

CMS/CS/EE 144

Networks: Structure & Economics

Administrivia

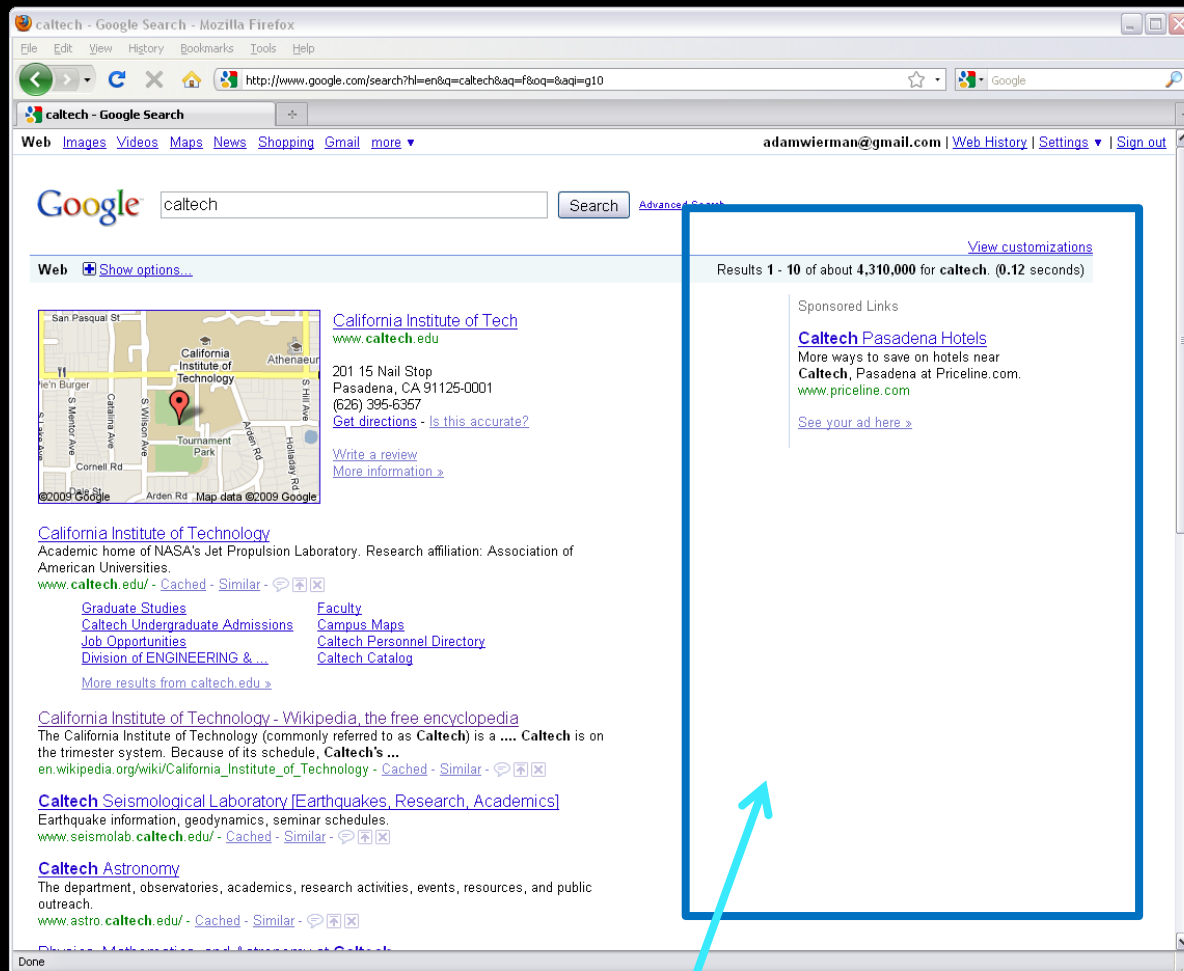
- 1) Rankmaniac debriefing...
...thanks for all the feedback on how to improve the assignment!
- 2) Pandemaniac starts Thursday!
...this should be much less time consuming
- 3) Don't forget about HW5
...it's short and sweet, get it done early and it'll help you be ready for the lectures.
- 4) Don't forget to think about project ideas
...they're due in a just over two weeks!
...we'll do a writing mini-lecture next Tuesday to help you prepare (likely with a quiz to encourage attendance).

