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CS 596 MW
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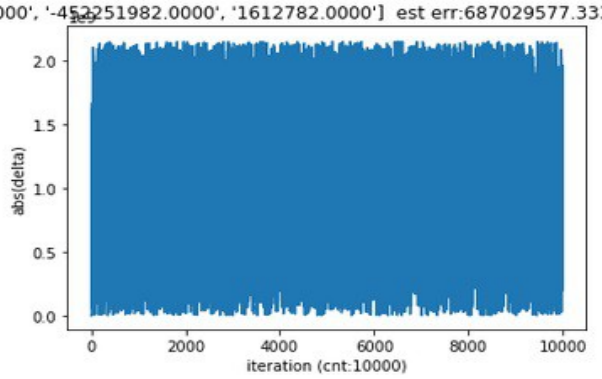
Homework Assignment 2

Alpha = 1
delta = abs(iterError)+np.mean(abs(estimatedUnitPrice – groundUnitPrice))
initial predictions = random

```
iteration:9998, delta:1123187954.6666665
estimated unite price  [-1607223931  -227335559   338987416]
ground unit price  [20 25  8]
estimatedUnitPrice updated:  [-1607223931  -452251982     1612782]
iteration:9999, delta:1249320633.3333335
estimation error:687029577.3333334
```

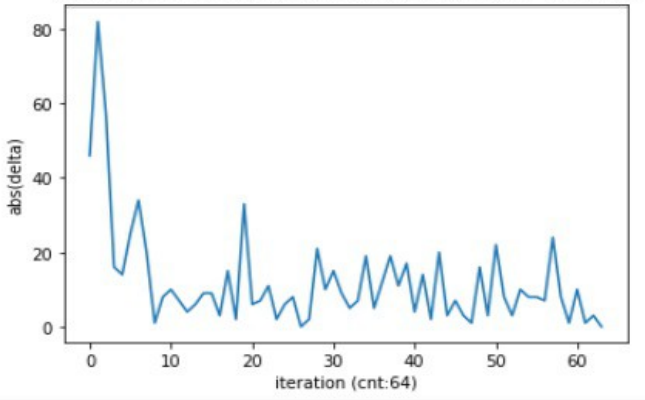
Final:['-1607223931.0000', '-452251982.0000', '1612782.0000'] est err:687029577.3333 actl Δ:1249320633.3333



Alpha = .1
delta = abs(iterError)+np.mean(abs(estimatedUnitPrice - groundUnitPrice))
initial predictions = random

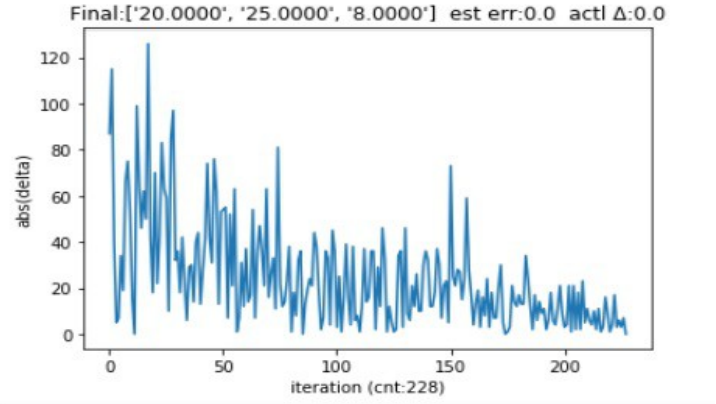
```
iteration:62, delta:3.0
estimated unite price  [20 25  8]
ground unit price  [20 25  8]
estimatedUnitPrice updated:  [20 25  8]
estimation error:0.0
```

