EE 527: Machine Learning Laboratory

Assignment 5

Due date: 13 Feb 2023

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1. Stochastic Search (SS)

Consider the objective function $f(x, y)$ given by

$$z = 1.7 * \exp\left[-\left\{\frac{(x-3)^2}{10} + \frac{(y-3)^2}{10}\right\}\right] + \exp\left[-\left\{\frac{(x+5)^2}{8} + \frac{(y+5)^2}{8}\right\}\right] +$$
$$2 * \exp\left[-\left\{\frac{x^2}{4} + \frac{y^2}{5}\right\}\right] + 1.5 * \exp\left[-\left\{\frac{(x-4)^2}{18} + \frac{(y+4)^2}{16}\right\}\right] +$$
$$1.2 * \exp\left[-\left\{\frac{(x+4)^2}{18} + \frac{(y-4)^2}{16}\right\}\right]$$

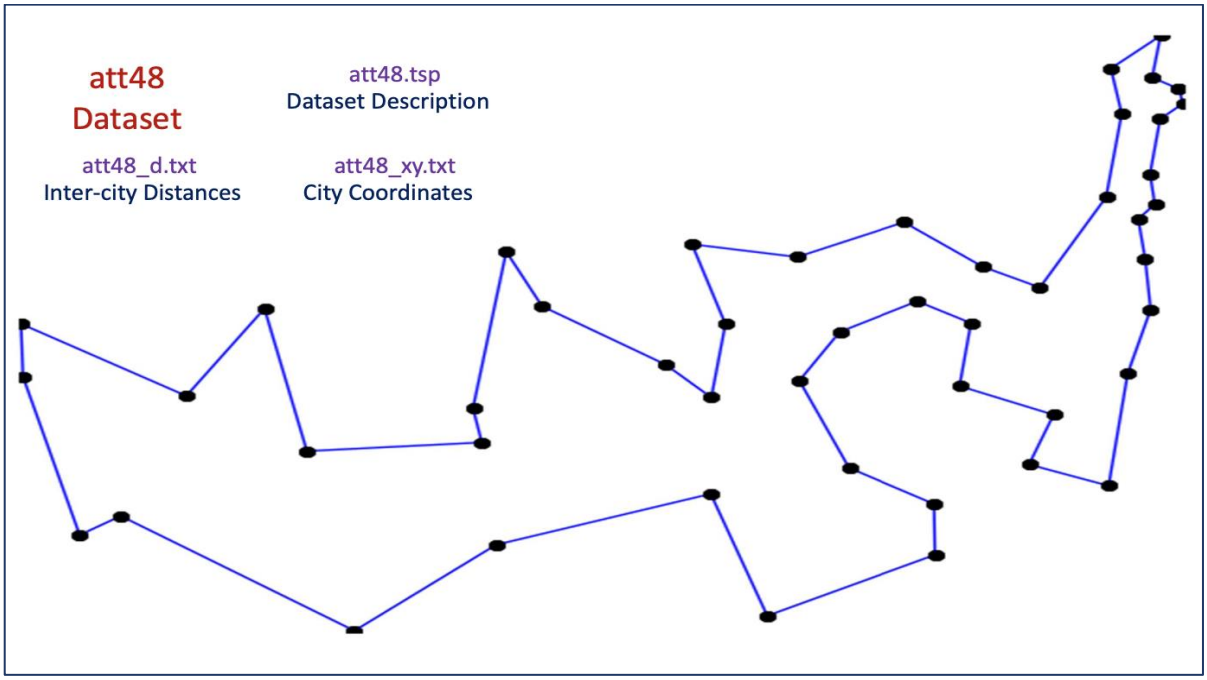
Find the maxima $z^* = f(x^*, y^*)$ using Stochastic Search. The search space for the solution is given by the bounds $X_{min} = [x_{min,}\, y_{min}]^T = [-10, -10]^T$ and $X_{max} = [x_{max,}\, y_{max}]^T = [10,\ 10]^T$.

Write the following function in Python.

$$[bestX,\ bestY,\ \ maxF] = stochasticSearch\ (X_{min}\ ,\ X_{max}\ ,\ popSize,\ nbhSize,\ maxItr)$$

Here, $z^* = \max F = f(bestX = x^*,\ bestY = y^*)$ is the best solution found by Stochastic Search with a Solution Population Size of *popSize* and *maxItr* Iterations (or Generations). During pure exploitation, children solutions of a parent *px* are generated in a hyper-sphere of radius *nbhSize* centered at *px*. Display the scatter plot of the solutions in each iteration on the contour plot of $f(x, y)$ to visualize the trajectories of the solutions in the population. Experiment with different values of *popSize*, *nbhSize* and *maxItr* and report the best solution.

2. Travelling Salesman Problem (TSP)



Consider the 48 city problem described by the *att48.tsp* dataset. Consider a Tour starting from *city 1* and ending at *city 1*. Search for an appropriate travel itinerary involving visits to all the remaining 47 cities in a certain sequence while minimizing the total tour length. Solve this problem using stochastic search. Choose appropriate stochastic search parameters.

(a) Plot the algorithm progress *i.e.* best distance value in each iteration.

(b) Plot the best tour (path connecting city sequence) obtained after each K (user choice for plotting) iterations.