A Domain-Agnostic Approach to Spam-URL Detection via Redirects

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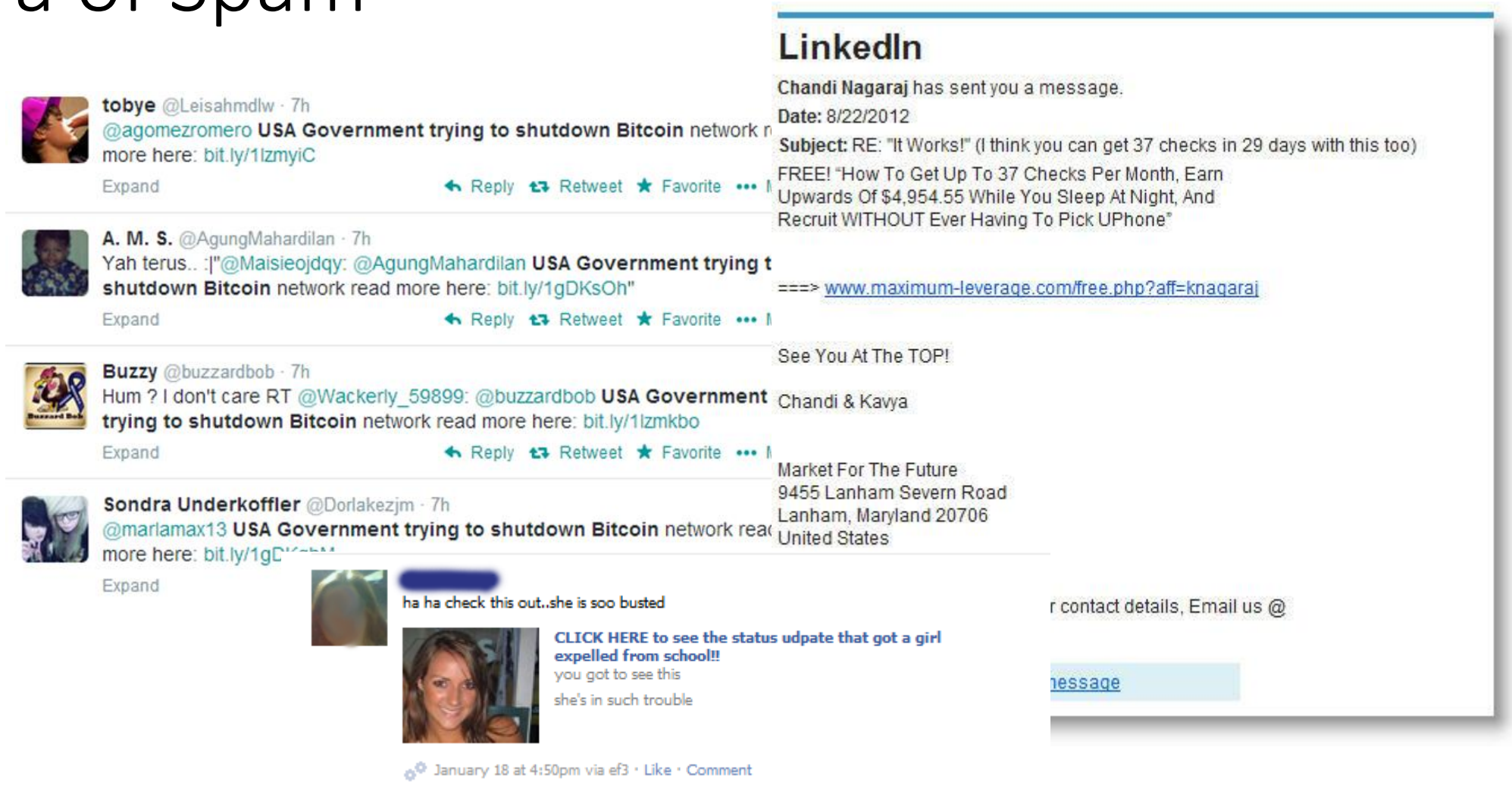
Era of Spam



