

Experiments with Travelling Salesman Problem

```
clear;  
cities = importdata('cities.csv');  
nGenes = length(cities.data);
```

Experiment 1

Mutation: Use random swapping of cities when mutating Recombination: Use one point crossover

```
p(1).maxGenerations = 3000;  
p(1).populationSize = 20;  
p(1).crossoverRate = 0.9;  
p(1).mutationRate = 1/nGenes;  
p(1).nSpecies = p(1).populationSize/4;  
p(1).useSpeciation = true;  
p(1).useRandomMutation = true;  
p(1).useOnePointCrossover = true;  
p(1).cities = cities;  
name{1} = 'speciation random one point';
```

Experiment 2

Mutation: Swap neighboured cities only when mutating Recombination: Use one point crossover

Speciation: kMeans

```
p(2) = p(1);  
p(2).useRandomMutation = false;  
p(2).useOnePointCrossover = true;  
name{2} = 'speciation neighbour one point';
```

Experiment 3

Mutation: Use random swapping of cities when mutating Recombination: Use two point crossover

Speciation: kMeans

```
p(3) = p(1);  
p(3).useRandomMutation = true;  
p(3).useOnePointCrossover = false;  
name{3} = 'speciation random two point';
```

Experiment 4

Mutation: Swap neighboured cities only when mutating Recombination: Use two point crossover

Speciation: kMeans

```
p(4) = p(1);  
p(4).useRandomMutation = false;  
p(4).useOnePointCrossover = false;  
name{4} = 'speciation neighbour two point';
```

Experiment 5

Mutation: Swap cities randomly when mutating Recombination: Use one point crossover Speciation: none

```
p(5) = p(1);  
p(5).useRandomMutation = true;  
p(5).useOnePointCrossover = true;  
p(5).useSpeciation = false;  
name{5} = 'random one point';
```

Experiment 6

Mutation: Use random swapping of cities when mutating Recombination: Use two point crossover Speciation: none

```
p(6) = p(1);  
p(6).useRandomMutation = true;  
p(6).useOnePointCrossover = false;  
p(6).useSpeciation = false;  
name{6} = 'random two point';
```

Experiment 7

Mutation: Swap neighboured cities only when mutating Recombination: Use one point crossover Speciation: none

```
p(7) = p(1);  
p(7).useRandomMutation = false;  
p(7).useOnePointCrossover = true;  
p(7).useSpeciation = false;  
name{7} = 'neighbour one point';
```

Experiment 8

Mutation: Swap neighboured cities only when mutating Recombination: Use two point crossover Speciation: none

```
p(8) = p(1);  
p(8).useRandomMutation = false;  
p(8).useOnePointCrossover = false;  
p(8).useSpeciation = false;  
name{8} = 'neighbour two point';
```

Run Experiments

```
for i=1:8  
    tic;  
    clear bestFitness medianFitness;  
    parfor run = 1:100  
        r(run) = doTsp(p(i));  
        bestFitness(run,:) = r(run).bestFitness;
```

```

        medianFitness(run,:) = r(run).medianFitness;
    end
    p(i).medianBestFitness = median(bestFitness,1);
    p(i).medianMedianFitness = median(medianFitness,1);
    toc;
end

```

```

Elapsed time is 568.008526 seconds.
Elapsed time is 528.545960 seconds.
Elapsed time is 561.705542 seconds.
Elapsed time is 527.127229 seconds.
Elapsed time is 332.680118 seconds.
Elapsed time is 328.580371 seconds.
Elapsed time is 290.638456 seconds.
Elapsed time is 290.643660 seconds.

