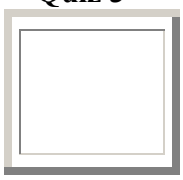
Quiz 3



The first letter of your LAST name

_____ First Name

_____ Last Name

Q3-1 (25 pts)	Q3-2 (30 pts)	Q3-3 (30 pts)	Q3-4 (15 pts)	Total

Note: You have 75 min. Be careful about the time allocation. Try not to leave any problems totally blank so that I can give you some partial credit. Good luck!

24-311 NUMERICAL METHOD Fall 02

QUIZ 3

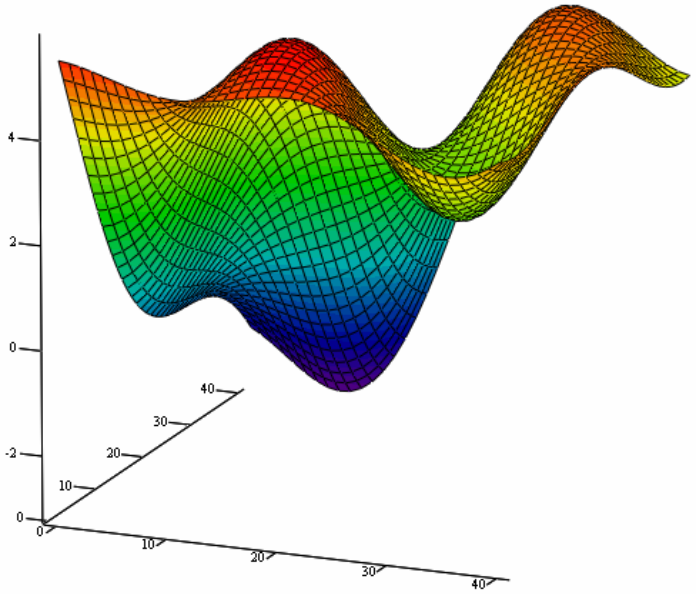
Date and time	10/22 (Tue), 10:30AM-11:45AM (75 min)
Weight	10 % of final grade
Coverage	lectures and reading assignments: 12-16 problem sets: PS6, PS7
Format	closed book, closed notes
Note	bring a basic calculator with + - x / keys (no computer allowed in quiz!)

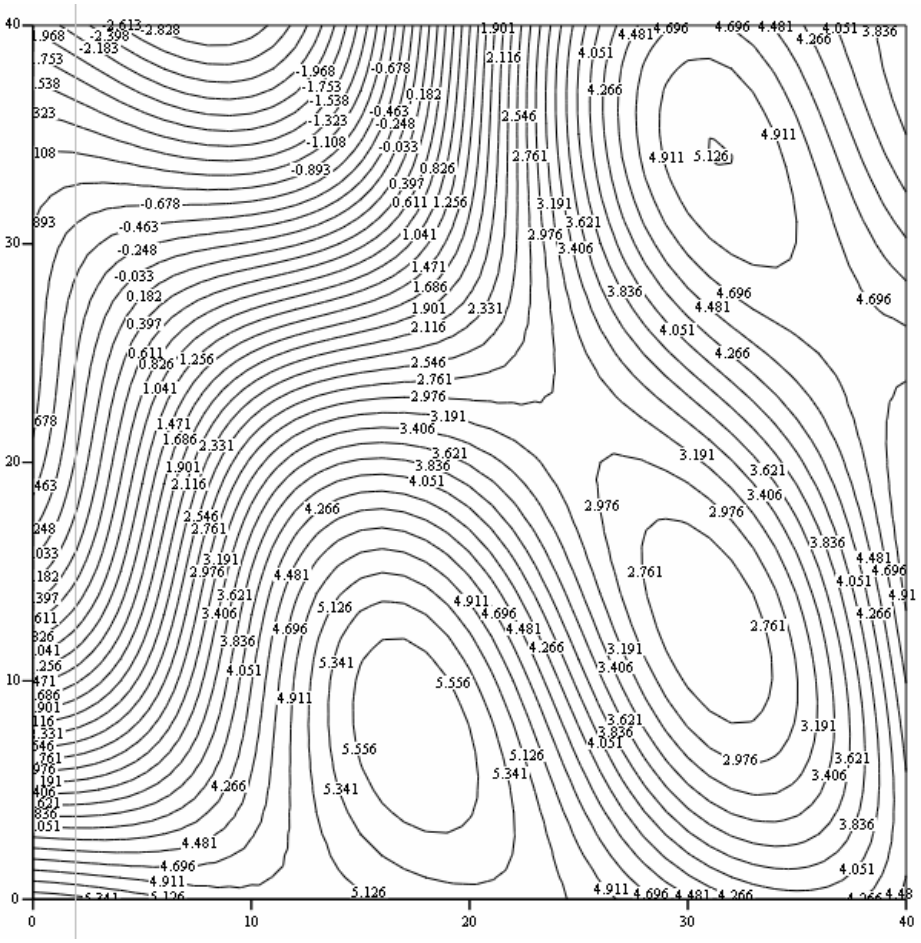
Q3-1 **(25pts)** Using Newton's method, find the maximum of the

