Small-World Networks

CMPS 17

Theresa Migler-VonDollen

Small worlds phenomenon

- Stanley Milgram 1933-1984

- Born in New York. Social psychologist.
- Know for his controversial study on obedience.
  - 26 out of 40 of the participants used the full range of voltages.

Small worlds phenomenon

Small world experiment:

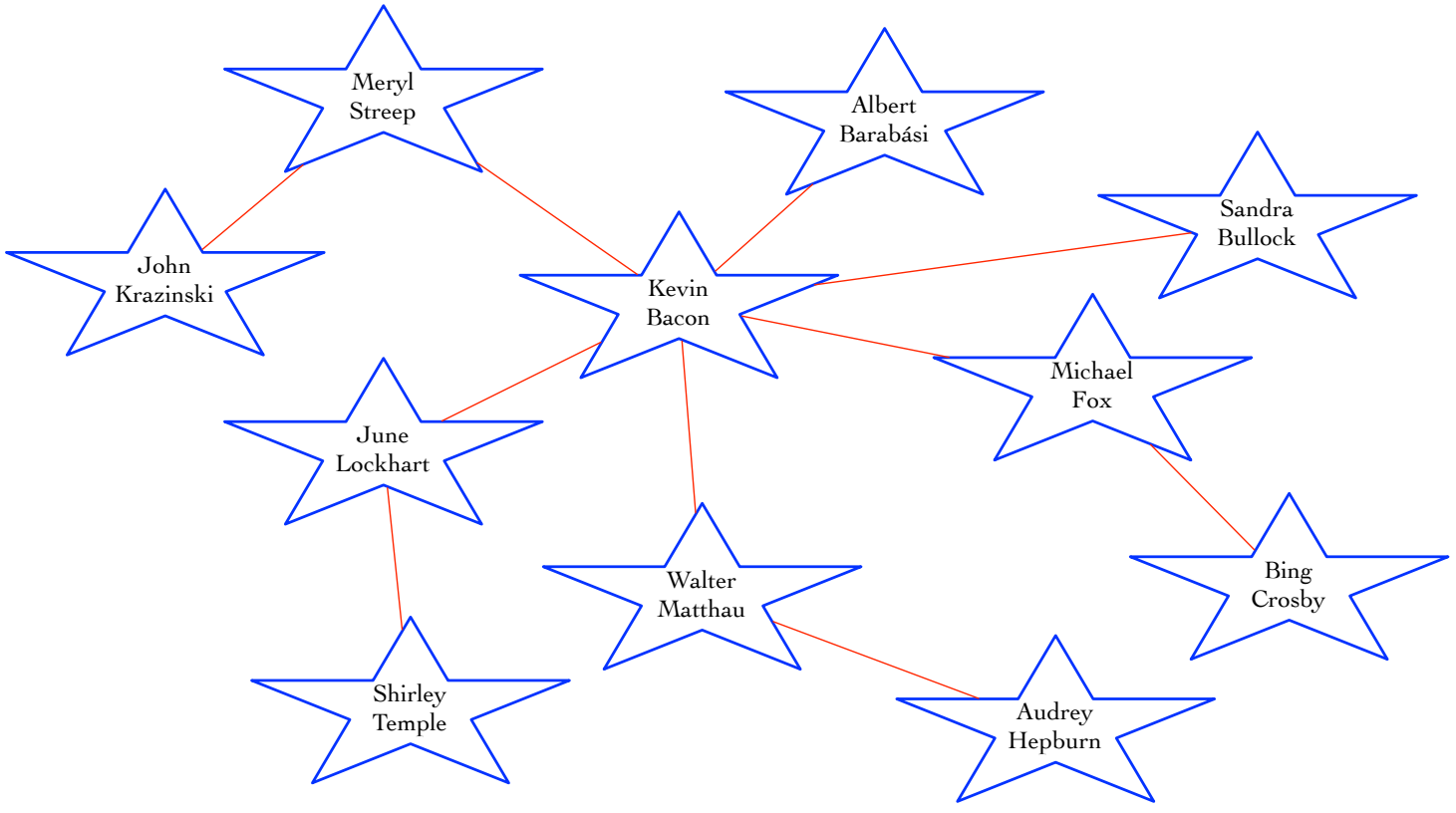
- 296 starters, 1 target (a stock broker in Boston)
- Given the target's name, address, and occupation
- Median path length of 6.
  - For letters that arrived....only a third did.

