

## Math 298: Directed Group Study

Fundamental Concepts in Computational and Applied Mathematics

December 9, 2013

**Instructions:** This is a self-assessment quiz for your own use. Give yourself 1 point for each question correctly answered. For maximum benefit I suggest taking the quiz without reviewing the class lecture slides.

1. Define *stability* and *conditioning*. Describe the difference between the two concepts and how they are related to numerical problems and algorithms.
2. Suppose we have a problem with a condition number,  $\kappa = 10^6$ . What can we say about the accuracy of our computed solution?

3. Suppose we have to solve,  $Ax = b$ , where the matrix  $A$  is *dense*. Give some advantages and disadvantages of using the following three methods: LU, LU with partial pivoting, QR.

4. What do we mean by a *sparse matrix*?

5. What is meant by an *iterative method* for solving a system of linear equations as opposed to a *direct* method?

6. What is a *splitting method* for solving a system of linear equations? Give an example.

7. What is the defining characteristic of a *structured grid*? Give one example where you would use a structured grid.

8. What is a *stencil*?

9. What do we mean by an *unstructured grid*? Give one example where using an unstructured grid would be appropriate.

10. What is an *FFT*? Give one example of where and how it might be used.

11. What is an  $N$ -body problem and where do they arise? What principle is used to improve the computational efficiency of standard algorithms for  $N$ -body problems?

12. What is meant by a *model-based* approach for solving a system of *nonlinear equations*?

13. What is the main idea underlying *Newton's* method for solving nonlinear equations?

14. Give some advantages and disadvantages of Newton's method for the solution of either nonlinear equations or optimization?

15. What are the 3 key elements of a good talk?

16. Name one common mistake when giving a talk?

17. What was your favorite algorithm or NA Classics paper that we discussed in class?