MATH 049: Mathematics Honors (1-3 Units) CRN 81349

Informally: “Introduction to Computer Algebra”

1. Computer Algebra?

A computer algebra system is a collection of software that performs symbolic and numerical calculations, produces graphics and allows for light programming. These tools can be used to solve all sorts of problems that simply can’t be done with pencil and paper calculations.

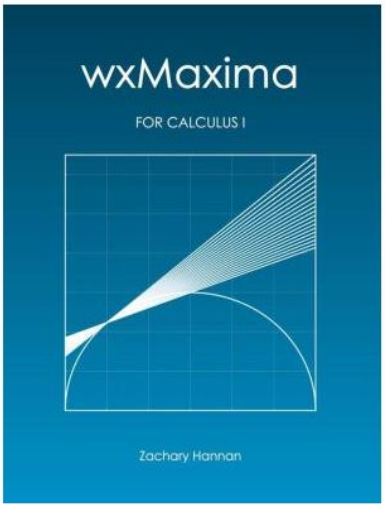
2. Why you should care:

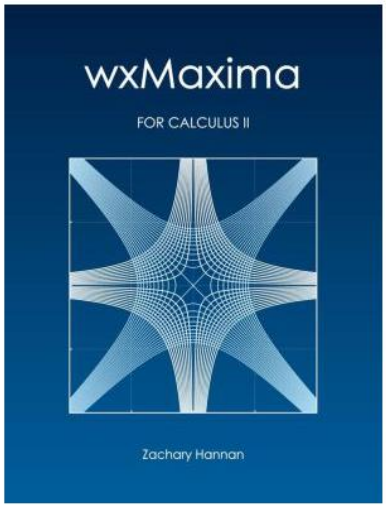
If you are an engineering major, your university peers are currently mastering MATLAB, which is a CAS with heavy numerical emphasis. You will make heavy use of it at the upper division level.

If you are a physical science major (physics in particular), your university peers are probably using Mathematica, and you will definitely use a CAS to perform simulations and symbolic calculations at the upper division level.

3. Outline of the course:

- **First 5 weeks**: introduction to wxMaxima in the context of single variable calculus.





- **Second 5 weeks:** 3-5 more serious problems from math and physics

projectiles with drag and lift: numerically modeling projectiles with no analytic solution

linear and non-linear oscillators: damped and driven motion, chaos, bifurcations

cellular automata: 1-D and 2-D, crystal growth and corrosion

random walks: 1-D and 2-D, calculations meaningful to probability and thermodynamics

numerical analysis: integration, curve fitting, solutions to ODEs, root finding, Monte Carlo methods

anything else you're interested in exploring

wxMaxima 15.08.1+git [projectile with drag.wxm*]

File Edit View Cell Maxima Equations Algebra Calculus Simplify Plot Numeric Help

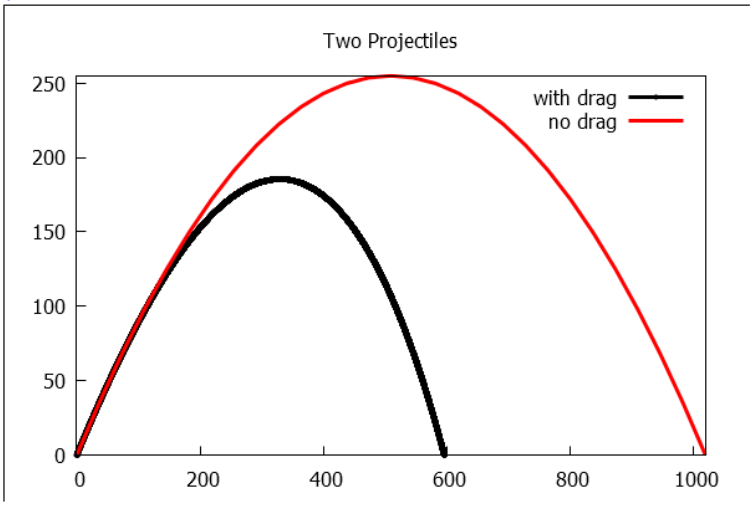
```
(for k:0 thru 15000 do
 (NEXTX:float(X+Vx*(t)-(C/(2*m))*sqrt(Vx^2+Vy^2)*Vx*(t)^2),
  NEXTY:float(Y+Vy*(t)-0.5*(g+(C/m)*sqrt(Vx^2+Vy^2)*Vy)*(t)^2),
  NEXTVx:float(Vx-(C/m)*sqrt(Vx^2+Vy^2)*Vx*(t)),
  NEXTVy:float(Vy-(g+(C/m)*sqrt(Vx^2+Vy^2)*Vy)*(t)),
  POINTS:append(POINTS,[[NEXTX,NEXTY]]),
  X:NEXTX,
  Y:NEXTY,
  Vx:NEXTVx,
  Vy:NEXTVy,
  if Y < 0 then print("LANDED AT [X,t]= ") and return([round(X),k*t]))
);
```

LANDED AT [X,t]=

(%o15) [596,12.25]

```
(%i17) wxdraw2d(
title="Two Projectiles",
color=black,
key="with drag",
point_type=7,
points_joined=true,
point_size=0.2,
line_width=3,
points(POINTS),
color=red,
key="no drag",
line_width=3,
NODRAG
);
```

(%t17)



(%o17)

- **Third 5 weeks:** write a polished paper on a large problem or class of problems

  learn to work in a LaTeX template

  present a poster or paper at an undergrad research conference: CMC^3 or UC Davis

4. Additional Information

Official prerequisite is B's in Math 20, 21 and Phys 6.

Contact me at zhannan@solano.edu