

Issues in Contemporary Metaphysics

Lecture 6: Space

1. Substantivalism and Relationism

Substantivalism

Says space (or spacetime) exists. Moreover it is that it exists *independently of material objects*. So universe devoid of an matter is still rife with existing things – regions of space.

Apparent quantification over regions is literal:

e.g. Bob Hope is located somewhere in the ground.

$\exists x \exists y (Lxy \ \& \ x = \text{Bob Hope and } y = \text{some place underground})$

e.g. Mwai Kibaki is in Kenya.

$\exists x \exists r \exists R (Fx \ \& \ Lxr \ \& \ PrR \ \& \ R = \text{Kenya})$

Relationism

Relationists say space doesn't exist. Just as things can be blue without *blue* existing, the planets can be eight in number without numbers existing and there can be three ways for me to win a chess match without possible worlds existing, this *doesn't* mean they believe some whacky theory like Idealism. Things are *in space* and things *stand in spatial relations* but none of this requires an extra entity to be included – the spatial regions.

2. Kant and Chirality

Take a left hand. Now take a *mirror image* of it. A right hand. No matter how you rotate the mirror image it can't be superimposed over the other one. Not every object and its mirror image is like that. Say anything that anything which *can't* be rotated and superimposed on its mirror image has the property of *chirality*. Chirality is important, not just to deciding which hands are left and which are right.

Next: we generally assume that spatial properties of an object depend upon something else. I am 5'11" (ish) just because my atoms are arranged in a certain way (such as the top one being nearly six feet from the bottom one). So my spatial property here depends (internally) on the properties and relations of my parts.

But this principle causes problems. If the hands were attached to arms, it'd be clear what fixed the chirality. But if you just had a lone left hand in space what would make it left handed? It would be left rather than right – an objective fact (that makes a huge difference in chemical cases). *What determines that fact?*

Can it be the properties of the parts of the hand? Kant says not as they're the same! So it must be a relation to *something else*. But what could that something else be? We are imagining a hand all on its own! So says Kant, it must be a relation to *absolute space*. 'Absolute space' being a big reified region of space. That is, you can never truly have a lonesome hand. You can have a hand unaccompanied by other material objects. But it can't be unaccompanied by a region of space.

3. Leibniz's Shift Argument

Imagine some objects related by spatial relations. Given relationism *that's it*. That's the whole story told. Given substantivalism, there's also absolute space. And the objects are located somewhere in it. But that means it makes sense to say that the objects could be elsewhere. That *all of them* – the *entire universe* – could be a few centimetres to the right. No-one would notice! *Nothing observable would be different!* That, says Leibniz, is ridiculous – so absolute space is ridiculous.

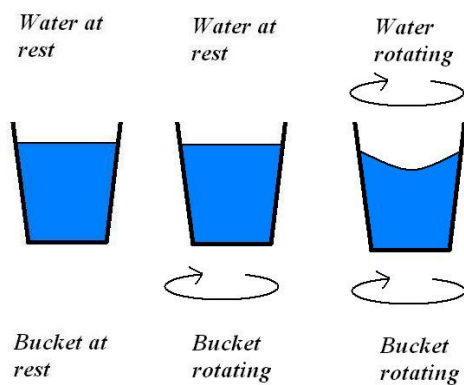
4. Newton's Bucket Argument

Velocity and Acceleration

Velocity is speed in a certain direction. It's also *relative* to something. Imagine you're in a box travelling along at 500 m/s. So you'd be going 500 m/s relative to me, and me to you. And relative to someone going 300 m/s, you'd be going 200 m/s. So are you going 500 m/s or 200 m/s? Well, depends who you ask.

You might think there's an *absolute* velocity. But most people think otherwise. If you were travelling at a constant 500 m/s relative to me, in a box, you'd never know. You wouldn't feel any forces. No forces – no way to tell. No way to tell – no difference in reality.

Acceleration is just a change in velocity. You can have relative accelerations. If you zoom off at 5 m/s² then we're accelerating at that rate relative to one another (with me accelerating relative to you in the other direction). But unlike velocity there are 'special' accelerations – if you listed all of my relative accelerations one of them would be special. I do know who is *really* accelerating out of you and me. This is because I can *feel* the difference.



