Neural Network Basics

1. What does a neuron compute?

- [ ] A neuron computes an activation function followed by a linear function ($z = Wx + b$).
- [x] A neuron computes a linear function ($z = Wx + b$) followed by an activation function.

> Correct, we generally say that the output of a neuron is $a = g(Wx + b)$ where g is the activation function (sigmoid, tanh, ReLU, ...).

- [ ] A neuron computes a function g that scales the input x linearly ($Wx + b$).
- [ ] A neuron computes the mean of all features before applying the output to an activation function.

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2. Which of these is the "Logistic Loss"?

- [ ] $\mathcal{L}^{(i)}(\hat{y}^{(i)}, y^{(i)}) = max(0,\ y^{(i)} - \hat{y}^{(i)})$
- [x] $\mathcal{L}^{(i)}(\hat{y}^{(i)}, y^{(i)}) = -\big(y^{(i)} log(\hat{y}^{(i)}) + (1 - y^{(i)}) log(1 - \hat{y}^{(i)})\big)$

> Correct, this is the logistic loss you've seen in lecture!

- [ ] $\mathcal{L}^{(i)}(\hat{y}^{(i)}, y^{(i)}) = |y^{(i)} - \hat{y}^{(i)}|$
- [ ] $\mathcal{L}^{(i)}(\hat{y}^{(i)}, y^{(i)}) = |y^{(i)} - \hat{y}^{(i)}|^2$

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3. Suppose img is a (32,32,3) array, representing a 32x32 image with 3 color channels red, green and blue. How do you reshape this into a column vector?

- [x] x = img.reshape((32 * 32 * 3, 1))
- [ ] x = img.reshape((1, 32 * 32 * 3))
- [ ] x = img.reshape((3, 32 * 32))
- [ ] x = img.reshape((32 * 32, 3))

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4. Consider the two following random arrays "a" and "b":

```
a = np.random.randn(2, 3) # a.shape = (2, 3)
b = np.random.randn(2, 1) # b.shape = (2, 1)
c = a + b
```

What will be the shape of "c"?

- [x] c.shape = (2, 3)

> Yes! This is broadcasting. b (column vector) is copied 3 times so that it can be summed to each column of a.

- [ ] The computation cannot happen because the sizes don't match. It's going to be "Error"!
- [ ] c.shape = (2, 1)

- [ ] c.shape = (3, 2)

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5. Consider the two following random arrays "a" and "b":

```
a = np.random.randn(4, 3) # a.shape = (4, 3)
b = np.random.randn(3, 2) # b.shape = (3, 2)
c = a * b
```

What will be the shape of "c"?

- [ ] c.shape = (3, 3)
- [x] The computation cannot happen because the sizes don't match. It's going to be "Error"!

> Indeed! In numpy the "*" operator indicates element-wise multiplication. It is different from "np.dot()". If you would try "c=np.dot(a, b)" you would get c.shape = (4, 2).

- [ ] c.shape = (4, 2)
- [ ] c.shape = (4, 3)

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6. Suppose you have n_x input features per example. Recall that $X = [x^{(1)}, x^{(2)} \dots x^{(m)}]$. What is the dimension of X?

- [ ] $(1, m)$
- [ ] (m, n_x)
- [ ] $(m, 1)$
- [x] (n_x, m)

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7. Recall that `np.dot(a,b)` performs a matrix multiplication on a and b, whereas `a*b` performs an element-wise multiplication. Consider the two following random arrays "a" and "b":

```
a = np.random.randn(12288, 150) # a.shape = (12288, 150)
b = np.random.randn(150, 45) # b.shape = (150, 45)
c = np.dot(a, b)
```

What is the shape of c?

- [ ] c.shape = (12288, 150)
- [ ] c.shape = (150, 150)
- [x] c.shape = (12288, 45)

> Correct, remember that a np.dot(a, b) has shape (number of rows of a, number of columns of b). The sizes match because:
>
> "number of columns of a = 150 = number of rows of b"

- [ ] The computation cannot happen because the sizes don't match. It's going to be "Error"!

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8. Consider the following code snippet:

```
# a.shape = (3,4)
# b.shape = (4,1)
for i in range(3):
  for j in range(4):
    c[i][j] = a[i][j] + b[j]
```

How do you vectorize this?

- [ ] c = a.T + b.T
- [ ] c = a.T + b
- [ ] c = a + b
- [x] c = a + b.T

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9. Consider the following code:

```
a = np.random.randn(3, 3)
b = np.random.randn(3, 1)
c = a * b
```

What will be c?

- [x] This will invoke broadcasting, so b is copied three times to become (3, 3), and $*$ is an element-wise product so c.shape will be (3, 3).
- [ ] This will invoke broadcasting, so b is copied three times to become (3, 3), and $*$ invokes a matrix multiplication operation of two 3x3 matrices so c.shape will be (3, 3).
- [ ] This will multiply a 3x3 matrix a with a 3x1 vector, thus resulting in a 3x1 vector. That is, c.shape = (3, 3).
- [ ] It will lead to an error since you cannot use "*" to operate on these two matrices. You need to instead use np.dot(a, b).

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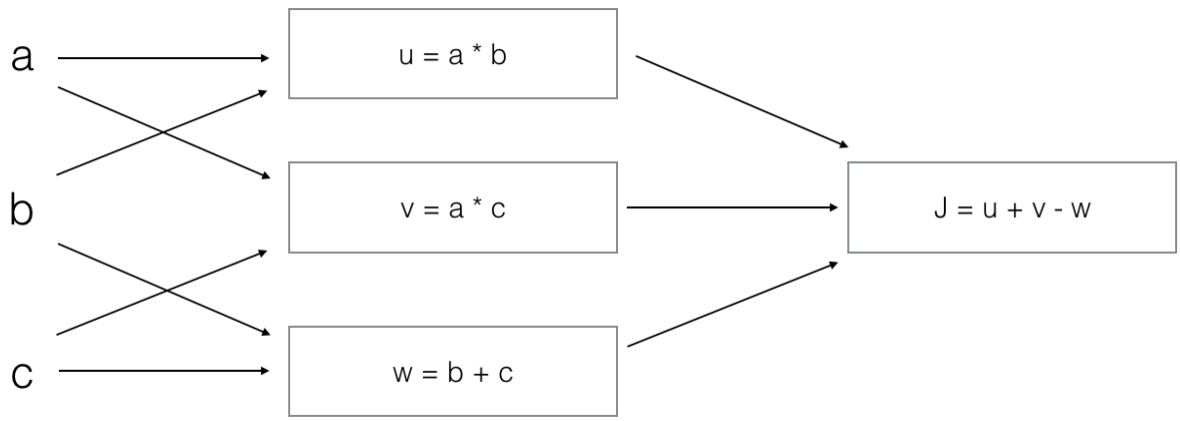
10. Consider the following computation graph.



- [ ] J = (c - 1) * (b + a)
- [x] J = (a - 1) * (b + c)

> Yes. J = u + v - w = a * b + a * c - (b + c) = a * (b + c) - (b + c) = (a - 1) * (b + c)

- [ ] J = a * b + b * c + a * c
- [ ] J = (b - 1) * (c + a)
