Developing Grounded Goals through Instant Replay Learning

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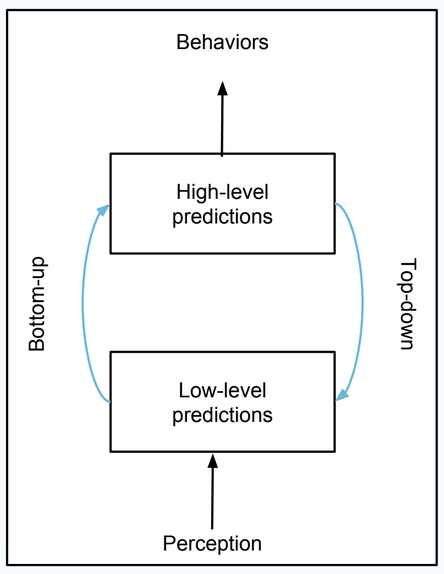
How can a developmental system discover and represent its own goals?

- Neural network model begins with no information about sensors, actions, or environment
- Designed a goal discovery mechanism based on motor babbling and instant replay learning
- Tested a learned goal representation vs an arbitrary representation
- Found that learned goal representations were able to:
  - Regenerate the motor sequences needed to revisit discovered goals
  - Apply flexibly to novel situations
  - Perform significantly better than arbitrary representations at revisiting discovered goals

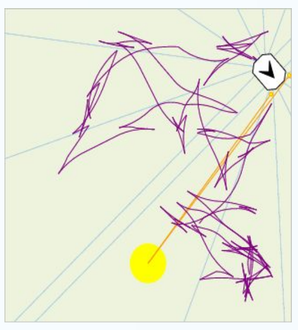
Developmental Model

- A two-level neural network trained via predictions
- Lower-level network learns perceptual consequences of actions
- Upper-level network learns abstracted, longer-term behaviors



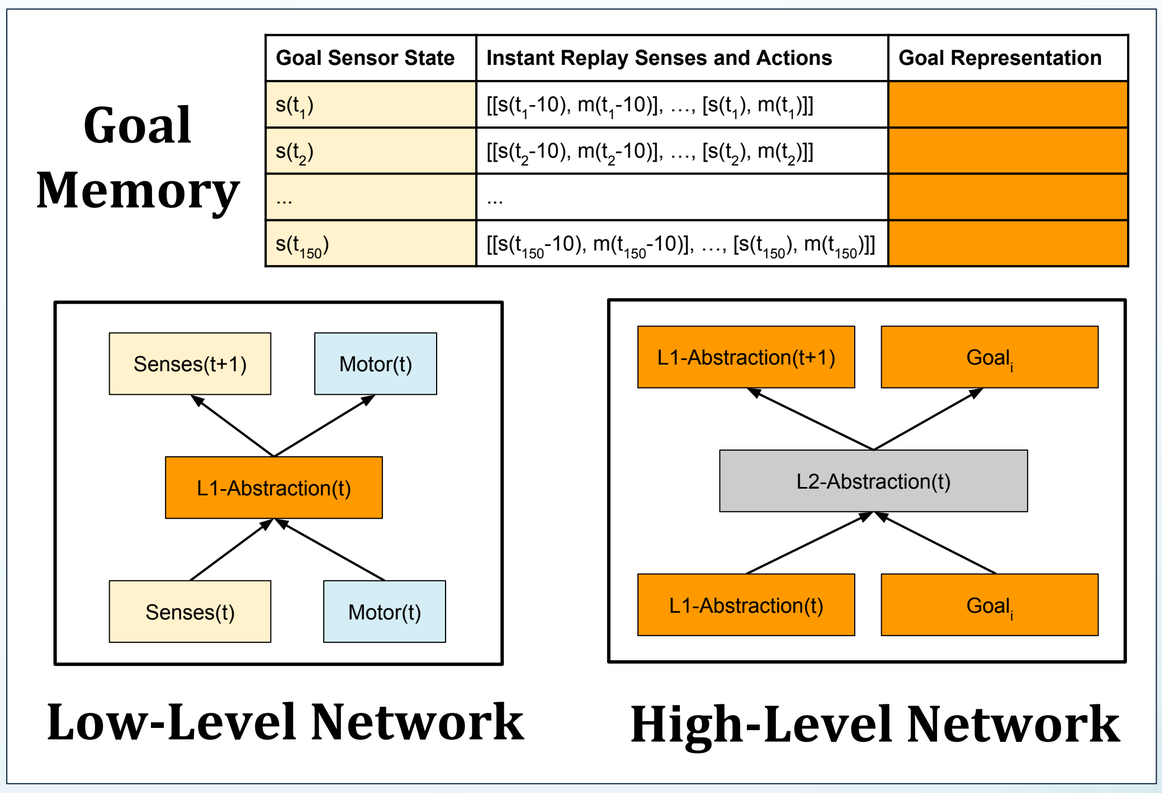
Motor Babbling

- Model finds interesting situations when sensory state changes dramatically
- Defines interesting states as goals and remembers sensory-motor sequences to enable instant replay learning

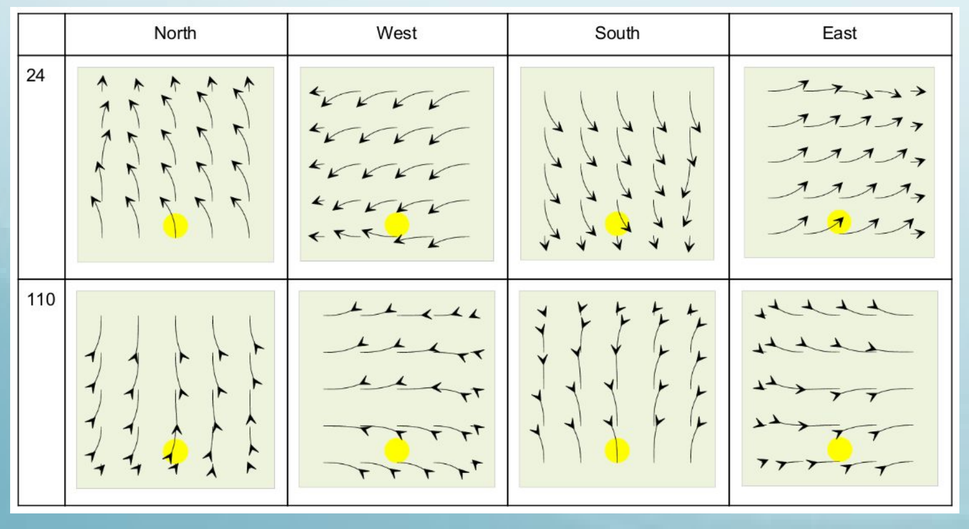


Training

1. Populate Goal Memory through motor babbling
2. Train Low-Level Network on Instant Replay senses and actions
3. Populate Goal Representations with either:
   a. Learned L1-Abstractions
   b. Arbitrary representations
4. Train High-Level Network on each Goal representation and its L1-Abstraction sequence from Low-Level Network



Adaptive Generative Behavior



Testing

1. Place robot in initial position with a goal representation from Memory
2. Generate L1-Abstraction with Low-Level Network
3. Use High-Level Network to generate next L1-Abstraction
4. Put L1-Abstraction on hidden layer for Low-Level Network and propagate to get Motor command
5. Go to step 2

CONTRIBUTED PAPER

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