

A Temporal Knowledge Graph Dataset for Conflicts, Trade and Value Networks

Nils Steinert

Julia Gastinger

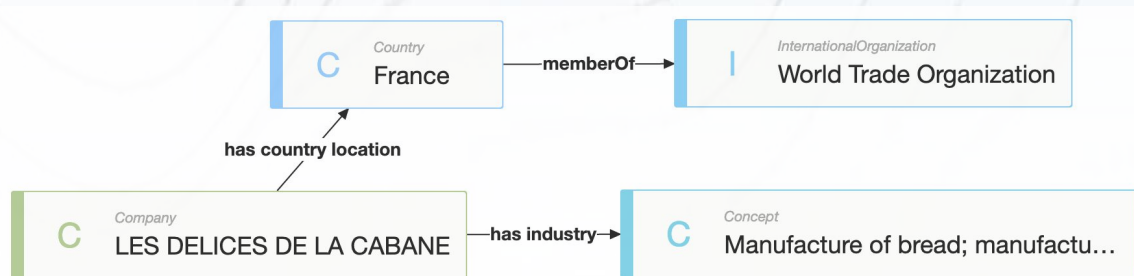
Sabine Gründer-Fahrer

Michael Martin



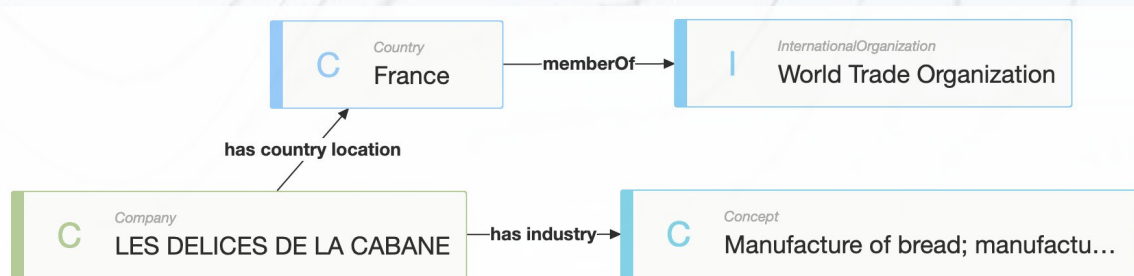
Introduction

- Knowledge Graphs
 - Structure data as interconnected nodes (entities) and edges (relationships)
- Temporal Knowledge Graphs
 - Knowledge graphs extended with timestamps
 - Entities and relationships can occur, recur, or evolve over time



Introduction

- Resilience Research
 - Exploring the ability of systems (individuals, communities, economies, or ecosystems) to withstand, recover from, and adapt to disruptions or changes
- CoyPu Project
 - Knowledge graphs for modelling macro-economic systems and interdependencies
 - *Identify vulnerabilities, increase economic transparency, capture system dynamics, predict system-wide reactions to shocks (conflicts, natural disasters, pandemics, etc.)*



Clairvoyance Knowledge Graph

- Scenario
 - Predict future global trade sanctions based on armed conflicts
- Application
 - Temporal Knowledge Graph Forecasting based on Machine Learning
- Data
 - Trade Sanctions: **Global Trade Alerts (GTA)**
 - Conflict Events: **Armed Conflict Location & Event Database (ACLED)**
 - Extracted as RDF triples from CoyPu Knowledge Graph

GTA

- Real-time open database of global trade-related policies since 2008
- Covers broad range of policy types by nations
- In-depth information on sectors and industries most impacted by policies
- Details on implementing and affected jurisdictions per policy



ACLED

- Global non-profit focused on collecting and analyzing conflict, political violence and protest data
- Weekly updates covering over 200 countries
- Offers insights on conflict actors, locations, dates, types, and intensity
- Data sourcing from media monitoring, crowdsourcing, and open intelligence