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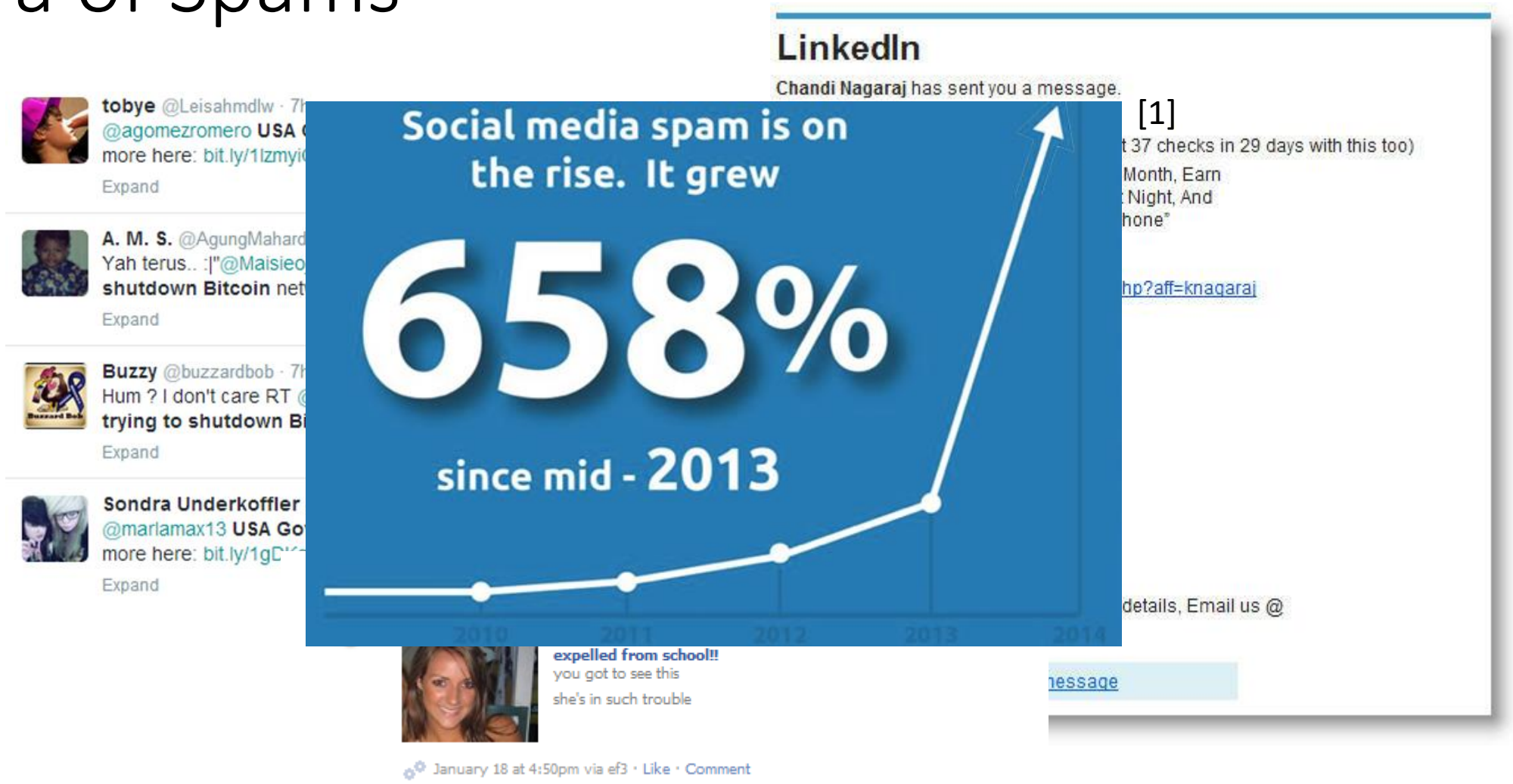
Era of Spams



[1] Social Media Spamming Grew By 658% Between 2013 And 2014: Entertainment, Financial And News Categories Main Target, https://dazeinfo.com/2014/12/15/social-media-spamming-growth-2014-facebook-twitter-entertainment/

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Popular Solutions

- IP blacklisting
  - Popular for social media and URL shortening services
  - False negative rates between 40.2 to 98.1%
  - Slow and unscalable

- Account based approach
  - Limited ability to detect compromised accounts
  - Require a history of malicious behavior
  - Not generalizable to different services

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Popular Solutions

- IP blacklisting

URL-level decisions are required
- able to filter individual post
- more generalizable

