Raising AI: Tutoring Matters

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Path to Adult-Level AI

- Typical AI project:
  - The system only learns on the final task
  - The system is alone
- Raising AI:
  - Helping an AI system learn, grow from baby-AI into adult-AI, and realize its potential

Why raising?

- Guidance necessary to deal with complex new situations
- Less sophisticated system needed to reach the same level of intelligence
- Biologically plausible

Goals for the paper

- Argue for the importance of research into raising AI
- Discuss issues related to raising and tutoring
- Unite research from different fields under the perspective of raising AI
- Provide a starting point for various techniques for tutoring AI

Tutoring matters

- Focus on tasks rather than environments or cognitive stages
- Tutoring methods and learning algorithms impose requirements on each other
- Tutoring doesn’t always help
- Tutoring can be difficult
- Human tutors may be expensive and/or inefficient

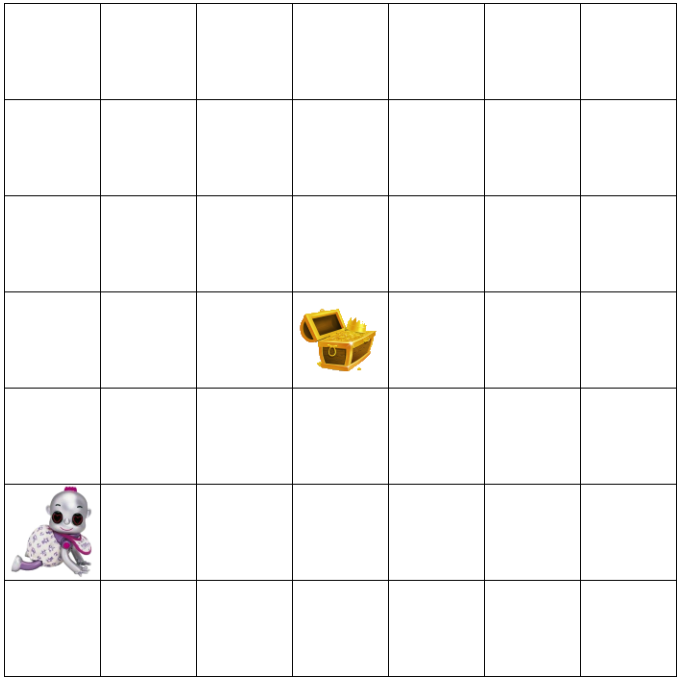
Tutoring Techniques

- Heuristic Rewarding
- Decomposition
- Simplification
- Situation Selection
- Teleoperation
- Demonstration
- Coaching
- Explanation
- Cooperation

Tutoring by Demonstration

- Show the learner what to do
- Add tutor observation dimensions to state
- Requirements:
  - Generalization
  - Desire to imitate
  - Ability to map tutor actions to learner actions

- Tabular Q-learning agent
- Simple grid navigation task



Questions?

- Heuristic Rewarding
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end of presentation

Heuristic Rewards

- Giving the learner intermediate feedback about performance

- Related:
  - Reward shaping
  - Gamification
  - Heuristics in e.g. minimax game playing

Decomposition

- Decomposition of whole, complex tasks into smaller components

- Related:
  - Whole-task vs. part-task training
  - Curriculum learning
  - (Catastrophic interference)
  - (Transfer learning)
  - (Multitask learning)

Simplification

- Starting with a simplified version of the final task and gradually increasing the complexity

- Related:
  - Shaping (B.F. Skinner)
  - Curriculum learning
  - Decomposition

Situation Selection

- Selecting situations (or data) for the learner to focus on
  - e.g. simpler or more difficult situations
- Related
  - Boosting
  - ML application development
  - Big Data
  - Active learning / teaching

Teleoperation

- Temporarily taking control of the learner's actions so they can experience them
  - Right level of abstraction
- Applications:
  - Tennis / golf / chess
  - Robot ping pong
  - Artificial tutor

Demonstration

- Showing the learner how to accomplish a task
- Requirements:
  - Desire to imitate
  - Ability to map tutor's actions onto own actions
  - Generalization ability
- Related:
  - Apprenticeship learning
  - Inverse reinforcement learning
  - Imitation learning

Coaching

- Giving the learner direct instructions of what action to take during the task

- Requirements:
  - Ability to map language-based instruction onto actions
  - Generalization ability

- Related:
  - Supervised learning

Explanation

- Explaining to the learner how to approach certain situations before the starts (a new instance of) the task

- Requirements:
  - Language
  - Generalization ability

- Related:
  - Imperative programming
  - Analogies

Cooperation

- Doing a task together with the learner to facilitate other tutoring techniques