Small worlds phenomenon

Milgram's experiment demonstrated two facts about social networks:

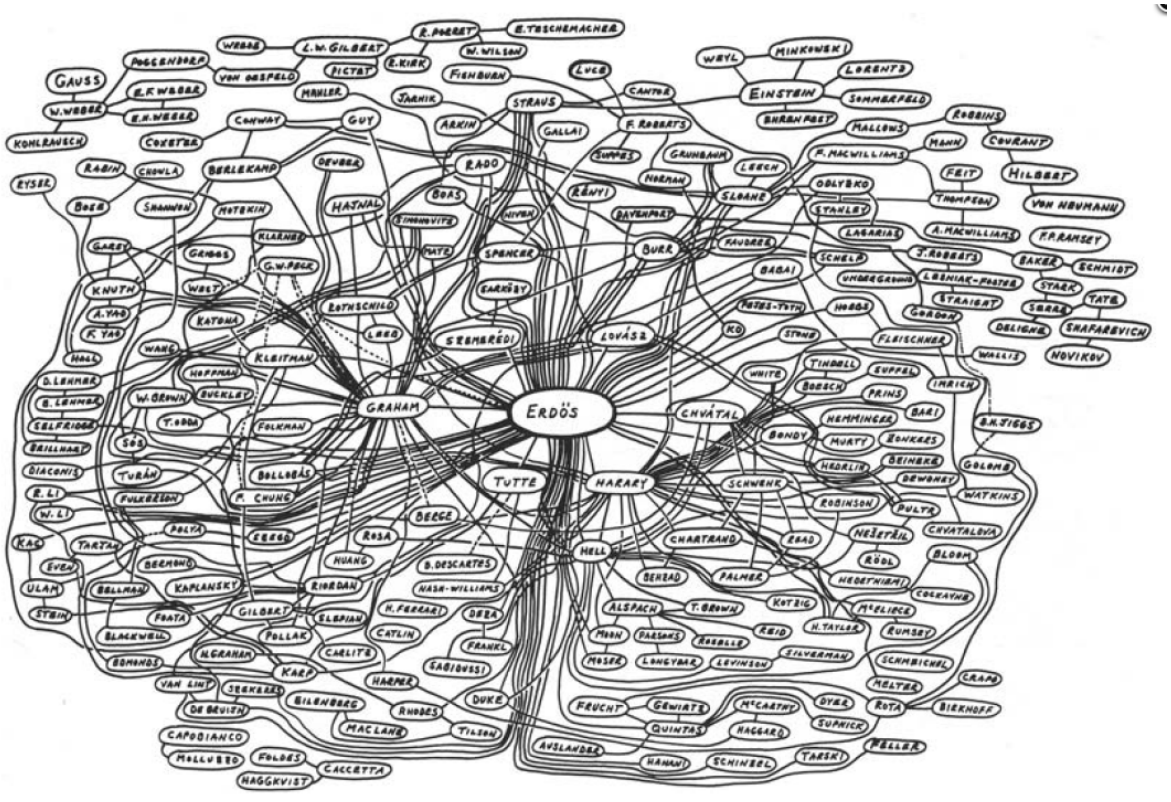
- There are many short paths in social networks.
- People can act very efficiently "locally", without any global map of the network.

Hollywood small world



Average Bacon number is 2.9!

