

The slide features decorative curved lines in shades of green and blue, positioned in the top-left and bottom-right corners. The main title is centered in a dark blue, serif font.

The computational mechanics approach in analyzing emotion contagion on social media

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PSC256B

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● Emotion contagion

“The tendency to automatically mimic and synchronize expressions, vocalizations, postures, and movements with those of another person’s and, consequently , to converge emotionally.”



1. Hatfield E, Cacioppo JT, Rapson RL. Emotional Contagion. *Current Directions in Psychological Science*. 1993;2(3):96-100. doi:10.1111/1467-8721.ep10770953
2. Belkin, L. Y., Kurtzberg, T. R., & Naquin, C. E. (2006). Emotional contagion in the online environment: Investigating the dynamics and implications of emotional encounters in mixed-motive situations in the electronic context.
3. Kramer, A. D., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences*, 111(24), 8788-8790.

● Why does digital emotion contagion matter?

Ubiquity and scale of digital media around us

- online social movements, all highly driven by emotions [3].
- personal emotions online in a way that affects not only our own well-being [4] but also the well-being of others who are connected to us [5].

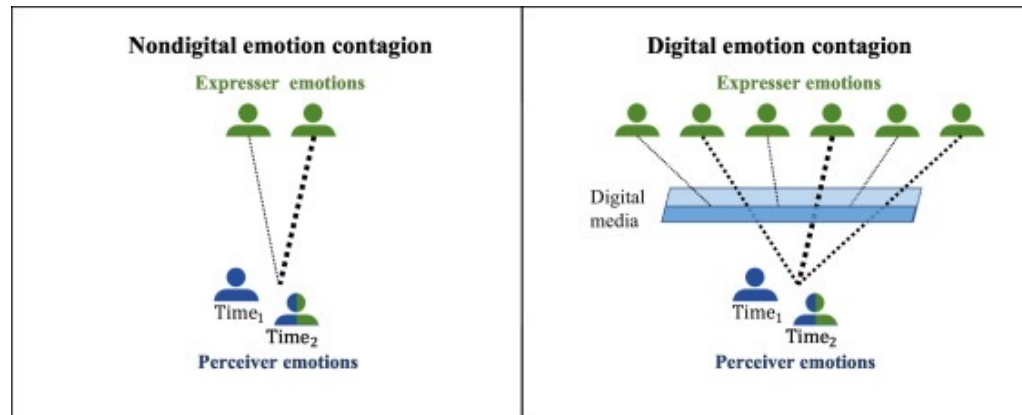


Figure1: Nondigital vs digital emotion contagion by Goldenberg, A., & Gross, J. J. (2020).
Digital emotion contagion. *Trends in cognitive sciences*, 24(4), 316-328.

1. Kramer, A. D., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences*, 111(24), 8788-8790.
2. Panger, G. (2016). Reassessing the Facebook experiment: critical thinking about the validity of Big Data research. *Information, Communication & Society*, 19(8), 1108-1126.
3. Crockett, M. J. (2017). Moral outrage in the digital age. *Nature human behaviour*, 1(11), 769-771.
4. Lomanowska, A. M., & Guitton, M. J. (2016). Online intimacy and well-being in the digital age. *Internet interventions*, 4, 138-144.
5. Hill, A. L., Rand, D. G., Nowak, M. A., & Christakis, N. A. (2010). Emotions as infectious diseases in a large social network: the SISa model. *Proceedings of the Royal Society B: Biological Sciences*, 277(1701), 3827-3835.

● Background

- Twitter: modeling the aggregate behavior of large collections of users (Darmon, 2015)
- Stock Market trading: (Hilbert et. al., 2020)
- Simulating twitter behavior patterns: (Ariyaratne, 2016)

● Research questions

- Are there any hidden patterns in negative sentiment expression on social media?

