Ch1: Basic Definitions

Ordinary: single independent variable. **Partial**: multiple independent variables. **Order**: highest derivative. **Linear diffeq**: additive combination of first powers: $a_n(x)\frac{d^n y}{dx^n} + a_{n-1}\frac{d^{n-1}y}{dx^{n-1}} + \cdots + a_1(x)\frac{dy}{dx} + a_0(x)y = F(x)$.

Example of linear: $t^3\frac{dx}{dt} - x = t^3$. **Nonlinear**: $\frac{d^2y}{dy^2} + y^3 = 0$ bc of y^3 term. Another: $\frac{d^2y}{dx^2} - y\frac{dy}{dx} = cosx$ bc of ydy term.

Explicit Soln: function $\phi(x)$ when sub for y in eqn satisfies for $\forall x$ in interval. **Implicit Soln**: Verify by differentiate implicit soln wrt ind. var on both sides to check if same as original.

Note: Diff of y wrt x becomes $\frac{dy}{dx}$

Existence & Uniqueness: 1. Find the form of the differential equation $\frac{dy}{dx} = f(x,y)$. 2. Identify the function $f(x,y)$ and the partial derivative $\frac{\partial y}{\partial x}$ such that both are continuous in the rectangle $(x, f(x))$. **Autonomous eqns**: $y' = f(y)$, rhs is fxn of dependent var only.

Method of Isoclines: $y' = f(x,y) = c$, solve for y to make isoclines (dotted lines), slope same along isocline.

Euler's Method: $y_{n+1} = y_n + hf(x_n, y_n)$, where h is step size $(\frac{dist}{numstep})$.

Ch2: Solving Linear 1st Order

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