COMPSCI 145

Representing, Storing, and Retrieving Information

LECTURE #4

COMPUTING WITH GEARS

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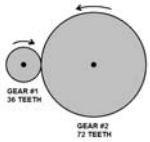
We can Compute with Gears, too!

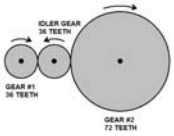
- Here are a couple of gears:



- No matter the speed of Gear #1, Gear #2 will run at half the speed, but in the opposite direction.
- So, if Gear #1 is running at +20 RPM, Gear #2 is running at -10 RPM.

How can we get Gear #2 to go the same direction as Gear #1?

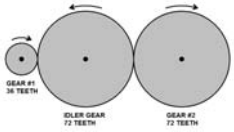
- Use a small "idler" gear to change direction:



- Now Gear #2 will go the same direction as Gear #1.
- So, if Gear #1 is running at +20 RPM, the idler runs at -20 RPM, and Gear #2 is running at +10 RPM.

Is there another way to do this?

- Use a large "idler" gear to change direction:



- Gear #2 still goes the same direction as Gear #1.
- If Gear #1 is running at +20 RPM, the idler runs at -10 RPM, and Gear #2 still runs at +10 RPM.

Which way is "Better"?

- In both cases, Gear #2 runs at the same speed and in the same direction.
- Are they the same?
- I say "NO". Why?
- In the first case, the small idler gear runs at the faster speed.
- In the second case, the large idler gear runs at the slower speed.
- You have a **trade-off**, typical of engineering decisions:
  - Do I want a smaller device where the idler might wear out faster, or…
  - Do I want a device that won't wear out as fast but is a lot bigger?

Which way is "Better"?

- This is a representational trade-off problem, size versus reliability.
- There is no "better" except in the context of what is needed by the environment where it will be used:
  - If space is limited, use the smaller, faster idler gear and accept that it might wear out quickly.
  - If it has to run a long time without complex maintenance, use the larger, slower idler gear and accept that it takes up a lot of space.
- Thus, there is no "right answer".

For Further Explorations

- Antikythera Mechanism
  - Dates to 65 B.C.E. (found in ancient shipwreck in 1901),
  - Many more gears than any other contemporary device,
  - Analog Astronomical Computer (computes moon phases, eclipses, etc.),
  - Unique artifact (nothing else like it until the clockwork automata of the 14TH and 15TH Centuries),
  - "Decoding the Heavens: A 2000-Year-Old-Computer—and the Century-long Search to Discover Its Secrets" Jo Marchant, 2010.
- Navy Fire Control Computer Training Videos (1953)
  - http://www.youtube.com/watch?v=s1i-dnAH9Y4