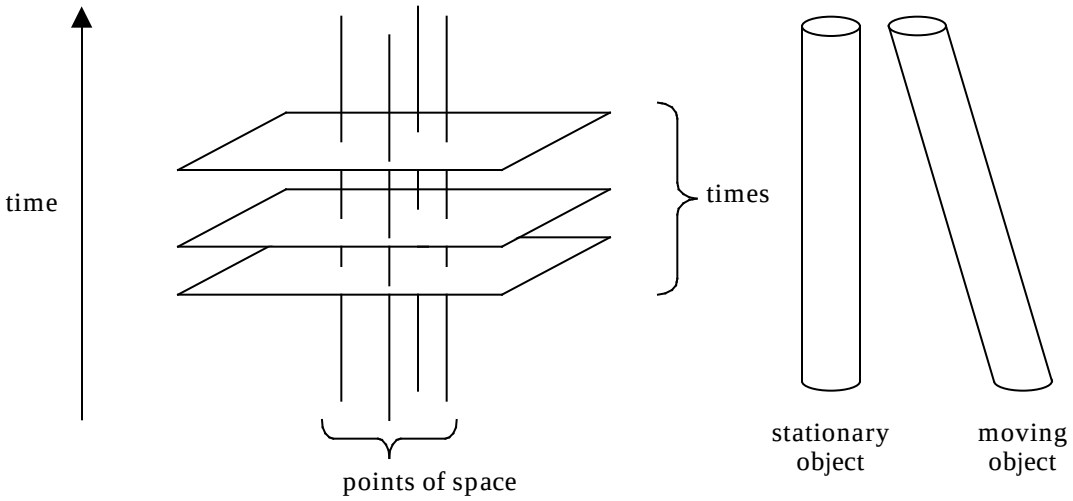
Spacetime
February 7, 2001

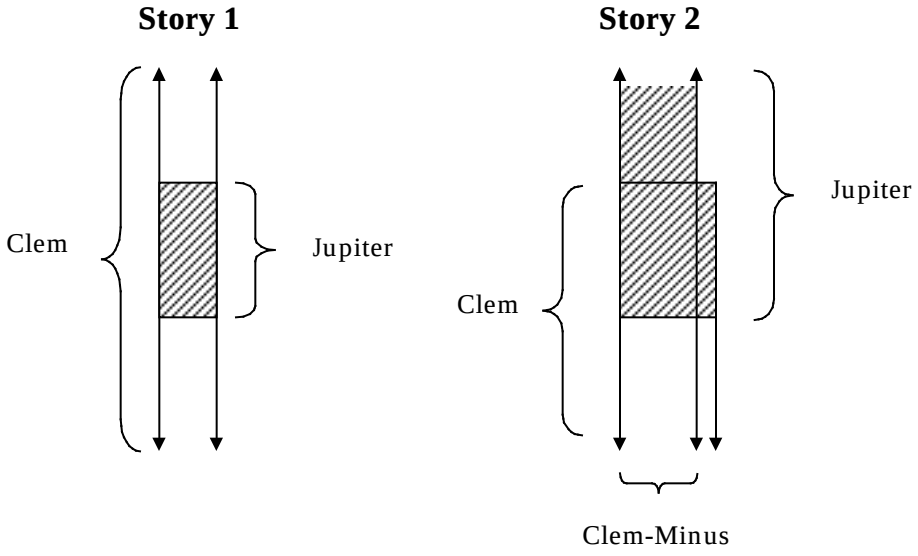
1. Maps of space, maps of time and maps of spacetime

To draw a perfect map of spacetime you would need four spatial dimensions. So in practice we pretend that space is two- or one-dimensional.

The 'Newtonian' way to read a spacetime diagram: each point in the diagram picks out (i) a point of space, and (ii) a time. A line parallel to the time axis corresponds to a point of space; a plane perpendicular to the time axis corresponds to a time. A stationary object occupies a region of the diagram that is parallel to the time axis; a moving object occupies a slanted region.



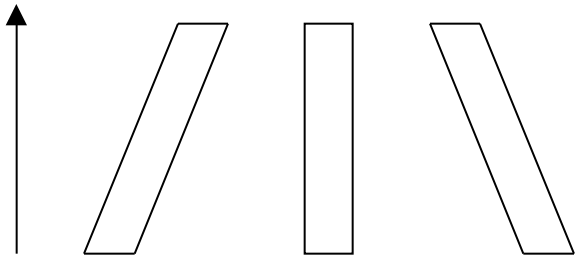
2. Diagrams of statues and lumps



3. More on the geometry of spacetime

Even on the Newtonian view, there is nothing to stop us introducing the notion of a "spacetime point"—the sort of thing represented by a point in a spacetime diagram. We could take a spacetime point to be a pair comprising a point of space and a time.

However, there are considerations coming from physics that support the view that spacetime points should be taken as the basic entities, with spaces and times being built up from them (somehow). The principle of Galilean Relativity, which follows from Newton's laws of motion, says that there is no observable difference between two situations that differ only by a 'boost': the addition of the same component to everything's velocity. This suggests that we should deny that the notion of absolute rest has any real, physical meaning. It is just a matter of convention which of the following diagrams we choose to represent a certain situation:



There is nothing special about any one set of parallel straight lines that intersect all times that could make us call them, rather than any such set, the points of space. This structure is called *Neo-Newtonian Spacetime*.

In the twentieth century, Einstein introduced the special theory of relativity, which makes it natural to take a different view of the geometry of spacetime: this is called *Minkowski spacetime*. The *general* theory of relativity involves something even stranger.

4. The Doctrine of Temporal Parts

AKA: four-dimensionalism; the claim that things perdure

(i) For every material object and every temporal interval [or instant], there is a material object that occupies exactly those spacetime points that are occupied by that object and occur during that interval [or at that instant].

(ii) For every material object and every temporal interval [or instant], there is a material object **which is part of the first material object** that occupies exactly those spacetime points that are occupied by that object and occur during that interval [or at that instant].