Let's first take a very simple example whereby I have two point masses which are connected through a mass less rod-- a little bit artificial, but later I will relax the situation. I have here a mass m 1, I have here a mass m 2, and I would assume that these masses themselves have no finite size-- it's a point mass-- so there are these two discrete masses. I rotate the system about an axis perpendicular to the line that connects them. Let this distance be r 1, let this distance b r 2, and I want to know the moment of inertia about this axis.

As we defined, moment of inertia is this sum of m of i over all the masses here-- in this case, i equals 1 to 2, because we only have 2-- r i squared, and r is the distance from the mass elements through the axis of rotation. That's relatively easy here. This is a distance from this mass to this axis, because it's already 90 degrees, and this is the distance from this mass to the axis. In this particular case, we find that I about this axis equals m 1 times r 1 squared plus m 2 times r 2 squared.

Now imagine that I rotate this system about this axis-- again, perpendicular to the to the direction that connects the two masses. I want to know what the moment of inertia is about this axis. Since m 1 has no size, r 1 is now 0, there is no distance between this mass and this axis of rotation-- so the only mass that contributes to the moment of inertia is mass 2. We now find that the sum of m of i R i squared is simply m 2, times this distance-- the distance from m 2 through this axis, which is r 1 plus r 2 squared.

This number is different from this number-- the two are clearly not the same, so this shows you that moments of inertia do depends very much on which axis you choose. It's not an intrinsic property of, in this case, two masses-- it depends on how you choose the axis. If I chose the axis to coincide with the mass less rod that connects the two, then the moment of inertia would be 0. If here is that point mass m 2, here is the point mass m 1, and here is the mass less rod that connects them, clearly if this is a point mass, the distance of this mass through this axis of rotation is 0, both for this one and for this one-- so here, you would have a moment of inertia which equals 0. There's a huge difference about how you choose the axis.

If I continue with this rather artificial situation whereby we have point masses-- m 2, and we have a point mass m 1-- point mass means no finite size, and this is a mass less bar that connects the two. If now I make them rotate about this axis at an angle theta-- and this is r 1, and this is r 2. I now have to remember that I equals the sum-- I equals 1 to 2 of m i times r i squared, but r i is the distance from the mass to the axis of rotation. That distance is this: [? r ?] 1, and this equals r 1 times the sine of theta. That distance here equals r 2 times the sine of theta.

Now the moment of inertia becomes m 1 times r 1 sine theta squared plus m 2 times r 2 sine theta squared. I could write down that it is sine squared theta times m 1 r 1 squared plus m 2 r 2 squared. You can see immediately that when theta equals 90 degrees-- that means when the axis is perpendicular to the line that connects them, that you have a maximum. We already derived that, but when theta equals 0, and the axis is like this, then the moment of inertia equals 0. Here, the moment of inertia is the maximum value possible-- it very much depends on the geometry.