



# Hierarchical Reinforcement Learning in NLG

Speech Technology Seminar

Cuong Nguyen Viet

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# Motivation

- Popular research topic
- Automatic data-driven optimization of behaviours of Dialogue System
- Human-likeness – efficient and productive interactions

# Reinforcement Learning



- State, action, reward and policy
  - $\pi = P(s, a)$
- Goal:
  - Maximize long-term rewards
  - Optimal policy

# Reinforcement Learning in NLG

- Why Reinforcement Learning?
  - NLG is goal-driven
  - NLG plan a sequence of actions
  - Actions change environment states
  - Effect of action is uncertain

# Reinforcement Learning in NLG

- Formulate dialogue strategy in RL
  - State – information obtained from user
  - Action – system dialogue actions
  - Reward – user's reaction to dialogue actions
  - Goal – choose actions that lead to successful conclusion

# Example 1

- Input: Communicative Goal by Dialogue Manager
  - Dialogue Act \_ present\_items( $i_1, i_2, i_5, i_8$ )
  - System Goal \_ user\_choose\_one\_of( $i_1, i_2, i_5, i_8$ )
- Possible actions
  - SUMMARY
  - COMPARE
  - RECOMMEND

# Example 1

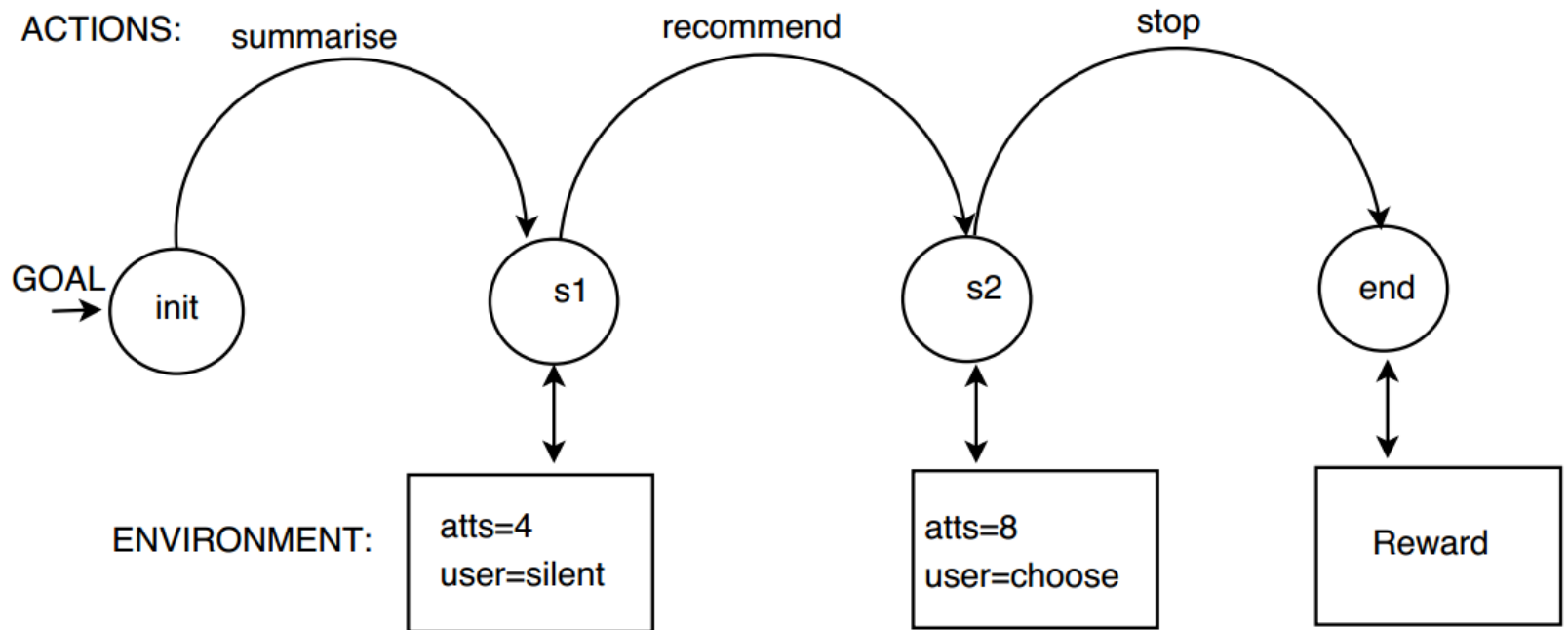


Figure 2: Example RL-NLG action sequence for Table 4 [1]



