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Statistical Analysis of User-Event Data for Digital Forensics

Chris Galbraith
Advised by Padhraic Smyth

University of California, Irvine

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Project Goals

1. Develop statistical methodologies to address questions such as
   - Are two event streams from the same individual or not?
     - Galbraith, C., & Smyth, P. (2017). “Analyzing user-event data using score-based likelihood ratios with marked point processes.” *Digital Forensic Research Workshop (DFRWS),* in press.
   - Are there unusual and significant changes in behavior?
2. Develop testbed data sets to evaluate these methodologies
3. Develop open-source software for use in the forensics community

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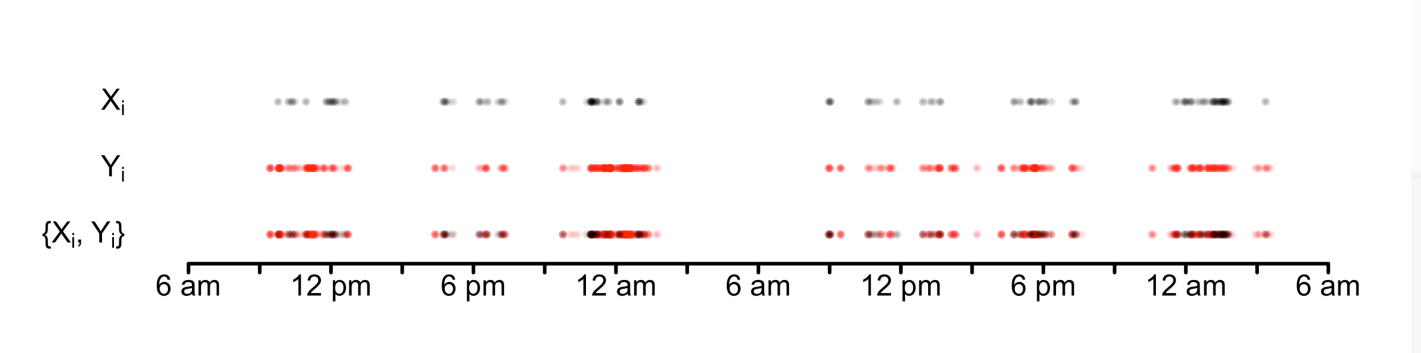
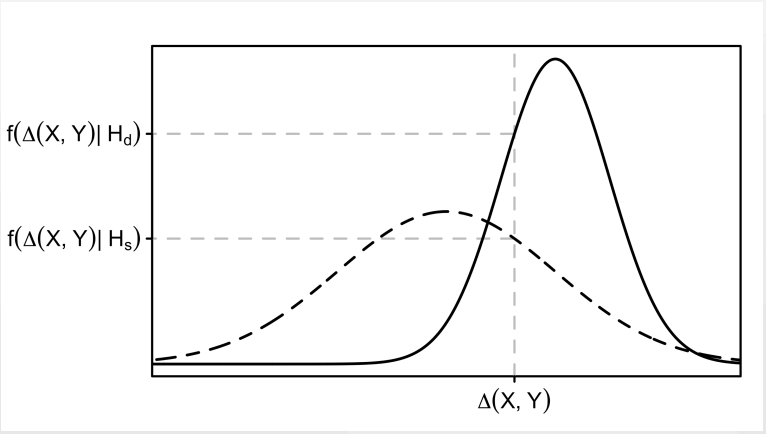
- Use indices from *marked point process* literature as score functions that measure similarity between event streams



- Construct *score-based likelihood ratios* using these indices:

$$SLR_{\Delta} = \frac{\hat{f}(\Delta(X,Y)|H_s)}{\hat{f}(\Delta(X,Y)|H_d)}$$



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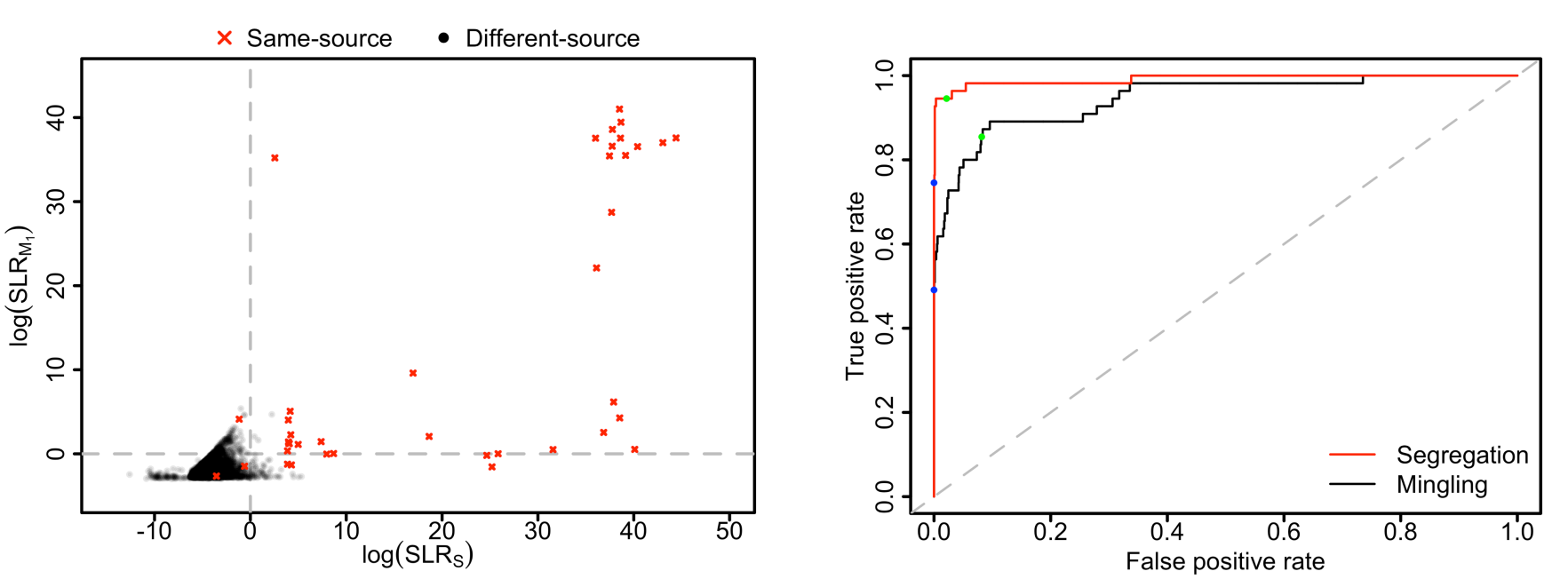
- Data: event streams (Facebook & non-FB web browsing) from 55 students measured for one week
- SLR_{Δ} estimated for each pairwise combination of individuals and their event streams, based on data from all *other* individuals



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- **Conclusions:**
  - Marked point processes can provide a general statistical framework for the analysis of human-generated event data in digital forensics
  - SLRs based on mpp indices showed significant promise in addressing whether two event streams came from the same or different individuals, using a real-world data set of web browsing events
  - Results are *only for one specific data set* and may not generalize to others
- **Future Work:**
  - Broaden the scope of the statistical methodology
    - e.g., inter-event times & multiple types (>2) of event streams
  - Gather additional real-world testbed data sets
  - Disseminate ideas at technical forensics conferences (DFRWS & ICFIS)
  - Investigate robustness and applicability of randomization methods
  - Investigate theoretical limits of detectability & different types of dependence

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