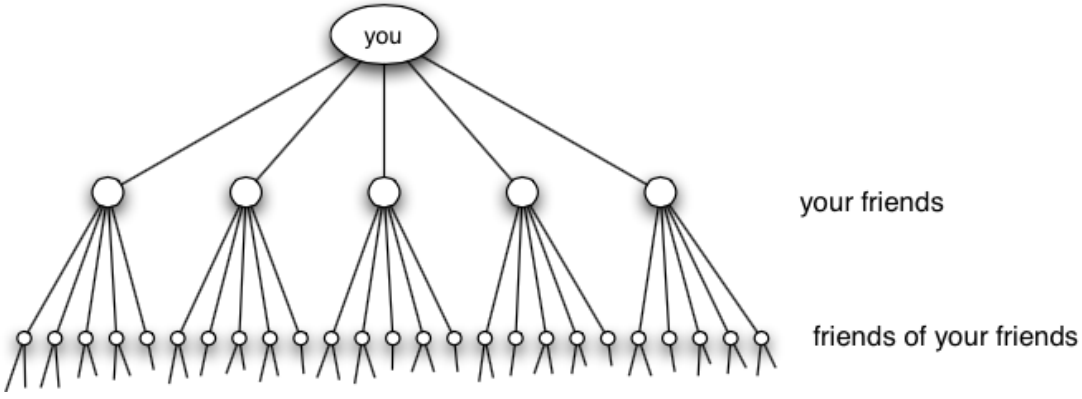
Erdős small world



My Erdős number is 5: Theresa Migler-Kent Morrison-Arno Berger-Steven Evans-Persi Diaconis-Paul Erdős

Short paths?

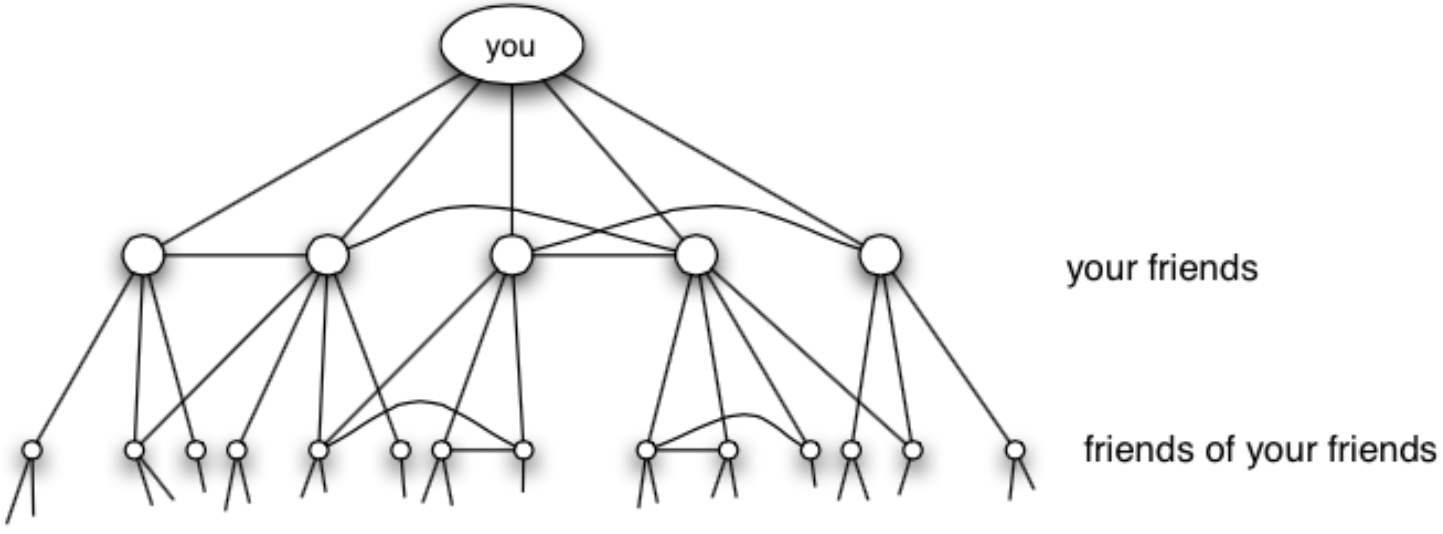
Should we be surprised that path lengths are so short?
Suppose that you know 100 on a first name basis. And each of your friends knows at least 100 other people on a first name basis...



There are 100 people one step from you, 10,000 people two steps from you, 1,000,000 people three steps from you, 100,000,000 people four steps from you, 10,000,000,000 people five steps from you.
7.125 billion people on Earth in 2013.
Should it be five degrees of separation?