Course outline

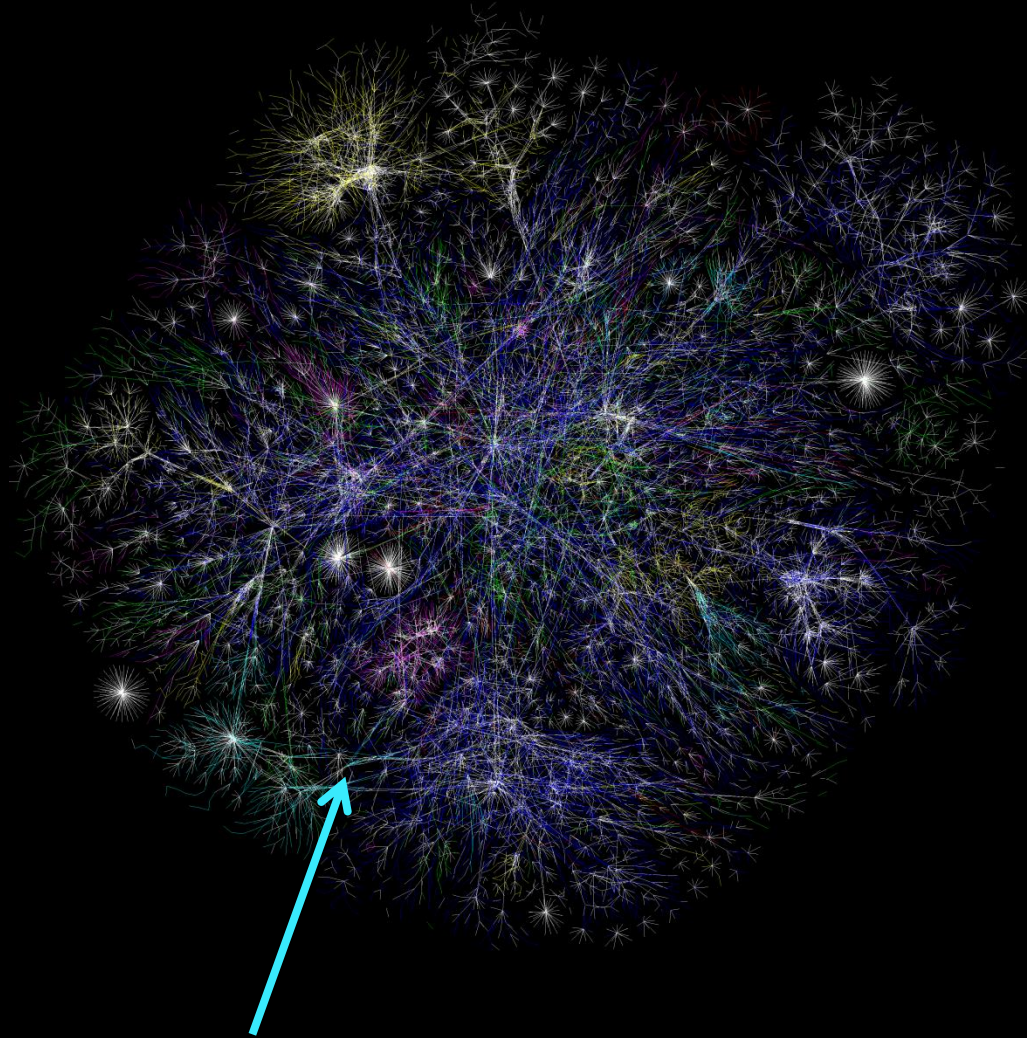
- 1) Understanding network structure
- 2) Exploiting network structure
- 3) Network economics

