# JuMP Developers Workshop

June 12-16, 2017. MIT MANAGEMENT SLOAN SCHOOL

## Speakers

**Chris Coey**, MIT • **Carleton Coffrin**, LANL • **Steven Diamond**, Stanford • **Joaquim Dias Garcia**, PSR & PUC-Rio • **Oscar Dowson**, U. of Auckland • **Joey Huchette**, MIT • **Jordan Jalving**, UW-Madison • **Benoît Legat**, UCL • **Miles Lubin**, MIT • **Yee Sian Ng**, MIT • **Jarrett Revels**, MIT • **Nestor Sepulveda**, MIT • **Bartolomeo Stellato**, U. of Oxford • **Juan Pablo Vielma**, MIT

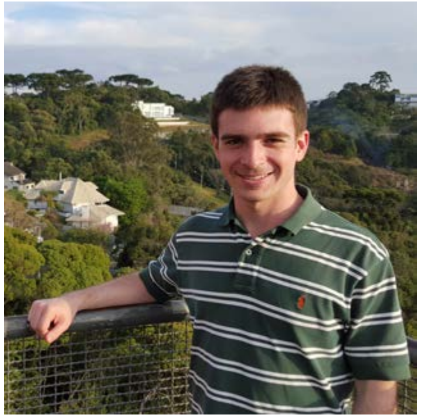
Sponsored by: MIT MANAGEMENT LATIN AMERICA OFFICE

**www.juliaopt.org/developersmeetup**

# Welcome and Thanks!

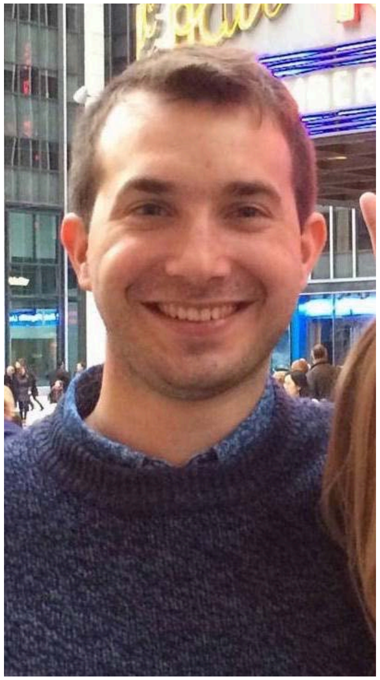
- Organizing committee:

Jennifer Challis



Miles Lubin

Chris Coey



Joey Huchette

# Welcome and Thanks!

- Sponsor:

MIT MANAGEMENT
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# Welcome and Thanks!

- Speakers (besides Chris, Joey and Miles):
  - Carleton Coffrin, Los Alamos National Lab
  - Steven Diamond, Stanford
  - Joaquim Dias Garcia, PSR-Inc. & PUC-Rio
  - Oscar Dowson, University of Auckland
  - Jordan Jalving, University of Wisconsin-Madison
  - Benoît Legat, Université Catholique de Louvain
  - Yee Sian Ng, MIT
  - Jarrett Revels, MIT
  - Nestor Sepulveda, MIT
  - Bartolomeo Stellato, University of Oxford

# Welcome and Thanks!

- Audience and Julia/JuMP community:

Julia and JuMP Tutorial at Universidad Adolfo Ibáñez, Santiago, Chile. January, 2014.


JuMP Developers Workshop. MIT Sloan, Cambridge, MA. June, 2017.