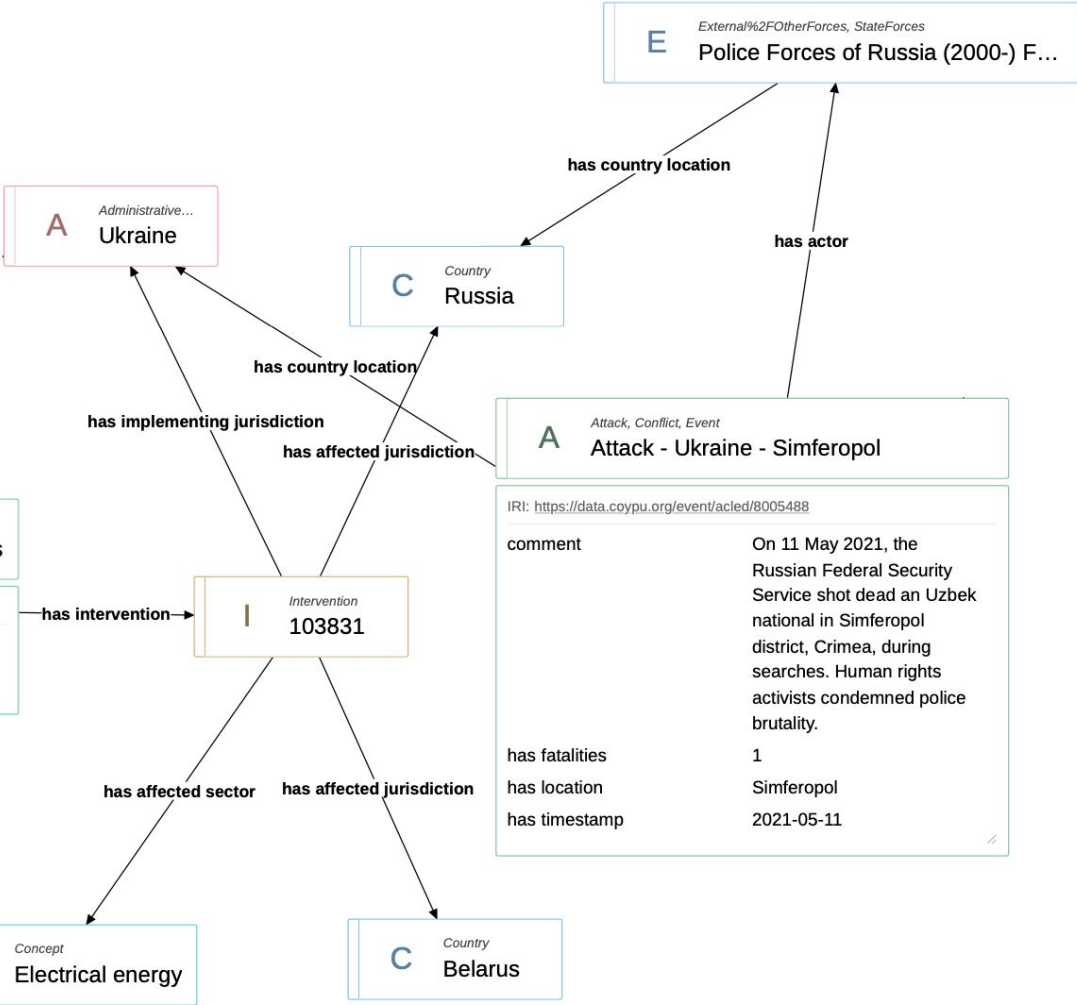
ACLED

Bringing clarity to crisis

Insights

- Conflicts can lead to trade sanctions
 - *EU / US foreign trade sanctions against Russia (2022 - present)*
- Trade policies can exacerbate conflicts
 - *US semiconductor sanctions against China (2020 - present)*
- Conflicts can disrupt trade flows
 - *Ukrainian grain trade with northern Africa (2022 - present)*

Example



E *Event, StateAct*
Ukraine: Temporary import ban on electricity from Russia and Belarus

