Academic Round Table [July 6, 2022]

Joan Bruna: Associate Professor at Courant Institute, New York University (NYU)
Aristides Gionis, WASP professor at KTH Royal Institute of Technology
Helen Margetts: Professor of Society and the Internet at the University of Oxford
Balaji Padmanabhan: University of South Florida, Anderson Professor of Global Management

Joan
BRUNA

Aristides
GIONIS

Helen
MARGETTS

Balaji
PADMANABHAN

Hi! PARIS
PARIS ARTIFICIAL INTELLIGENCE FOR SOCIETY
SUMMER SCHOOL

Research Examples

Balaji Padmanabhan
Director, Center for Analytics & Creativity
Anderson Professor of Global Management
Muma College of Business
University of South Florida

bp@usf.edu

Research Agenda

- Motivation
  - AI/ML problems motivated by business/societal objectives
  - Problems often driven by industry conversations

- Themes
  - Pattern Discovery
    - General algorithms
    - Cross-domain
  - Systems, not models
    - Bias/value is driven by systems, not models
  - Applications
    - Operations, marketing, finance, politics, media

UNIVERSITY of SOUTH FLORIDA
Muma College of Business

Motivation: Business Engagement

- Practice Center Projects
  - Over 100 projects in 7 years with ~30 companies
- Custom Executive Education Programs
  - Citizen data science programs for companies
  - Physician data science program
  - Analytics-driven leadership programs
- Outreach initiatives
  - Economic Analytics / USF State of the Region
  - Florida Business Analytics Forum
  - K-Force Big Data Day
- Sponsored Research Projects

UNIVERSITY of SOUTH FLORIDA
Muma College of Business

Theme 1: Pattern Discovery

- General algorithms, cross-domain

  - Padmanabhan, B., & Barfar, A. (2021). Learning individual preferences from aggregate data: A genetic algorithm for discovering baskets of television shows with affinities to political and social interests. *Expert Systems with Applications*, *168*, 114184.

  - Barfar, A., & Padmanabhan, B. (2021). Pattern discovery, validation, and online experiments: a methodology for discovering television shows for public health announcements. *Journal of the American Medical Informatics Association*, *28*(7), 1374-1382.

  - Barfar, A. and Padmanabhan, B., 2015. Does television viewership predict presidential election outcomes?. *Big data*, *3*(3), pp.138-147.

UNIVERSITY of SOUTH FLORIDA
Muma College of Business

Theme 2: Systems not Models

- Smart testing for COVID
  - Wang, Y., Yahav, I., & Padmanabhan, B. (2021). Smart Testing with Vaccination: A Bandit Algorithm for Active Sampling for Managing COVID-19. *medRxiv*.
  -
- Recommender systems on platforms
  - Malgonde, O., Zhang, H., Padmanabhan, B., & Limayem, M. (2020). TAMING COMPLEXITY IN SEARCH MATCHING: TWO-SIDED RECOMMENDER SYSTEMS ON DIGITAL PLATFORMS. *Mis Quarterly*, *44*(1).
  - Prawesh, S., & Padmanabhan, B. (2021). A complex systems perspective of news recommender systems: Guiding emergent outcomes with feedback models. *Plos one*, *16*(1), e0245096.
- Frameworks
  - Padmanabhan, B., Sahoo, N., & Burton-Jones, A. (2022). Machine Learning in Information Systems Research. *Management Information Systems Quarterly*, *46*(1), iii-xix.
  - Samtani, S., Zhu, H., Padmanabhan, B., Chai, Y. and Chen, H., 2020. Deep learning for information systems research. *arXiv preprint arXiv:2010.05774*.
- Fairness in lending and social networks
  - WIP