# (My) Quick Intro to

# JuMP & JuliaOpt

# 20th Century Optimization Modelling Languages

- User-friendly algebraic modelling languages (AML):

GAMS
AMPL

Standalone and Fast

PYOMO ⟷ python™
CVX RESEARCH ⟷ MATLAB®

Based on General Language and Versatile, but Slow

- Commercial and Open-Source C/C++ frameworks:

COIN|OR
SCIP
GUROBI OPTIMIZATION

Fast and Versatile, but complicated (and some proprietary)

# 21st Century Optimization Modelling Language

JuMP ⟷ julia

## Greedy Wish List:

- Modern, modular, easy to embed...
  - Within a simulation, interactive visualization, etc.
- Interact with solvers while they are running
- Easy to extend to specialized problem classes

# Large Software Stack and Vibrant Community

JuliaOpt

JuMP | Convex.jl

MathProgBase.jl

Cbc.jl | Clp.jl | CPLEX.jl

ECOS.jl | GLPK.jl | Gurobi.jl

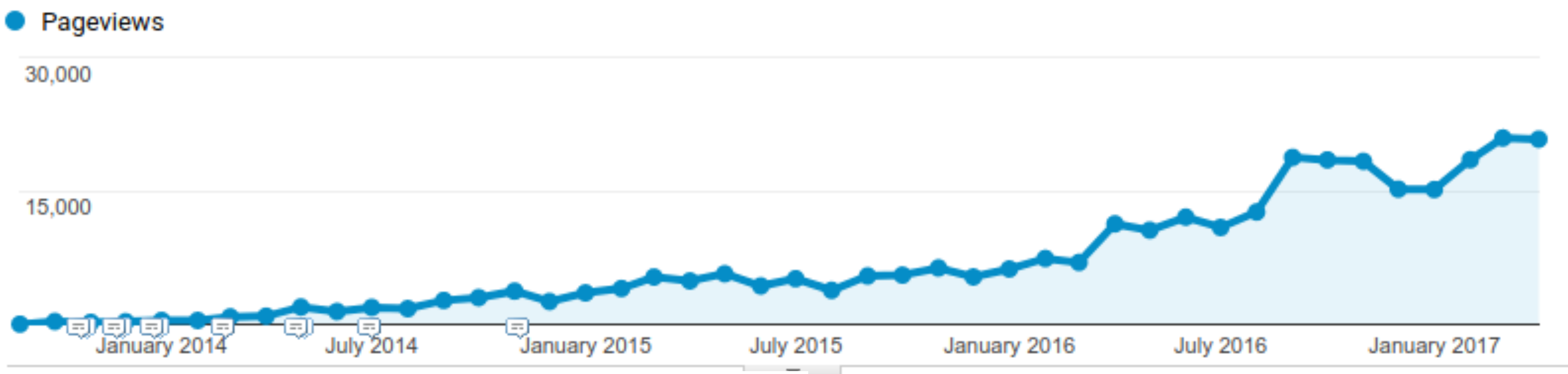
Ipopt.jl | KNITRO.jl | Mosek.jl

NLopt.jl | SCS.jl



# Sustained Growth and Some Miles Stones

- **Version 0.2**: Solver callbacks (December, 2013)
- **Version 0.5**: Nonlinear optimization (May, 2014)
- **Version 0.10**: Semidefinite optimization (August, 2015)
- **Version 0.12**: Rewrote nonlinear optimization (February, 2016)
- **Version 0.13**: Renamed everything from camelCase (April, 2016)
- **Version 0.15**: **sum{}** becomes **sum()** (December, 2016)




Hits to JuMP documentation

# JuliaOpt in University Courses

MIT

SAPIENZA
UNIVERSITÀ DI ROMA

Universidad
Carlos III de Madrid

Stanford University

THE
UNIVERSITY
OF IOWA

UCL
Université
catholique
de Louvain

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

UB
University at Buffalo
The State University of New York

USF
UNIVERSITY OF
SOUTH FLORIDA

USC University of
Southern California

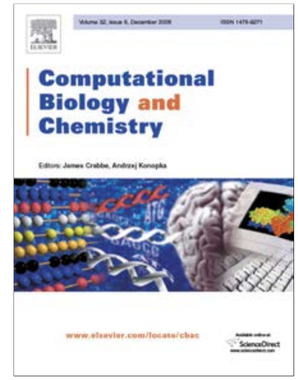
Université
de Liège
ULg

VCU
VIRGINIA COMMONWEALTH UNIVERSITY

# Serious Use of JuliaOpt

Optimal hybrid sequencing and assembly: Feasibility conditions for accurate genome reconstruction and cost minimization strategy