Network economics

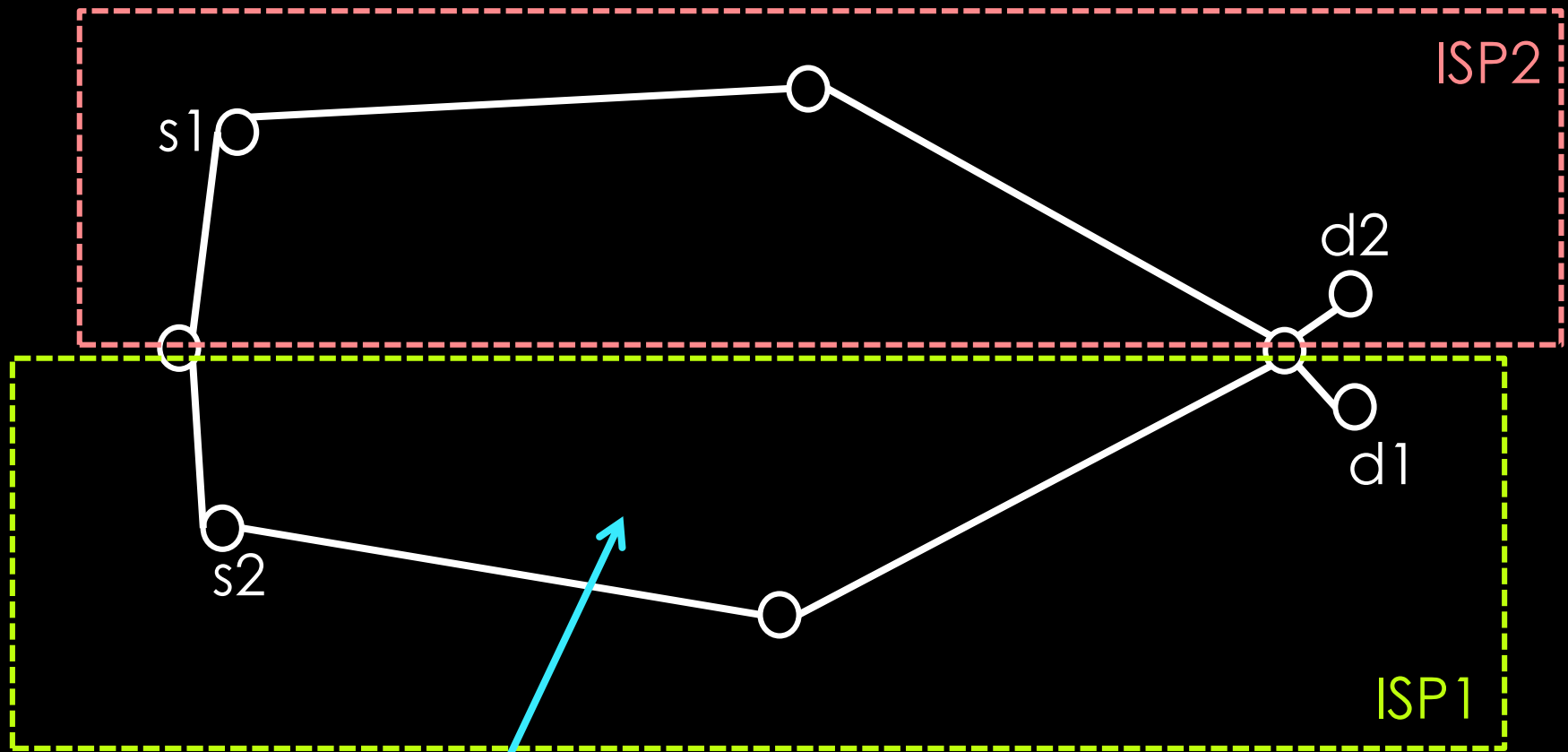
You can't really understand the web/internet without going into economics anymore.



How does google make money?



Network formation really depends on strategic behavior



How do routing decisions get made?

