The Small-World Phenomenon

Saptarshi Pyne

Assistant Professor
Department of Computer Science and Engineering
Indian Institute of Technology Jodhpur, Rajasthan, India 342030

What we discussed in the last class

Q. How does information flow through social groups?

The small-world phenomenon

Q. How connected are these social groups?

    - It turns out that different social groups can be connected by **very short** paths.

The Milgram experiment

The Small-World Problem
By Stanley Milgram

Psychology Today, 1967

Fred Jones of Peoria, sitting in a sidewalk cafe in Tunis, and needing a light for his cigarette, asks the man at the next table for a match. They fall into conversation; the stranger is an Englishman who, it turns out, spent several months in Detroit studying the operation of an interchangeable-bottlecap-factory. "I know it's a foolish question," says Jones, "but did you ever by any chance run into a fellow named Ben Arkadian? He's an old friend of mine, manages a chain of supermarkets in Detroit . . ."

"Arkadian, Arkadian," the Englishman mutters. "Why, upon my soul, I believe I do! Small chap, very energetic, raised merry hell with the factory over a shipment of defective bottlecaps."

"No kidding!" Jones exclaims in amazement.

"Good lord, it's a small world, isn't it?'

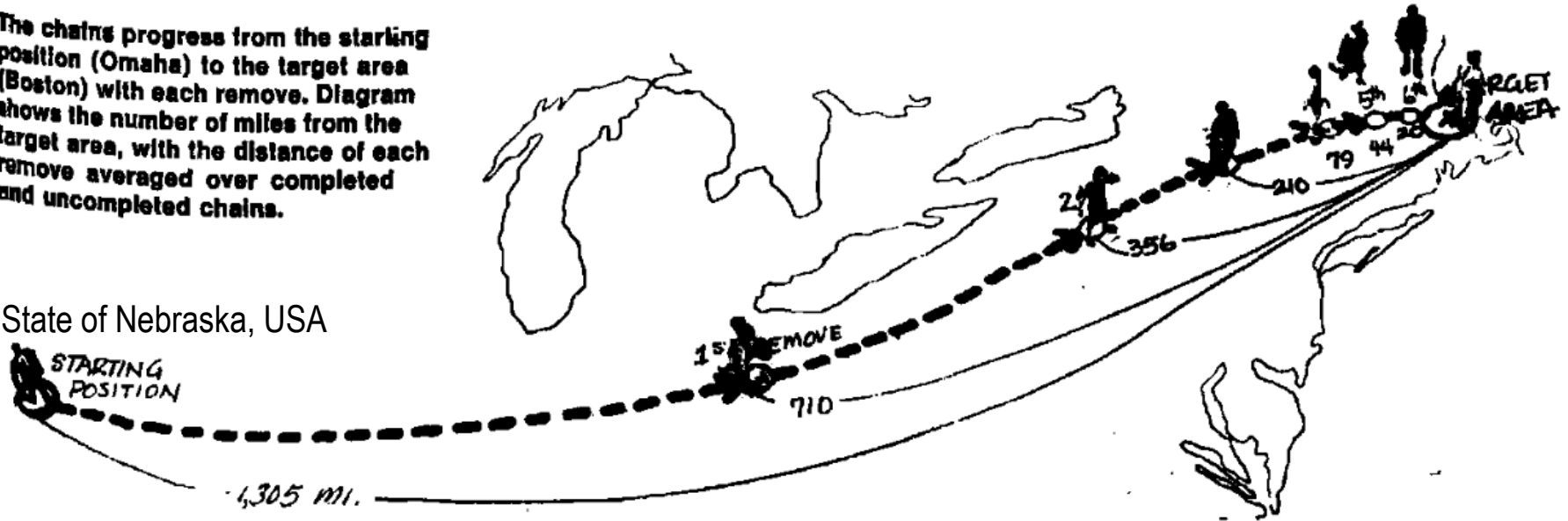**A**lmost all of us have had the experience of encountering someone

