THE ERDŐS INSTITUTE

Helping PhDs get jobs they love.
Helping you hire the PhDs you need.

# Academia to tech: A guided tour

## Invitations to industry

**Luis Serrano**
**Quantum artificial intelligence research scientist, Zapata Computing**

ZAPATA

# Backstory

Bachelors in Math

Masters in Math

PhD in Math

Postdoctoral Fellowship in Math

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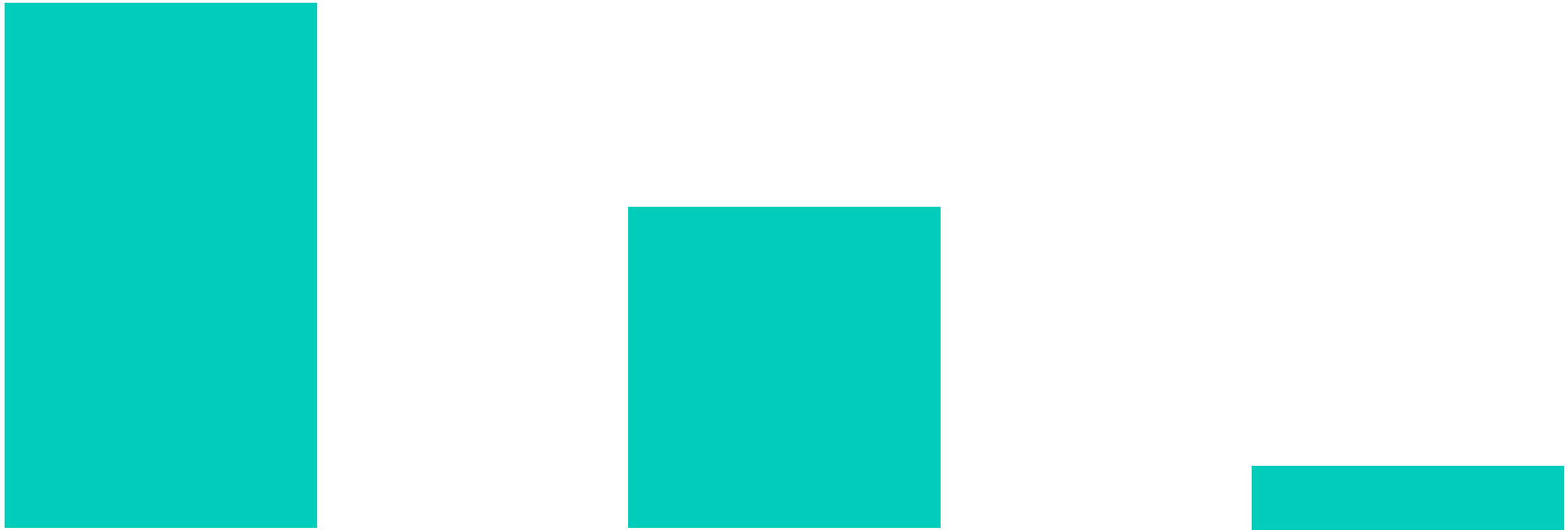
Software Engineer — Code/ML

