In this tutorial, you're going to learn about Venn diagrams, which are an ever important idea in probability theory. Venn diagrams were invented by a guy named John Venn, who was a logician. And they're useful for understanding the relationships between two different sets of objects. Or in our case, two different events in probability.

So let's take a look. A typical Venn diagram with two sets, intersecting sets in it, has four parts to it. There's the part of it that only is in event A but not in event B. There's a part of it that's only in event B, but not event A. There's the part that's both events A and B. And then there's the part that's neither A nor B.

All right, so let's take a look. Suppose that in a high school of 80 students, 18 of them take statistics, 15 take economics, and eight students take both. So what would that look like in terms of the number of students that go in each of these four areas? The first instinct of most people is to say 18 goes here in the statistics bubble, 15 goes here in the economics bubble, eight goes here in the both bubble, and whatever's left of the 80 goes on the outside. And that's not a horrible idea. The only issue that arises is-- well, we'll get to in a second.

Take a look. We're going to start with the innermost part, the eight students that take both. When I go back and I look at the 15 students that take economics, that means that within this entire circle of students that take economics, there are 15 of them. Now we've already seen that eight of them are also taking statistics. That doesn't mean they're not taking economics. It means they're taking economics and statistics.

So of the 15 that are taking econ, seven of them are taken econ only. And eight of them are taking statistics too. So we're going to put seven in the economics only area. We're going to apply the same logic to the other side and say, of the students taking statistics, there are 18 of them. Eight of them are also taking econ, which means there are only 10 students taking statistics only. Now that adds up to 10, 18, 25 students that are taking either one or both of statistics or econ. That means there are for the 80 students that remain, 55 of them are taking neither of the two.

We can also show complements in a Venn diagram. And remember, complements are everything that's not in a particular event. So if I'm talking about the complement of A, it's everything outside of the A bubble, including this part of B. But this overlap portion is in fact in A. And so we're not going to shade it as part of the complement. But the part of B that's B only and the part that's neither are the complement of A.

Now, not all Venn diagrams need overlap like this. Sometimes, the two events, A and B, don't have any outcomes in common. So suppose A was the event of rolling an even number, and B was the event rolling a five. There's no overlap between the two ideas. So we can draw the bubbles as separate with no overlap instead. And we'll put the even numbers in A, just the five because rolling a five is in B. There's no both. And then the neither odd nor five is one and three. So we can list these specific outcomes in a Venn diagram as well.

And so to recap, many relationships between events can be represented. We talked about complements. We talked about overlap. We talked about not overlap. And there's a lot of different things that we can do with a Venn diagram when we're talking probability. Two event Venn diagrams, which is the ones that we were doing, consist of four areas, the A only area, the B only area, the both area, and the neither area.

And the total number of items can be found by adding up all the subcategories within that event. So this was like when we were doing the 18 statistics students, eight of which were already accounted for. So we only needed to put 10 in the statistics only category. So Venn diagrams are very, very useful tools. Good luck. And we'll see you next time.