8Queens_Problem_using_Genetic_Algorithm

February 20, 2022

The goal of this assignment is to implement a genetic algorithm to solve 8 queens problem

Import necessary libraries

[1]:
```
import random
import matplotlib.pyplot as plt
```

[2]:
```
class Individual:
    def __init__(self, indiv):
        self.indiv = indiv
        self.fitness = self.fitnessfunction()
        self.si = 2          #any nonsensical number

    def fitnessfunction(self) -> int:
        nonattacking = 0
        for i in range(len(self.indiv)):
            h = i - 1
            j = i + 1
            right = left = 1
            while (h >= 0 or j < len(self.indiv)):
                if h>= 0 :
                    if self.indiv[h] != self.indiv[i] and self.indiv[h] != self.
↪indiv[i]-left and self.indiv[h] != self.indiv[i]+left :
                        nonattacking += 1
                    left += 1
                    h -= 1
                if j < len(self.indiv):
                    if self.indiv[j] != self.indiv[i] and self.indiv[j] != self.
↪indiv[i]-right and self.indiv[j] != self.indiv[i]+right :
                        nonattacking += 1
                    right += 1
                    j += 1
        nonattacking = nonattacking/2
        return nonattacking
```

Selection of parents

[3]:
```
def roulette(population):
    x = random.random()
```

```
    current = 0
    for individual in population:
        current += individual.si
        if current > x:
            return individual
```

[4]:
```
def newPopulation(population):
    newPopulation = []
    while len(newPopulation) < PopulationSize:
        parent1 = roulette(population).indiv
        parent2 = roulette(population).indiv
        crossover = random.randint(0, 7)
        child1 = parent1[:crossover] + parent2[crossover:]
        child2 = parent2[:crossover] + parent1[crossover:]
        mutation(child1)
        mutation(child2)
        newPopulation.append(Individual(child1))
        newPopulation.append(Individual(child2))
    sumfitness = sum(c.fitness for c in newPopulation)
    for individual in newPopulation:
        individual.si = individual.fitness / sumfitness
    avgfitness = sumfitness/PopulationSize
    return (newPopulation, avgfitness)
```

Defining mutation

[5]:
```
def mutation(child):
    if(random.random() < MutationPct):
        index = random.randint(0,7)
        child[index] = random.randint(1,8)
```

[6]:
```
def myplot(numofgenerations, avgfitnessarray):
    plt.plot(numofgenerations, avgfitnessarray)
    plt.ylabel("Average fitness")
    plt.xlabel("Generation")
    #plt.yticks(range(0,30,2))
    #plt.xticks(range(0,100,10))
    plt.ylim(0,28)
    plt.tight_layout()
    plt.show()
```

[7]:
```
#MutationPct can be a random value between 0.0 and 1.0
MutationPct = 0.3
#PopulationSize can be 10,100,500,1000 etc
PopulationSize = 100
#Number of Iterations
NumIterations = 500
population = []
```