1. Darmon, D. (2015). *Statistical methods for analyzing time series data drawn from complex social systems* (Doctoral dissertation, University of Maryland, College Park).
2. Hilbert, M., & Darmon, D. (2020). How Complexity and Uncertainty Grew with Algorithmic Trading. *Entropy*, 22(5), 499.
3. Ariyaratne, A. (2016). *Large Scale Agent-Based Modeling: Simulating Twitter Users* (Doctoral dissertation).



Methodology

- Platform
 - Reddit
- Data collection
 - Reddit post history through Google Big Query and selected the 15 most active users from the hundred most popular posts in political subreddit on May 17, 2018,
 - 15,558 comments with all parent comments (the comment which is the first one in a thread).
- Sentiment analysis
 - IBM Watson Natural Language Understanding
 - Variable of interest: Sentiment score

Methodology

Causal State Splitting Reconstruction (CSSR) algorithm (Darmon, 2015; Crutchfield & Young, 1989)

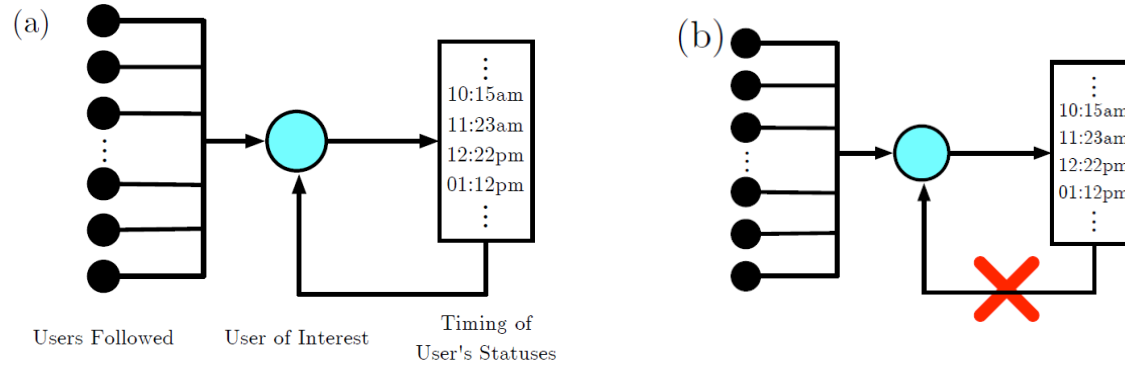


Figure 2 (Darmon, 2015): transducer and e-machine representing a) autoregressive model where users' sentiment is influenced by social input and their own past sentiment and, 2) model where users' current sentiments are driven by their own past sentiments.

$$X_t(v) = \begin{cases} 1, & \text{user } v \text{ having negative sentiments during } [(t-1)\delta, t\delta] \\ 0, & \text{otherwise} \end{cases}$$

$$Y_t(v) = \begin{cases} 1, & \text{user } v \text{ getting negative social input during } [(t-1)\delta, t\delta] \\ 0, & \text{otherwise} \end{cases}$$

