

## 7\_March\_mongo\_version

March 8, 2021

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

```
[228]: NUM_FEATURES=11
LB_LIMIT=-10
UB_LIMIT=10
MAX_ITR=15
MIN_COST=-999999 # ??/
POP_SIZE=36
MUT_RATE=0.2
RETENTION_RATE=0.25 # selection rate from prev generation
TODAY = "PROPER 3rd 7th March, STINT_3 for 0.95 max + 0.05 min"
```

```
[229]: 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']
```

```
[230]: 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 8

```
[231]: #print(locals())

global_storage=[]
```

```
[232]: 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'))
```

```
[233]: anmol_arr=[]
```

```
[234]: 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)
        annol_arr.append({"array_stuff":coeff_arr, "errors_returned":val, "gen":
↪curr_gen_num})

        ↵
↪#print("-----")

    return val

```

```

[235]: 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()
        annol_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

```

```

[236]: 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

```

```
[237]: 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}})
```

```
[238]: global_json=[]
```

```
[239]: print(global_json)
```

```
[]
```

```
[240]: 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= 0.95 * max(t,v) + 0.05 * min(t,v)
```

```
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
```

```
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

```

```

[242]: 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

```

```

[243]: 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

```

```

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()

```

```

[244]: 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  $r_j \sim U(0, 1)$ , and  $\eta > 0$  is the distribution index. Deb and Agrawal
    →suggested
    that  $\eta = 1$ .'''

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

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

```

```

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()

```

```

[245]: 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
```

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

CURR_GEN_NUM=1
init_arr=np.array(
[
    [
        0.0,
        -9.875299804205226e-13,
        -5.3944821589819837e-14,
        7.930563099592005e-11,
        -2.0984549655895666e-10,
        -1.4378337510064146e-15,
        8.060220128248057e-16,
        2.2757658578306265e-05,
        -1.989031728863744e-06,
        -8.908335865469784e-09,
        8.161584966021705e-10
    ],
    [
        0.14372121890411654,
        -1.4890811563918534e-12,
        -1.2047276118323332e-13,
        6.663500558677813e-11,
        -3.209473950124739e-10,
        -4.851020561469704e-16,
        5.922444470241633e-16,
        2.4759096674780938e-05,
        -1.4579318080095177e-06,
        -1.705784324447362e-08,
        7.045245746926344e-10
    ],
    [
        0.24025369570399946,
        -1.2348128209557806e-12,
        -6.362901079256093e-14,
        4.7166226305704806e-11,
        -3.276886509601226e-10,
        -1.210826911909016e-15,
        1.0421659283608714e-15,
        1.828214366396874e-05,
        -1.552477721977954e-06,
        -9.534761062798623e-09,
        6.660737453491892e-10
    ]
])
```

```

],
[
    0.010271807773104644,
    -1.1947167220101649e-12,
    -1.346442133492086e-13,
    6.395655579106194e-11,
    -7.872513032684012e-11,
    -1.0796148320595799e-15,
    6.535200197400842e-16,
    2.5973200088067378e-05,
    -1.8563764687677866e-06,
    -1.5246002909443635e-08,
    8.445163600284704e-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)
```

(4, 11)

Starting pop is

```
[ 0.00000000e+00 -9.87529980e-13 -5.39448216e-14  7.93056310e-11
 -2.09845497e-10 -1.43783375e-15  8.06022013e-16  2.27576586e-05
 -1.98903173e-06 -8.90833587e-09  8.16158497e-10]

[ 1.43721219e-01 -1.48908116e-12 -1.20472761e-13  6.66350056e-11
 -3.20947395e-10 -4.85102056e-16  5.92244447e-16  2.47590967e-05
 -1.45793181e-06 -1.70578432e-08  7.04524575e-10]

[ 2.40253696e-01 -1.23481282e-12 -6.36290108e-14  4.71662263e-11
 -3.27688651e-10 -1.21082691e-15  1.04216593e-15  1.82821437e-05
 -1.55247772e-06 -9.53476106e-09  6.66073745e-10]

[ 1.47300288e-01 -1.28241317e-12 -7.00690462e-14  6.70537831e-11
 -2.09845497e-10 -1.80936268e-15  8.06022013e-16  2.27576586e-05
 -2.55919348e-06 -7.70402941e-09  8.16158497e-10]

[ 1.17194212e-01 -1.12177248e-12 -1.36024430e-13  6.85310001e-11
 -3.20947395e-10 -4.85102056e-16  5.92244447e-16  2.47590967e-05
 -1.45793181e-06 -1.70578432e-08  5.16152591e-10]

[ 2.40253696e-01 -1.18031455e-12 -6.36290108e-14  4.91556557e-11
 -2.68346973e-10 -1.21082691e-15  1.04216593e-15  1.82821437e-05
 -1.28549746e-06 -9.53476106e-09  6.14103999e-10]

[ 1.55242815e-01 -9.87529980e-13 -4.57473937e-14  7.19090644e-11
 -2.09845497e-10 -1.78648880e-15  8.06022013e-16  2.34765984e-05
 -1.98903173e-06 -8.90833587e-09  9.35190399e-10]

[ 1.43721219e-01 -1.50489774e-12 -1.20472761e-13  6.66350056e-11
 -3.20947395e-10 -4.59129394e-16  5.92244447e-16  2.80853210e-05
 -1.45793181e-06 -1.70578432e-08  6.20385131e-10]

[ 2.12658176e-01 -1.14401603e-12 -6.36290108e-14  4.71662263e-11
 -3.14670428e-10 -1.21082691e-15  1.18892329e-15  2.28918915e-05
 -1.56616040e-06 -9.53476106e-09  7.35525764e-10]

[ 1.56259611e-01 -9.87529980e-13 -6.08102477e-14  7.53579583e-11
 -2.09845497e-10 -1.43783375e-15  6.27107332e-16  2.27576586e-05
 -1.42371303e-06 -1.03618075e-08  6.48164483e-10]

[ 1.43721219e-01 -1.48908116e-12 -1.20472761e-13  4.94150577e-11
```

