Lifelong Learning of Perception & Action in Autonomous Systems

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Specialized Functions: Lifelong Learning Machines (L2M)

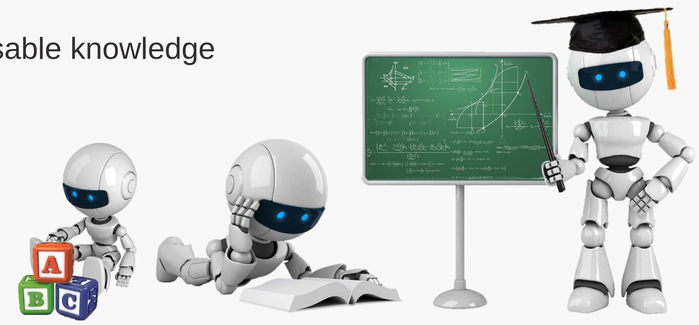
RESEARCH OBJECTIVES

Develop a **comprehensive approach to lifelong machine learning in autonomous systems** that includes:

- A general-purpose continual learning framework that integrates classification, regression, and reinforcement learning
- Safe knowledge transfer between diverse tasks
- Scalable lifelong knowledge maintenance of structured, composable knowledge
- Self-directed learning for autonomous discovery
- Modeling the non-stationary distribution of tasks

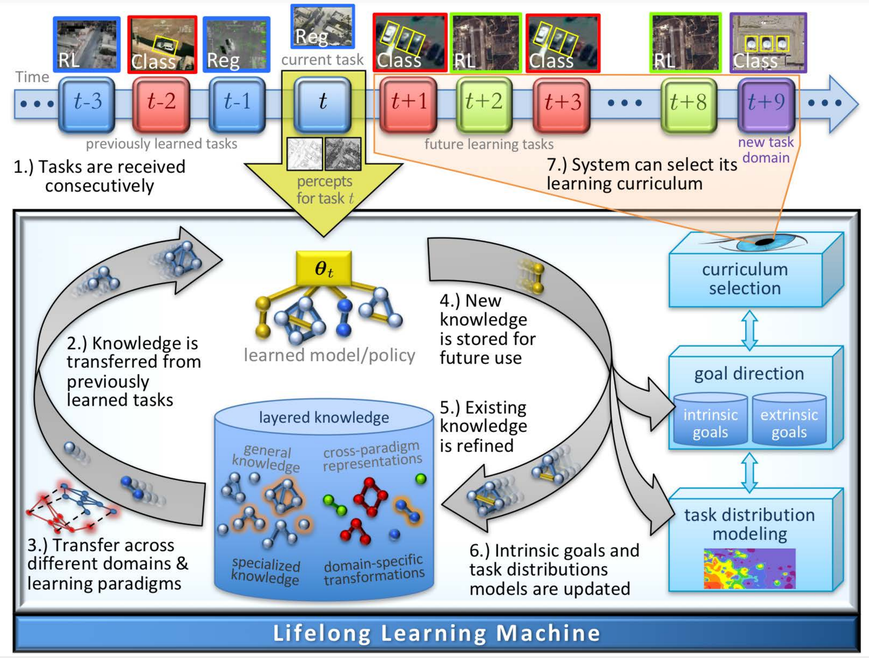
Apply L2M to **autonomous mobile service robots**

- Focus on integrated perception and action
- Real and simulated unstructured, dynamic environments
- Persistent deployment of service robots across our universities



