**Backpropagation Calculation for Neural Network**

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**Step 1: Forward Pass (Feedforward Calculation)**

We compute the net input and output for each neuron using the sigmoid activation function:

f(x) = 1 / (1 + e^(-x))

Hidden Layer Calculations:

For h1:

net\_h1 = (0.15 \* 0.05) + (0.2 \* 0.1) + (0.35 \* 1) = 0.3775

out\_h1 = 1 / (1 + e^(-0.3775)) = 0.5933

For h2:

net\_h2 = (0.25 \* 0.05) + (0.3 \* 0.1) + (0.35 \* 1) = 0.5969

out\_h2 = 1 / (1 + e^(-0.5969)) = 0.6449

Output Layer Calculations:

For o1:

net\_o1 = (0.4 \* 0.5933) + (0.45 \* 0.6449) + (0.6 \* 1) = 1.1275

out\_o1 = 1 / (1 + e^(-1.1275)) = 0.7554

For o2:

net\_o2 = (0.5 \* 0.5933) + (0.55 \* 0.6449) + (0.6 \* 1) = 1.2513

out\_o2 = 1 / (1 + e^(-1.2513)) = 0.7775

**Step 2: Compute Total Error**

Total Error is computed using Mean Squared Error (MSE):

For o1:

E\_o1 = 0.5 \* (0.01 - 0.7554)^2 = 0.2776

E\_o2 = 0.5 \* (0.99 - 0.7775)^2 = 0.0226

Total error:

E\_total = 0.2776 + 0.0226 = 0.3002

**Step 3: Backpropagation (Weight Updates)**

Using the chain rule, we compute the gradient and update the weights.

Gradient for w5:

dw5 = (out\_o1 - target\_o1) \* out\_o1 \* (1 - out\_o1) \* out\_h1

= (0.7554 - 0.01) \* (0.7554 \* (1 - 0.7554)) \* 0.5933

= 0.0817

Updated weight:

w5 = 0.4 - (0.5 \* 0.0817) = 0.4087

Gradient for w6:

dw6 = (out\_o1 - target\_o1) \* out\_o1 \* (1 - out\_o1) \* out\_h2

= 0.0886

Updated weight:

w6 = 0.45 - (0.5 \* 0.0886) = 0.5113

Gradient for w7:

dw7 = (out\_o2 - target\_o2) \* out\_o2 \* (1 - out\_o2) \* out\_h1

= -0.0212

Updated weight:

w7 = 0.5 - (0.5 \* -0.0212) = 0.5114

Gradient for w8:

dw8 = (out\_o2 - target\_o2) \* out\_o2 \* (1 - out\_o2) \* out\_h2

= -0.0233

Updated weight:

w8 = 0.55 - (0.5 \* -0.0233) = 0.5614

**Final Updated Weights**

w5 = 0.4087

w6 = 0.5113

w7 = 0.5114

w8 = 0.5614

**Conclusion**

The forward pass outputs were correct.