- A
  - Require a history of malicious behavior

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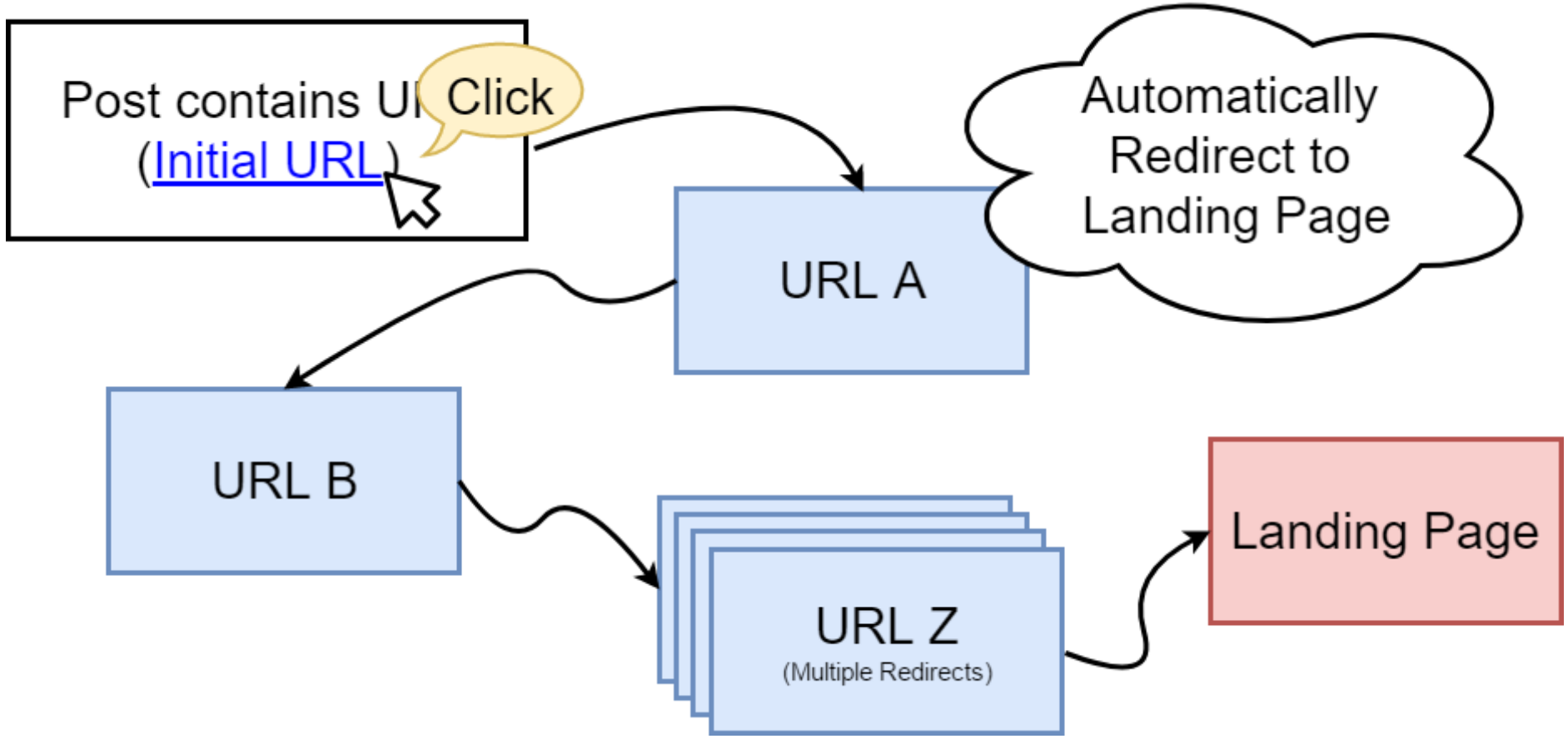
Domain-Agnostic Approach

- Leverages widespread of redirect chains by spammers
- Extracts robust features to capture the nature of spammers' behavior
- Can be applied into different domains

Redirect Chain



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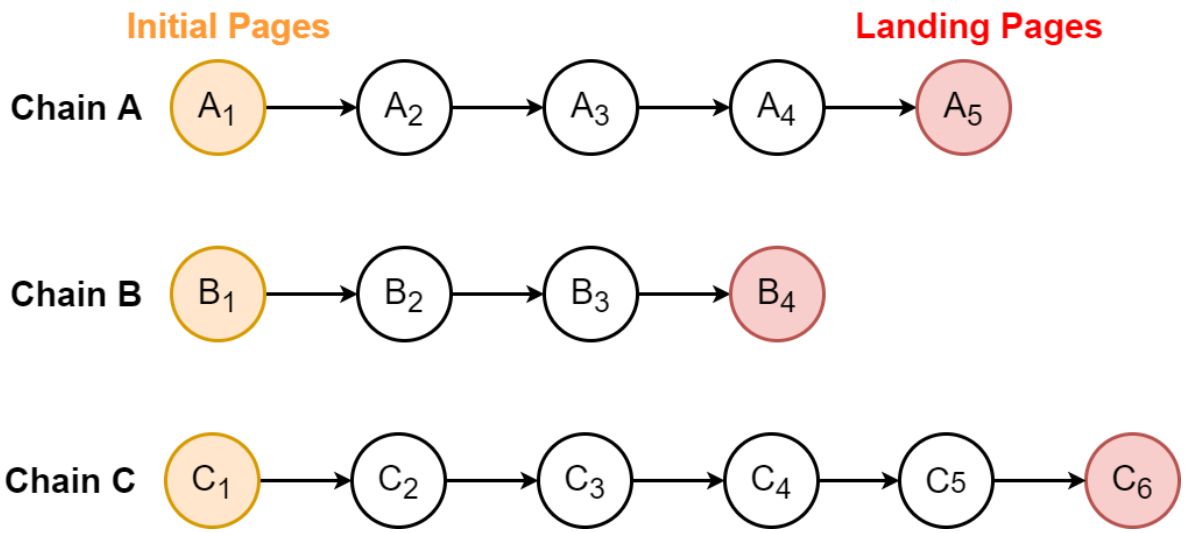
Redirect Chain