UNIVERSITY of SOUTH FLORIDA
Muma College of Business

Theme 3: Business & Social Applications

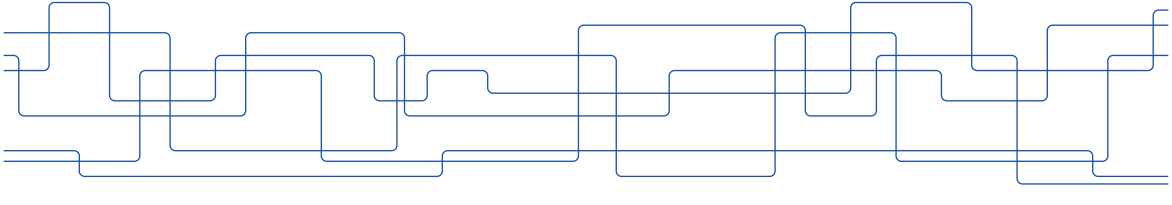
- Healthcare Examples
  - Bouayad, L., Padmanabhan, B., & Chari, K. (2019). Audit policies under the sentinel effect: deterrence-driven algorithms. *Information Systems Research*, *30*(2), 466-485.
  - Bouayad, L., Padmanabhan, B., & Chari, K. (2020). Can Recommender Systems Reduce Healthcare Costs? The Role of Time Pressure and Cost Transparency in Prescription Choice. *MIS Quarterly*, *44*(4).
  - Singh, V.K., Shrivastava, U., Bouayad, L., Padmanabhan, B., Ialynytchev, A. and Schultz, S.K., 2018. Machine learning for psychiatric patient triaging: an investigation of cascading classifiers. *Journal of the American Medical Informatics Association*, *25*(11), pp.1481-1487.
- Operations Examples
  - Barfar, A., Padmanabhan, B. and Hevner, A., 2017. Applying behavioral economics in predictive analytics for B2B churn: Findings from service quality data. *Decision Support Systems*, *101*, pp.115-127.
  - Barfar, A., Padmanabhan, B. and Hevner, A., 2021. Peak cubes in service operations: Bringing multidimensionality into decision support systems. *Decision Support Systems*, *140*, p.113442.
- Social Networks
  - Maleki, N., Padmanabhan, B. and Dutta, K., 2022. Representing Social Networks as Dynamic Heterogeneous Graphs
  - Maleki, N., Padmanabhan, B. and Dutta, K., 2022. Monetary Incentives and Social Media Content: A Exploratory Comparison of Reddit and Steemit
  - Wang, Y., Yahav, I., & Padmanabhan, B. (2022). Cyberbullying, WIP.

UNIVERSITY of SOUTH FLORIDA
Muma College of Business

Aristides Gionis

argioni@kth.se

KTH Royal Institute of Technology



about myself

since 2020	WASP professor in KTH, Sweden
2013 – 2019	Aalto University, Finland
2018	visiting fellow in ISI, Turin
2016	visiting professor in Sapienza, Rome
2006 – 2012	group leader in Yahoo! Research, Barcelona
2003 – 2006	postdoc in University of Helsinki
2003	PhD, Stanford University, USA

my research interests

- theoretical and application-driven research in data mining
- most recent work on graph mining
  - e.g., mining labeled, temporal, signed networks
- structure discovery or optimization problems
  - finding communities, events, dense subgraphs, frequent motifs, role mining, network inference, network alignment, team formation
- study complex dynamic phenomena
  - tracking important nodes and network evolution, information diffusion, reconstruction of cascades and epidemics, opinion formation
- develop novel applications
- design efficient algorithms

current research topics

1. computational methods for quantifying and for reducing bias and polarization in online media

– online media and social networks facilitate people connectivity, personalization, and democratization of content . . .

. . . but they are also conductive to adverse phenomena, such as, polarization and radicalization, misinformation and disinformation, manipulation and harassment

– we study computational methods to detect these adverse phenomena and we develop mechanisms for mitigation

themes in social-media research

- DISCOVERY
  - can we detect patterns of bias, polarization, conflict, and lack of information flow in online media?
- EXPLORATION
  - can we help users understand the global information landscape, users gain control on their news diet, and explore alternative view points?
- RECOMMENDATION
  - can we provide recommendations that increase diversity and balance information exposure?

current research topics

2. optimization of submodular functions

- submodular functions are ubiquitous in machine learning
  - applications : document summarization, sensor placement, viral marketing
- optimization of submodular functions has a rich mathematical theory
- we consider optimizing submodular functions for ranking problems, and robust submodular maximization against deletions

current research topics

3. fairness in unsupervised machine learning

- fairness in machine learning typically considers supervised settings
  - e.g., no discrimination in college admissions
- fairness in unsupervised machine, e.g., data clustering, has also attracted some work
- we have worked on fairness in data clustering
- we consider fairness constraints on clustering costs of different groups, and equitable representation of cluster centers

thank you!

argioni@kth.se

NEW YORK UNIVERSITY

Joan Bruna

Associate Professor of Computer Science,
Data Science and Mathematics (affil.)
Courant Institute, New York University