Head of Artificial Intelligence Content

AI Educator — Teaching

Quantum AI Research Scientist — Research

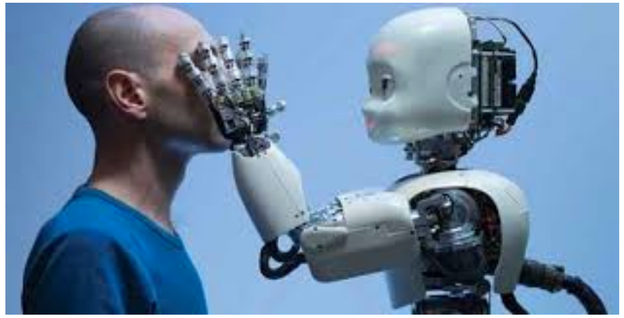
# Problem



# Options


Finance

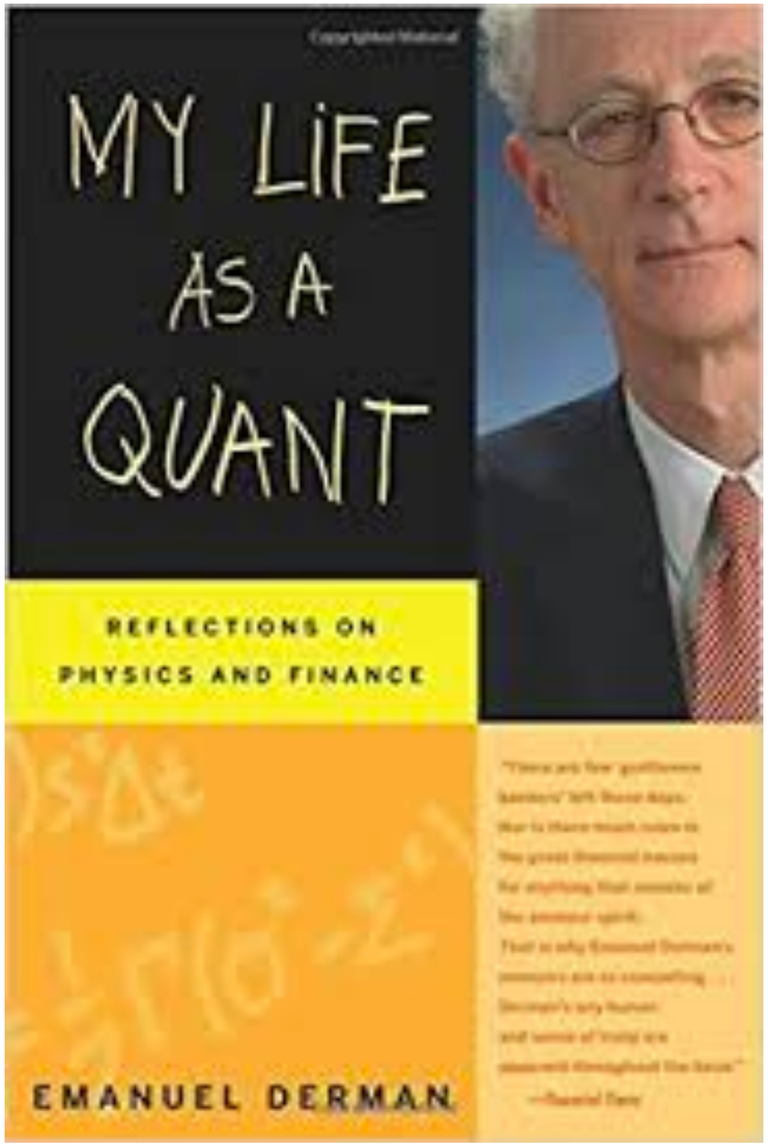
Consulting



Technology


# Finance

# Finance


MY LIFE AS A QUANT
REFLECTIONS ON PHYSICS AND FINANCE
EMANUEL DERMAN

# Finance

Trader

Quant

# Finance


# Finance

**Math questions**

153+83?

145-57?

**Probability questions**

I play the following game:

I roll a die. I can stick with that result, or roll again.

If I roll again, I have to stick with the second result.

What’s the strategy and the expected outcome?

