COMPUTER PROJECT 3
Lagrange Multipliers

DUE: 01/28/2026

Instructions: Use *Mathematica* to solve the following problems. Be sure to clearly label each section of your notebook based on which problem you are solving. You can change an input cell to a text cell by selection the Format tab from the top menu and choosing Text from the Style option. Email a copy of your finalized notebook to `byoung@wyomingseminary.org` with the subject "Computer Project 3."

For this project, you will be given an objective function of the form $f(x, y, z) = Axy + Byz + z^p$ and an ellipsoid of the form

$$\frac{x^2}{a} + \frac{y^2}{b} + \frac{z^2}{c} = 1.$$

These data are different for each student and can be found after the instructions.

1) Use *Mathematica* to identify the absolute maximum and minimum of the given objective function f over the ellipsoid.

   a) Identify a list of points on the ellipsoid where maxima and minima of f could possibly occur. Make a table of values showing the value of f at these critical points.

   b) Produce a plot of the ellipsoid using the function f to color the surface. Add the critical points you found above to this plot.

2) Repeat Problem 1) with your given ellipsoid, but change the objective function f to something of your own choosing! We will have a contest for the coolest/most-interesting-looking plots!

3) Use *Mathematica* to find the points on the intersection of the hyper-ellipsoid $x^2 + \frac{y^2}{4} + \frac{z^2}{4} + w^2 = 1$ and the hyper-plane $x - 2y + z - w = 0$ that are closest to and farthest from the origin. DO NOT TRY TO PLOT THIS!!!

Project 3 Data

- Yang Cao: $f(x, y, z) = 2xy + 4yz + z^3$, ellipsoid: $x^2/6 + y^2/2 + z^2/2 = 1$
- Abigail Ryu: $f(x, y, z) = 3xy + 4yz + z^3$, ellipsoid: $x^2/5 + y^2/7 + z^2/4 = 1$
- Andrew Tsui: $f(x, y, z) = 3xy + 5yz + z^3$, ellipsoid: $x^2/6 + y^2/4 + z^2/6 = 1$
- Theo Yang: $f(x, y, z) = 2xy + 6yz + z^2$, ellipsoid: $x^2/5 + y^2/4 + z^2/4 = 1$