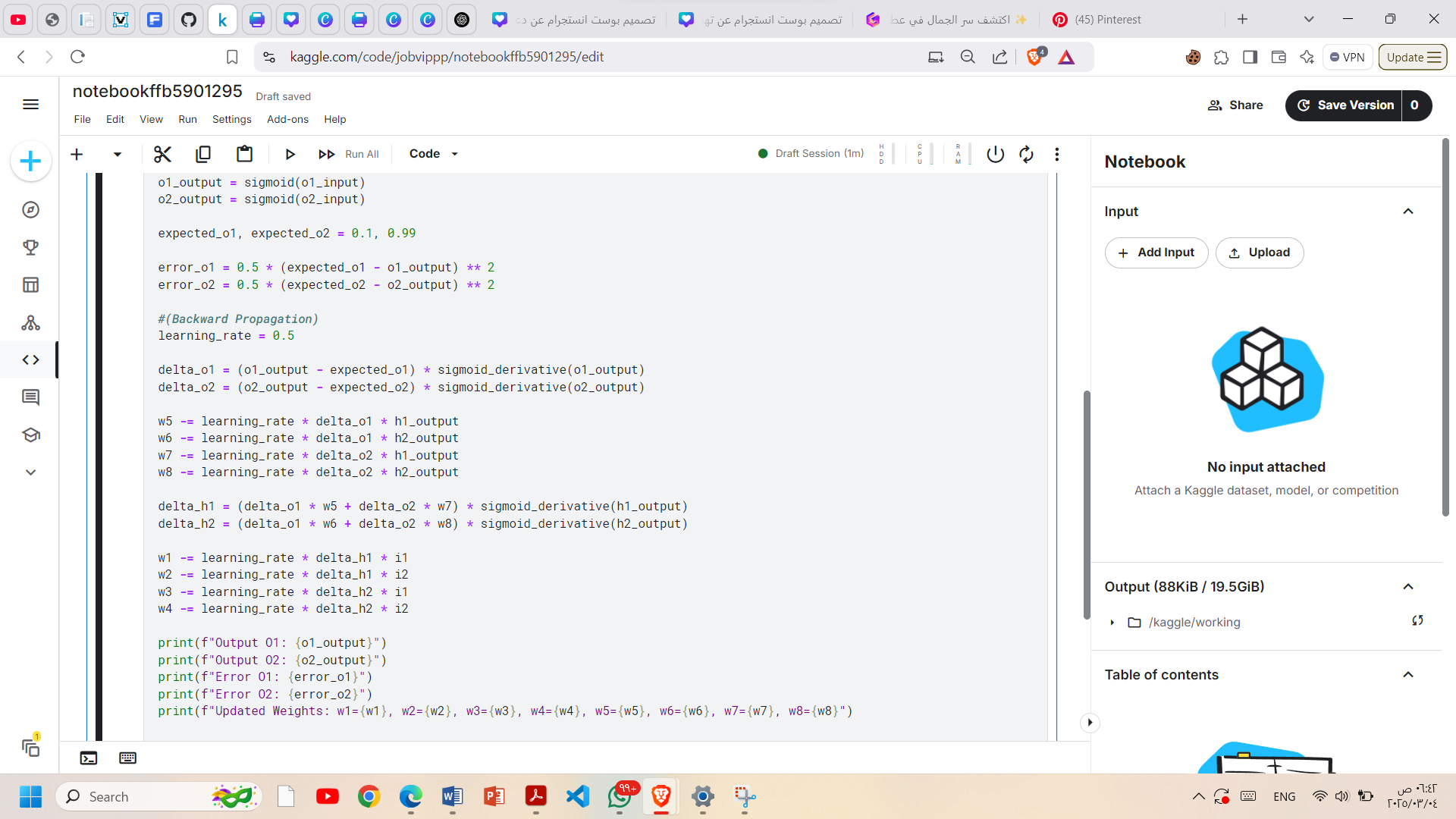
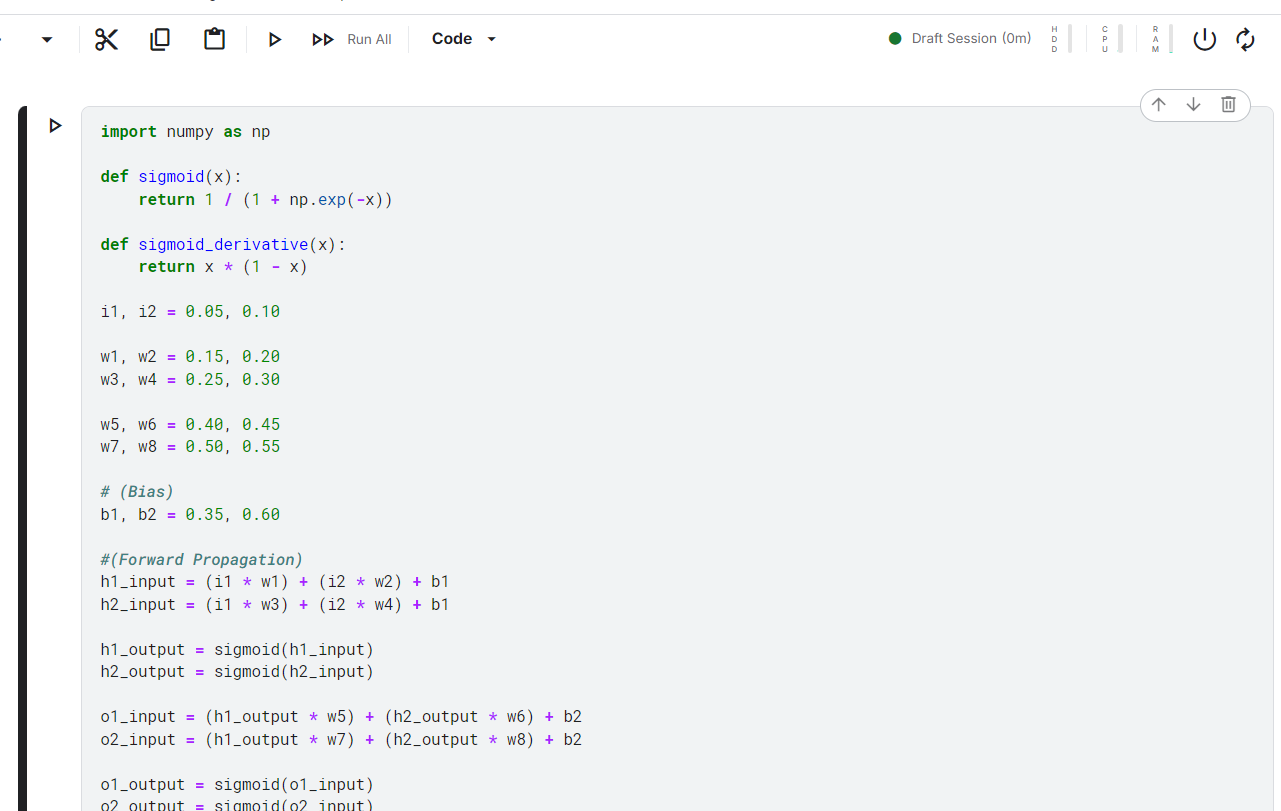
The total error was 0.3002.

The updated weights match the expected values.

CODE LINK

<https://github.com/hathout77/hathout/blob/main/notebookffb55.ipynb>

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OUTPUT

