Track Introduction

Data Science and Scientific Computing

presented by Christoph Lampert (TrackRep)

IST AUSTRIA

Institute of Science and Technology

Today’s Schedule

10:00-10:30	Christoph Lampert	Overview of the DSSC Track
10:30-10:45	Gasper Tkacik	Theoretical Biophysics and Neuroscience
10:45-11:00	Bingqing Cheng	Computational Materials Science
11:00-11:15	Marco Mondelli	Machine Learning at IST Austria
11:15-11:30	Matthew Robinson	Medical Genomics
11:30-11:45	Caroline Muller	Atmosphere and Ocean Dynamics
11:45-12:00	all of the above	overflow buffer and Q&A

Data Science and Scientific Computing (DSSC)

Interdisciplinary Track in the Graduate School, combining aspects of:

- data analysis
- information processing
- modelling
- numerical simulation

Beatriz Vicoso

SEX-CHROMOSOME BIOLOGY AND EVOLUTION

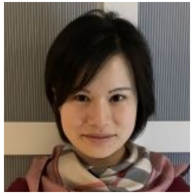
Nick Barton

EVOLUTIONARY GENETICS

Bernd Bickel

COMPUTER GRAPHICS AND DIGITAL FABRICATION

Bingqing Cheng



COMPUTATIONAL MATERIALS SCIENCE

Edouard Hannezo

PHYSICAL PRINCIPLES IN BIOLOGY

Marco Mondelli

INFORMATION-THEORETIC VIEW OF DATA SCIENCE

Carl Goodrich

COMPUTATIONAL SOFT-MATTER PHYSICS

Caroline Muller

ATMOSPHERE AND OCEAN DYNAMICS

Christoph Lampert

MACHINE LEARNING AND COMPUTER VISION

Matt Robinson

MEDICAL GENOMICS

Chris Wojtan

COMPUTER GRAPHICS AND PHYSICS SIMULATION

Gasper Tkacik

THEORETICAL BIOPHYSICS AND NEUROSCIENCE

Sandra Siegert

NEURO-IMMUNOLOGY

future professors

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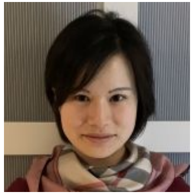

COMPUTATIONAL MATERIALS SCIENCE

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Deputy TrackRep

…CIPLES IN BIOLOGY

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Sex-Chromosome Biology and Evolution

How do sex chromosomes evolve?

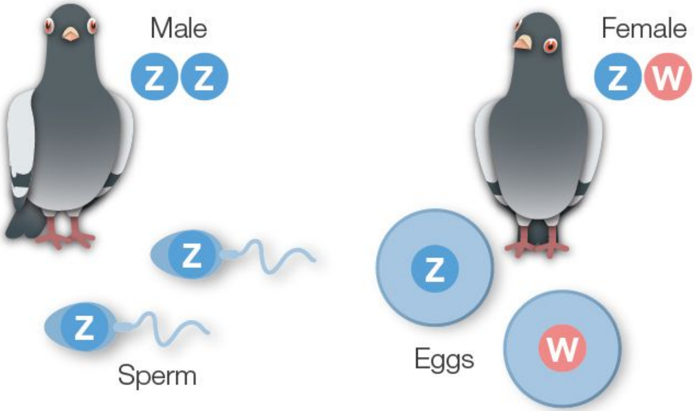


Image: Wikipedia

Nick Barton

Evolutionary Genetics

Hybrid zones:

- study selection, gene flow, random fluctuations

Genetics of complex traits:

