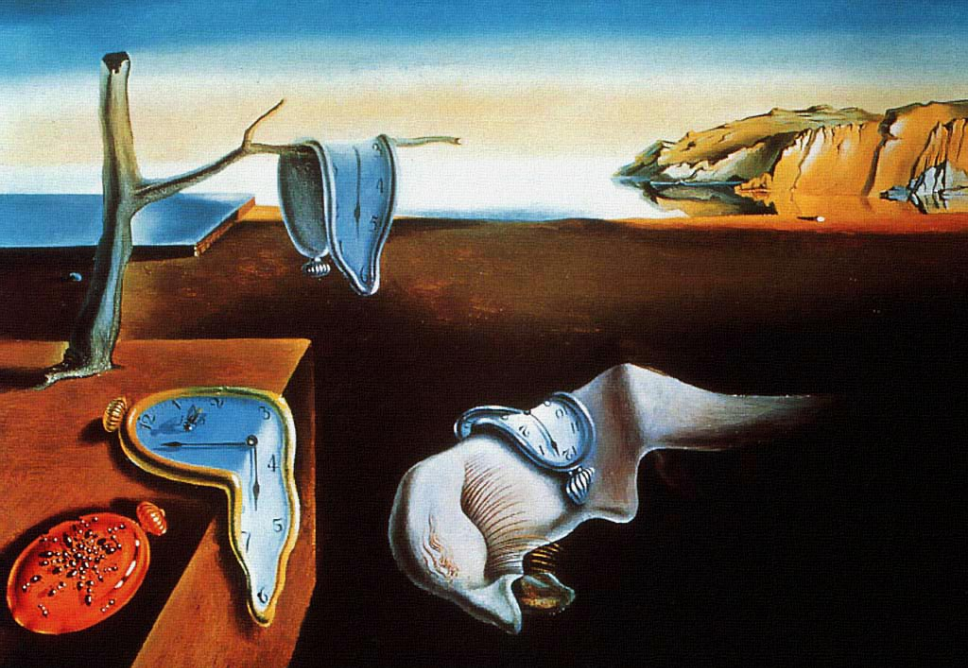


The Time Story

A glowing clock face is held in two hands, with a bright light emanating from it. The clock face is white with black numbers and hands. The hands are positioned to show approximately 10:10. The background is dark with green grass and water droplets. The text is overlaid on the clock face.

Mahn-Seo Choi (Korea Univ)

October 1, 2013 (v5.4)



The Persistence of Memory (Salvador Dalí, 1931)

Image courtesy of <https://apah.wikispaces.com/>

The Concept of Time

in literary fiction

“Humans see time as a straight line. It’s like putting notches on a long straight stick. The notch here is the future, the one on this side is the past, and the present is this point right here. Do you understand?”

“I think so.”

“But actually time isn’t a straight line. It doesn’t have a shape. In all senses of the term, it doesn’t have any form. But since we can’t picture something without form in our minds, for the sake of convenience we understand it as a straight line. At this point, humans are the only ones who can make that sort of conceptual substitution.”

1Q84 (Murakami 2011)

The Concept of Time

in literary fiction

Time: Human beings and ants perceive the passage of time very differently. For human beings, time is absolute.

Whatever happens, seconds always have the same periodicity and duration. For ants, on the other hand, time is relative. When it is hot, the seconds are very short. When it is cold, they stretch out indefinitely until consciousness is lost during hibernation.

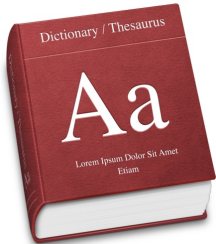
This elastic time gives them a very different perception of the speed of things from our own. **To define a movement, insects use not only space and duration but also a third dimension, temperature.**

Empire of the Ants (Werber 1999)

So, what is time?

“Time”

(in dictionaries)



the indefinite continued progress of **existence** and **events** in the past, present, and future regarded as a whole

<http://apple.com/>



Time is part of the measuring system used to sequence events, to compare the durations of **events** and the **intervals** between them, and to quantify the motions of objects.

