MAT 332, Fall 2018. Assignment 1. Due on Thursday, September 27, in class.

You must submit the assignment as a hardcopy – no emails will be accepted.

1. Linearize the system of equations describing the motion of a double pendulum (you will find the equations of motion together with the Java simulation in the supporting material on the course web page). What assumptions do you have to make in order for the linearized system to be a reasonable approximation of the physical model? Theorize as to what behaviour one should observe in the linearized system (bonus points for a supporting Maple plot).

2. This problem concerns the differential equations approach to describing the dynamics of love affairs. We denote $R(t)$ Romeo's love/hate to Juliet, and $J(t)$ love/hate of Juliet to Romeo. The general linear system describing the relationship is

$$\left\{ \begin{array}{l} R' = aR + bJ \\ J' = cR + dJ \end{array} \right\}$$

a. Describe what possible outcomes can be expected when Romeo and Juliet are both cautious lovers; that is, $a,\ d < 0$, and $b,\ c > 0$. Use Maple to illustrate the possible outcomes by plotting the phase portraits with particular values of a, b, c, d.

b. Do opposites attract? Analyze the situation when $J' = -aJ - bR$. Again illustrate with a Maple plot.

c. What if Romeo and Juliet are romantic twins: $J' = aJ + bR$.

d. Design your own example of a system of three differential equations describing a love triangle. Select some values for the coefficients, and give an informal description of the situation the system describes. Classify the equilibrium solution of the system, and give long-term predictions based on this analysis. Illustrate with a 3d Maple plot.