# Things to know:

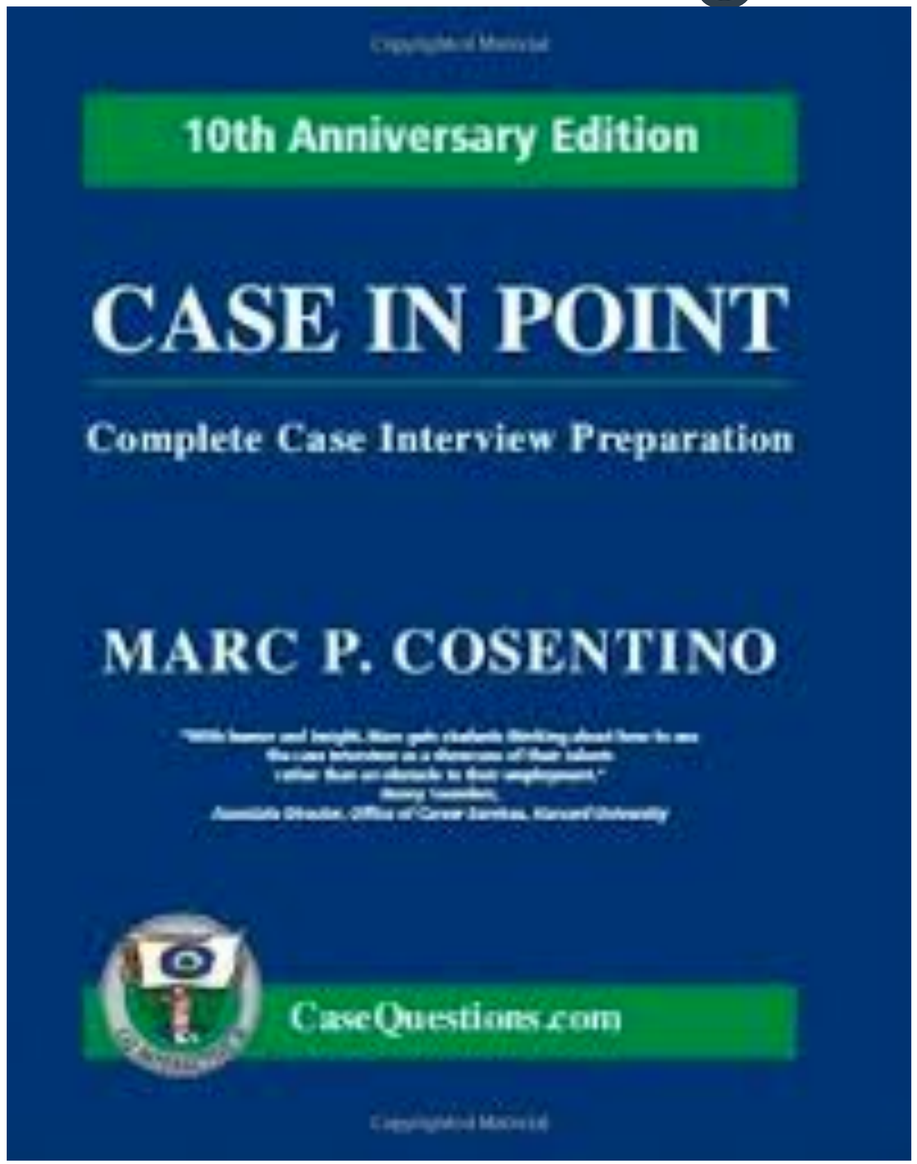
Probability (Bayes Theorem)

Programming (Python, C++)

Machine learning

# Consulting

# Consulting


10th Anniversary Edition
CASE IN POINT
Complete Case Interview Preparation
MARC P. COSENTINO
CaseQuestions.com

# Consulting

McKinsey&Company

BCG
THE BOSTON CONSULTING GROUP

BAIN

Bain

# Consulting

## Human Question

- convinced someone/a group of doing something they didn’t want to do
- achieved a goal you had set for yourself
- had to persuade a group
- deal with a crisis/difficult situation

## Case Question

- Industry Analysis
- Merger and Acquisitions
- Entering a New Market
- Pricing Strategies

# Practical Question

Entering a new market

- You work for the CEO of a dog food company.
- There are three types of dog food: premium, medium, and basic
- The company does very well on premium and medium
- They want to enter the market for the basic dog food
- Design their strategy

- Don’t cannibalize on your other markets (i.e., lowering price)
- Small calculations: Estimate how many people buy dog food in US

# Things to know:

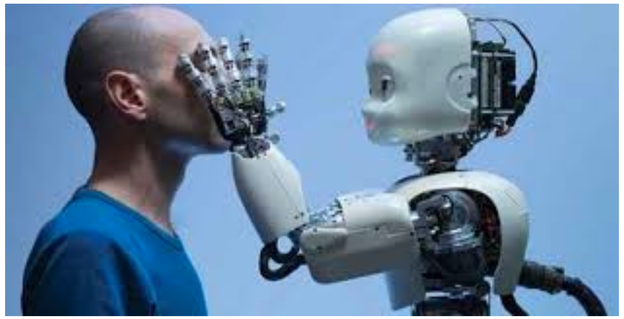
Take one business course (online, etc.)

