problem_size_analysis

October 10, 2020

! pip install mlrose ! pip install sklearn ! pip install numpy ! pip install matplotlib

[1]:

```
import six
import sys
sys.modules['sklearn.externals.six'] = six
import mlrose
from sklearn import preprocessing
from sklearn import metrics
from sklearn.model_selection import train_test_split
import time
import random
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

[2]:

```
def __discrete_bit_size_problems(problem,algorithm,length, max_iter,␣
 ↪max_attempt,init_state,edges=None,coords=None):
    if problem == 'fourpeaks':
        __fit = mlrose.FourPeaks()
        __problem = mlrose.DiscreteOpt(length=length, fitness_fn = __fit,␣
 ↪maximize=True, max_val=2)
    elif problem == 'kcolor':
        __fit = mlrose.MaxKColor(edges=edges)
        __problem = mlrose.DiscreteOpt(length=length, fitness_fn = __fit,␣
 ↪maximize=True)
    elif problem == 'flipflop':
        __fit = mlrose.OneMax()
        __problem = mlrose.DiscreteOpt(length=length, fitness_fn = __fit,␣
 ↪maximize=True, max_val=2)
    elif problem == 'continouspeaks':
        __fit = mlrose.ContinuousPeaks()
        __problem = mlrose.DiscreteOpt(length=length, fitness_fn = __fit,␣
 ↪maximize=True, max_val=2)
    elif problem == 'travellingsales':
        __fit = mlrose.TravellingSales(coords=coords)
        __problem = mlrose.TSPOpt(length=length, fitness_fn = __fit,␣
 ↪maximize=False)
```

```
    if algorithm == 'random_hill_climb':
        start_time = time.time()
        best_state, best_fitness, best_curve = mlrose.
↪random_hill_climb(__problem, max_iters =␣
↪max_iter,max_attempts=max_attempt,init_state=init_state,curve=True)
        end_time = time.time() - start_time
    elif algorithm == 'simulated_annealing':
        start_time = time.time()
        best_state, best_fitness, best_curve = mlrose.
↪simulated_annealing(__problem, max_iters =␣
↪max_iter,max_attempts=max_attempt,init_state=init_state,curve=True)
        end_time = time.time() - start_time
    elif algorithm == 'genetic_alg':
        start_time = time.time()
        best_state, best_fitness, best_curve = mlrose.genetic_alg(__problem,␣
↪max_iters = max_iter,max_attempts=max_attempt,curve=True)
        end_time = time.time() - start_time
    elif algorithm == 'mimic':
        start_time = time.time()
        best_state, best_fitness, best_curve = mlrose.mimic(__problem,␣
↪max_iters = max_iter,max_attempts=max_attempt,curve=True)
        end_time = time.time() - start_time

    return best_fitness, end_time, best_curve
```

[3]:

```
def train_discrete_bit_size_problem(problem,␣
↪max_iter=100000,max_attempt=1000,__range=range(20, 100)):
    __fitness_ = {}
    for algorithm in ['random_hill_climb', 'simulated_annealing',␣
↪'genetic_alg', 'mimic']:
        __fitness = []
        __times = []
        __evaluations = []
        print(algorithm)
        for i in __range:
            init_state = np.random.randint(2,size=i)
            if problem == 'flipflop':
                best_fitness, time, best_curve =␣
↪__discrete_bit_size_problems(problem,algorithm,i,␣
↪max_iter,max_attempt,init_state, edges=None,coords=None)
                __fitness.append(best_fitness)
                __times.append(time)
                #print(best_fitness, time, best_curve, best_curve.shape[0])
                __evaluations.append(best_curve.shape[0])
            elif problem == 'fourpeaks':
                best_fitness, time, best_curve =␣
↪__discrete_bit_size_problems(problem,algorithm,i,␣
↪max_iter,max_attempt,init_state, edges=None,coords=None)
                __fitness.append(best_fitness)
                __times.append(time)
                __evaluations.append(best_curve.shape[0])
            elif problem == 'kcolor':
                #edge_list = []
                #while len(edge_list) < i:
                #    new_coord = (random.randrange(0, __range[0]), random.
↪randrange(0, __range[0]))
                #    if new_coord not in edge_list:
                #        edge_list.append(new_coord)
                #edge_list = []
                edge_list = [(random.randrange(0, __range[0]), random.
↪randrange(0, __range[0])) for i in range(__range[len(__range)-1] -␣
↪__range[0])]
                best_fitness, time, best_curve =␣
↪__discrete_bit_size_problems(problem,algorithm,i, max_iter,␣
↪max_attempt,init_state, edges=edge_list,coords=None)
                __fitness.append(best_fitness)
                __times.append(time)
                __evaluations.append(best_curve.shape[0])
            elif problem == 'continouspeaks':
                best_fitness, time, best_curve =␣
↪__discrete_bit_size_problems(problem,algorithm,i,␣
↪max_iter,max_attempt,init_state, edges=None,coords=None)
                __fitness.append(best_fitness)
                __times.append(time)
                __evaluations.append(best_curve.shape[0])
            elif problem == 'travellingsales':
                #coords = [(random.randrange(0, __range[0]), random.
↪randrange(0, __range[0])) for i in range(__range[len(__range)-1] -␣
↪__range[0])]
                coords = [(1, 1), (4, 2), (5, 2), (6, 4), (4, 4), (3, 6), (1,␣
↪5), (2, 3)]
                best_fitness, time, best_curve =␣
↪__discrete_bit_size_problems(problem,algorithm,i,␣
↪max_iter,max_attempt,init_state, edges=None,coords=coords)
                __fitness.append(best_fitness)
                __times.append(time)
                __evaluations.append(best_curve.shape[0])