Network economics

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Common theme: Independent agents acting in their best interests without full knowledge of others' actions

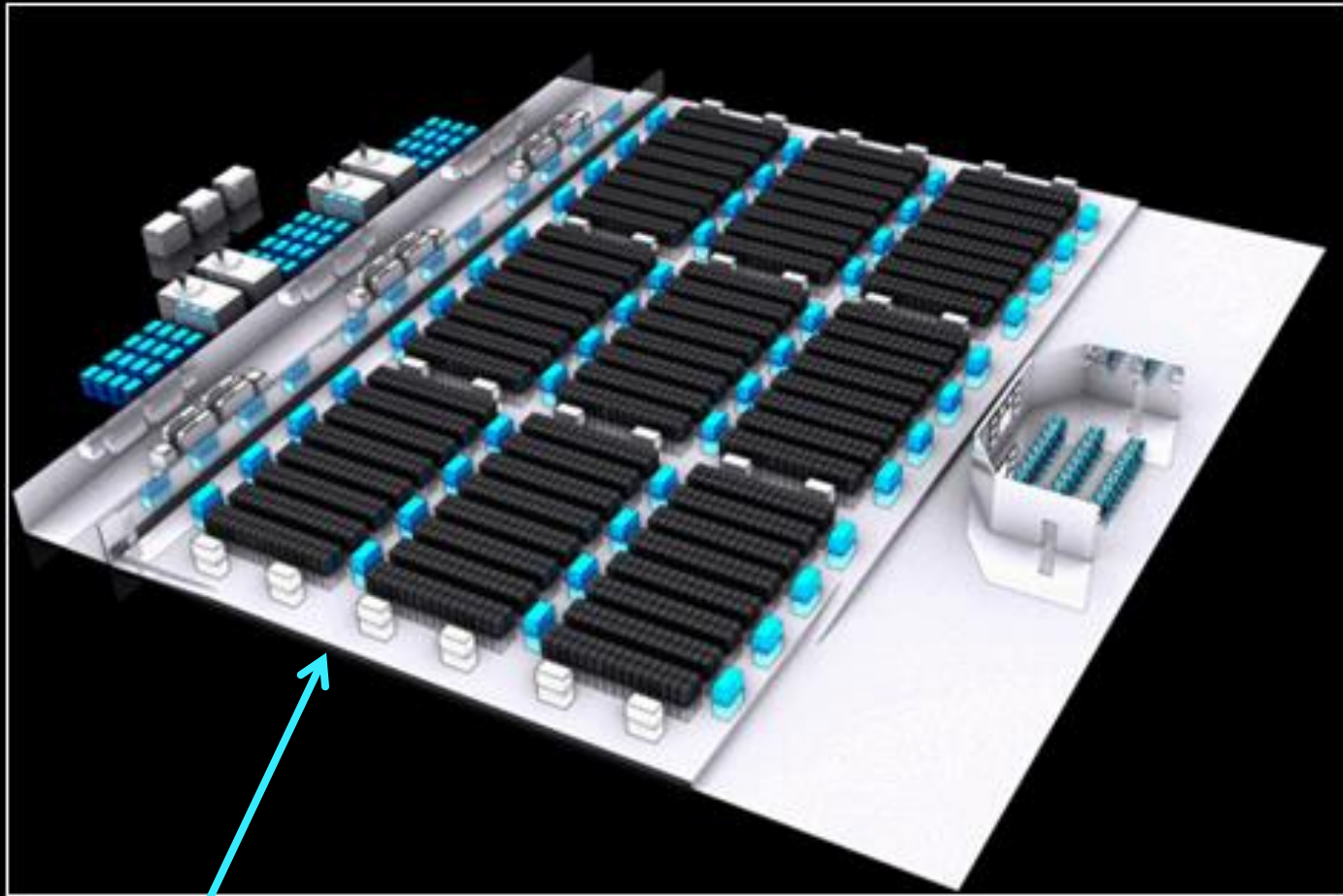
Network economics

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Economics is even important where money isn't involved





What happens when scheduling decisions are decentralized?