Try to have some real life experience

Internship

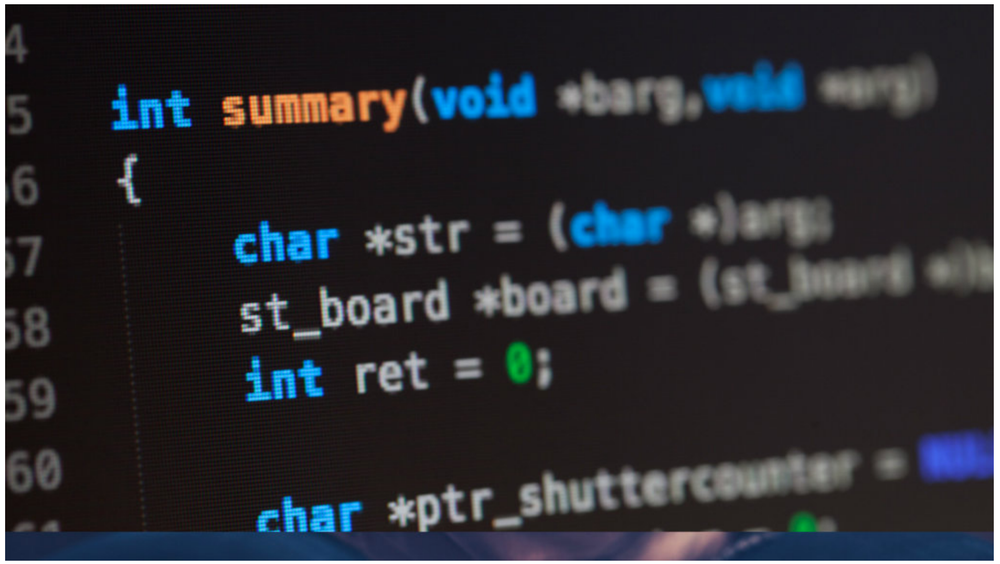
Volunteering

etc.