IRI: <https://data.coypu.org/event/gta/63924>

has announcement date	2021-05-26
has state act id	63924

A *Attack, Conflict, Event*
Attack - Ukraine - Simferopol

IRI: <https://data.coypu.org/event/acled/8005488>

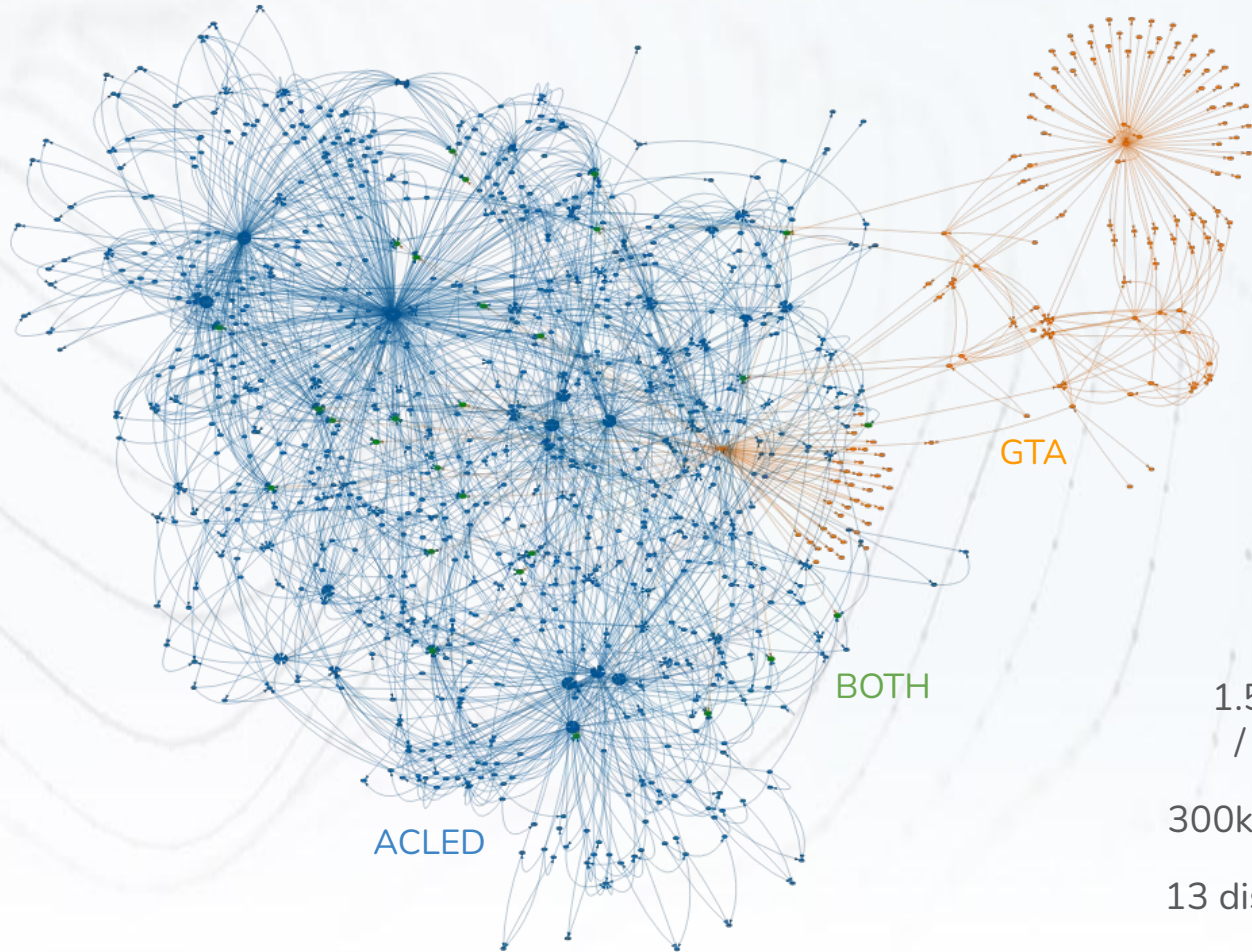
comment	On 11 May 2021, the Russian Federal Security Service shot dead an Uzbek national in Simferopol district, Crimea, during searches. Human rights activists condemned police brutality.
has fatalities	1
has location	Simferopol
has timestamp	2021-05-11

Note: Correlation \nRightarrow Causation

Dataset Implementation

- Simplify
 - Create RDF subgraph (containing only relevant entities) from larger knowledge graph
 - Remove redundant or superfluous triples
- Aggregate
 - Reduce complexity by grouping categories (according to standardized classification schemes)
- Merge
 - Link ACLED and GTA entities via their *Country* annotations
- Temporalify
 - Create quadruples from RDF triples + *Timestamp* annotations
 - Daily granularity timesteps, covering all of 2021
 - Output as ML-friendly TXT