$\delta = 1$ hour, $\{X_t(v)\}$ captures the daily patterns of the user,

$\alpha = 0.001$,

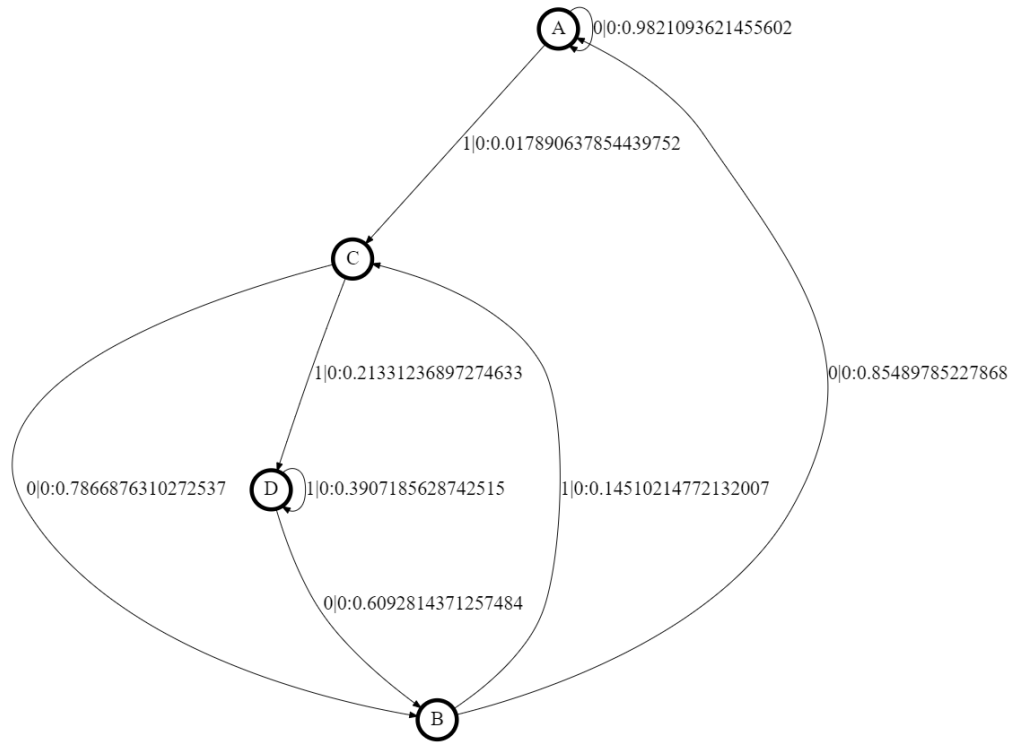
$L(\max) = 2$

Primitive analysis

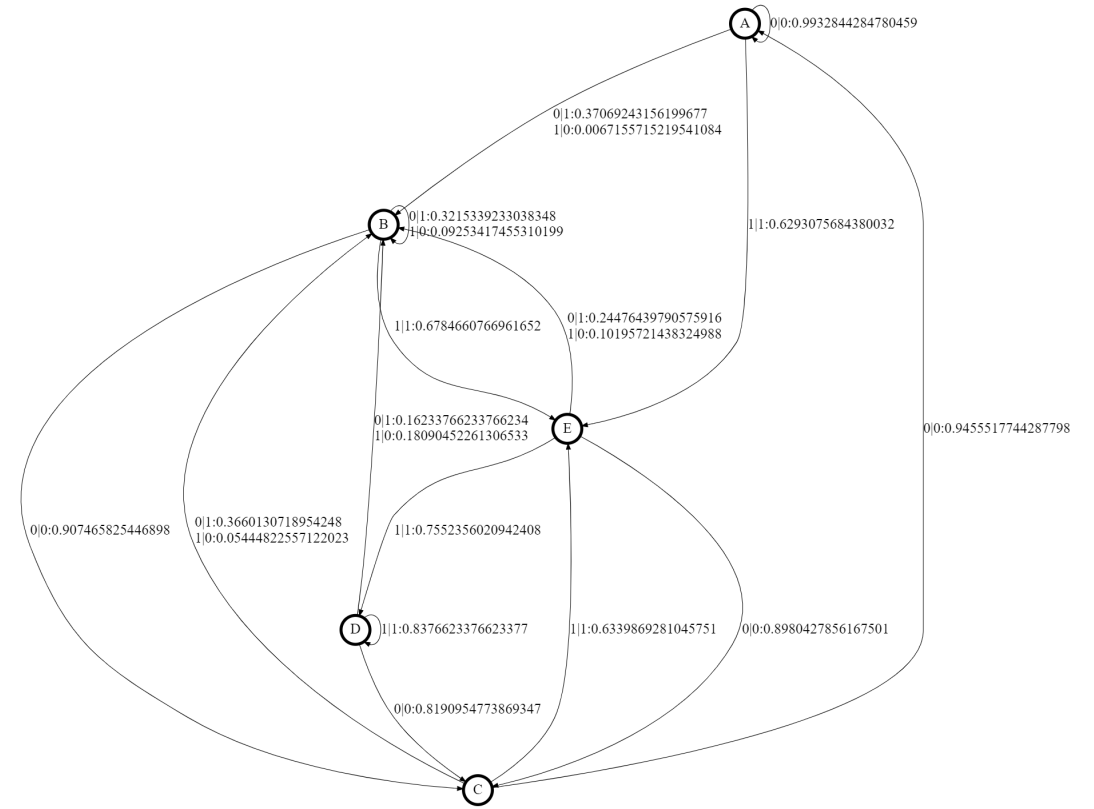


● Aggregated (unit of analysis: whole community)