Network economics

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Common theme: Independent agents acting in their best interests without full knowledge of others' actions

~~Network economics~~

Game theory

A mathematical theory designed to model:
how rational individuals should behave when
individual outcomes depend on collective behavior

Disclaimer: we will focus on a very small subset of game theory. You should take a true game theory course if you find this stuff interesting! ...and learn it from a real economist...

~~Network economics~~

Game theory

A mathematical theory designed to model:
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individual outcomes depend on collective behavior



Algorithmic game theory

- Economics & Networks
- Economics & Complexity
- Economics & Learning
- Economics & Security/Privacy

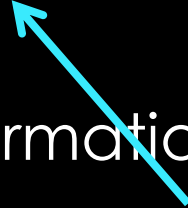
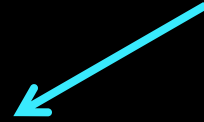
Using GT to analyze an algorithm

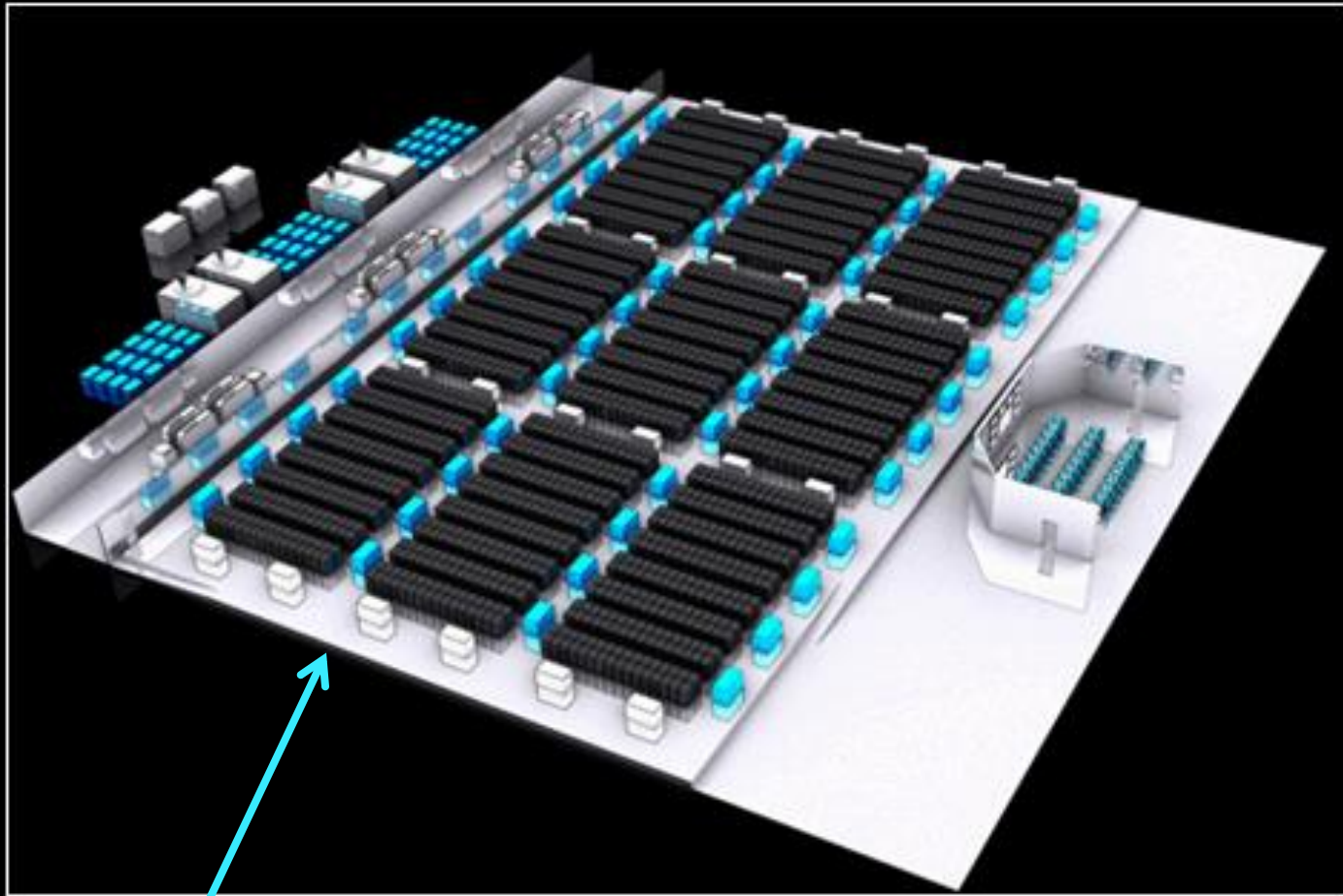
Our plan

- 1) Load balancing games (warmup)
- 2) Routing games
- 3) Ad auctions
- 4) Strategic network formation (if time)

Using GT to make money

Using GT to model
behavior





What happens when scheduling decisions are decentralized?

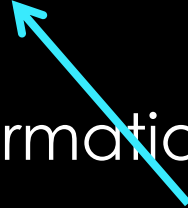
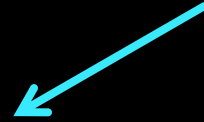
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Braess' Paradox



