AI Today: Applications
Merging vision, language, planning, hardware

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Recurring themes

- Do not equate AI with Generative AI

- Surprisingly, AI should be avoided as far as possible

- AI is actually not one single thing – the only unifying theme is a lack of fixed logic

- Most effective applications use multiple methods, both AI and non-AI

- When in doubt, always return to the concept of a single neuron

- Avoid anthropomorphising

Where are we today?

THE FOUR INDUSTRIAL REVOLUTIONS

INDUSTRY 1.0
Mechanization

Mechanization and the introduction of steam and water power

INDUSTRY 2.0
Electrification

Mass production assembly lines using electrical power

INDUSTRY 3.0
Automatization

Automated production, computers, IT-systems and robotics

INDUSTRY 4.0
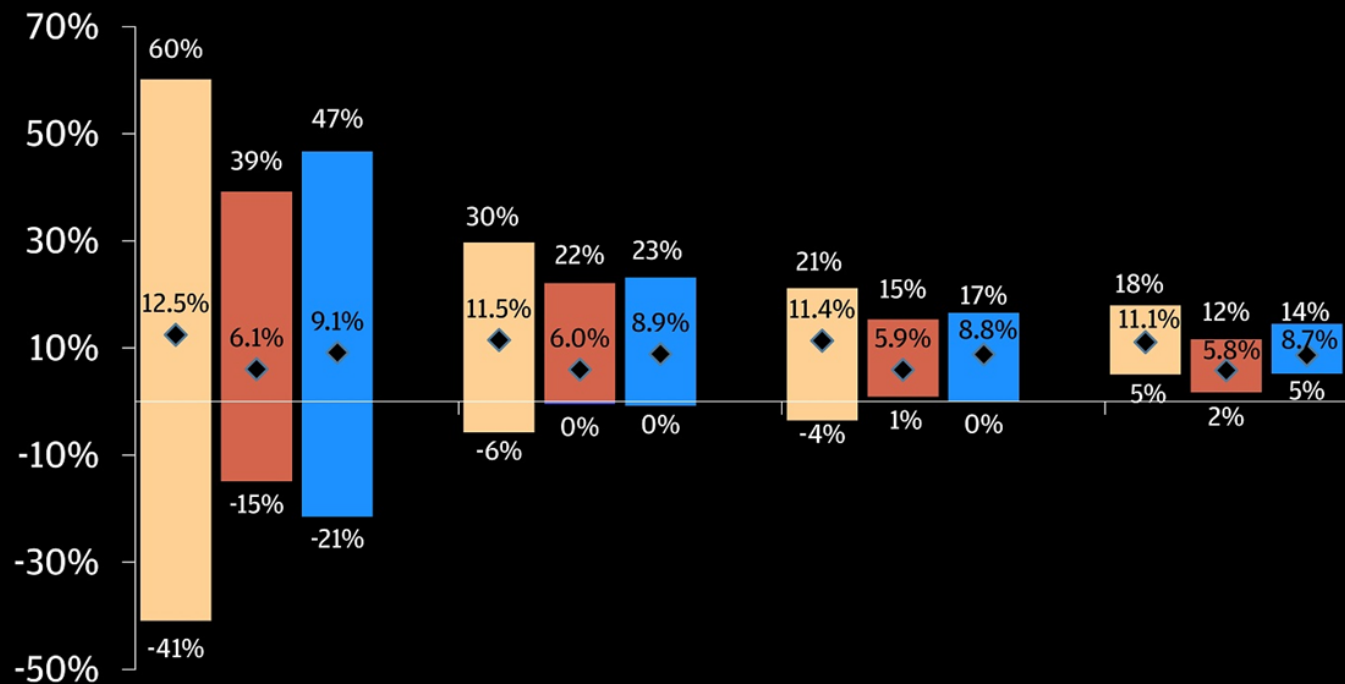Cyber-Physical Systems

The Smart Factory. Autonomous systems, IoT, machine learning