- theory, experimental evolution, data analysis

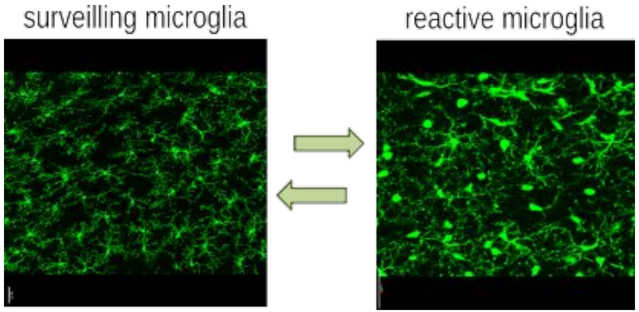
Making sense of DNA sequence:

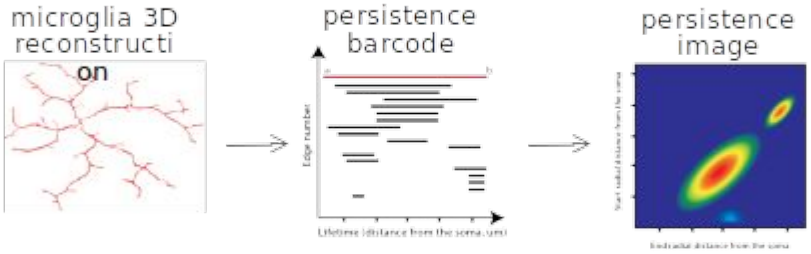
- how can we infer population history, and detect selection?

Sandra Siegert

Neuroimmunology in Health and Disease

(Topological) data analysis to classify immune cells’ morphology and function.





Edouard Hannezo

Physical Principles in Biology

Example: how do cells “know” how to make the right decisions?

Bernd Bickel

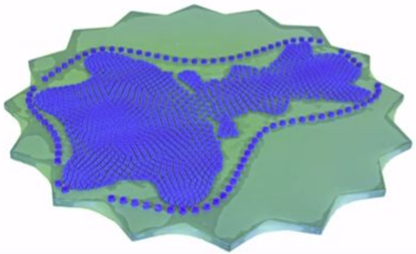
Computer Graphics and Digital Fabrication

Chris Wojtan

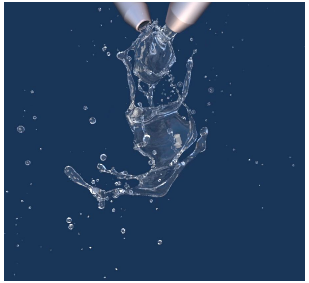
Physics Simulation and Geometry Processing

Methods for modeling, simulating and optimizing (printable) 3D objects

Example: CurveUps



Numerical algorithms for solving differential equations



Efficient and robust methods for animating physics

Create tools for manipulating shapes

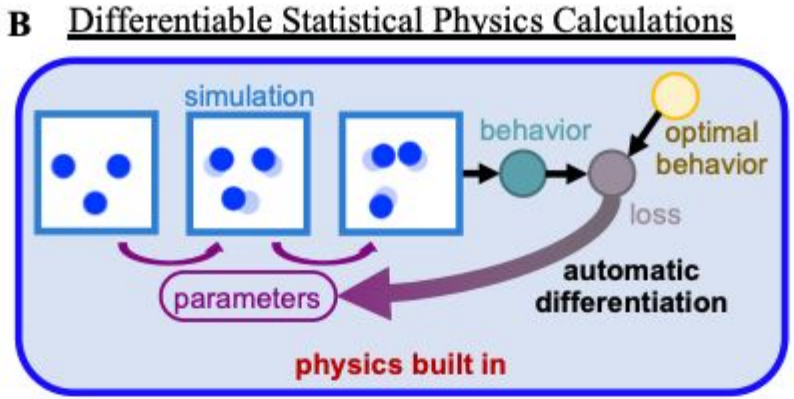
Carl Goodrich

Theoretical and Computational Soft Matter

Christoph Lampert

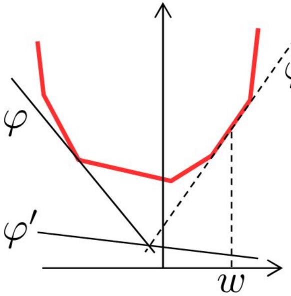
Machine Learning and Computer Vision

Discovering basic soft matter principles using computational and theoretical tools, such as artificial neural networks



