

Neural Dynamic Representation of Action Plans: Structure and Flexibility

Stephan Sehring

Based on: Sehring et al., 2024

Institute for Neural Computation, Ruhr-University Bochum



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Structured Actions

DFT-Research Group

Intentional autonomous agents
(for example (Tekülve, 2022; Tekülve and Schöner, 2022; Tekülve et al., 2019)).

Perceptual grounding of language meaning
(for example (Richter et al., 2021; Sabinasz et al., 2020; Sabinasz and Schöner, 2022)).

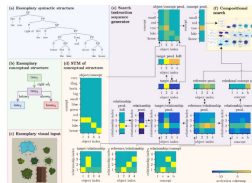
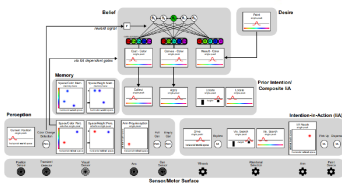


Figure: Compositionally structured actions in intentional agents (Sabinasz et al., 2023).

Action Grammar

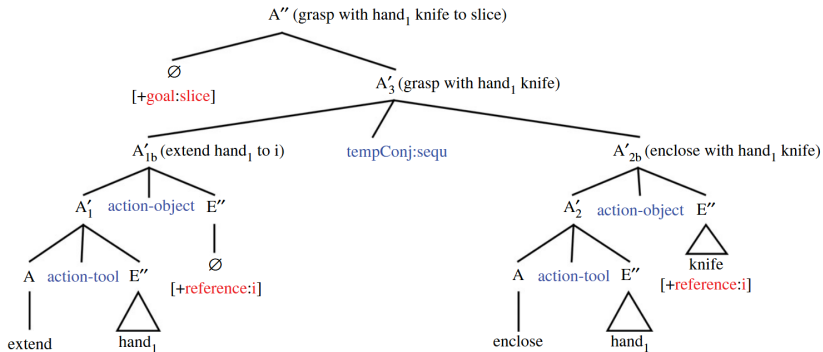


Figure: Compositional structure of action (Pastra and Aloimonos, 2012)

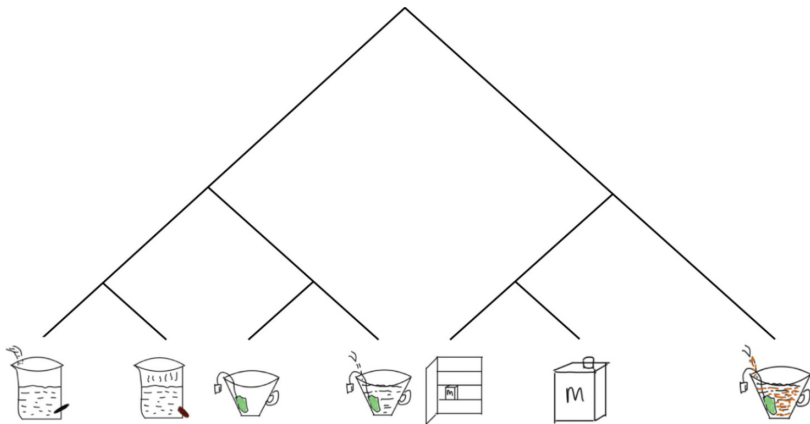


Figure: Partial ordering of action sequences (Coopmans et al., 2023)

Table Top Scenario



Figure: Simulation Environment

Architecture

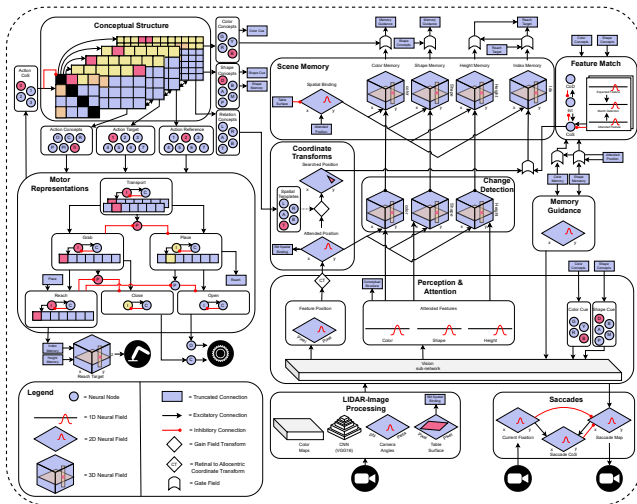


Figure: Neural Field Architecture

Conceptual Structure

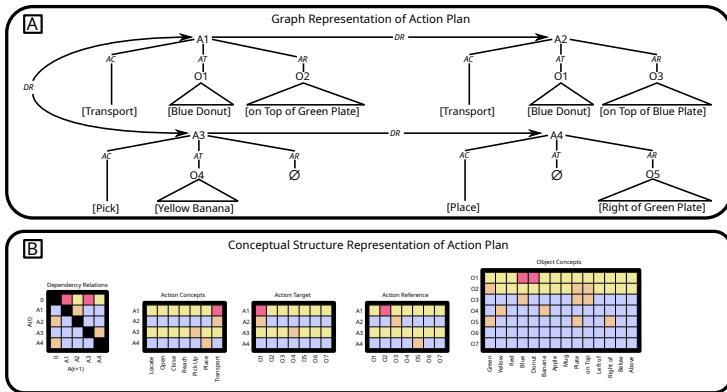


Figure: Representational substrate for action sequences.

Video

Takeaways

- ▶ Compositional representation of actions: binding objects to actions in structured “action phrases.”
- ▶ Sequential dependencies capture flexible orderings of elementary actions.
- ▶ Competition and stabilization at the conceptual structure level generate sequences of action representations.

- Coopmans, C. W., Kaushik, K., & Martin, A. E. (2023). Hierarchical structure in language and action: A formal comparison.. *Psychological Review*, 130(4), 935–952. <https://doi.org/10.1037/rev0000429>
- Pastra, K., & Aloimonos, Y. (2012). The minimalist grammar of action. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 367(1585), 103–117. <https://doi.org/10.1098/rstb.2011.0123>
- Sabinasz, D., Richter, M., & Schöner, G. (2023). Neural dynamic foundations of a theory of higher cognition: The case of grounding nested phrases. *Cognitive Neurodynamics*. <https://doi.org/10.1007/s11571-023-10007-7>
- Sehring, S., Koebe, R. J. P., Aerdker, S., & Schöner, G. (2024). A Neural Dynamic Model Autonomously Drives a Robot to Perform Structured Sequences of Action Intentions. *Proceedings of the Annual Meeting of the Cognitive Science Society*, 49. <https://escholarship.org/uc/item/3gh831nw>