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Assignment 1 : Logistic Regression with Neural Network mindset

```
import numpy as np
import matplotlib.pyplot as plt
import h5py
import scipy
from PIL import Image
from scipy import ndimage

def load_dataset():
    train_dataset = h5py.File('train_catvnoncat.h5', "r")
    train_set_x_orig = np.array(train_dataset["train_set_x"][:]) # your train set features
    train_set_y_orig = np.array(train_dataset["train_set_y"][:]) # your train set labels

    test_dataset = h5py.File('test_catvnoncat.h5', "r")
    test_set_x_orig = np.array(test_dataset["test_set_x"][:]) # your test set features
    test_set_y_orig = np.array(test_dataset["test_set_y"][:]) # your test set labels

    classes = np.array(test_dataset["list_classes"][:]) # the list of classes

    train_set_y_orig = train_set_y_orig.reshape((1, train_set_y_orig.shape[0]))
    test_set_y_orig = test_set_y_orig.reshape((1, test_set_y_orig.shape[0]))

    return train_set_x_orig, train_set_y_orig, test_set_x_orig, test_set_y_orig, classes


%matplotlib inline
```

```
from google.colab import files
uploaded = files.upload()
```

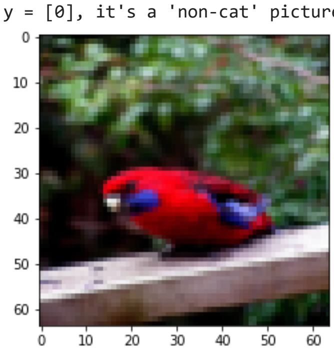
Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving test_catvnoncat.h5 to test_catvnoncat.h5
Saving train_catvnoncat.h5 to train_catvnoncat.h5
```

```
train_set_x_orig, train_set_y, test_set_x_orig, test_set_y, classes = load_dataset()
```

```
index = 35
plt.imshow(train_set_x_orig[index])
print ("y = " + str(train_set_y[:, index]) + ", it's a '" + classes[np.squeeze(train_set_y[:, index])].decode("utf-8") +  "' picture.")
```

```
y = [0], it's a 'non-cat' picture.
```




```
m_train = train_set_x_orig.shape[0]
m_test = test_set_x_orig.shape[0]
num_px = test_set_x_orig.shape[1]
print ("Number of training examples: m_train = " + str(m_train))
print ("Number of testing examples: m_test = " + str(m_test))
print ("Height/Width of each image: num_px = " + str(num_px))
print ("Each image is of size: (" + str(num_px) + ", " + str(num_px) + ", 3)")
print ("train_set_x shape: " + str(train_set_x_orig.shape))
print ("train_set_y shape: " + str(train_set_y.shape))
```

```
print ("test_set_x shape: " + str(test_set_x_orig.shape))
print ("test_set_y shape: " + str(test_set_y.shape))
```

```
Number of training examples: m_train = 209
Number of testing examples: m_test = 50
Height/Width of each image: num_px = 64
Each image is of size: (64, 64, 3)
train_set_x shape: (209, 64, 64, 3)
train_set_y shape: (1, 209)
test_set_x shape: (50, 64, 64, 3)
test_set_y shape: (1, 50)
```

```
# Reshape the training and test examples
train_set_x_flatten = train_set_x_orig.reshape(train_set_x_orig.shape[0], -1).T
test_set_x_flatten = test_set_x_orig.reshape(test_set_x_orig.shape[0], -1).T
print ("train_set_x_flatten shape: " + str(train_set_x_flatten.shape))
print ("train_set_y shape: " + str(train_set_y.shape))
print ("test_set_x_flatten shape: " + str(test_set_x_flatten.shape))
print ("test_set_y shape: " + str(test_set_y.shape))
print ("sanity check after reshaping: " + str(train_set_x_flatten[0:5,0]))
```

```
train_set_x_flatten shape: (12288, 209)
train_set_y shape: (1, 209)
test_set_x_flatten shape: (12288, 50)
test_set_y shape: (1, 50)
sanity check after reshaping: [17 31 56 22 33]
```

```
train_set_x = train_set_x_flatten/255.
test_set_x = test_set_x_flatten/255.
```

```
def sigmoid(z):
    s = 1 / (1 + np.exp(-z))
    return s
```

```
print ("sigmoid([0, 2]) = " + str(sigmoid(np.array([0,2]))))
```

```
sigmoid([0, 2]) = [0.5        0.88079708]
```

```
def initialize_with_zeros(dim):
    w = np.zeros((dim, 1))
    b = 0
    assert(w.shape == (dim, 1))
    assert(isinstance(b, float) or isinstance(b, int))
    return w, b
```

```
dim = 2
w, b = initialize_with_zeros(dim)
print ("w = " + str(w))
print ("b = " + str(b))
```

