

What is Numerical Analysis? It is an area of math that creates, analyzes, and implements algorithms for solving numerically problems of continuous mathematics:

- real-world applications of Calculus, Geometry, Linear Algebra, Real Analysis occurring throughout natural sciences, engineering, medicine, business, etc.

Growth in computer power \Rightarrow increasing use of realistic math models \Rightarrow need NA,

Background: numerical algorithms are almost as old as human civilization:

- ancient Egypt (~ 1650 B.C.):

papyrus describing a rootfinding method for solving simple equations.

- ancient Greece, Archimedes (287-212 BC)

creates "new math": "method of exhaustion" for calculating lengths, areas, volumes,...

(Ex: computing the area of a circle by filling the circle w/ a polygon of a greater area & increasing the number of sides, and using $\frac{A_{\text{polygon}}}{r^2} \approx \pi$
 $\Rightarrow A_{\text{circle}} \approx A_{\text{polygon}} \approx \pi r^2$)

- Calculus (17th cent.) developed by Newton and Leibnitz (independently!) led to accurate math models first in physics, then in other sciences.

- Read Chapter 1: modeling in computer animation, physics, sports, ecology, Google. (2)

Q: What we will be covering in this course?

Ch. 4 : Rootfinding problems ($f(x)=0$)

Ch. 5 : Computer Arithmetic

Ch. 8 : Approximation theory (approximating functions)

Ch. 9 : Numerical differentiation / Richardson extrapolation

Ch. 10 : Numerical integration

We will also talk about stability, error analysis, some problems of numerical linear algebra.

Ch. 11 : Numerical solutions of the IVP for ODEs.