Mauricio Tec

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About Me

My current work seeks to advance the applicability of reinforcement learning in real-world settings, often integrating tools from Bayesian inference, causality, and deep learning. At Harvard University, I am applying these methods to improve climate disasters alerting systems by using time series and forecasts to decide when to intervene. My ultimate goal is to develop trustworthy AI systems that make decisions for and with humans in real-world applications.

Education

Ph.D. in Statistics, The University of Texas at Austin, 2017–2022
• Developed *Bayesian and causal deep learning* methods supervised by James Scott and Corwin Zigler at the statistics department. • Conducted *reinforcement learning and robotics research* in the *Learning Agents Research Group* (LARG) directed by Peter Stone at the computer science department.

M.Sc. in Mathematics, University of Cambridge, 2014–2015
Part III of the mathematical tripos with focus on probability theory, geometry and topology.

B.Sc. in Applied Mathematics, Instituto Tecnologico Autonomo de Mexico (ITAM), 2007–2012

Work Experience

Harvard University, *Postdoctoral Research Fellow/Research Associate,* 2022–date
• Designing critical deep reinforcement learning applications to optimize the issuance of US heat alerts that utilize daily timeseries and forecasts to make smart decisions about when and how to take action. • Writing and publishing papers and software in top ML conferences and stats journals. • Key role in writing four grant proposals (two funded by NSF/NIH). • Mentoring doctoral students. • Promoted to research associate in 09/23.

Facebook AI Research (FAIR), *Research Intern,* 2020
Implemented world-model reinforcement learning models, performing code optimizations and algorithmic improvements to outperform the original Dreamer implementation for MuJoCo robotic simulator benchmarks.

Intel AI, *Research Intern,* 2019
Measured neural network corruption when removing error correction code in edge computing. Developed a mitigation strategy to increase resiliency. Tested on ResNet ImageNet benchmarks.

The University of Texas at Austin, *Graduate Research Assistant,* 2019–2021
Developed a new self-supervised method for causal inference with spatial dependencies, evaluating it in downstream air pollution studies, allowing the use of simpler causal inference methods for otherwise complex tasks.

CIBanco Financial Asset Management, *Data Scientist,* 2016–2017
• Applied statistical and ML methods (risk parities, bayesian shrinkage, forecasting) to optimize multi-asset class investments. • Integrated production-level analytics with the bank's financial information streamed databases. • Actively participated in weekly committees with senior stakeholders, influencing investment decisions.

ITAM, *Lecturer, Applied Mathematics Department,* 2015–2017
Taught courses in computational statistics and stochastic processes to undergraduate students.

CIDAC, *Data Analyst,* 2013–2014
Conducted data analysis supporting the Mexican think tank CIDAC's economic policy recommendation.

Other Relevant Experience

Memorial Sloan Kettering Cancer Center, *(Drug Discovery with Active Learning),* 2022
• Co-designed the underlying probabilistic model and code implementation of a novel experiment design framework using *active learning* to discover synergistic drug combinations for cancer treatment. • The framework is being used in Tansey's lab to conduct weekly experiments, leading to new combination therapy discoveries.

RoboCup World Cup Competition, *(Autonomous Robot Soccer),* 2020–2022
• Published a lightweight real-time robotic computer vision framework for detecting soccer field objects; trained the deep learning model in PyTorch for super low-resolution YUYV robot vision and transferred it to TFLite. • Competed for the UT Austin Villa team using our proposed model implemented in our in-house robotic OS and C++, achieving fourth and fifth place in the SPL league (2020, 2021).

UT Austin COVID-19 Consortium, *(Informing Stay-at-home Policy),* 2020–2021
• Quickly prototyped, co-designed and fully implemented Bayesian statistical and epidemiological models using mobility data to nowcast infections. • The model results were published in the Proceedings at National Academy of Sciences (PNAS), featured in CNN, and used by government officials to guide policy in Austin, TX.

Microsoft Research Textworld Competition, *(Text-based RL Agents),* 2019
• Designed a reinforcement learning agent that learns to play text-based games using Monte Carlo Tree Search and an attention neural network to evaluate unseen game states. • Achieved tenth place in the competition.

