

BooleanFunction

January 30, 2019

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In [1]: import numpy as np
        from numpy.random import rand as U
```

```
In [2]: x_train = np.array([[0, 0, 0],
                             [0, 0, 1],
                             [0, 1, 0],
                             [0, 1, 1],
                             [1, 0, 0],
                             [1, 0, 1],
                             [1, 1, 0],
                             [1, 1, 1],])
```

```
        y_train = np.zeros((8,1))
```

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In [3]: def activation(x):
        return 1/(1+np.exp(-x))
```

```
In [4]: def Delta(x, y, o):
        dW = x*y*(y - o)*(y - 1)
        return (np.sum(dW, axis = 0)).reshape((x.shape[1],1))
```

```
In [5]: def output(x, y, z):
        y = (activation(np.dot(np.array([[x, y, z]]), W) + b))
        y = y > 0.5
        return int(y)
```

Please provide your 3 input binary function.

===== | **NOTE** | ===== - Use x, y, z as 3 inputs and for writing not of x write it as x' - use '.' for 'AND' and '+' for 'OR' operators. - write the function as sum of products.

=====

Example: x'.y.z + y'.z + z'

```
In [7]: print("- Use x, y, z as 3 inputs and for writing not of x write it as x' \n- use '.' for
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```
        f = input("Function: ")
        bool_exp = ""
```

```

# convert the inputed function into string mathematical expression
# The expression gives > 0 for logic 1 and 0 for logic 0
for j in range(len(f)):
    if f[j] == "'":
        bool_exp = bool_exp[:-1] + "(1 - " + str(bool_exp[-1]) + ")"
    elif f[j] == ".":
        bool_exp += "*"
    else:
        bool_exp += f[j]

print(bool_exp)

```

- Use x, y, z as 3 inputs and for writing not of x write it as x'
- use '.' for 'AND' and '+' for 'OR' operators.
- write the function as sum of products.

Example: x'.y.z + y'.z + z'

Function: x.y.z

x*y*z

```

In [10]: for i in range(8):
        x = x_train[i][0]
        y = x_train[i][1]
        z = x_train[i][2]

        y_train[i] = not (not (eval(bool_exp)))

In [16]: W = U(3,1) - 0.5
        b = U(1,1) - 0.5
        lr = 1

        print("=====[ Start Learning ]=====")
        for e in range(1000):
            y = (activation(np.dot(x_train, W) + b)).reshape(-1,1)
            if e%100 == 0:
                error = np.sum((y-y_train)*(y-y_train))/8
                print('Epoch: ', e, 'Error: ', error)
            dW = Delta(x_train, y, y_train)
            db = Delta(np.ones((8,1)), y, y_train)

            W += lr*dW
            b += lr*db

        =====[ Start Learning ]=====
Epoch: 0 Error: 0.250527355271912
Epoch: 100 Error: 0.032530420500026455
Epoch: 200 Error: 0.017509857393176374
Epoch: 300 Error: 0.011573023632999536
Epoch: 400 Error: 0.008494881473271581

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Epoch: 500 Error: 0.00664749920262615
Epoch: 600 Error: 0.0054294483997166035
Epoch: 700 Error: 0.004571956845817852
Epoch: 800 Error: 0.0039385132615136625
Epoch: 900 Error: 0.00345303098842862
```

```
In [19]: print('Veirfy f = ' + f + '\n')
         print('[x y z] [ f ]')
         for test in x_train:
             print(test, '[', output(test[0], test[1], test[2]), ']')
```

```
Veirfy f = x.y.z
```

```
[x y z] [ f ]
[0 0 0] [ 0 ]
[0 0 1] [ 0 ]
[0 1 0] [ 0 ]
[0 1 1] [ 0 ]
[1 0 0] [ 0 ]
[1 0 1] [ 0 ]
[1 1 0] [ 0 ]
[1 1 1] [ 1 ]
```

```
In [ ]:
```