- Initial Pages
  - URL displayed to users
- Landing Pages
  - Where the user ends up

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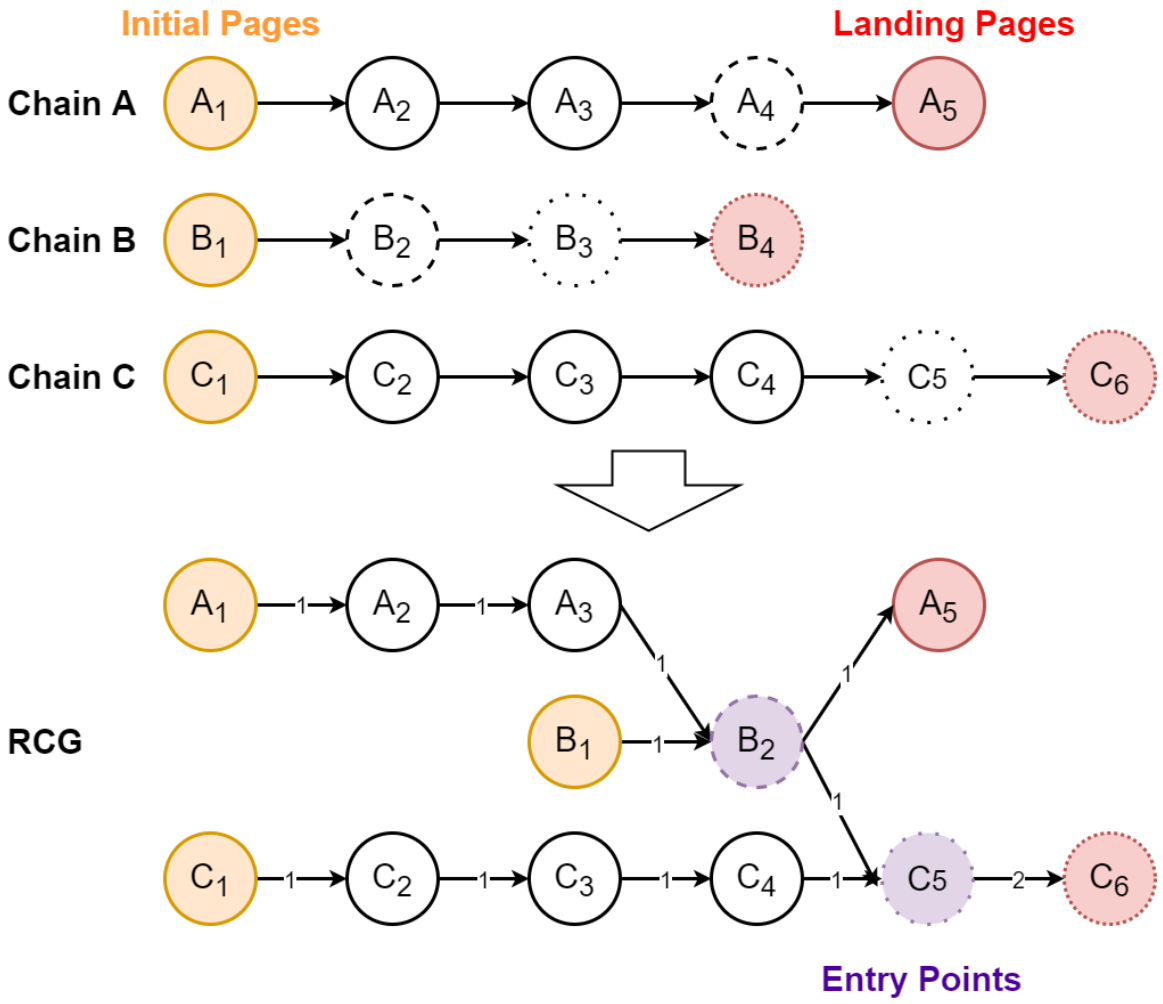
Redirect Chain Graph



- Identify same URLs
- Aggregate chains
- Find Entry points
  - Largest in-weight node in each chain

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Feature Design

- Three groups of Features that characterize spammers' behavior
  - Shared resources
  - Heterogeneity
  - Flexibility