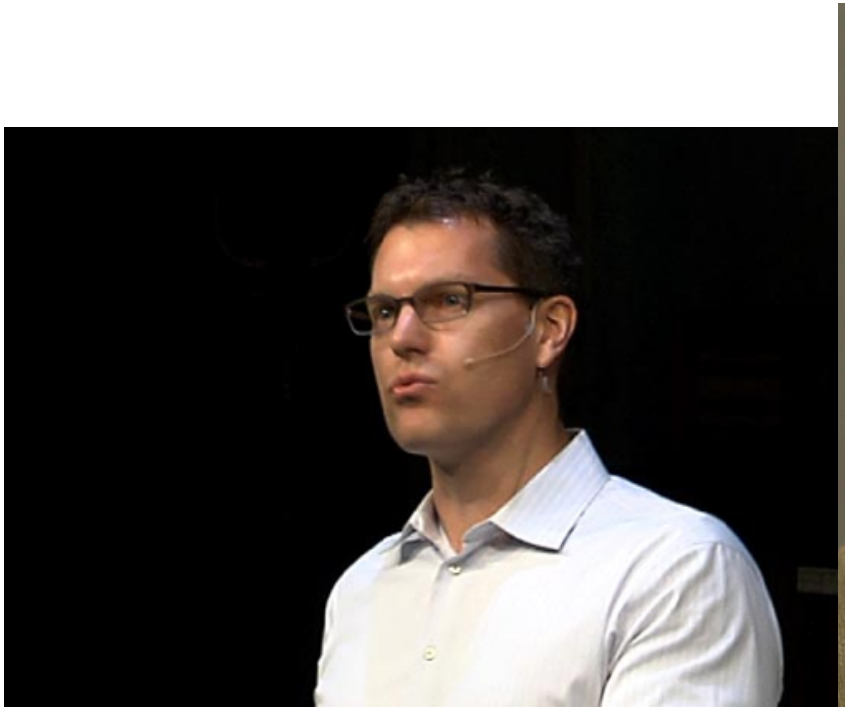
Short paths?

Some of your friends and friends with your friends...



