



Calculus

Dr. Ajay Vadakkepatt
Department of Computer Science
Amrita Vishwa Vidyapeetham

Calculus

- Calculus
 - Mathematical study of continuous change or rates of change
 - Mathematical modeling framework
- Differential calculus
- Integral calculus
- Differential equations



Gottfried Wilhelm Leibniz



Sir Isaac Newton

Right amount of calculus

- Calculus taught in many semesters
- Focus on big picture
- Attempt to understand rather than memorization and manipulations
- Top down approach
- Most important - to enable students to use them in practice

Too Much Calculus

Calculus I, Calculus II, Calculus III—what an imbalance in our teaching! All the rest of mathematics is overwhelmed by calculus. The next course might be differential equations (more derivatives), and the previous course is probably pre-calculus. I really think it is our job to adjust this balance, we cannot expect others to do it. We know the central role of linear algebra. It is much more than a random math course, its applications touch many more students than calculus. We are in a digital world now.

Since I am urging that we do something about our teaching which might mean persuading and even leading our colleagues, I should highlight the good that can come. When more students take linear algebra, the mathematics department is doing something right. Statistics and discrete mathematics are needed too. The chair (and even the dean) will approve. Most of all, we are doing something right for our students.

The feeling that “Linear Algebra is a good course” is communicated to the class. They won’t be stars, but this is a course they can catch on to. The web can help

<http://web.mit.edu/18.06/www/Essays/too-much-calculus.pdf> - Essay by Prof. Strang

Online reference materials

- Highlights of calculus – Prof. Gilbert Strang, MIT
<https://ocw.mit.edu/courses/res-18-005-highlights-of-calculus-spring-2010/>
- Essence of calculus - Grant Sanderson
<https://www.youtube.com/playlist?list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr>
- Calculus 1 and 2 – Prof. Linda Green, UNC
https://www.youtube.com/watch?v=HfACrKJ_Y2w&t=2495s
<https://www.youtube.com/watch?v=7gigNsz4Oe8>



Calculus

Dr. Ajay Vadakkepatt
Department of Computer Science
Amrita Vishwa Vidyapeetham

Language of Calculus

THE LANGUAGE OF LINEAR ALGEBRA

GILBERT STRANG



To express the ideas of linear algebra we need words. To use those words — to speak this subject — is to connect those ideas. Our goal in teaching is mastery of the language, which requires mastery of the words and ideas.

Certainly, the words don't all come at once. We build from one level to the next, as safely as possible. At level zero are the real numbers. At level one, m numbers are the components of a vector. At level two, we take linear combinations of n vectors; these vectors a_1, \dots, a_n

Motivation



Language of Calculus

- Functions
- Limits
- Continuity
- Differentiation
- Integration
- Slope
- Tangent
- Instantaneous rate of change
- Derivatives
 - First derivative
 - Second derivative
 - Higher order derivatives
- Single variable calculus
- Multi variable calculus
- Gradient
- Hessian

Language of Calculus

- Chain rule
- L'Hôpital's rule
- Substitution
- Implicit differentiation
- Concave and convex functions
- Points of local minima/maxima
- Inflection point
- First derivative test
- Second derivative test
- Antiderivatives
- Summation
- Indefinite integrals
- Definite integrals
- Integration by parts
- Reimann sum
- Mean value theorem
- Fundamental theorems of calculus
- Infinite Series
- Taylor Series

Language of Calculus

- Ordinary differential equation
- Partial differential equation
- Initial conditions
- Boundary conditions
- First order differential equations
- Second order differential equations
- Linear differential equation
- Non-Linear differential equation