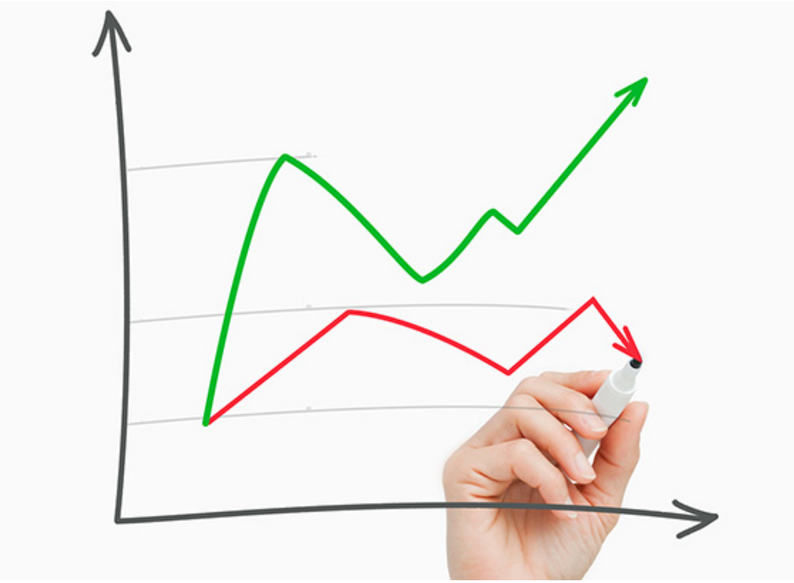


Technology

# Types of Tech Jobs

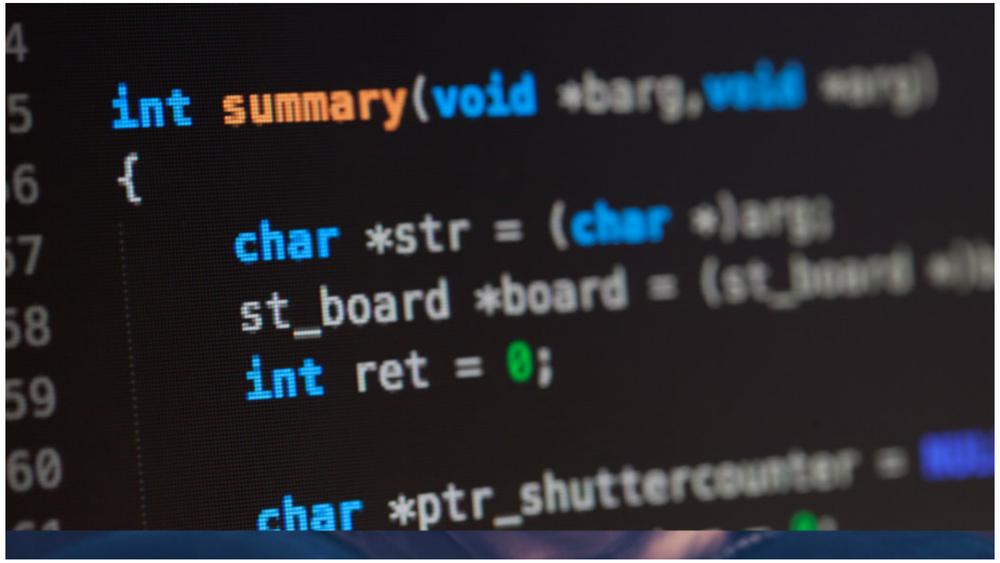



Software Engineer



Data Scientist

# Types of Tech Jobs




Software Engineer

# Mathematical Software


Python Course

- REFERRAL
- Technical Assessment
- Phone Interview
- On-site Interview

# Google Interview Question

Question:  Determine if two words are anagrams of each other
(e.g., stressed, desserts)

- Solve it the stupid way
- Write pseudocode
- Calculate complexity
- Make it faster
- (iterate if needed)
- Write code

# Google Interview Question

- Algorithms: Mergesort, Quicksort, BFS, DFS, …
- Data structures: Stack, Queue, Trees, Linked Lists, …
- Complexity: O(n), O(log(n)), …
- Fast at coding: Python
- Coding on the board

# Types of Tech Jobs

Data Scientist

# Data Science Interview

Can you code?

Can you do math?

Do you have data intuition?

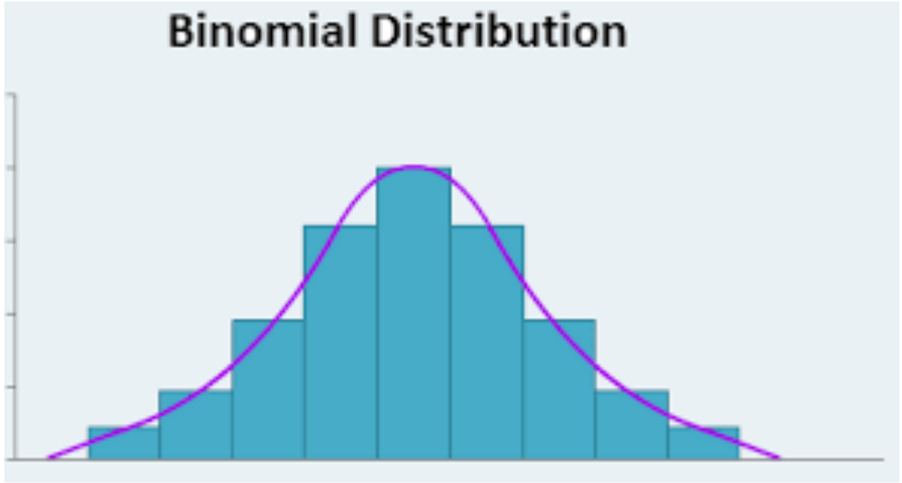
Machine Learning Knowledge

# Coding



# Can you do math?

You throw a coin 100 times
It lands heads 80 times
Do you think the coin is rigged?




