TSINGHUA MATHCAMP 2017: COMPUTATIONAL MATHEMATICS

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Computational mathematics involves mathematics where computing plays a central and essential role. It creates, analyzes, and implements algorithms for numerically solving real-world problems from different disciplines including physics, biology, economics, social science, engineering, and computer science. The overall goal is to design and analyze efficient and reliable numerical methods and use them to model, study, and solve important applications such as fluid dynamics, mechanics, image processing, bioinformatics, and machine learning.

In this course, we will start with some simple questions, for example, "How does my calculator compute the square root of 2?". We will focus on the development of numerical algorithms and computational techniques and the primary objective of the course is to understand the construction of numerical algorithms and, more importantly, the applicability and limits of their usages. We will discuss the mathematical foundations of numerical algorithms and their implementations on computers under finite precision arithmetic.

The topics of the course include: floating-point arithmetic, approximation theory, numerical integration, solving linear and nonlinear equations, numerical optimization, and numerical solution to differential equations. As for pre-requisite for this course, knowledge of high school mathematics and a little bit basic calculus would be enough.

There will be homework assignments regularly as well as research projects. They will feature some of the practical applications of numerical algorithms to solve real-world problems. Homework problems will consist of written problems as well as computer programming assignments in Matlab (or your favorite programming language). Mathcampers are encouraged to work together.