        __fitness_[algorithm] = {'fitness': __fitness, 'times':␣
↪__times,'evaluations' : __evaluations}
```

```
    return __fitness_
```

[4]:
```
def␣
↪plot_bit_size(y_axis,results,x_label,y_label,title,filename,__range=range(20,␣
↪100)):
    x= list(__range)
    [plt.plot(x,results[algorithm][y_axis],'o-',label=algorithm)  for algorithm␣
↪in ['random_hill_climb', 'simulated_annealing', 'genetic_alg', 'mimic'] ]
    plt.xlabel(x_label)
    plt.ylabel(y_label)
    plt.title(title)
    plt.legend(loc='best')
    #plt.savefig(filename)
    plt.show()
    plt.clf()
```

[5]:
```
__max_iter = 20000
__max_attempt=200
__range = range(20,81,20)
__fitness_vals = train_discrete_bit_size_problem('flipflop',␣
↪__max_iter,__max_attempt,__range)
```

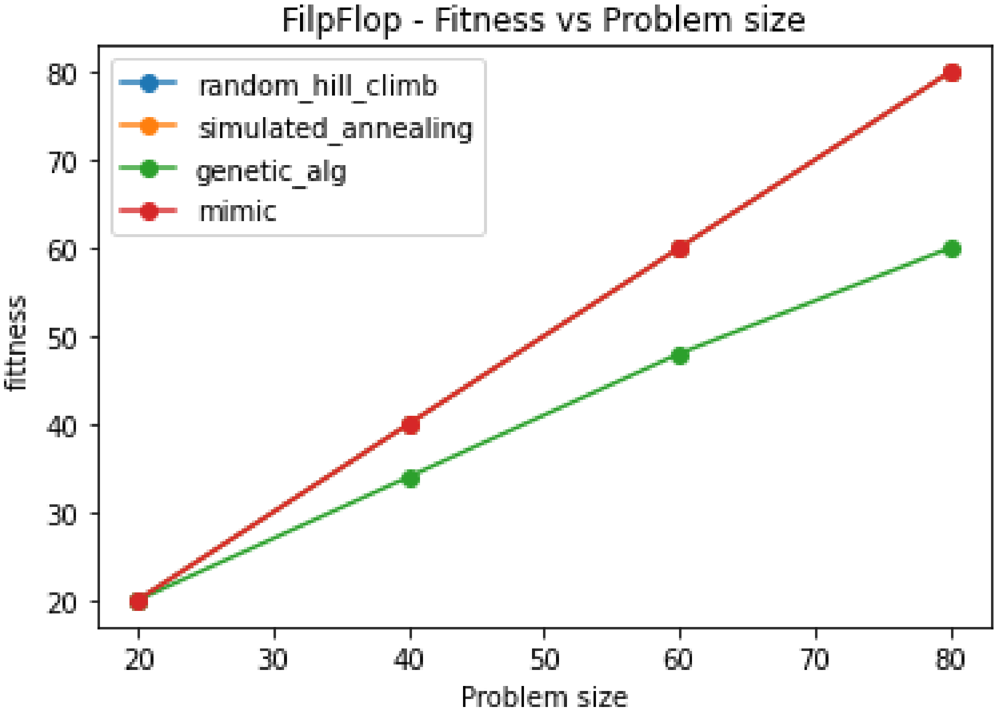
```
random_hill_climb
simulated_annealing
genetic_alg
mimic
```

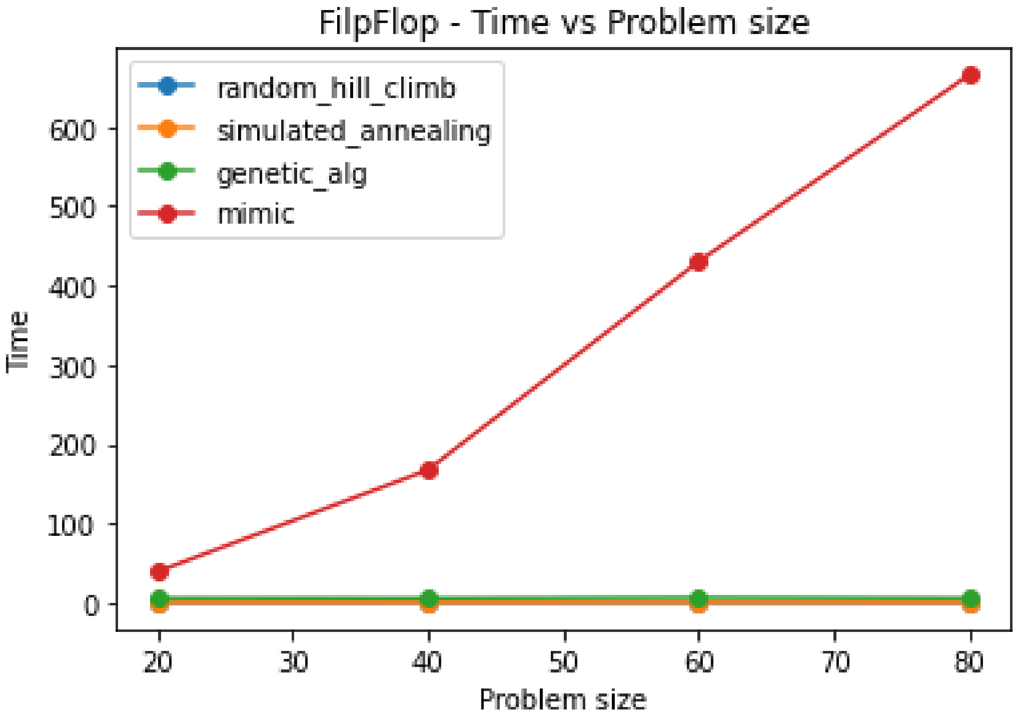
[6]:
```
print(__fitness_vals)
```

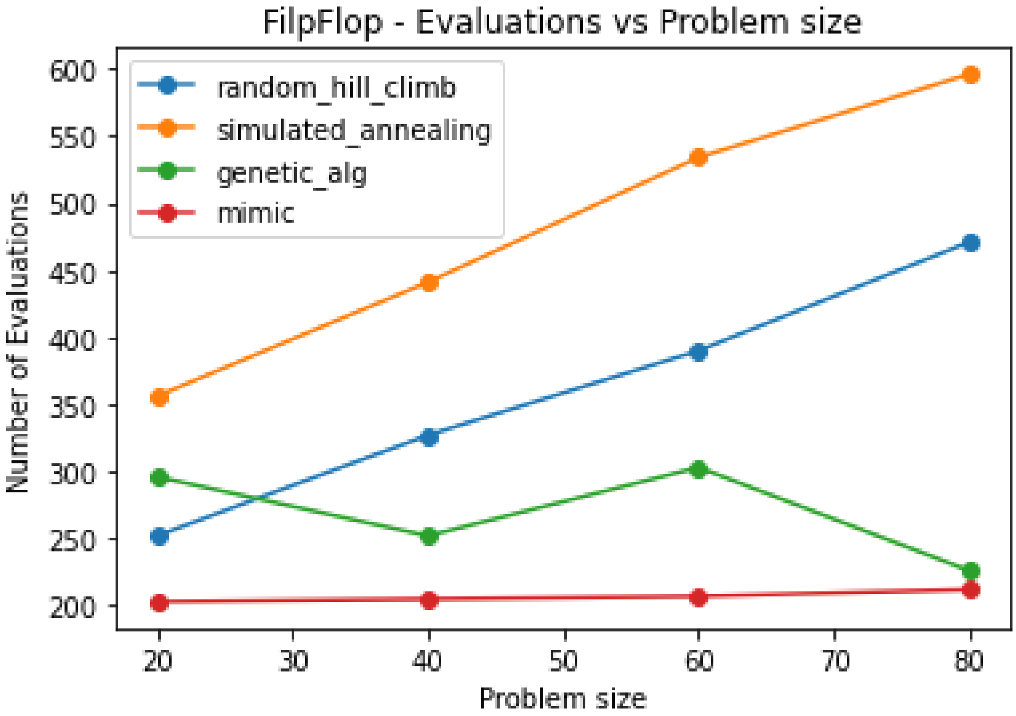
```
{'random_hill_climb': {'fitness': [20.0, 40.0, 60.0, 80.0], 'times':
