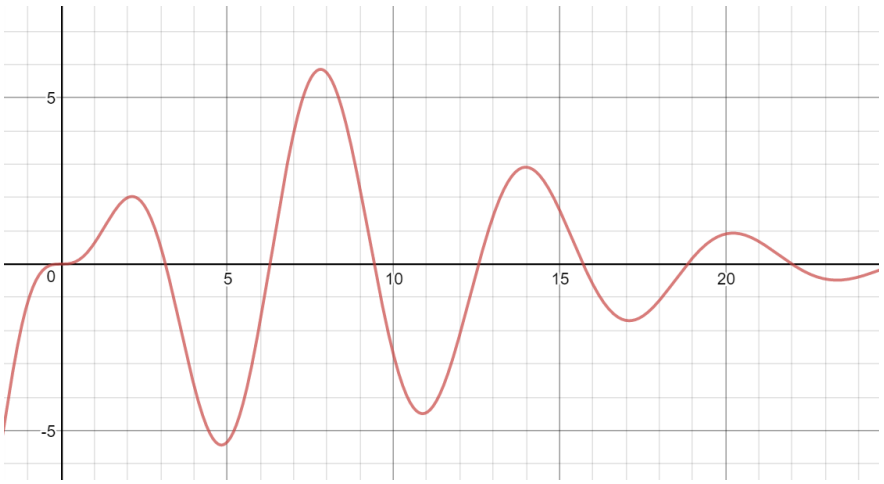
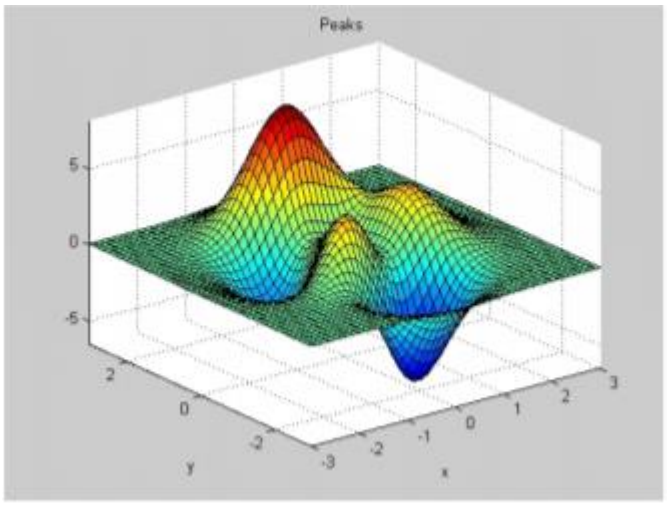
Local Search – Practice Questions



Consider above function in dimension 1

1. Indicate on the graph above which regions would lead to the global maximum, and which would lead to local maxima after a sufficient number of iterations.
2. Assuming each initial condition in [0,24] is equally likely, approximately how many restarts would it take if we implemented a hill climb with random restarts?
3. Similarly, indicate which regions would lead to the global minimum, and which would lead to local minima after a sufficient number of iterations.
4. Assuming each initial condition in [0,24] is equally likely, approximately how many restarts would it take if we implemented a hill climb with random restarts?
5. As the computational time increases (towards infinity), is the standard hill climb guaranteed to find a solution?
6. As the computational time increases (towards infinity), is the hill climb with random restarts guaranteed to find a solution?
7. What is the difference between gradient ascent and hill climbing in this case? Which method do you prefer?

Consider following function in dimension 2:



8. What is the main challenge using hill climbing on this function?

9. What is the difference between gradient ascent and hill climbing in this case? Which method do you prefer?

Gradient Descent

In this problem we aim to minimize function $\mathrm{f(x)} = (x-1)^2$ using gradient descent. Continue following gradient descent step with step size for several steps

1. What is the gradient $\nabla f(x)$?
2. What is the minimizer of this function (by inspection).?
3. Using $x_0 = 0$ as initial point. Run 5 iterations of gradient descent using different step size η.(you can either do it manually or write a program). Give the value of $x_1 \sim x_5$ and $y_1 \sim y_5$.
   1) $\eta = 0.1$
   2) $\eta =$ 0.5
   3) η=1
   4) $\eta = 2$

What will happen if step size is too small? What will happen if step size is too big?