Statistical machine learning:

- transfer learning, continual learning, trustworthy learning, theory of deep learning



Applications in Computer Vision:

- scene understanding
- generative models of dynamic scenes

future professor(s)

… keep checking the IST Austria homepage …

PRESS VISITORS JOBS INTRANET DONORS ALUMNI DE CONTACT SEARCH

IST AUSTRIA
Institute of Science and Technology

RESEARCH EDUCATION NEWS & EVENTS CAMPUS INSTITUTE

Five new professors join IST Austria

IST Austria President Thomas Henzinger presents successful young researchers | Appointments in neuroscience, physics, mathematics, and computer science

DSSC Courses 2021/22

Applications of Stochastic Processes
(Nick Barton) - Fall II

The course will cover basic stochastic processes, emphasizing examples from a range of fields. This will include Markov chains, branching processes, and the diffusion approximation. Mathematical rigour will be avoided.

Applied Algorithms and Datastructures
(Tobias Meggendorfer) -- Fall I+II

This course aims to teach the concepts of efficient algorithms through a practical, hands-on format. Each week treats a particular class of problems, beginning with basic data structures and simple algorithms, and continuing with more advanced topics, e.g. shortest path or dynamic programming.

Computational Physics (Chris Wojtan) -- Fall I

This course surveys some moderate/advanced topics for solving problems in computational physics and computer animation. The course will be structured as a seminar, with students primarily presenting material and discussing the details of various approaches.

Information Theory (for Data Science)
(Marco Mondelli) -- Fall I

The goal of the course is to present fundamental concepts in Information Theory and describe their relevance to emerging problems in Data Science and Machine Learning.

DSSC Courses 2021/22

Introduction to Python Programming for Data Science **(Eder Miguel Villalba) -- Fall I**

The goal of the course is to provide a deeper understanding of programming fundamentals in Python, develop programming skills through small programming projects and learn how to use some of the most common Python libraries for scientific computing and data analysis.

Methods of Data Analysis **(Gasper Tkacik) -- Fall II**

This course introduces five topics in data analysis and simulation methods. The focus is on sampling and inferring probabilistic models.

Statistical Machine Learning

(Christoph Lampert) -- Fall I (inverted classroom format)

Introduction to modern statistical machine learning, in particular probabilistic models. The focus is on concepts, not applications.

Computational Bayesian Statistics

(Matthew Robinson) -- Spring II

This course aims to start from the basic fundamentals of Bayesian inference and slowly evolves to cover more recent advances. The focus is on methods and algorithms closer to the application level, but with the hope of providing a solid theoretical foundation.