# Some practical AI applications

Range of stock, bond, and blended allocation total returns

Rolling annualized total returns, 1950 – 2022

Sources: Barclays, FactSet, Federal Reserve, Robert Shiller, Strategas/Ibbotson, J.P. Morgan Asset Management. Returns shown are rolling monthly returns from 1950 to 2022. Stocks represent the S&P 500 Shiller Composite, and Bonds represent Strategas/Ibbotson government bonds and corporate bonds for periods from 1950 to 2017, then the average of Bloomberg U.S. Aggregate Total Return Index and Bloomberg U.S. Treasury Total Return index from 2017 to 2022. 50/50 portfolio is rebalanced monthly and assumes no cost. Analysis is based on the J.P. Morgan Guide to the Markets – Principles for Successful Long-term Investing. *Actual worst 5-year rolling return of hypothetical 50/50 portfolio: -0.068%. Data as of December 31, 2022.
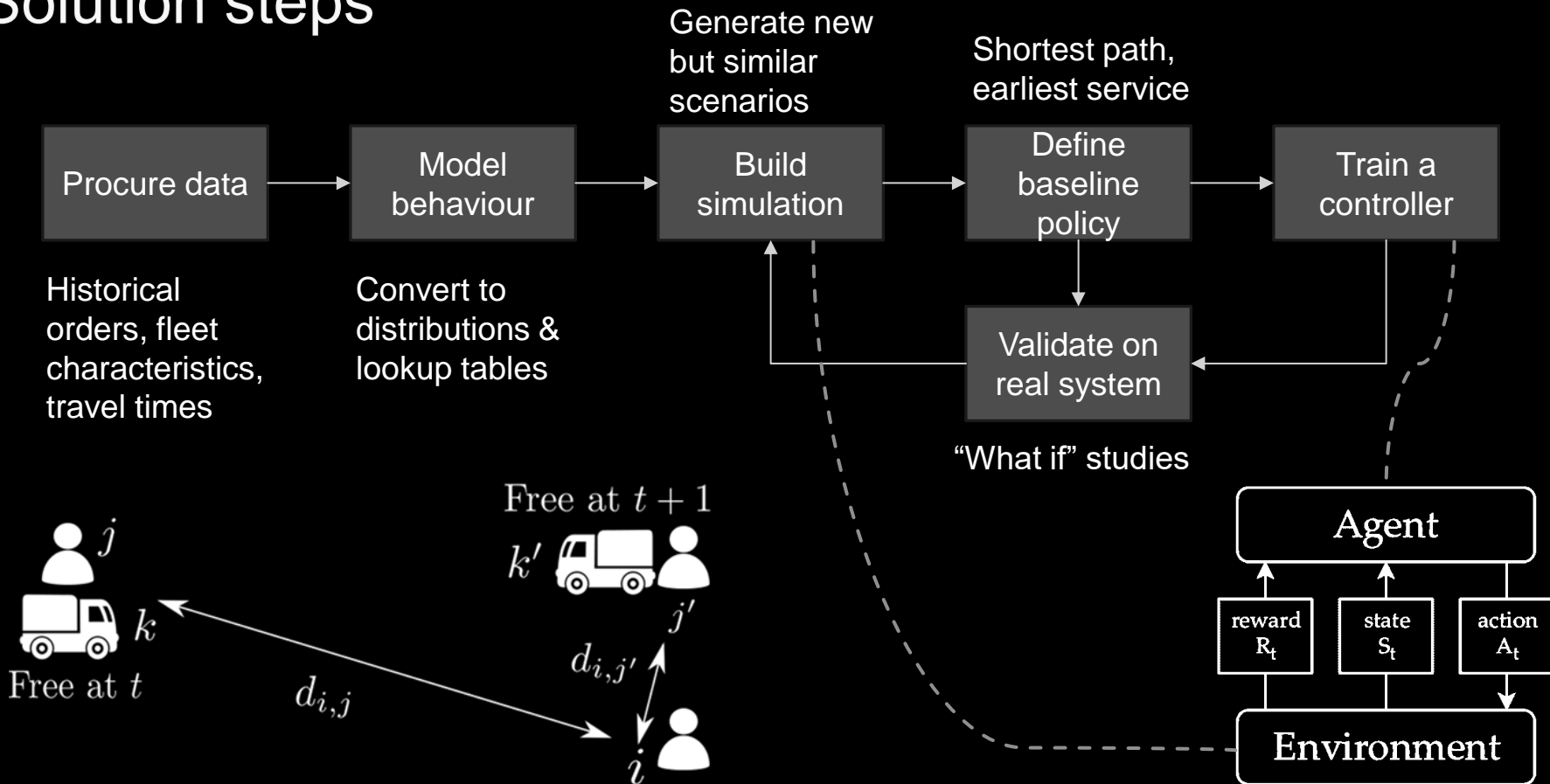
Some practical AI applications

Free at $t+1$

k' j'