$$f(x) = x^4 - x^3 - 1$$

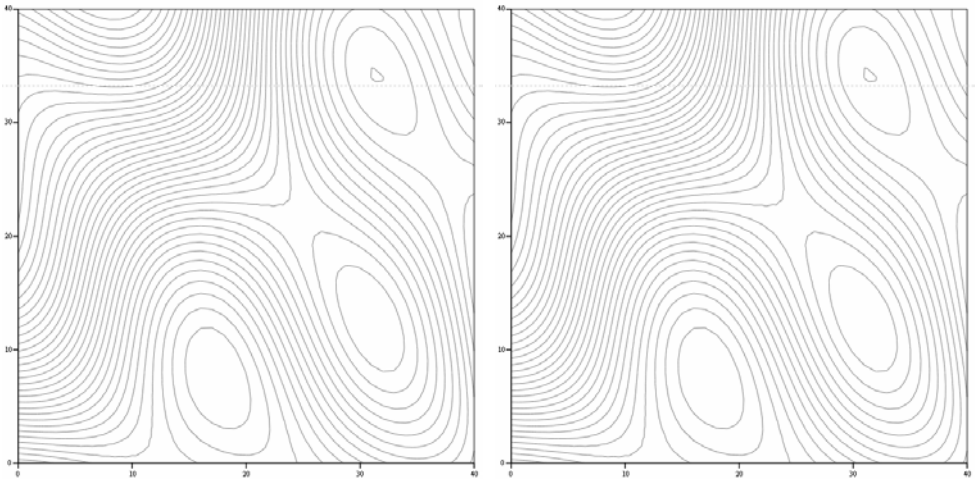
with an initial guess of $x_0 = 2$. Run two iterations. You must show all the steps for the full credit.

Q3-2 **(30pts)** The following figure shows the surface plot and contour plot of a function $f(x, y)$. The function is defined only within the range, $0 \le x \le 40, 0 \le y \le 40$.