[0.009973287582397461, 0.011966705322265625, 0.015958070755004883,
0.01695394515991211], 'evaluations': [252, 327, 390, 471]},
'simulated_annealing': {'fitness': [20.0, 40.0, 60.0, 80.0], 'times':
[0.015958547592163086, 0.011968374252319336, 0.02094268798828125,
0.016956329345703125], 'evaluations': [356, 441, 534, 596]}, 'genetic_alg':
{'fitness': [20.0, 34.0, 48.0, 60.0], 'times': [5.8204381465911865,
5.574092149734497, 6.477679252624512, 5.7047436237335205], 'evaluations': [296,
252, 303, 226]}, 'mimic': {'fitness': [20.0, 40.0, 60.0, 80.0], 'times':
[38.864556550979614, 167.3406960964203, 430.19709610939026, 665.7636823654175],
'evaluations': [203, 205, 207, 212]}}
```

[7]:
```
plot_bit_size('fitness',__fitness_vals,'Problem size','fittness','FilpFlop -␣
↪Fitness vs Problem size','./plot/flipflop_fitness_bitsize.png',__range)
plot_bit_size('times',__fitness_vals,'Problem size','Time','FilpFlop - Time vs␣
↪Problem size','./plot/flipflop_time_bitsize.png',__range)
```