Final:['20.0000', '25.0000', '8.0000'] est err:0.0 actl Δ:0.0



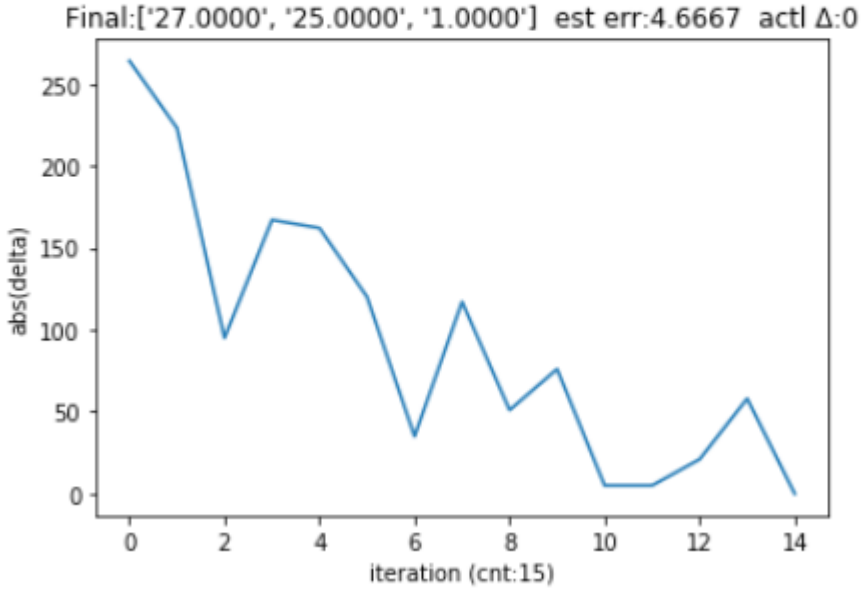
Alpha =.01
delta = abs(iterError)+np.mean(abs(estimatedUnitPrice – groundUnitPrice))
initial predictions =random

```
iteration:226, delta:7.0
estimated unite price  [20 25  8]
ground unit price  [20 25  8]
estimatedUnitPrice updated:  [20 25  8]
estimation error:0.0
```



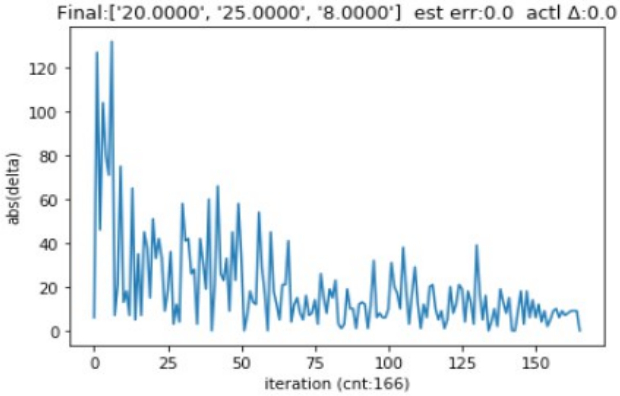
Alpha = .01
delta = iterError
Initial predictions= random

```
iteration:13, delta:58
estimated unite price  [27 25  1]
ground unit price  [20 25  8]
estimatedUnitPrice updated:  [27 25  1]
estimation error:4.666666666666667
```



Alpha = .01
delta = abs(iterError)+np.mean(abs(estimatedUnitPrice – groundUnitPrice))
Initial predictions= [10, 10, 10]

```
iteration:164, delta:9.0
estimated unite price  [20 25  8]
ground unit price  [20 25  8]
estimatedUnitPrice updated:  [20 25  8]
estimation error:0.0
```



Write-up

Importing math to use ceil and floor function:
For this assignment I imported math for the function math.ceil and math.floor. I noticed that without having the number round up or down sometimes the algorithm would return the same estimated unit price without changing it. This was because the unit price was in integers and would not round if we did not a high enough alpha value.

For delta:
I was not sure how to code delta but I wanted to have a perfect fit. I did this by making sure that both the iterError and the error was 0. Side note, it is not always a good thing in machine learning to have a perfect fit.