```
w = [[0.]
 [0.]]
b = 0
```

```
def propagate(w, b, X, Y):
    m = X.shape[1]
    # FORWARD PROPAGATION (FROM X TO COST)
    A = sigmoid(np.dot(w.T, X) + b) # compute activation
    cost = -1.0 / m * np.sum(Y * np.log(A) + (1-Y) * np.log(1 - A)) # compute cost
    # BACKWARD PROPAGATION (TO FIND GRAD)
    dw = 1.0 / m * np.dot(X, (A - Y).T)
    db = 1.0 / m * np.sum(A - Y)
    assert(dw.shape == w.shape)
    assert(db.dtype == float)
    cost = np.squeeze(cost)
    assert(cost.shape == ())
    grads = {"dw": dw,
             "db": db}
    return grads, cost
```

```
w, b, X, Y = np.array([[1.],[2.]]), 2., np.array([[1.,2.,-1.],[3.,4.,-3.2]]), np.array([[1,0,1]])
grads, cost = propagate(w, b, X, Y)
print ("dw = " + str(grads["dw"]))
print ("db = " + str(grads["db"]))
print ("cost = " + str(cost))
```

```
dw = [[0.99845601]
 [2.39507239]]
db = 0.001455578136784208
cost = 5.801545319394553
```

```
def optimize(w, b, X, Y, num_iterations, learning_rate, print_cost = False):
    costs = []
    for i in range(num_iterations):
        # Cost and gradient calculation (≈ 1-4 lines of code)
        grads, cost = propagate(w, b , X, Y)
        # Retrieve derivatives from grads
        dw = grads["dw"]
        db = grads["db"]
        # update rule (≈ 2 lines of code)
        w = w - learning_rate * dw
        b = b - learning_rate * db
        # Record the costs
        if i % 100 == 0:
            costs.append(cost)
        # Print the cost every 100 training iterations
        if print_cost and i % 100 == 0:
            print ("Cost after iteration %i: %f" %(i, cost))
    params = {"w": w,
              "b": b}
    grads = {"dw": dw,
             "db": db}
    return params, grads, costs
```

```
params, grads, costs = optimize(w, b, X, Y, num_iterations= 100, learning_rate = 0.009, print_cost = False)
print ("w = " + str(params["w"]))
print ("b = " + str(params["b"]))
print ("dw = " + str(grads["dw"]))
print ("db = " + str(grads["db"]))
```

```
w = [[0.19033591]
 [0.12259159]]
b = 1.9253598300845747
dw = [[0.67752042]
 [1.41625495]]
db = 0.21919450454067657
```

```
def predict(w, b, X):
    m = X.shape[1]
    Y_prediction = np.zeros((1,m))
    w = w.reshape(X.shape[0], 1)
    # Compute vector "A" predicting the probabilities of a cat being present in the picture
    A = sigmoid(np.dot(w.T, X) + b)
    for i in range(A.shape[1]):
        # Convert probabilities A[0,i] to actual predictions p[0,i]
        if A[0,i] <= 0.5:
            Y_prediction[0, i] = 0
        else:
            Y_prediction[0, i] = 1
    assert(Y_prediction.shape == (1, m))
    return Y_prediction
```

```
w = np.array([[0.1124579],[0.23106775]])
b = -0.3
X = np.array([[1.,-1.1,-3.2],[1.2,2.,0.1]])
print ("predictions = " + str(predict(w, b, X)))
```

```
predictions = [[1. 1. 0.]]
```

```
def model(X_train, Y_train, X_test, Y_test, num_iterations = 2000, learning_rate = 0.5, print_cost = False):
    # initialize parameters with zeros (≈ 1 line of code)
    w, b = initialize_with_zeros(X_train.shape[0])
    # Gradient descent (≈ 1 line of code)
    parameters, grads, costs = optimize(w, b, X_train, Y_train, num_iterations = num_iterations, learning_rate = learning_rate, print_cost
    # Retrieve parameters w and b from dictionary "parameters"
```

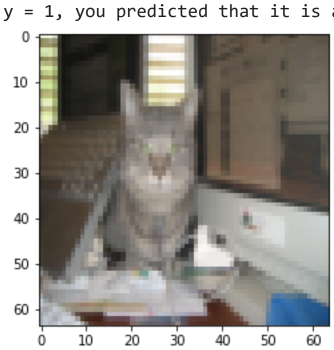
```
    w = parameters["w"]
    b = parameters["b"]
    # Predict test/train set examples (≈ 2 lines of code)
    Y_prediction_test = predict(w, b, X_test)
    Y_prediction_train = predict(w, b, X_train)
    # Print train/test Errors
    print("train accuracy: {} %".format(100 - np.mean(np.abs(Y_prediction_train - Y_train)) * 100))
    print("test accuracy: {} %".format(100 - np.mean(np.abs(Y_prediction_test - Y_test)) * 100))
    d = {"costs": costs,
         "Y_prediction_test": Y_prediction_test,
         "Y_prediction_train" : Y_prediction_train,
         "w" : w,
         "b" : b,
         "learning_rate" : learning_rate,
         "num_iterations": num_iterations}
    return d
```

