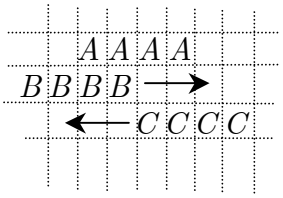
Homework #2. Due: Thurs 9/21

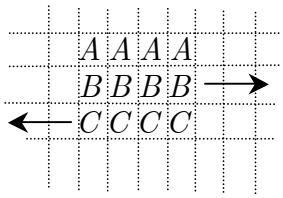
1. Here is one interpretation of Zeno's Paradox of the Arrow. (see Moore, pg. 25). A straight line can be infinitely divided, because it consists of points, and between any two points, no matter how close they are to each other, is another point. This suggests that a point has no dimension; it has no "parts". Similarly an interval of time consists of "instants", and between any two instants, no matter how close, is another. So, like a point, an instant has no parts. In this case, we can say that an instant has no "before" and no "after". Now ask the question: Does an arrow move during an instant of the time interval it's in flight? Zeno's answer is no, because motion assumes a "before" and an "after", and we've established that an instant doesn't have such parts. But, if an arrow doesn't move during an instant of the time interval of its flight, and the time interval consists of the collection of all of its instants, then the arrow doesn't move at all! (Zeno concluded that motion in general is impossible.)

   (a) Does motion assume a "before" and an "after"? If so, why? If not, why not?
   (b) Is it necessarily true that if an arrow doesn't move during an instant, then it can't be said to move during a time interval? How could it be otherwise?
   (c) Consider a snap-shot of an arrow in flight. Suppose the picture is taken with a very high-speed shutter, so there's no blurring. Could you tell that it was a picture of a moving arrow and not a picture of an arrow at rest? If so how?

2. Here is one interpretation of Zeno's last paradox (brifely mentioned on pg. 25 of Moore). Instead of three bodies A, B, C, let's image three sets of four chariots each, call them the A-chariots, the B-chariots, and the C-chariots. Image they are lined up in a stadium and moving according to the following diagrams:



At time t_1:
The A-chariots are at rest.
The B-chariots are moving to the right at speed v.
The C-chariots are moving to the left at speed v.



At time t_2:
All chariots are lined up.

Now assume:
(a) Each chariot occupies one unit of space.
(b) The B's and C's are moving at speed $v = 1$ space-unit/1 time-unit
(c) Space and time units have no parts.

Zeno now asks, How many time units are there between t_1 and t_2? He thinks there are two equally possible responses:

   (i) 2 units of time. The first B-chariot moves past 2 A-chariots, and the first C-chariot also moves past 2 A-chariots. At speed v, to move 2 space-units requires 2 time-units.
   (ii) 4 units of time. The first B-chariot moves past 4 C-chariots. The first C-chariot moves past 4 B-chariots. At speed v, to move 4 space-units requires 4 time-units.

Both responses can't be right! (Zeno concluded, again, that motion is impossible.) Which is the correct response and why?