$d_{i,j'}$

j

k

Free at t

$d_{i,j}$

i
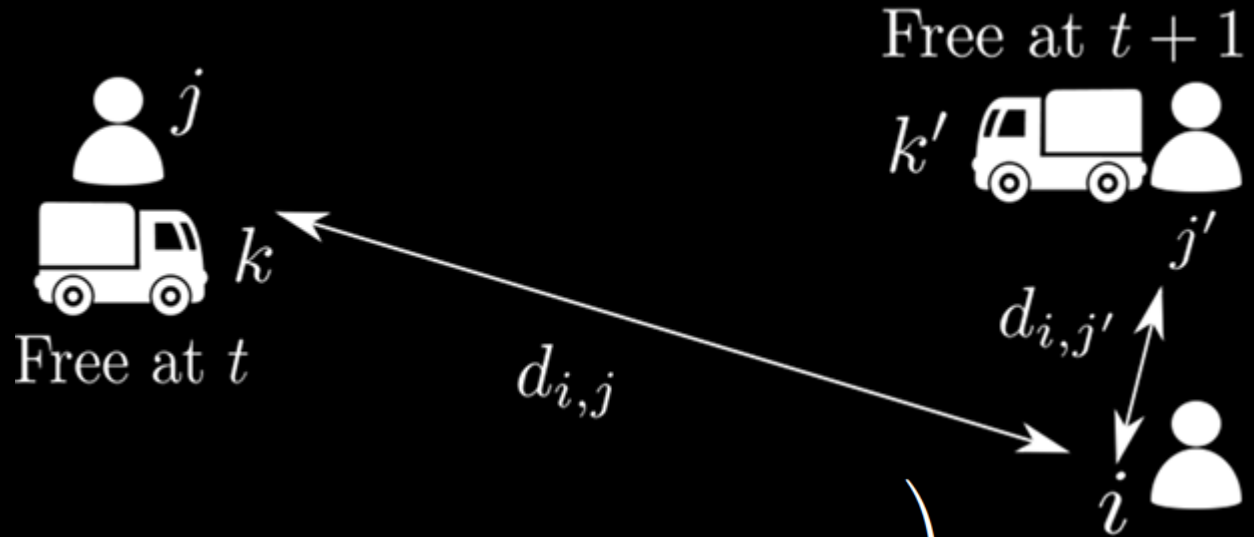
$$J = \min_{a_*,\, f_*,\, l_*} \left(\sum_{i,j,k} d_{i,j}\, a_{i,j,k} + \sum_{i,k} d_{o,i}\, f_{i,k} + \sum_{i,k} d_{o,i}\, l_{i,k} \right)$$

"A Learning Approach for Discovering Cost-Efficient Integrated Sourcing and Routing Strategies in E-Commerce"
Omkar Shelke, Pranavi Pathakota, Anandsingh Chauhan, Hardik Meisheri, Harshad Khadilkar, Balaraman Ravindran

