7_March_mongo_version

March 7, 2021

```python
[113]: import numpy as np
       import math
       import random
       import json
       import requests
       from matplotlib import pyplot as plt
       from pymongo import MongoClient
       import copy
```

```python
[114]: NUM_FEATURES=11
       LB_LIMIT=-10
       UB_LIMIT=10
       MAX_ITR=10
       MIN_COST=-999999 # ??/
       POP_SIZE=20
       MUT_RATE=0.3
       RETENTION_RATE=0.25  # selection rate from prev generation
       TODAY = "7th March, STINT_2  for 0.9 max +  0.1 min"
```

```python
[115]: client = MongoClient("mongodb+srv://Raj:mongodb123@cluster0.lnsqb.mongodb.net/
        ↪ml-proj?retryWrites=true&w=majority")
       db = client['ml-proj']
       coll = db['main-coll']
       details = db['details-2']
```

```python
[116]: surviving_members_num=math.floor(POP_SIZE*RETENTION_RATE)
       if surviving_members_num%2==1:
           surviving_members_num-=1
       num_cells_mutate=math.ceil((POP_SIZE-1)*NUM_FEATURES*MUT_RATE) ## ??????
       num_matings_per_itr=math.ceil((POP_SIZE-surviving_members_num)/2)
       print("surviving members num is ", surviving_members_num)
```

```
surviving members num is  4
```

```python
[117]: #print(locals())

       global_storage=[]
```

```
[118]: API_ENDPOINT = 'http://10.4.21.156'
       MAX_DEG = 11
       SECRET_KEY = 'BKeUYuWnLNaT7N2zzbmzI9VktYLNGrwbMX2lBfiGksBb3m6mOR'
       # SECRET_KEY = "none"

       def urljoin(root, path=''):
           if path:
               root = '/'.join([root.rstrip('/'), path.rstrip('/')])
           return root


       def send_request(id, vector, path):
           api = urljoin(API_ENDPOINT, path)
           vector = json.dumps(vector)
           response = requests.post(api, data={'id': id, 'vector': vector}).text
           if "reported" in response:
               print(response)
               exit()

           return response

       def get_errors(id, vector):
           for i in vector:
               assert 0 <= abs(i) <= 10
           assert len(vector) == MAX_DEG

           return json.loads(send_request(id, vector, 'geterrors'))
```

```
[119]: anmol_arr=[]
```

```
[120]: def get_fitness_value(coeff_arr, curr_gen_num):
           #coeff_arr=coeff_arr.tolist()


           #return [1,2]

           #return random.random()

           assert(len(coeff_arr)==NUM_FEATURES)
           for i in range(0,NUM_FEATURES):
               if coeff_arr[i]>=10:
                   coeff_arr[i] = 10
               elif i<=-10:
                   coeff_arr[i] = -10

           val = get_errors(SECRET_KEY, coeff_arr)
           #print(f"coeff arr is {coeff_arr}")
```

```
    #print("val is ", val)
    anmol_arr.append({"array_stuff":coeff_arr, "errors_returned":val, "gen":
 ↪curr_gen_num})

    ␣
 ↪#print("--------------------------------------------------------------------")

    return val
```

[121]:
```
def get_fitness_value_alt(coeff_arr, curr_gen_num):
    assert(len(coeff_arr)==NUM_FEATURES)
    x=coeff_arr[0]
    y=coeff_arr[1]
    '''x_add=x*math.sin(4*x)
    y_add= 1.1 * y * math.sin(2*y)'''

    '''
    x_add=x*math.sin(4*x)
    y_add= 1.1 * y * math.sin(2*y)
    '''

    # x_add=x
    # y_add=y
    # print(f"x and x_add is {x} : {x_add}")
    # print(f"y and y_add is {y} : {y_add}")
    assert(x>=LB_LIMIT and x<=UB_LIMIT)
    assert(y>=LB_LIMIT and y<=UB_LIMIT)
    # val=x_add+y_add

    # val=0.01*( x*x*(y-2)*(y-3) - (x+y)**3 + y*y*y*(y-2*x))
    val_arr=[x+y]*2
    #print(val)
    #coeff_arr=coeff_arr.tolist()
    anmol_arr.append({"array_stuff":coeff_arr, "errors_returned":val_arr, "gen":
 ↪curr_gen_num})
    #res_ret=[val,val]
    #print("val returned is ", res_ret)
    return val_arr
```

[122]:
```
def create_starting_population(num_members, num_features, lb, ub):
    # Adam and Eve
    sample_pop = np.random.uniform(low=lb, high=ub,␣
 ↪size=(num_members,num_features))
    return sample_pop
```

```python
[123]: def insert_single_member_into_db(gen_id, features, errors):
           coll.insert_one({
               'generation': gen_id,
               'try_vector': features,
               'errors': errors,
               'desc' : TODAY
           })
           details.update_one({"try_vector": features},
                              {"$set": {"errors": errors}})
```

```python
[124]: global_json=[]
```

```python
[125]: print(global_json)
```

```
[]
```

```python
[126]: def calculate_fitness_for_curr_pop(members_list, curr_gen_num):
           '''receives a 2D array'''

           tot_len=len(members_list)
           fitness_arr=[]

           errors_traced=[]

           for i in range(0,tot_len):
               its_fitness_val = [0, 0]
               exist_vec = coll.find({'try_vector': members_list[i]}).count()

               print('exist? ', exist_vec)
               if exist_vec > 0:
                   doc_found = coll.find_one({'try_vector': members_list[i]})
                   its_fitness_val = doc_found['errors']
                   details.update_one({"try_vector": members_list[i]},
                                     {"$set": {"errors": doc_found['errors']}})
                   #print('DOC', doc_found)
                   #print('VAL', its_fitness_val)
               else:
                   its_fitness_val = get_fitness_value(members_list[i], curr_gen_num)
                   insert_single_member_into_db(curr_gen_num,␣
        ↪members_list[i],its_fitness_val)


               fitness_val=0
               t=its_fitness_val[0]
               v=its_fitness_val[1]

               fitness_val= 0.9 * max(t,v) + 0.1 * min(t,v)
```

```python
            fitness_arr.append(fitness_val)

            if type(its_fitness_val)!=list:
                raise TypeError("WEIRD TYPE GOLIATH ERROR")
            errors_traced.append(its_fitness_val)
        #print("fitness arr being sent is ")
        #print(*fitness_arr, sep="\t")
        return fitness_arr,errors_traced
```

```python
[127]: def sort_generation_members(members_list, curr_gen_num):
    #     print(f"type is {type(members_list)}  and arg is ")
        #print(*members_list, sep='\n')
        tot_len=len(members_list)
        cost_arr , unsorted_errors_traced_here = np.
     →array(calculate_fitness_for_curr_pop(members_list, curr_gen_num))

        sort_indices = np.argsort(cost_arr)

        # Descending
        #sort_indices=sort_indices[::-1]

        if type(members_list[0])!=list:
            raise TypeError("Friday error")

        sorted_members_list=[]
        sorted_costs=[]
        # print("member is ", members_list)
        for num in range(0,tot_len):
            i=sort_indices[num]
            #print(f"here member for {i} is ", members_list[i])

            sorted_members_list.append(members_list[i])
            sorted_costs.append(cost_arr[i])



            # $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$



        # print("Sorted indices are \n", sort_indices)
        #sin(x) : 0, 45, 90
        #90, 45,0  (1, 1/root 2, 0)
        #45->1/root 2
        #0->0
        '''print("\nSorted members are \n")
        print(*sorted_members_list, sep='\n')
```

```
    print("----------------------------")

    print("\nSorted costs are \n")
    print(*sorted_costs, sep='\n')
    print("###################################################")
    '''
    return sorted_members_list, sorted_costs, unsorted_errors_traced_here,␣
 ↪sort_indices
```

```python
[128]: def get_probabilities(n):
           numerator=np.arange(1,n+1)
           #print("init is ", numerator)
           numerator*=-1
           denom=(n*(n+1))/2
           numerator+=n+1
           #print("init is ", numerator)

           numerator=np.divide(numerator, denom)
           return numerator
```

```python
[129]: def blend_crossover(parent1, parent2):

           '''
           [ x1- (x2-x1), x2+ (x2-x1)]
           '''
           child1 = np.empty(NUM_FEATURES)
           child2 = np.empty(NUM_FEATURES)
           #print(f"parent 1 is {parent1}")
           #print(f"parent 2 is {parent2}")

           num_genes=len(parent1)
           alpha=0.5


           for i in range(num_genes):
               max_val=max(parent1[i], parent2[i])
               min_val=min(parent1[i], parent2[i])

               lb=min_val-alpha*(max_val-min_val)
               ub=max_val+alpha*(max_val-min_val)

               set_val_1=random.uniform(lb, ub)
               child1[i]=set_val_1

               set_val_2=random.uniform(lb, ub)
               child2[i]=set_val_2
```

```python
    for i in range(len(child1)):
        child1[i]=max(child1[i],LB_LIMIT)
        child1[i]=min(child1[i],UB_LIMIT)

    for i in range(len(child2)):
        child2[i]=max(child2[i],LB_LIMIT)
        child2[i]=min(child2[i],UB_LIMIT)

    #print(f"CHILD 1 is {child1}")
    #print(f"CHILD 2 is {child2}")

    print("#-------------------------------------")

    return child1.tolist(), child2.tolist()
```

```python
[130]: def crossover(parent1, parent2):

    '''
    Deb and Agrawal [196] developed the simulated binary crossover (SBX) to␣
    ↪simulate the
    behavior of the one-point crossover operator for binary representations.
    '''
    child1 = np.empty(NUM_FEATURES)
    child2 = np.empty(NUM_FEATURES)
    print(f"parent 1 is {parent1}")
    print(f"parent 2 is {parent2}")


    u = random.random()
    n_c = 3
    '''where rj   U(0, 1), and   > 0 is the distribution index. Deb and Agrawal␣
    ↪suggested
    that   = 1.'''

    '''The SBX operator generates offspring symmetrically about the parents,␣
    ↪which prevents
    bias towards any of the parents. For large values of   there is a higher␣
    ↪probability that
    offspring will be created near the parents. For small   values, offspring␣
    ↪will be more
    distant from the parents.'''

    if (u < 0.5):
        beta = (2 * u)**((n_c + 1)**-1)
```

```python
        else:
            beta = ((2*(1-u))**-1)**((n_c + 1)**-1)


        parent1 = np.array(parent1)
        parent2 = np.array(parent2)
        child1 = 0.5*((1 + beta) * parent1 + (1 - beta) * parent2)
        child2 = 0.5*((1 - beta) * parent1 + (1 + beta) * parent2)

        for i in range(len(child1)):
            child1[i]=max(child1[i],LB_LIMIT)
            child1[i]=min(child1[i],UB_LIMIT)

        for i in range(len(child2)):
            child2[i]=max(child2[i],LB_LIMIT)
            child2[i]=min(child2[i],UB_LIMIT)

        #child1=(parent1+parent2)/2
        #child2=(parent1-parent2)/2

        print(f"CHILD 1 is {child1}")
        print(f"CHILD 2 is {child2}")

        print("#-------------------------------------")

        return child1.tolist(), child2.tolist()
```

```python
[131]: def get_mutated_version(arr, really=False):
           mut_prob_now=0.5
           arr=arr.tolist().copy()
           if really:
               #arr=arr.tolist()
               #print(arr)
               len_arr=len(arr)
               for i in range(0,len_arr):
                   prob=random.uniform(0, 1)
                   if prob<=mut_prob_now:
                       curr_val=arr[i]
                       if curr_val==0:
                           curr_val=1
                       d_val=random.uniform(-abs(0.3*curr_val), abs(0.3*curr_val))
                       arr[i]+=d_val
                       arr[i]=min(arr[i],UB_LIMIT)
                       arr[i]=max(arr[i],LB_LIMIT)
                       #print(f"{i} mutated {curr_val}->{arr[i]}")
               return arr
           else:
```

```
            return arr
```

[132]:
```python
# Iterations
#parents_now=sorted_initial_pop.copy()

CURR_GEN_NUM=1
init_arr=np.array(
[
[0.07144470438737868, -1.024341258927964e-12, -2.234254875776415e-14, 7.
↪518054647321033e-11, -1.801621324121818e-10, -1.3903926150219416e-15, 1.
↪0363630046234666e-15, 1.972934634335282e-05, -1.8376799350638052e-06, -7.
↪682037245173995e-09, 7.433548643729261e-10],
[0.04141639993961189, -1.0117081002184981e-12, -1.2994472471499564e-14, 7.
↪893352705113582e-11, -1.604137146808921e-10, -1.485052578582483e-15, 1.
↪0198774026946e-15, 2.0174164573336113e-05, -1.8350397232297526e-06, -7.
↪936364861853528e-09, 7.44044375654244e-10],
[-0.12826988257084007, -1.3783500660791644e-12, -6.618301505877671e-14, 4.
↪627780406755569e-11, -1.7964979058119056e-10, -1.3330380203323678e-15, 7.
↪763006729384186e-16, 2.2757658578306265e-05, -1.9193275505106666e-06, -8.
↪894106807593951e-09, 7.758133607867065e-10]
]




)
#init_arr = np.array([5,5])

print(init_arr.shape)

#init_arr=np.array([LB_LIMIT+0.1,UB_LIMIT-0.1])
# # Create the initial population
starting_population_mat=create_starting_population(POP_SIZE, NUM_FEATURES,␣
↪LB_LIMIT, UB_LIMIT)

for i in range(0,POP_SIZE):
    if i<3:
        starting_population_mat[i]=get_mutated_version(np.array(init_arr[i%3]),␣
↪False)
    else:
        starting_population_mat[i]=get_mutated_version(np.
↪array(init_arr[i%3]),True)

'''starting_population_mat = np.array([
])
    '''
```

```
starting_population_mat=starting_population_mat
print("\nStarting pop is \n")
print(*starting_population_mat, sep="\n\n")

generation_info=[]
generation_info.append({"members":starting_population_mat.tolist(),␣
 ↪"avg_fitness":0, "min_fitness":0})
#print(generation_info)
```

(3, 11)

Starting pop is

[7.14447044e-02 -1.02434126e-12 -2.23425488e-14 7.51805465e-11
 -1.80162132e-10 -1.39039262e-15 1.03636300e-15 1.97293463e-05
 -1.83767994e-06 -7.68203725e-09 7.43354864e-10]

[4.14163999e-02 -1.01170810e-12 -1.29944725e-14 7.89335271e-11
 -1.60413715e-10 -1.48505258e-15 1.01987740e-15 2.01741646e-05
 -1.83503972e-06 -7.93636486e-09 7.44044376e-10]

[-1.28269883e-01 -1.37835007e-12 -6.61830151e-14 4.62778041e-11
 -1.79649791e-10 -1.33303802e-15 7.76300673e-16 2.27576586e-05
 -1.91932755e-06 -8.89410681e-09 7.75813361e-10]

[7.14447044e-02 -1.02434126e-12 -2.23425488e-14 9.62769225e-11
 -1.41441464e-10 -1.04129627e-15 1.03636300e-15 1.97293463e-05
 -1.83767994e-06 -6.11701557e-09 7.43354864e-10]

