INT. Professor Freidrich - Classroom

A mathematician in a lab coat stands in front of a whiteboard. Scrolled across the whiteboard in large letters is written: SYMMETRY by Professor Freidrich.

PROFESSOR FREIDRICH

Hello disciples of the numbers, I am professor Friedrich and in today's video we will be discussing symmetry. Look around you, our beautiful reality is brimming with symmetry, just look at yourself, two feet attached to two legs split by two cheeks! The uses of symmetry are endless, whether it be mathematics, physics, architecture, biology, the list goes on and on. In this video I'll introduce symmetry and we'll look at developing basic linear matrix transformations as they apply to a graph in R2.

Let's start basic and try to find the symmetry of a line with respect to the x axis, or in other words: reflect over the x axis.

Take the line x = y.

Lets first visualize what the reflected line will look like.

Professor Freidrich pulls out a mirror and places it along the axis on the paper, facing the camera.

When the mirror is placed down, the reflection forms a **V** with the reflected line. The mirror also reflects the camera itself. In the background is a large angry woman who is holding the swivel of a tripod in one hand and an enormous pickle in the left. She takes a bite out of the enormous pickle.

PROFESSOR FREIDRICH

Now that we can see the line the next step is to describe the transformation. We can

see that both lines share the same x values but the y values of the new line are the -y values of the original.

The woman reaches behind her and pulls out a cosco size jar of mayo. She plunges the pickle into the jar, prodding around in the tub of sauce before achieving a satisfactory dollop. She pulls it out and takes another bite.

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I now want you to pause the video and try to work out what the matrix that describes this transformation might look like.

She frowns and inspects the jar of mayo, as if to check the expiration date. The woman takes two fingers and scoops out a dollop. The video pauses right as she brings her finger to her nose and takes a deep whiff. Her eyes wide as she takes in the pungent stench of expired mayo.

The video continues.
Professor Friedrich removes the mirror and the women can no longer be seen.

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Reflecting over the y axis is no different than reflecting over the x. However we cannot limit ourselves to solely reflecting over the axis. Instead, lets now use the equation x=y as the line of reflection. Let's take a square in the second quadrant. If we reflect over the x=y line we get:

Professor Friedrich pulls the mirror back out and places it on the line. The woman is again in view. She is now holding an ant farm in her lap. She dips a single finger into the ant farm and waits. Slowly, a brigade of ants pushes up her pointer. After the first ant reaches her knuckle she removes the finger and thrusts it into her mouth, slowly she slides it out.

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This time, it's a bit harder to form the matrix equation. Let us begin by examining the slope of the line.

Professor Friedrich picks up the mirror and places it to his side. In the reflection a mound of empty mayo jars in what would normally be used as a fireplace. A greasy dog licks at the rims.

PROFESSOR FREIDRICH
Where symmetry really starts to get interesting is when we look at continuous functions such as a parabola or higher level polynomial that naturally display symmetry.

The mirror again faces the women. A young child runs up to the woman whose finger has a fresh coat of ants. The woman notices the child extends her finger, allowing the child to suckle upon the appendage. The child goes to stick its finger in the ant farm but the woman quickly grabs her pickle and slashes the child's wrists, banishing it away.

PROFESSOR FREIDRICH
And because of these properties symmetry comes in useful in analyzing systems such as magnetic fields or constructing diagrams for bridges and other complex structures. Symmetry helps break up complex problems.