Solution steps

Generate new but similar scenarios

Shortest path, earliest service

```
Procure data → Model behaviour → Build simulation → Define baseline policy → Train a controller
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Historical orders, fleet characteristics, travel times

Convert to distributions & lookup tables

Validate on real system

"What if" studies

j

Free at $t+1$

k'

j'

k

Free at t

$d_{i,j}$

$d_{i,j'}$

i

Agent

reward R_t

state S_t

action A_t

Environment

Single-agent AI for robotics: Sense-Analyse-Respond

Single-agent AI for robotics: Sense-Analyse-Respond
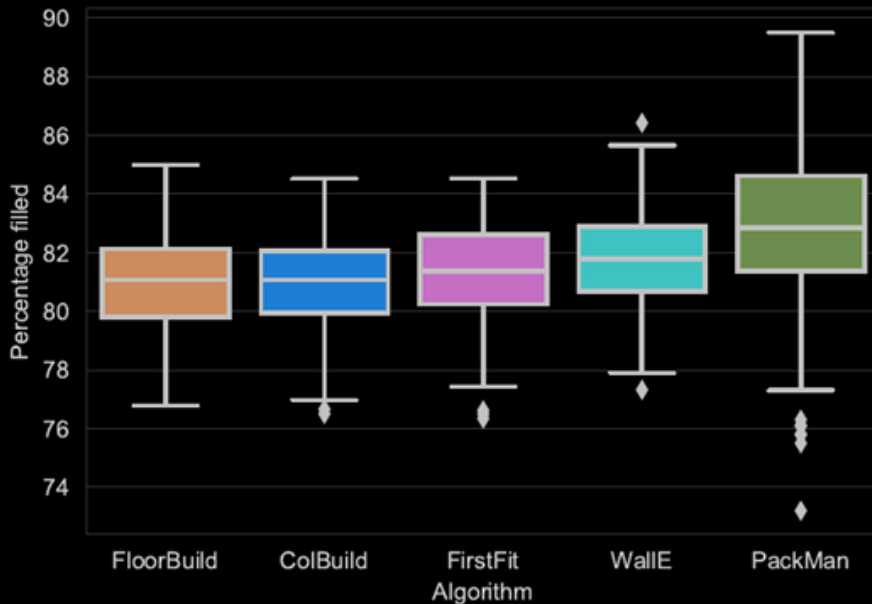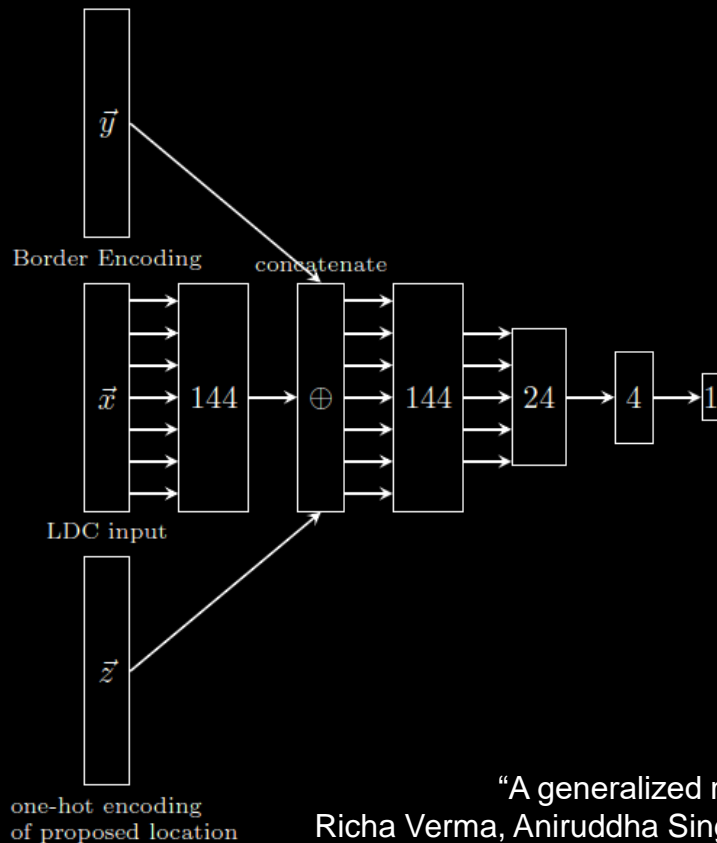
"A generalized reinforcement learning algorithm for online 3d bin-packing"
Richa Verma, Aniruddha Singhal, Harshad Khadilkar, Ansuma Basumatary, Siddharth Nayak, Harsh Vardhan Singh, Swagat Kumar, Rajesh Sinha

