Assignment 05

EE-527 Machine Learning Laboratory

Due Date - 11:59 pm 14 February, 2022

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

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

1 Gradient Ascent

Find the maxima $z^\star = f(x^\star, y^\star)$ using Gradient Ascent. Experiment with multiple initial values $(x^{(0)}, y^{(0)}) \in [-10, 10] \times [-10, 10]$ and different number of iterations. Visualize the contour plot of $f(x, y)$ and show the trajectories of the gradient ascent solution iterations. Report the best solutions $x^\star, y^\star, z^\star$.

2 Stochastic Search

Find the maxima $z^\star = f(x^\star, y^\star)$ using Stochastic Search. The solution search space is given by the search space 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, $z^\star = maxF = f(bestX = x^\star, bestY = y^\star)$ is the best solution found by Stochastic Search with a Solution Population Size of $popSize$ and $maxItr$ Iterations (or Generations). During pure exploitation, the 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.