Chun-Chi Chen[a], Noushin Ghaffari[b], Xiaoning Qian[a], , Byung-Jun Yoon[a],
Show more





**Simultaneous identification of specifically interacting paralogs and interprotein contacts by direct coupling analysis**

Thomas Gueudré[a,1], Carlo Baldassi[a,b,1], Marco Zamparo[a], Martin Weigt[c,2], and Andrea Pagnani[a,b,2]

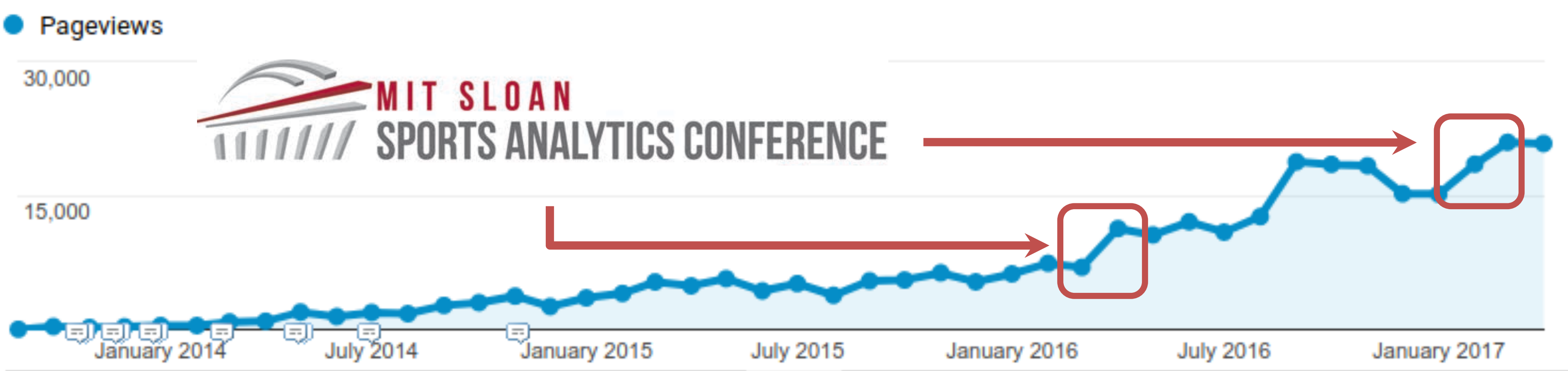
IOP Publishing Plasma Physics and Controlled Fusion
Plasma Phys. Control. Fusion 58 (2016) 045016 (16pp) doi:10.1088/0741-3335/58/4/045016

**Inversion methods for fast-ion velocity-space tomography in fusion plasmas**

A S Jacobsen[1], L Stagner[2], M Salewski[1], B Geiger[3], W W Heidbrink[2], S B Korsholm[1], F Leipold[1], S K Nielsen[1], J Rasmussen[1], M Stejner[1], H Thomsen[4], M Weiland[3] and the ASDEX Upgrade team[3]

# Not So Serious Use of JuliaOpt

**Picking Winners Using Integer Programming**
David Scott Hunter, Juan Pablo Vielma, Tauhid Zaman
**arXiv:1604.01455,**
**https://github.com/dscotthunter/Fantasy-Hockey-IP-Code**