[4.14163999e-02 -1.01170810e-12 -1.42234471e-14 8.71006530e-11
 -1.75247894e-10 -1.48505258e-15 1.15524653e-15 2.05723784e-05
 -1.62899190e-06 -7.93636486e-09 5.46247973e-10]

[-1.28269883e-01 -1.32217006e-12 -6.61830151e-14 4.62778041e-11
 -1.79649791e-10 -1.45223733e-15 5.50119460e-16 1.69284527e-05
 -1.91932755e-06 -6.86787030e-09 6.72604942e-10]

[8.81225759e-02 -1.24348701e-12 -1.67465426e-14 7.51805465e-11
 -1.80162132e-10 -1.45688250e-15 1.03636300e-15 1.97293463e-05
 -1.63873555e-06 -5.65186992e-09 7.72527444e-10]

[3.52399892e-02 -1.01170810e-12 -1.29944725e-14 7.89335271e-11
 -1.18608942e-10 -1.48505258e-15 1.30567185e-15 2.01741646e-05
 -1.81222464e-06 -8.51478778e-09 7.44044376e-10]

[-1.45084269e-01 -1.37835007e-12 -6.61830151e-14 3.25150921e-11
```

```
 -1.79649791e-10 -9.98162367e-16  7.76300673e-16  2.27576586e-05
 -1.93104590e-06 -9.54863490e-09  8.45472837e-10]

[ 7.14447044e-02 -1.14892887e-12 -2.23425488e-14  8.12567008e-11
 -1.80162132e-10 -1.39039262e-15  1.03636300e-15  1.67681814e-05
 -1.83767994e-06 -5.69316260e-09  5.43450171e-10]

[ 4.71846258e-02 -1.01170810e-12 -1.29944725e-14  7.89335271e-11
 -1.92476787e-10 -1.48505258e-15  1.01987740e-15  2.01741646e-05
 -2.37769369e-06 -1.00208796e-08  7.44044376e-10]

[-1.28269883e-01 -1.56153226e-12 -4.89364973e-14  4.70300929e-11
 -1.69531748e-10 -1.57418762e-15  8.61022773e-16  2.27576586e-05
 -2.16402513e-06 -8.89410681e-09  7.75813361e-10]

[ 7.14447044e-02 -1.11995595e-12 -2.23425488e-14  7.51805465e-11
 -1.36314939e-10 -1.17186562e-15  1.03636300e-15  1.75178057e-05
 -1.64382061e-06 -6.21666203e-09  6.58138428e-10]

[ 3.41208549e-02 -1.10389941e-12 -9.75119578e-15  7.89335271e-11
 -1.60413715e-10 -1.48505258e-15  1.06644448e-15  2.10916782e-05
 -1.86326712e-06 -5.70771449e-09  7.44044376e-10]

[-1.64702332e-01 -1.37835007e-12 -6.61830151e-14  4.36951856e-11
 -1.79649791e-10 -1.33303802e-15  7.76300673e-16  1.79268090e-05
 -2.38385800e-06 -6.40511672e-09  7.75813361e-10]

[ 7.14447044e-02 -1.11082598e-12 -2.23425488e-14  5.48282058e-11
 -1.91066713e-10 -1.39039262e-15  1.31949215e-15  1.97293463e-05
 -2.28031660e-06 -7.68203725e-09  7.43354864e-10]

[ 4.66828886e-02 -8.96246904e-13 -1.29944725e-14  6.33873673e-11
 -1.60413715e-10 -1.71509703e-15  1.01987740e-15  2.15155298e-05
 -1.83503972e-06 -6.54100412e-09  7.44044376e-10]

[-1.28269883e-01 -1.37835007e-12 -8.50658224e-14  3.77047586e-11
 -1.65425291e-10 -1.16179115e-15  7.76300673e-16  2.27576586e-05
 -1.54303571e-06 -8.49082266e-09  7.75813361e-10]

[ 7.14447044e-02 -1.00834624e-12 -2.44793240e-14  6.34121349e-11
 -1.80162132e-10 -1.71392545e-15  1.03636300e-15  1.97293463e-05
 -1.46594214e-06 -9.96667597e-09  9.18717034e-10]

[ 4.14163999e-02 -1.01170810e-12 -1.35920668e-14  7.89335271e-11
 -1.25311514e-10 -1.48505258e-15  8.75165561e-16  2.10157868e-05
 -1.96144193e-06 -9.46788522e-09  7.44044376e-10]
```

```
[133]:  for member in starting_population_mat:
            member=member.tolist()
            details.insert_one({
                'generation': CURR_GEN_NUM,
                'try_vector': member, #after mutation
                'errors': [-1,-1],
                'mother_vec': member,
                'father_vec': member,
                'before_mutation': member,
                'beta': -1,
                'cross_over_point': -1,
                'desc' : TODAY
                })
```

```
[134]:  trace_arr=[]
        trace_now=[]

        for i in range(0,POP_SIZE):
            vec=copy.deepcopy(starting_population_mat[i])
            vec=vec.tolist()
            obj_to_store={
                'generation': CURR_GEN_NUM,
                'try_vector': vec, #after mutation
                'errors': [-1,-1],
                'mother_vec':vec,
                'father_vec': vec,
                'before_mutation':vec,
                'beta': -1,
                'cross_over_point': -1,
                'desc' : TODAY,
                'survived':False
                }
            trace_now.append(obj_to_store)

        print(*trace_now, sep='\n\n')
```

```
{'generation': 1, 'try_vector': [0.07144470438737868, -1.024341258927964e-12,
-2.234254875776415e-14, 7.518054647321033e-11, -1.801621324121818e-10,
-1.3903926150219416e-15, 1.0363630046234666e-15, 1.972934634335282e-05,
-1.8376799350638052e-06, -7.682037245173995e-09, 7.433548643729261e-10],
'errors': [-1, -1], 'mother_vec': [0.07144470438737868, -1.024341258927964e-12,
-2.234254875776415e-14, 7.518054647321033e-11, -1.801621324121818e-10,
-1.3903926150219416e-15, 1.0363630046234666e-15, 1.972934634335282e-05,
-1.8376799350638052e-06, -7.682037245173995e-09, 7.433548643729261e-10],
'father_vec': [0.07144470438737868, -1.024341258927964e-12,
-2.234254875776415e-14, 7.518054647321033e-11, -1.801621324121818e-10,
-1.3903926150219416e-15, 1.0363630046234666e-15, 1.972934634335282e-05,
```

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-1.643820608253183e-06, -6.2166620304727474e-09, 6.581384284971805e-10],
'before_mutation': [0.07144470438737868, -1.119955952479052e-12,
-2.234254875776415e-14, 7.518054647321033e-11, -1.363149393789821e-10,
-1.171865621470783e-15, 1.0363630046234666e-15, 1.7517805652149366e-05,
-1.643820608253183e-06, -6.2166620304727474e-09, 6.581384284971805e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': '7th March, STINT_2 for 0.9 max + 0.1
min', 'survived': False}

{'generation': 1, 'try_vector': [0.034120854861637594, -1.1038994081709107e-12,
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-1.485052578582483e-15, 1.0664444800255005e-15, 2.1091678231319236e-05,
-1.8632671165752922e-06, -5.70771448801447e-09, 7.44044375654244e-10], 'errors':

[-1, -1], 'mother_vec': [0.034120854861637594, -1.1038994081709107e-12,
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-1.485052578582483e-15, 1.0664444800255005e-15, 2.1091678231319236e-05,
-1.8632671165752922e-06, -5.70771448801447e-09, 7.44044375654244e-10],
'father_vec': [0.034120854861637594, -1.1038994081709107e-12,
-9.751195775238662e-15, 7.893352705113582e-11, -1.604137146808921e-10,
-1.485052578582483e-15, 1.0664444800255005e-15, 2.1091678231319236e-05,
-1.8632671165752922e-06, -5.70771448801447e-09, 7.44044375654244e-10],
'before_mutation': [0.034120854861637594, -1.1038994081709107e-12,
-9.751195775238662e-15, 7.893352705113582e-11, -1.604137146808921e-10,
-1.485052578582483e-15, 1.0664444800255005e-15, 2.1091678231319236e-05,
-1.8632671165752922e-06, -5.70771448801447e-09, 7.44044375654244e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': '7th March, STINT_2 for 0.9 max + 0.1
min', 'survived': False}

{'generation': 1, 'try_vector': [-0.1647023320648312, -1.3783500660791644e-12,
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-1.3330380203323678e-15, 7.763006729384186e-16, 1.7926809046949045e-05,
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-1.3330380203323678e-15, 7.763006729384186e-16, 1.7926809046949045e-05,
-2.3838580010590117e-06, -6.405116723935932e-09, 7.758133607867065e-10],
'father_vec': [-0.1647023320648312, -1.3783500660791644e-12,
-6.618301505877671e-14, 4.3695185573455413e-11, -1.7964979058119056e-10,
-1.3330380203323678e-15, 7.763006729384186e-16, 1.7926809046949045e-05,
-2.3838580010590117e-06, -6.405116723935932e-09, 7.758133607867065e-10],
'before_mutation': [-0.1647023320648312, -1.3783500660791644e-12,
-6.618301505877671e-14, 4.3695185573455413e-11, -1.7964979058119056e-10,
-1.3330380203323678e-15, 7.763006729384186e-16, 1.7926809046949045e-05,
-2.3838580010590117e-06, -6.405116723935932e-09, 7.758133607867065e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': '7th March, STINT_2 for 0.9 max + 0.1
min', 'survived': False}

{'generation': 1, 'try_vector': [0.07144470438737868, -1.1108259761960623e-12,
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-1.3903926150219416e-15, 1.31949215443932e-15, 1.972934634335282e-05,
-2.280316600901714e-06, -7.682037245173995e-09, 7.433548643729261e-10],
'errors': [-1, -1], 'mother_vec': [0.07144470438737868, -1.1108259761960623e-12,
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-1.3903926150219416e-15, 1.31949215443932e-15, 1.972934634335282e-05,
-2.280316600901714e-06, -7.682037245173995e-09, 7.433548643729261e-10],
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-1.3903926150219416e-15, 1.31949215443932e-15, 1.972934634335282e-05,
-2.280316600901714e-06, -7.682037245173995e-09, 7.433548643729261e-10],
'before_mutation': [0.07144470438737868, -1.1108259761960623e-12,
-2.234254875776415e-14, 5.4828205832823184e-11, -1.9106671273448288e-10,

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min', 'survived': False}

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-1.7150970273329634e-15, 1.0198774026946e-15, 2.1515529821334757e-05,
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'errors': [-1, -1], 'mother_vec': [0.0466828886267574, -8.962469040311406e-13,
-1.2994472471499564e-14, 6.33873672624067e-11, -1.604137146808921e-10,
-1.7150970273329634e-15, 1.0198774026946e-15, 2.1515529821334757e-05,
-1.8350397232297526e-06, -6.541004115419129e-09, 7.44044375654244e-10],
'father_vec': [0.0466828886267574, -8.962469040311406e-13,
-1.2994472471499564e-14, 6.33873672624067e-11, -1.604137146808921e-10,
-1.7150970273329634e-15, 1.0198774026946e-15, 2.1515529821334757e-05,
-1.8350397232297526e-06, -6.541004115419129e-09, 7.44044375654244e-10],
'before_mutation': [0.0466828886267574, -8.962469040311406e-13,
-1.2994472471499564e-14, 6.33873672624067e-11, -1.604137146808921e-10,
-1.7150970273329634e-15, 1.0198774026946e-15, 2.1515529821334757e-05,
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min', 'survived': False}

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-1.6542529115084238e-10, -1.161791150000213e-15, 7.763006729384186e-16,
2.2757658578306265e-05, -1.5430357126661288e-06, -8.490822660046785e-09,
7.758133607867065e-10], 'father_vec': [-0.12826988257084007,
-1.3783500660791644e-12, -8.506582240146595e-14, 3.770475856663682e-11,
-1.6542529115084238e-10, -1.161791150000213e-15, 7.763006729384186e-16,
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-1.6542529115084238e-10, -1.161791150000213e-15, 7.763006729384186e-16,
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STINT_2 for 0.9 max + 0.1 min', 'survived': False}

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'errors': [-1, -1], 'mother_vec': [0.07144470438737868, -1.0083462381605529e-12,

-2.4479324046479617e-14, 6.341213491376858e-11, -1.801621324121818e-10,
-1.7139254451987334e-15, 1.0363630046234666e-15, 1.972934634335282e-05,
-1.4659421392047532e-06, -9.96667596723528e-09, 9.187170341302074e-10],
'father_vec': [0.07144470438737868, -1.0083462381605529e-12,
-2.4479324046479617e-14, 6.341213491376858e-11, -1.801621324121818e-10,
-1.7139254451987334e-15, 1.0363630046234666e-15, 1.972934634335282e-05,
-1.4659421392047532e-06, -9.96667596723528e-09, 9.187170341302074e-10],
'before_mutation': [0.07144470438737868, -1.0083462381605529e-12,
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-1.7139254451987334e-15, 1.0363630046234666e-15, 1.972934634335282e-05,
-1.4659421392047532e-06, -9.96667596723528e-09, 9.187170341302074e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': '7th March, STINT_2 for 0.9 max + 0.1
min', 'survived': False}

{'generation': 1, 'try_vector': [0.04141639993961189, -1.0117081002184981e-12,
-1.3592066770983757e-14, 7.893352705113582e-11, -1.2531151403983765e-10,
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'errors': [-1, -1], 'mother_vec': [0.04141639993961189, -1.0117081002184981e-12,
-1.3592066770983757e-14, 7.893352705113582e-11, -1.2531151403983765e-10,
-1.485052578582483e-15, 8.751655611794948e-16, 2.1015786822793542e-05,
-1.9614419340955956e-06, -9.467885222272088e-09, 7.44044375654244e-10],
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-1.3592066770983757e-14, 7.893352705113582e-11, -1.2531151403983765e-10,
-1.485052578582483e-15, 8.751655611794948e-16, 2.1015786822793542e-05,
-1.9614419340955956e-06, -9.467885222272088e-09, 7.44044375654244e-10],
'before_mutation': [0.04141639993961189, -1.0117081002184981e-12,
-1.3592066770983757e-14, 7.893352705113582e-11, -1.2531151403983765e-10,
-1.485052578582483e-15, 8.751655611794948e-16, 2.1015786822793542e-05,
-1.9614419340955956e-06, -9.467885222272088e-09, 7.44044375654244e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': '7th March, STINT_2 for 0.9 max + 0.1
min', 'survived': False}

[135]:
```python
verified=input("Have you taken care of get_fitness_vals, \nexist_vec!=0 ,\
\ncollection name,\ndetails name ?\n\
Have you switched on VPN ?\n JSON file name")
if verified!='y':
    raise TypeError
```

```
Have you taken care of get_fitness_vals,
exist_vec!=0 ,
collection name,
details name ?
Have you switched on VPN ?
 JSON file namey
```

[136]:
```python
MUT_RATE
```