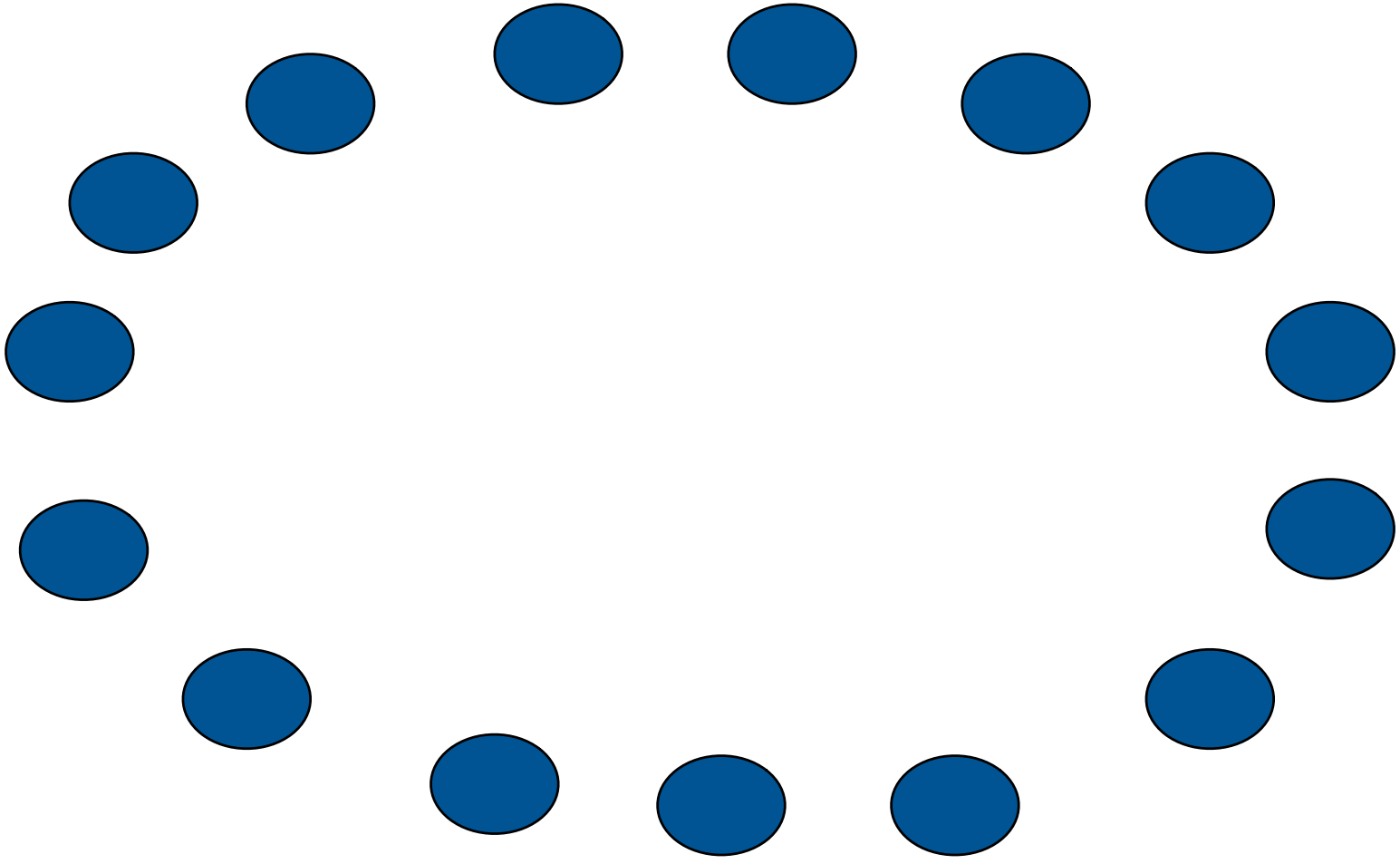
Watts-Strogatz model

- Duncan Watts and Steve Strogatz (Cornell)

