

RATIONAL TANGLES

אם יותר נוח לכם, אשמח להסביר את הדברים הבאים גם בעברית.

Take a piece of string, loop it around itself in several different ways, and tie the two ends together. You have created a knot. You might get something like one of these:



In more abstract mathematical language, you can think of a knot as a continuous one-to-one map f of the circle $\mathbb{T} := \{(x, y) : x^2 + y^2 = 1\}$ into \mathbb{R}^3 .

Suppose I give you two quite complicated knots. They might look very different, but perhaps they are somehow the same knot. Can you transform one of them into the other by pushing it smoothly, without any part of it intersecting or crossing any other part of it? This is a basic question in knot theory and very sophisticated methods have been developed to answer it. You might care to look, for example, at the Wikipedia article on knot theory. As you will discover there, knot theory is not just a fancy game. It has deep connections with several other fields of mathematics, physics and even biology. There are faculty members in our department who do research in knot theory.

I invite you to participate in a summer project, not exactly about knot theory as such, but in a closely related topic called Rational Tangles. Part of what we do will be “hands-on”, working with real pieces of string, tangling them together via a series of well defined actions, and then seeing how we can untangle them. We will use special functions to assign a special number to our tangled pieces of string after each action, and we shall see that we can untangle even a quite messy tangle of strings obtained in this way by doing another series of actions which make that special number go back to zero. We will explore the connection of what we are doing here with group theory, with a special group of matrices. Among other things, we might ultimately also be able to give a public lecture to other students and faculty in the department and show them a quite dramatic live demonstration of tangling and untangling.

You can get an idea of some of the things that we will be doing, or at least trying to do, by reading this article.

<http://www.geometer.org/mathcircles/tangle.pdf>

and there is quite a lot of other material about rational tangles on the internet.

I will be happy to discuss this further with you, if you wish.

Wishing you all the best, including of course success in your studies and research.

כל טוב, בהצלחה!

מיכאל צויקל

Michael Cwikel

`mcwikel@math.technion.ac.il`