```
[136]: 0.3

[137]: mut_magnitude=0.05
       tot_crosses=0
       same_crosses=0



       if type(starting_population_mat)!=np.ndarray:
           raise TypeError("Mismatch of starting pop mat")


       for itr_num in range(0, MAX_ITR+1):
           #print("args being sent are \n")
           #print(*generation_info[-1]["members"],sep='\n')
           parents_now, sorted_fitness_vals, unsorted_errors_main, sorted_indices =␣
        ↪sort_generation_members(generation_info[-1]["members"], CURR_GEN_NUM)

           for i in range(POP_SIZE):
               trace_now[i]["errors"]=unsorted_errors_main[i]

               '''if unsorted_errors_main[i]!=list:
                   raise TypeError("Pitts ERROR")'''

           trace_tmp=copy.deepcopy(trace_now)

           for i in range(0,POP_SIZE):
               trace_now[i]=copy.deepcopy(trace_tmp[sorted_indices[i]])

           trace_arr.append(copy.deepcopy(trace_now))



           #[{obj}] -> obj -> errors -> fitness value




           generation_info[-1]["avg_fitness"]=np.average(sorted_fitness_vals)
           generation_info[-1]["min_fitness"]=np.min(sorted_fitness_vals)
           generation_info[-1]["gen_number"]=CURR_GEN_NUM
           generation_info[-1]["fitness_vals_stored"]=sorted_fitness_vals
           print(f'Avg fitness is {generation_info[-1]["avg_fitness"]}' )
           print(f'MIN fitness is {generation_info[-1]["min_fitness"]}' )
```

```python
    print(f"fitness vals are: -> \n")
    print(*sorted_fitness_vals, sep='\n')

    stop_or_not = input("Enter y to continue.")
    #stop_or_not = 'y'
    if stop_or_not!='y' or itr_num==MAX_ITR:
        break

  ⎵
↪###################################################################################

    CURR_GEN_NUM+=1
    # https://stackoverflow.com/a/7851237/6427607
    matings_pending=num_matings_per_itr
    probs=get_probabilities(POP_SIZE)
    cum_probs=np.cumsum(probs)
    # https://numpy.org/doc/stable/reference/generated/numpy.hstack.html
    cum_probs=np.hstack(([0],cum_probs))
    #print(f"Probs are {probs}\nCumProbs are {cum_probs}")


    '''Selection
    '''
    pick_1=np.random.uniform(low=0, high=1, size=(matings_pending))
    pick_2=np.random.uniform(low=0, high=1, size=(matings_pending))

    #print(f"PICK_1 is {pick_1} \n AND \nPICK_2 is {pick_2} ")
    mother_idx=[]
    father_idx=[]

    for ic in range(0,matings_pending):
        tot_crosses+=1
        for idx in range(1,POP_SIZE+1):

            if pick_1[ic]<=cum_probs[idx] and pick_1[ic]>cum_probs[idx-1]:
                mother_idx.append(idx-1)
            if pick_2[ic]<=cum_probs[idx] and pick_2[ic]>cum_probs[idx-1]:
                father_idx.append(idx-1)
        if mother_idx[-1]==father_idx[-1]:
                father_idx[-1]=((mother_idx[-1])+1)%POP_SIZE


    new_parents=parents_now.copy()
    for i in range(0, surviving_members_num):
        details.insert_one({
        'generation': CURR_GEN_NUM,
        'try_vector': new_parents[i], #after mutation
```

```python
            'errors': [-1,-1],
            'mother_vec': new_parents[i],
            'father_vec': new_parents[i],
            'before_mutation': new_parents[i],
            #'beta': -1,
            #'cross_over_point': -1,
            'desc' : TODAY
            })
    #trace_now=copy.deepcopy(trace_prev)

    for mating_num in range(0, matings_pending):
        par_one_idx=mother_idx[mating_num]
        par_two_idx=father_idx[mating_num]

        child_one=parents_now[par_one_idx].copy()
        child_two=parents_now[par_two_idx].copy()

        child_one, child_two=crossover(child_one, child_two)


        '''CrossOver
        '''
        '''special_cell_idx=random.randint(0,NUM_FEATURES-1)

        beta=random.random()

        xy=parents_now[par_one_idx][special_cell_idx]-\
            parents_now[par_two_idx][special_cell_idx]

        child_one[special_cell_idx]=parents_now[par_one_idx][special_cell_idx]␣
↪- beta*xy
        child_two[special_cell_idx]=parents_now[par_two_idx][special_cell_idx]␣
↪+ beta*xy


        if special_cell_idx!=NUM_FEATURES-1:
            #print("CHILD ONE IS ", child_one)
            #print("CHILD TWO IS ", child_two)
            child_one[:] = np.hstack((child_one[:special_cell_idx]    \
                        ,   child_two[special_cell_idx:]    ))

            child_two[:] = np.hstack((child_two[:special_cell_idx]    \
                        ,   child_one[special_cell_idx:]    ))    '''


        new_parents[surviving_members_num + 2* mating_num] = child_one
        new_parents[surviving_members_num + 2* mating_num + 1] = child_two
```

```python
        if type(child_one)!=list:
            raise TypeError("NOT A LIST")

        if type(parents_now[par_one_idx])!=list:
            raise TypeError("IT ALSO NOT A LIST")

        obj_one={
        'generation': CURR_GEN_NUM,
        'try_vector': child_one, #after mutation
        'errors': [-1,-1],
        'mother_vec':parents_now[par_one_idx],
        'father_vec': parents_now[par_two_idx],
        'before_mutation': child_one,
        #'beta': beta,
        #'cross_over_point': special_cell_idx,
        'desc' : TODAY,
        'survived':False,
        "mut_rate":MUT_RATE
        }

        obj_two={
        'generation': CURR_GEN_NUM,
        'try_vector': child_two, #after mutation
        'errors': [-1,-1],
        'mother_vec':parents_now[par_one_idx],
        'father_vec': parents_now[par_two_idx],
        'before_mutation': child_two,
        #'beta': beta,
       # 'cross_over_point': special_cell_idx,
        'desc' : TODAY,
        'survived':False,
        "mut_rate":MUT_RATE

        }

        trace_now[surviving_members_num + 2* mating_num]=obj_one
        trace_now[surviving_members_num + 2* mating_num + 1] =obj_two
        details.insert_one(copy.deepcopy(obj_one))
        details.insert_one(copy.deepcopy(obj_two))


#print("OLD Parents  are \n")
#print(*parents_now, sep='\n')
#print("NEW Parents  are \n")
#print(*new_parents, sep='\n')
```

```python
    '''
    %_____
    % Mutate the population
    '''
    #mut_rows=np.random.uniform(low=0, high=1, size=(num_cells_mutate))
    #mut_rows*=(POP_SIZE-1)
    # https://numpy.org/doc/stable/reference/random/generated/numpy.random.
→randint.html
  mut_rows=np.random.randint(POP_SIZE, size=num_cells_mutate)
  for i in range(0,len(mut_rows)):
      # mut_rows[i]=int(math.round(mut_rows[i]))
      assert(mut_rows[i]<POP_SIZE)
  mut_rows.sort()


    # mut_cols=np.random.uniform(low=0, high=1, size=(num_cells_mutate))
    # mut_cols*=(NUM_FEATURES-1)

  mut_cols=np.random.randint(NUM_FEATURES, size=num_cells_mutate)

  for i in range(0,len(mut_cols)):
      #mut_cols[i]=int(math.round(mut_cols[i]))
      assert(mut_cols[i]<NUM_FEATURES)

  for i in range(0,num_cells_mutate):
      row_c=int(mut_rows[i])
      col_c=int(mut_cols[i])
      #print(f"Contenders are {row_c}:{col_c}")
      #new_parents[row_c][col_c]=random.random()*(UB_LIMIT-LB_LIMIT)+LB_LIMIT
      CHNG = mut_magnitude * (new_parents[row_c][col_c])
      add=random.uniform(-CHNG,CHNG)
      #print(f"mut mag is {mut_magnitude}\tChange is {CHNG} and \tadd is␣
→{add}")


      upd_val = new_parents[row_c][col_c] + add
      upd_val = max(LB_LIMIT, upd_val)
      upd_val = min(UB_LIMIT, upd_val)


      old_vec= copy.deepcopy(new_parents[row_c])
      new_parents[row_c][col_c] = upd_val
      details.update_one({"before_mutation": old_vec},
                          {"$set": {"try_vector": new_parents[row_c]}})
```

```python
    ##/////////////////////////////////////////////////////////////////////////////////////
↪/////////

    for i in range(POP_SIZE):
        if type(new_parents[i])!=list:
            raise TypeError("Pegasus type error")
        #trace_now[i]["try_vector"]=new_parents[i]
        trace_now[i]["try_vector"]=copy.deepcopy(new_parents[i])
        if i< surviving_members_num:
            trace_now[i]["survived"]=True
    ##/////////////////////////////////////////////////////////////////////////////////////
↪/////////


    print("Generation info is ", generation_info)

 ␣
↪###############################################################################3
    x_c=[]
    y_min=[]
    y_avg=[]
    #print(len(generation_info))
    for j in range(0,len(generation_info)):
        x_c.append(j)
        y_min.append(generation_info[j]["min_fitness"])
        y_avg.append(generation_info[j]["avg_fitness"])

    plt.figure(figsize=(8,8))
    plt.plot(x_c, y_min, label="min")
    plt.show()
    plt.figure(figsize=(8,8))
    plt.plot(x_c, y_avg, label="avg")
    #print('Min: ',y_min[-1])
    #print('Avg: ',y_avg[-1])
    #print('Vector: ',generation_info[-1]["members"])
    #print(*y_min,sep='\n')
    plt.legend()
    plt.show()
    ################################################################
    print("-----------------------------------------------------------")

    # random_rows=
```

```
    '''
    %_____
    % The new offspring and mutated chromosomes are
    % evaluated
    '''
    #print(type(new_parents))

    parents_now=new_parents
    generation_info.append({"members":new_parents, "mut_magnitude":
↪mut_magnitude})