[8]:
```python
for i in range(PopulationSize):
   population.append(Individual(random.sample(range(1,9),8)))
sumfitness = sum(c.fitness for c in population)
for individual in population:
    individual.si = individual.fitness / sumfitness
avgfitness = sumfitness/PopulationSize
print("Initial population")
for individual in population:
    print(individual.indiv, '  ', individual.fitness, '  ', individual.si)
```

```
Initial population
[3, 7, 5, 2, 1, 6, 4, 8]    25.0    0.010813148788927335
[6, 8, 5, 3, 7, 2, 1, 4]    21.0    0.009083044982698962
[1, 2, 8, 4, 6, 5, 7, 3]    16.0    0.006920415224913495
[6, 1, 4, 2, 5, 8, 3, 7]    25.0    0.010813148788927335
[7, 4, 8, 6, 5, 2, 1, 3]    22.0    0.009515570934256055
[6, 5, 2, 3, 8, 4, 7, 1]    23.0    0.009948096885813149
[4, 3, 1, 2, 8, 6, 5, 7]    22.0    0.009515570934256055
[6, 7, 2, 3, 4, 1, 8, 5]    20.0    0.00865051903114187
[7, 6, 5, 4, 8, 3, 1, 2]    17.0    0.007352941176470588
[2, 8, 5, 7, 3, 6, 4, 1]    26.0    0.01124567474048443
[8, 4, 7, 1, 3, 5, 6, 2]    26.0    0.01124567474048443
[4, 5, 7, 3, 1, 2, 8, 6]    25.0    0.010813148788927335
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[4, 5, 8, 3, 1, 6, 2, 7]    25.0    0.010813148788927335
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[3, 6, 7, 2, 4, 1, 8, 5]    27.0    0.011678200692041523
[8, 3, 5, 6, 4, 7, 2, 1]    20.0    0.00865051903114187
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[5, 6, 3, 8, 7, 1, 2, 4]    20.0    0.00865051903114187
[1, 4, 2, 8, 5, 3, 7, 6]    24.0    0.010380622837370242
[4, 6, 1, 5, 3, 2, 8, 7]    22.0    0.009515570934256055
[7, 4, 6, 3, 5, 2, 1, 8]    24.0    0.010380622837370242
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[3, 2, 5, 8, 4, 7, 6, 1]    23.0    0.009948096885813149
[6, 8, 1, 5, 7, 4, 3, 2]    21.0    0.009083044982698962
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[3, 1, 8, 4, 7, 2, 5, 6]	24.0	0.010380622837370242
[3, 5, 6, 4, 1, 2, 8, 7]	24.0	0.010380622837370242
[5, 1, 7, 3, 8, 2, 4, 6]	26.0	0.01124567474048443
[1, 6, 8, 7, 2, 4, 3, 5]	25.0	0.010813148788927335
[5, 2, 8, 1, 4, 3, 7, 6]	24.0	0.010380622837370242
[5, 3, 4, 2, 6, 1, 8, 7]	19.0	0.008217993079584774
[3, 7, 4, 1, 8, 6, 5, 2]	27.0	0.011678200692041523
[8, 3, 1, 7, 2, 6, 4, 5]	24.0	0.010380622837370242
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[2, 7, 8, 1, 4, 6, 5, 3]	24.0	0.010380622837370242
[3, 1, 4, 7, 6, 5, 2, 8]	23.0	0.009948096885813149
[5, 4, 3, 6, 1, 8, 2, 7]	19.0	0.008217993079584774
[6, 8, 7, 4, 5, 2, 3, 1]	19.0	0.008217993079584774
[6, 8, 4, 3, 1, 7, 5, 2]	23.0	0.009948096885813149