-4.12413879e-10 -3.81451848e-16 5.92244447e-16 2.75323302e-05  
 -1.45793181e-06 -1.70578432e-08 7.04524575e-10]

[ 2.40253696e-01 -1.23481282e-12 -7.87974810e-14 3.46238335e-11  
 -3.27688651e-10 -1.21082691e-15 1.04216593e-15 1.30862386e-05  
 -1.55247772e-06 -1.10089886e-08 6.30330259e-10]

[ 0.00000000e+00 -7.54514927e-13 -5.39448216e-14 7.93056310e-11  
 -1.85559481e-10 -1.52199755e-15 8.06022013e-16 2.27576586e-05  
 -1.98903173e-06 -8.90833587e-09 9.55652143e-10]

[ 1.43721219e-01 -1.72737774e-12 -1.20472761e-13 7.23118203e-11  
 -3.02998578e-10 -4.60289373e-16 5.92244447e-16 2.51981836e-05  
 -1.45793181e-06 -1.70578432e-08 7.04524575e-10]

[ 2.40253696e-01 -1.23481282e-12 -6.89657024e-14 4.71662263e-11  
 -3.27688651e-10 -1.21082691e-15 7.42163791e-16 1.82821437e-05  
 -1.55247772e-06 -9.53476106e-09 6.66073745e-10]

[-2.67183619e-01 -1.06861124e-12 -6.77090367e-14 8.59063833e-11  
 -2.40855864e-10 -1.83829103e-15 8.26276196e-16 2.27576586e-05  
 -1.98903173e-06 -6.68843479e-09 9.50663069e-10]

[ 1.43721219e-01 -1.48908116e-12 -1.20472761e-13 6.66350056e-11  
 -3.20947395e-10 -4.85102056e-16 5.92244447e-16 2.54912240e-05  
 -1.37639433e-06 -1.60120410e-08 6.57081468e-10]

[ 2.40253696e-01 -1.23481282e-12 -4.79630816e-14 4.71662263e-11  
 -3.27688651e-10 -1.21082691e-15 1.04216593e-15 1.82821437e-05  
 -1.21713067e-06 -9.53476106e-09 6.50019789e-10]

[ 0.00000000e+00 -9.87529980e-13 -6.45679468e-14 7.20955363e-11  
 -2.59564020e-10 -1.37280075e-15 6.14732320e-16 2.27576586e-05  
 -2.38907181e-06 -7.00459578e-09 7.83016925e-10]

[ 1.36436055e-01 -1.47219228e-12 -1.36113080e-13 6.66350056e-11  
 -3.20947395e-10 -5.37966345e-16 5.87726353e-16 2.47590967e-05  
 -1.52110995e-06 -1.90451778e-08 6.15899419e-10]

[ 2.40253696e-01 -1.34620995e-12 -6.36290108e-14 4.71662263e-11  
 -3.06042017e-10 -1.21082691e-15 1.04216593e-15 1.50438417e-05  
 -1.42276143e-06 -9.92121628e-09 6.66073745e-10]

[ 0.00000000e+00 -1.03490453e-12 -5.10741027e-14 9.15653371e-11  
 -1.93070540e-10 -1.80601338e-15 8.06022013e-16 2.27576586e-05  
 -2.13158482e-06 -8.90833587e-09 8.07744128e-10]

[ 1.43721219e-01 -1.48908116e-12 -1.20472761e-13 6.66350056e-11

-2.49023526e-10 -4.85102056e-16 6.46847331e-16 2.09740750e-05  
 -1.62808757e-06 -1.84713788e-08 5.11029617e-10]

[ 2.40253696e-01 -1.23481282e-12 -6.36290108e-14 3.36933525e-11  
 -3.27688651e-10 -1.21082691e-15 1.00146893e-15 2.35211019e-05  
 -1.46010740e-06 -9.53476106e-09 6.79132302e-10]

[ 0.00000000e+00 -9.87529980e-13 -5.69211971e-14 6.79512613e-11  
 -2.09845497e-10 -1.55625365e-15 8.06022013e-16 2.27576586e-05  
 -1.83926740e-06 -8.90833587e-09 8.16158497e-10]

[ 1.43721219e-01 -1.48908116e-12 -1.20472761e-13 6.66350056e-11  
 -3.64853472e-10 -6.01576337e-16 4.60833452e-16 2.47590967e-05  
 -1.45793181e-06 -1.70578432e-08 8.38884678e-10]

[ 1.81197933e-01 -1.14342291e-12 -5.88002593e-14 6.01279819e-11  
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 -1.95296559e-06 -9.53476106e-09 5.35251006e-10]

[ 5.63820825e-02 -9.87529980e-13 -5.85852596e-14 8.56878069e-11  
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 -2.43734843e-06 -8.90833587e-09 9.58034882e-10]

[ 1.43721219e-01 -1.48908116e-12 -1.01797991e-13 7.76214701e-11  
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 -1.69199801e-06 -1.94694028e-08 5.49955310e-10]

[ 2.40253696e-01 -1.28902320e-12 -4.54831547e-14 5.28872607e-11  
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[ 0.00000000e+00 -9.87529980e-13 -5.39448216e-14 8.59971401e-11  
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[ 1.43721219e-01 -1.77566603e-12 -1.00124965e-13 6.50029347e-11  
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[ 1.15699718e-01 -1.48908116e-12 -1.20472761e-13 6.66350056e-11

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-3.91765249e-10 -4.85102056e-16 6.87449735e-16 2.47590967e-05
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```

```
[249]: 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
        })
```

```
[250]: 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')
```

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-6.362901079256093e-14, 5.169562678489439e-11, -3.276886509601226e-10,
-1.528160821690075e-15, 1.0421659283608714e-15, 1.828214366396874e-05,
-1.957521768773042e-06, -1.0698722212529322e-08, 6.862794830933225e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': 'PROPER 3nd 7th March, STINT_3 for 0.95 max
+ 0.05 min', 'survived': False}