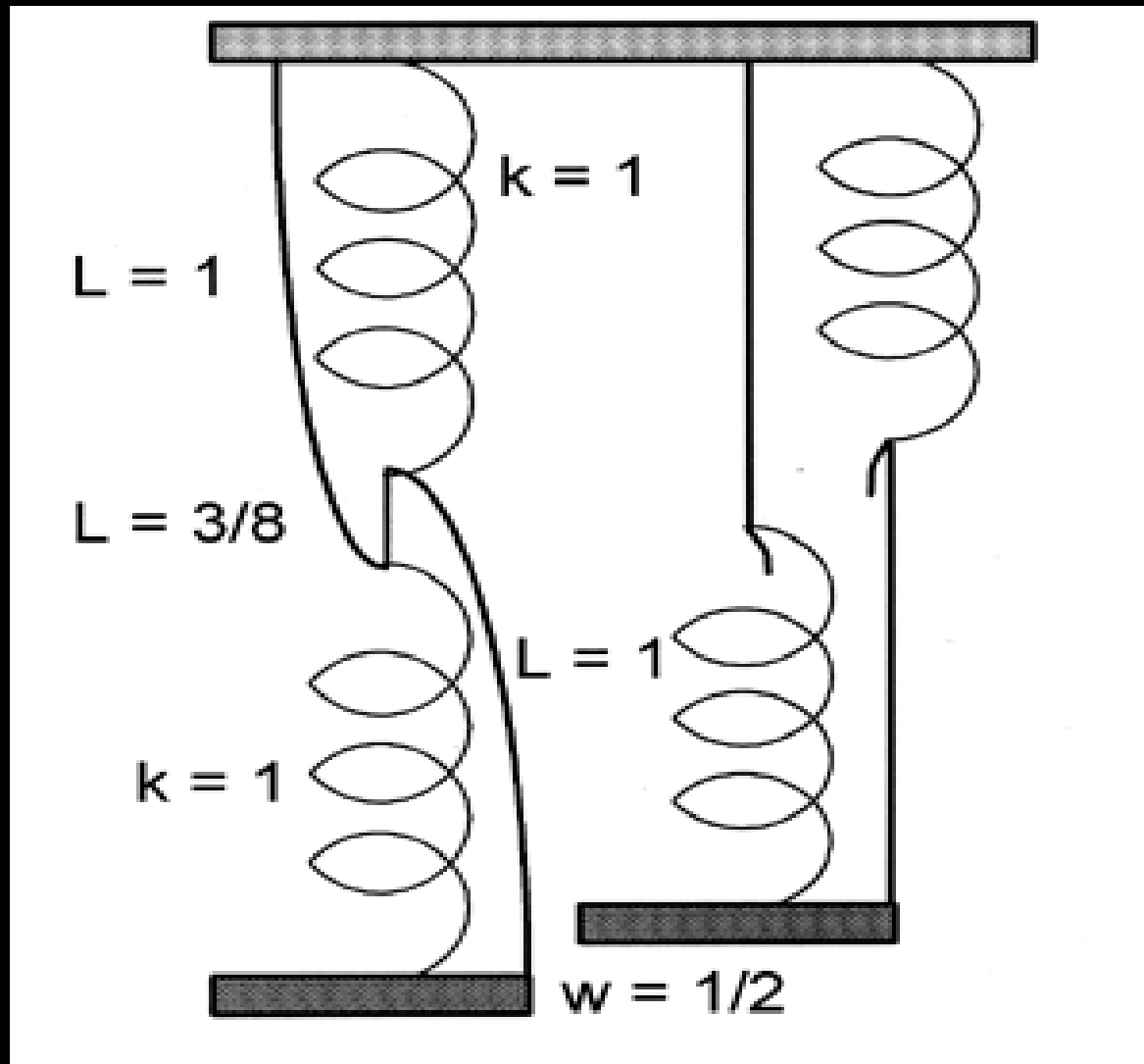
Seoul, South Korea

Closing highway, which carried 160000 cars a day, reduced congestion



42nd street new york

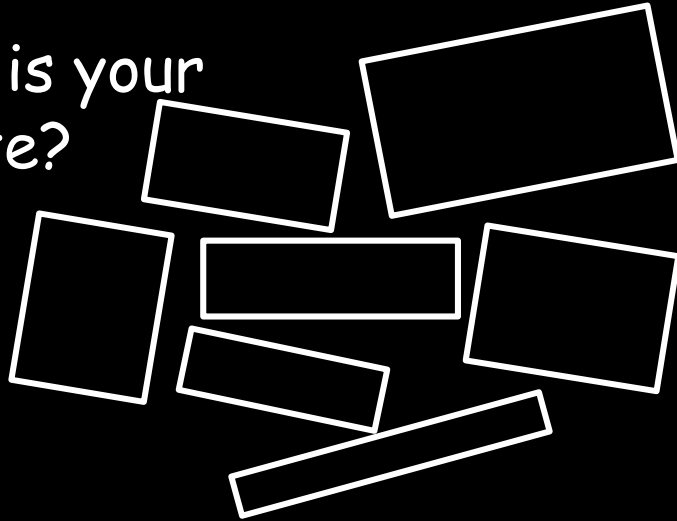
1990 closing of street reduced congestion



