## Class Exercise 1

Estimate the parameters $k_1, k_2$ and $k_3$, of the chemical reaction ODE system below. Initial conditions and data(only for A) are given in the code.

$$\frac{d[A]}{dt} = -k_1[A][B] - k_2[A][C] - k_3[A][D]$$

$$\frac{d[B]}{dt} = -k_1[A][B]$$

$$\frac{d[C]}{dt} = +k_1[A][B] - k_2[A][C]$$

$$\frac{d[D]}{dt} = +k_2[A][C] - k_3[A][D]$$

$$\frac{d[E]}{dt} = +k_3[A][D]$$

$$\frac{d[F]}{dt} = k_1[A][B] + k_2[A][C] + k_3[A][D].$$

## Class Exercise 2

Estimate the parameters of the nonlinear model $y = \frac{1}{1+\exp(-(\theta_1+\theta_2 x))}$ . Use both fminsearch and lsqcurvefit. Data is provided in the code.

## Class Exercise 3

Estimate the parameters of the nonlinear model $y = \frac{1}{\exp(\theta_1+\theta_2 x^2)}$ using the data below. Use both fminsearch and lsqcurvefit.

x = [5 7 11 12 15 17 19]'
y = [0.93 0.91 0.84 0.82 0.76 0.71 0.66]';

Use initial guess of parameters as theta_init = [0.1 0.5];

## Class Exercise 4

Fit the ODE model parameters $a, b, c$ below to the data provided in ODE1_data.mat using fminsearch optimizer (The data provided is for the states y and z).

$$\frac{dx}{dt} = x + ay - z$$
$$\frac{dy}{dt} = x + z$$
$$\frac{dz}{dt} = bx - by + cz$$

using the initial conditions x(0)=1, y(0)=2, and z(0)=3. Use initial guess of parameters as abc_init = [10 30 7 ];

## Class Exercise 5

Estimate the parameters of the nonlinear model $y = \frac{x}{\theta_1 + \theta_2 x}$ using the data below. Use both fminsearch and lsqcurvefit.

data.xdata = [1:3:9, 11 14 19 21 23]'
data.ydata = [0.13 0.24 0.27 0.29 0.30 0.31 0.31 0.31]'

Use initial guess of parameters as theta_init = [100 50];

## Class Exercise 6

Fit the parameters $r, a, s, b$ of the predator-prey system of ODE below to the data provided in ODE_data.mat using fminsearch optimizer. (The data provided is for the states N_p).

$$\frac{dN_p}{dt} = rN_p - aN_pN_h$$
$$\frac{dN_h}{dt} = -sN_h + bN_pN_h$$

using the initial conditions for prey and predator given as $N_p(0)$=40, $N_h(0)$=9. Use initial guess of parameters as param_init = [0.2 0.025 0.02 0.01];