 1. 두번째 시도

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| Input Dimension (> 2): 3  Input Random Range (min, max): -1 1  Function: x2 = 0.169911 x1 + 0.137407  Function: x2 = 0.169911 x1 + 0.137407  Function: x2 = 0.169911 x1 + 0.137407  Function: x2 = 0.169911 x1 + 0.137407  Try Count: 1, Wrong Count: 3  Function: x2 = 3.98606 x1 -3.01435  Function: x2 = 3.98606 x1 -3.01435  Function: x2 = 3.98606 x1 -3.01435  Function: x2 = 3.98606 x1 -3.01435  Try Count: 2, Wrong Count: 2  …  Function: x2 = -0.594087 x1 + 1.75553  Function: x2 = -0.594087 x1 + 1.75553  Function: x2 = -0.594087 x1 + 1.75553  Function: x2 = -0.594087 x1 + 1.75553  Try Count: 94, Wrong Count: 1  **Function: x2 = -1.91199 x1 + 1.96728**  **Function: x2 = -1.91199 x1 + 1.96728**  **Function: x2 = -1.91199 x1 + 1.96728**  **Function: x2 = -1.91199 x1 + 1.96728**  **Try Count: 95, Wrong Count: 0**  ALL PASS Above 4 function  --------------------------------------------------------  Theta Value : 0.726529  Weights : 0.77131, 0.403407, 0.0670872  [Input Fixed Value]  x1 : 0.0, 0.0, 1.0, 1.0  x2 : 0.0, 1.0, 0.0, 1.0  x3: -1, -1, -1, -1  x2\*w2 = theta - sum - x1\*w1  [Output 1]  left term : 0  right term : 0.793616  [Output 2]  left term : 0.403407  right term : 0.793616  [Output 3]  left term : 0  right term : 0.0223063  [Output 4]  left term : 0.403407  right term : 0.0223063  -------------------------------------------------------- |

* 1. 세번째 시도

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| Input Dimension (> 2): 3  Input Random Range (min, max): -1 1  **Function: x2 = -0.820831 x1 + 1.19762**  **Function: x2 = -0.820831 x1 + 1.19762**  **Function: x2 = -0.820831 x1 + 1.19762**  **Function: x2 = -0.820831 x1 + 1.19762**  **Try Count: 1, Wrong Count: 0**  ALL PASS Above 4 function  --------------------------------------------------------  Theta Value : 0.315426  Weights : 0.372015, 0.453218, 0.227354  [Input Fixed Value]  x1 : 0.0, 0.0, 1.0, 1.0  x2 : 0.0, 1.0, 0.0, 1.0  x3: -1, -1, -1, -1  x2\*w2 = theta - sum - x1\*w1  [Output 1]  left term : 0  right term : 0.54278  [Output 2]  left term : 0.453218  right term : 0.54278  [Output 3]  left term : 0  right term : 0.170765  [Output 4]  left term : 0.453218  right term : 0.170765  -------------------------------------------------------- |

1. 결과 2 (입력 배열 크기: 10)
   1. 첫번째 시도

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| Input Dimension (> 2): 10  Input Random Range (min, max): -1 1  Function: x2 = -0.79908 x1 + 0.341612  Function: x2 = -0.79908 x1 + 0.341612  Function: x2 = -0.79908 x1 + 0.341612  Function: x2 = -0.79908 x1 + 0.341612  Try Count: 1, Wrong Count: 2  Function: x2 = -1.54795 x1 + 3.11466  Function: x2 = -1.54795 x1 + 3.11466  Function: x2 = -1.54795 x1 + 3.11466  Function: x2 = -1.54795 x1 + 3.11466  Try Count: 2, Wrong Count: 1  …  Function: x2 = 0.710377 x1 -11.0066  Function: x2 = 0.710377 x1 -11.0066  Function: x2 = 0.710377 x1 -11.0066  Function: x2 = 0.710377 x1 -11.0066  Try Count: 8, Wrong Count: 1  Function: x2 = -0.866562 x1 + 1.16698  Function: x2 = -0.866562 x1 + 1.16698  Function: x2 = -0.866562 x1 + 1.16698  Function: x2 = -0.866562 x1 + 1.16698  Try Count: 9, Wrong Count: 0  ALL PASS Above 4 function  --------------------------------------------------------  Theta Value : 0.733725  Weights : 1.72029, 1.98519, -0.837524, -0.273405, 0.881692, 1.59018, -0.916616, -0.560138, -0.234787, 1.93357  [Input Fixed Value]  x1 : 0.0, 0.0, 1.0, 1.0  x2 : 0.0, 1.0, 0.0, 1.0  x3: -1, -1, -1, -1  x4: -1, -1, -1, -1  x5: -1, -1, -1, -1  x6: -1, -1, -1, -1  x7: -1, -1, -1, -1  x8: -1, -1, -1, -1  x9: -1, -1, -1, -1  x10: -1, -1, -1, -1  x2\*w2 = theta - sum - x1\*w1  [Output 1]  left term : 0  right term : 2.31669  [Output 2]  left term : 1.98519  right term : 2.31669  [Output 3]  left term : 0  right term : 0.596397  [Output 4]  left term : 1.98519  right term : 0.596397  -------------------------------------------------------- |