```
plot_bit_size('evaluations',__fitness_vals,'Problem size','Number of␣
↪Evaluations','FilpFlop - Evaluations vs Problem size','./plot/
↪flipflop_evaluations_bitsize.png',__range)
```




FilpFlop - Time vs Problem size
random_hill_climb
simulated_annealing
genetic_alg
mimic
Time
0
100
200
300
400
500
600
20
30
40
50
60
70
80
Problem size


FilpFlop - Evaluations vs Problem size
random_hill_climb
simulated_annealing
genetic_alg
mimic
Number of Evaluations
200
250
300
350
400
450
500
550
600
20
30
40
50
60
70
80
Problem size

```
<Figure size 432x288 with 0 Axes>
```

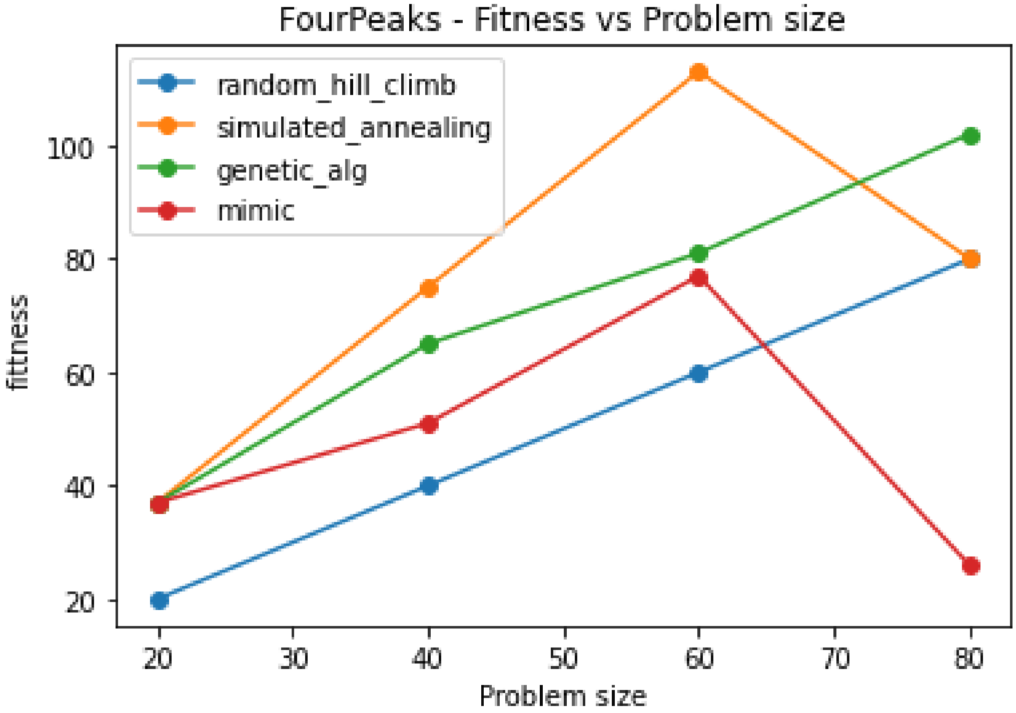
```
[8]: __max_iter = 20000
     __max_attempt= 200
     __range = range(20,81,20)
     __fitness_vals = train_discrete_bit_size_problem('fourpeaks',␣
      ↪__max_iter,__max_attempt,__range)
```

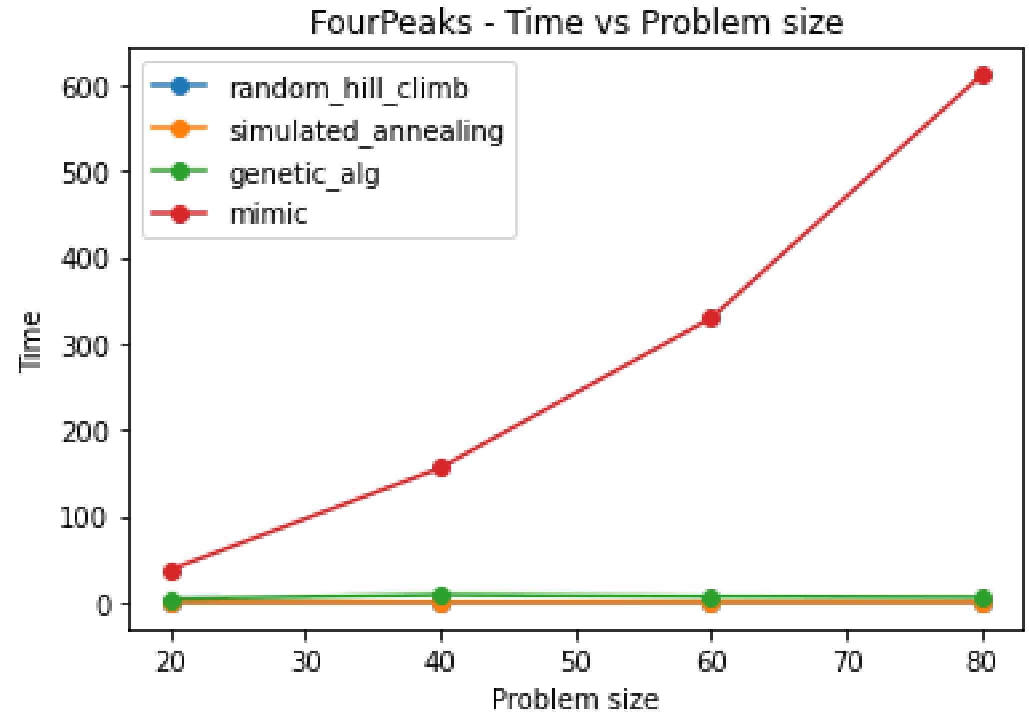
```
random_hill_climb
simulated_annealing
```

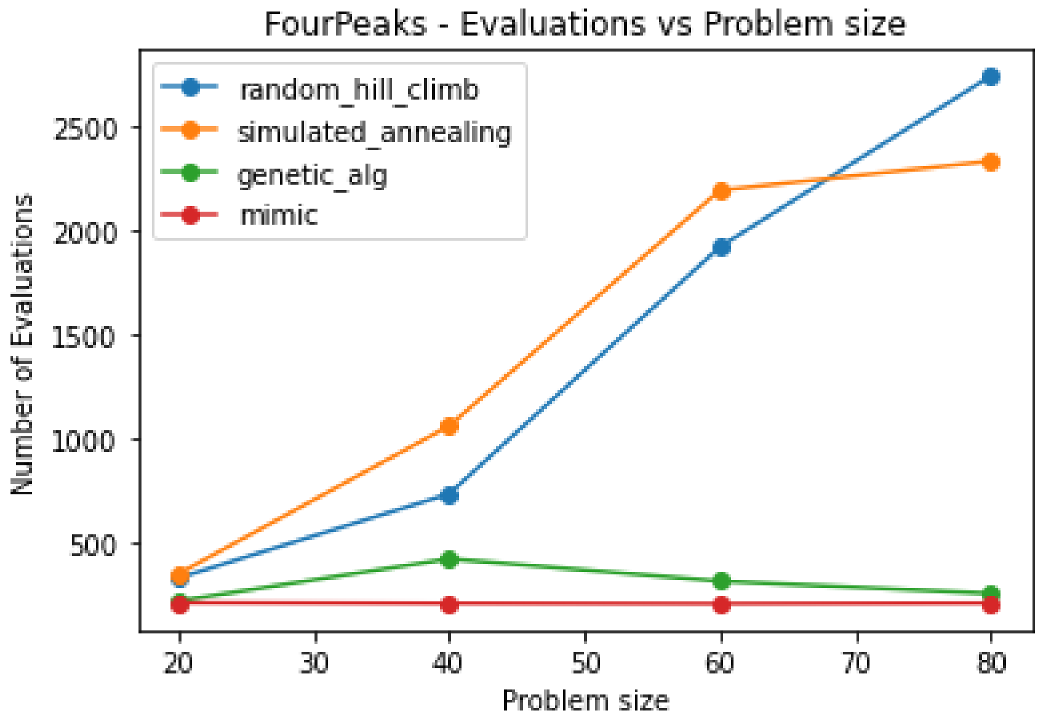
```
C:\Dev\Anaconda3\envs\VitrualEnv\lib\site-packages\mlrose\algorithms.py:311:
RuntimeWarning: overflow encountered in exp
  prob = np.exp(delta_e/temp)
```