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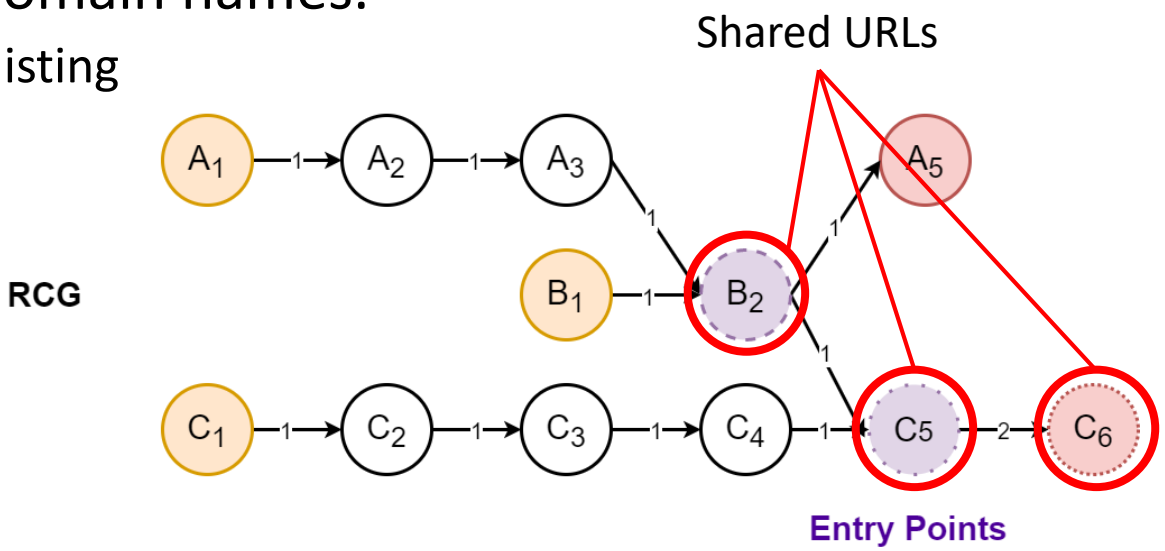
Features – Shared Resources

- To reduce costs, sharing resources is inevitable
  - Reuse of URLs
  - Same servers hosting many different domain names.
    - To evade and stay ahead of domain blacklisting
- Total 17 features



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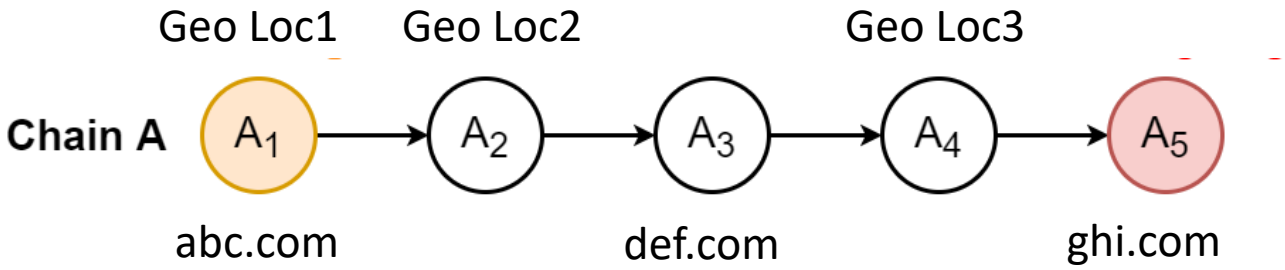
Features – Heterogeneity

- “Don't put all your eggs in one basket”
  - Place servers to different geo-locations
  - Use of compromised servers and bot machines
- Total 12 features



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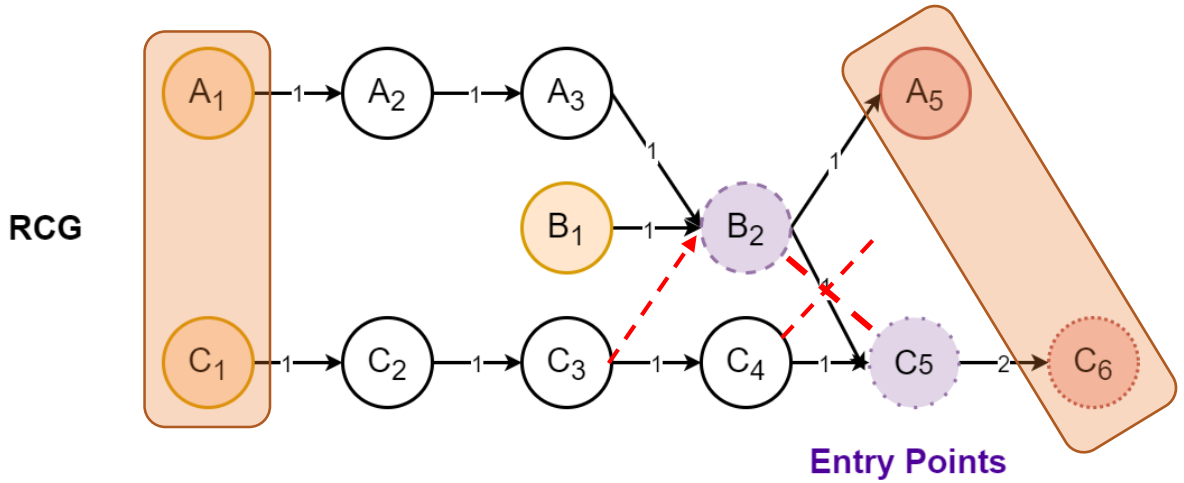
Features – Flexibility