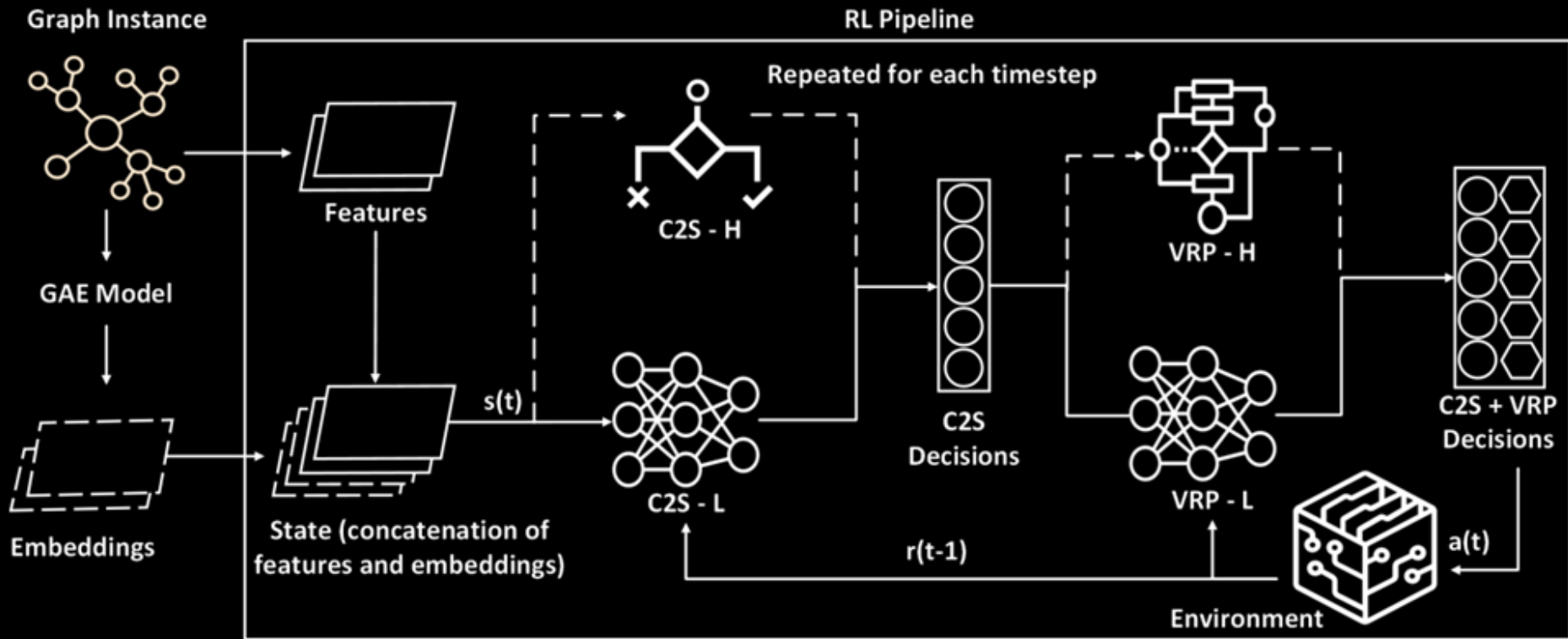# Multi-agent AI needs *negotiation*

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Other considerations

Delays: Communication channels, Processing, Action

"Revisiting state augmentation methods for reinforcement learning with stochastic delays"
S Nath, M Baranwal, H Khadilkar

Errors: Measurement noise, Modelling simplifications

"Follow your Nose: Using General Value Functions for Directed Exploration in Reinforcement Learning"
