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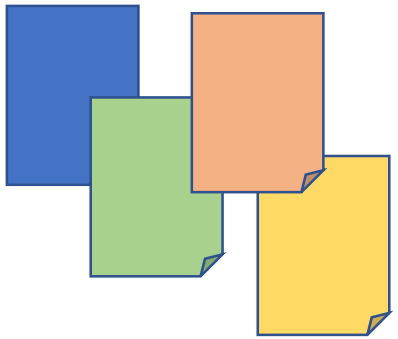
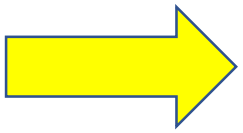
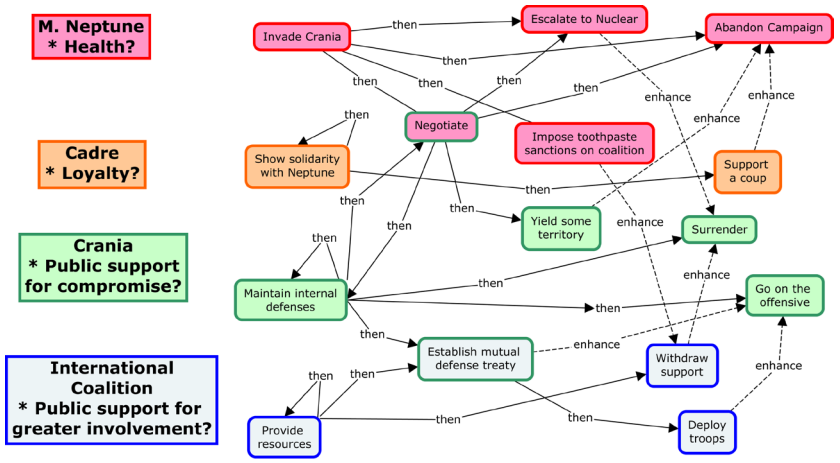
GALISTEO

GEARS: Graphical Evaluation of Analytic ReaSoning







Static: Evaluate quality of reasoning

Dynamic: Prioritize relevant evidence

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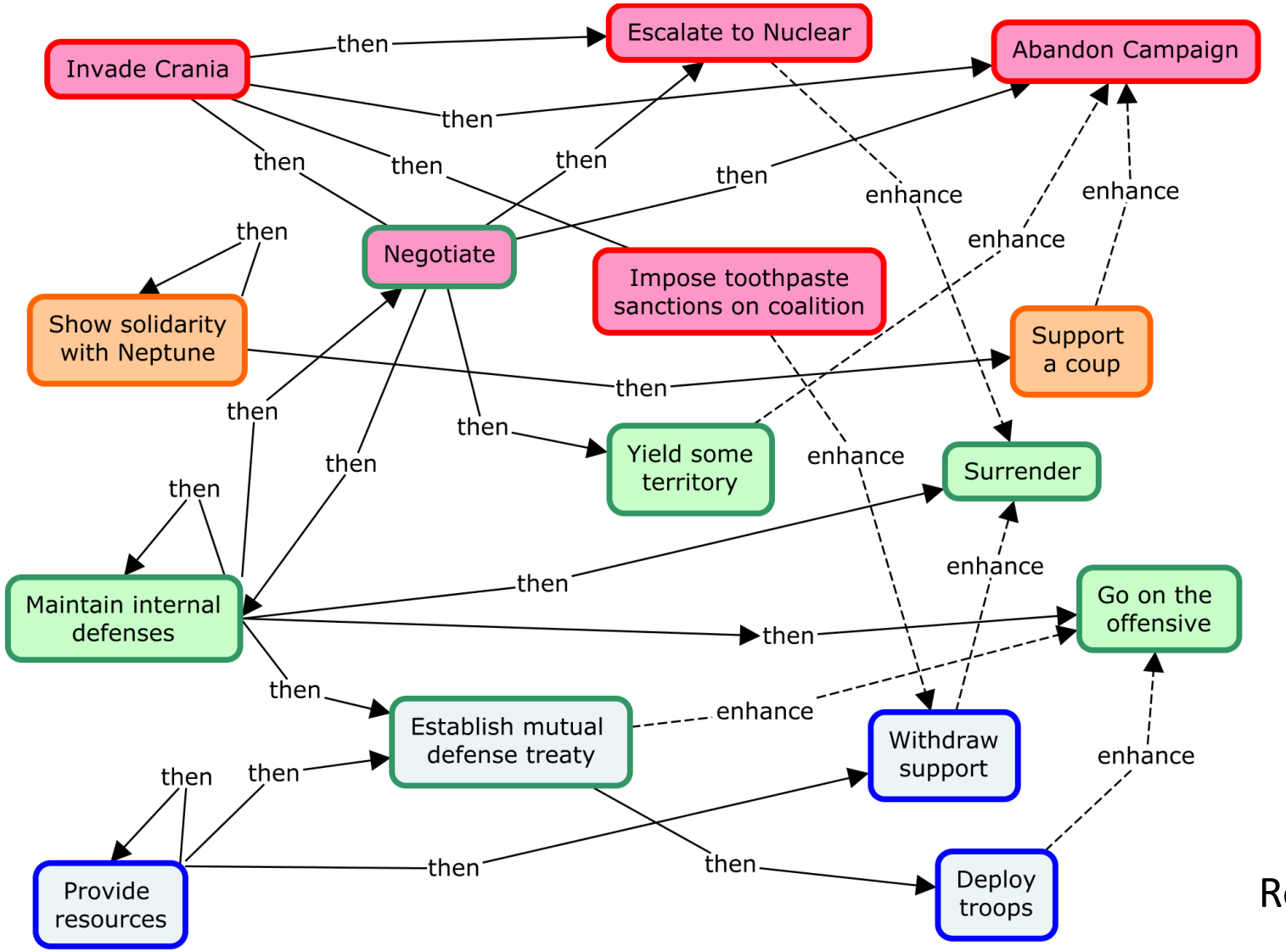
Key Insight: causal insights in analytic products can be represented as **executable graphs** of **events** in the SCAMP causal language.

