Milgram Experiment

- Recipient was a stockbroker in Boston - “Single” target.
- 296 Senders from Boston and Omaha.
- Surprisingly only 20% of the sender messages reached target.
- 25% attrition rate at every forward phase.
- People are more likely to forward the message to a person:
  - In close physical proximity.
  - Share a connection with
- Average chain length ~ 6.5.
Milgram Findings

<table>
<thead>
<tr>
<th>Starting Population</th>
<th>Mean Chain Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nebraska Random</td>
<td>5.7</td>
</tr>
<tr>
<td>Nebraska Stockholders</td>
<td>5.4</td>
</tr>
<tr>
<td>All Nebraska</td>
<td>5.5</td>
</tr>
<tr>
<td>Boston Random</td>
<td>4.4</td>
</tr>
<tr>
<td>All</td>
<td>5.2</td>
</tr>
</tbody>
</table>
Small World Network

• Messages tend to circulate along short paths.
• People tend to forward messages to their closest/most-suited acquaintance.
• People are generally good at finding the acquaintance.
• This network needs a search algorithm and structure to satisfy these conditions.
• Small world phenomenon are well realized in social networks.
Non-Conformance to local search

• Existing local search algorithms need an underlying network structure of minimal connectedness to achieve propagation.
• But social networks don’t have this lattice + links structure.
• Also search algorithms perform better in the presence of “hubs”.
• Social Networks again lack these, then how do messages propagate?
• What are the notions of “closest” and “social distance”?  
• Social Networks rely on “weak” ties.
Social Network Model

- Every participant has an identity encompassing attributes like:
  - <Location, Religious Beliefs, Recreational Activities, Type of Employment>
- Groups are formed by people with at least one similar attribute.
- Identity and Search in Social Networks follow hierarchies.
- Hierarchies are modelled on attributes.
- Individuals are the leaf nodes of the hierarchy trees.
- The social distance between two people is the distance between the lowest common ancestor.
- A context is analogous to breaking an attribute into sub-attributes.
- A context space is a collection of hierarchy trees.
- Attributes ⇔ Contexts ⇔ Interactions ⇔ Networks.
Hierarchy Tree
Homophily
Context Space

Generalized affiliation networks

geography

occupation

age

- Blau & Schwartz [2], Simmel [11], Breiger [3], Watts et al. [13]; see also Google+ Circles.
Six Propositions - Six Degrees?

• Individuals have identities and belong to various groups that reflect these identities.
• Individuals break down the world into a hierarchy of categories.
• Individuals are more likely to know each other the closer they are within a hierarchy. - Homophily
• Each attribute of identity ≡ hierarchy.
• “Social distance” is the minimum distance between two nodes in all hierarchies.
• Reachability - Individuals know the identity vectors of
  • Themselves
  • Their Friends
  • The Target?
“An Experimental Study of Search in Global Social Networks”

- 18 Targets spread across 13 countries.
- Starters were asked to forward an email to acquaintance who might know the target.
- ~90K people registered, but only ~69K participated.
- Shorter average chain length ~4.5
- Attrition rate at each remove on average approx. 63% (vs 25%)
- Only 384 completed chains, which is 1.6% of all chains (vs 20%)
- Longer chains of $L>=10$, had a very small probability of completion(~0.37%).
- This can be explained by lack of incentive and social capital?
Findings of the Experiment

- Decrease in Attrition rate, resulted in a huge increase in the completion rate. (15% dec -> 800% inc).
- Successful chains utilized the attributes of identities discussed earlier like:
  - Weak ties
  - Professional ties
  - Ties originating at college
  - Target’s work.
- Interestingly participants avoided hubs and family ties.
- Participants only forwarded an email, when they envisioned a path to the target.
- Motivation/Perception/Incentives hence matter.
Resulting Graphs
Characteristics of “Search-ability”

• Notation:
  • q-probability of arbitrary message chain reaching target.
  • r - the desired distance.
  • p- probability of failure of message at propagate at a particular length L.
  • If message chain fails at a node, then we can say the L:
    • \( L = \ln r / \ln (1 - p) \)
  • Interestingly the number of nodes value, doesn’t contribute to the above.

• Paths are creatable only if nodes have knowledge of the network.
• Identity plays a very important role in the search-ability, it leads to creation of contexts-> higher interactions.
References

• “An Experimental Study of Search in Global Social Networks” - Peter Sheridan Dodds, Roby Muhamad, Duncan J. Watts

• Peter Dodds’ Youtube lecture “S9E18: The theory of finding things in small-world networks” https://www.youtube.com/watch?v=9-Kmv8F5NAE