

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no books, calculators, cellphones, other electronic devices, communication with others, scratchpaper, etc.

Name \_\_\_\_\_

1.

- (a) (5) Write the formula for computing the step direction in Newton's method.
- (b) (5) Apply one step of Newton's method (with stepsize  $\alpha = 1$ ) to the problem

$$\min_x x^4 + 5x^3$$

starting at the point  $x = 5$ .

2. (10) Recall the Sherman-Morrison-Woodbury formula:

$$(\mathbf{A} - \mathbf{Z}\mathbf{V}^T)^{-1} = \mathbf{A}^{-1} + \mathbf{A}^{-1}\mathbf{Z}(\mathbf{I} - \mathbf{V}^T\mathbf{A}^{-1}\mathbf{Z})^{-1}\mathbf{V}^T\mathbf{A}^{-1}$$

Suppose we have computed an LU factorization of the  $n \times n$  matrix  $\mathbf{A}$ , and suppose that  $\mathbf{Z}$  and  $\mathbf{V}$  are  $n \times 1$ . Show how the formula above can be used to solve the linear system  $(\mathbf{A} - \mathbf{Z}\mathbf{V}^T)\mathbf{x} = \mathbf{b}$  in  $O(n^2)$  operations, instead of the  $n^3$  it would otherwise take.