{'generation': 1, 'try_vector': [0.0, -7.190556509044214e-13,
-5.3944821589819837e-14, 7.930563099592005e-11, -2.0984549655895666e-10,
-1.4378337510064146e-15, 8.060220128248057e-16, 2.7210856442058913e-05,
-1.989031728863744e-06, -1.0305300416013763e-08, 6.495798369986417e-10],
'errors': [-1, -1], 'mother_vec': [0.0, -7.190556509044214e-13,
-5.3944821589819837e-14, 7.930563099592005e-11, -2.0984549655895666e-10,
-1.4378337510064146e-15, 8.060220128248057e-16, 2.7210856442058913e-05,
-1.989031728863744e-06, -1.0305300416013763e-08, 6.495798369986417e-10],

```

```
'father_vec': [0.0, -7.190556509044214e-13, -5.3944821589819837e-14,
7.930563099592005e-11, -2.0984549655895666e-10, -1.4378337510064146e-15,
8.060220128248057e-16, 2.7210856442058913e-05, -1.989031728863744e-06,
-1.0305300416013763e-08, 6.495798369986417e-10], 'before_mutation': [0.0,
-7.190556509044214e-13, -5.3944821589819837e-14, 7.930563099592005e-11,
-2.0984549655895666e-10, -1.4378337510064146e-15, 8.060220128248057e-16,
2.7210856442058913e-05, -1.989031728863744e-06, -1.0305300416013763e-08,
6.495798369986417e-10], 'beta': -1, 'cross_over_point': -1, 'desc': 'PROPER 3nd
7th March, STINT_3 for 0.95 max + 0.05 min', 'survived': False}
```

```
{'generation': 1, 'try_vector': [0.11569971801055445, -1.4890811563918534e-12,
-1.2047276118323332e-13, 6.663500558677813e-11, -3.917652493839742e-10,
-4.851020561469704e-16, 6.874497351914317e-16, 2.4759096674780938e-05,
-1.4579318080095177e-06, -1.8545080296485888e-08, 7.045245746926344e-10],
'errors': [-1, -1], 'mother_vec': [0.11569971801055445, -1.4890811563918534e-12,
-1.2047276118323332e-13, 6.663500558677813e-11, -3.917652493839742e-10,
-4.851020561469704e-16, 6.874497351914317e-16, 2.4759096674780938e-05,
-1.4579318080095177e-06, -1.8545080296485888e-08, 7.045245746926344e-10],
'father_vec': [0.11569971801055445, -1.4890811563918534e-12,
-1.2047276118323332e-13, 6.663500558677813e-11, -3.917652493839742e-10,
-4.851020561469704e-16, 6.874497351914317e-16, 2.4759096674780938e-05,
-1.4579318080095177e-06, -1.8545080296485888e-08, 7.045245746926344e-10],
'before_mutation': [0.11569971801055445, -1.4890811563918534e-12,
-1.2047276118323332e-13, 6.663500558677813e-11, -3.917652493839742e-10,
-4.851020561469704e-16, 6.874497351914317e-16, 2.4759096674780938e-05,
-1.4579318080095177e-06, -1.8545080296485888e-08, 7.045245746926344e-10],
'beta': -1, 'cross_over_point': -1, 'desc': 'PROPER 3nd 7th March, STINT_3 for
0.95 max + 0.05 min', 'survived': False}
```

```
{'generation': 1, 'try_vector': [0.24025369570399946, -1.1296556118439912e-12,
-8.055456468339725e-14, 4.5560354735283955e-11, -3.276886509601226e-10,
-1.210826911909016e-15, 1.0421659283608714e-15, 2.1803961996252827e-05,
-1.552477721977954e-06, -9.534761062798623e-09, 6.660737453491892e-10],
'errors': [-1, -1], 'mother_vec': [0.24025369570399946, -1.1296556118439912e-12,
-8.055456468339725e-14, 4.5560354735283955e-11, -3.276886509601226e-10,
-1.210826911909016e-15, 1.0421659283608714e-15, 2.1803961996252827e-05,
-1.552477721977954e-06, -9.534761062798623e-09, 6.660737453491892e-10],
'father_vec': [0.24025369570399946, -1.1296556118439912e-12,
-8.055456468339725e-14, 4.5560354735283955e-11, -3.276886509601226e-10,
-1.210826911909016e-15, 1.0421659283608714e-15, 2.1803961996252827e-05,
-1.552477721977954e-06, -9.534761062798623e-09, 6.660737453491892e-10],
'before_mutation': [0.24025369570399946, -1.1296556118439912e-12,
-8.055456468339725e-14, 4.5560354735283955e-11, -3.276886509601226e-10,
-1.210826911909016e-15, 1.0421659283608714e-15, 2.1803961996252827e-05,
-1.552477721977954e-06, -9.534761062798623e-09, 6.660737453491892e-10], 'beta':
-1, 'cross_over_point': -1, 'desc': 'PROPER 3nd 7th March, STINT_3 for 0.95 max
+ 0.05 min', 'survived': False}
```

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

```
[ ]: MUT_RATE
```

```
[251]: 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"]}')
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
        '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

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')

'''
%-----
% 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]}})

##////////////////////////////////////
→////////////////////////////////

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
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
exist? 0
Avg fitness is 16354893620691.678
MIN fitness is 115438382216.42989
fitness vals are: ->
```

