# AMATH 581: Homework 1

Kelly Liu

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# Preliminaries

- If you don't have a scorelator (CompSoftBook) account, contact Eli ASAP.
  (the TAs don't have admin access to add people)
- If you cannot log in to scorelator, try:
  - use IE or firefox, allow flash plug-in
  - reset password using the email address
- If you are coding in Python and need help: contact Ryan or Eli.

# Matlab basics

- Use vectorization, avoid loops.
  `https://www.mathworks.com/help/matlab/matlab_prog/vectorization.html`
- Functions: can either create a function handle inside the main script, or create a separate function file.
  `https://www.mathworks.com/help/matlab/ref/functions.html`

# Problem 1

For each dt in the dt_list:

$t = [0 : dt : 5]$

compute ytrue (using vectorization)

create an empty y vector (of the same length as ytrue)

$y(1) = \cdots$

for $j = 1 : length(t) - 1$:

$y(j+1) = \cdots$ %% step forward using forward Euler/ Heun's

end

$E = mean(abs(ytrue - y)) \rightarrow$ store in Err_list

end

loglog(dt_list, Err_list) $\rightarrow$ create a loglog plot

polyfit(log(dt_list), log(Err_list), 1) $\rightarrow$ fit a linear function

# Problem 2

ode45(@(t,y) vdPol (t, y, eps), tspan, [sqrt(3),1])
vdPol (convert the second-order differential equation to a system of first-order differential equation):

$$\frac{d}{dt}\begin{bmatrix} y \\ y' \end{bmatrix} = \begin{bmatrix} y' \\ y'' \end{bmatrix} = \begin{bmatrix} y' \\ -\epsilon(y^2-1) * y' - y \end{bmatrix}$$

Note:

- 'vdp' is a built-in in Matlab; so better to use a different name for your function
- do not specify tolerance for part (a)

# Problem 3

ode15s(@(t,y) fitzhugh(t, y, d12, d21), tspan, [0.1, 0.1, 0, 0])
where $y(1) = v_1$, $y(2) = v_2$, $y(3) = w_1$, $y(4) = w_2$.
fitzhugh:

$$\frac{dy}{dt} = \frac{d}{dt}\begin{bmatrix} v1 \\ v2 \\ w1 \\ w2 \end{bmatrix} = \begin{bmatrix} \cdots \\ \cdots \\ \cdots \\ \cdots \end{bmatrix}$$