1 Lecture 25

Definition 1.1. An ordinary differential equation is a differential equation where the state vector depends only on one variable, usually time. A partial differential equation has the state vector depend on several variables.

Definition 1.2. A partial differential equation is in implicit form, if for each derivative of the state vector y that we denote by y^k, we have

$$f(t, y, y^2, \dots y^k) = 0$$

By contrast, an ODE is said to be in explicit form is we can write y^k as

$$f(t, y', y'', \dots, y^{k-1})$$

Definition 1.3. The order of an ODE is the degree of the highest derivative that occurs in the implicit form representation of an ODE.

Remark 1.4. We will restrict our attention to first order ODEs, for suppose we are given an explicit ODE, then we can define $u_k = y^k = f(t, y, y'', \dots y^{k-1})$ and we will find that

$$\begin{bmatrix} u_2 \\ u_3 \\ u_4 \end{bmatrix} = \begin{bmatrix} u_1' \\ u_2' \\ u_3' \end{bmatrix}$$

which is a system of kn first order equations (here, realize that u_k is a vector in $\mathbb{R}^n$).