```
115438382216.42989
126405761082.70477
138991608515.2893
138991608515.2893
138991608583.92154
183021960408.04834
321019020675.51086
328312035497.20496
369945344246.61066
839228602200.4637
1205705979156.9475
2353022227316.279
2684476640738.635
3105326941959.285
3310669048805.9146
3537571895821.4595
3976910980843.922
4403116963937.975
8229253026647.087
9042400649913.86
11029806663419.285
13249727283880.023
13669655011152.883
13931478633264.24
18037746939906.977
18321239698886.668
20584820544075.4
22754514023222.547
28029777549203.78
29093866645732.52
```

31896786348523.426  
 40376018355418.125  
 45737229176388.96  
 64470334160709.266  
 78001558954185.36  
 95042810069848.11  
 parent 1 is [0.24025369570399946, -1.2348128209557806e-12,  
 -6.896570241755704e-14, 4.7166226305704806e-11, -3.276886509601226e-10,  
 -1.210826911909016e-15, 7.421637907484947e-16, 1.828214366396874e-05,  
 -1.552477721977954e-06, -9.534761062798623e-09, 6.660737453491892e-10]  
 parent 2 is [0.19006509369391375, -1.31806072014313e-12, -6.362901079256093e-14,  
 5.169562678489439e-11, -3.276886509601226e-10, -1.528160821690075e-15,  
 1.0421659283608714e-15, 1.828214366396874e-05, -1.957521768773042e-06,  
 -1.0698722212529322e-08, 6.862794830933225e-10]  
 CHILD 1 is [ 2.35890940e-01 -1.24204933e-12 -6.85017987e-14 4.75599545e-11  
 -3.27688651e-10 -1.23841187e-15 7.68242142e-16 1.82821437e-05  
 -1.58768707e-06 -9.63594097e-09 6.67830174e-10]  
 CHILD 2 is [ 1.94427849e-01 -1.31082421e-12 -6.40929146e-14 5.13018986e-11  
 -3.27688651e-10 -1.50057587e-15 1.01608758e-15 1.82821437e-05  
 -1.92231242e-06 -1.05975423e-08 6.84523055e-10]  
 #-----  
 parent 1 is [0.24025369570399946, -1.2348128209557806e-12,  
 -6.362901079256093e-14, 4.7166226305704806e-11, -3.276886509601226e-10,  
 -1.210826911909016e-15, 1.0421659283608714e-15, 1.828214366396874e-05,  
 -1.552477721977954e-06, -9.534761062798623e-09, 6.660737453491892e-10]  
 parent 2 is [0.11569971801055445, -1.4890811563918534e-12,  
 -1.2047276118323332e-13, 6.663500558677813e-11, -3.917652493839742e-10,  
 -4.851020561469704e-16, 6.874497351914317e-16, 2.4759096674780938e-05,  
 -1.4579318080095177e-06, -1.8545080296485888e-08, 7.045245746926344e-10]  
 CHILD 1 is [ 2.44069010e-01 -1.22702412e-12 -6.18877836e-14 4.65698623e-11  
 -3.25725868e-10 -1.23305718e-15 1.05303153e-15 1.80837428e-05  
 -1.55537383e-06 -9.25875863e-09 6.64895927e-10]  
 CHILD 2 is [ 1.11884404e-01 -1.49686986e-12 -1.22213988e-13 6.72313696e-11  
 -3.93728032e-10 -4.62871787e-16 6.76584134e-16 2.49574975e-05  
 -1.45503570e-06 -1.88210827e-08 7.05702393e-10]  
 #-----  
 parent 1 is [0.14372121890411654, -1.5048977371394834e-12,  
 -1.2047276118323332e-13, 6.663500558677813e-11, -3.209473950124739e-10,  
 -4.591293941396151e-16, 5.922444470241633e-16, 2.8085320959677563e-05,  
 -1.4579318080095177e-06, -1.705784324447362e-08, 6.20385130628648e-10]  
 parent 2 is [0.14372121890411654, -1.4890811563918534e-12,  
 -1.2047276118323332e-13, 6.663500558677813e-11, -3.209473950124739e-10,  
 -4.851020561469704e-16, 5.922444470241633e-16, 2.4759096674780938e-05,  
 -1.4579318080095177e-06, -1.705784324447362e-08, 7.045245746926344e-10]  
 CHILD 1 is [ 1.43721219e-01 -1.50875870e-12 -1.20472761e-13 6.66350056e-11  
 -3.20947395e-10 -4.52789245e-16 5.92244447e-16 2.88972808e-05  
 -1.45793181e-06 -1.70578432e-08 5.99845971e-10]  
 CHILD 2 is [ 1.43721219e-01 -1.48522019e-12 -1.20472761e-13 6.66350056e-11

```

-3.20947395e-10 -4.91442206e-16 5.92244447e-16 2.39471368e-05
-1.45793181e-06 -1.70578432e-08 7.25063735e-10]
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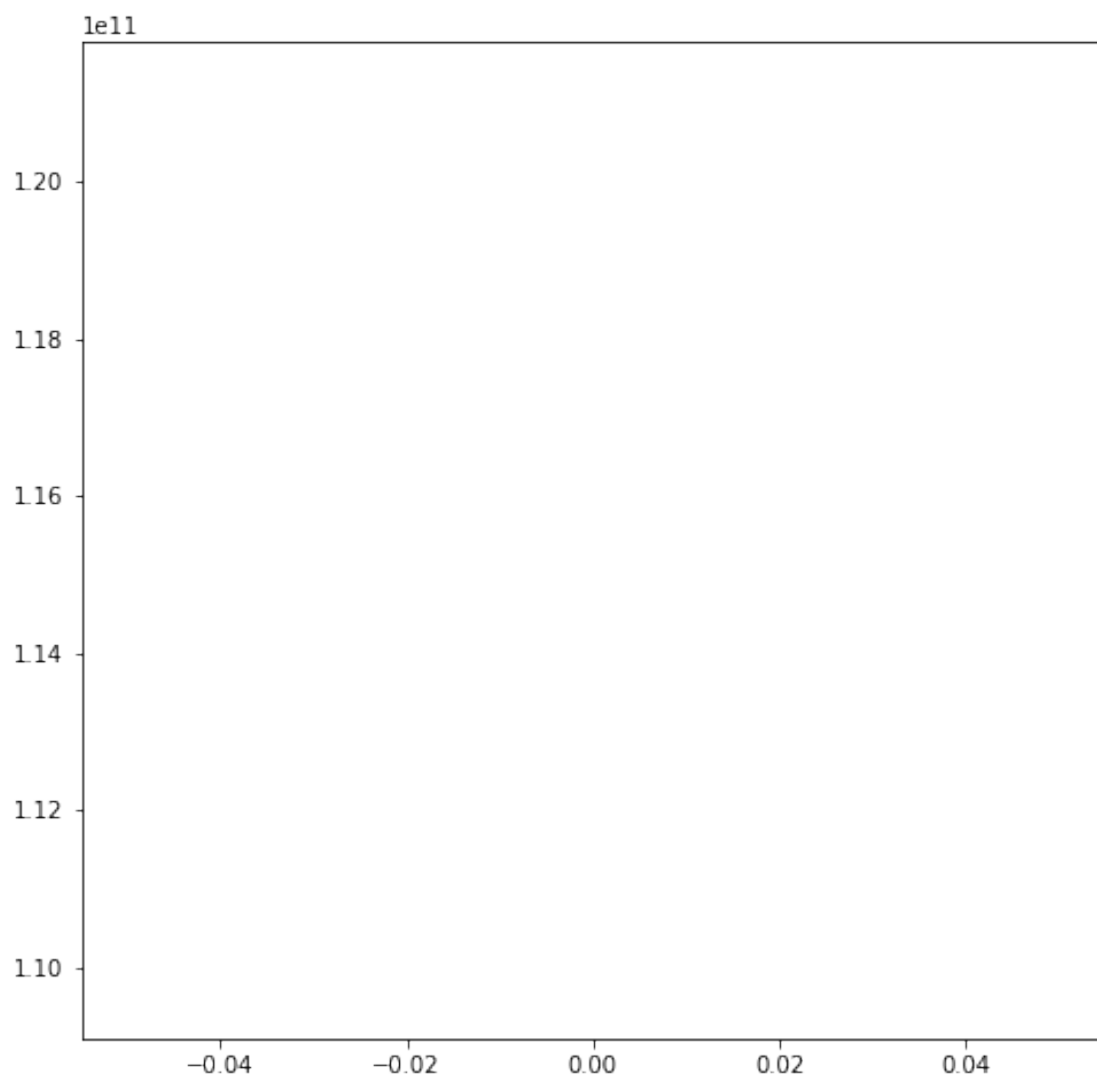