Visiting Scholar
Center for Computational Mathematics
Flatiron Institute

My Research

MATHEMATICS OF MACHINE LEARNING

Fundamental Primitives to extract information from high-dimensional data

GEOMETRIC DEEP LEARNING

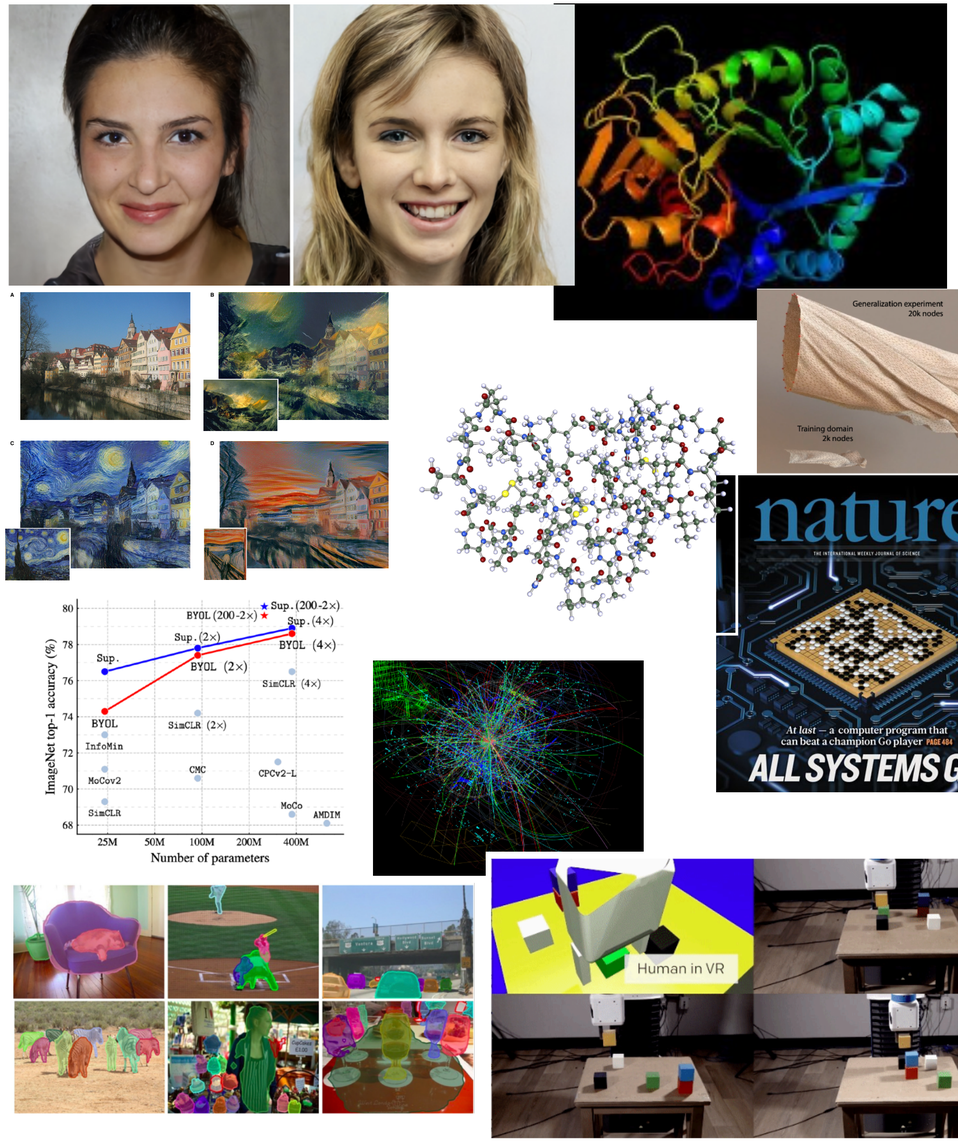
Unifying guiding principles based on symmetry and multi-scale priors

SCIENTIFIC MACHINE LEARNING

Practical deployment of these principles in computational science

Mathematics of Machine Learning

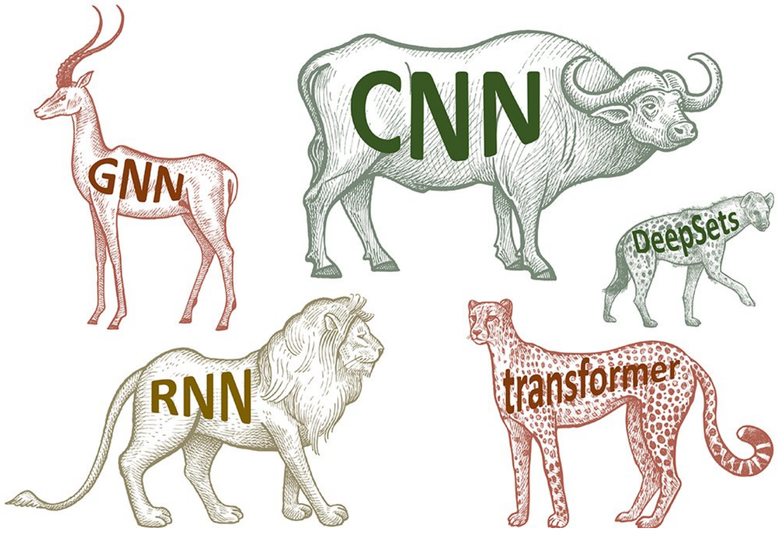
- Provable learning guarantees for high-dimensional problems.
- Challenge: simultaneously address approximation, statistical and computational aspects.
- Our work focuses on NNs trained with GD:
  - Depth-Separation: benefits of depth.
  - Optimization aspects (mean-field measure dynamics, beyond GD).
  - Lower bounds using crypto-reductions.
- Generative modeling: diffusion vs transport.

