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Doctoral Candidate
Computer Engineering

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Expressive and Interpretable User Engagement Prediction using Multivariate Survival Processes

Abstract. The ability to characterize how information diffuses online is of paramount importance to stakeholders that are interested in tasks such as proposing solutions for mitigating and countering dis/misinformation, predicting user engagement of content in social media, planning marketing campaigns to roll-out products and planning dissemination of political campaign messaging among others. One such facet of learning the dynamics of information diffusion is the ability to predict user engagement or the popularity of a single piece of information as it spreads through an online medium. Existing works in this regard mainly either obfuscate user level information or utilize frameworks that are difficult to interpret underlying user behaviors.

Survival analysis is a powerful statistical approach that can be used to model information diffusion by taking advantage of elegant representations of underlying probability distributions. We utilize this probabilistic framework to propose a novel model for user engagement prediction that considers unobserved heterogeneity in user behaviors. In addition to this, we propose a novel deep learning framework to predict user engagement by modeling underlying functions in survival analysis using expressive neural networks while retaining the rich interpretable aspects of survival analysis.

We also propose two new variants of a discriminative loss function that is designed to train a single model for arbitrary observation periods and forecast horizons. We show via experiments that these discriminative loss functions perform better than traditional generative loss (log-likelihood) when data is scarce. We also describe how our proposed approaches retain the rich interpretable framework of point processes by exploring how we can infer Granger-causal relationships among diffusion actors. We then illustrate how these estimates can be used to extract meaningful insights from real-world data.

Education

M.Sc. in Computer Engineering, Florida Institute of Technology, USA, 2019.
B.Sc. in Computer Engineering, Florida Institute of Technology, USA, 2018.

Selected Peer-Reviewed Publications

- **Akshay Aravamudan**, Xi Zhang, and Georgios C. Anagnostopoulos. An Expressive yet Interpretable Approach to Anytime User Engagement Predictions. Submitted for consideration to Association for Computing Machinery Knowledge Special Interest Group on Data Discovery and Data Mining ACM SIGKDD 2025 conference. Estimated acceptance rate: 20.1%. Under review.
- **Akshay Aravamudan**, Xi Zhang, and Georgios C. Anagnostopoulos. Anytime user engagement prediction in information cascades for arbitrary observation periods. In Proceedings of the 37th AAAI Conference on Artificial Intelligence (AAAI 2023), volume 37 of Proceedings of Machine Learning Research, pages 4999–5009. PKP Publishing Services, Jun. 2023. Acceptance rate: 19.6%. [DOI]
- **Akshay Aravamudan**, Xi Zhang, Jihye Song, Stephen M. Fiore, and Georgios C. Anagnostopoulos. Influence dynamics among narratives. In Robert Thomson, Muhammad Nihal Hussain, Christopher Dancy, and Aryn Pyke, editors, Social, Cultural, and Behavioral Modeling, pages 204–213, Cham, 2021. Springer International Publishing. Acceptance rate: 57%. [DOI]
- Xi Zhang, **Akshay Aravamudan** and Georgios C. Anagnostopoulos. A Generalized Time Rescaling Theorem for Temporal Point Processes. Neural Computation, pages 1-15, March, 2025, ISSN 0899-7667. Impact Factor: 3.28. [DOI]
- Zimeena Rasheed**, Akshay Aravamudan**, Xi Zhang, Georgios C. Anagnostopoulos, and Efthymios I. Nikolopoulos. Combining global precipitation data and machine learning to predict flood peaks in ungauged areas with similar climate. Advances in Water Resources Volume 192,2024, 104781, ISSN 0309-1708. Impact Factor: 4.26. [DOI]
- Xi Zhang, **Akshay Aravamudan** and Georgios C. Anagnostopoulos. Anytime information cascade popularity prediction via self-exciting processes. In Proceedings of the 39th International Conference on Machine Learning (ICML 2022), volume 162 of Proceedings of Machine Learning Research, pages 26028–26047. PKP Publishing Services, Jul. 2022. Acceptance rate: 21.9%. [DOI]

Acknowledgments

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Dissertation Defense

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Conference Room 202,
Olin Physical Sciences Building
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