M. Neptune
*** Health?**

Cadre
*** Loyalty?**

Crania
*** Public support for compromise?**

International Coalition
*** Public support for greater involvement?**



Refs [1,2]

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Static Analysis of analytic graph
→ strengths & weaknesses in **reasoning**

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4 choices
5 trajectories
Depth 3

M. Neptune
*** Health?**

1 choice
1 trajectories
Depth 2

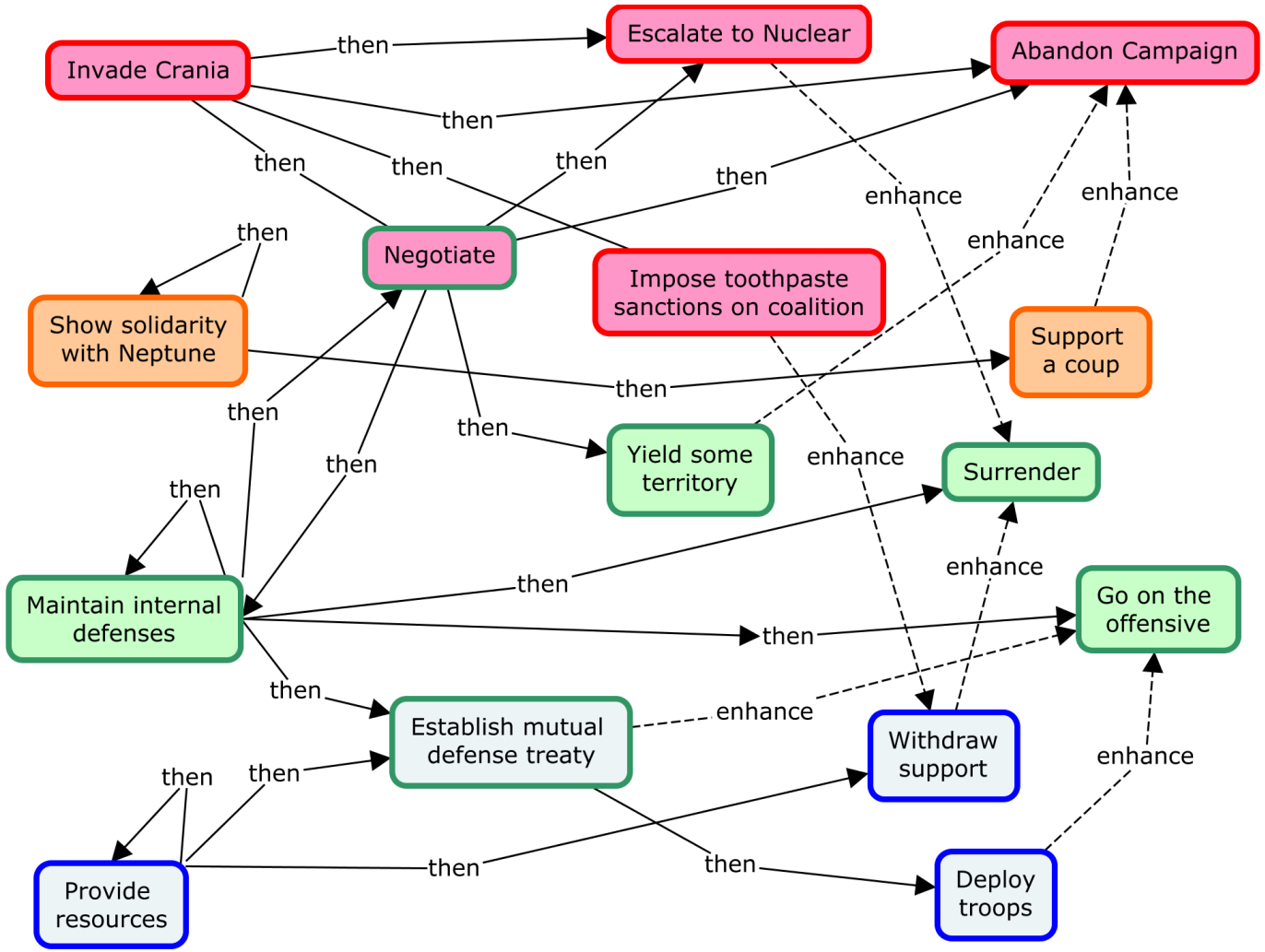
Cadre
*** Loyalty?**

4 choices
6 trajectories
Depth 3

Crania
*** Public support for compromise?**

2 choices
2 trajectories
Depth 2

International Coalition
*** Public support for greater involvement?**

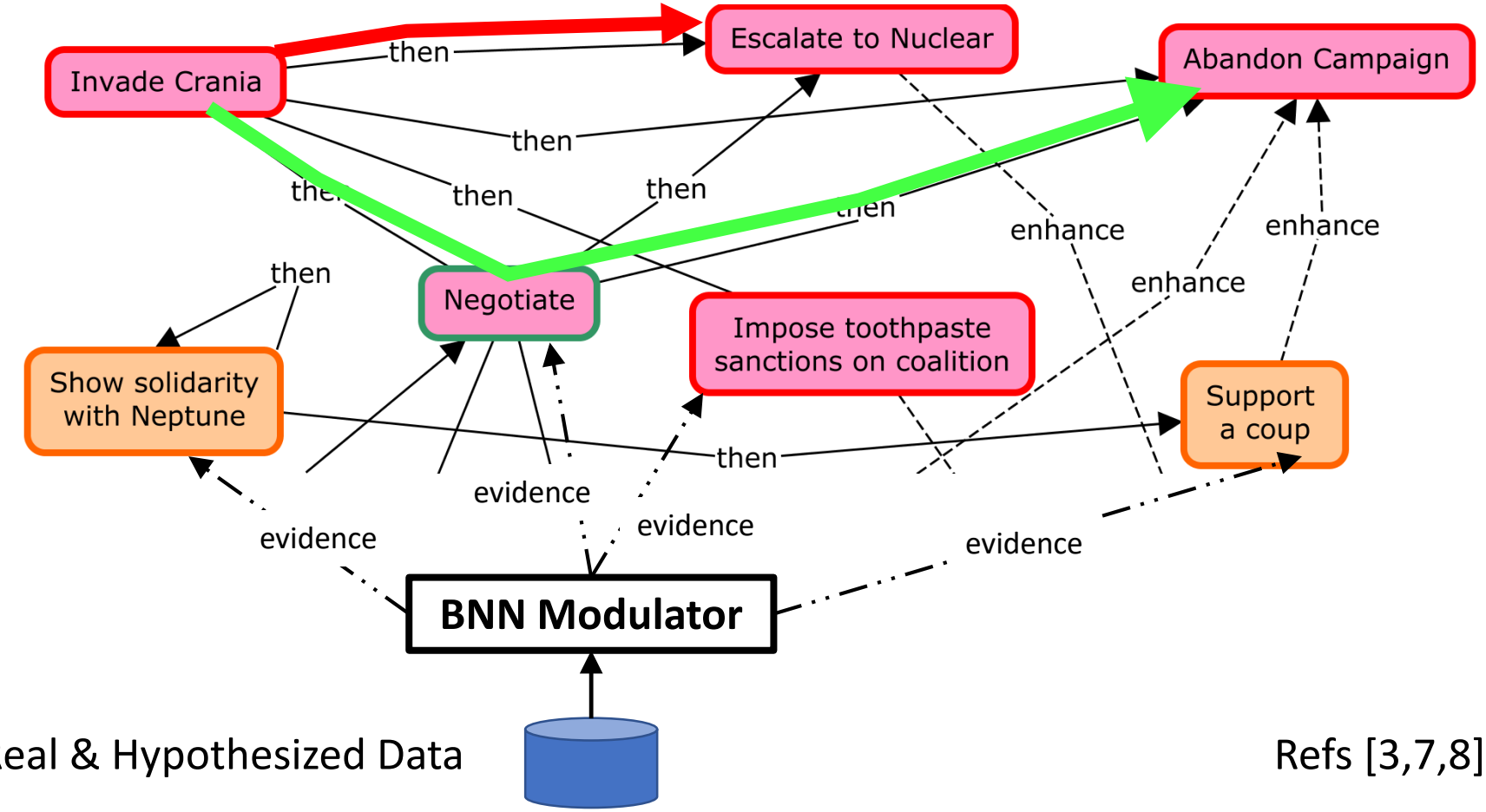


Dynamic Analysis of analytic graph
→ relative impact of **evidence** on expected behavior

Value evidence by how much it would change conclusions
Evolutionary exploration of evidence space

M. Neptune
*** Health?**

Cadre
*** Loyalty?**



Refs [3,7,8]

Making the GEARS Turn

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We have …

Cognitive Task Analysis
Human performance analysis [5]
Impact estimation

