% In-Lecture Assignment #4 on April 15, 2019

% Consider performing an iterative maximization of
% $J(x) = 8 - x^2 + 6\cos(6x)$
% via the steepest descent algorithm (JSK equation (6.5) on page 116)
% with the sign on the update reversed from negative to positive so that
% the algorithm will maximize rather than minimize; i.e.
% $x[k+1] = x[k] + \mu \frac{dJ(x)}{dx}\Big]_{x=x[k]}$

% a. Visualize and analyze the shape of the objective function $J(x)$.
% 1) Plot $J(x)$ for $-5 < x < 5$. Give the Matlab code for your answer.

```
x = [-5 : 0.01 : 5];
J = 8 - x .^ 2 + 6 * cos(6*x);
plot(x, J);   %% At end of document
```

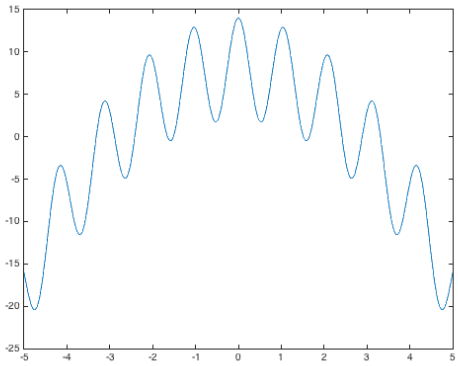
% 2) Describe the plot.
% It's a sum of a concave down parabola and a cosine, which creates
% multiple local maxima.
% 3) How many local maxima do you see?
% 11
% 4) Of these local maxima, how many are global maxima?
% Only one, located at $x = 0$.

% b. Derive the steepest descent update equation (compute the derivative of $J(x)$).
% dJ(x)/dx = -2x - 36*sin(6*x)

```
% Code below modified from a solution by a Spring 2019 student
% polyconverge.m find the maximum of J(x)=x via steepest descent
N=50;                       % number of iterations
mu=0.001;                   % algorithm stepsize
x=zeros(1,N);               % initialize sequence of x values to zero
x(1)=0.7;                   % starting point x(1)
for k=1:N-1
  x(k+1)= x(k) + (-36*sin(6*x(k)) - 2*x(k))*mu;    % update equation
end

figure();
stem(x);          % to visualize approximation
x(N)
```

% c. Implement the steepest descent algorithm in Matlab with $x[0] = 0.7$.
% 1) To what value does the steepest descent algorithm converge?
% x = 1.0376
% 2) Is the convergent value of x in the global maximum of $J(x)$? Why or why not?
% No. The only global maximum of J(x) occurs at x = 0.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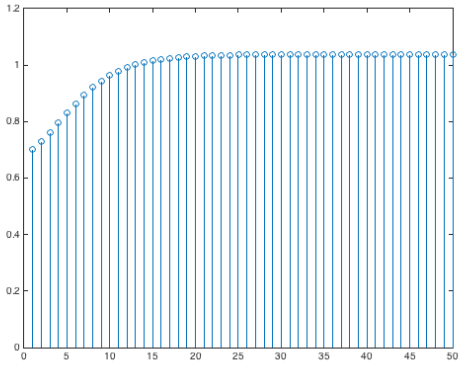
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