Chapter 5

1. What does the bracket condition imply?
2. What does the conditioning of a root-finding problem depend on?
3. In the case of a multiple root, $x^*$, what is the condition number of the root finding problem at $x^*$?
4. When is a sequence line, superlinear, quadratic, etc?
5. Run two steps of bisection.
6. What is the convergence rate of bisection? How many digits does it gain in accuracy in each iteration?
7. Run two steps of fixed-point.
8. Under what conditions does fixed-point converge?
9. What is the rate of the convergence?
10. What is fixed-point iteration for a system of nonlinear equations?
11. Run two steps of Newton’s Method.
12. How fast does it converge and how quickly?
13. Run two steps of the Secant Method.
14. How fast does it converge and how quickly?
15. What are the disadvantages and advantages of Newton vs Secant.
16. What is Newton’s Method for a system of nonlinear equations?
17. When will this fail to converge?
18. What is a reason to use Broyden’s method and what (intuitively) is the difference between Newton’s method?

Chapter 6

1. What is a coercive function and why is it useful?
2. Find the gradient of a function? What is the Hessian?
3. When is $x^*$ a minimum of $f$? When is it a maximum? Are there other scenarios?
4. When is a solution a minimum in a constrained optimization problem?
5. What is the conditioning of an optimization problem? Is it the same as a root finding problem?
6. Run one step of Newton’s method to find a minimum.
7. Run one step of steepest descent.
8. What is one advantage of SD? What is one disadvantage?
10. What is the reason to use a method such as BFGS or CG?
11. What is Guass-Newton (conceptually)?
Chapter 7

1. What should one consider when interpolating data/functions? (p311)
2. For \( k \) points, what degree polynomial is a unique interpolant?
3. For a given basis, how do you set up an interpolation problem and what is the cost? What are coefficients and what are basis functions?
4. What is a Monomial basis?
5. How do you construct such an interpolant and what is the cost? What are the disadvantages and advantages?
6. What is a Lagrange basis?
7. How do you construct such an interpolant and what is the cost? What are the disadvantages and advantages?
8. What is a Newton basis?
9. How do you construct such an interpolant and what is the cost? What are the disadvantages and advantages?
10. Construct a Newton or Lagrange interpolant for some data or a function.
11. What is an orthogonal polynomial and how does one construct a family of orthogonal polynomials.
12. What are orthogonal polynomials useful.
13. Why is interpolating the Runge function problematic for equispaced nodes?
14. What are two ways to improve interpolation in this situation?
15. What is a Hermite interpolant? What is a cubic spline?
16. How many free conditions does a general cubic spline have? What are the options for creating a unique cubic spline?
17. Review Questions: 7.3, 7.4, 7.5, 7.8, 7.10, 7.12, 7.14, 7.15, 7.16, 7.17, 7.23, 7.24, 7.26, 7.27

Chapter 8

1. What is the conditioning of an integration problem?
2. What is a quadrature rule?
3. What is the degree of precision of a quadrature rule?
4. How is method of undetermined coefficients used to determine a quadrature rule of the highest degree of precision possible?
5. What is a Newton-Cotes rule? How accurate is it?
6. What is a Gauss rule? How accurate is it?
7. What is a composite rule?
8. Use Midpoint, Trapezoid, Simpson, N-pt Gauss to compute the approximation to an integral.
9. What is the conditioning of numerical differentiation?
10. What is the forward, backward, central finite difference approximation to a derivative of a given set of data or function?
11. Review Questions: 8.4, 8.5, 8.12, 8.13, 8.15, 8.21, 8.22, 8.24, 8.41