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. Your friend has a data set represented by vectors **x** and **y** and is considering using a polynomial interpolation, a spline interpolation, or a least squares approximation.
   (a) For polynomial interpolation, explain to them:
      - what it is,
      - how you get it in MATLAB, and
      - in what situations it is better than the other methods.

   (b) Do the same for spline interpolation.
   (c) Do the same for least squares approximation.

2. Estimate the integral $\int_{-1}^{3} x^2\,dx$ using L_4, R_4, T_4 and S_4. Calculate the exact value and the errors of each of the approximations.

3. Approximate the integral $\int_0^{\pi} \sin x\,dx$ using M_4 and S_4. Which do you expect to be more accurate?

4. Write a MATLAB **function** program to do the Trapezoid Rule for integration of a function given by data. Let the inputs be vectors `x` and `y`, representing a list of points $(x_i, y_i) = (x_i, f(x_i))$. Assume $x_i < x_{i+1}$ but do not assume the x values are evenly spaced. Include many comments.

5. Write a MATLAB **function** program to do the midpoint method for integration. Let the inputs be the function f, the endpoints a, b and the number of subintervals n.

6. Write a MATLAB **function** program to do the trapezoid method for integration. Let the inputs be the function f, the endpoints a, b and the number of subintervals n.

7. Write a MATLAB **function** program to do the four-corners method for integration of a function $f(x, y)$ on a rectangle $a \le x \le b$, $c \le y \le d$ using m subintervals in x and n subintervals in y. Let the inputs be `(f,a,b,c,d,m,n)`. Include many comments.

8. Describe and give formulas for 2 methods to approximate double integrals based on triangles.

9. For the function $f(x) = x^2$ you need to find $f'(5)$, but you can't remember whether $f'(x) = 2x$ or $f'(x) = x^3/3$. You remember that
$$f'(5) = \lim_{h\to 0} \frac{f(5+h) - f(5)}{h},$$
so you try:
```
> h=10^(-50)
> ((5+h)^2-5^2)/h
```
which gives the result: `ans = 0`. Is this the correct answer? Explain what happened and why.

10. Write a MATLAB **function** program to do the center-point method for integration of a function $f(x, y)$ on a rectangle $a \le x \le b$, $c \le y \le d$ using m subintervals in x and n subintervals in y. Let the inputs be `(f,a,b,c,d,m,n)`. Include comments.

11. Explain what would happen if you ran the following MATLAB commands:
```
> format long
> for i=1:30
>    x=10^i+pi
>    mypi=x-10^i
>    error=(pi-mypi)/pi
> end
```