# News

# 2016 ICS Prize for JuMP

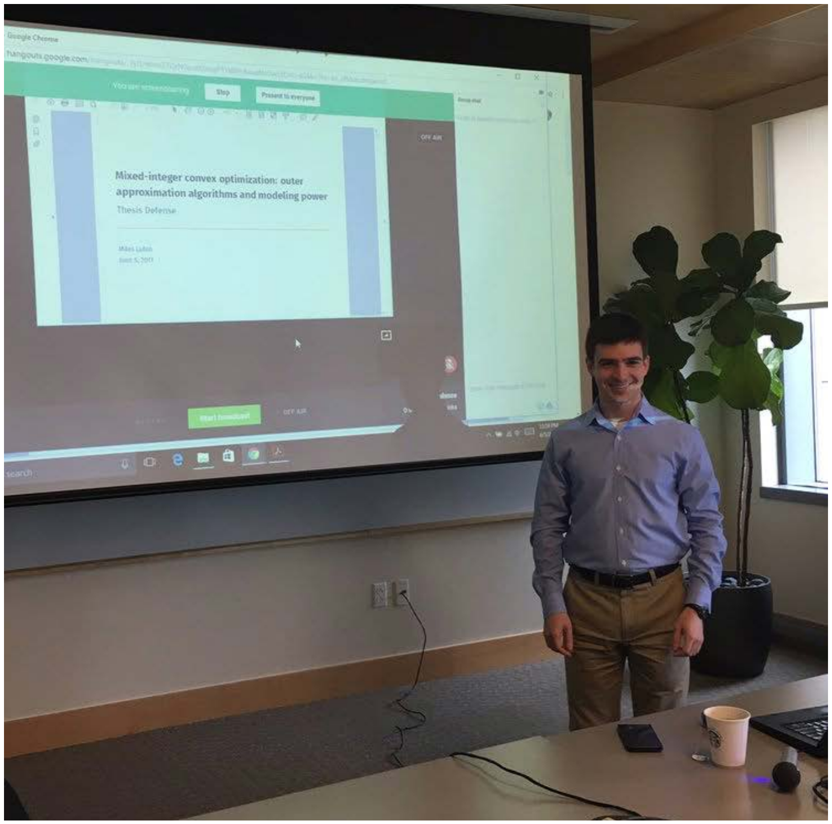

INFORMS COMPUTING

"JuMP's design leverages advanced features of the Julia language to offer distinctive functionality while achieving performance in instance creation often similar to commercial modeling tools."

- "Computing in operations research using Julia", M. Lubin, I. Dunning. INFORMS Journal on Computing 27 (2), 238-248.
- "JuMP: A modeling language for mathematical optimization", I. Dunning, J. Huchette, M. Lubin. SIAM Review 59 (2), 295-320

# Congratulations Dr. Lubin!

http://youtu.be/Vifryc-Iqao




**Mixed-integer convex optimization: outer approximation algorithms and modeling power**

by

Miles Lubin

B.S., The University of Chicago (2011)
M.S., The University of Chicago (2011)

Submitted to the Sloan School of Management
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2017

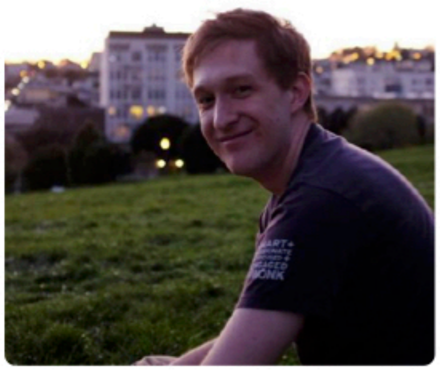


OPERATIONS RESEARCH CENTER → Google Research

# Welcome Jarrett!

JuMP “Sponsored Research Technical Staff”

Overview | Repositories 22 | Stars 29 | Followers 53 | Following 21



**Jarrett Revels**
jrevels

Follow

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MIT
Cambridge, MA
jarrettrevels@gmail.com