    mut_magnitude=float(input("Enter mutation magnitude:"))
    MUT_RATE=float(input("Enter fraction of cells you want to mutate:"))
    num_cells_mutate=math.ceil((POP_SIZE-1)*NUM_FEATURES*MUT_RATE) ## ??????
```

/home/anmolagarwal/anaconda3/lib/python3.7/site-
packages/ipykernel_launcher.py:11: DeprecationWarning: count is deprecated. Use
Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

exist? 1
exist? 1
exist? 1
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
exist? 0
Avg fitness is 15299214303287.838
MIN fitness is 227461522284.22757
fitness vals are: ->

227461522284.22757
268713619435.57886
278308570691.89056
292509351292.8799

27

340500934882.61804
1194483479039.056
1396665637006.1628
1543521244986.0142
2910722668525.732
5280109616099.31
9351481152874.473
9929363039073.482
10905345305047.67
20076801423314.824
25021797085540.64
27994433620917.06
29875876056356.367
30242281088252.695
63425336474716.47
65428574175419.625
Enter y to continue.y
parent 1 is [-0.145084268911607, -1.3783500660791644e-12,
-6.618301505877671e-14, 3.251509206967353e-11, -1.7964979058119056e-10,
-9.981623666600635e-16, 7.763006729384186e-16, 2.2757658578306265e-05,
-1.9310458981608398e-06, -9.548634903429014e-09, 8.454728370578283e-10]
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CHILD 1 is [-1.33533977e-01 -1.35486558e-12 -6.27761347e-14 3.54883274e-11
 -1.75739947e-10 -1.02934910e-15 8.10208432e-16 2.25921783e-05
 -1.92343505e-06 -9.48241400e-09 8.38976050e-10]
CHILD 2 is [2.36896975e-02 -1.03519258e-12 -1.64013529e-14 7.59602917e-11
 -1.22518785e-10 -1.45386585e-15 1.27176409e-15 2.03396449e-05
 -1.81983549e-06 -8.58100868e-09 7.50541163e-10]
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parent 2 is [0.07144470438737868, -1.024341258927964e-12,
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-1.8376799350638052e-06, -6.11701556608308e-09, 7.433548643729261e-10]
CHILD 1 is [-1.68805711e-01 -1.45020281e-12 -7.50812616e-14 3.61295433e-11
 -1.87404888e-10 -1.39225249e-15 7.23516135e-16 2.33723115e-05
 -1.93589947e-06 -9.45776967e-09 7.82401423e-10]
CHILD 2 is [1.11980533e-01 -9.52488519e-13 -1.34443022e-14 1.06425183e-10