Binomial Distribution
Approximate with Gaussian
Calculate p(≥ 80 heads)
If $p < 0.05$, then rigged

# Data intuition (management)

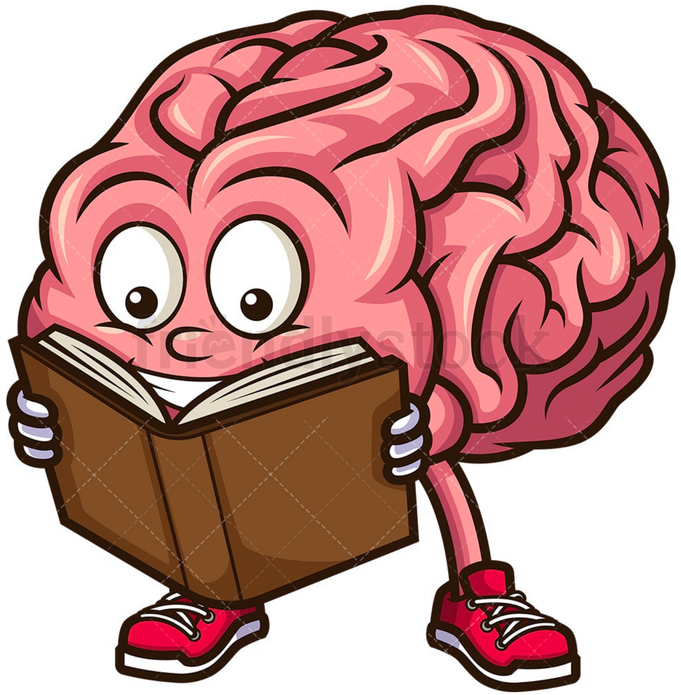
| | age | workclass | education_level | education-num | marital-status | occupation | relationship | race | sex | capital-gain | capital-loss | hours-per-week | native-country | income |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 39 | State-gov | Bachelors | 13.0 | Never-married | Adm-clerical | Not-in-family | White | Male | 2174.0 | 0.0 | 40.0 | United-States | <=50K |
| **1** | 50 | Self-emp-not-inc | Bachelors | 13.0 | Married-civ-spouse | Exec-managerial | Husband | White | Male | 0.0 | 0.0 | 13.0 | United-States | <=50K |
| **2** | 38 | Private | HS-grad | 9.0 | Divorced | Handlers-cleaners | Not-in-family | White | Male | 0.0 | 0.0 | 40.0 | United-States | <=50K |
| **3** | 53 | Private | 11th | 7.0 | Married-civ-spouse | Handlers-cleaners | Husband | Black | Male | 0.0 | 0.0 | 40.0 | United-States | <=50K |
| **4** | 28 | Private | Bachelors | 13.0 | Married-civ-spouse | Prof-specialty | Wife | Black | Female | 0.0 | 0.0 | 40.0 | Cuba | <=50K |
| **5** | 37 | Private | Masters | 14.0 | Married-civ-spouse | Exec-managerial | Wife | White | Female | 0.0 | 0.0 | 40.0 | United-States | <=50K |
| **6** | 49 | Private | 9th | 5.0 | Married-spouse-absent | Other-service | Not-in-family | Black | Female | 0.0 | 0.0 | 16.0 | Jamaica | <=50K |
| **7** | 52 | Self-emp-not-inc | HS-grad | 9.0 | Married-civ-spouse | Exec-managerial | Husband | White | Male | 0.0 | 0.0 | 45.0 | United-States | >50K |
| **8** | 31 | Private | Masters | 14.0 | Never-married | Prof-specialty | Not-in-family | White | Female | 14084.0 | 0.0 | 50.0 | United-States | >50K |
| **9** | 42 | Private | Bachelors | 13.0 | Married-civ-spouse | Exec-managerial | Husband | White | Male | 5178.0 | 0.0 | 40.0 | United-States | >50K |