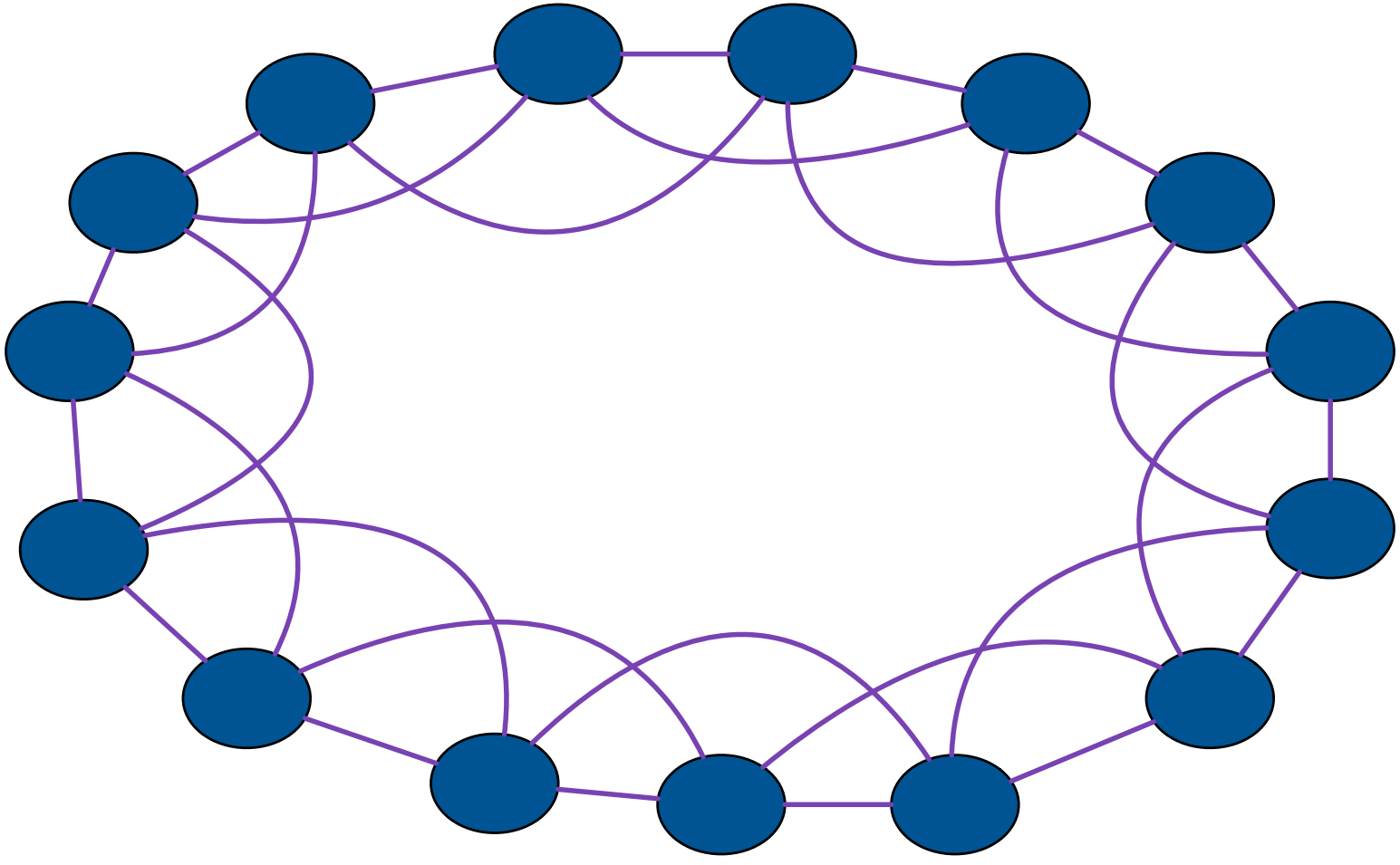


- Created a model that strives to achieve both short average path lengths and high clustering (many triangles).
- We will present the model as it was in the original