Data Science and Scientific Computing Track Core Course

Track Core Course -- Spring I+II

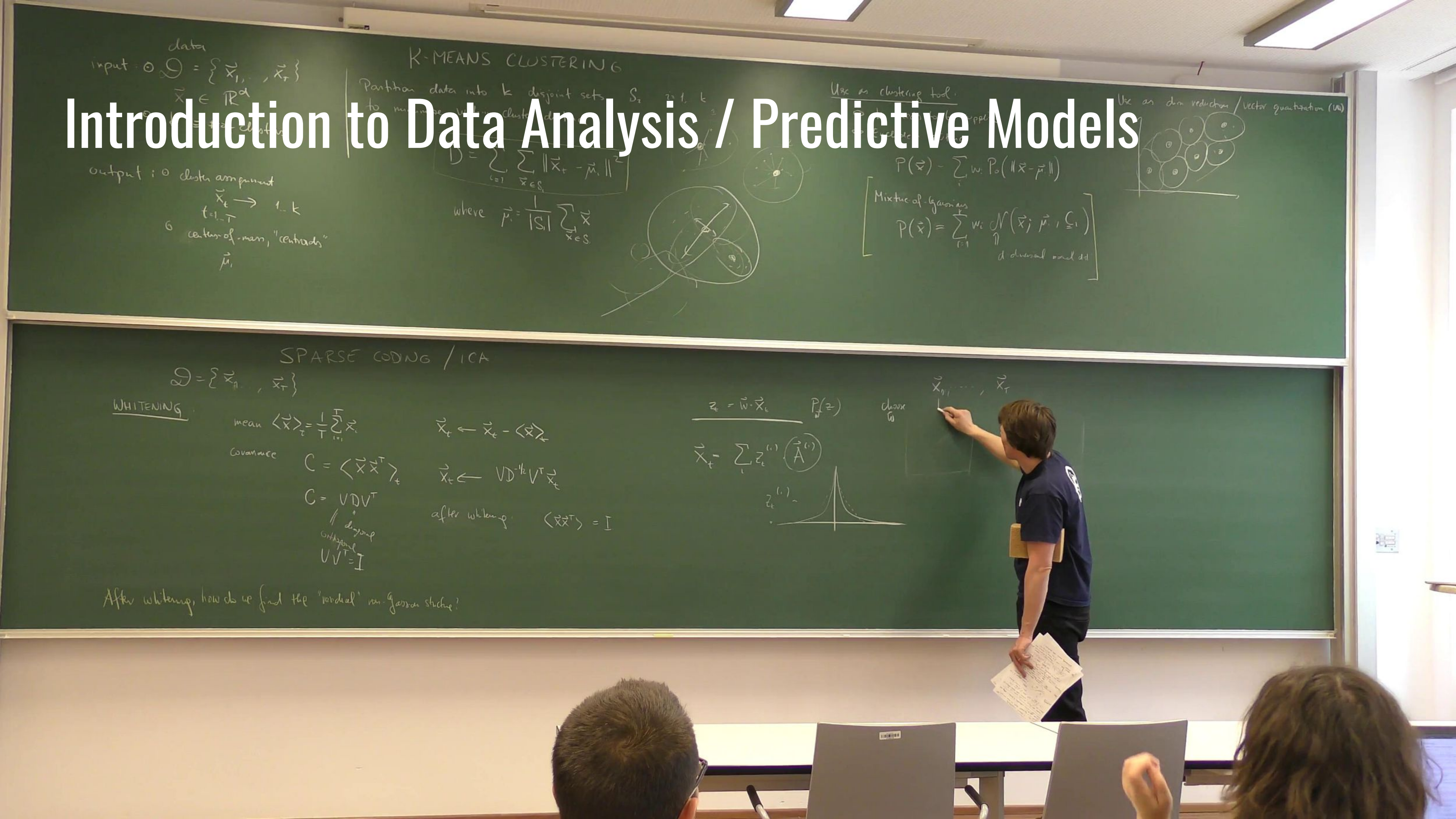
- introduction to data analysis / predictive models
- introduction to numerical simulation / optimization
- individual projects that combine both aspects



