Essl 290 Spring 21

Lecture 2

Fri: Will cover pgs 6-11. ← background
14-20

Mon: Assignment due by 5pm
- available on website
- turn in written responses on seperate page
- can discuss with other students but write individual responses

Help? - me in office hrs.

Grades - each graded out of 20
- collectively count 30%

Class attendance - sign attendance sheet
- describe attendance policy.

Class discussion - write name on card.
- when you have contributed, place card in box and I will record these.
- for full credit contribute once every two week period.

Ancient timekeeping

The initial part of this course will consider timekeeping done by the ancient classical European civilizations, i.e. Greece and Rome. A rough timeframe is:

* Ancient Greece 9th century B.C.E → 600 C.E
* Ancient Rome 750 B.C.E → 476 C.E.

In general these were societies with organized cities, systems of governance and economies. Such societies left records via buildings, objects and written information that enables us to assess their workings.

How was time kept in such societies. There were:

1) limited mechanical devices, e.g. Antikythera mechanism

Image: Wikipedia Antikythera mechanism page

2) astronomical means involving observation of stars.

There are fundamental similarities and differences between these approaches, at very broad levels.

Q What might be similar?

Q What are fundamental differences (try to think from an ancient perspective)?

Timekeeping and repetition

Without asking about the true nature of time, we can focus on devices that measure it. These all rely on a regular repetitive pattern in some physical system. Examples include:

1) pendulum swinging back + forth
2) spring + mass oscillating.
3) electronic oscillations
4) repetitive motion in the natural world.

The earliest timekeeping schemes did not have adequate technology to try the first three and relied on motion in the natural world.

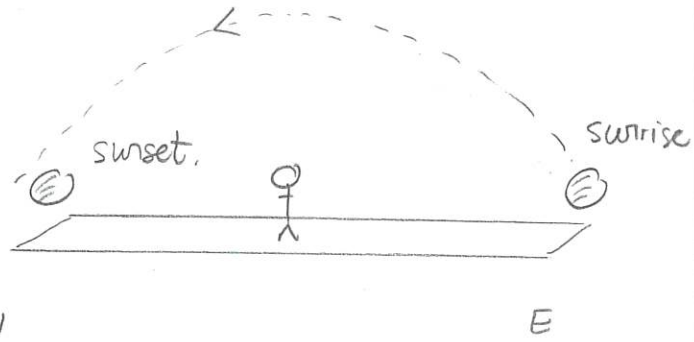
Astronomical Timekeeping

Consider the possibility of using natural phenomena to record the passage of time.

Q Suggest natural phenomena that can be used to by any person to roughly track the passage of time.

We can use the apparent motion of celestial objects (Sun, Moon, stars, planets) to chart how time passes. Specifically the most important is the apparent motion of the Sun during the day. This will be attached to our notion of a day and eventually an hour and a second.

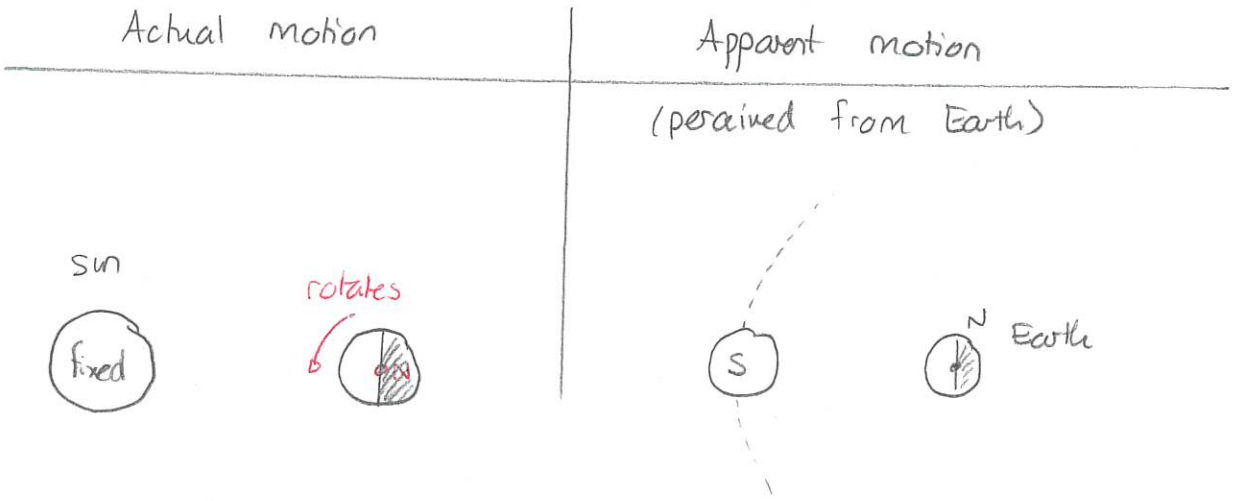
Viewed from Earth we would see that the Sun appears to trace out a path across the sky. We now know that this progress results from the rotation of Earth about its axis.