Skills

- *Programming Languages*: Python (preferred); Julia, R (proficient); C++ (intermediate);
- *High-performance Computing*: Slurm (advanced); AWS/Azure Cloud (intermediate);
- *Data Science*: SQL (advanced); tidyverse, ggplot, pandas, ggplot, networkx (proficient); NLP (advanced);
- *Development and Pipelines*: Git, Docker, SnakeFlow, Linux (advanced);
- *Deep Learning*: PyTorch, Tensorflow, Image segmentation/Object detection, Spatial methods, (proficient); GNNs, Attention-based models (advanced); Multi-GPU, Distributed training (intermediate);
- *Experiment Design/ Sequential Decision-making*: Active learning, Reinforcement learning, Tree search (proficient);
- *Statistics*: Bayesian inference, Causal inference, A/B testing (proficient);

Scholarships, Grants, and Awards

- *NIH Supplement 3RF1AG080948-01S1* (2023–2025). Enhancing SpaCE, an innovative Python package for benchmarking spatial confounding machine-learning methods. *Role*: Research personnel. Substantial role in writing the proposal and co-leading the work. *PI*: Michelle Bell. *Amount:* $220k direct.
- *Harvard Chan-NIEHS Pilot Project (2023–2024)*. Novel spatial deep learning methods to estimate the effects of climate change on air quality disparities. *Role*: Co-PI with F. Dominici. *Amount*: $30k direct.
- *Keller Award* (2022). Distinction to doctoral students demonstrating exceptional leadership skills by engaging in academic, research, and social community-building activities.
- *UT Austin GC Fellowship* (2021–2022). $32,000 and full tuition. Awarded to Ph.D. students based on major accomplishments and research program.
- *Conacyt Cambridge Trust Scholarship* (2014–2015). $5,000 and full tuition for graduate studies.
- *Fulbright Garcia-Robles Scholarship* (2013). Full scholarship for graduate studies. Award declined.
- *ITAM Bailleres-Mancera* (2007–2012). Full scholarship undergraduate studies.

Software

- `broach` (2024). The *Bayesian Rewards Over Actual Climate Data* project (BROACH) provides a Python simulator for training RL agents to optimize the issuance of heat alerts to minimize health impacts. Companion of our JASA submission. *To be released upon paper acceptance*.
- `SpaCE` (2023). A Python package providing the first benchmarking toolkit for spatial causal inference. Companion of our ICLR submission. URL: https://github.com/NSAPH-Projects/space.
- `weather2vec-app` (2022). Provides access to trained self-supervised embeddings of weather covariates better suited for confounding adjustment in causal inference studies. Users can specify locations and time points. Companion of our AAAI paper. URL: https://huggingface.co/spaces/mauriciogtec/w2vec-app.
- `AdaptiveRejectionSampling.jl` (2018) Julia Package for super-fast sampling of log-concave densities, handy in efficient Bayesian inference. Currently used as a component of other community Julia packages. URL: https://github.com/mauriciogtec/AdaptiveRejectionSampling.jl

Service

Peer-review
- *ML Conferences*: NeurIPS (2023); WCB@ICML (2022); IEEE (2022); AISTATS (2023, 2021); AAAI (2023).
- *Journals*: JASA (2023); AJE (2023); IJPH(2022); JCGS (2022); Nature (2021); Biometrics (2021);.

Organizational Leadership
- Organizing committee Robocup: Standard Platform League 2023.
- Co-founder *PAcMan*: *P*ostdoc *A*ccelerated *MAN*uscripts. Pilot group to accelerate collaborative publishing among postdocs. NSAPH, Harvard T.H. Chan School of Public Health (2022–2023).
- Organizing committee WCB@ICML Workshop (2022).
- Co-organizer of the RL in Statistics Reading Group. UT Austin (2021).
- Organizing committee 50th Wolfson College Research Event, University of Cambridge (2015).

Community Engagement
- Secretary, Tenant Advisory Board, University Housing, UT Austin (2021–2022).
- Seminar Speaker-student Liaison. Statistics Department, UT Austin (2019).
- Graduate Student Assembly Representative. UT Austin (2018).

Talks and Seminars

- Invited Speaker. AI for Environmental Risk Seminar 2024. University of Cambridge, Cambridge, UK
- Invited Speaker. Joint Statistical Meeting (JSM) 2024. Portland, OR.
- Invited Speaker. Causal Inference Seminar Spring 2024. Michigan State University.
- Contributed talk. AAAI 2023, Artificial Intelligence for Social Impact
- Contributed talk. Harvard Biostatistics Department Lightning Talks (Fall 2022 and Spring 2023).
- Invited Speaker. ENAR 2023, International Biometric Society.
- Invited Speaker. Biology Scholars Program Seminar, 2020.

Publications

* indicates shared first authorship; ** indicates senior authorship.