[2, 3, 6, 8, 7, 1, 4, 5]	25.0	0.010813148788927335
[7, 5, 6, 1, 8, 4, 3, 2]	22.0	0.009515570934256055
[7, 6, 2, 8, 4, 3, 5, 1]	21.0	0.009083044982698962
[8, 7, 4, 5, 2, 6, 3, 1]	20.0	0.00865051903114187
[6, 8, 5, 4, 3, 7, 1, 2]	20.0	0.00865051903114187
[2, 3, 1, 8, 7, 4, 6, 5]	24.0	0.010380622837370242
[5, 7, 4, 8, 3, 1, 2, 6]	23.0	0.009948096885813149
[1, 4, 5, 8, 7, 6, 3, 2]	20.0	0.00865051903114187
[6, 8, 7, 4, 3, 2, 1, 5]	21.0	0.009083044982698962
[3, 5, 8, 7, 2, 4, 1, 6]	24.0	0.010380622837370242
[5, 1, 4, 6, 2, 7, 3, 8]	25.0	0.010813148788927335
[3, 4, 8, 5, 6, 2, 1, 7]	24.0	0.010380622837370242
[5, 2, 6, 3, 8, 7, 4, 1]	25.0	0.010813148788927335
[3, 1, 5, 8, 4, 6, 2, 7]	22.0	0.009515570934256055
[2, 4, 6, 7, 3, 1, 5, 8]	26.0	0.01124567474048443
[8, 4, 6, 1, 2, 3, 5, 7]	22.0	0.009515570934256055
[7, 4, 2, 1, 8, 3, 6, 5]	20.0	0.00865051903114187
[4, 1, 6, 8, 5, 7, 3, 2]	24.0	0.010380622837370242
[3, 5, 6, 2, 1, 7, 4, 8]	26.0	0.01124567474048443
[3, 6, 2, 8, 4, 5, 7, 1]	23.0	0.009948096885813149
[4, 1, 7, 3, 5, 8, 2, 6]	25.0	0.010813148788927335
[6, 5, 2, 8, 7, 4, 1, 3]	26.0	0.01124567474048443
[6, 4, 3, 5, 7, 2, 8, 1]	24.0	0.010380622837370242
[7, 3, 6, 1, 8, 2, 4, 5]	21.0	0.009083044982698962
[5, 4, 2, 7, 1, 3, 6, 8]	24.0	0.010380622837370242
[8, 7, 4, 6, 5, 2, 1, 3]	25.0	0.010813148788927335
[4, 3, 5, 7, 1, 6, 8, 2]	25.0	0.010813148788927335
[3, 5, 7, 6, 1, 8, 2, 4]	23.0	0.009948096885813149
[6, 5, 4, 3, 2, 8, 7, 1]	17.0	0.007352941176470588
[2, 6, 8, 1, 5, 3, 7, 4]	26.0	0.01124567474048443
[5, 7, 2, 4, 1, 3, 8, 6]	26.0	0.01124567474048443
[5, 2, 3, 6, 1, 4, 7, 8]	18.0	0.007785467128027681
[1, 8, 7, 6, 3, 4, 2, 5]	21.0	0.009083044982698962
[3, 7, 2, 5, 1, 6, 8, 4]	24.0	0.010380622837370242

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[7, 2, 6, 8, 4, 1, 3, 5]    27.0    0.011678200692041523
[6, 7, 4, 3, 8, 2, 5, 1]    23.0    0.009948096885813149
[1, 2, 8, 3, 5, 7, 4, 6]    24.0    0.010380622837370242
[3, 1, 7, 5, 8, 6, 2, 4]    26.0    0.01124567474048443
[6, 4, 5, 8, 2, 7, 1, 3]    25.0    0.010813148788927335
[5, 8, 1, 3, 2, 4, 6, 7]    22.0    0.009515570934256055
[6, 4, 8, 5, 3, 1, 7, 2]    26.0    0.01124567474048443
[6, 8, 4, 1, 2, 3, 5, 7]    22.0    0.009515570934256055
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[1, 2, 4, 3, 6, 5, 8, 7]    18.0    0.007785467128027681
[6, 3, 1, 5, 2, 4, 7, 8]    24.0    0.010380622837370242
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[6, 2, 7, 3, 5, 8, 1, 4]    25.0    0.010813148788927335
[7, 1, 2, 8, 3, 4, 6, 5]    22.0    0.009515570934256055
```