paper, your book uses the grid model which is equivalent.

Watts-Strogatz model



Watts-Strogatz model



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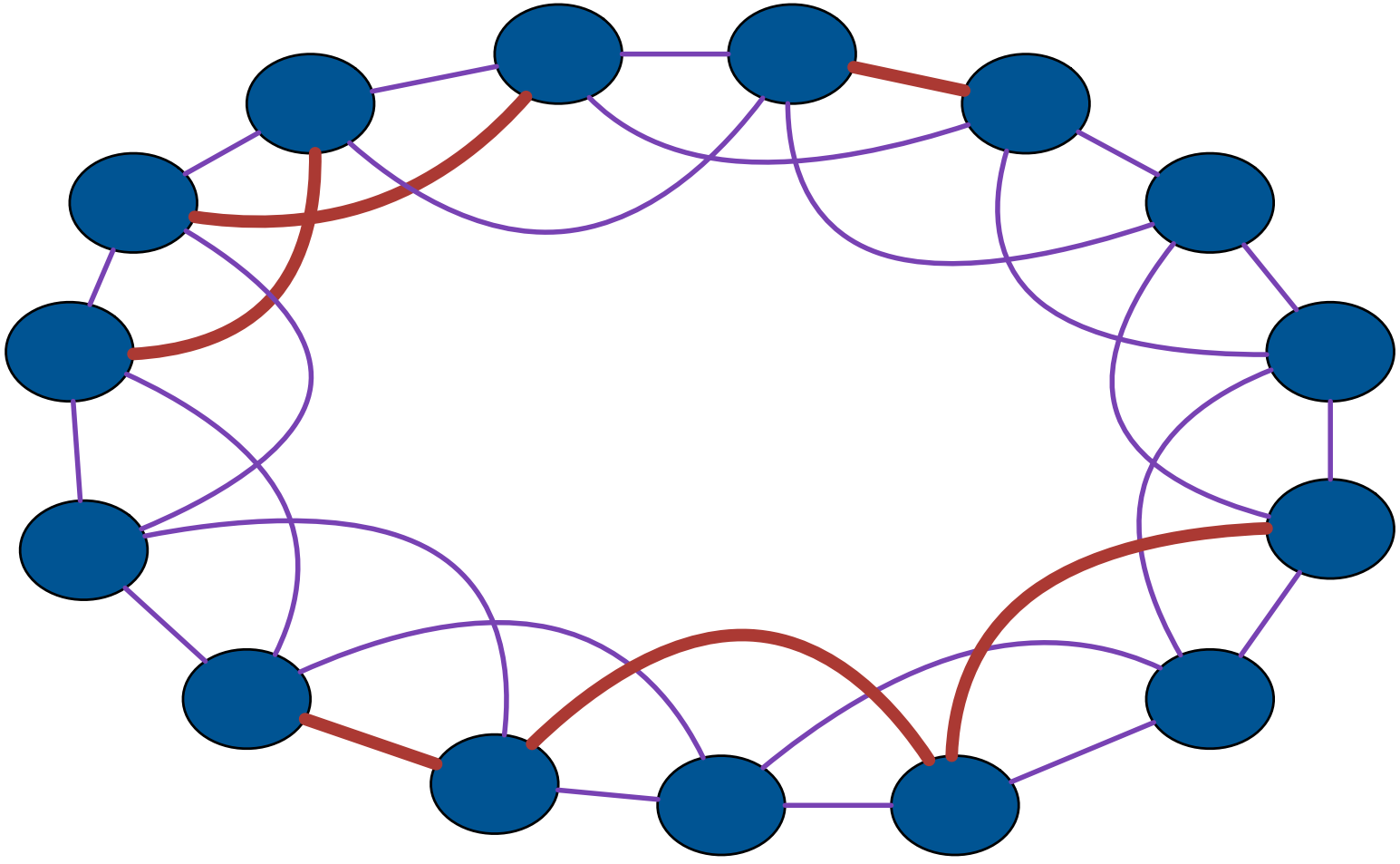