Robot Images Credit: Viktoriya Sukhanova © 123RF.com

APPROACH

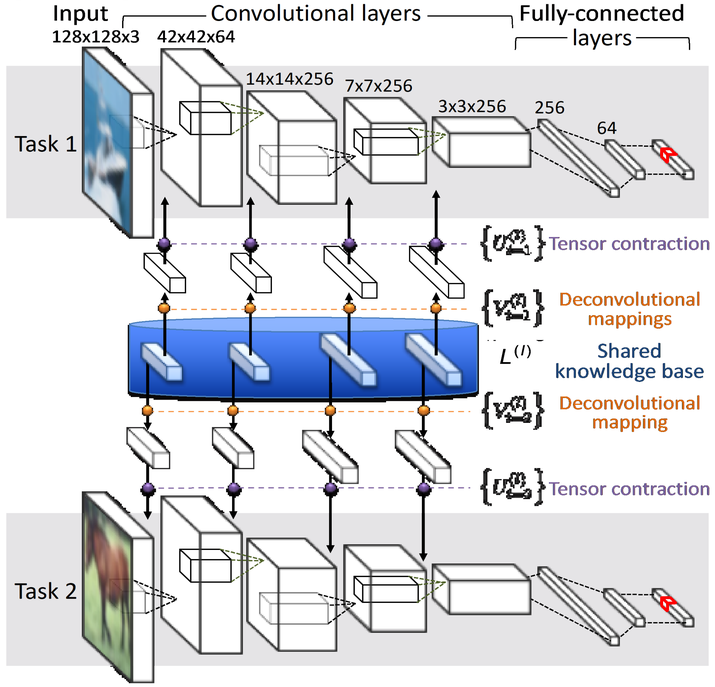


Our General Purpose L2M Framework for Continual Lifelong Learning

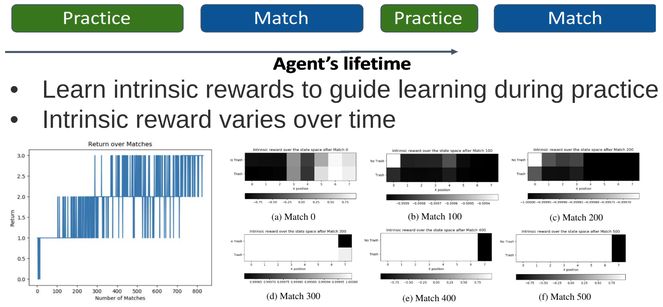
YEAR 1 ACCOMPLISHMENTS

Lifelong Deep Learning via Deconvolutional Factorization

[IJCAI '19]



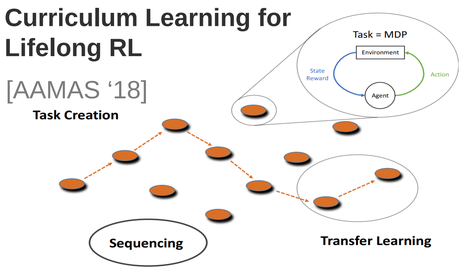
Learning Intrinsic Rewards for Practice-Match Settings



- Learn intrinsic rewards to guide learning during practice
- Intrinsic reward varies over time

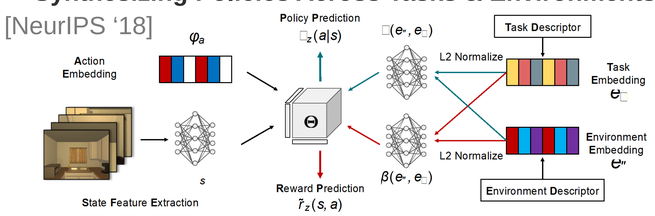
Curriculum Learning for Lifelong RL

[AAMAS '18]

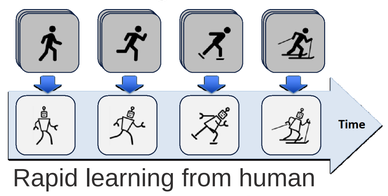


Synthesizing Policies Across Tasks & Environments

[NeurIPS '18]

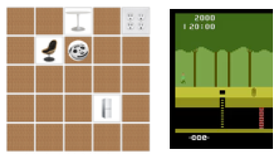


Lifelong Inverse RL



Rapid learning from human demonstration by building on lifelong experience [NeurIPS '18]

Linear Temporal Logic for Task Goals



IMPACT
Application to Autonomous Service Robots

L2M methods will be applied to control real and simulated service robots that are continually deployed in unstructured indoor office/university environments.

- Lifelong transfer across tasks/environments, enabling robots to learn new tasks and adapt dynamically
- Versatile robots that are capable of performing diverse tasks

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THE ELECTRONICS RESURGENCE INITIATIVE

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