

TSINGHUA MATHCAMP 2021 COURSE: LINEAR ALGEBRA

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Linear algebra may be thought of as the study of linear equations, like the familiar equation $x + y + z = 1$. But the subject permeates other ends of the mathematical world including topology, geometry, analysis, not to mention algebra itself! As a tool, its power can also be felt throughout mathematical sciences at large, reaching the deepest corners of physics, biology, economics, and countless other fields. All fancy stuff.

We, however, will go all the way back to the very beginning instead, and ask very basic questions. We solve equations using numbers. But what are *numbers*? *Why* linear equations? Solving them tells us what? How do we solve them? How do we *describe* solutions – their shapes and sizes? What does it mean to say that “the equation $x + y + z = 1$ describes a plane in 3-space?” Given a point P and a plane H in 3-space, how do we find the point in H closest to P ? Given n points on a plane, can we find a straight line that is the ‘closest’ to all those points? Some of these questions obviously connect linear equations with geometrical objects we can visualize. We will dig deeper into this algebra-geometry connection to see how understanding objects in geometry tells us about linear algebra problems and vice versa.

As for pre-requisite or background for this course, Mathcampers are not expected to have had any prior advanced training in mathematics, but good working knowledge of high school algebra – equations in one or two variables, real numbers – some familiarity with calculus and complex numbers, plus a bit curiosity would give them a great start!

Homework problems will be assigned in class almost daily during the lecture, and they will be checked and returned to students on a regular basis. One or more research projects will be announced during the first week of Mathcamp. Mathcampers will be meeting and working with two Coaches in this course, in addition to the Lecturer. The Coaches will be meeting with Mathcampers everyday, to work with them on their homework assignments and their research projects. Mathcampers are also very much encouraged to work with each other.