Here are some sample questions from old tests. Some topics that we covered are not represented by these questions, but are still fair game.

1. List your 10 least favorite **Matlab** commands.
2. Suppose $f(x)$ has been defined as an inline function. Give MATLAB commands to plot it on the interval $[0, 10]$.
3. Write a MATLAB function program that calculates the sum of the squares of the first n integers.
4. For $f(x) = x^3 - 6$, do 2 iterations of Newton's method, starting with $x_0 = 2$.
5. For $f(x) = x^2 - 5$, do 2 iterations of Newton's method, starting with $x_0 = 2.0$. What is the relative error of x_2? About how many more steps would be needed to make the error less than 10^{-16}?
6. Write a **Matlab** program to do n steps of the bisection method for a function f with starting interval $[a, b]$. Let f, a, b and n be the inputs and the final x the output.
7. Write a MATLAB program to do n steps of Newton's method for a function f with starting interval $[a, b]$. Let f, f', x_0 and n be the inputs and the final x the output.
8. Write a MATLAB script program that will use Newton's method to find a root of the system of functions $f_1(x, y) = x^3 - y^2 + 1$ and $f_2(x, y) = y^3 + x - 1$ starting from the initial guess $(0, 0)$.
9. For $f(x) = x^2 - 5$, do 2 iterations of the bisection method, starting with $[a, b,] = [2, 3]$. What is the relative error? About how many more steps would be needed to make the error less than 10^{-6}?
10. Write a function program which will find the roots of a function f on an interval $[a, b]$.
11. Let $A = \begin{bmatrix} 1 & .5 \\ 2 & 1 \end{bmatrix}$. Find the LU factorization with pivoting.
12. Let $A = \begin{bmatrix} -1 & 5 \\ 2 & 2 \end{bmatrix}$. Find the LU factorization with pivoting.
13. Find the LU decomposition of A using pivoting if needed:
    $A = \begin{bmatrix} 3 & -2 \\ 6 & 1 \end{bmatrix}$
14. Given that the LU decomposition of $A = \begin{bmatrix} 3 & 3 \\ 1 & 2 \end{bmatrix}$ is $LU = \begin{bmatrix} 1 & 0 \\ 1/3 & 1 \end{bmatrix} \begin{bmatrix} 3 & 3 \\ 0 & 1 \end{bmatrix}$, solve $A\mathbf{x} = \mathbf{b}$ where $\mathbf{b} = (1, 2)'$.

15. Write a **Matlab** program to that solves a linear system $A\mathbf{x} = \mathbf{b}$ using LU decomposition. Let A, $\mathbf{b}$ and *tol* be the inputs and $\mathbf{x}$ the output. If the error (residual) is not less than *tol*, then display a warning.

16. Suppose $A^{-1} = \begin{bmatrix} -1 & 2 \\ 1 & -1 \end{bmatrix}$. Using $\mathbf{v}_0 = (1,1)'$ as the starting vector do 2 iterations of the Inverse Power Method for A. What do the results mean?

17. Suppose $A = \begin{bmatrix} -1 & 2 \\ 1 & -1 \end{bmatrix}$. Using $\mathbf{v}_0 = (1,1)'$ as the starting vector do 2 iterations of the Power Method for A. What do the results mean?

18. Write a **Matlab** program to do n iterations of the Power Method. Let the matrix A and n be inputs and let [e v] (the eigenvalue and eigenvector) be the outputs.

19. What is the condition number of a matrix? How do you find it with **Matlab**? What are the implications of the condition number when solving a linear system? What is the engineering solution to a problem with a bad condition number?

20. Give the MATLAB commands, or sequences of commands for solving a linear system $A\mathbf{x} = \mathbf{b}$ in as many ways as you know. Which of these are the worst and best?

21. What is the command in MATLAB to produce the eigenvalues and eigenvectors of a matrix. Which method does it use? What will be the form of the output?

22. Find the eigenvalues and eigenvectors of the matrix:
$A = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$

23. Write a MATLAB function program that takes an input n, produces a random $n \times n$ matrix A and random vector $\bar{b}$, solves $A\bar{x} = \bar{b}$ (using the built in command) and outputs the residual (number).