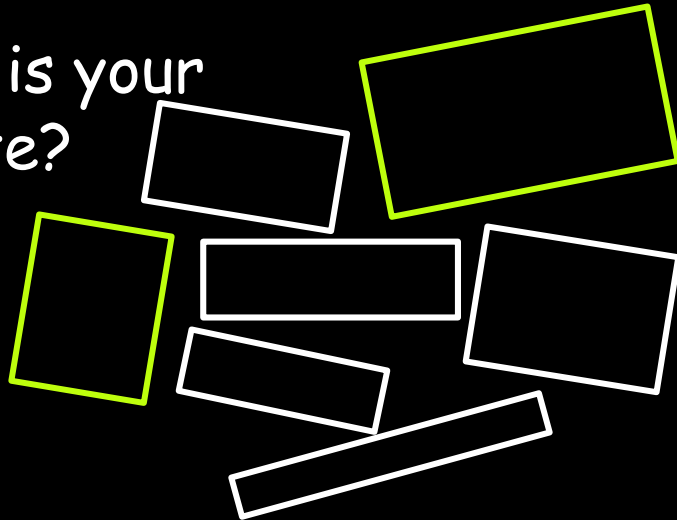
Shows up in: mechanical networks
...and electrical, hydraulic, and thermal networks

The golden ratio

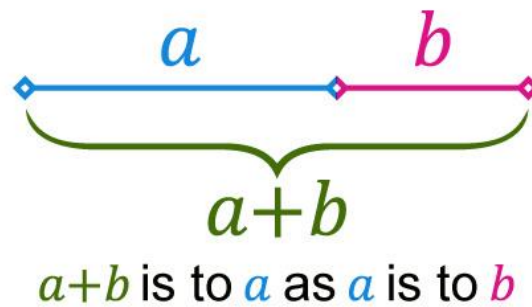
Which is your
favorite?



