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Industrial applications of reinforcement learning

Harshad Khadilkar TCS Research <u>Sep</u> 27, 2017

> Experience certainty. IT Services Business Solutions Outsourcing

Well-known RL applications

- Autonomous driving
- Gameplay: Go, blackjack, Atari, …
- Robotics: path planning, task allocation







Joint Research with IIT Kanpur Robotics Lab

5^{th} in 2016 4^{th} in 2017

TATA CONSULTANCY SERVICES Experience certainty.

TCS Research Areas

- Software
- Life Sciences
- Physical Sciences
- Behavioral, Social, Business Sciences
- Cyber-Physical Systems
- Embedded Systems & Robotics
- Data and Decision Sciences
 - Machine perception (speech, text, vision)
 - Predictive modeling (sensor fusion, IoT)
 - Intelligent control & planning (RL)

Industry-related RL initiatives at TCS



irfca.org
Port Planning



www.123rf.com

Supply Chain Operations



www.rbic.com

Energy Trading



nortech.oulu.fi

Railway scheduling

A time-indexed mapping of trains to track resources



Railway scheduling

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Experience certainty.

Primary challenges Scale, Deadlocks, Flexibility



Base lab location: Mumbai

Supply Chain Operations

Improve efficiency using globally-aware decision making



iimfwebtraining.com

Base lab location: Mumbai

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Experience certainty.

Supply Chain Operations

Current use case: distribution center operations

Goal: Reduce time from order receipt to shipment departure



wepartypatriots.com

TATA CONSULTANCY SERVICES Experience certainty. Base lab location: Mumbai

Supply Chain Operations

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Experience certainty.



Base lab location: Mumbai

Container Loading in Ports

Minimize number of shuffles when loading containers



www.123rf.com



Base lab location: Delhi

Container Loading in Ports

Vessel: 5 slots {23 rows, 1 bay}



"Trip allocation and stacking policies", Guven and Eliiyi, 2014

TATA CONSULTANCY SERVICES Experience certainty. Base lab location: Delhi

Contracts in energy markets



4th in 2017



TATA CONSULTANCY SERVICES Experience certainty. Base lab location: Hyderabad INFORMATION TECHNOLOGY H Y D E R A B A D

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- RL is moving quickly from theory to application
- More field testing should generate new interesting problems
- Therefore, new thesis topics!