```
d = model(train_set_x, train_set_y, test_set_x, test_set_y, num_iterations = 2000, learning_rate = 0.005, print_cost = True)
```

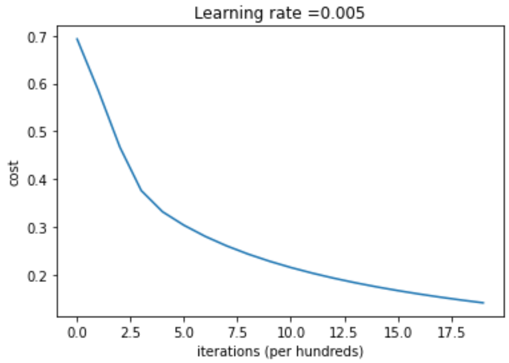
```
Cost after iteration 0: 0.693147
Cost after iteration 100: 0.584508
Cost after iteration 200: 0.466949
Cost after iteration 300: 0.376007
Cost after iteration 400: 0.331463
Cost after iteration 500: 0.303273
Cost after iteration 600: 0.279880
Cost after iteration 700: 0.260042
Cost after iteration 800: 0.242941
Cost after iteration 900: 0.228004
Cost after iteration 1000: 0.214820
Cost after iteration 1100: 0.203078
Cost after iteration 1200: 0.192544
Cost after iteration 1300: 0.183033
Cost after iteration 1400: 0.174399
Cost after iteration 1500: 0.166521
Cost after iteration 1600: 0.159305
Cost after iteration 1700: 0.152667
Cost after iteration 1800: 0.146542
Cost after iteration 1900: 0.140872
train accuracy: 99.04306220095694 %
test accuracy: 70.0 %
```

```
import math
# Example of a picture that was wrongly classified.
index = 7
plt.imshow(test_set_x[:,index].reshape((num_px, num_px, 3)))
y1 = str(test_set_y[0,index])
print(y1)
d1 = d["Y_prediction_test"][0,index]
print(d1)
a1 = classes[math.floor(d1)].decode("utf-8")
print ("y = " + y1 + ", you predicted that it is a \"" + a1 +  "\" picture.")
```

```
1
1.0
y = 1, you predicted that it is a "cat" picture.
```

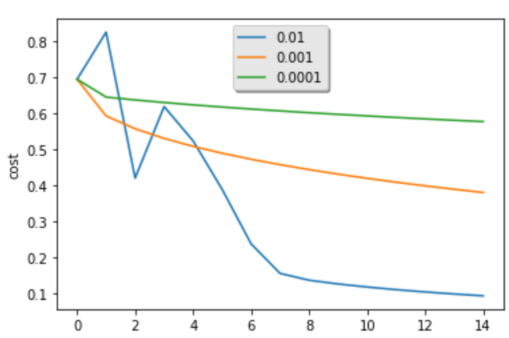


```
# Plot learning curve (with costs)
costs = np.squeeze(d['costs'])
plt.plot(costs)
plt.ylabel('cost')
plt.xlabel('iterations (per hundreds)')
plt.title("Learning rate =" + str(d["learning_rate"]))
plt.show()
```




```
learning_rates = [0.01, 0.001, 0.0001]
models = {}
for i in learning_rates:
    print ("learning rate is: " + str(i))
    models[str(i)] = model(train_set_x, train_set_y, test_set_x, test_set_y, num_iterations = 1500, learning_rate = i, print_cost = False)
    print ('\n' + "-------------------------------------------------------" + '\n')

for i in learning_rates:
    plt.plot(np.squeeze(models[str(i)]["costs"]), label= str(models[str(i)]["learning_rate"]))

plt.ylabel('cost')
plt.xlabel('iterations (hundreds)')

legend = plt.legend(loc='upper center', shadow=True)
frame = legend.get_frame()
frame.set_facecolor('0.90')
plt.show()

```

```
learning rate is: 0.01
train accuracy: 99.52153110047847 %
test accuracy: 68.0 %

-------------------------------------------------------

learning rate is: 0.001
train accuracy: 88.99521531100478 %
test accuracy: 64.0 %

-------------------------------------------------------

learning rate is: 0.0001
train accuracy: 68.42105263157895 %
test accuracy: 36.0 %

-------------------------------------------------------
```




```
my_image = "my_image4.jpg" # change this to the name of your image file
# We preprocess the image to fit your algorithm.
```

```
fname = "../input/catvsnoncat/" + my_image
import matplotlib
matplotlib.pyplot
# image = np.array(ndimage.imread(fname, flatten=False))
image = np.array(matplotlib.pyplot.imread(fname))
image = image/255.
# original
# my_image = scipy.misc.imresize(image, size=(num_px,num_px)).reshape((1, num_px*num_px*3)).T
# stackoverflow
# from PIL import Image
# my_image = Image.fromarray(image).resize(size=(num_px, num_px))
# without resize
my_image = image.reshape((1, num_px*num_px*3)).T
my_predicted_image = predict(d["w"], d["b"], my_image)
plt.imshow(image)
print("y = " + str(np.squeeze(my_predicted_image)) + ", your algorithm predicts a \"" + classes[int(np.squeeze(my_predicted_image)),].deco
```