For updating estimatedUnitPrice:
I tried several equations for this but it didn't work out properly. From the slide it said to use :
delta_fish = delta_fish – (estimated price – true price) x_i.
In class I remember we discussed something about higher orders should have some weight in how we adjust our estimated unit price.
Equation:
estimatedUnitPrice[g]=estimatedUnitPrice[g]–ALPHA*(estimatedTotalPrice-cashierPrice)*(x_i/sum(x_i))
I did this because the alpha I wanted to use the zero if we encounter it and to incorporate the proportion to the meal placed order. For example if we order 9 fish, 0 chips, and 2 ketchup. I would not want ketchup and fish estimatedUnitPrice to increase at the same rate. The order that will affect the total price the most will be the fish.

Additional things:
Added some print statements for the estimated unit price, ground unit price, and the updated estimated unit price.
Added a flag for the special case of placing an order of [0, 0, 0]. Without this flag we will get an error for dividing by zero.

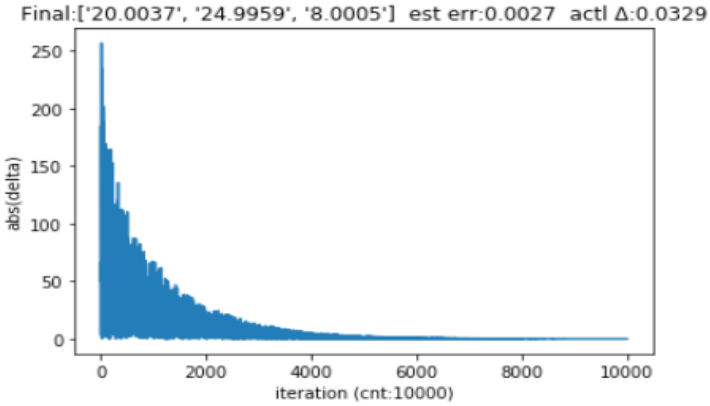
The proper equation for updating the estimated UnitPrice is:
estimatedUnitPrice = estimatedUnitPrice - ALPHA / MAX_ITERATION *np.dot((expectedTotalPrice-cashierPrice),randomMealPortions)

The difference between them:
For the equation that I used it will return incorrect answers when alpha is greater than 1. I using the function floor and ceil my machine learning predictions will not be able to predict any price that is not an integer. I decided to use the equation that I made up because I like how it was able to guess the number on the spot.

Using theta= theta – alpha / m [sum(est price – true price)x_i]:
estimatedUnitPrice = estimatedUnitPrice - ALPHA / MAX_ITERATION *np.dot((expectedTotalPrice-cashierPrice),randomMealPortions)

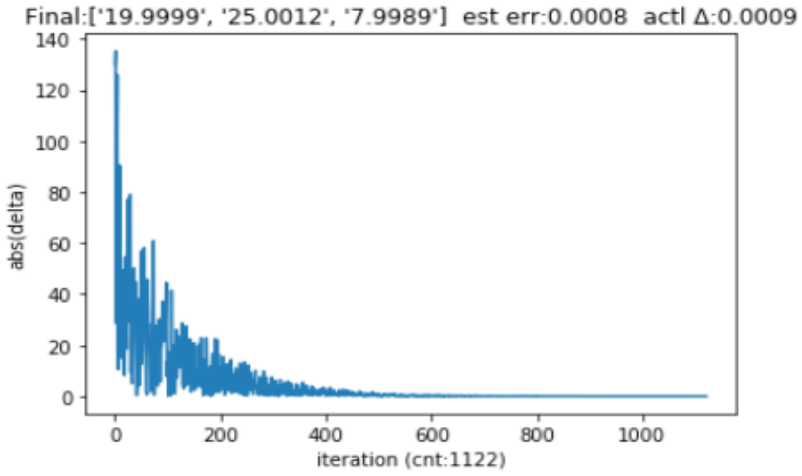
Alpha = 1:
delta = abs(iterError)+np.mean(abs(estimatedUnitPrice – groundUnitPrice)):
Initial predictions= random

```
iteration:9998, delta:0.003132914267871693
estimated unit price  [20.00372473 24.99593352  8.00048665]
ground unit price  [20 25  8]
iterError  0.030111222312712016
dot  66056.73858413436
estimatedUnitPrice updated:  [20.00370064 24.99593051  8.00045955]
iteration:9999, delta:0.03285445039646421
estimation error:0.002743228083752195
```