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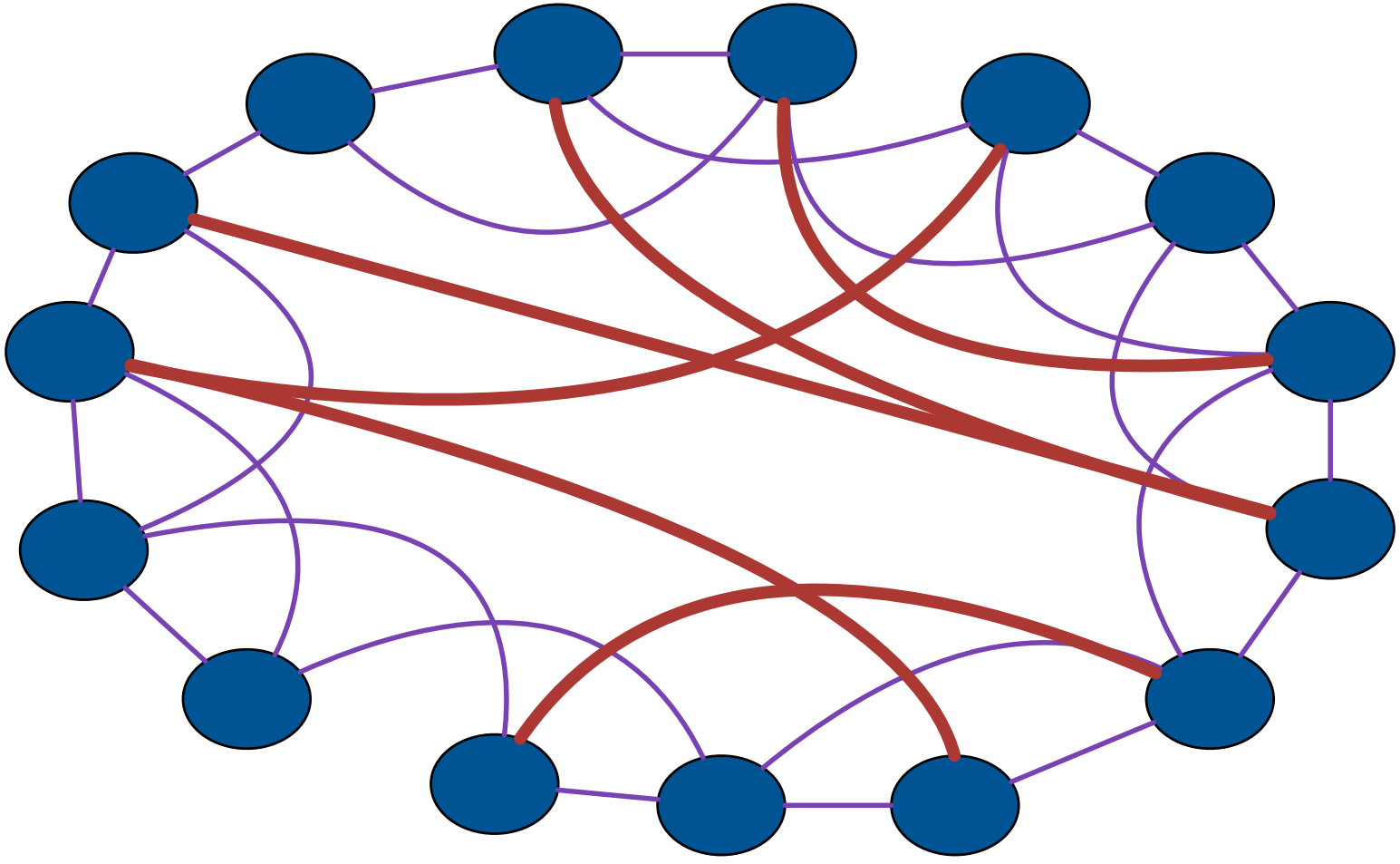
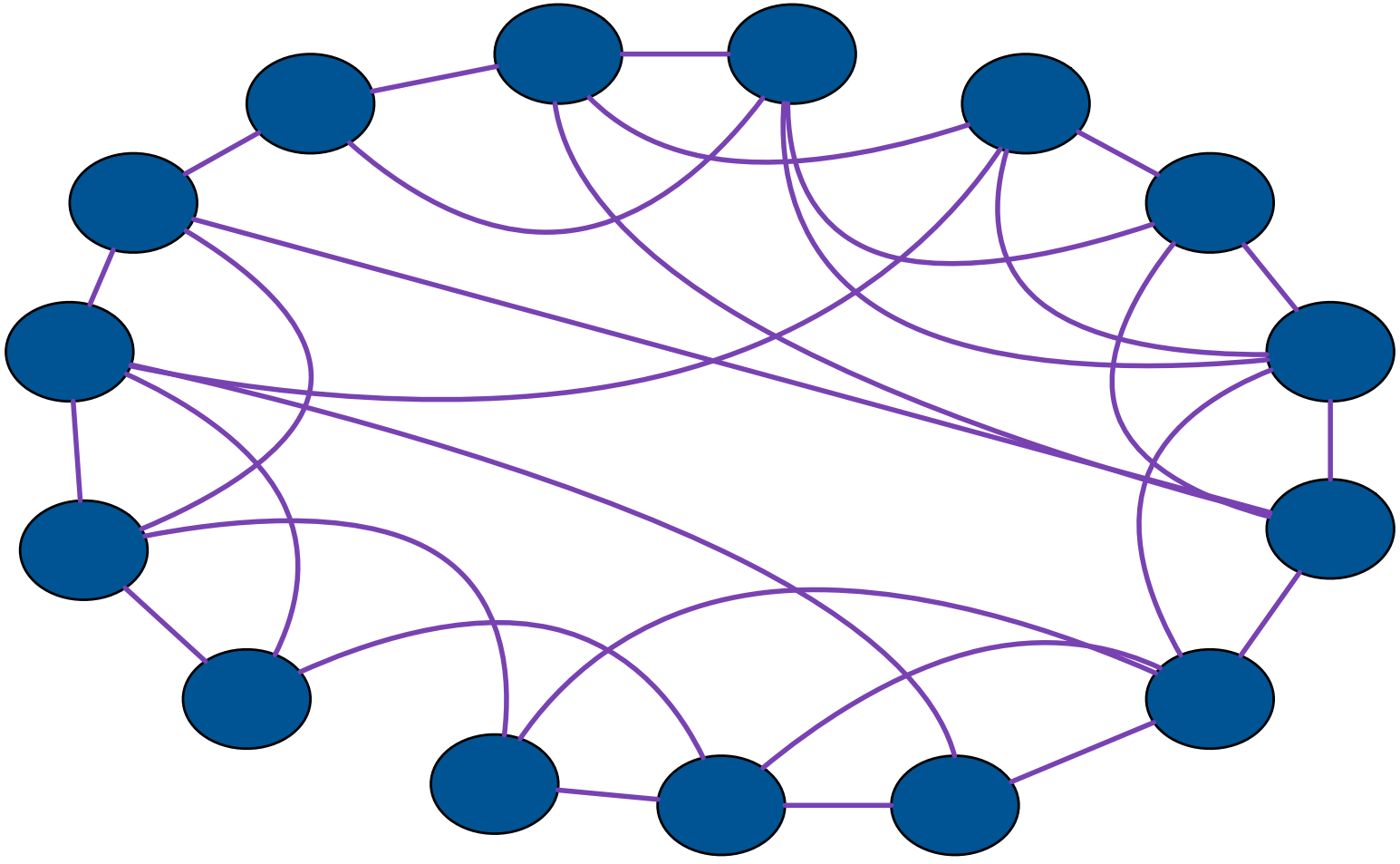


Watts-Strogatz model



Decentralized search

In the Milgram small world experiment, even though no person had a road map of the network in which they were operating, they managed to efficiently deliver their letters.
How?