- Filling empty data
- Scaling
- Feature selection
- Categorizing
- Transforms

# Machine Learning Knowledge

- A bunch of pretty algorithms (explain how one works)
- How would you use (improve) this algorithm in a sample data?
- Tell us about a project you've done before

# How to learn these skills?



# Online courses



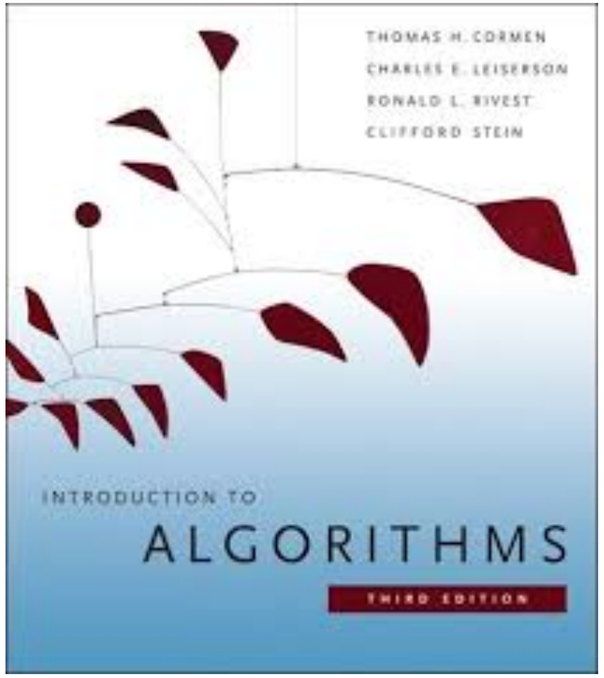


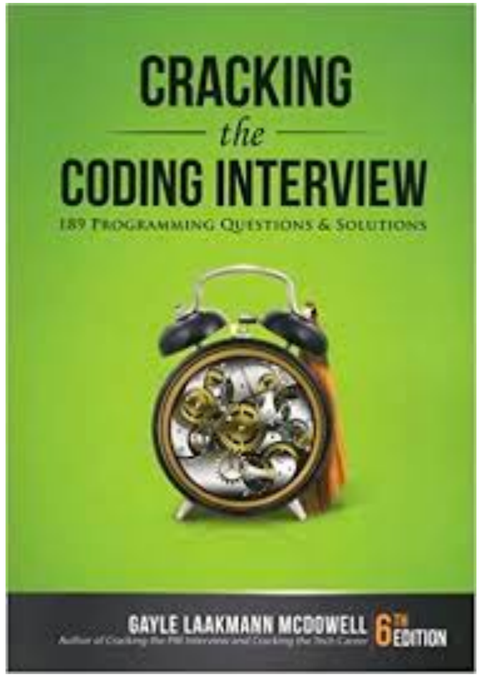






# Books


THOMAS H. CORMEN
CHARLES E. LEISERSON
RONALD L. RIVEST
CLIFFORD STEIN
INTRODUCTION TO
ALGORITHMS
THIRD EDITION


CRACKING
the
CODING INTERVIEW
189 Programming Questions & Solutions
GAYLE LAAKMANN MCDOWELL
6TH EDITION


grokking
Machine Learning
Luis G. Serrano
Foreword by Sebastian Thrun

# Best ways to practice

HackerRank

LeetCode

The Project Euler Sprint

WRITE CODE. DO MATH. MAKE FRIENDS.