```
genetic_alg
mimic
```

```
[9]: plot_bit_size('fitness',__fitness_vals,'Problem size','fittness','FourPeaks -␣
      ↪Fitness vs Problem size','./plot/fourpeaks_fitness_bitsize.png',__range)
     plot_bit_size('times',__fitness_vals,'Problem size','Time','FourPeaks - Time vs␣
      ↪Problem size','./plot/fourpeaks_time_bitsize.png',__range)
     plot_bit_size('evaluations',__fitness_vals,'Problem size','Number of␣
      ↪Evaluations','FourPeaks - Evaluations vs Problem size','./plot/
      ↪fourpeaks_evaluations_bitsize.png',__range)
```




FourPeaks - Time vs Problem size
random_hill_climb
simulated_annealing
genetic_alg
mimic
Time
0
100
200
300
400
500
600
20
30
40
50
60
70
80
Problem size


FourPeaks - Evaluations vs Problem size
random_hill_climb
simulated_annealing
genetic_alg
mimic
Number of Evaluations
500
1000
1500
2000
2500
20
30
40
50
60
70
80
Problem size

```
<Figure size 432x288 with 0 Axes>
```

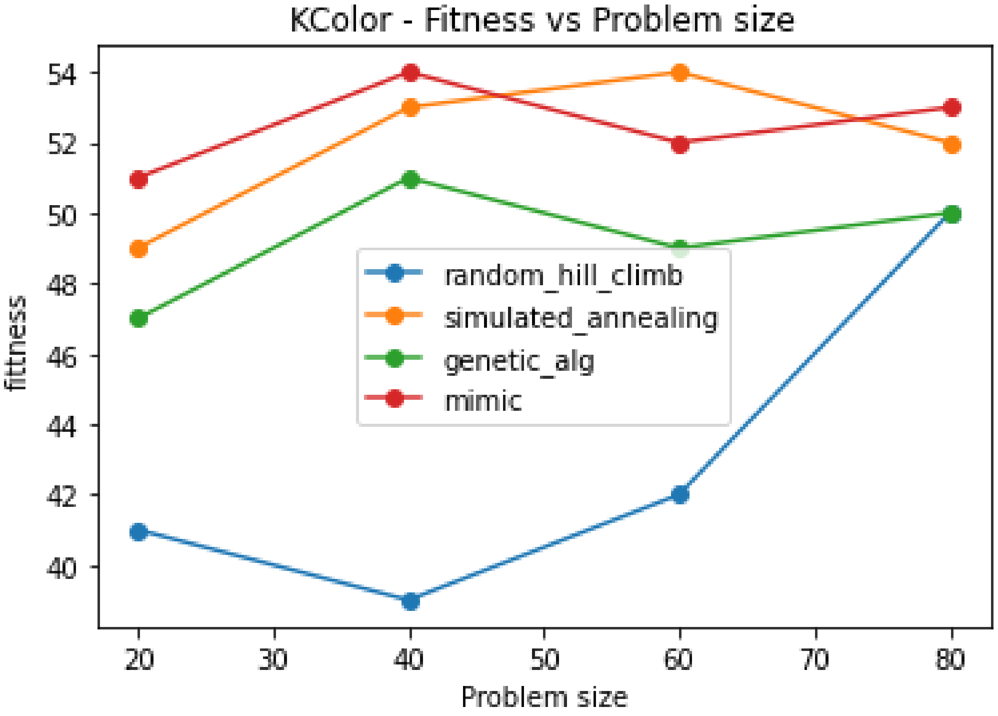
[10]:

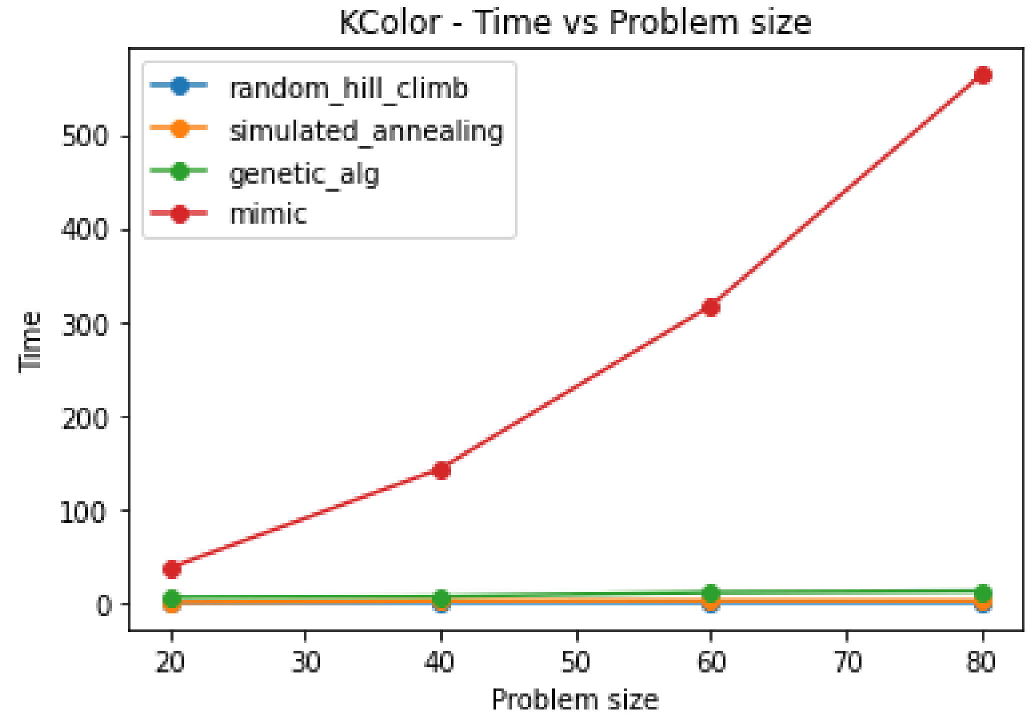
```
__max_iter = 20000
__max_attempt=200
__range = range(20,81,20)
__fitness_vals = train_discrete_bit_size_problem('kcolor',␣
 ↪__max_iter,__max_attempt,__range)
```

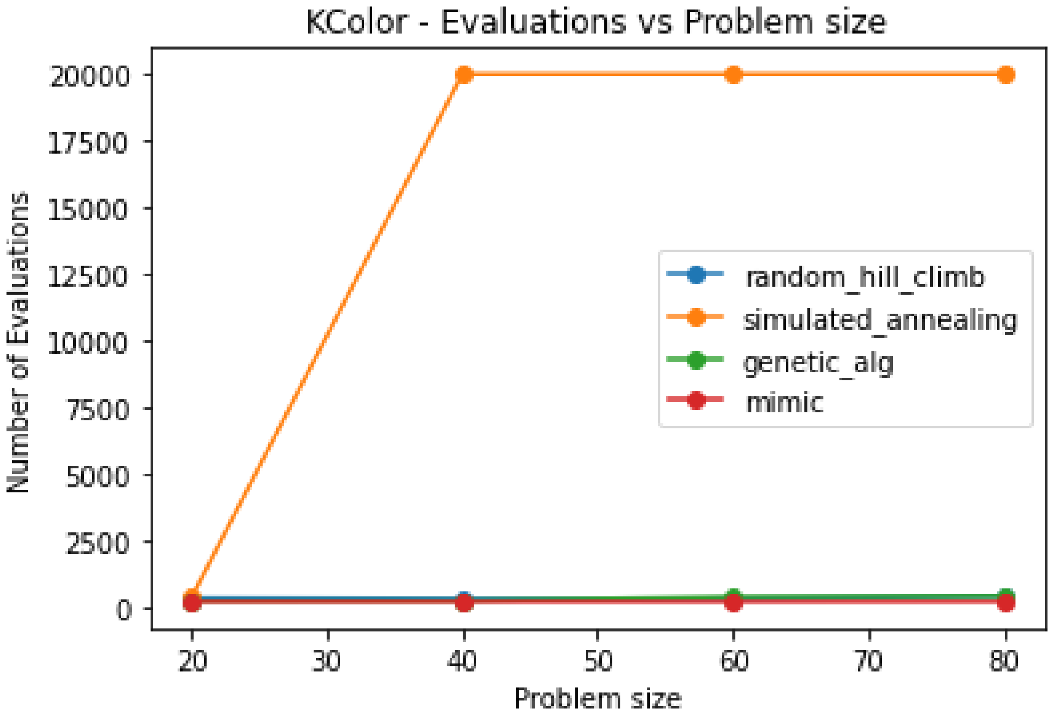
```
random_hill_climb
simulated_annealing
genetic_alg
mimic
```

[11]:

```
plot_bit_size('fitness',__fitness_vals,'Problem size','fittness','KColor -␣
 ↪Fitness vs Problem size','./plot/kcolor_fitness_bitsize.png',__range)
plot_bit_size('times',__fitness_vals,'Problem size','Time','KColor - Time vs␣
 ↪Problem size','./plot/kcolor_time_bitsize.png',__range)
plot_bit_size('evaluations',__fitness_vals,'Problem size','Number of␣
 ↪Evaluations','KColor - Evaluations vs Problem size','./plot/
 ↪kcolor_evaluations_bitsize.png',__range)
```




KColor - Time vs Problem size
Time
Problem size
0
100
200
300
400
500
20
30
40
50
60
70
80
random_hill_climb
simulated_annealing
genetic_alg
mimic


KColor - Evaluations vs Problem size
Number of Evaluations
Problem size
0
2500
5000
7500
10000
12500
15000
17500
20000
20
30
40
50
60
70
80
random_hill_climb
simulated_annealing
genetic_alg
mimic

```
<Figure size 432x288 with 0 Axes>
```

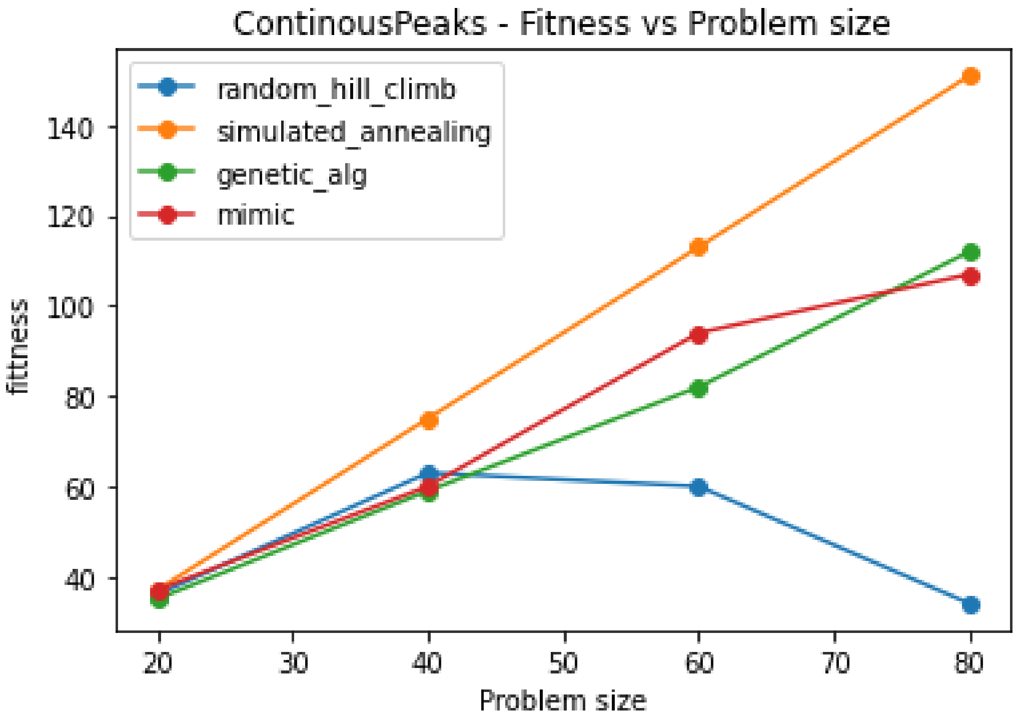
```
[12]: __max_iter = 20000
      __max_attempt=200
      __range = range(20,81,20)
      __fitness_vals = train_discrete_bit_size_problem('continouspeaks',␣
       ↪__max_iter,__max_attempt,__range)
```

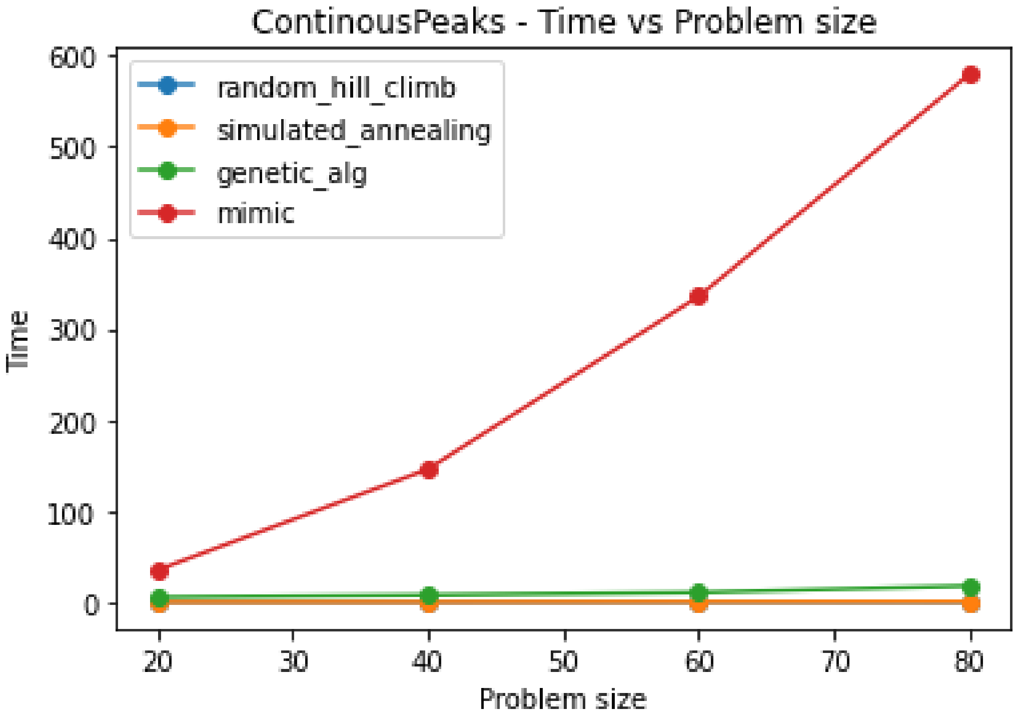
```
random_hill_climb
simulated_annealing
```