- Two types of flexibility:
  - For luring more users
    - Multiple different initial URLs
  - For evading detection
    - Using multiple landing URLs with redundant content
    - Same URLs with different IPs
    - Dynamicity and selectivity using long redirect chains
- Total 10 features



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Dataset

- Tweets
  - 3,764,395 tweets have URLs
    - 3,871,911 initial URLs are identified
- Redirect Chain
  - Chain lengths are vary from 1 to 46
  - 99% of chains are less than length 6
- Redirect Chain Graph
  - 4,874,256 nodes
  - 3,839,633 edges

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Experiment

- Supervised Detection
  - Compare between context-free and context-aware detection

- Semi-supervised Detection
  - Small fraction of labels are revealed (1% or 5%)
  - Loopy belief propagation (LBP) through user-URL bipartite graph

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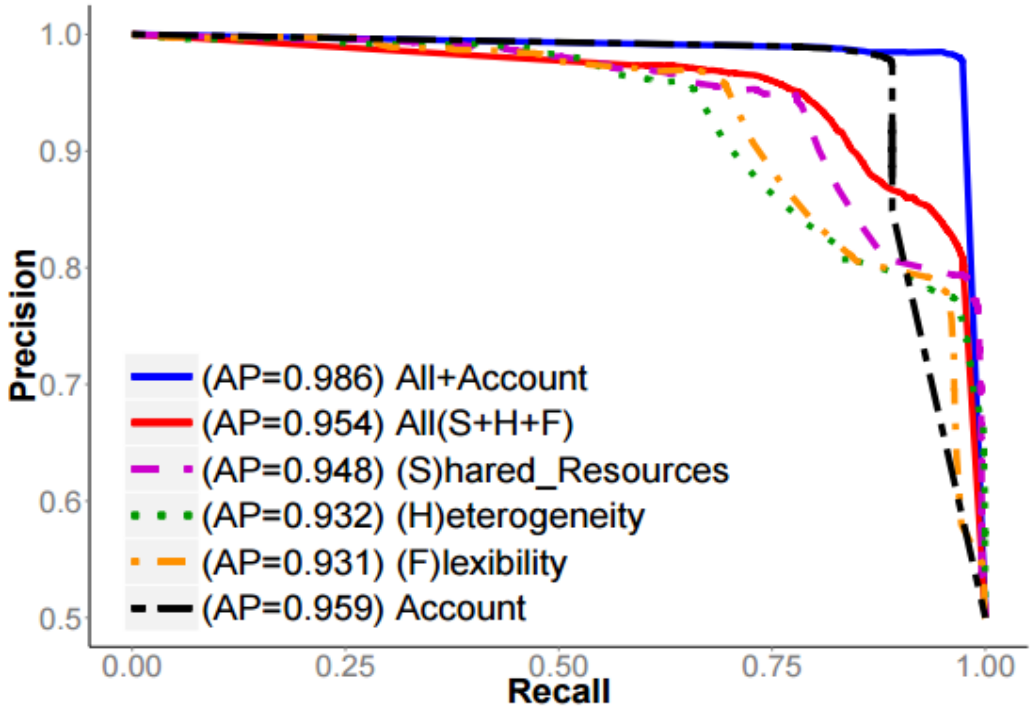
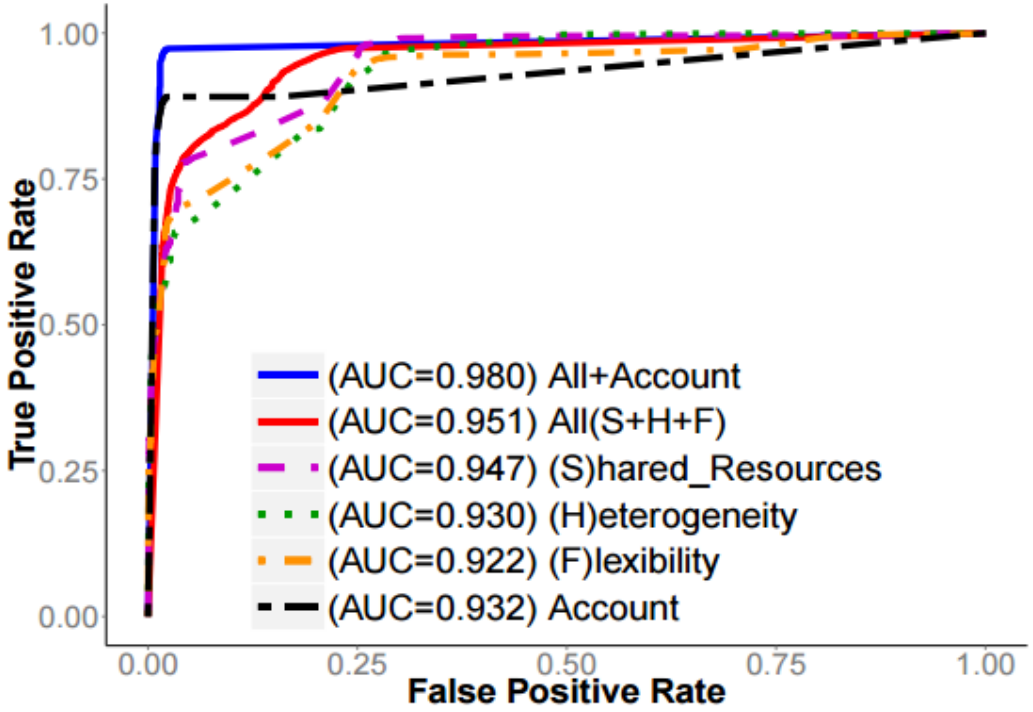
Result – Supervised methods





