# TAMAS MADARASZ

MediaTek Research

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## EXPERIENCE

### Staff Research Scientist/Deep Learning Researcher
**MediaTek Research**
December 2021 – ongoing

- At MediaTek my research focuses on reinforcement learning, responsible decision making and open-ended learning. I have introduced a novel method for efficient planning and knoweldge transfer between tasks by learning positional invariances in event sequences[1]. On the more applied side, I use approaches like hierarchical RL and quality diversity to develop AI-driven technologies for chip design that can better interact with human designers.

### Machine Learning Researcher
**Huawei R&D UK**
December 2020 – December 2021

- At Huawei R%D, I was part of the AI Theory team in Noah's Ark lab, working on fundamental research as well as applications in areas like compiler optimization and self-driving technologies. The main focus of my work has been on learning transferable representations for combinatorial optimization and planning problems. I also helped develop a new compositional transfer learning algorithm in the computer vision domain[2].

### AI/ML fellow
**GSK**
June 2020 – Deccember 2020

- During my fellowship, I worked on reinforcement learning approaches to assist scientists in the optimization of new medicines, by learning to extract and supplement human expertise using databases from past drug discovery cycles.

### Postdoctoral Researcher
**University of Oxford**
March 2018 – May 2020

- Developed sample-efficient deep reinforcement learning algorithms that quickly adapt to solve new tasks in a continual and multi-task learning setting[4], and by decomposing complex task structures into subtasks[3].

### Postdoctoral Researcher
**University of Geneva**
October 2015 – December 2017

- Researched reinforcement learning and planning algorithms for partially observable decision problems, and using approximate dynamics models of the task environment. Developed a dynamical systems model of representation learning for sensory systems (in particular olfaction) in the brain[6].

## BACKGROUND AND SKILLS

- Programming: Python  Matlab  C++
- DL frameworks: Tensorflow  Pytorch  Theano
- ML areas: Reinforcement Learning and Planning, Responsible Decision Making and Fairness, Deep Learning, Probabilistic Modelling, Bayesian Statistics, NLP, Computer Vision, Causal Inference

## EDUCATION

### Ph.D. in Neuroscience
**New York University**
2009– 2015

### B.A. in Mathematics
**University of Cambridge**
1999 – 2002

### Masters and Performance degrees as a classical cellist
**Robert-Schumann-Academy, Dusseldorf, Ecole Normale de Musique de Paris**
2002 – 2008

## AWARDS

- Samuel J. and Joan B. Williamson Dissertation Fellowship
- NYU Dean's Dissertation Fellowship
- MacCracken Graduate Fellowship
- Cambridge Overseas Trust and Trinity College full undergraduate scholarship
- NeurIPS, RLDM and Cosyne travel awards

## SERVICE

- Ad hoc reviewer: Science  Nature Neuroscience  Biological Cybernetics  IBM Journal of Research and Development
- **Mentorship**:
  - David Ireland, PhD Intern, MediaTek Research
  - Antonin Vidon, Intern, Huawei R&D UK
  - Frank Catuela, Omar Akhand, Samit Roy Undergraduate Researchers, NYU.

# SELECTED PROJECTS

- Some of the open challenges preventing RL agents form autonomously and safely navigating real-world problems are the understanding of the nonstationarities and feedback loops their decisions can create, the ability to break down complex tasks into manageable subtasks, and the potential to transfer knowledge from one task/sub-task to another. In a series of papers and ongoing work I have contributed new algorithmic tools to decompose and reason about the structure of complex, non-Markovian reinforcement learning problems, while also allowing efficient planning in new settings. By representing temporal and causal invariances in the reward functions of such tasks, and a savvy re-evaluation of past experience given the current problem setting, this approach allows fast generalization of to new tasks within a task family.
- Published at the Workshop on Responsible Decision Making in Dynamic Environments at **ICML 2022** and at the
- Causal Learning and Decision Making Workshop at **ICLR 2020**.

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- An important problem when transferring knowledge in the RL setting is to know how to act when our goals or the available rewards in the environment change. But how do we know when these changes happen, which policies to reuse, how to quickly adapt them, and how to discover newly available rewards? The Bayesian Successor Representation algorithm gives some answers to these questions by continually evaluating task similarity online, clustering similar tasks, and quickly approximating optimal policies for newly emerging reward functions. By combining nonparametric clustering methods with flexible deep RL, it provides an efficient approach to quickly solve new tasks as rewards change, and outperforms competing approaches on continual learning problems.
- Awarded a **spotlight talk** at **NeurIPS 2019**.