Town of Sharon, State of Massachusetts, USA

The chains progress from the starting position (Omaha) to the target area (Boston) with each remove. Diagram shows the number of miles from the target area, with the distance of each remove averaged over completed and uncompleted chains.
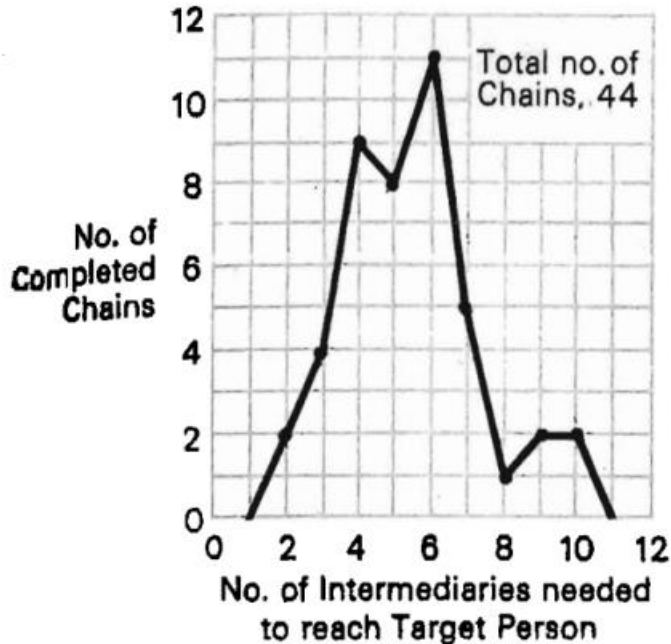
State of Nebraska, USA

n-th 'remove' = n-th recipient

The Milgram experiment (contd.)

12

Total no. of
Chains, 44

10

No. of
Completed 6
Chains

4

2

0
0   2   4   6   8   10   12

No. of Intermediaries needed
to reach Target Person

In the Nebraska Study the chains varied
from two to 10 intermediate acquaintances
with the median at five.

Total no. of completed chains = 44
Total no. of chains = 160

Therefore, the target person was 6 edges away from the starting person on median.
This result is known as **the six degrees of separation**.

What makes the world small?

Town of Sharon, State of Massachusetts, USA

The chains progress from the starting position (Omaha) to the target area (Boston) with each remove. Diagram shows the number of miles from the target area, with the distance of each remove averaged over completed and uncompleted chains.

State of Nebraska, USA

STARTING POSITION

1,305 mi.