```

Plot Routes

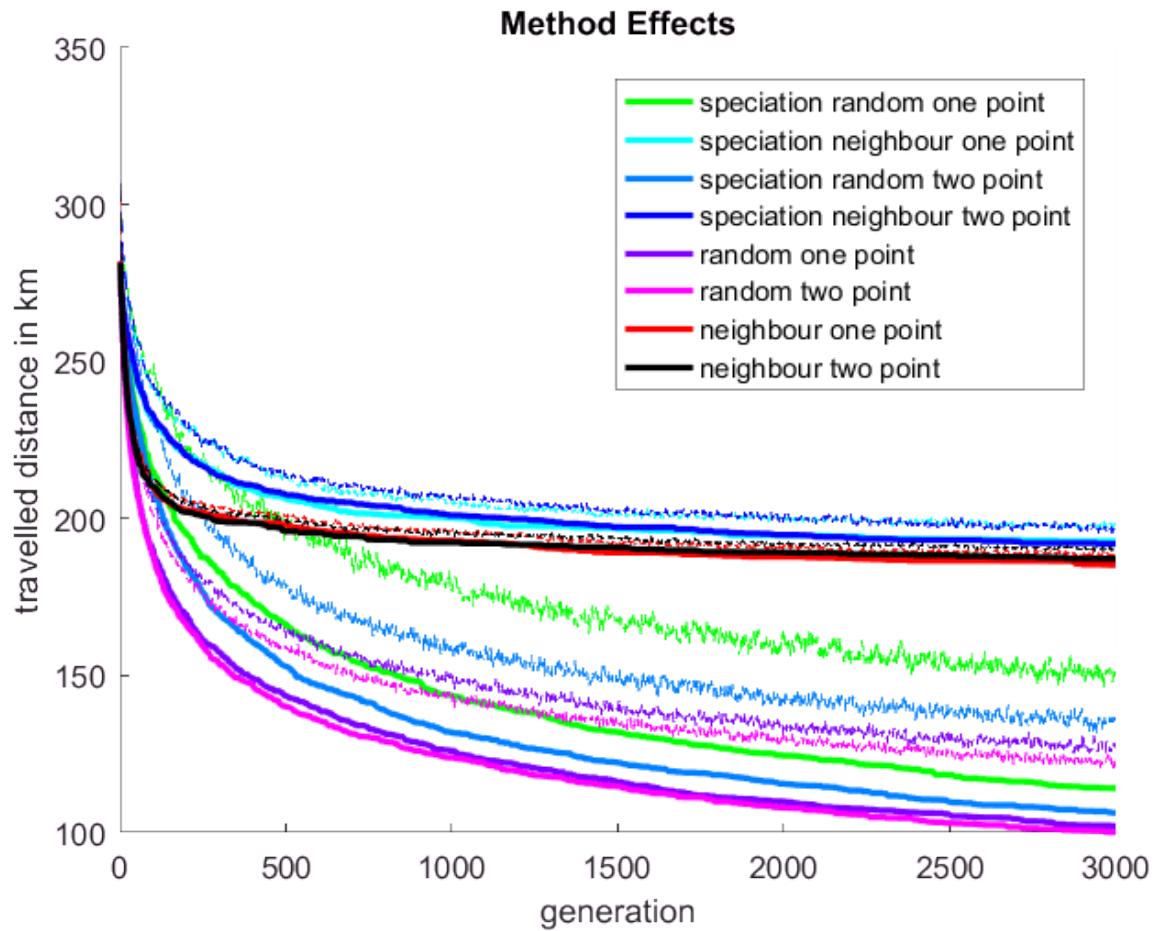
```
for i=1:8 figure(i);clf;hold on; plotRoute(cities, r(i)); title(name{i}); end
```

Plot Fitnesses

```

figure(1);clf;hold on;
% Helper Library for a better color distribution over plots
colorSet = varycolor(8);
for i=1:8
    lineHandles(i) = plot(-1*p(i).medianBestFitness, '-', 'LineWidth',2, 'Color',colorSet(i,:));
    plot(-1*p(i).medianMedianFitness, '--', 'Color',get(lineHandles(i), 'Color'));
end
ylabel('travelled distance in km');
xlabel('generation');
legend(lineHandles,name, 'Location', 'NorthEast');
title('Method Effects');

```



Conclusion

Not only can be seen that the random mutation outperforms the swapping of only neighbouring cities. It can also be seen that the experiments that did not use speciation performed better than those who did. Last but not least and intuitively the experiments using speciation took longer to finish than the others. The conclusion is that for this problem kmeans as a form of speciation is not a good choice compared to not using speciation at all. Random mutation in combination with two point crossover works best.