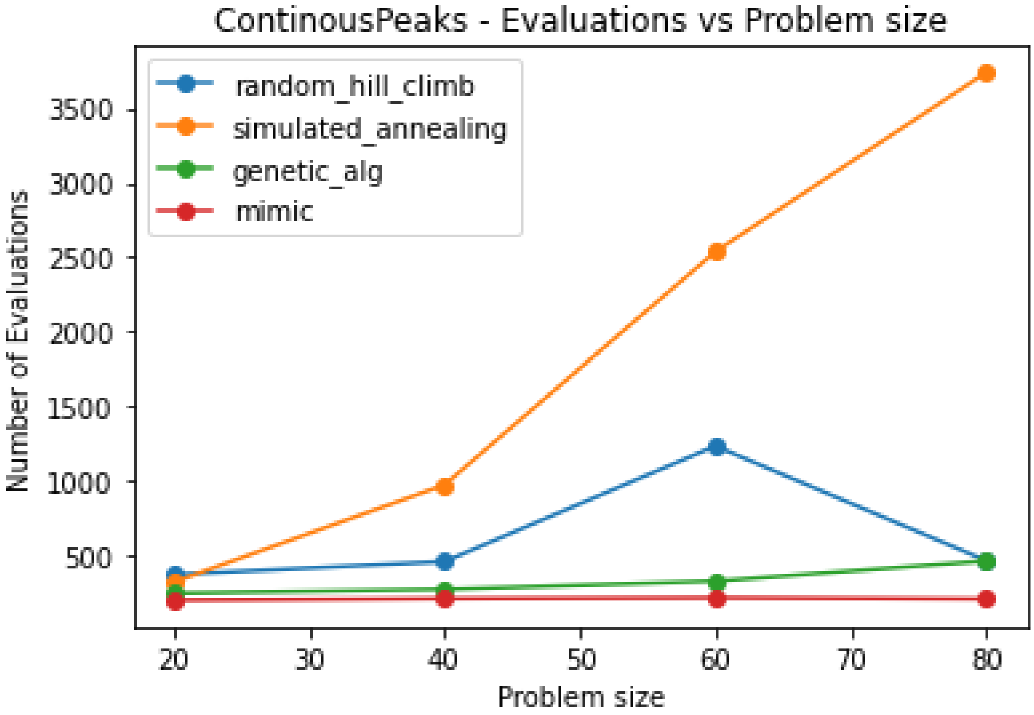
```
C:\Dev\Anaconda3\envs\VitrualEnv\lib\site-packages\mlrose\algorithms.py:311:
RuntimeWarning: overflow encountered in exp
  prob = np.exp(delta_e/temp)
```

```
genetic_alg
mimic
```

```
[13]: plot_bit_size('fitness',__fitness_vals,'Problem␣
       ↪size','fittness','ContinousPeaks - Fitness vs Problem size','./plot/
       ↪continouspeaks_fitness_bitsize.png',__range)
      plot_bit_size('times',__fitness_vals,'Problem size','Time','ContinousPeaks -␣
       ↪Time vs Problem size','./plot/continouspeaks_time_bitsize.png',__range)
      plot_bit_size('evaluations',__fitness_vals,'Problem size','Number of␣
       ↪Evaluations','ContinousPeaks - Evaluations vs Problem size','./plot/
       ↪continouspeaks_evaluations_bitsize.png',__range)
```




ContinousPeaks - Time vs Problem size
Time
Problem size
0
100
200
300
400
500
600
20
30
40
50
60
70
80
random_hill_climb
simulated_annealing
genetic_alg
mimic


ContinousPeaks - Evaluations vs Problem size
Number of Evaluations
Problem size
500
1000
1500
2000
2500
3000
3500
20
30
40
50
60
70
80
random_hill_climb
simulated_annealing
genetic_alg
mimic

```
<Figure size 432x288 with 0 Axes>
```

[ ]:

```

```