E-machine

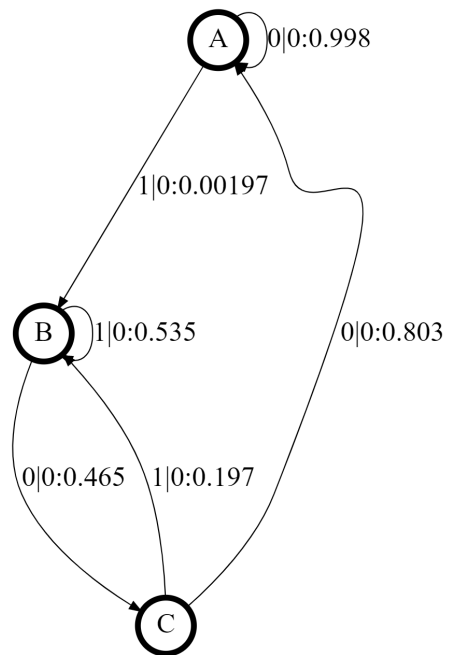


transducer

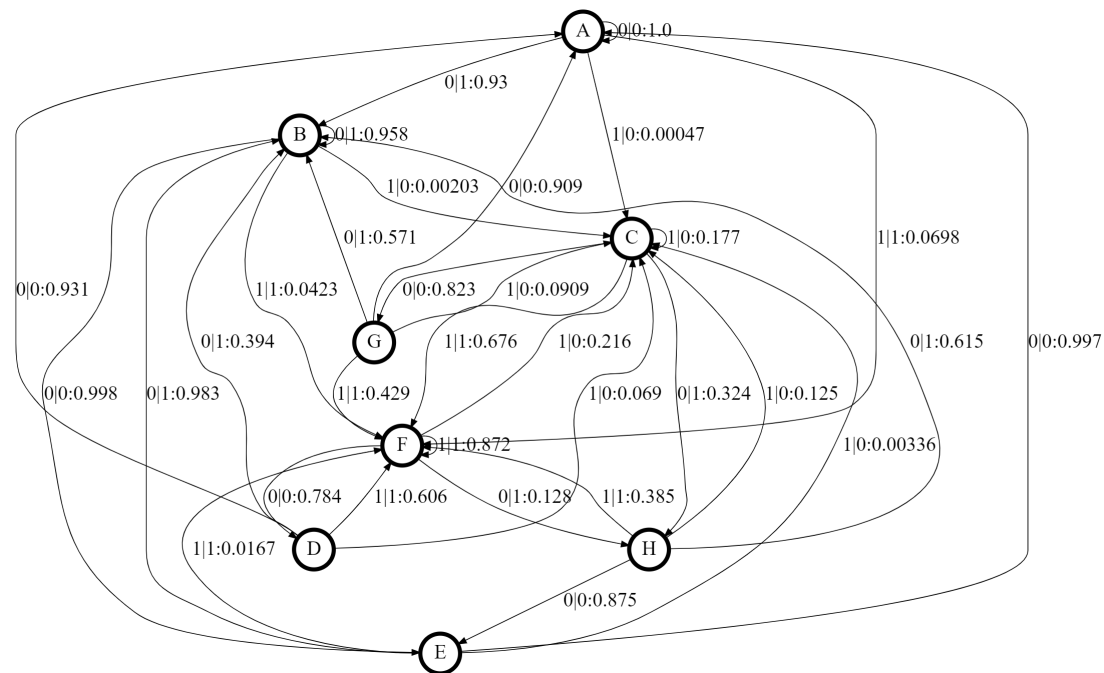


● Individual (unit of analysis: individual user)