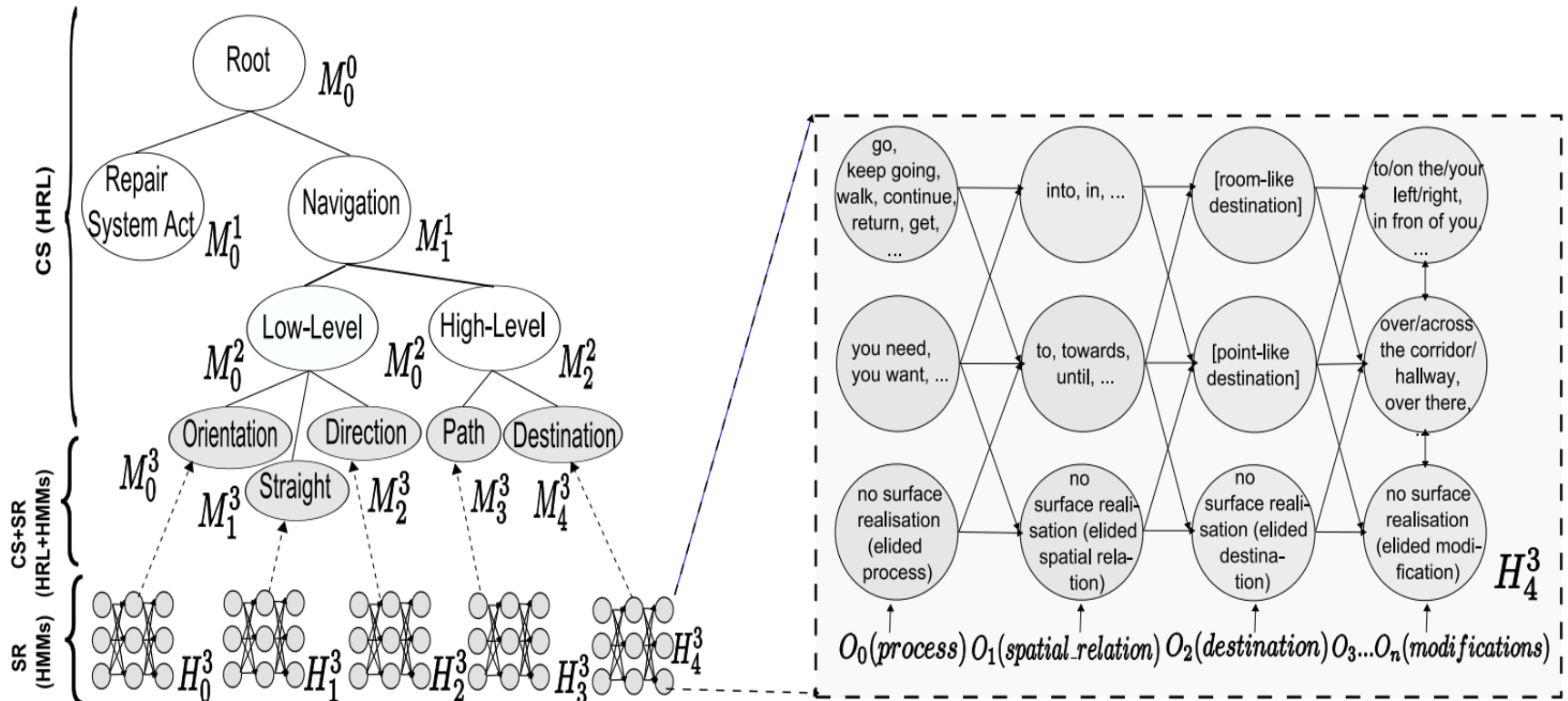
# Hierarchical Reinforcement Learning

- Idea – partial policies
- Abstraction
  - Sequence of operators or actions
  - Basis of hierarchical – can include other abstraction
- Semi Markov Decision Process (SMDPs)

# Hierarchical RL in NLG

- RL focus on a single area of optimisation
- HRL used for joint optimisation for
  - Content Selection
  - Surface Realisation
- HRL can be used for scale-up problems

# Example 2



[2]

# Conclusion

- RL as a statistical planning model outperforms several baselines derived from previous rule-based systems
- Possible extension – joint optimisation in a hierarchical manner
- HRL leads to more task success and human-like dialogue

# THE END!

Thank you for your attention.  
Question?

- Reference

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3. A. Barto & S. Mahadevan. Recent Advances in Hierarchical Reinforcement Learning.