 -1.33686366e-10 -9.82081802e-16 1.08914754e-15 1.91146935e-05
 -1.82110802e-06 -5.55335271e-09 7.36766803e-10]
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28

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 -1.41387257e-10 -1.04002839e-15 1.03627706e-15 1.97254539e-05
 -1.83760683e-06 -6.11818501e-09 7.43352894e-10]
CHILD 2 is [3.40142144e-02 -1.10412672e-12 -9.71522018e-15 7.88839741e-11
 -1.60467922e-10 -1.48632046e-15 1.06653043e-15 2.10955706e-05
 -1.86334022e-06 -5.70654505e-09 7.44046346e-10]
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 -1.86221222e-06 -7.43740828e-09 7.22096963e-10]
CHILD 2 is [-6.82625672e-02 -1.23268282e-12 -5.30104735e-14 5.49620770e-11
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 -1.89479527e-06 -7.11249927e-09 6.93862843e-10]
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CHILD 2 is [-1.37286408e-01 -1.58146813e-12 -5.01371357e-14  4.57591828e-11
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#------------------------------------
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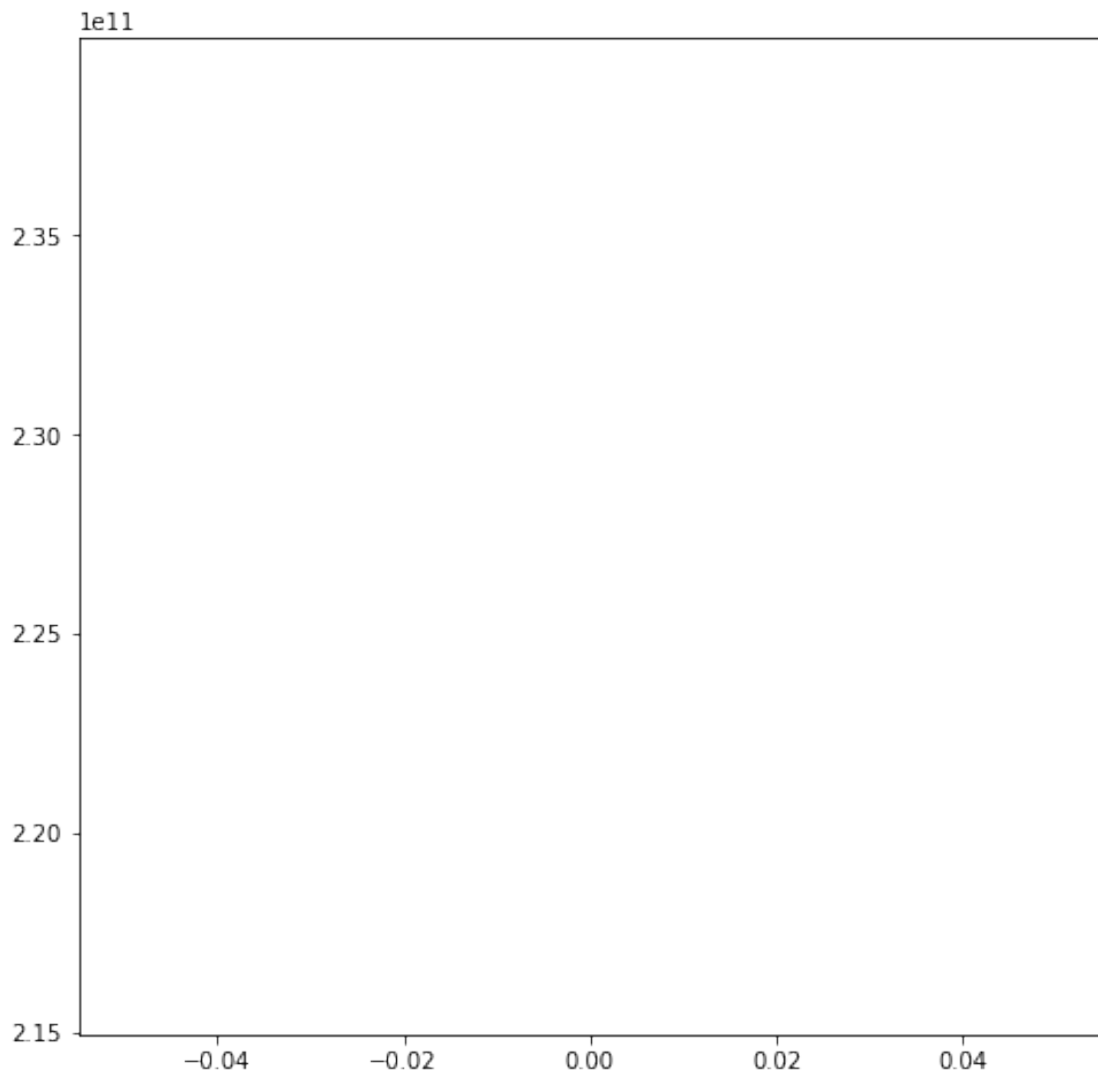```

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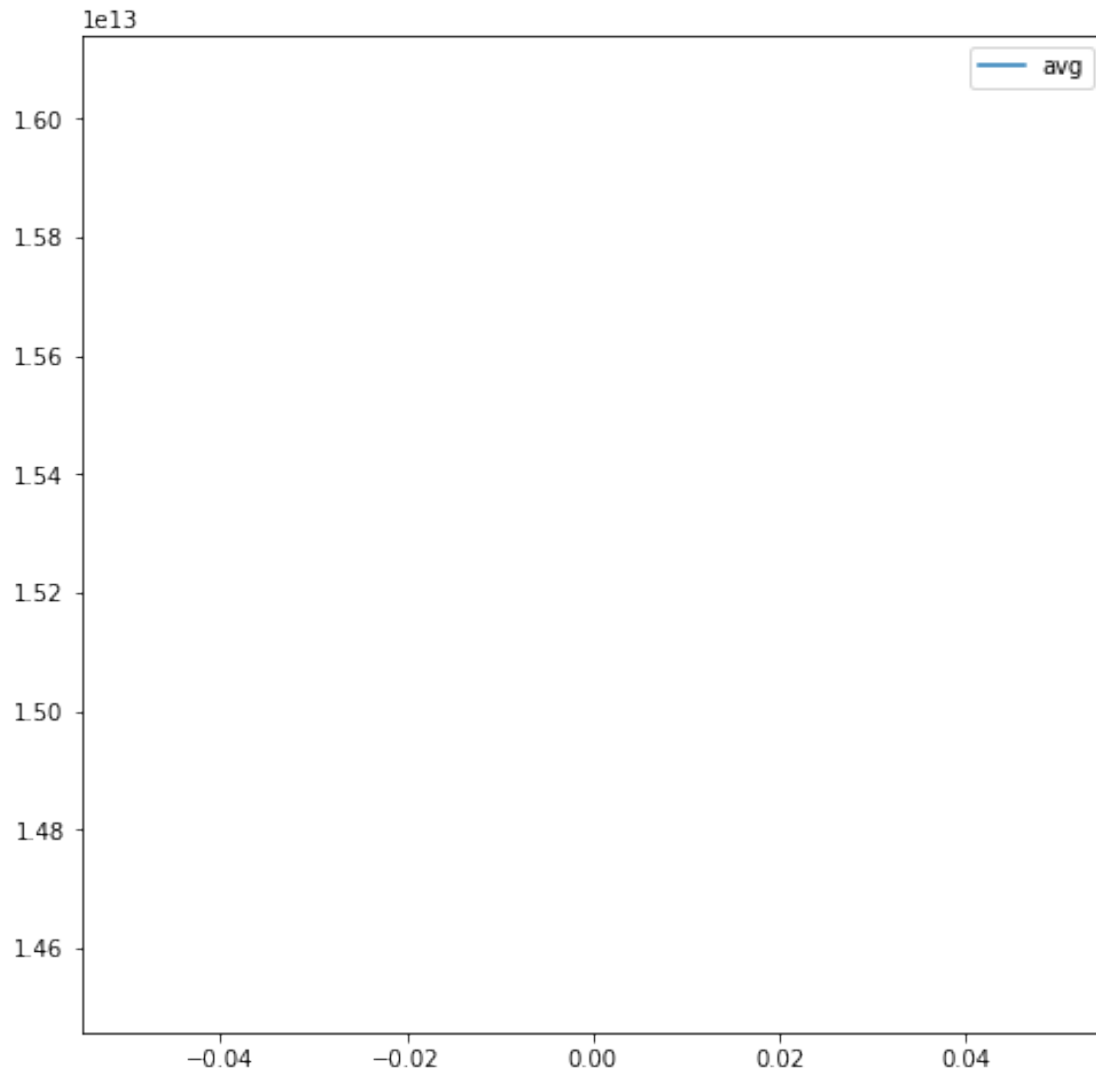----------------------------------------------------------------
Enter mutation magnitude:0.05
Enter fraction of cells you want to mutate:0.2

/home/anmolagarwal/anaconda3/lib/python3.7/site-
packages/ipykernel_launcher.py:11: DeprecationWarning: count is deprecated. Use
Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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exist?  0
exist?  0
exist?  0
exist?  0
exist?  0
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exist?  0
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Avg fitness is 5079831095931.949
MIN fitness is 227461522284.22757
fitness vals are: ->

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Enter y to continue.y
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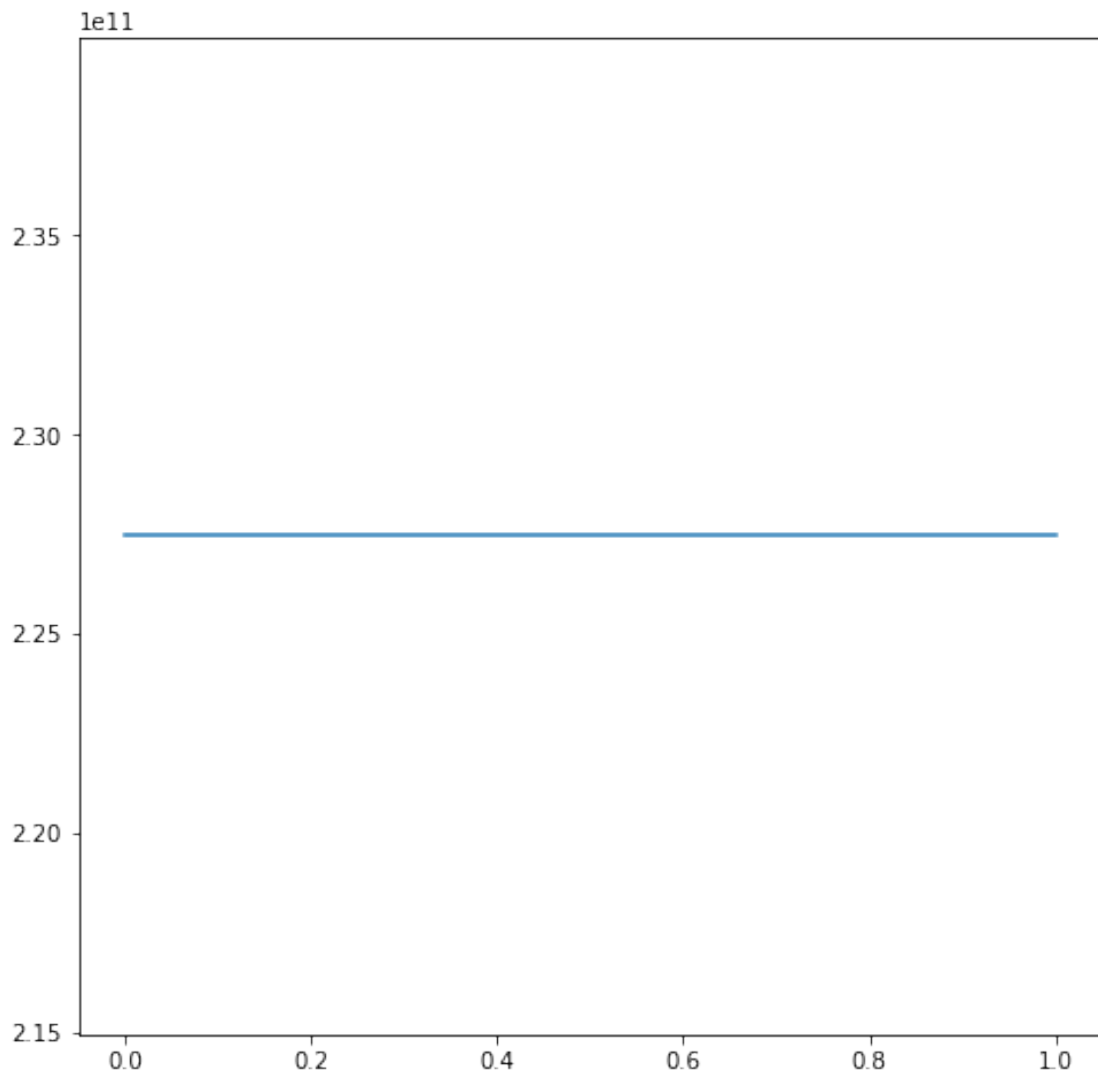#-----------------------------------
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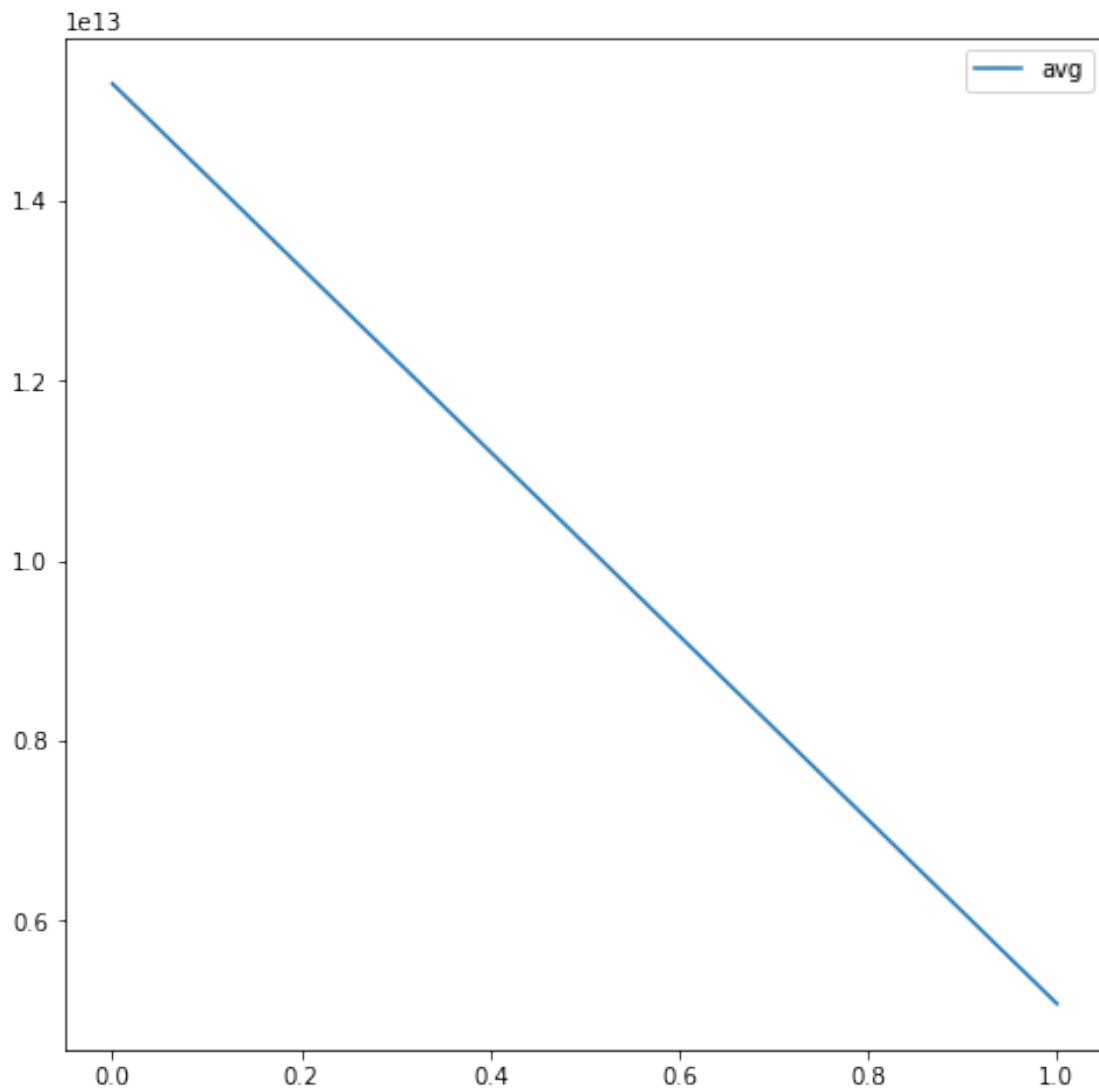----------------------------------------------------------------