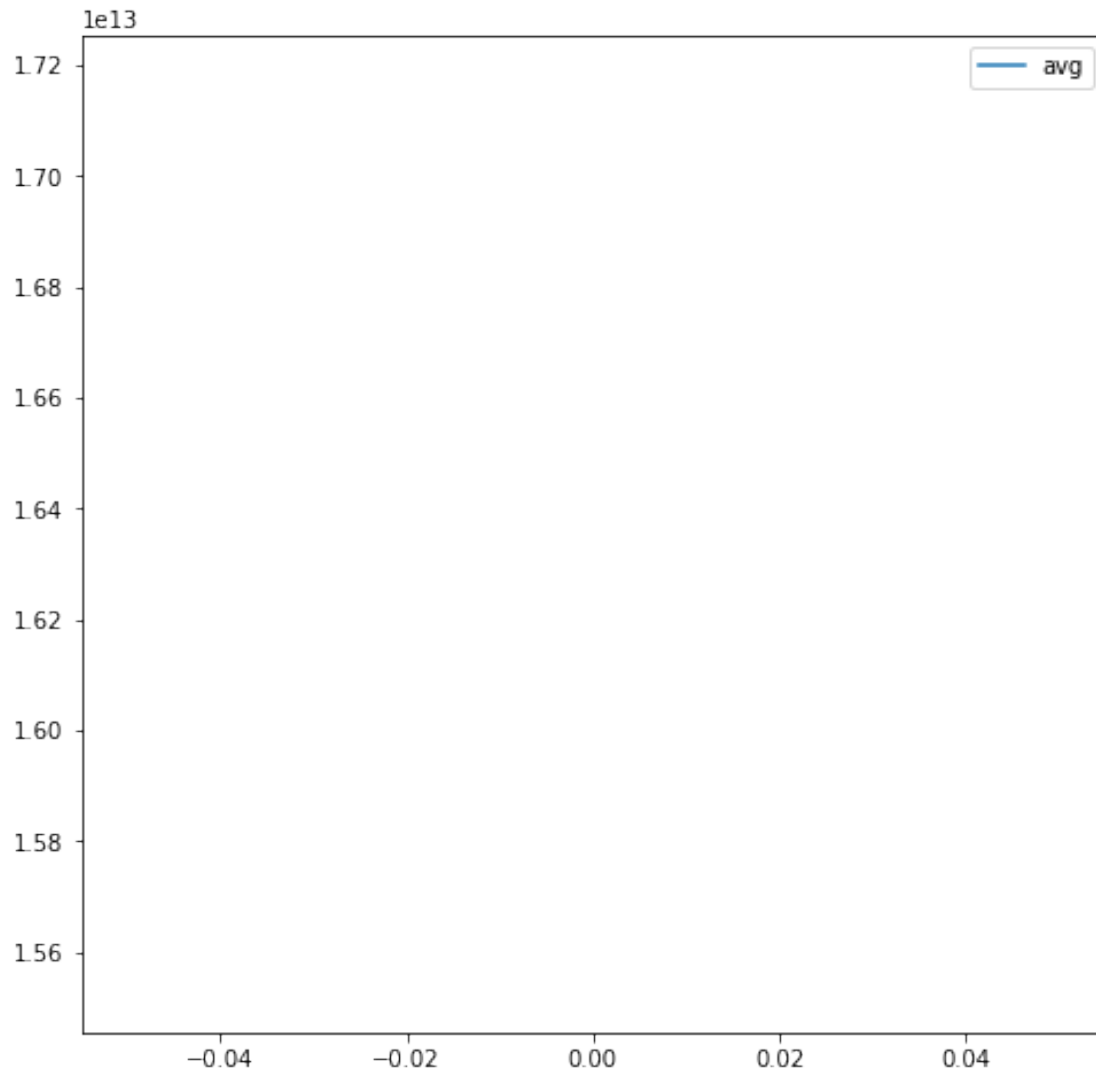
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Enter fraction of cells you want to mutate:0.3

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Collection.count\_documents instead.