Demo: ~~Video~~ YT video up to basic rotation

We can see that as Earth rotates the illuminated potion changes.

Demo: Globe

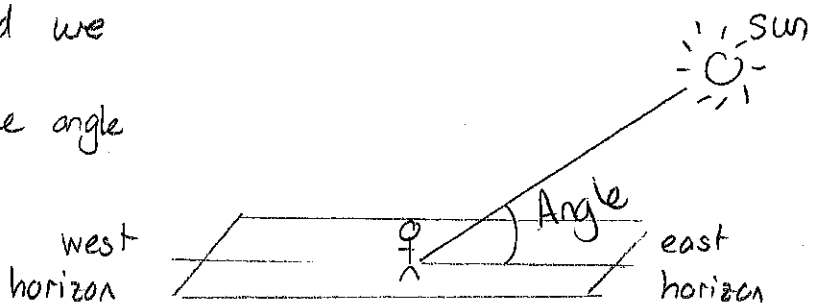


In our modern units of time it takes Earth about 24hr to rotate once. We will explain the slight discrepancy later. So

Earth's rotation measures a day.

We can subdivide the day by measuring the Sun's angular position at any instant

In a perfectly flat world we could try to measure the angle from the horizon



We could use this angular measure to decide time (after sunrise, before sunset).

1 Solar angle time-keeping

Suppose that you aim to use the angle made by the Sun to determine the time of the day. To simplify this, imagine that you are living in a perfectly flat region and that, on the day on which you aim to determine the time the sun passes from directly east, through directly overhead to directly west. The time from which the sun rose (6:00am) until it set (6:00pm) would be exactly 12hours. The aim of this exercise is to see if a timekeeping method using an outstretched hand is adequate for various tasks.

a) Through what angle (how many degrees) will the Sun move from sunset to sunrise?

b) Suppose that your outstretched hand makes an angle of 18°. You can use the hand to break up the motion of the Sun during the day into a number of evenly spaced segments. How many segments will there be if you do this?

c) How much time does it take for the Sun to pass through each of these segments? Can you mark off the actual time at the beginning and end of each segment?

d) Suppose that a friend asked you to meet at the beach and said that meeting anytime between 9:00am and 11:00am would be fine (the friend would wait to meet during all of that time). Would you be able to use this angle time keeping method to meet with the friend as arranged?

e) Suppose that you needed to have lunch and can only do it between 12:30pm and 1:00pm. Could your this angle time keeping method determine when to have lunch?

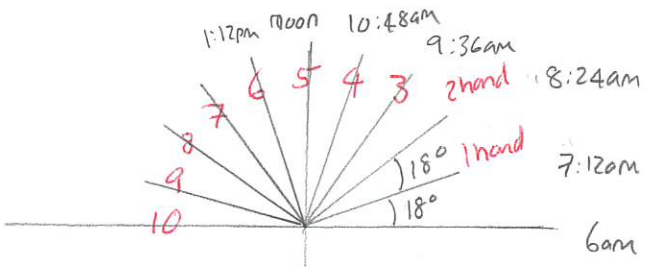
a) 180°

6pm ——— 6 am 180°

b) Divide 180° into segments 18° each ~ 10 segments

c) Twelve hours for 10 segments $\frac{12\,hr}{10} = 1.2\,hr = 1\,hr\ 12min$

d) If we arrive for 3 or 4 "hands" then yes we would arrive in the time window



e) somewhere between 5 and 6 "hands". No we cannot arrive at the right time with certainty