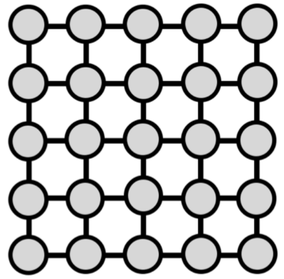


Geometric Deep Learning

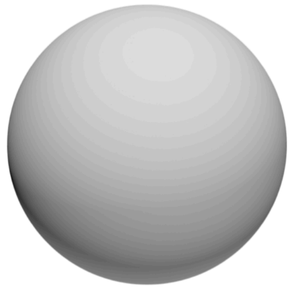
- Breaking the curse of dimensionality with geometric/ physical priors: symmetries and multiscale structure.

- Geometric Deep Learning: develop unifying mathematical and algorithmic principles for learning under physical priors, in domains such as grids, graphs, groups, meshes.

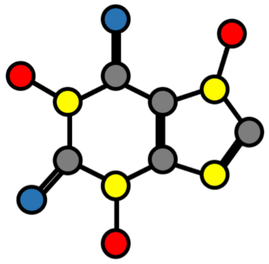




Grids

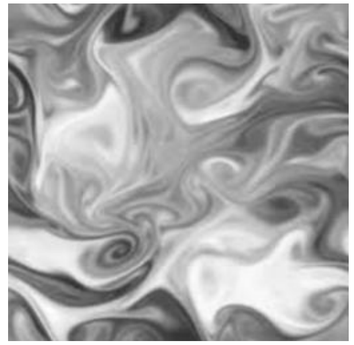
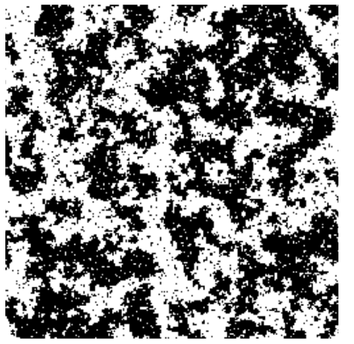
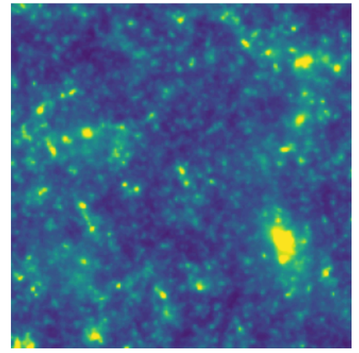
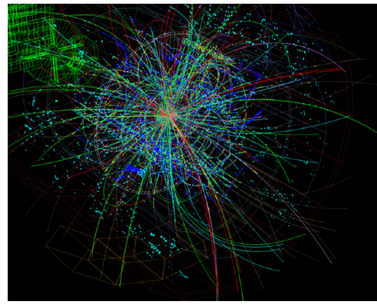
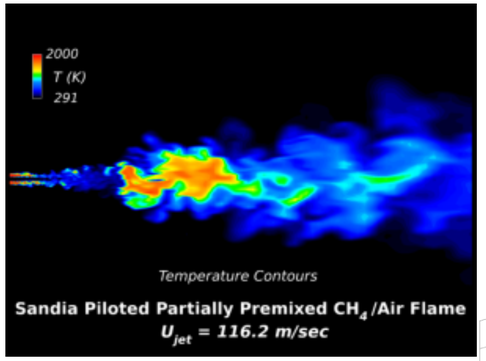
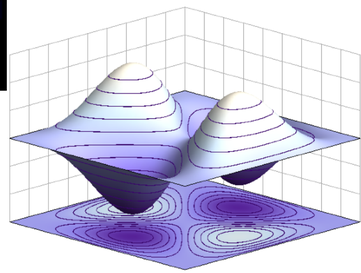


Groups



Graphs

Geodesics & Gauges

Scientific Machine Learning

- High-dimensional structured data arises in many areas of computational science.
- Can the techniques and algorithms developed in ML/DL bring fundamental advances to computational science? And vice-versa, what can SC contribute to ML?
- Climate modeling: use ML to improve closure modeling in turbulence (M2Lines collaboration)
- Quantum Chemistry: ‘neural’ Ansatz with fermion anti-symmetry.