# This is added back by InteractiveShellApp.init\_path()

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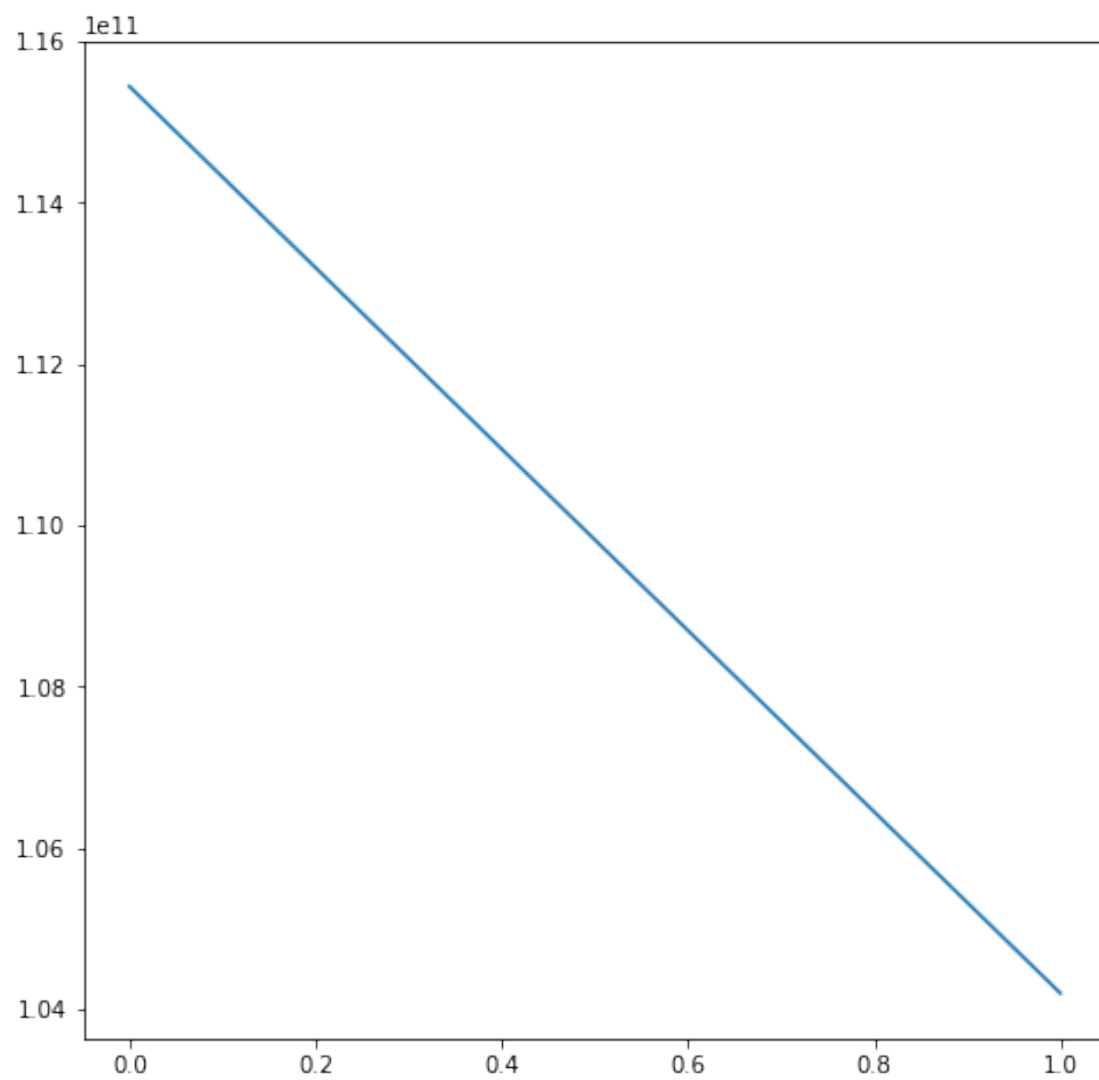
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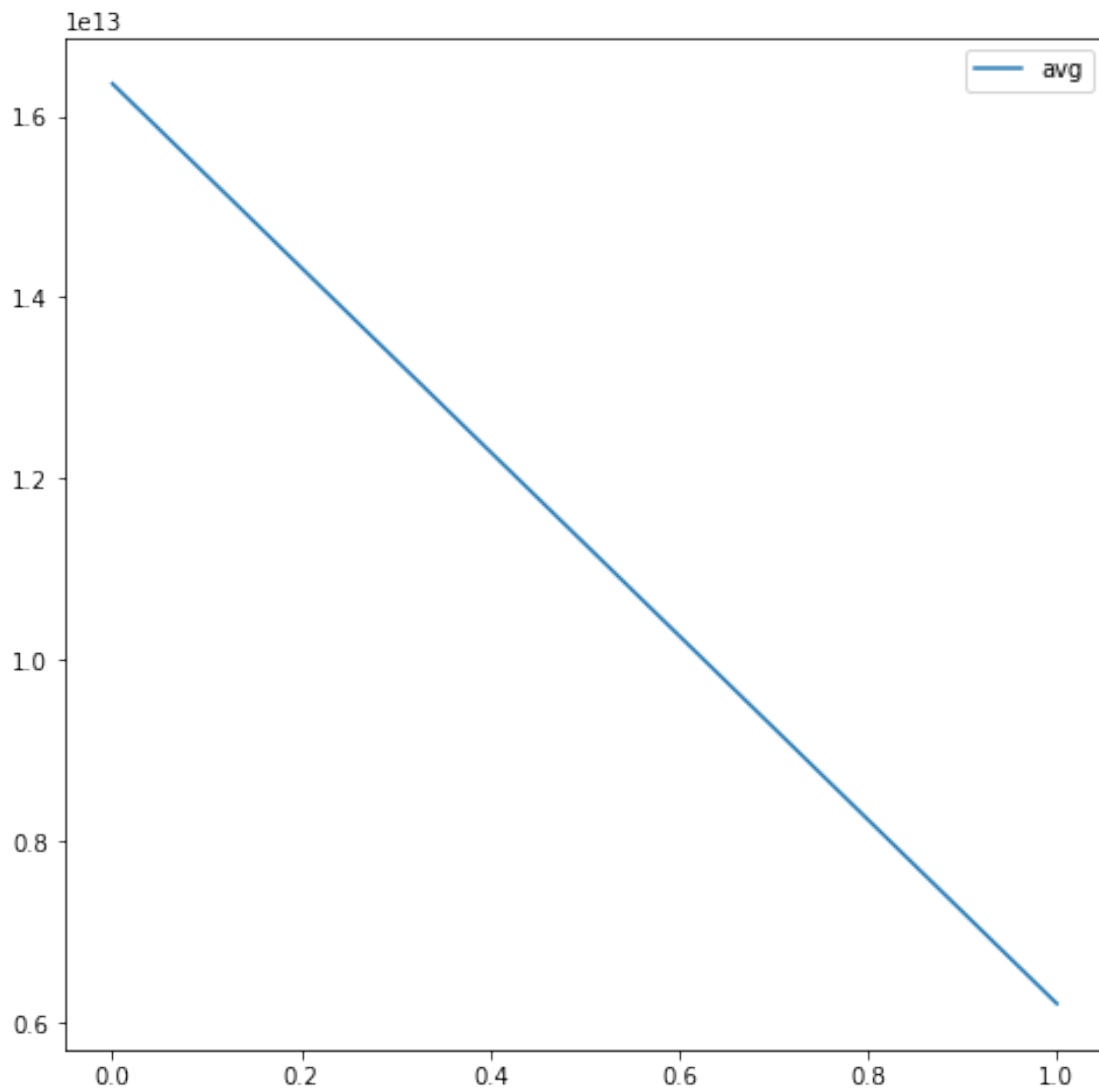