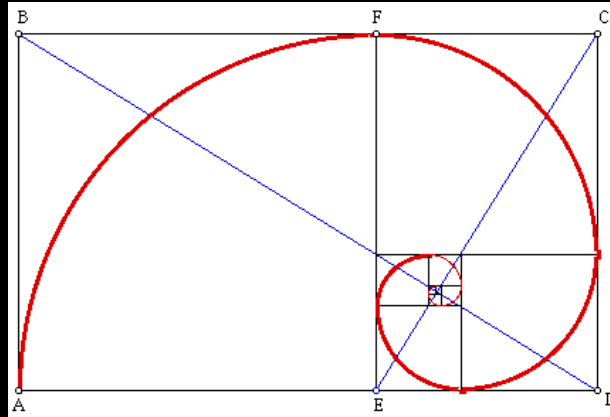
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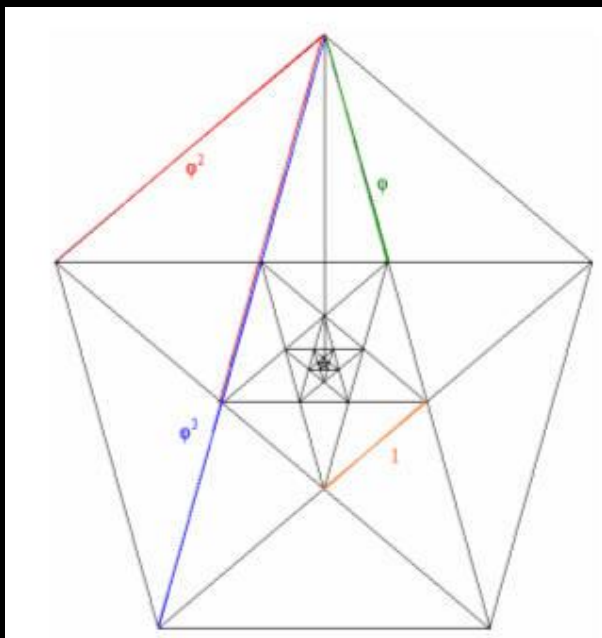


The golden ratio



...in geometry

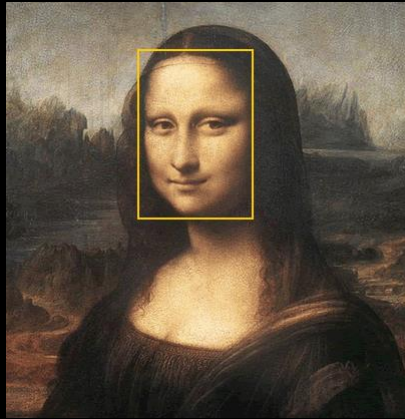




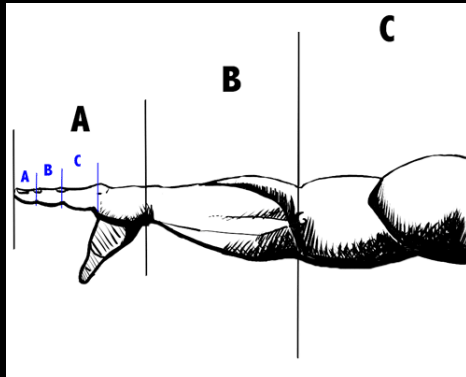
...in geometry

...in architecture





...in art



...in us



...in nature