Pinned repositories

**JuliaDiff/ReverseDiff.jl**
Reverse Mode Automatic Differentiation for Julia
Julia ★ 41 12

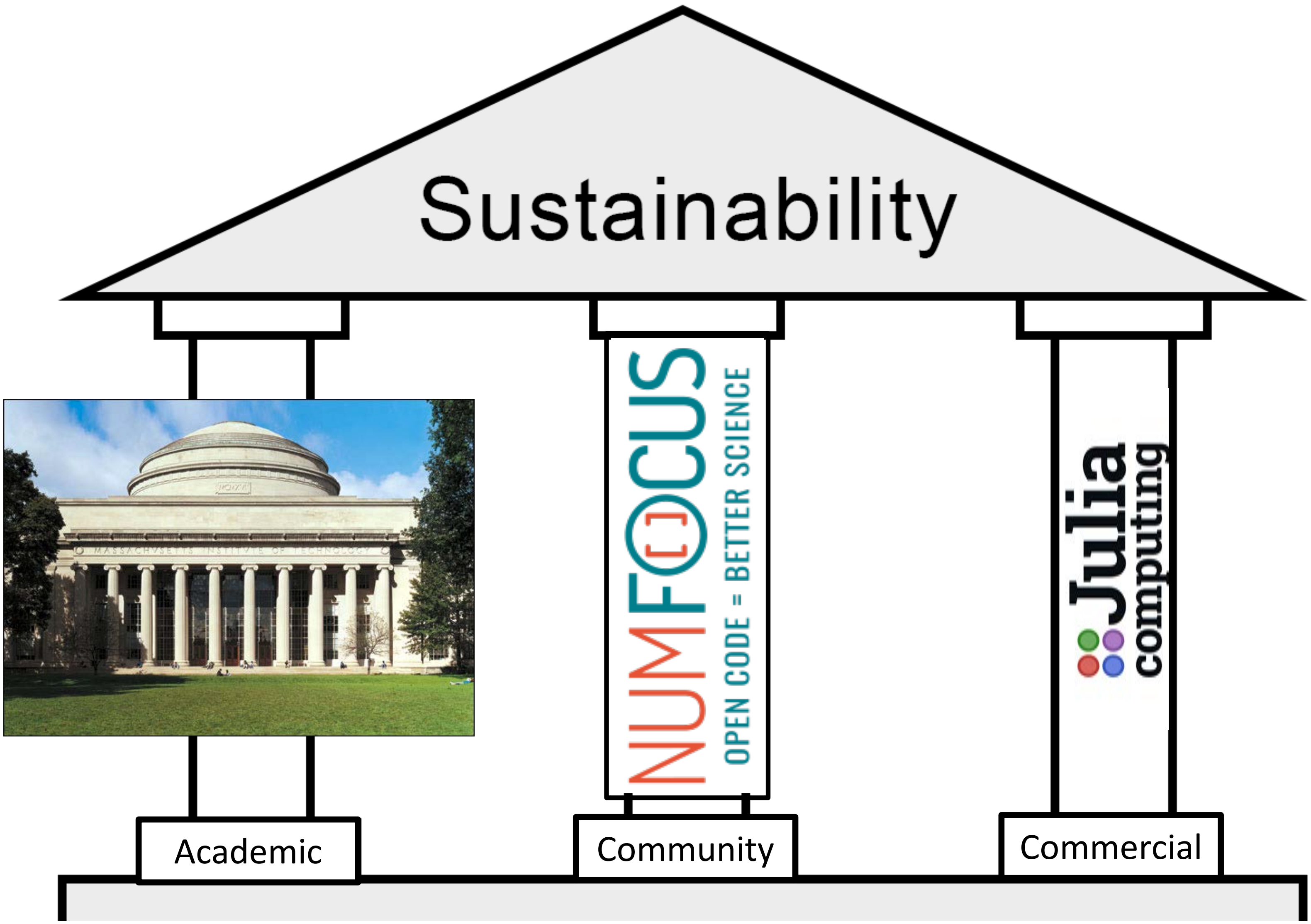
**JuliaDiff/ForwardDiff.jl**
Forward Mode Automatic Differentiation for Julia
Julia ★ 109 32

**JuliaCI/BenchmarkTools.jl**
A benchmarking framework for the Julia language
Julia ★ 59 8

**JuliaCI/Nanosoldier.jl**
A package for running JuliaCI services on MIT's Nanosoldier cluster
Julia ★ 5 4

**JuliaWeb/GitHub.jl**
A Julia package for interfacing with GitHub
Julia ★ 47 25

# Sustainability Plan for JuMP (and Julia)




Remain (Primarily) Open-Source

# More JuMP in Latin America

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@J_P_Vielma

Santiago in August