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Enter fraction of cells you want to mutate:0.4

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Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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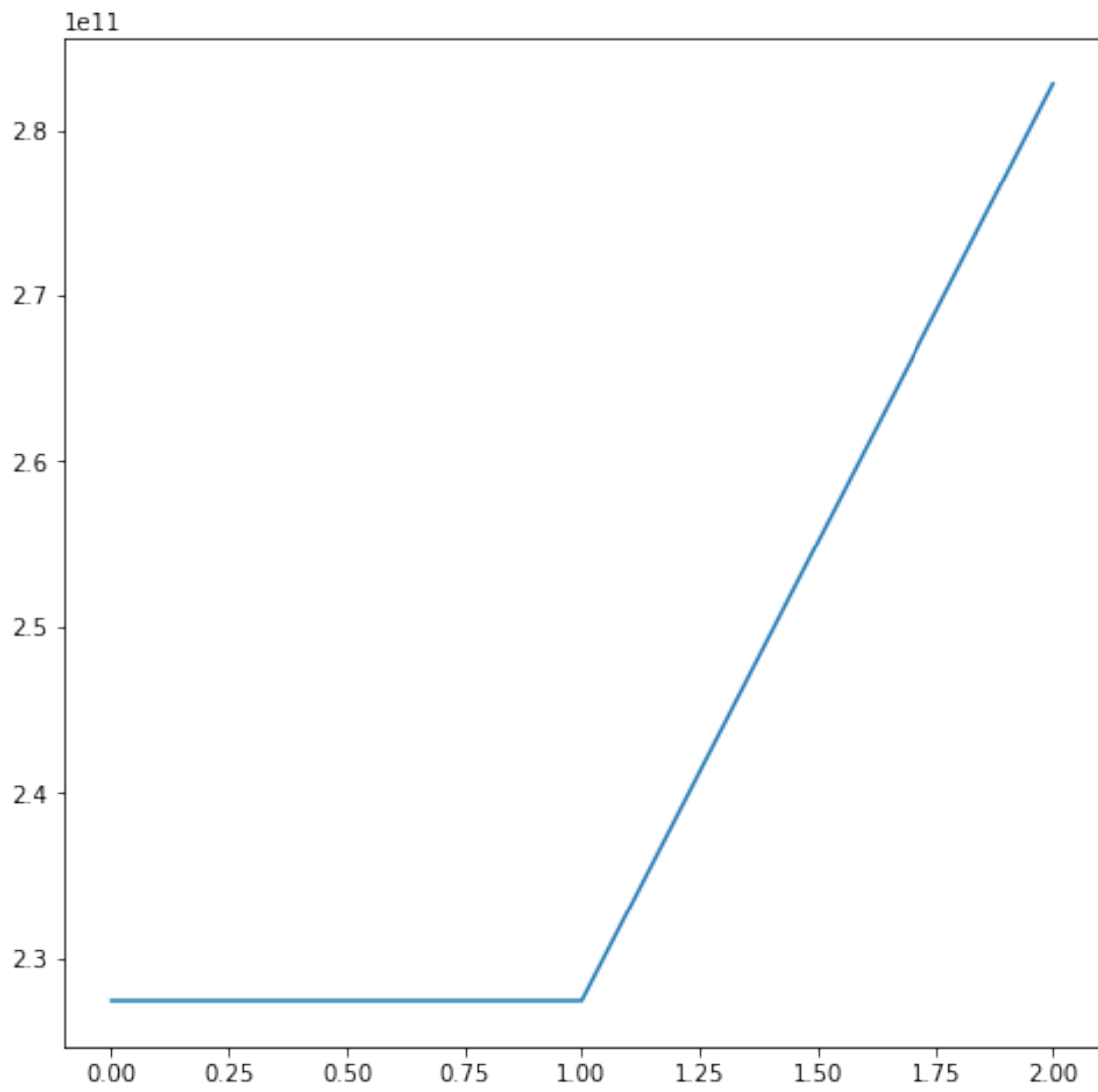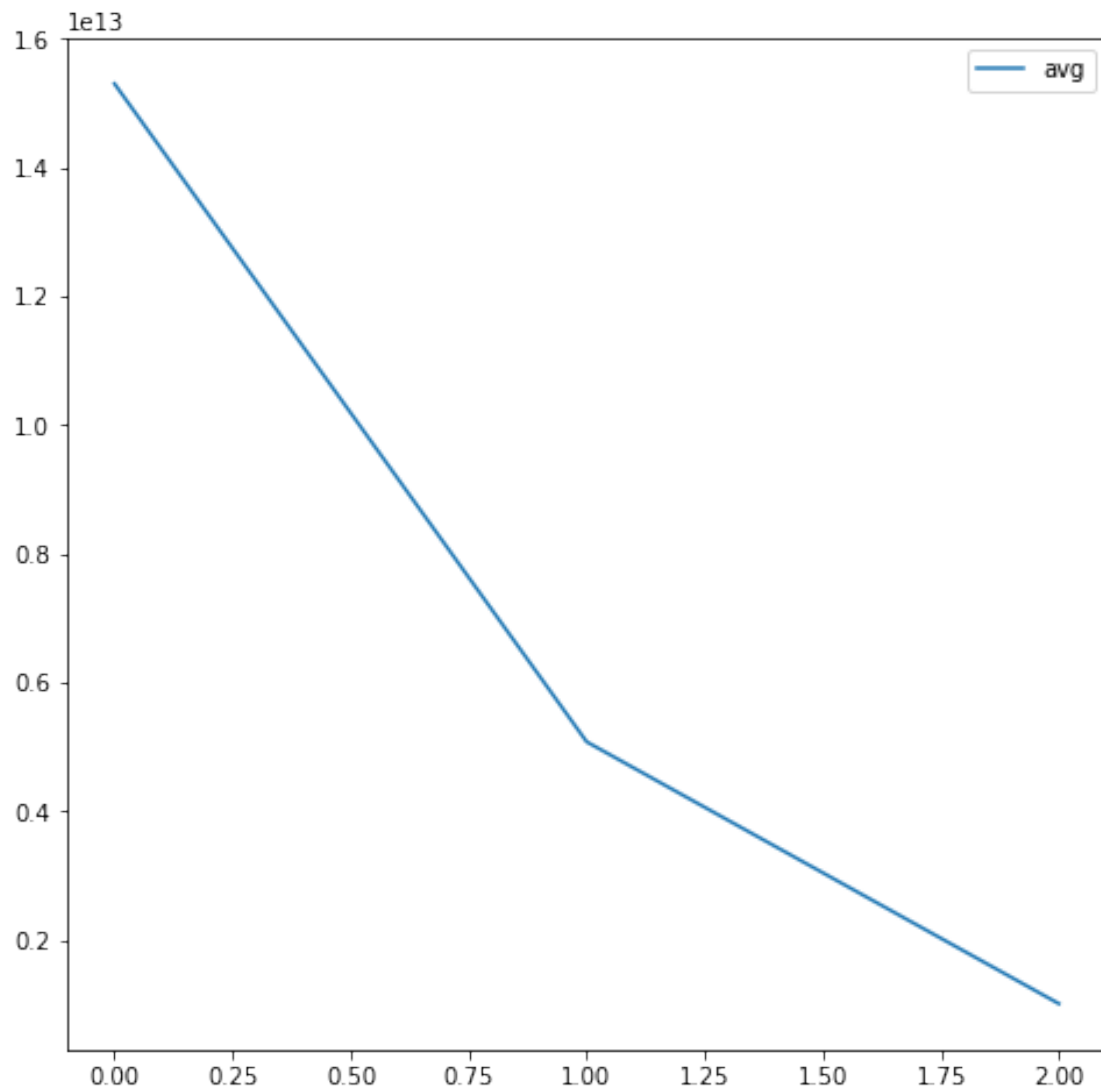----------------------------------------------------------------
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Enter fraction of cells you want to mutate:0.5

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Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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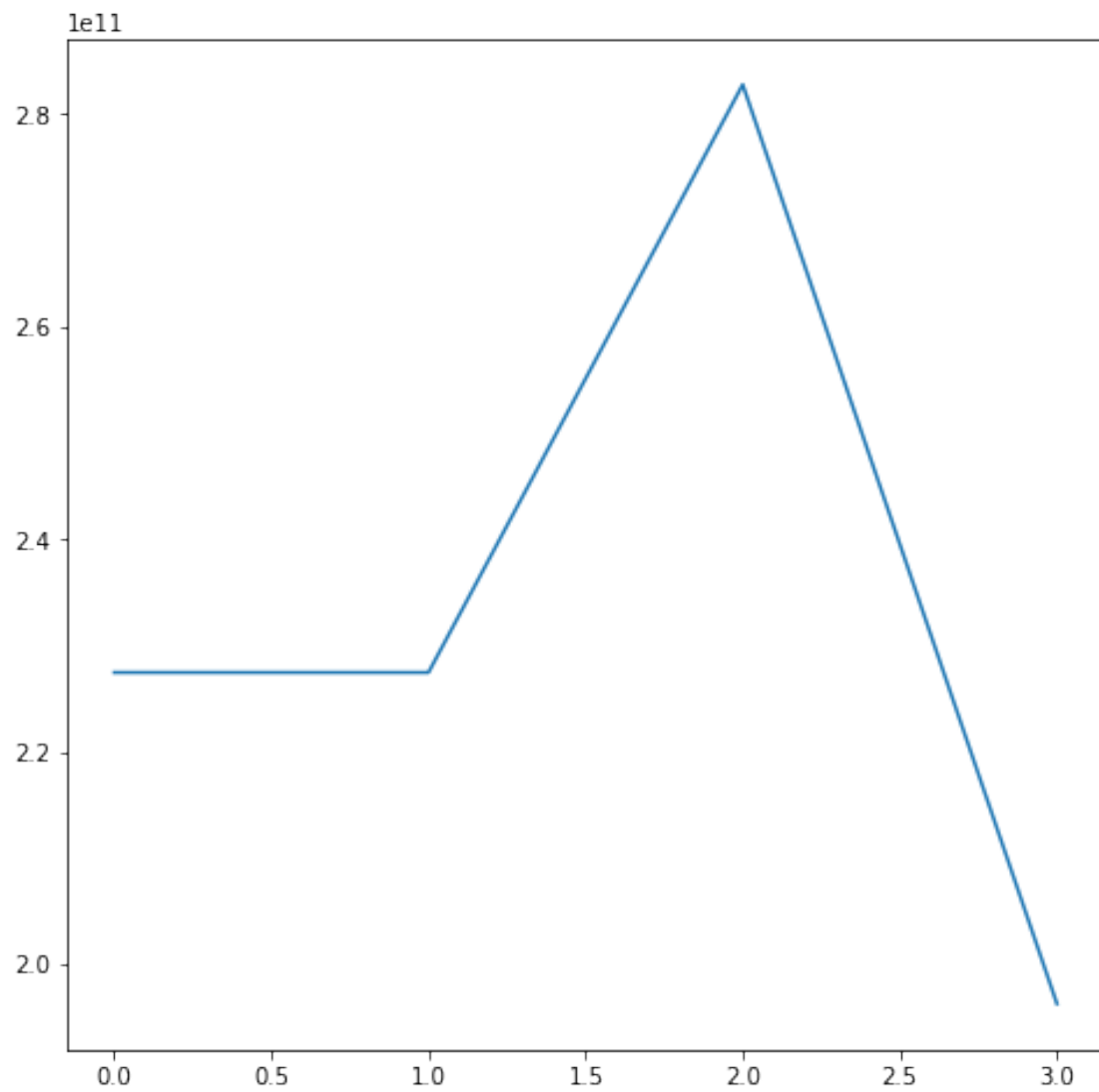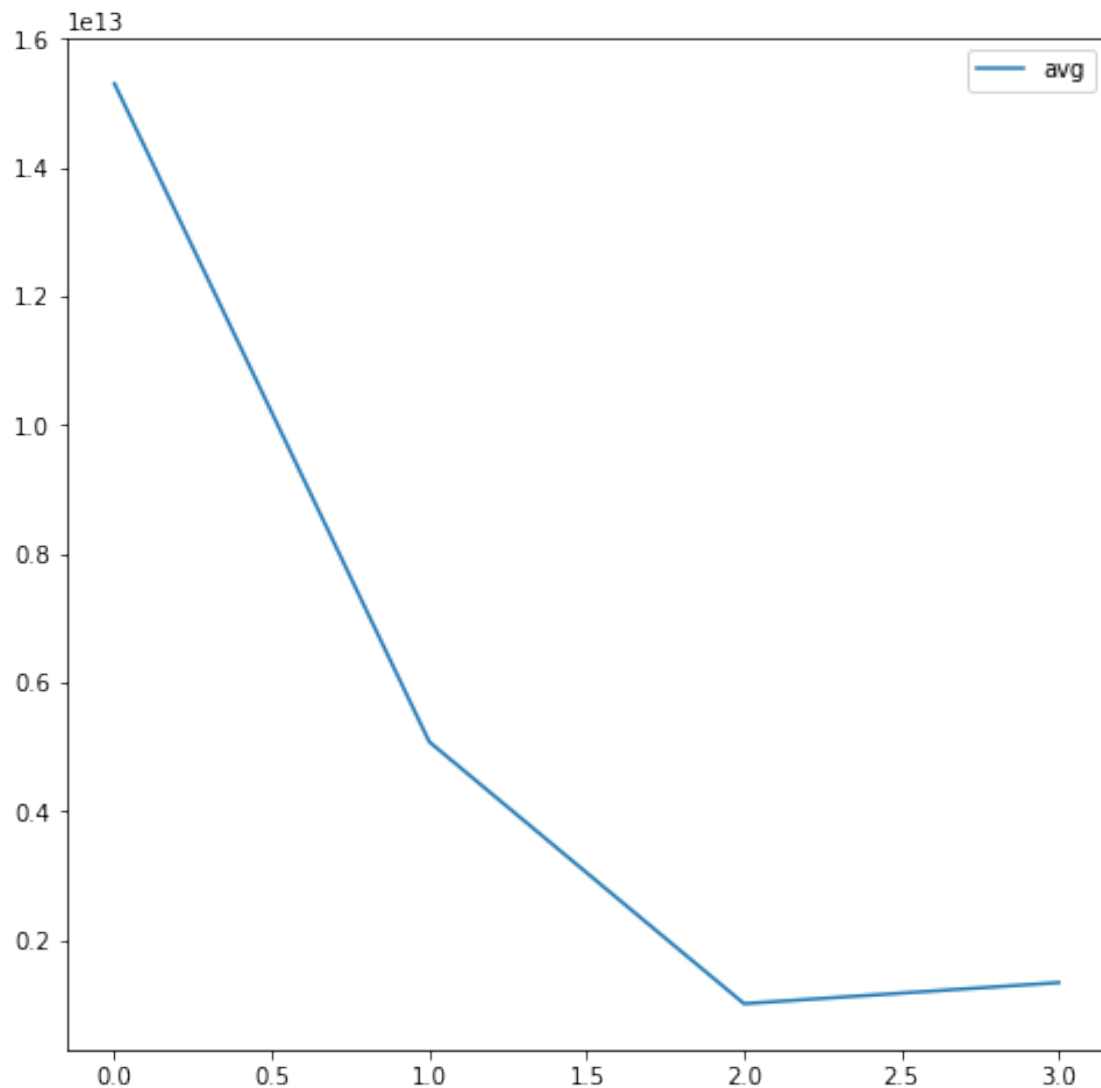----------------------------------------------------------------
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Enter fraction of cells you want to mutate:0.4

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Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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Enter mutation magnitude:0.4
Enter fraction of cells you want to mutate:0.3

/home/anmolagarwal/anaconda3/lib/python3.7/site-
packages/ipykernel_launcher.py:11: DeprecationWarning: count is deprecated. Use
Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

exist? 0
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exist? 0
exist? 0
exist? 0
exist? 0

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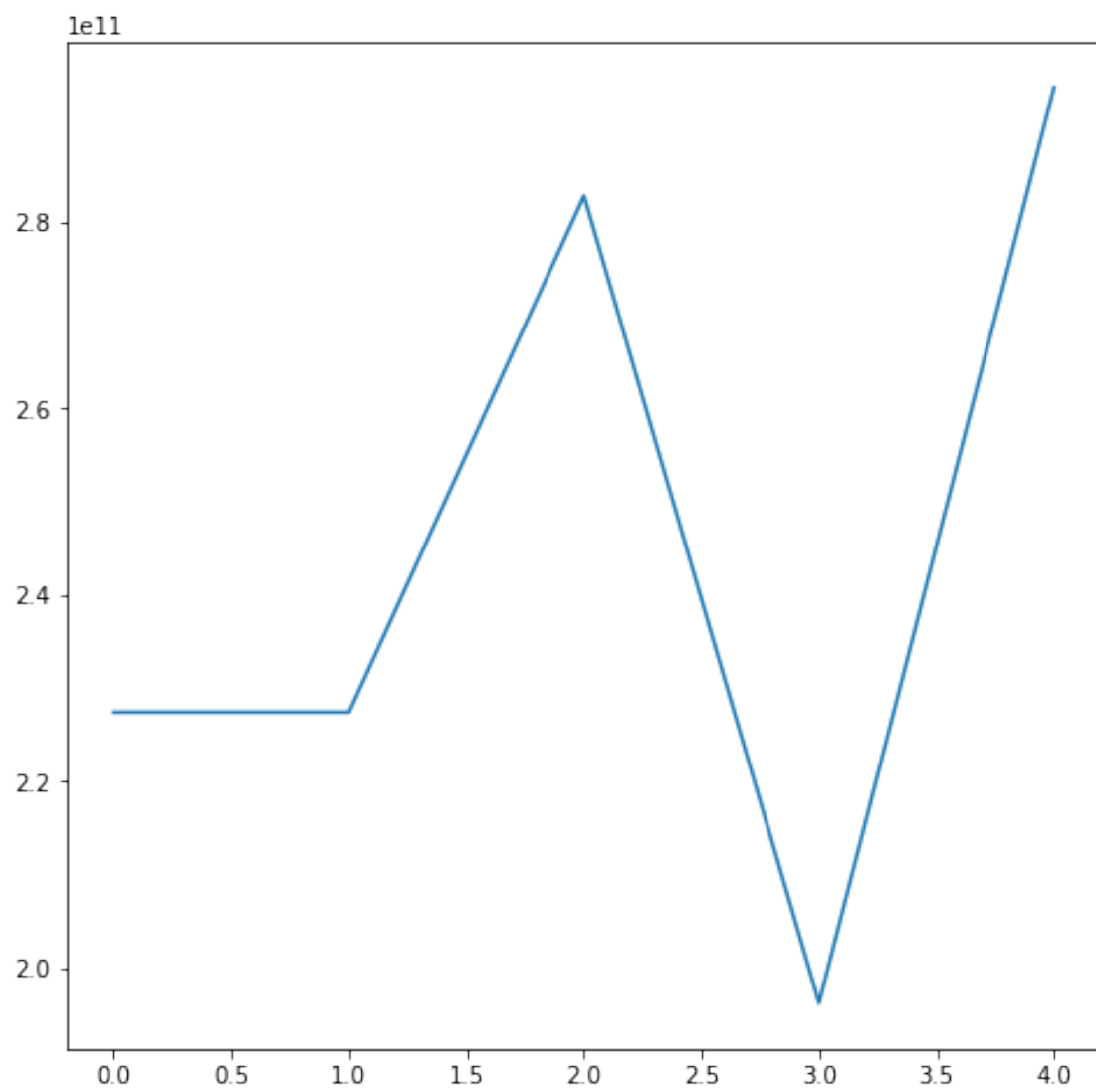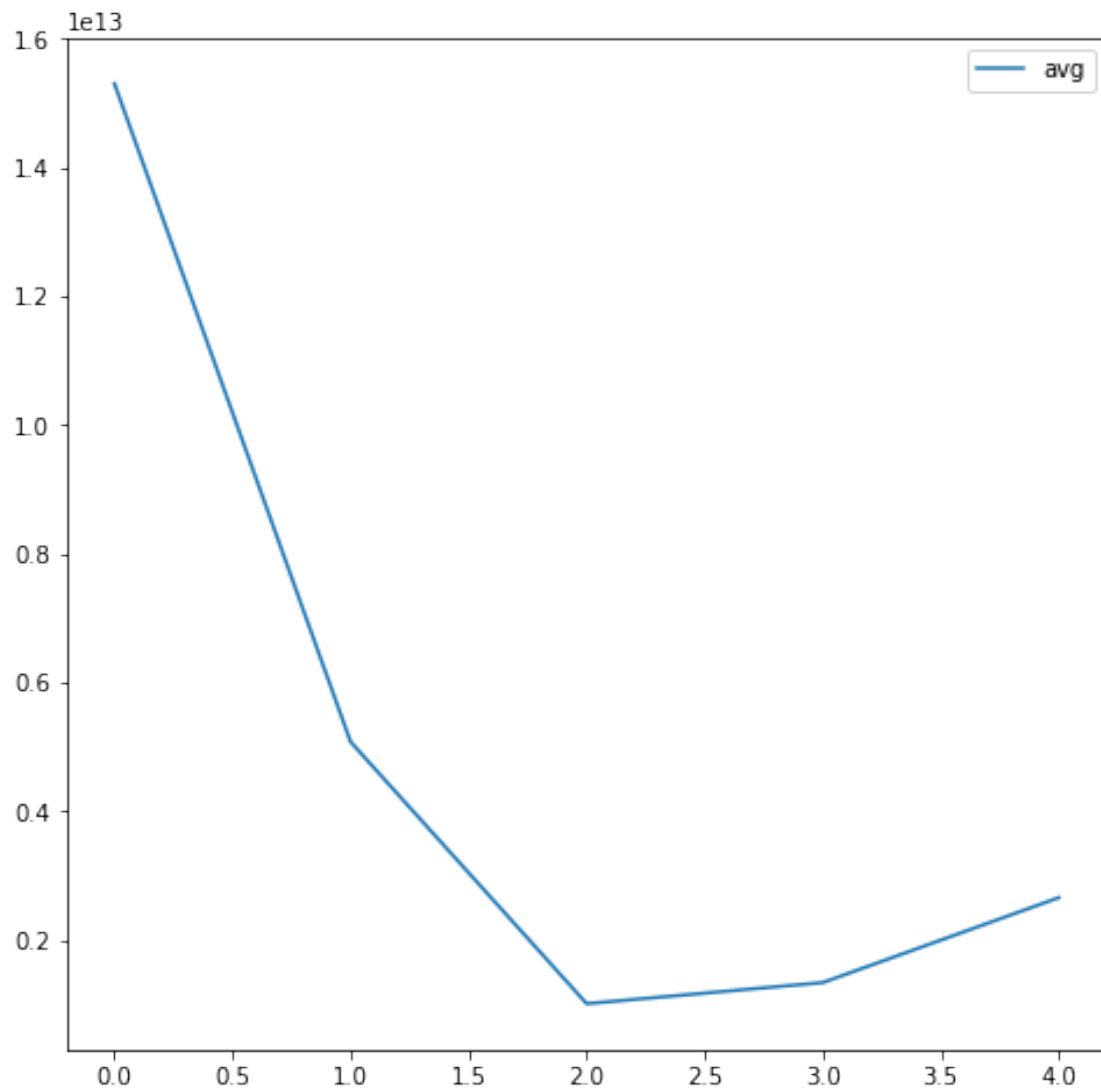exist?  0
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Avg fitness is 1304687817054.4048
MIN fitness is 176917260117.8882
fitness vals are: ->

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227748000863.34744
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Enter y to continue.y
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  -1.86589969e-06 -9.33565940e-09  7.81200756e-10]
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CHILD 2 is [-2.83848898e-01 -1.64131063e-12 -9.36802413e-14 2.04734210e-11
