Modeling Topic-Partitioned Assortatitivy and Disassortativity in Dyadic Event Data

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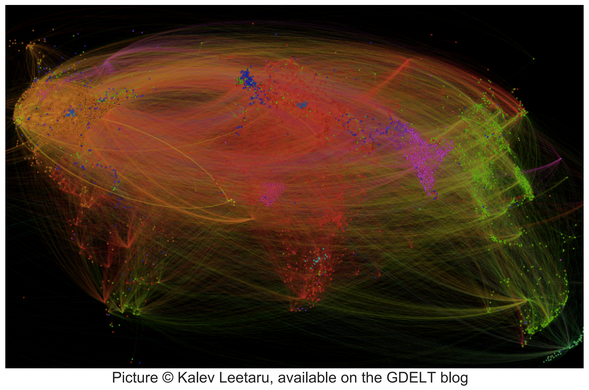
Dyadic event data

who did what to whom, when

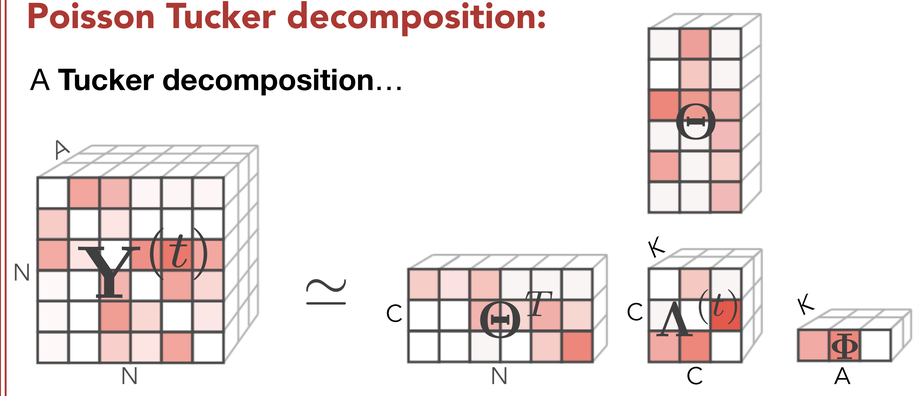


Picture © Kalev Leetaru, available on the GDELT blog

$y^{(t)}_{i \xrightarrow{a} j}$: number of times **actor *i*** took **action *a*** towards **actor j** during **time t**

Poisson Tucker decomposition:

A **Tucker decomposition**…

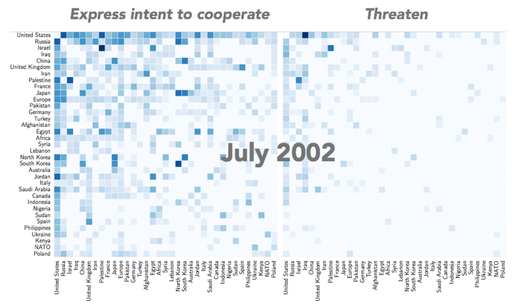


…with a **Poisson** assumption.