1st REMOVE

710

356

24

210

79 44

5th
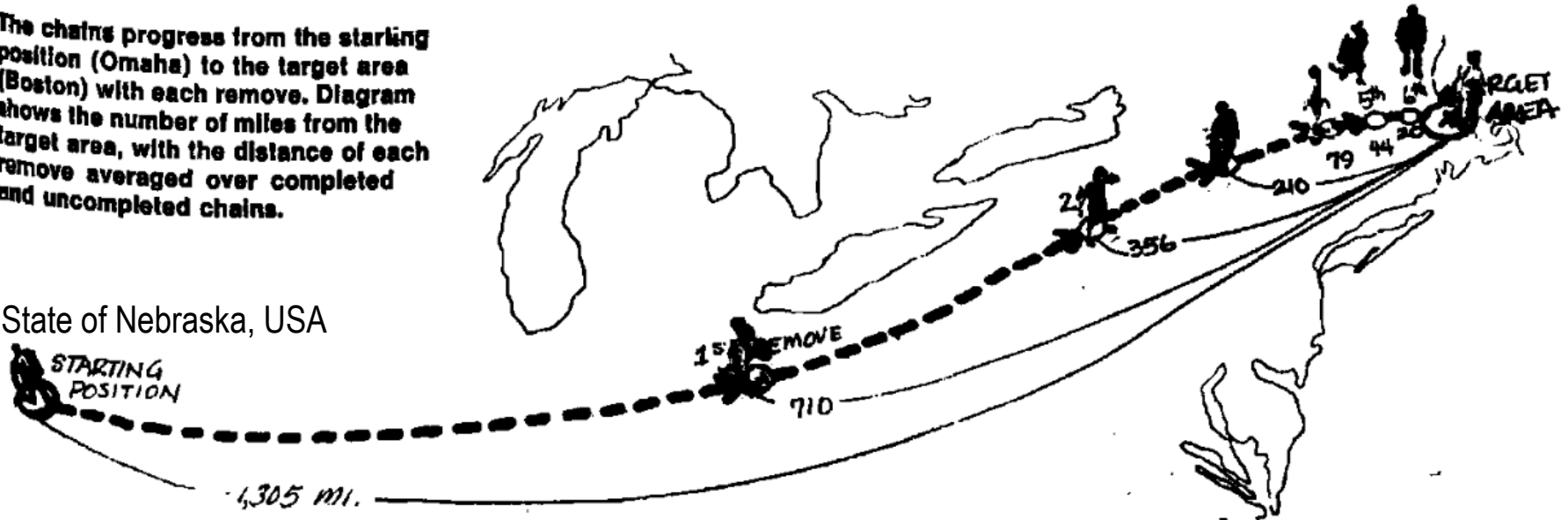
TARGET AREA

n-th 'remove' = n-th recipient

Weak ties make the world small.

What should be the range of these weak ties?

Town of Sharon, State of Massachusetts, USA

The chains progress from the starting position (Omaha) to the target area (Boston) with each remove. Diagram shows the number of miles from the target area, with the distance of each remove averaged over completed and uncompleted chains.

State of Nebraska, USA

STARTING POSITION

1ST REMOVE

710

1,305 mi.

356

21

210

79 44 28
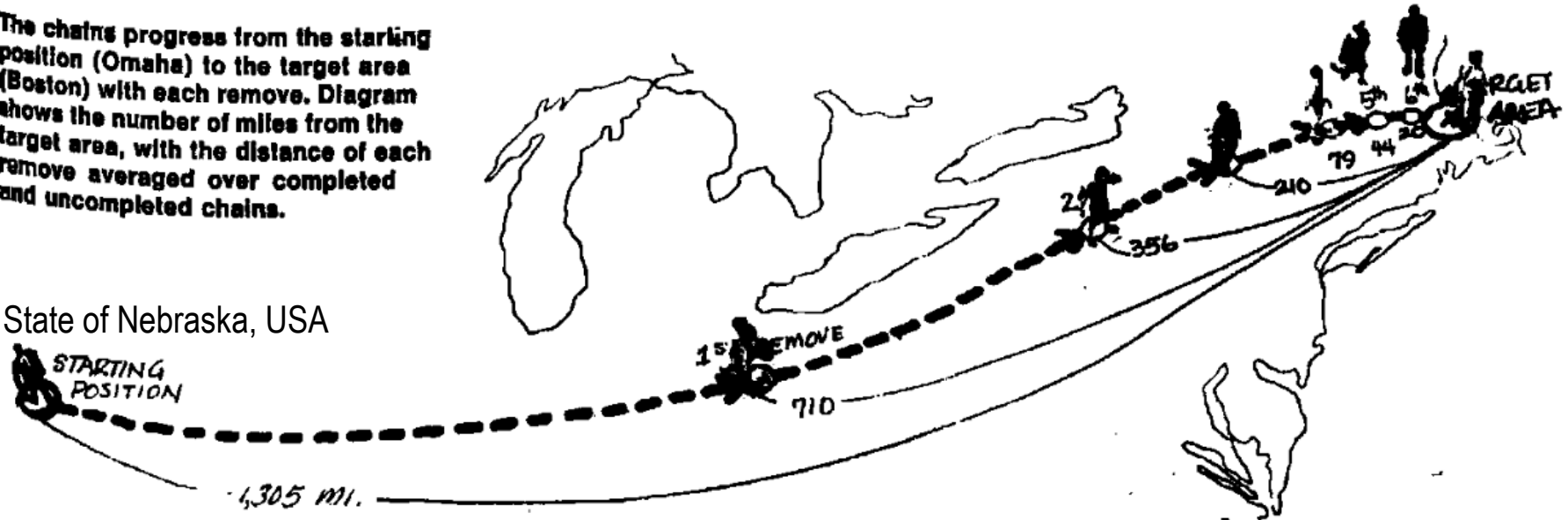
TARGET AREA

n-th 'remove' = n-th recipient

"There is **a progressive closing in on the target area** as each new person is added to the chain." ~ Stanley Milgram. With each step, a letter reduces its distance to the target by approximately a factor of two. Hence, we need long-range weak ties followed by intermediate-range weak ties.

