IMPACT OF MESSAGE SORTING ON ACCESS TO NOVEL INFORMATION IN NETWORKS

BENJAMIN D. HORNE & SIBEL ADALI
RENSSELAER POLYTECHNIC INSTITUTE

KEVIN CHAN
US ARMY RESEARCH LABORATORY

ASONAM 2016
Feed based networks can cause information overload

- Information can be...
  - Irrelevant
  - overly duplicated
  - too much
ALGORITHMIC INFORMATION SORTING IN NETWORKS

• Algorithms change what users see
  • In overload, important information may never be seen
• We will concentrate on message sorting
PROBLEM:
ARE INDIVIDUALS IN THE NETWORK MORE INFORMED UNDER DIFFERENT MESSAGE SORTING SCHEMES?

• How can algorithms help the network receive
  • more diverse information
  • in a timely manner
RELATED WORK

• Growing concern in access to information in social networks
  • Homophily limits access to different points of view
  • Predictive algorithms tend to amplify homophily\textsuperscript{1,2,3}
• The impact of the basic sorting is not yet studied


SIMULATE AGENTS IN NETWORK
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
SIMULATE AGENTS IN NETWORK

**Inbox Sortings:**
1. Last in-First out (LIFO)
2. First in-First out (FIFO)
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)

Already sent
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)

Agent Attributes:
1. Capacity
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)

Agent Attributes:
1. Capacity
2. Propensity to send
SIMULATE AGENTS IN NETWORK

Inbox Sortings:
1. Last in-First out (LIFO)
2. First in-First out (FIFO)

Agent Attributes:
1. Capacity
2. Propensity to send

$P_s = 0.6$
$C = 1$
INFORMATION TRAFFIC PATTERNS
INFORMATION TRAFFIC PATTERNS

High Traffic Burst
INFORMATION TRAFFIC PATTERNS

High Traffic Burst

Streaming Traffic
HOW WE UNDERSTAND PERFORMANCE
HOW WE UNDERSTAND PERFORMANCE

1. Average number of unique facts known per agent

   -The more unique facts an agent knows the better!
HOW WE UNDERSTAND PERFORMANCE

1. Average number of unique facts known per agent
   - The more unique facts an agent knows the better!

2. Total number of agents sending information per time step
HOW WE UNDERSTAND PERFORMANCE

1. Average number of unique facts known per agent
   - The more unique facts an agent knows the better!

2. Total number of agents sending information per time step

3. Number of copies made for each facts (branching factor)
SIMULATIONS RAN 50 TIMES & AVERAGED

- Small World graphs
- 256 nodes
- 50% Rewire probability
- Similar densities
FIFO out performs LIFO in High Traffic
LIFO suffers from synchronization on duplicate facts

FIFO

LIFO
SYNCHRONIZATION IS WHEN EACH AGENT IN THE NETWORK HAS THE SAME STACK OF ALREADY SENT FACTS
RELATED WORK

• Epidemic Networks
  • Flare-up synchronization\textsuperscript{1,2}

• Synchronization in literature is different from the synchronization found in this work
  • Single states vs Queuing of states


LIFO IS IMPACTED BY SYNCHRONIZATION; FIFO IS NOT
LIFO can outperform FIFO in Streaming Traffic
Streaming traffic helps mitigate the synchronization in LIFO

**FIFO**

- **# facts known**
  - Y-axis: # facts known
  - X-axis: time
  - Data points indicate an increasing number of facts known over time.

- **# actors sending information**
  - Y-axis: # actors sending information
  - X-axis: time
  - Graph shows a decreasing trend in the number of actors sending information.

**LIFO**

- **# facts known**
  - Y-axis: # facts known
  - X-axis: time
  - Data points indicate an increasing number of facts known over time.

- **# actors sending information**
  - Y-axis: # actors sending information
  - X-axis: time
  - Graph shows a fluctuating trend in the number of actors sending information.
In LIFO facts that are sent go viral, In FIFO more facts are sent
Streaming traffic has an effect on FIFO branching distribution
DUPPLICATION IS THE KEY DIFFERENCE
When duplicates are removed, LIFO and FIFO converge

**FIFO WITH NO DUPLICATES**

- # facts known
- # actors sending information

**LIFO WITH NO DUPLICATES**

- # facts known
- # actors sending information
Use FIFO in High Traffic and LIFO in Stream Traffic

HIGH TRAFFIC BURST

STREAMING TRAFFIC

5000 Facts in the system
Feed sorting is a crucial factor in information spread

• **LIFO** - users are prone to becoming synchronized on duplicate or already seen information; problematic for high traffic information arrival patterns

• **FIFO** – users can gain significantly more diverse information out of the box, especially in high traffic information arrival patterns

• Duplication of messages is the key cause in performance difference

• **Future** - explore much more intricate sorting mechanisms, develop analytical frameworks to better these sorting mechanisms in networks
BENJAMIN D. HORNE
HORNEB@RPI.EDU
HOMEPAGES.RPI.EDU/~HORNEB/

THANKS TO:
SIBEL ADALI AND KEVIN CHAN

[RENSSELAER POLYTECHNIC INSTITUTE]

[ARL]