

Math 350 Midterm 2 Review

The written part of the exam should take about 30–45 minutes to complete. No computers are permitted for this part of the exam. When done with the written part, turn in your work and then use the remaining class time to complete the computer portion.

For the computer portion of the exam, you can use Mathematica and its documentation but not our previous lectures or sets or any internet resources. Turn in the computer portion to Canvas as usual.

The written portion

Just like in Midterm 1, there are 4 types of problems on the written portion of the exam:

1. Write down Mathematica code that will produce the following output:
2. What would result if these expressions are evaluated? (Act as Mathematica and run the code).
3. Using English sentences, describe what the following commands will do.
4. Write down Mathematica commands that will output the following.

The computer portion

Here are sample questions for the computer portion of the exam:

- a. Write a function **RealEigenvectors** with input a square matrix and output a list of linearly independent nonzero real eigenvectors of the matrix (removing any zero vectors or complex valued eigenvalues from **Eigenvectors**). Additionally, any output vectors should be scaled to have length 1 (see **Normalize**).
- b. Let V be the set of tuples of 0's and 1's of length 3. Create the graph with vertex set V with an edge between u and v if the number of 0's in $u - v$ is even.
- c. If $z = f[x, y]$ is the equation of a surface in \mathbb{R}^3 , then the gradient vector $\text{Grad}[z - f[x, y], x, y, z]$ gives a vector perpendicular to the surface. Show a 3D plot of the surface $z = \text{Sin}[x + xy]$ together with the plane tangent to the surface (consider **Hyperplane**) at the $\{x, y\}$ coordinate $\{Pi, 0\}$.
- d. The average value of a function f on the interval from a to b is given by $\text{Integrate}[f[x], x, a, b] / (b - a)$. Find a value of t such that the average value of the function $\text{Exp}[-x] \text{Sin}[x]$ on the interval from 0 to t is equal to 1 (consider **FindRoot**).
- e. Plot the graph of $\text{Exp}[-x^2]$ on the interval from -3 to 3 together with the plot of the function found by taking first 5 terms in the **Series** for this function centered at $x = 0$.
- f. Use the Monte Carlo method to approximate value of the second smallest eigenvalue of the **KirchhoffMatrix** for a random graph with 25 vertices and 50 edges.