Submitted

1. Considine E, Nethery R, Wellenius G, Dominici F, and **Tec M****.** *Optimizing Heat Alert Issuance for Public Health in the United States with Reinforcement Learning.* Under review at JASA. 2024
2. Tosh C, **Tec M**, [...], and Tansey W. *A Bayesian active learning platform for scalable combination drug screens.* Under review at Nature Biotechnology. 2024
3. **Tec M**, Trisovic A, Audirac M, and Dominici F. *SpaCE: The Spatial Confounding Environment.* Under review at ICLR. 2024
4. **Tec M**, Mudele O, Josey K, and Dominici F. *Causal Estimation of Exposure Shifts with Neural Networks.* Under review at ICLR. 2024

Refereed ML conferences

5. **Tec M**, Scott J, and Corwin Z. "Weather2vec: Representation Learning for Causal Inference with Non-Local Confounding in Air Pollution and Climate Studies". In: *Association for the Advancement of Artificial Intelligence (AAAI).* 2023
6. Durugkar I, **Tec M**, Niekum S, and Stone P. "Adversarial Intrinsic Motivation for Reinforcement Learning". In: *Neural Information Processing Systems (NeurIPS)* (2021)
7. Holman B, Anwar A, Akash S, **Tec M**, Hart J, and Stone P. "Watch where you're going! Gaze and head orientation as predictors for social robot navigation". In: *IEEE International Conference on Robotics and Automation (ICRA)* (2021)
8. Williamson S and **Tec M**. "Random clique covers for graphs with local density and global sparsity". In: *Uncertainty in Artificial Intelligence (UAI)* (2019)

Peer-reviewed journals

9. Kim, C, **Tec M**, and Corwin Z. "Bayesian Nonparametric Adjustment of Confounding". In: *Biometrics* (2023)
10. **Tec M**, Duan Y, and Müller P. "Bayesian Sequential Design and Reinforcement Learning: A Comparative Tutorial". In: *The American Statistician* (2022)
11. Müller P, Duan Y, and **Tec M**. "Simulation-based sequential design". In: *Pharmaceutical Statistics* 21.4 (2022), pp. 729–739
12. Audirac M*, **Tec M***, Meyers LA, Fox S, and Zigler CM. "How Timing of Stay-home Orders and Mobility Reductions Impacted First-Wave COVID-19 Deaths in US Counties". In: *The American Journal of Epidemiology* (2021)
13. Fox S*, Lachmann M*, **Tec M**, ..., and Meyers LA. "Real-time pandemic surveillance using hospital admissions and mobility data". In: *Proceedings of the National Academy of Sciences (PNAS)* (2021)
14. Cramer EY, ..., **Tec M**, ..., and Reich N. "Evaluation of Individual and Ensemble Probabilistic Forecasts of COVID-19 Mortality in the US". in: *Proceedings of the National Academy of Sciences (PNAS)* (2021)
15. Zuniga-Garcia N, **Tec M**, Scott J, and Machemehl R. "Evaluation of E-Scooters as Transit Last-Mile Solution". In: *Transportation Research Part C* (2021)
16. Audirac M, **Tec M**, Garcia-Tejeda E, and Fox S. "Estimating Importation Risk of COVID-19 in Hurricane Evacuations: A Prediction Framework Applied to Hurricane Laura in Texas". In: *International Conference on Geospatial Information Sciences (iGISc)* (2021)
17. Aiken A, Starling J, Gomperts R, **Tec M**, Scott J, and Aiken C. "Demand for Self-Managed Online Telemedicine Abortion in the United States During the Coronavirus Disease 2019 (COVID-19) Pandemic". In: *Obstetrics and Gynecology* 136.4 (2020)
18. Zuniga-Garcia N, **Tec M**, Scott J, Ruiz-Juri N, and Machemehl R. "Evaluation of Ride-Sourcing Search Frictions and Driver Productivity: A Spatial Denoising Approach". In: *Transportation Research Part C* (2019)

Workshop and symposium papers (non-archival, peer reviewed)

19. **Tec M**, Trisovic A, Audirac M, and Dominici F. "SpaCE: The Spatial Confounding (Benchmarking) Environment". In: *Causal Learning and Reasoning (CLeaR)* (2023)
20. **Tec M**, Cadei R., Dominici F., and Zigler C. "Projecting the climate penalty on pm2.5 pollution with spatial deep learning". In: *ICLR 2023 Workshop on Tackling Climate Change with Machine Learning.* 2023
21. **Tec M**, Duan Y, and Müller P. "A Comparative Tutorial for Bayesian Sequential Design and Reinforcement Learning for Clinical Applications". In: *Reinforcement Learning and Decision Making (RLDM).* 2022
22. **Tec M**, Scott J, and Zigler M. "Weather2vec: Representation Learning for Causal Inference with Non-Local Confounding in Air Pollution and Climate Studies". In: *Causal Representation Learning Workshop at Uncertainty in Artificial Intelligence (CRL@UAI).* 2022
23. Narayanaswami S, **Tec M**, ..., and Stone P. "Towards a Real-Time, Low-Resource, End-to-end Object Detection Pipeline for Robot Soccer". In: *Robot World Cup XXV Proceedings.* 2022