AMSC/CMSC 660 Quiz 6 , Fall 2004

1. (20) Fill in the following table, giving features of various algorithms for minimizing $f(x)$. The first line has been done for you, as an example.

Method	convergence rate	Storage	f evals/itn	g evals/itn	H evals/itn
Truncated Newton	> 1	$O(n)$	1	$\leq n+1$	0
Newton	2	$O(n^2)$	0^1	1	1
Quasi-Newton	$> 1^2$	$O(n^2)$	0^1	1	0
steepest descent	1	$O(n)$	0^1	1	0
Conjugate gradients	1	$O(n)$	0^1	1	0

Notes on Answer:

1. Once the counts for the linesearch are omitted, no function evaluations are needed, but credit was given for 1, too, as long as you were consistent about it.

2. For a single step, Quasi-Newton is superlinear; it is n-step quadratic.

- Assume that all of these methods are convergent and that any line search is exact (i.e., the true optimal value of the steplength parameter is used).
- Don't include the cost of the line search in your table entries. We are omitting this cost because it is the same, independent of method.
- f is the function, g is the gradient, and H is the Hessian matrix. "evals/itn" means the number of evaluations per iteration.
- The convergence rate should be "1" for linear, "$>$ 1" for superlinear, or "2" for quadratic.
- Storage should be either $O(1)$, $O(n)$, or $O(n^2)$, where n is the number of variables (i.e., the dimension of x).
- "Conjugate gradients" means the nonlinear cg method, not the one for solving linear systems (minimizing quadratics).