D Kalwar, O Shelke, S Nath, H Meisheri, H Khadilkar

Adversaries: Unintentional, Intentional

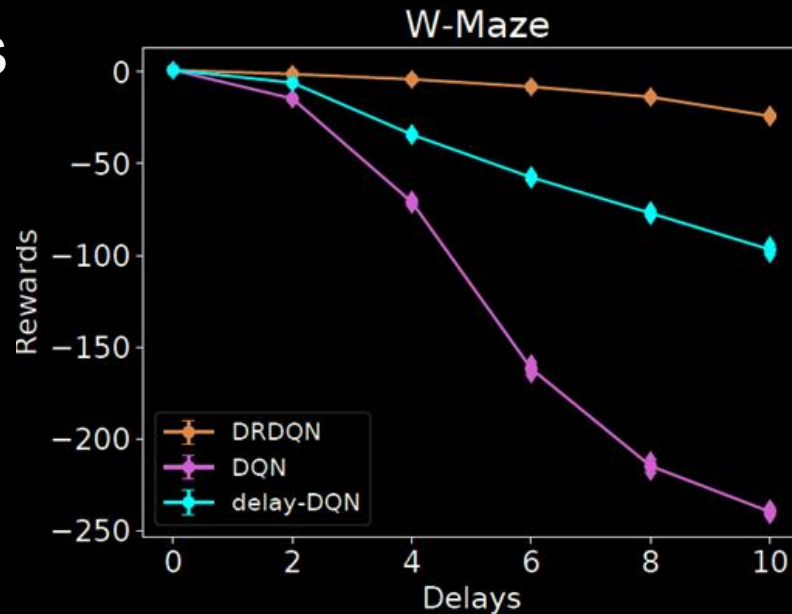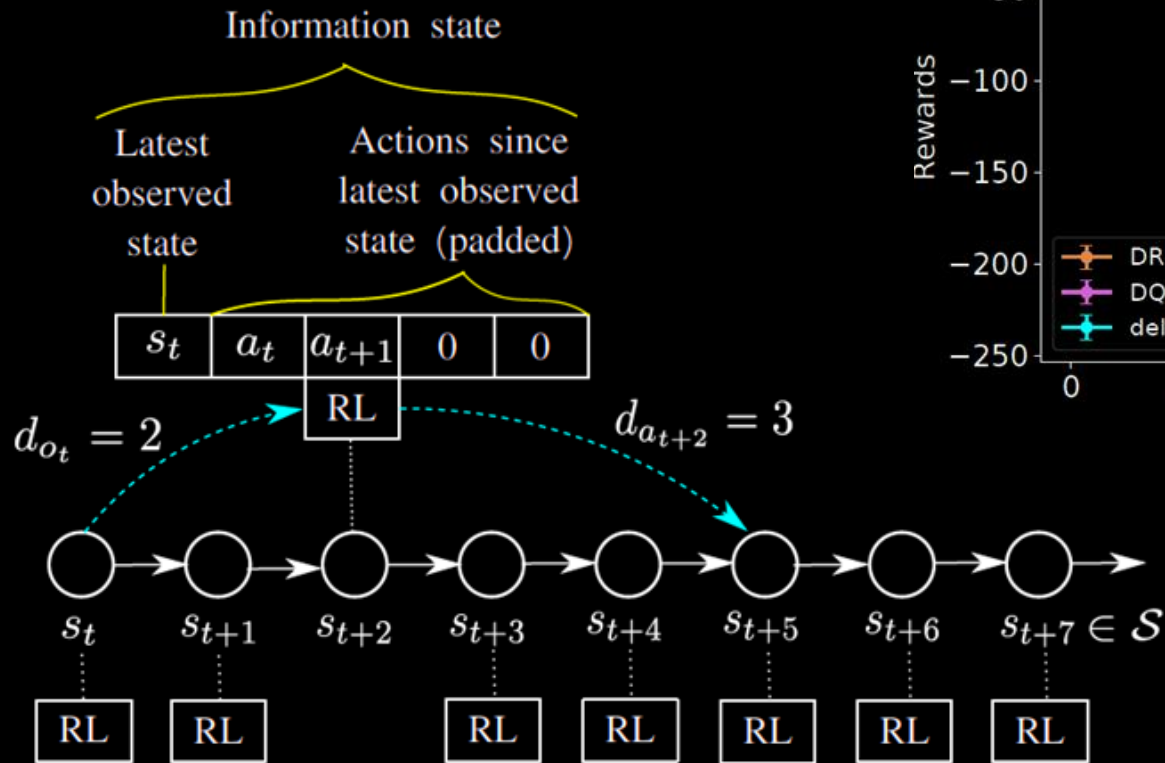"Sample Efficient Training in Multi-Agent Adversarial Games with Limited Teammate Communication"
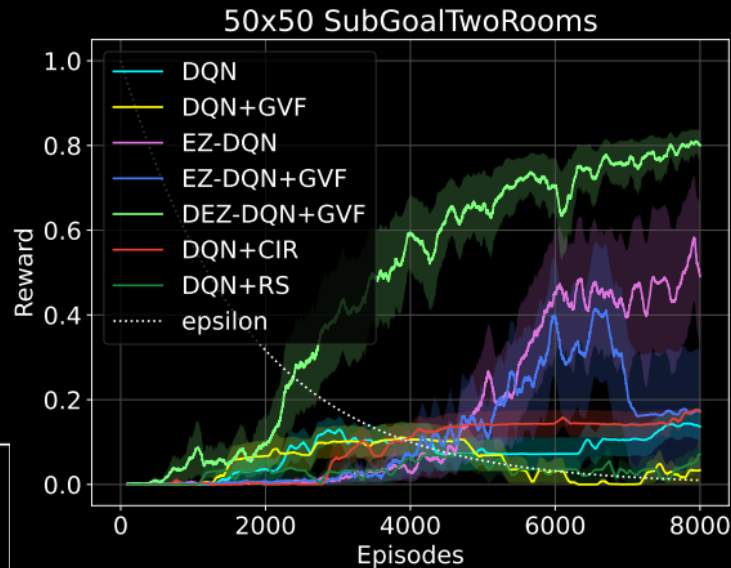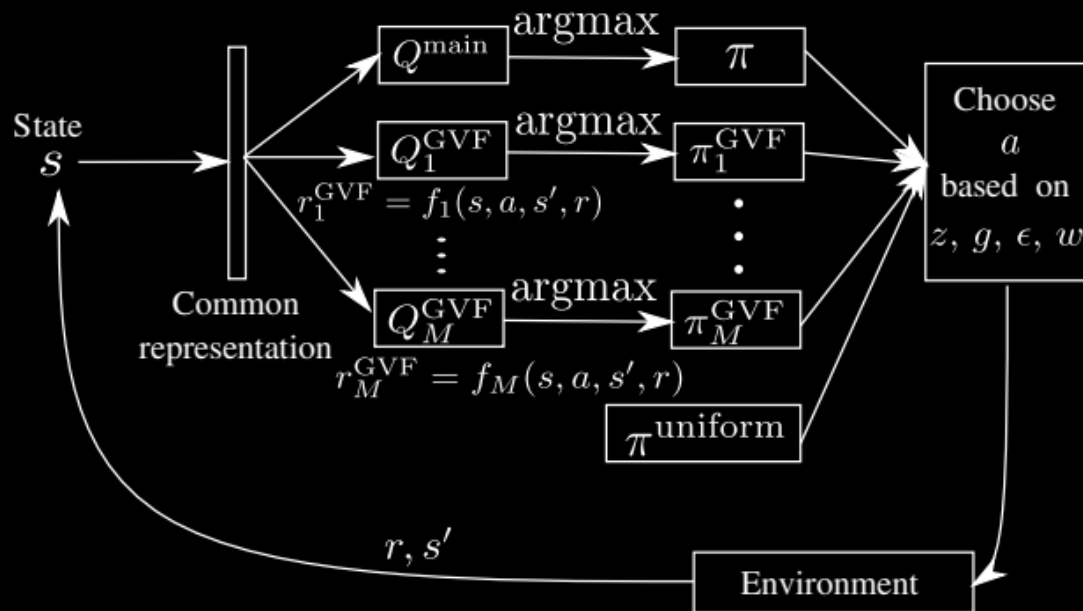H Meisheri, H Khadilkar

Ethics: Fairness, Bias, Liability

"A novel data augmentation technique for out-of-distribution sample detection using compounded corruptions"