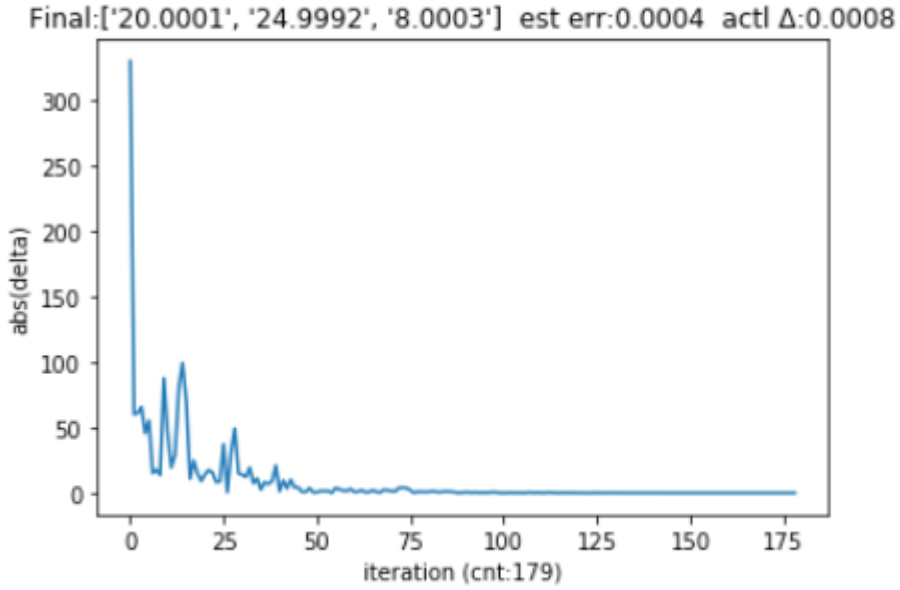
Alpha = 10:

```
iteration:1120, delta:0.00264736262209464
estimated unit price  [19.99985343 25.00124943  7.99887114]
ground unit price  [20 25  8]
iterError  5.087261874336946e-05
dot  56644.01210768326
estimatedUnitPrice updated:  [19.99985297 25.00124933  7.99887109]
estimation error:0.0008417539076486236
```



Alpha = 100:

```
iteration:177, delta:0.0020816001941697713
estimated unit price  [20.00005419 24.99922728  8.00029238]
ground unit price  [20 25  8]
iterError  -0.00040524033849465013
dot  36863.92219385501
estimatedUnitPrice updated:  [20.00005824 24.99924349  8.00032885]
estimation error:0.0003812002021537826 4
```