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- Given limited data, we can construct many different predictive models of our environments, with varying statistical complexity. Some of these will focus on a small number of strong predictive relationships, while others will encompass a broader range of associations. During my PhD, I formulated a computational framework explaining how biological learning deals with ambiguity in the predictive relationships in the environment, through weighing different plausible explanatory models.
- Published as an article in **Nature Neuroscience**.

# PUBLICATIONS


[1] **Madarasz TJ** (2022)
LPI: Learned Positional Invariances for Transfer of Task Structure and Zero-shot Planning.
***ICML**, 39th International Conference on Machine Learning, Workshop on Responsible Decision Making in Dynamic Environments.*

[2] Parisot S, Esperanca PM, McDonagh S, **Madarasz TJ**, Yang Y, Li Z (2022)
Long-tail Recognition via Compositional Knowledge Transfer.
***CVPR**, 2022 IEEE Conference on Computer Vision and Pattern Recognition .*

[3] **Madarasz TJ** , Behrens TEJ (2020)
Learning transferable task schemas by representing causal invariances.
***ICLR**, Eighth International Conference on Learning Representations, Causal learning for decision making workshop.*

[4] **Madarasz TJ**, Behrens TEJ (2019) Better transfer learning with inferred successor maps.
***NeurIPS**, 33rd Conference on Neural Information Processing Systems, Vancouver, Canada.*
**Spotlight oral presentation** *(<3% of submissions).*

[5] **Madarasz TJ**, Behrens TEJ (2019) Inferred predictive maps in the hippocampus for better transfer learning. **RLDM**, *Multidisciplinary Conference on Reinforcement Learning and Decision Making, Montreal.*

[6] Yamada Y*, Bhaukaurally K*, **Madarasz TJ,** Pouget A, Rodriguez I, Carleton A (2017)
Context- and output layer-dependent long-term ensemble plasticity in a sensory circuit. ***Neuron**, Volume 93 , Issue 5 , 1198 - 1212.*

[7] **Madarasz TJ,** Diaz-Mataix L, Akhand O, Ycu EA, LeDoux, JE, Johansen JP (2016)
Evaluation of ambiguous associations in the amygdala by learning the structure of the environment. ***Nature Neuroscience** 19, 965–972.*

[8] **Madarasz TJ**, LeDoux JE, Johansen JP (2015) Evaluating predictive variables by a dual system of structure and parameter learning. **RLDM**, *Multidisciplinary Conference on Reinforcement Learning and Decision Making, Edmonton.*

# CONFERENCE PRESENTATIONS

**Madarasz, TJ**, Behrens TEJ (2019) Flickering hope? Inferred hippocampal maps and splitter cells support multi-task learning COSYNE: *Computational and Systems Neuroscience, Lisbon.*

Fink AE, **Madarasz TJ**, LeDoux JE (2015) Short-term plasticity as a homeostatic mechanism in the lateral amygdala. *Society for Neuroscience.*

**Madarasz TJ,** Diaz-Mataix L, Akhand O, LeDoux JE, Johansen JP (2015) Evaluating ambiguous associations in the amygdala by learning the structure of the environment. COSYNE: *Computational and Systems Neuroscience, Salt Lake City, Utah.*

**Madarasz TJ**, Johansen JP, LeDoux JE (2013) Causality and its neural underpinnings in active and passive aversive learning. *Society for Neuroscience.*

**Madarasz TJ**, Diaz-Mataix L, Boyden SE, LeDoux JE, Johansen JP (2012) Temporally specific optogenetic inactivation of lateral amygdala pyramidal neurons reverses the effects of contingency degradation on fear learning. *Society for Neuroscience.*

**Madarasz TJ**, Roy SS, Boyden ES, LeDoux JE, Johansen JP (2011) Making predictions in a complex world: mechanisms of contingency degradation in fear conditioning. *Society for Neuroscience.*

Gervan P, Berencsi A, **Madarasz TJ,** Kovacs I (2010) Development and plasticity of primary visual and motor function in humans. *II. Dubrovnik Conference on Cognitive Science.* x

# INTERNSHIPS

2012, 2013 RIKEN Brain Science Institute Summer Intern

# TEACHING

- Neuromatch Academy Mentor
- Computational and Cognitive Neuroscience Summer School, Shanghai
- Mathematical Tools for Cognitive and Neural Science NYU-TA.
- Statistics and General Physics, Lecturer, McDaniel College, Budapest