The Argument

If velocity is to be relative to something, and acceleration is a change in velocity, then acceleration has to be relative to something. The special *absolute* acceleration – what is that relative to? What if there *wasn't* anything for it to be relative to – that is, no object? Imagine a bucket suspended by a piece of rope. Twist said rope, then release the bucket. The bucket begins to spin. So in the first case: *both* bucket and water are at rest with one another. In the second case: bucket and water are in motion relative to one another. In the

third case: *both* bucket and water are at rest with one another (the water now moving with the same velocity as the bucket). But in the third case, the water surface is concave. There's a difference between the two! It's caused by *inertial forces*, by the *absolute acceleration* of the water. But what's that acceleration relative to? It can't be the bucket! It's at rest relative to the water! It's Absolute Space!

Responses

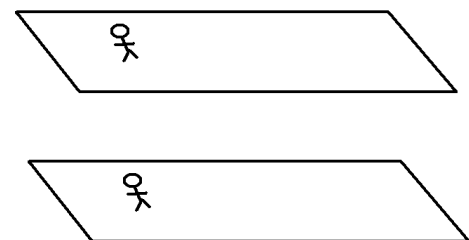
Relationists don't give up the ghost yet. There are responses: Mach's response (that is acceleration to 'the stars') and Sklar's response that absolute acceleration isn't relative to anything.

5. Spacetime

Galilean Spacetime

Imagine that guy didn't move. What would that area of space look like later on? We might say he is in the same place – sound good? But that's *bad!* To be in the same place would be to have velocity of 0 – to not have moved. But that's only ever true *relative* to some inertial frame. That is, if absolute space existed there'd be no difference between him staying where he was and him moving constantly to the right at 5 m/s. So one can only be 'in the same place as' something else *at a different time* once you fix its inertial frame of reference.

If there's no physical difference, people suspect *there is no difference*. That is, not only are we *unable to tell* when I am in the same place as something from another time (without mentioning a



frame of reference) but *there is no fact of the matter*. So the relation ‘the same place as’ can only hold between things that exist at the same time.

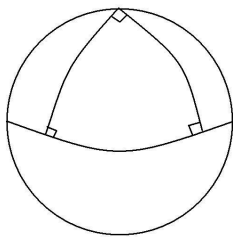
Minkowski Spacetime

Just as it’s impossible to tell whether you’re in the same place as something else until you figure out your inertial frames of reference the theory of special relativity (more next lecture) says that you can only tell whether you’re *simultaneous* as something else once you’ve figured out the inertial frame of reference.

So if I am going at one speed and you’re going at a different one, what’s simultaneous relative to us differs. We might be simultaneous with one another, but you might be simultaneous with events that I’m not simultaneous with. Now, just as it is unacceptable to say that something is ‘the same place as’ something else without mentioning inertial frames, we can’t even do that for simultaneity! Now the distinction between space and time is (allegedly) destroyed. Instead of space and times it’s all one big piece of spacetime, and different slices of spacetime are instants *relative to* someone’s inertial frame of reference.

6. General Theory of Relativity and Non-Euclidean Geometry

Euclidean Geometry



Starts with Euclid. He had many axioms of geometry that guaranteed various geometrical truths. *e.g.* triangles have angles adding up to 180 degrees. Gauss, Bolyai and Lobachevski all came up with Non-Euclidean Geometries: systems that were consistent, but denied the parallel postulate. These systems were logically on a par with Euclidean geometry – if one contained a contradiction, they all would! Conclusion: Non-Euclidean geometries weren’t contradictory, and maybe triangles had more than 180 degrees (see diagram).

General Theory of Relativity

GTR seizes upon this, and stops treating gravity like a force and instead treated it as a result of spacetime being curved in a certain way. It explains certain things, such as gravitational lensing. Why does this make spacetime curved? Well, if nothing travels superluminally then a beam of light will always trace the shortest path between two points (the ‘null geodesic’). If objects with mass affects this path, then an object with mass *literally* changes the shortest path between points! It must be warping spacetime.

How does this relate to the substantialist/relationist debate? Consider examples from above of non-Euclidean space – there are observable differences. If it’s warped around on itself (like the cylinder) it’s finite. You can discover this! And the angles of triangles change etc. Same goes for spacetime. So if spacetime was non-Euclidean (like GTR suggest) there would be noticeable differences! How does this affect the debate? Recall the argument for Relationism – we could live without spacetime, it had no value, no explanatory purpose. Certain effects could be explained by the shape of spacetime. So spacetime *is* explanatory! So the shape of the spacetime *explains* why it takes me so long to cross the room. So in those cases spacetime would have a role to play.