[9]:
```
count = 0
numofgenerations = [0]
avgfitnessarray = [avgfitness]
```

[10]:
```
while count < NumIterations:
    count += 1
    numofgenerations.append(count)
    print("Iteration: ", count)
    (population, avgfitness) = newPopulation(population)
    avgfitnessarray.append(avgfitness)
    # print(avgfitness)
    # for individual in population:
    #         print(individual.indiv, '   ', individual.fitness, '   ', individual.
 ↪si)
    for individual in population:
        if individual.fitness == 28:
            for elem in population:
                    print(elem.indiv)
            print("Resolved: ", individual.indiv)
            myplot(numofgenerations, avgfitnessarray)
            exit(1)
```

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[5, 8, 4, 1, 8, 4, 5, 2]
[5, 1, 3, 2, 7, 8, 5, 4]
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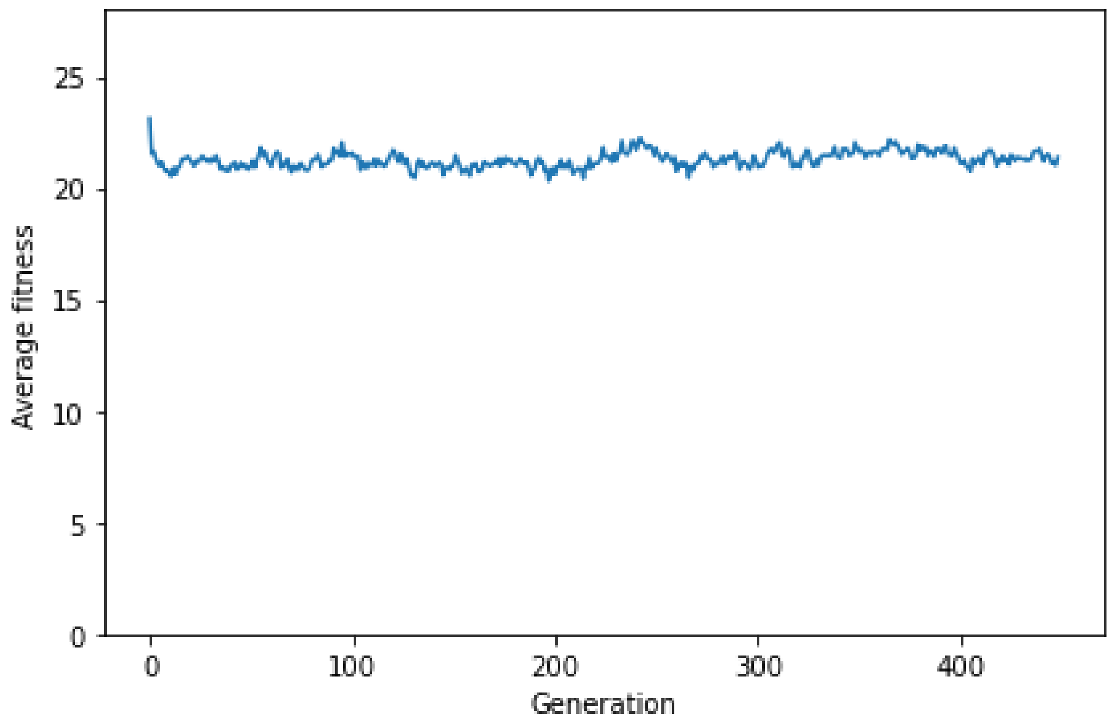
[1, 8, 8, 3, 5, 6, 1, 7]
[8, 3, 2, 4, 3, 8, 8, 3]
[6, 6, 4, 6, 5, 2, 5, 5]
[2, 1, 4, 6, 7, 5, 1, 7]
[3, 6, 6, 6, 7, 4, 2, 7]
[5, 3, 4, 6, 7, 1, 2, 4]
[5, 7, 4, 6, 5, 2, 1, 5]
[1, 3, 6, 6, 7, 2, 8, 5]
Resolved:  [5, 1, 4, 6, 8, 2, 7, 3]
```




```
Iteration:  449
Iteration:  450
Iteration:  451
Iteration:  452
Iteration:  453
Iteration:  454
Iteration:  455
Iteration:  456
Iteration:  457
Iteration:  458
Iteration:  459
Iteration:  460
```

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Iteration:  461
Iteration:  462
Iteration:  463
Iteration:  464
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Iteration:  495
Iteration:  496
Iteration:  497
Iteration:  498
Iteration:  499
Iteration:  500
```

[11]:
```
print(count, " Iterations completed")
```

```
500  Iterations completed
```