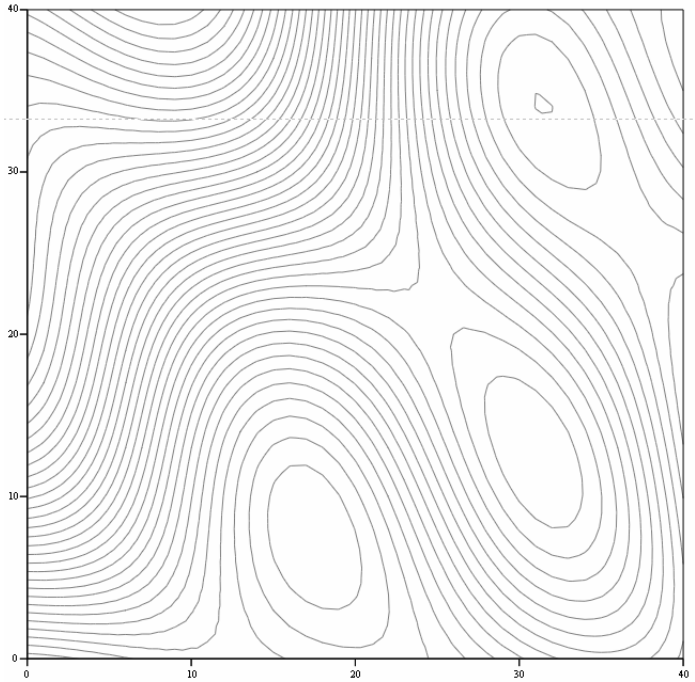




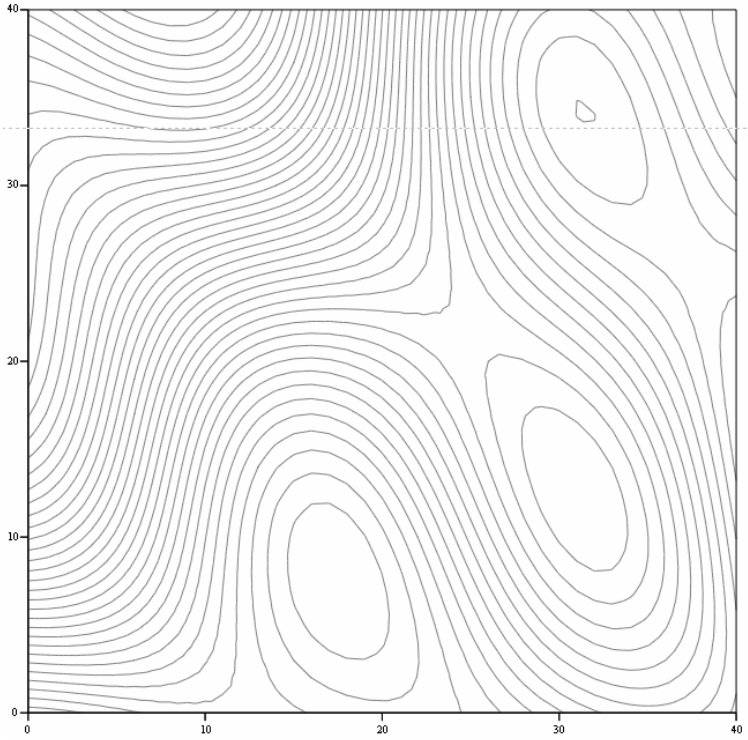
(1) In the left contour plot below, mark with X all the maximum points (including global and local max). In the right contour plot below, mark with X all the saddle points.



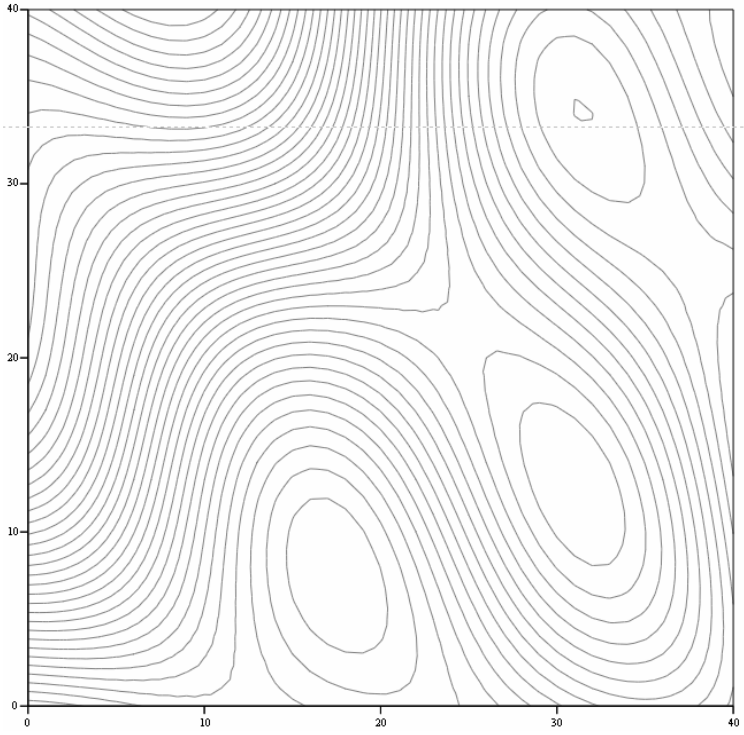
(2) In the contour plot below, show with an arrow the steepest descent direction at point (30, 30). Draw two parallel lines, $y = 15$ and $y = 12.5$, and find the conjugate gradient direction using the two lines.



(3) In the contour plot below show the trajectory of finding <u>minimum</u> with the univariate search. Use an initial point, (0, 0), and start the search in the x direction. Run the one-dimensional search two times in the x direction and y direction respectively. Show the convergence path, consisting of four line segments.



(4) In the contour plot below show the trajectory of finding <u>maximum</u> with the optimized steepest ascent search. Use an initial point, (0, 20). Show the first three line segment of the convergence path.



Q3-3 **(30pts)**

(1) For a cost function of two variables, $f(x, y) = (x-1)^2 + (y-2)^2 - xy$, what are the necessary condition for having either a minimum, maximum, or saddle point? Find the coordinate of all the points that satisfy this condition.

(2) Find the Hessian matrix of the function,.

(2) Find the Hessian matrix, H, of function $f(x,y) = (x-1)^2 + (y-2)^2 - xy$. Also find $|H|$.

(3) Find the steepest descent direction of function $f(x,y) = (x-1)^2 + (y-2)^2 - xy$ at $(x,y) = (3,2)$

Q3-4

(15pts)

Suppose you are applying Powell's method to find the minimum of function $f(x,y) = (x-1)^2 + (y-2)^2 - xy$ with the initial point (0,0) and the two initial directions, $h_1 = (1,0)$ and $h_2 = (0,1)$, what is the third direction, h_3? You need to show the intermediate steps to find the x and y components of vector h_3 for full credit.

This is the last page of Quiz 3, and this page is intentionally left blank
so that you can use it if you need more space to write your solution or do some calculations.