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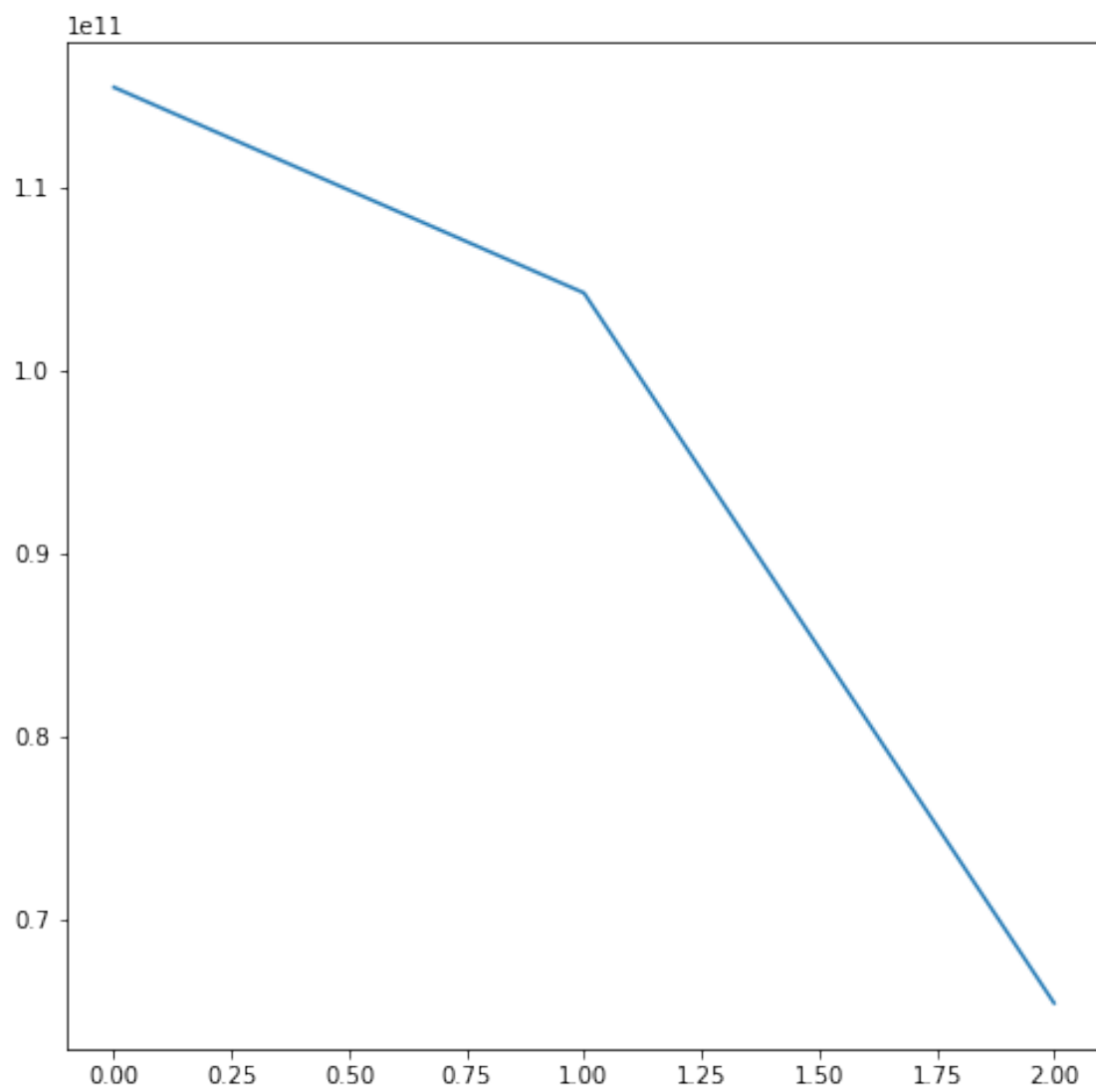
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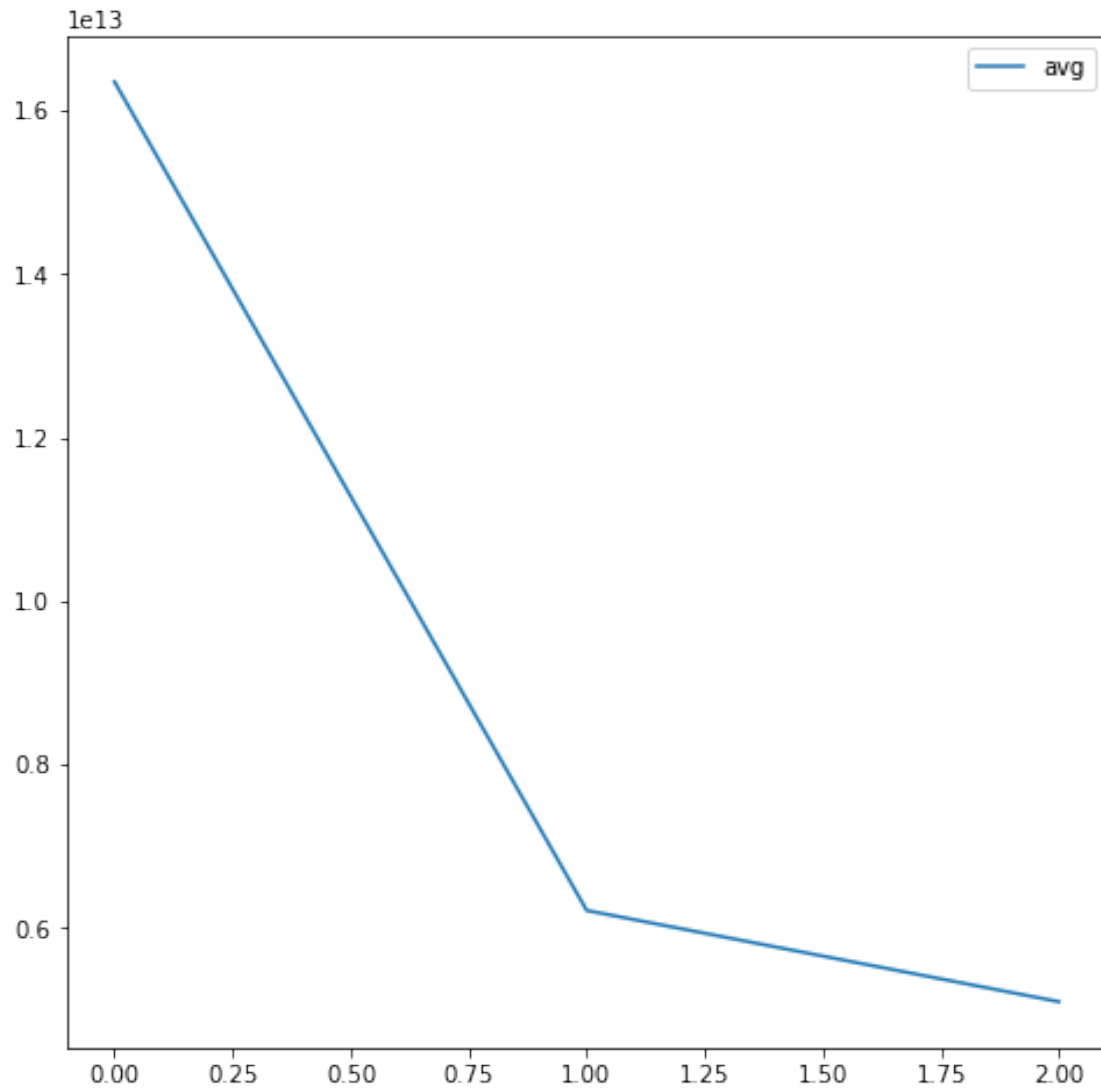