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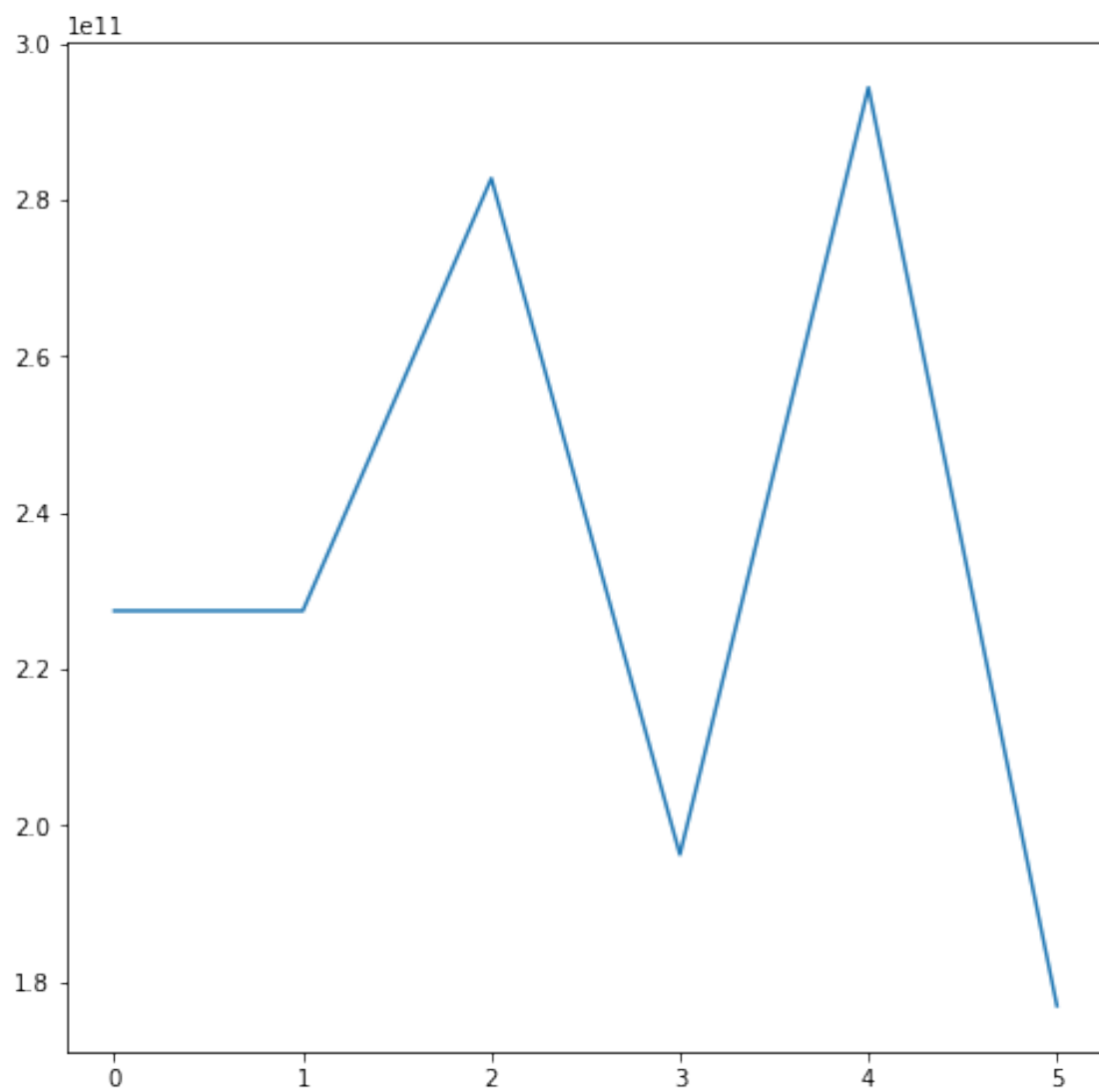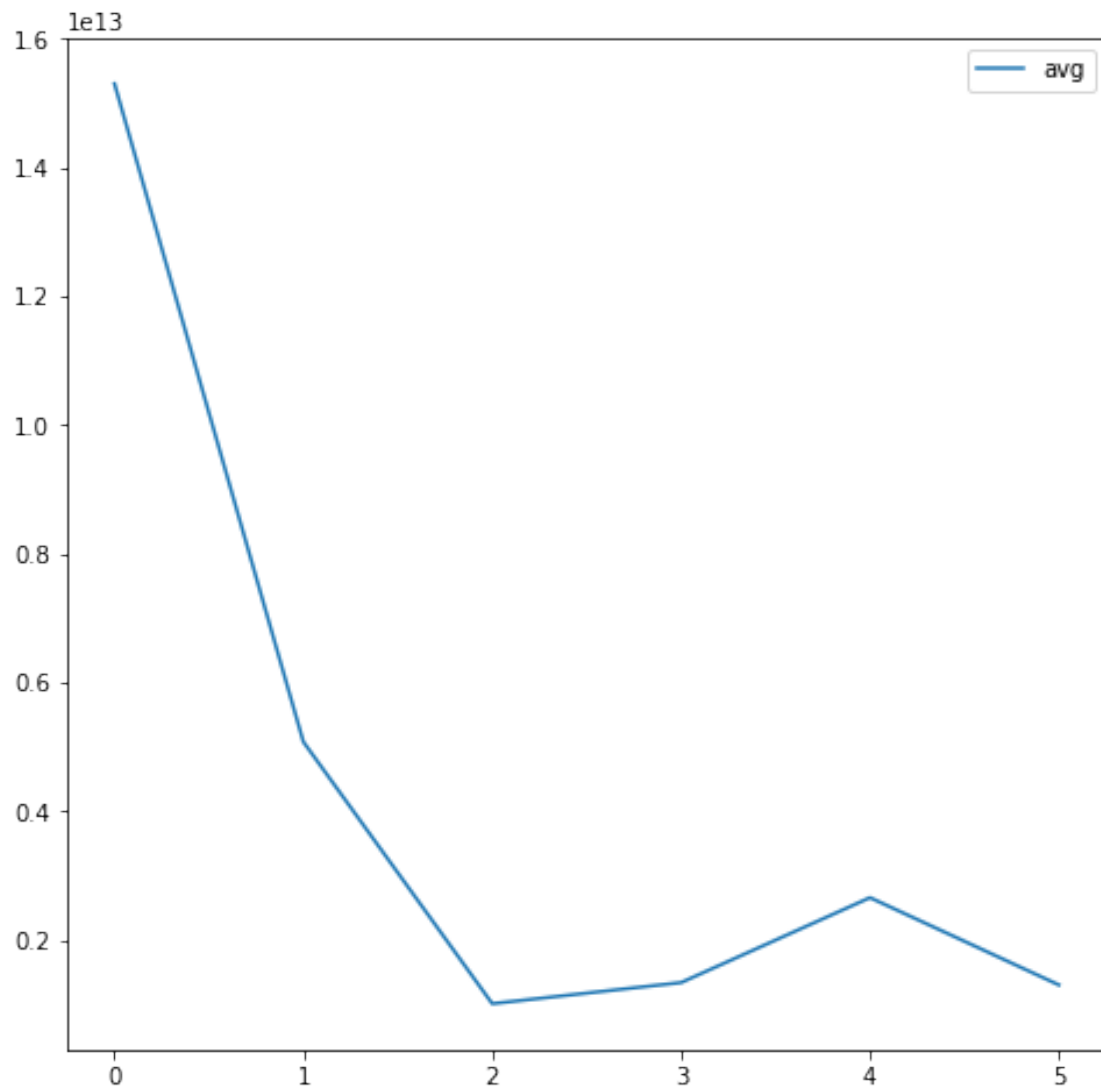--------------------------------------------------------------
Enter mutation magnitude:0.04
Enter fraction of cells you want to mutate:0.6

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packages/ipykernel_launcher.py:11: DeprecationWarning: count is deprecated. Use
Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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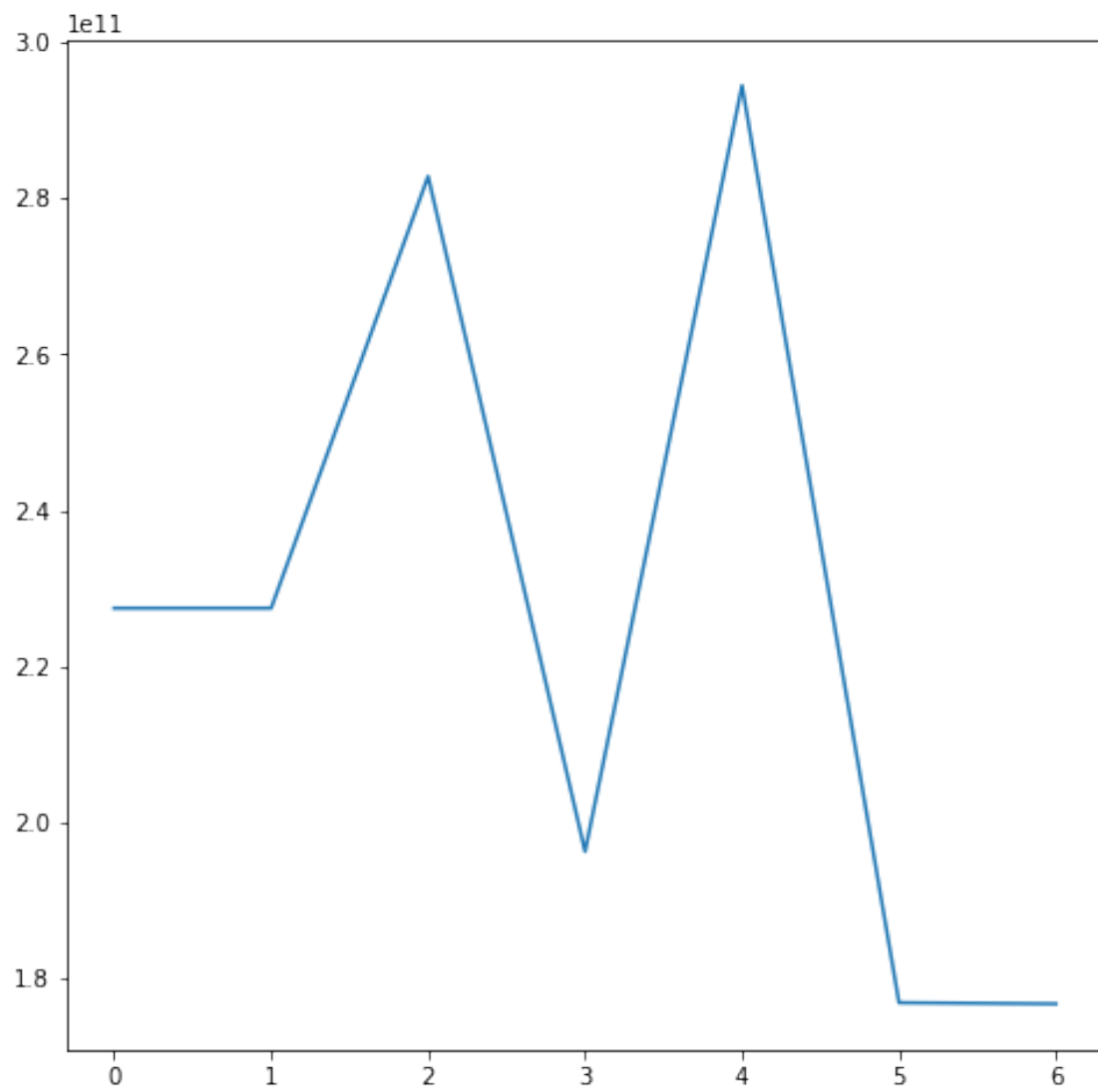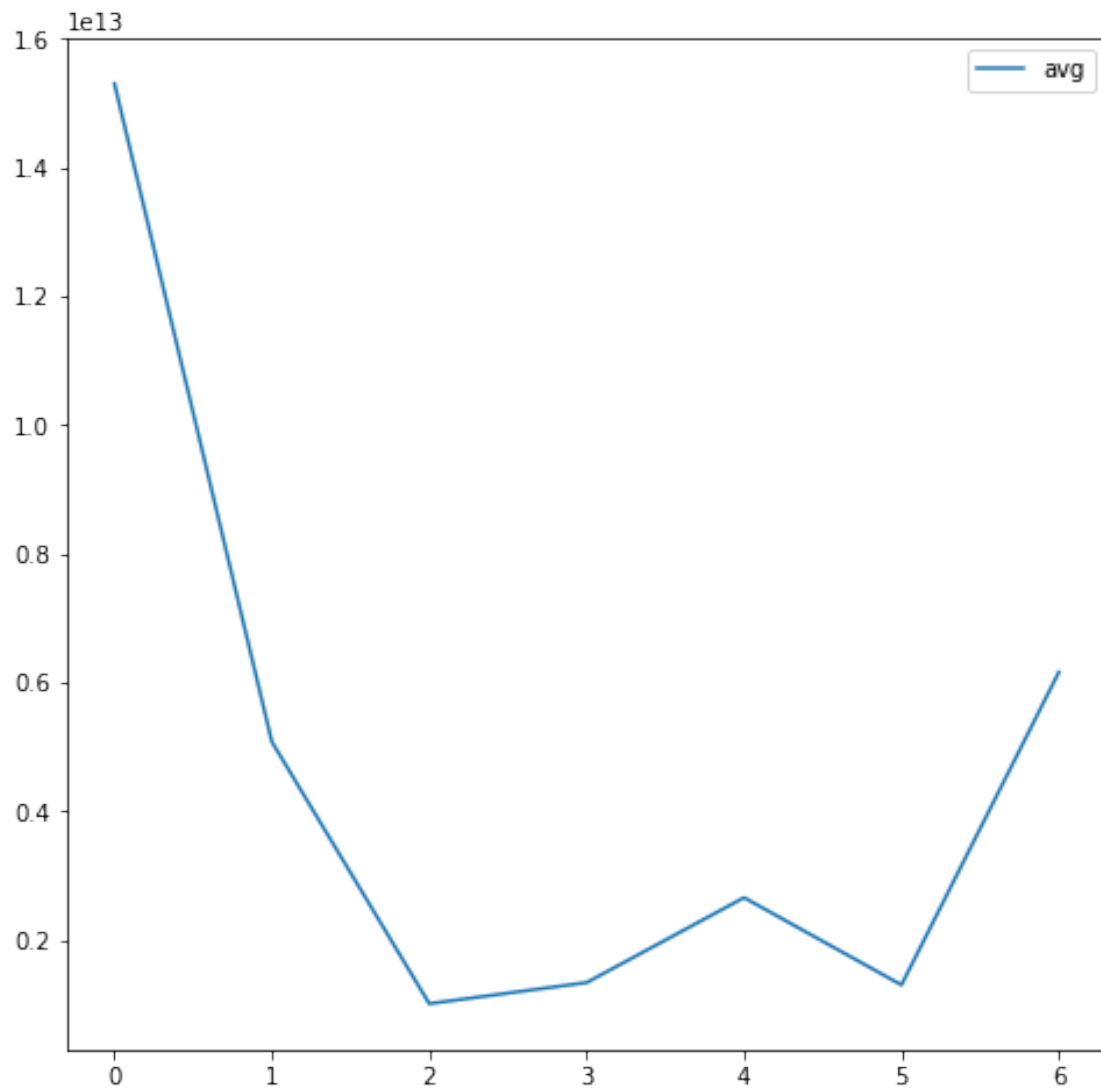----------------------------------------------------------------
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Enter fraction of cells you want to mutate:0.6

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Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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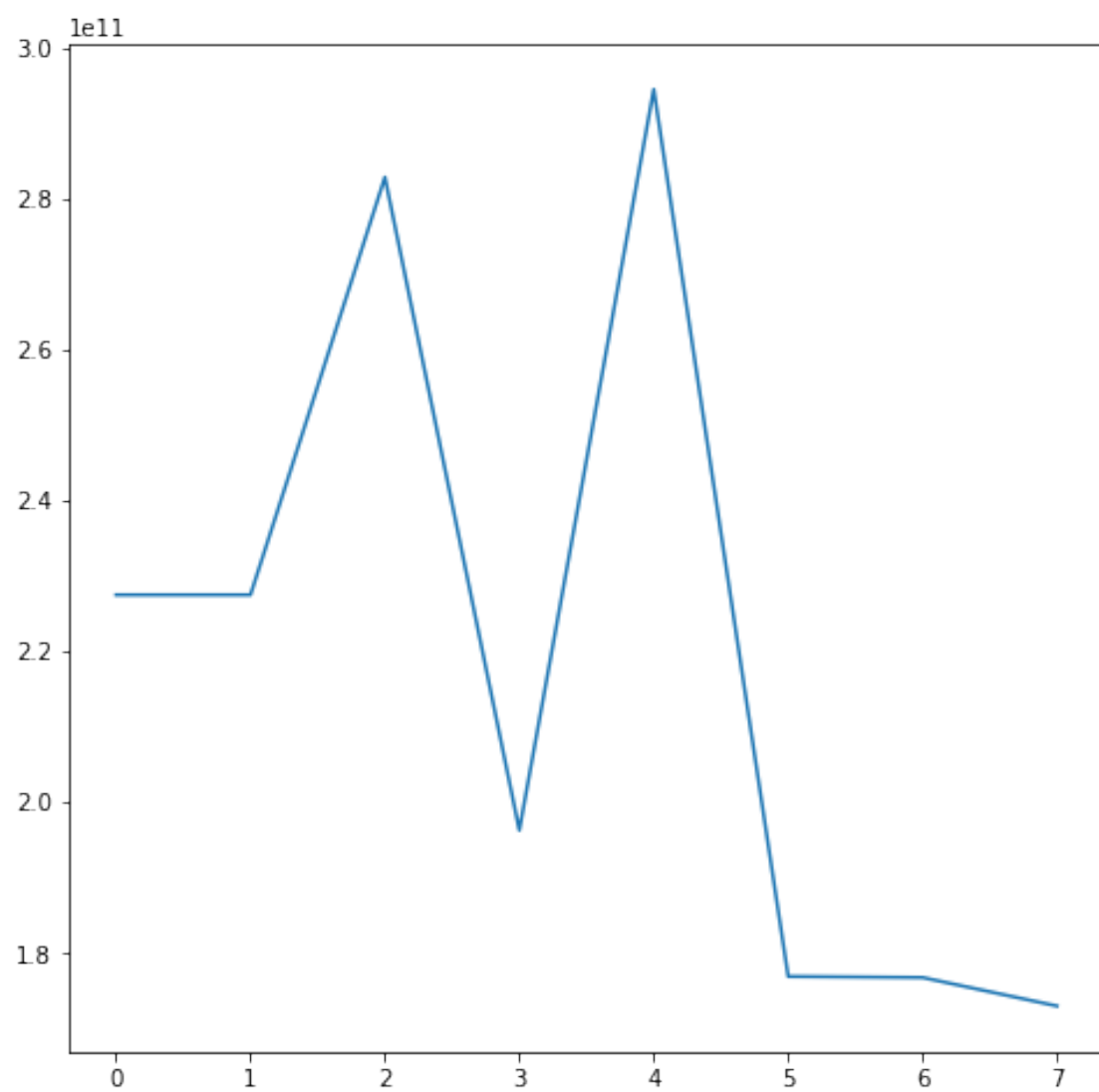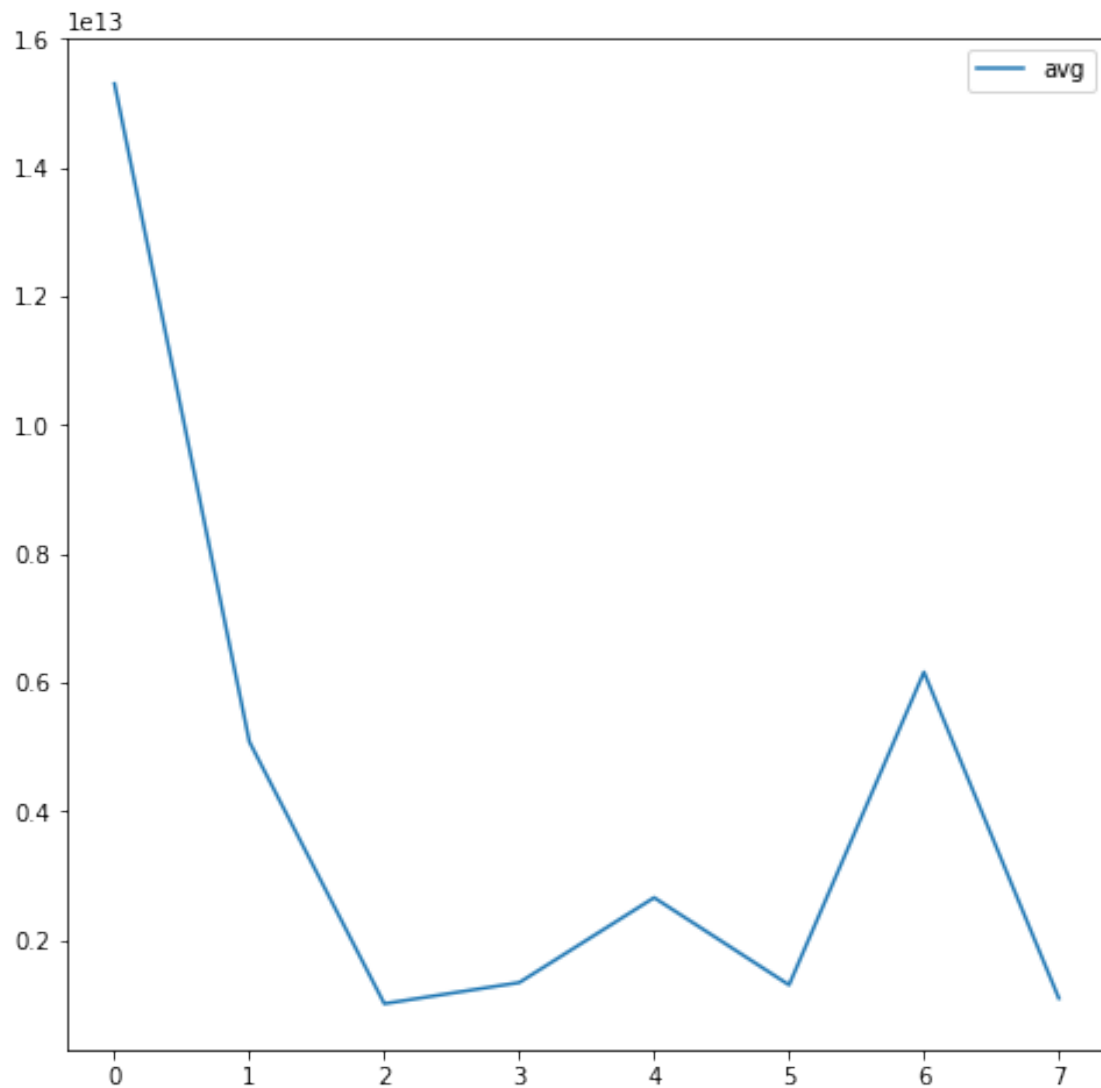--------------------------------------------------------------
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Enter fraction of cells you want to mutate:0.4

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Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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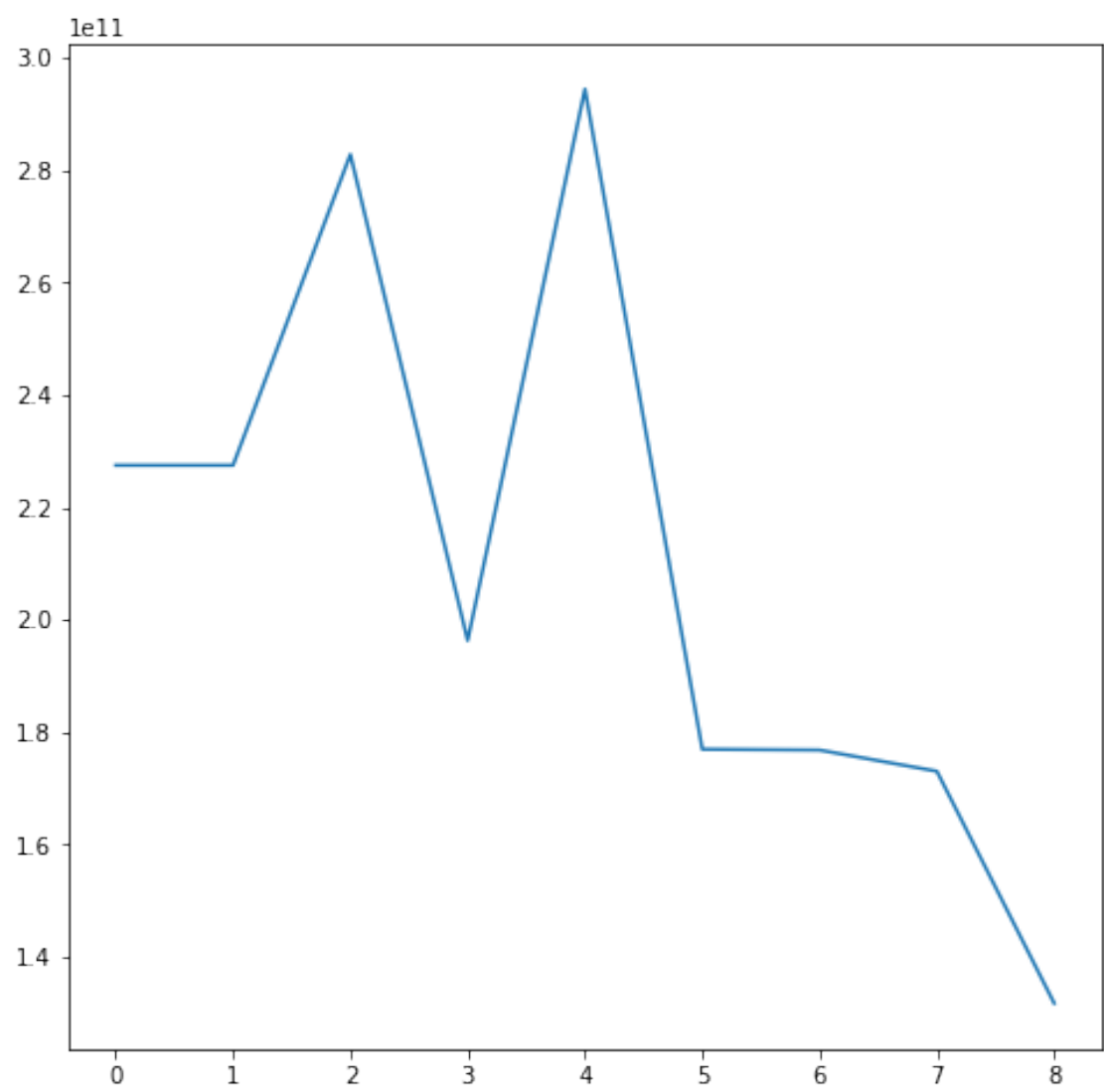------------------------------------------------------------
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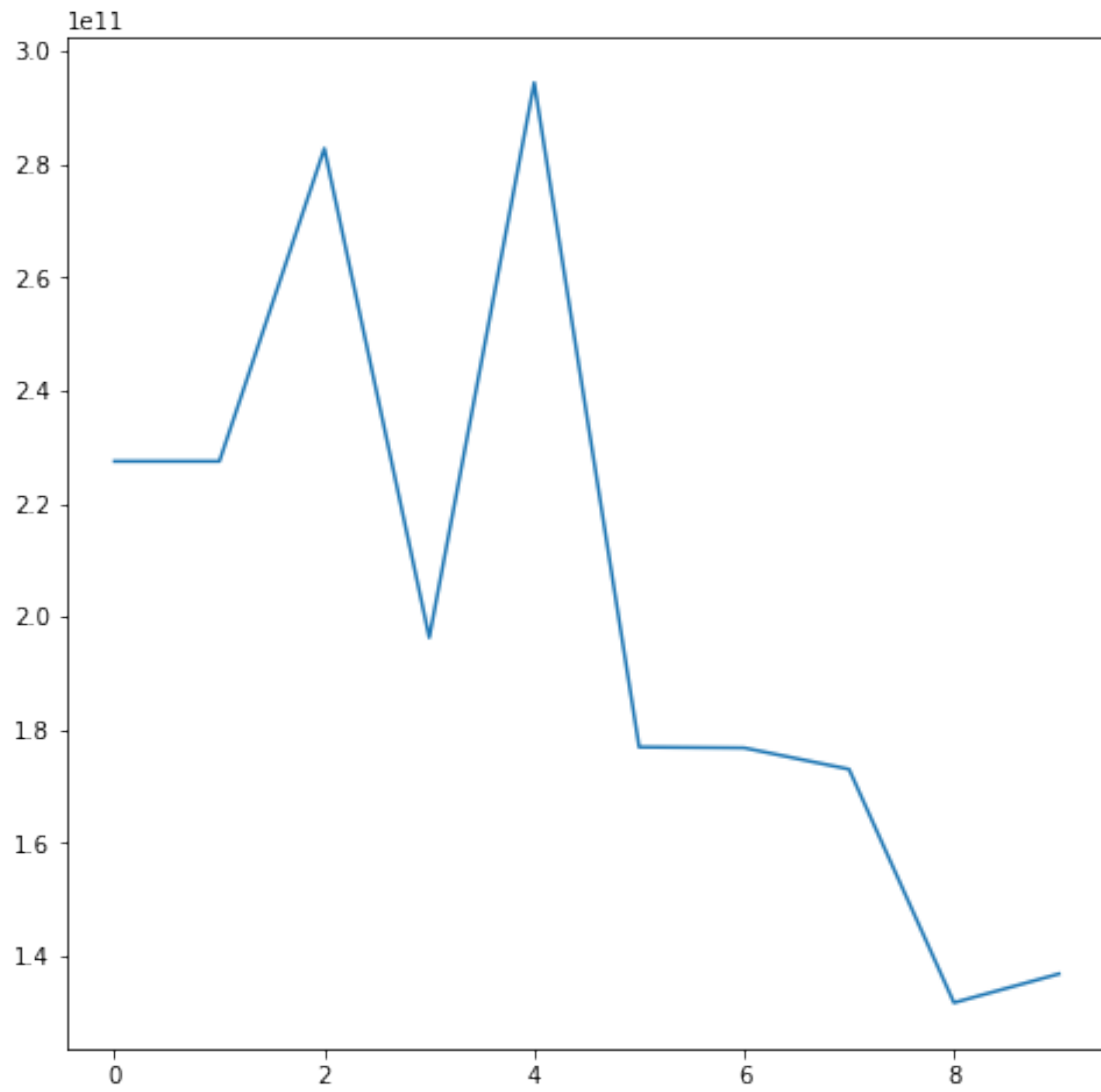
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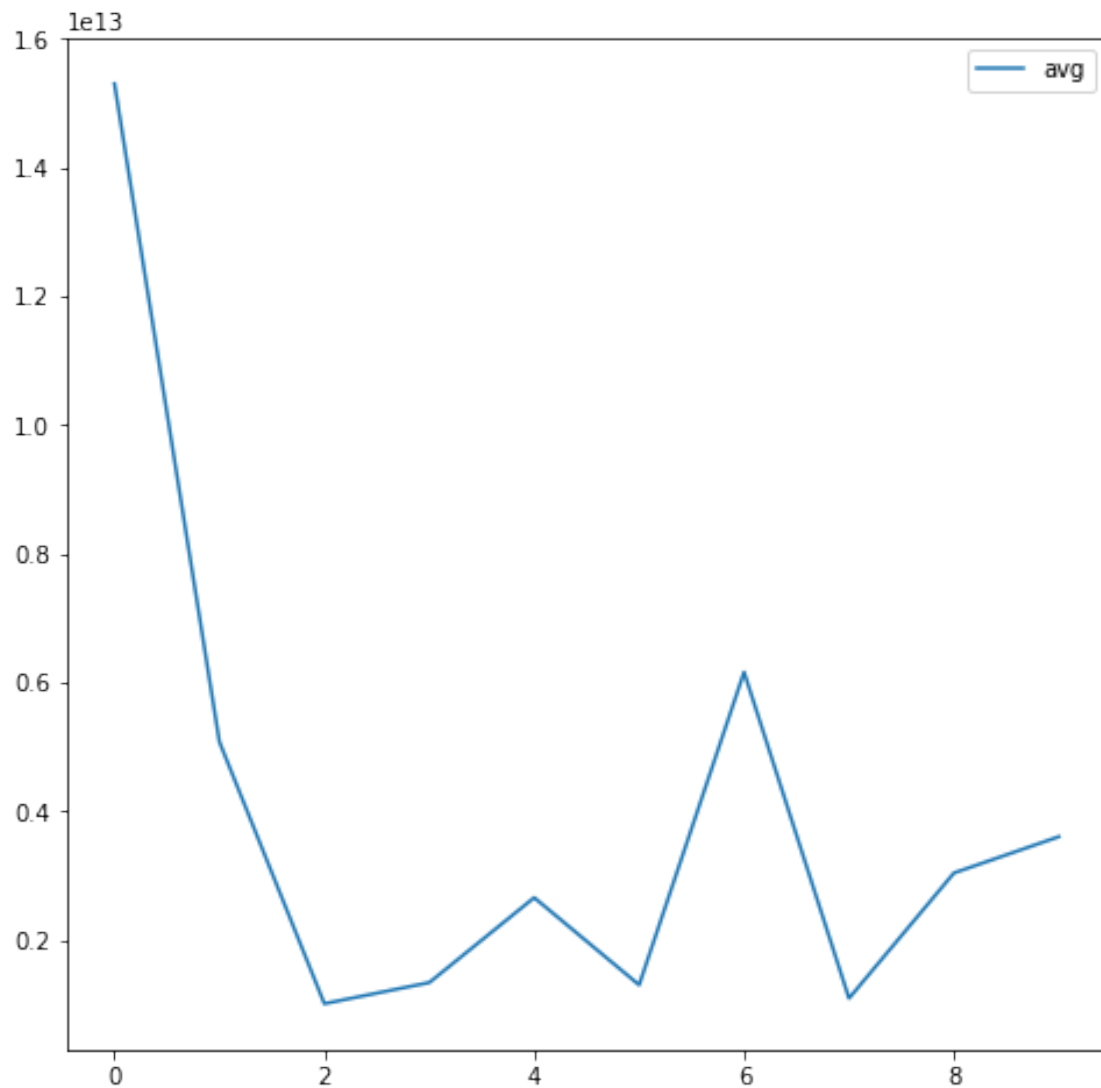------------------------------------------------------------
Enter mutation magnitude:0.2
Enter fraction of cells you want to mutate:0.6

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packages/ipykernel_launcher.py:11: DeprecationWarning: count is deprecated. Use
Collection.count_documents instead.
  # This is added back by InteractiveShellApp.init_path()

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MIN fitness is 138388121299.9854
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3738122965276.837
12407612723553.607
Enter y to continue.y
```