Code used in python:

```
import numpy as np
import matplotlib.pyplot as plt
import math
#from dataNormalization import rescaleNormalization

# Starting codes for the HA2 of CS596

# Fill in the codes between "%PLACEHOLDER#start" and "PLACEHOLDER#end"

# Ground-truth Cashier
groundUnitPrice = np.array([20, 25, 8]) # for fish, chip, and ketchup, respectively

# step 1: initialize your guess on the unit prices of fish, chip and ketchup.
estimatedUnitPrice = np.array(([10,10,10])) # initial unit prices.
MAX_POSSIBLE_UNIT_PRICE = 50
estimatedUnitPrice = np.random.randint(MAX_POSSIBLE_UNIT_PRICE,
size=len(groundUnitPrice))

# choose random initial guesses

#PLACEHOLDER_1#start: set your own stopping conditions and learning rate

#condition 1: maximal iterations, stop.
MAX_ITERATION = 10000
#condition 2: if the difference between your prediction and the cashier's price is smaller than a
threshold, stop.
MIN_DELTA = 0.001
# learning rate
ALPHA = .01#1e-3
#PLACEHOLDER_1#end
MAX_PLACE_ORDER = 10

# Y coordinates for plotting
deltaHistory = []
delta = 0

# step 2: iterative method
for i in range(0, MAX_ITERATION):
    yes_zero = False
    # order a meal (simulating training data)

    randomMealPortions = np.random.randint(MAX_PLACE_ORDER, size=3)

    # calculate the estimated price
    expectedTotalPrice = np.sum(estimatedUnitPrice * randomMealPortions )

    # calculate cashier/true price;
    cashierPrice = np.sum(groundUnitPrice * randomMealPortions)
```

```
    #%%%PLACEHOLDER_2#start
    print('estimated unit price ',estimatedUnitPrice)
    print('ground unit price ', groundUnitPrice)
#    print('random meal portions',randomMealPortions)
#    print('expected total price ',expectedTotalPrice)
#    print('cashier price ',cashierPrice)

    # calculate current error
    iterError = expectedTotalPrice - cashierPrice

    # append iterError to the history array
    deltaHistory.append(abs(iterError))
#    print('itererror: ',iterError)
    #update unit prices

#    print('eup[i]: ',estimatedUnitPrice[0])

   # print('random ',np.sum(randomMealPortions))
    for g in range(len(estimatedUnitPrice)):
        if g == 0 :#checks for randomMealPortions to see if it is all zero
            if randomMealPortions[g] ==0:
                if randomMealPortions[g+1] == 0:
                    if randomMealPortions[g+2]==0:
                        yes_zero=True;
                        break;
        #change = ALPHA * (iterError/len(estimatedUnitPrice))
*(randomMealPortions[g]/np.sum(randomMealPortions))
        change =ALPHA * iterError *(randomMealPortions[g]/np.sum(randomMealPortions))
        if change < 0:
            change=math.floor(change)
        else:
            change=math.ceil(change)
        estimatedUnitPrice[g] = estimatedUnitPrice[g] -change
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] - ALPHA*(estimatedUnitPrice[g]-
(cashierPrice*(randomMealPortions[g]/np.sum(randomMealPortions))))
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] -
(randomMealPortions[g]/np.sum(randomMealPortions))*(expectedTotalPrice-cashierPrice)
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] - ALPHA*iterError
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] - ALPHA* (estimatedUnitPrice[g]-
groundUnitPrice[g])
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] - ALPHA*(1/
(2*np.sum(randomMealPortions)))*(iterError)
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] -
ALPHA*(iterError)*(randomMealPortions[g]/np.sum(randomMealPortions))
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] - ALPHA*(estimatedUnitPrice[g]-
groundUnitPrice[g])*randomMealPortions[g]
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] - ALPHA * (expectedTotalPrice-cashierPrice)
        #d_of_f = ALPHA *(estimatedUnitPrice[g]-groundUnitPrice[g])*randomMealPortions[g]
```

```
        #estimatedUnitPrice[g] = estimatedUnitPrice[g] -
ALPHA*(randomMealPortions[g]/np.sum(randomMealPortions))*iterError
    if yes_zero == True:
        continue
    print('estimatedUnitPrice updated: ',estimatedUnitPrice)

    #%%%%PLACEHOLDER_2#end

    #delta = iterError
    delta=abs(iterError)+np.mean(abs(estimatedUnitPrice - groundUnitPrice))
    #print(delta)
    #check stop conditions
    if abs(delta) < MIN_DELTA:
        break

    print('iteration:{}, delta:{}'.format(i, abs(delta)))


# step 3: evaluation
error = np.mean(abs(estimatedUnitPrice - groundUnitPrice))
print('estimation error:{}'.format(error))

# visualize convergence curve: error v.s. iterations

plt.plot(range(0, len(deltaHistory)), deltaHistory)
plt.xlabel('iteration (cnt:{})'.format(len(deltaHistory)))
plt.ylabel('abs(delta)')
plt.title('Final:{}  est err:{}  actl Δ:{}'.format([ '%.4f' % elem for elem in estimatedUnitPrice ],
round(error, 4), round(delta, 4)))
plt.show()
```