E-machine



transducer

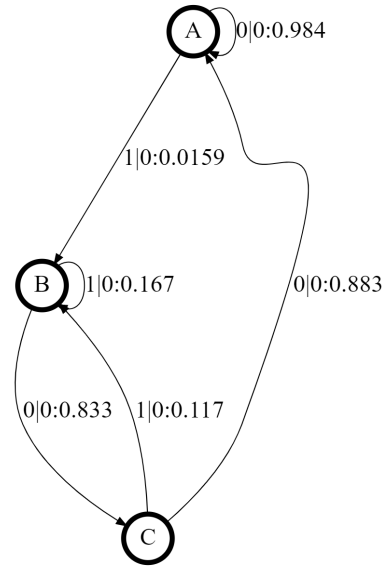


User 1

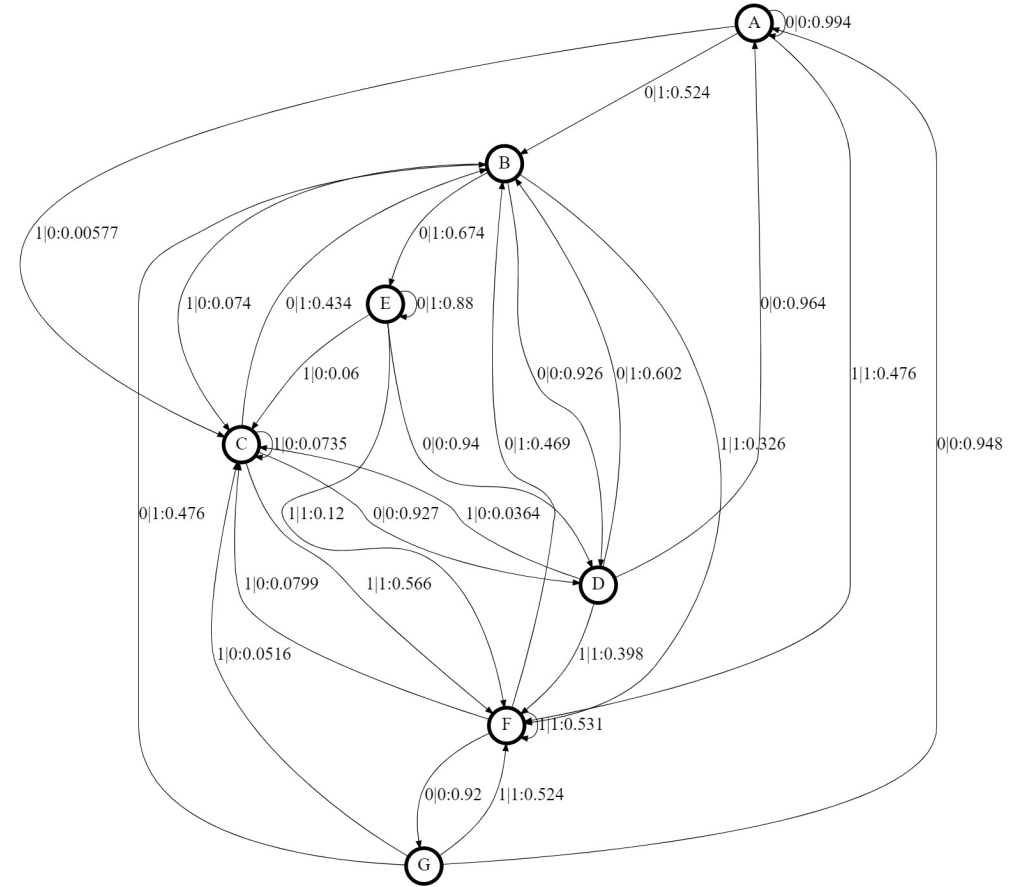


Individual (unit of analysis: individual user)