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```

-----
↳
-----
KeyboardInterrupt                                Traceback (most recent call↳
↳last)

~/anaconda3/lib/python3.7/site-packages/ipykernel/kernelbase.py in↳
↳_input_request(self, prompt, ident, parent, password)
    883         try:
--> 884             ident, reply = self.session.recv(self.stdin_socket,↳
↳0)

```

```

885             except Exception:

~/anaconda3/lib/python3.7/site-packages/jupyter_client/session.py in
↳recv(self, socket, mode, content, copy)
    802         try:
--> 803             msg_list = socket.recv_multipart(mode, copy=copy)
    804             except zmq.ZMQError as e:

~/anaconda3/lib/python3.7/site-packages/zmq/sugar/socket.py in
↳recv_multipart(self, flags, copy, track)
    474         """
--> 475         parts = [self.recv(flags, copy=copy, track=track)]
    476         # have first part already, only loop while more to receive

zmq/backend/cython/socket.pyx in zmq.backend.cython.socket.Socket.recv()

zmq/backend/cython/socket.pyx in zmq.backend.cython.socket.Socket.recv()

zmq/backend/cython/socket.pyx in zmq.backend.cython.socket._recv_copy()

~/anaconda3/lib/python3.7/site-packages/zmq/backend/cython/checkrc.pxd
↳in zmq.backend.cython.checkrc._check_rc()

```

KeyboardInterrupt:

During handling of the above exception, another exception occurred:

```

KeyboardInterrupt                                Traceback (most recent call
↳last)

<ipython-input-251-1f60e601e868> in <module>
    280         generation_info.append({"members":new_parents, "mut_magnitude":
↳mut_magnitude})
    281
--> 282         mut_magnitude=float(input("Enter mutation magnitude:"))
    283         MUT_RATE=float(input("Enter fraction of cells you want to mutate:
↳"))

```

```

284         num_cells_mutate=math.ceil((POP_SIZE-1)*NUM_FEATURES*MUT_RATE)
↳ ## ??????

```

```

~/anaconda3/lib/python3.7/site-packages/ipykernel/kernelbase.py in
↳ raw_input(self, prompt)
    857         self._parent_ident,
    858         self._parent_header,
--> 859         password=False,
    860     )
    861

```

```

~/anaconda3/lib/python3.7/site-packages/ipykernel/kernelbase.py in
↳ _input_request(self, prompt, ident, parent, password)
    887         except KeyboardInterrupt:
    888             # re-raise KeyboardInterrupt, to truncate traceback
--> 889             raise KeyboardInterrupt
    890         else:
    891             break

```

KeyboardInterrupt:

```

[252]: print(tot_crosses)
       print(same_crosses)

```

```

42
0

```

```

[ ]: print(len(generation_info))

```

```

[ ]: generation_info[0]

```

```

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

```

```

[253]: print(anmol_arr)

```

```

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```

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```
[254]: with open('json_dump_test_7th_MARCH_STINT_3_PROPOer.json','w') as fd:
        obj={}
        print(type(anmol_arr[0] ["errors_returned"]))
        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)

```
[255]: print("trace_arr is ", trace_arr)
```

```
trace_arr is [[{'generation': 1, 'try_vector': [0.14372121890411654,
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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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