Post office staffs follow the same principle
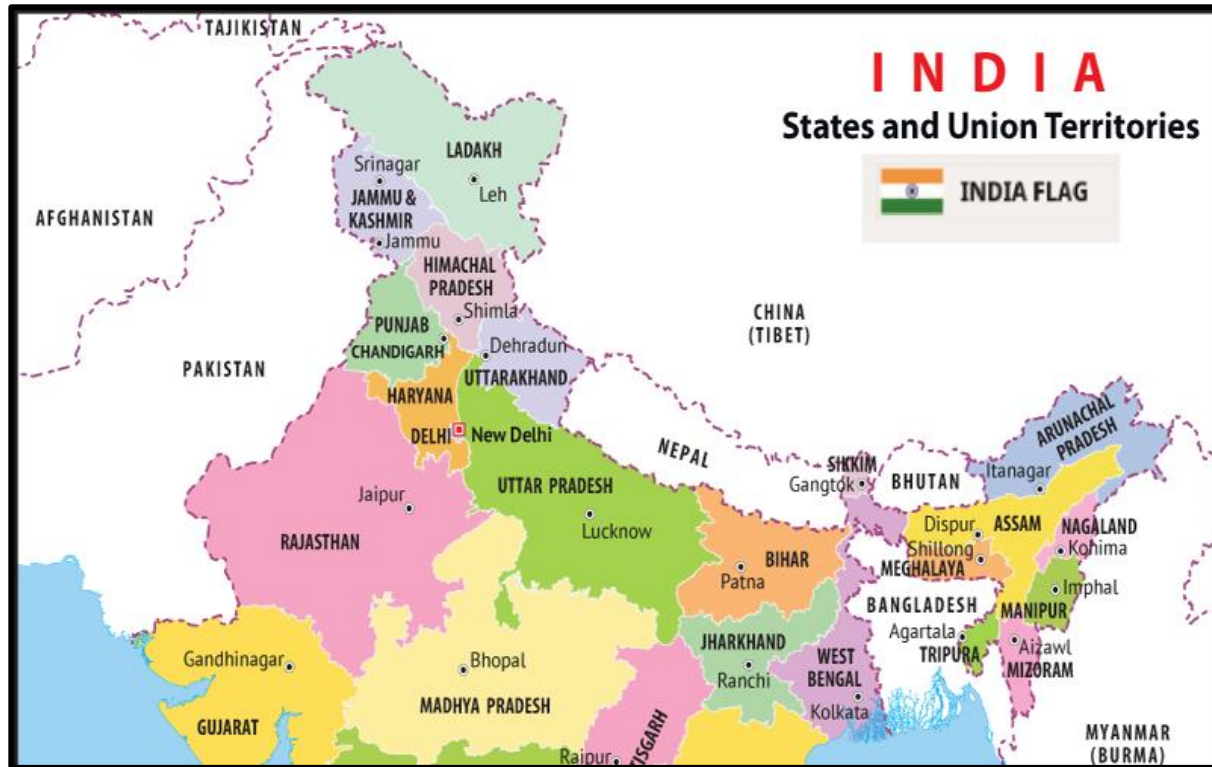
How to send a letter from Jodhpur to Imphal? **By progressively closing in on the target area**
➔ State: Manipur
➔ District: Imphal East / West
➔ City: Imphal
➔ Sub Post Office
➔ Home

References

- David Easley and Jon Kleinberg (2010), ***Networks, Crowds, and Markets: Reasoning About a Highly Connected World***, Cambridge University Press. Pre-publication draft. Book website.
  - Chapter 20 'The Small-World Phenomenon': Sections 20.1–20.6

Thank you