E-machine



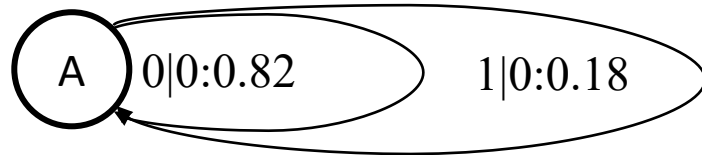
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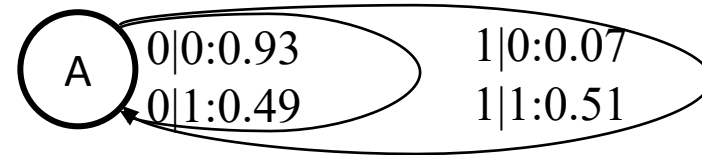
User 2

- Individual (unit of analysis: individual user)

E-machine



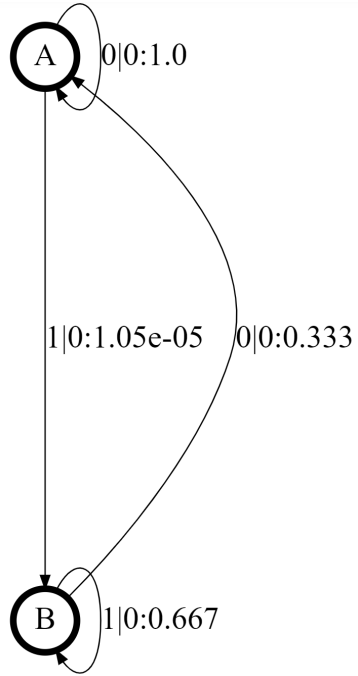
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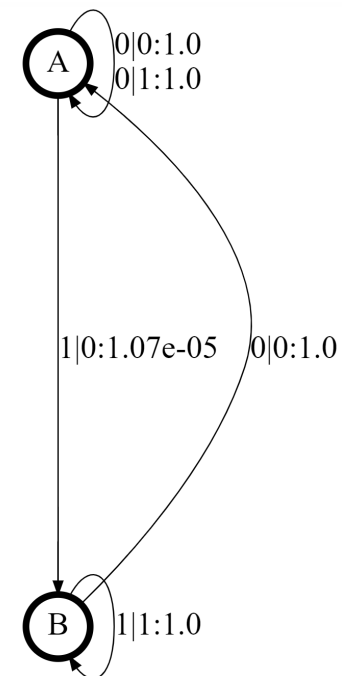
User3

- Individual (unit of analysis: individual user)

E-machine



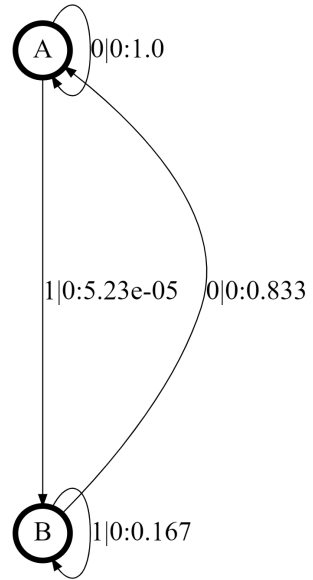
transducer



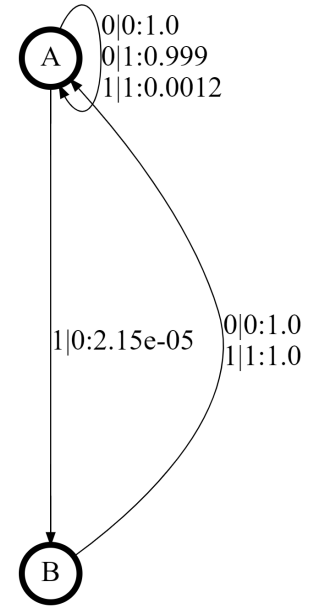
User 4

- Individual (unit of analysis: individual user)

E-machine



transducer



User 5

Future directions

- Expanding the analysis to full dataset.
- Build seasonally driven model where the user's sentiment is driven by the time of the day.
- Experiment different values of $L(\max)$.