[138]:
```python
print(tot_crosses)
print(same_crosses)
```

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80
0
```

[139]:
```python
print(len(generation_info))
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11

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[140]: generation_info[0]
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[28]: `#print(get_fitness_value(generation_info[0]["members"][0]))`

[141]: `print(anmol_arr)`

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    obj["anmol_arr"]=anmol_arr
    obj["generation_info"]=generation_info
    obj["trace_arr"]=trace_arr
    #print(type(anmol_arr))
    #obj["b"]=[1,2,3,4]
    json.dump(obj, fd)
```

```
<class 'list'>
```

#print(len(generation_info)) with open('json_dump.txt','w') as fd: for obj in generation_info: #print(obj) obj = {'members': obj['members'].tolist()} json.dump(obj, fd)

1 json.dumps(generation_info)

2 print(generation_info)

[143]: ```python
print("trace_arr is ", trace_arr)
```

trace_arr is  [[{'generation': 1, 'try_vector': [0.07144470438737868,
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-1.9193275505106666e-06, -8.894106807593951e-09, 7.758133607867065e-10],
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data = {} for i in range(0, 11): data[i] = [] data['errors_training'] = [] data['errors_validation'] =
[]

```
for doc in coll.find({}, {'_id': False}):
    # print(doc)
    for i in range(0, 11):
        data[i].append(doc['try_vector'][i])

    data['errors_training'].append(doc['errors'][0])
    data['errors_validation'].append(doc['errors'][1])
```

```
# print(data)

df = pd.DataFrame(data).sort_values(
    by=['errors_training', 'errors_validation'])
print(df)
with open('history.txt', 'w') as f:
    print(df, file=f)
```

[ ]:

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