- Context-free features achieve competitive performance

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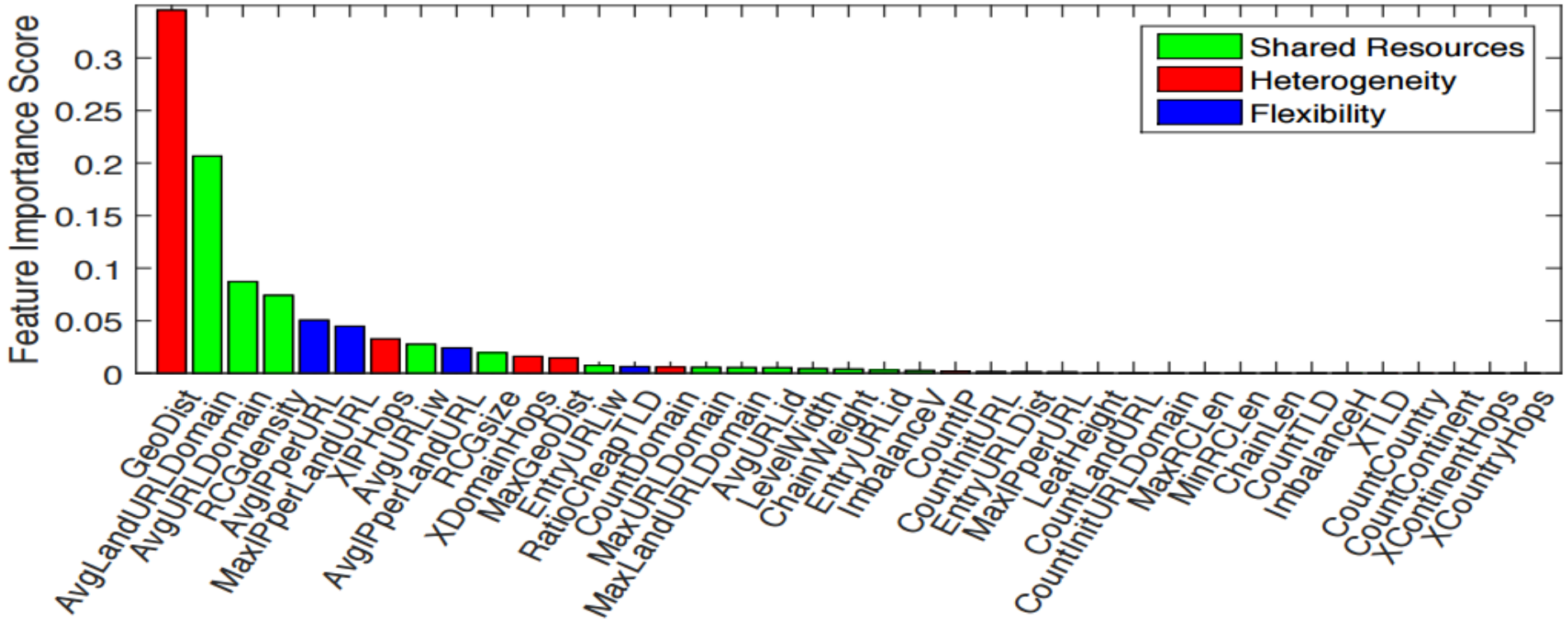
Result – Feature importance score