<http://en.wikipedia.org/>

The History of Korea

(a sequence of events)

King	Event
선조 즉위	임진왜란 정유재란
광해국 정권 시작	허준, "동의보감" 완성
인조 즉위	인조 반정 병자호란 강화도 함락
효종 즉위	

The History of Korea

(a sequence of events)

Year	King	Event
1567	선조 즉위	
1592		임진왜란
1597		정유재란
1608	광해국 정권 시작	
1610		허준, "동의보감" 완성
1623	인조 즉위	인조 반정
1636		병자호란
1637		강화도 함락
1649	효종 즉위	

Time

(a “regular” sequence of events)



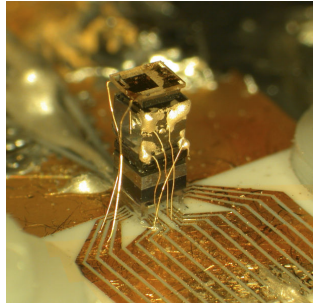
<http://creativethinkersintl.ning.com/>

Time

(a “regular” sequence of events)

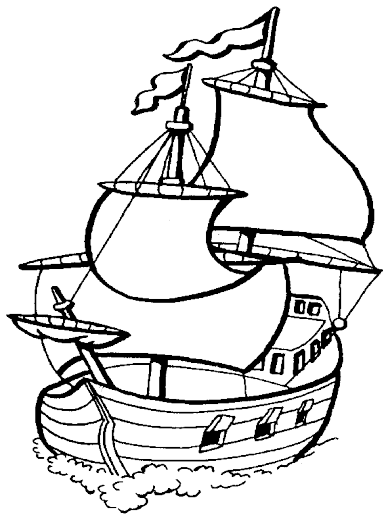


<http://creativethinkersintl.ning.com/>



<http://commons.wikimedia.org/>

The Concept of Simultaneity



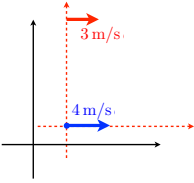
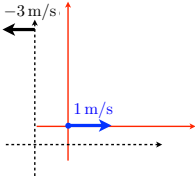
- The wind blows from the north to the south. The boat is at rest. In which direction does the flag fly?

- The wind blows from the north to the south. The boat is at rest. In which direction does the flag fly?
- There is no wind, and the boat sails to the west. In which direction does the flag fly?

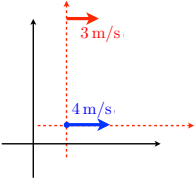
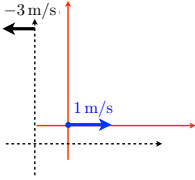
- The wind blows from the north to the south. The boat is at rest. In which direction does the flag fly?
- There is no wind, and the boat sails to the west. In which direction does the flag fly?
- The wind blows from the north to the south at 4 km/h. The boat sails 3 km/h to the west. In which direction does the flag fly?



Daredevils playing tennis on plane (New York Time, 1925)

Frame		
State	x, v	x', v' $x' = x - ct$ $v' = v - u$
Physical law	$F = ma$	$F = ma'$

Galilean Relativity

Frame		
State	x, v	x', v' $x' = x - ct$ $v' = v - u$
Physical law	$F = ma$	$F = ma'$

Theory of Relativity

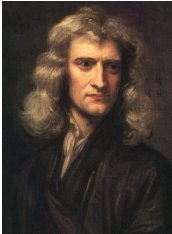
Physics should look the same in all inertial reference frames.

Two observers using two different sets of coordinates (based on two different reference frames) should agree on the predicted results of all possible experiments.*

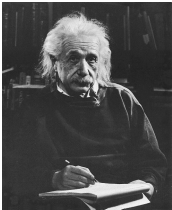
*An excerpt from Srednicki (2007).

The Concept of Time

(“simultaneity”)



Time is considered to be “absolute” and to flow “equally” for all observers. Events seen by two different observers in motion relative to each other produces a mathematical concept of time.



Invoking a method of synchronizing clocks using the constant, finite speed of light as the maximum signal velocity. This led directly to the result that observers in motion relative to one another will measure different elapsed times for the same event.

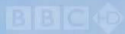
Source: Wikipedia
See also: Jammer (2006)

Space vs Time

Time in classical/quantum mechanics is merely a “parameter”.

	Nonrelativistic	Relativistic
Classical	Classical mechanics	Special theory of relativity General theory of relativity Maxwell equations
Quantum	Quantum mechanics	Dirac equation Quantum field theory QED, QCD, etc. String theory (?)

More About Time



Angel Falls, Venezuela

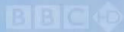


Angel Falls, Venezuela



Angel Falls, Venezuela

The Arrow of Time



Angel Falls, Venezuela

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- H. Murakami, *1q84*, trans. by J. Rubin & P. Gabriel (Knopf, New York, 2011).
- M. Srednicki, *Quantum field theory*, (Cambridge University Press, Cambridge, 2007).
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