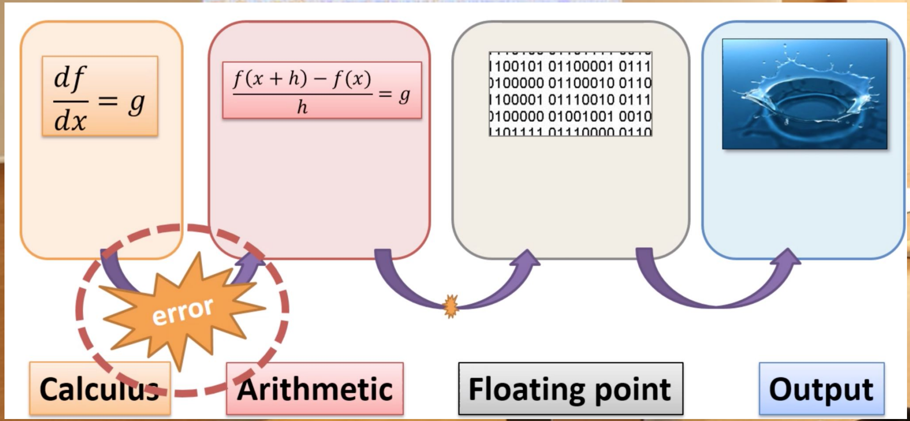
Prerequisites

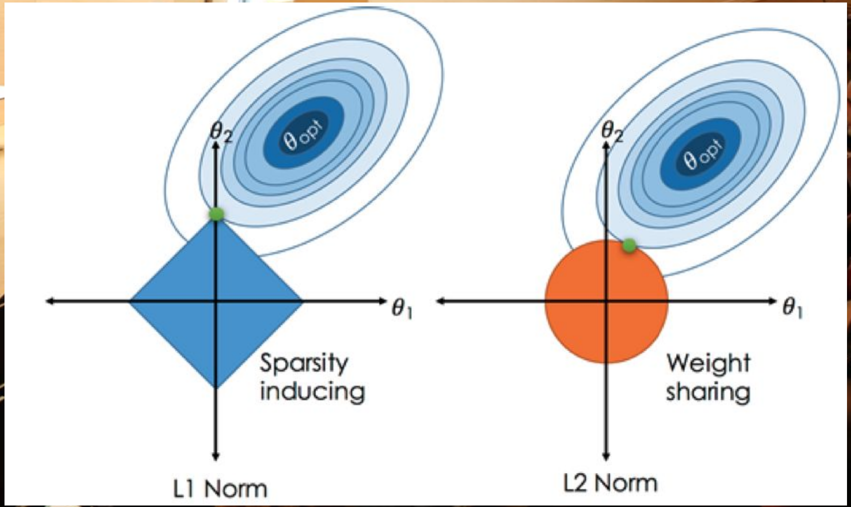
- programming skills (preferably Python)
- strong mathematical skills (linear algebra, calculus)
- good understanding of statistics / probabilities

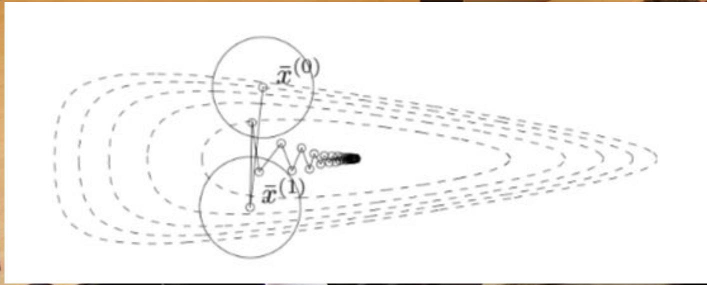
Introduction to Data Analysis / Predictive Models



Introduction to Numerics and Optimization







Individual Projects

- simulating neuron firing together and developing patterns
- simulating molecular dynamics of chiral proteins to learn group behaviors
- simulating/animating ant colonies
- N-body simulator to study evaporation of star clusters
- study of pattern formation in reaction-diffusion equations
- simulating a "turbidostat" - a lab tool for growing bacteria and studying mutations
- study of data set compression for machine learning models
- game theory simulation to find stable population behaviors
- study of stable/unstable balances between predator/prey interactions on a graph

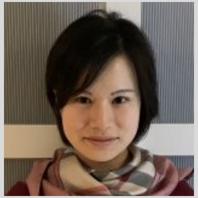

QUESTIONS
ANSWERS

Following: Individual Presentations

Gasper Tkacik

Theoretical Biophysics and Neuroscience

Bingqing Cheng



Computational Materials Science

Marco Mondelli

Machine Learning at IST Austria

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Medical Genomics

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Atmosphere and Ocean Dynamics