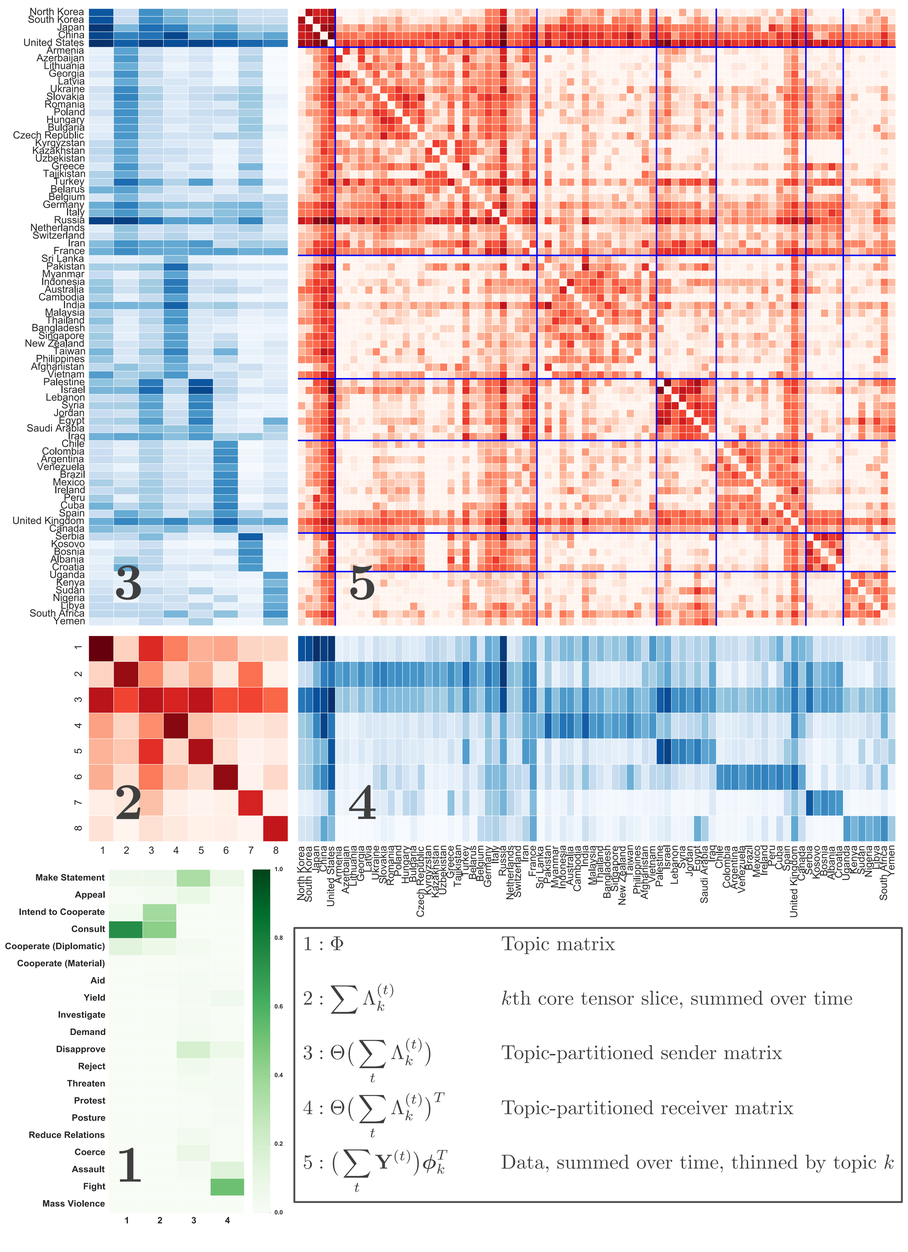
$$y^{(t)}_{i \xrightarrow{a} j} \sim \text{Pois}\left(\sum_{c_1=1}^{C} \theta_{ic_1} \sum_{c_2=1}^{C} \theta_{jc_2} \sum_{k=1}^{K} \lambda^{(t)}_{c_1 \xrightarrow{k} c_2} \phi_{ak}\right)$$

ICEWS dataset:

- 249 country actors
- 20 high level action types
- 1995-2012 daily events

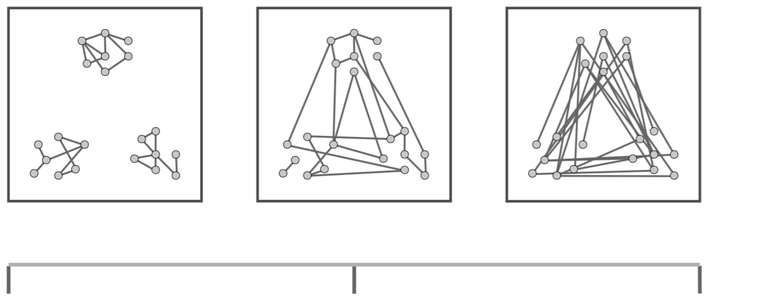


Example results on 1995-2000 data:



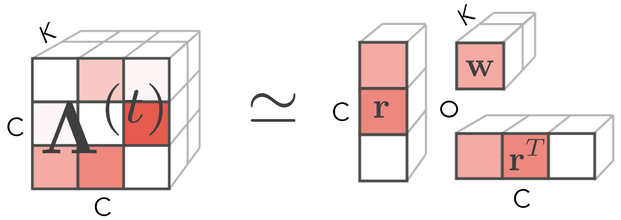
$1 : \Phi$	Topic matrix
$2 : \sum \Lambda^{(t)}_k$	kth core tensor slice, summed over time
$3 : \Theta(\sum_t \Lambda^{(t)}_k)$	Topic-partitioned sender matrix
$4 : \Theta(\sum_t \Lambda^{(t)}_k)^T$	Topic-partitioned receiver matrix
$5 : (\sum_t \mathbf{Y}^{(t)})\phi^T_k$	Data, summed over time, thinned by topic k

(Dis-, Non-)Assortativitivity



Gamma CP decomposition:

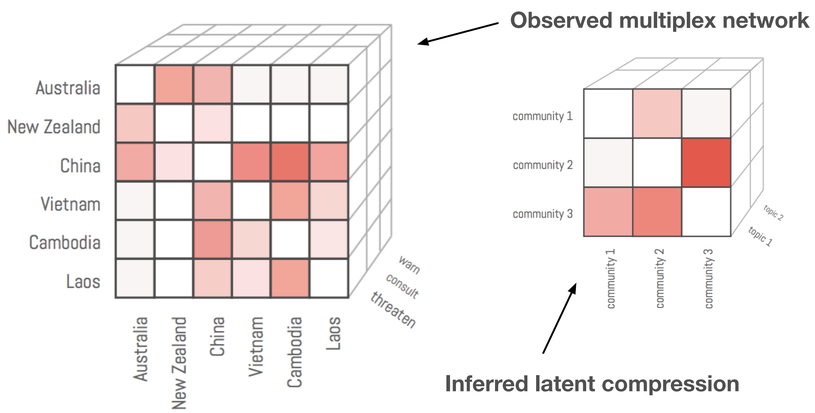
A **CP decomposition**…



…with a **Gamma** assumption.

$$\lambda^{(t)}_{c_1 \xrightarrow{k} c_2} \sim \begin{cases} \text{Gamma}\left(\xi r_{c_1} w_k,\ 1/d_t\right) & c_1 = c_2 \\ \text{Gamma}\left(r_{c_1} r_{c_2} w_k,\ 1/d_t\right) & c_1 \neq c_2 \end{cases}$$

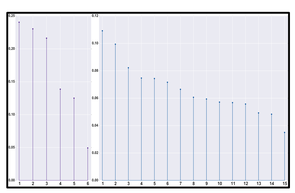
Topic-partitioned network structure



Shrinkage priors:

$$r_c \sim \text{Gamma}\left(\frac{\gamma_0}{C},\ \frac{1}{\beta}\right)$$

$$w_k \sim \text{Gamma}\left(\frac{\rho_0}{K},\ \frac{1}{\beta}\right)$$



Other priors:

$$\theta_{ic} \sim \text{Gamma}\left(a_i, \frac{1}{b_i}\right) \qquad a_i, b_i \sim \text{Gamma}\left(a_0, \frac{1}{b_0}\right)$$

$$\phi_k \sim \text{Dir}\left(\nu_1 \ldots \nu_A\right) \qquad d_t \sim \text{Gamma}\left(e_0, \frac{1}{f_0}\right)$$

$$\xi \sim \text{Gamma}\left(g_0, \frac{1}{h_0}\right)$$