* 1. 두번째 시도

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| Input Dimension (> 2): 10  Input Random Range (min, max): -1 1  Function: x2 = 1.13674 x1 -13.4385  Function: x2 = 1.13674 x1 -13.4385  Function: x2 = 1.13674 x1 -13.4385  Function: x2 = 1.13674 x1 -13.4385  Try Count: 1, Wrong Count: 1  **Function: x2 = -0.283733 x1 + 1.22097**  **Function: x2 = -0.283733 x1 + 1.22097**  **Function: x2 = -0.283733 x1 + 1.22097**  **Function: x2 = -0.283733 x1 + 1.22097**  **Try Count: 2, Wrong Count: 0**  ALL PASS Above 4 function  --------------------------------------------------------  Theta Value : 0.468566  Weights : 0.194424, 0.685236, -0.244608, 1.86936, -0.669942, -0.715879, 1.21679, -0.367721, -0.287941, -0.431972  [Input Fixed Value]  x1 : 0.0, 0.0, 1.0, 1.0  x2 : 0.0, 1.0, 0.0, 1.0  x3: -1, -1, -1, -1  x4: -1, -1, -1, -1  x5: -1, -1, -1, -1  x6: -1, -1, -1, -1  x7: -1, -1, -1, -1  x8: -1, -1, -1, -1  x9: -1, -1, -1, -1  x10: -1, -1, -1, -1  x2\*w2 = theta - sum - x1\*w1  [Output 1]  left term : 0  right term : 0.836654  [Output 2]  left term : 0.685236  right term : 0.836654  [Output 3]  left term : 0  right term : 0.64223  [Output 4]  left term : 0.685236  right term : 0.64223  -------------------------------------------------------- |

* 1. 세번째 시도

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| Input Dimension (> 2): 10  Input Random Range (min, max): -1 1  Function: x2 = -1.44706 x1 + 3.48767  Function: x2 = -1.44706 x1 + 3.48767  Function: x2 = -1.44706 x1 + 3.48767  Function: x2 = -1.44706 x1 + 3.48767  Try Count: 1, Wrong Count: 1  Function: x2 = 0.148598 x1 -8.88101  Function: x2 = 0.148598 x1 -8.88101  Function: x2 = 0.148598 x1 -8.88101  Function: x2 = 0.148598 x1 -8.88101  Try Count: 2, Wrong Count: 1  Function: x2 = 0.367238 x1 -8.37254  Function: x2 = 0.367238 x1 -8.37254  Function: x2 = 0.367238 x1 -8.37254  Function: x2 = 0.367238 x1 -8.37254  Try Count: 3, Wrong Count: 1  Function: x2 = -1.12056 x1 + 6.10141  Function: x2 = -1.12056 x1 + 6.10141  Function: x2 = -1.12056 x1 + 6.10141  Function: x2 = -1.12056 x1 + 6.10141  Try Count: 4, Wrong Count: 1  Function: x2 = -0.132932 x1 + 3.59493  Function: x2 = -0.132932 x1 + 3.59493  Function: x2 = -0.132932 x1 + 3.59493  Function: x2 = -0.132932 x1 + 3.59493  Try Count: 5, Wrong Count: 1  Function: x2 = -0.37897 x1 + 2.05437  Function: x2 = -0.37897 x1 + 2.05437  Function: x2 = -0.37897 x1 + 2.05437  Function: x2 = -0.37897 x1 + 2.05437  Try Count: 6, Wrong Count: 1  **Function: x2 = -4.31407 x1 + 4.54282**  **Function: x2 = -4.31407 x1 + 4.54282**  **Function: x2 = -4.31407 x1 + 4.54282**  **Function: x2 = -4.31407 x1 + 4.54282**  **Try Count: 7, Wrong Count: 0**  ALL PASS Above 4 function  --------------------------------------------------------  Theta Value : -0.222339  Weights : 1.14418, 0.265221, -0.428378, 0.247673, 1.63463, -0.770787, -0.622871, 1.41357, 0.921166, -0.967813  [Input Fixed Value]  x1 : 0.0, 0.0, 1.0, 1.0  x2 : 0.0, 1.0, 0.0, 1.0  x3: -1, -1, -1, -1  x4: -1, -1, -1, -1  x5: -1, -1, -1, -1  x6: -1, -1, -1, -1  x7: -1, -1, -1, -1  x8: -1, -1, -1, -1  x9: -1, -1, -1, -1  x10: -1, -1, -1, -1  x2\*w2 = theta - sum - x1\*w1  [Output 1]  left term : 0  right term : 1.20485  [Output 2]  left term : 0.265221  right term : 1.20485  [Output 3]  left term : 0  right term : 0.0606707  [Output 4]  left term : 0.265221  right term : 0.0606707  -------------------------------------------------------- |

1. 결론

위 결과에서 주의해서 봤던 것은 함수의 모양이었다. 아래의 식을 x2 에 대한 함수로 정리했을 때 좌항이 우항보다 크면 1, 작으면 0 으로 판단하도록 구현했다.

여기서 판단된 값은 AND Gate 의 출력값과 비교하는데, 입력배열의 크기가 작을 때는 각각의 weight 이 서로 비슷한 값인 경우 시도횟수가 적었고, 입력배열의 크기가 커지는 경우 각 xi의 값들에 받는 영향력도 커지기 때문에 weight 이 서로 차이가 나도 AND Gate의 출력과 동일한 것을 알 수 있다. 만약, 입력배열의 크기가 100 이상이거나 더 큰 경우 다른 값 xi의 영향력도 무시할 수 없기 때문에 weight 을 모든 입력값을 받은 뒤 출력을 모두 확인하고 나서 조정을 해주는 것이 아니라, 각 입력에 대해 출력을 확인해보고 원하는 출력값에 가까워지도록 weight 을 조정해줄 필요가 있다. 더불어, weight 을 상수로 조정하는게 아니라 입력값과 theta를 매개로 하는 특정 함수를 이용해야된다는 생각이 들었다. 위 함수에서 알 수 있듯이 각 입력값이 어떤지에 따라 weight 뿐만 아니라 theta 도 조정을 해주어야 하기 때문이다.