SCAMP Simulator [1]
D²REEM evolutionary algorithm [3]
Bayes net expertise [7,8]

Cognitive bias modeling [6]

SCAMP Language [2]

NLP (Galisteo) [4]
Structure mapping [7]
ASSIST graph matching

We need …

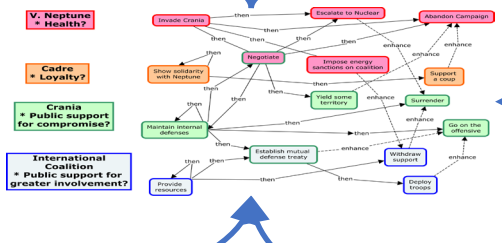
Analyst Workflow & Experience

HMI partner

Dynamic: Prioritize relevant evidence

Static: Evaluate quality of reasoning

Graph analysis

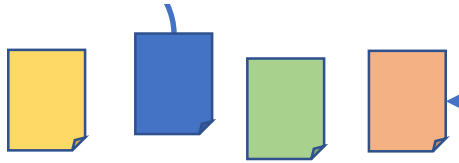


HMI partner

Parse into SCAMP Graph

Event typologies (e.g., CAMEO, IDEA) to align graphs from different analysts
Event databases (e.g., GDELT) for crowdsourcing

Crowd-Sourced Event Data



Analytic Reports

For more information …

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- [1] H. V. D. Parunak, J. Greanya, P. McCarthy, J. A. Morell, S. Nadella, and L. Sappelsa. SCAMP's Stigmergic Model of Social Conflict. *Computational and Mathematical Organization Theory*, 2021.
- [2] H. V. D. Parunak. How to Turn an MAS into a Graphical Causal Model. *Journal of Autonomous Agents and Multi-Agent Systems*, 36, 2022.
- [3] H. V. D. Parunak. Dynamic Data Relevance Estimation by Exploring Models (D^2REEM). *8th International Conference on Semantic Technologies for Intelligence, Defense, and Security (STIDS 2013)*, George Mason University, Fairfax, VA, 2013.
- [4] Peter A. Chew, Matthew H. Fort, Jonathan A. G. Chew. *Digital Disinformation: Computational Analysis of Culture and Conspiracy Theories in Russia and Eastern Europe*. Cham, Switzerland: Springer, 2023 (in press)
- [5] Juvina, I., Larue, O., Widmer, C., Ganapathy, S., Nadella, S., Minnery, B., ... & Weischedel, R. (2020). Computer-supported collaborative information search for geopolitical forecasting. In *Understanding and Improving Information Search* (pp. 245-266). Springer, Cham.
- [6] Larue, O., Hough, A., & Juvina, I. (2017). A core-affect model of decision making in simple and complex tasks. Proceedings of the 39th Annual Meeting of the Cognitive Science Society (CogSci 2017), London, UK, 16-29 July 2017.
- [7] Ménager, David H., Dongkyu Choi, and Sarah K. Robins. "A hybrid theory of event memory." *Minds and Machines. Vol 32* (2022): 365-394.
- [8] Ménager, David H., Dongkyu Choi, and Sarah K. Robins. "Modeling human memory phenomena in a hybrid event memory system." *Cognitive Systems Research. Vol. 75* (2022): 25-35.