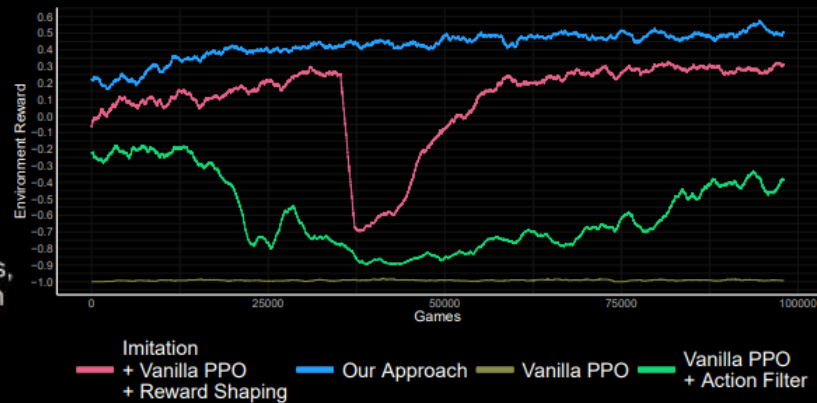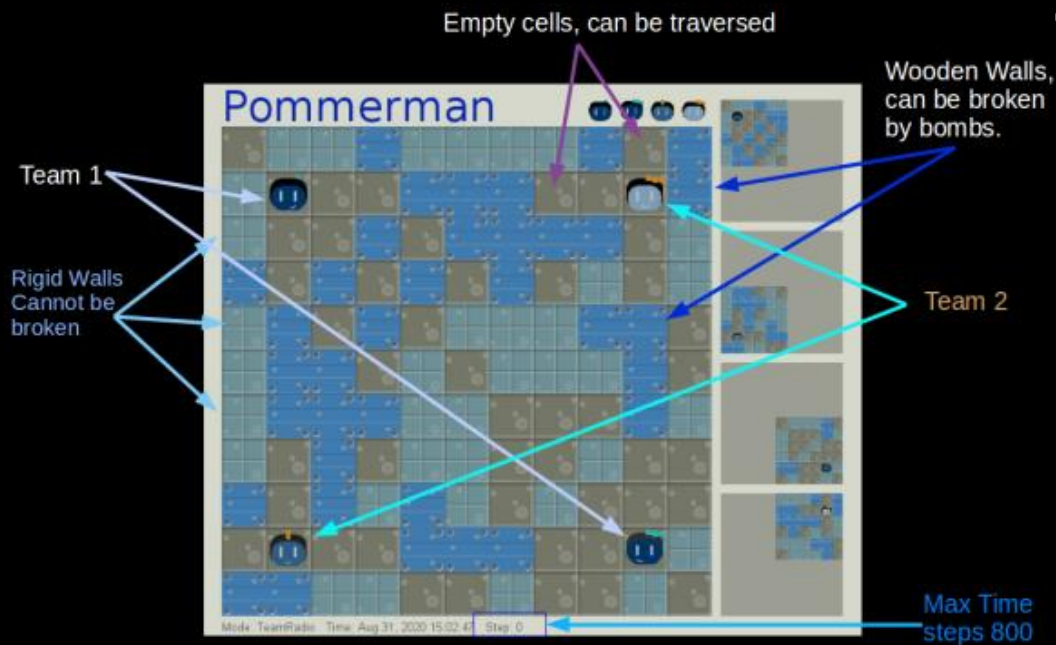R Hebbalaguppe, SS Ghosal, J Prakash, H Khadilkar, C Arora

Other considerations: Delays

Other considerations: Errors
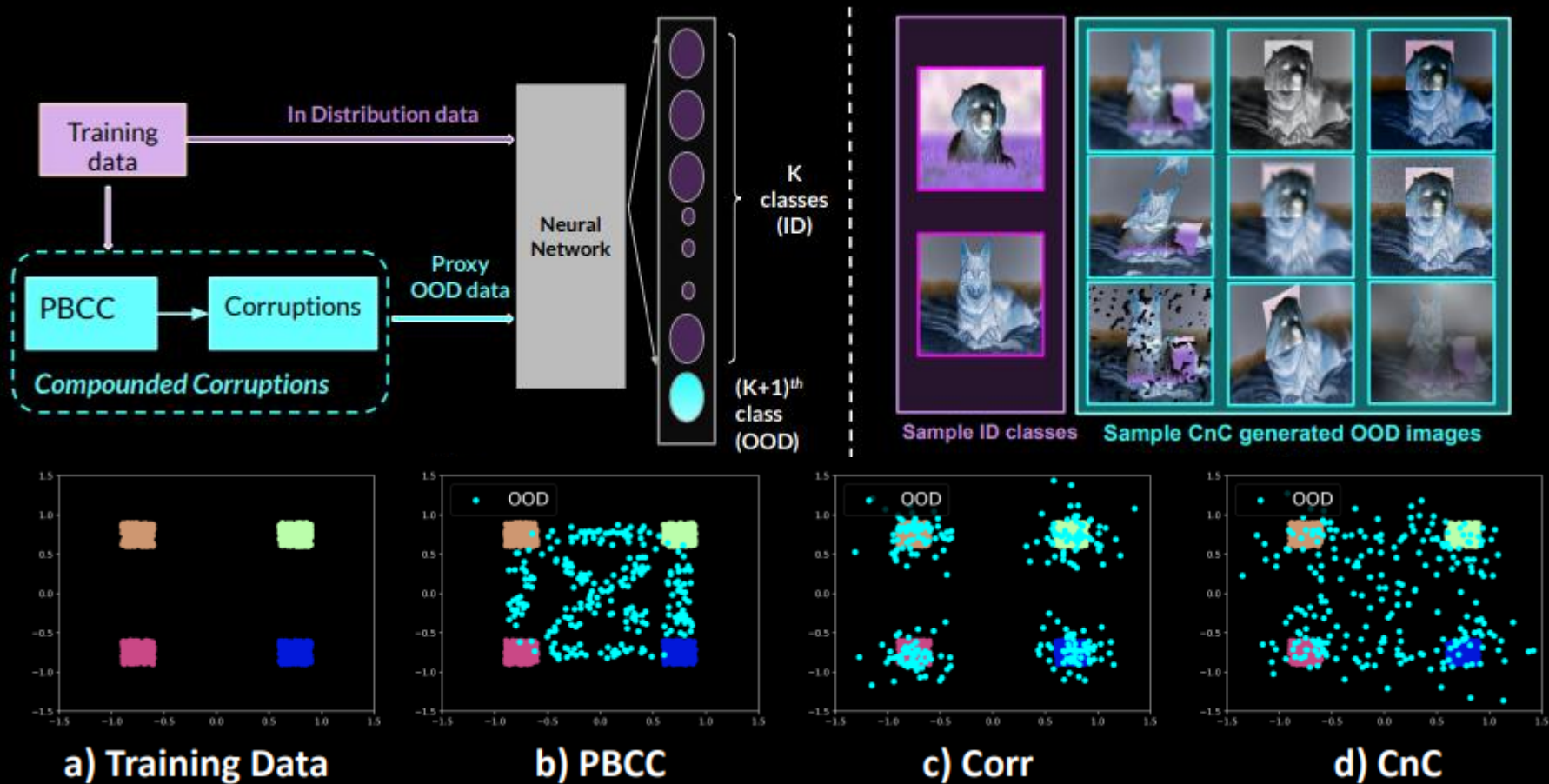
Other considerations: Adversaries

Other considerations: Ethics

a) Training Data   b) PBCC   c) Corr   d) CnC

Return to recurring themes

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