- Top features evenly come from all three categories

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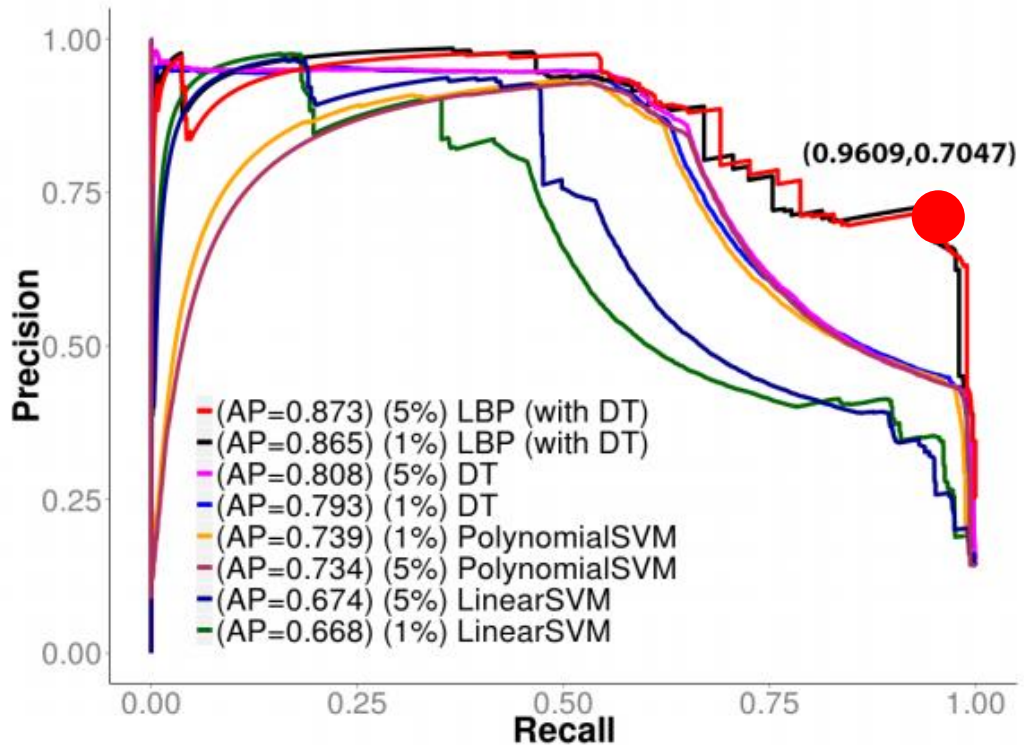
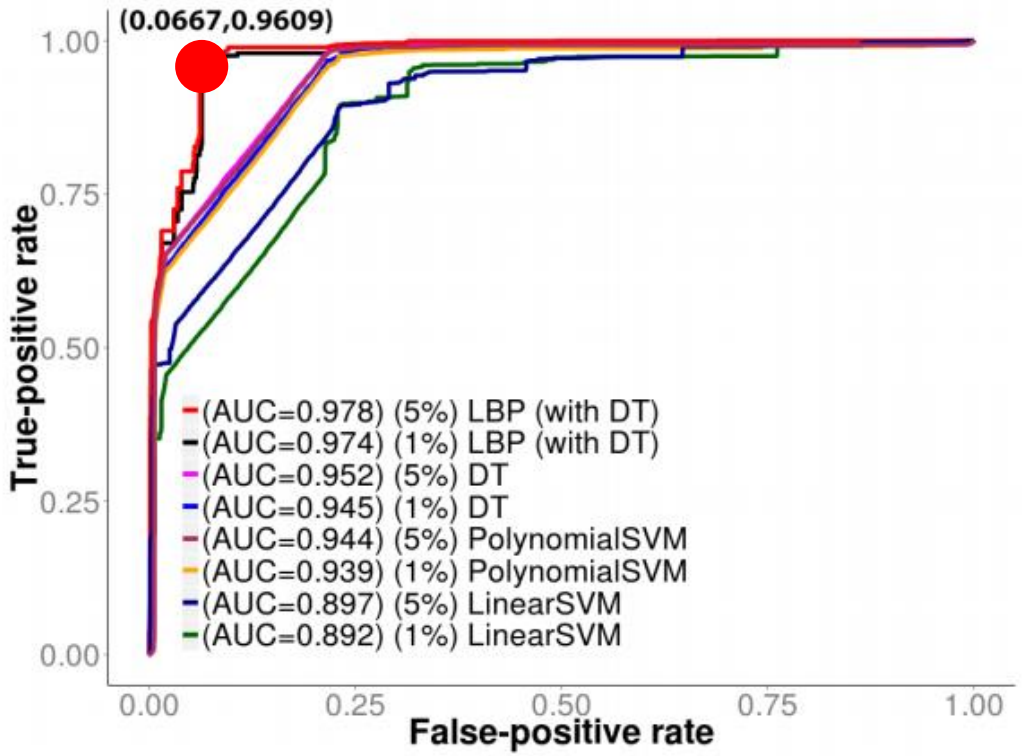
Result – Semi-supervised methods





- Red dots show the performance at threshold 0.5

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Conclusion

- Alternative approach to detect spam URL using Redirect Chain Graph
  - Context-free
  - Adversarially robust
  - Semi-supervised

data available at: http://cs.stonybrook.edu/~heekwon

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Thank you!