Graph



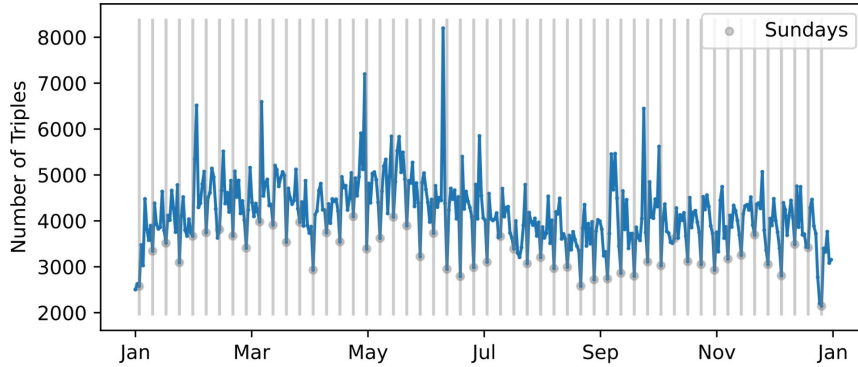
1.5m quadruples
/ 365 timesteps

300k distinct nodes

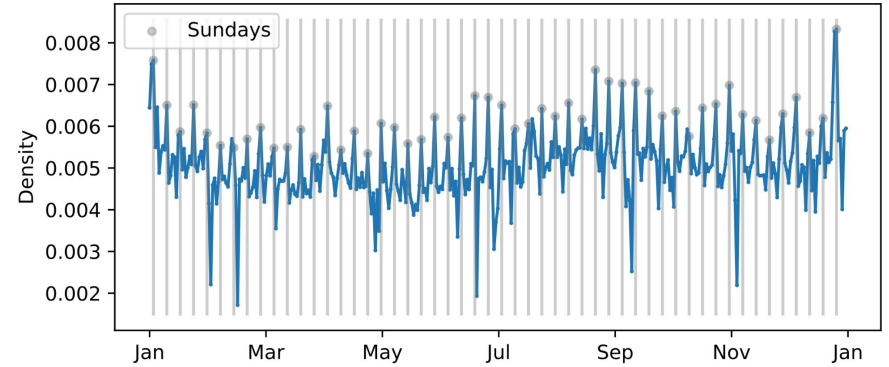
13 distinct relations

Analysis

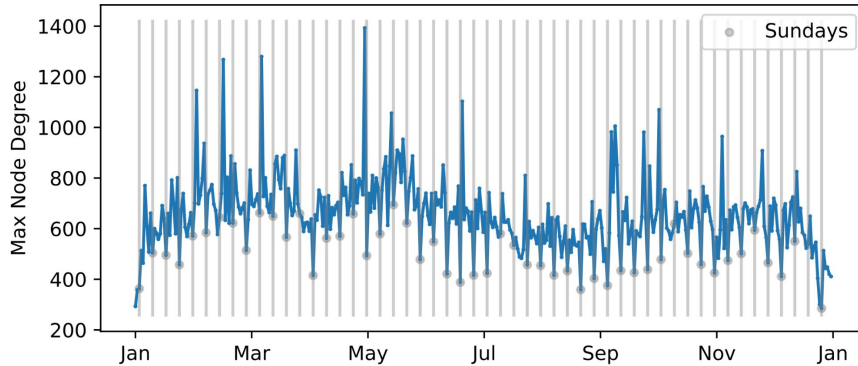
Number of Triples over Time



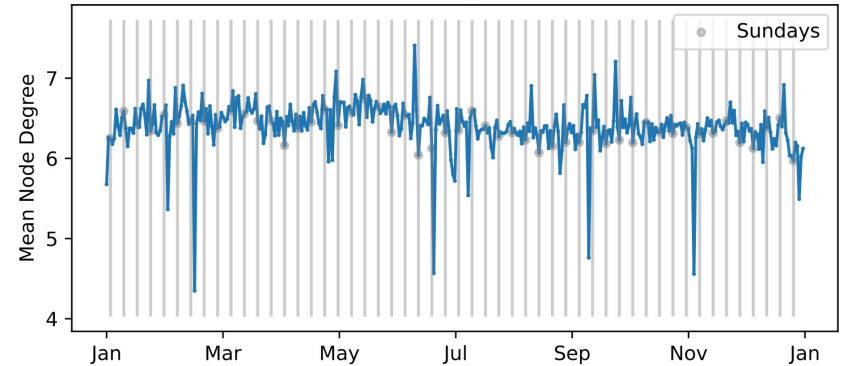
Density over Time



Max Node Degree over Time



Mean Node Degree over Time



Dataset Applications

- Future Work

- Identify patterns and forecast future links between crisis events and trade sanctions
- Deploy as live system with automated retraining on latest data

- Ideas

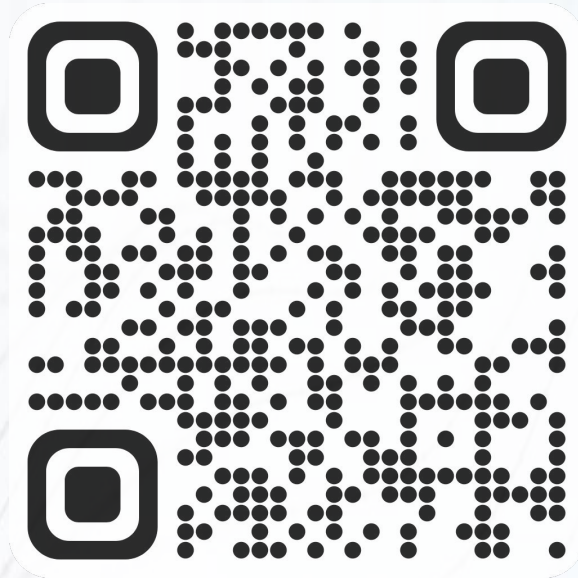
- Downstream analysis
- Anomaly detection
- Multi-hop link prediction
- Time-step prediction

Questions?

julia.gastinger@neclab.eu - Analytics

nils.steinert@implisense.com - Data

Download



github.com/GastJulia/TKG-ACLED-GTA-Dataset