# Project Euler

Project Euler.net

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## The millionth number with at least one million prime factors

**Problem 615**

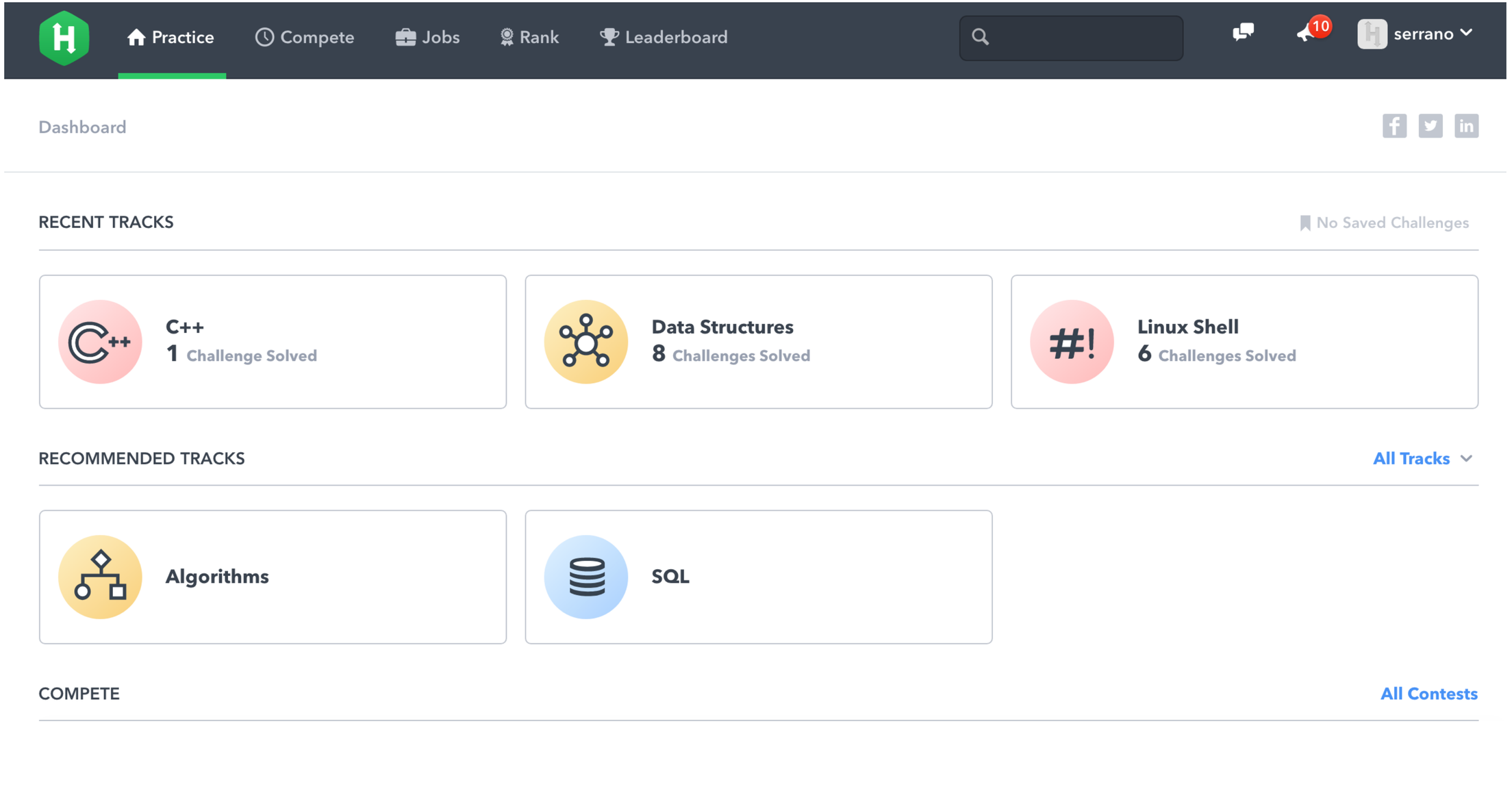
Consider the natural numbers having at least 5 prime factors, which don't have to be distinct.
Sorting these numbers by size gives a list which starts with:

32=2·2·2·2·2
48=2·2·2·2·3
64=2·2·2·2·2·2
72=2·2·2·3·3
80=2·2·2·2·5
96=2·2·2·2·2·3
...

So, for example, the fifth number with at least 5 prime factors is 80.

Find the millionth number with at least one million prime factors.
Give your answer modulo 123454321.

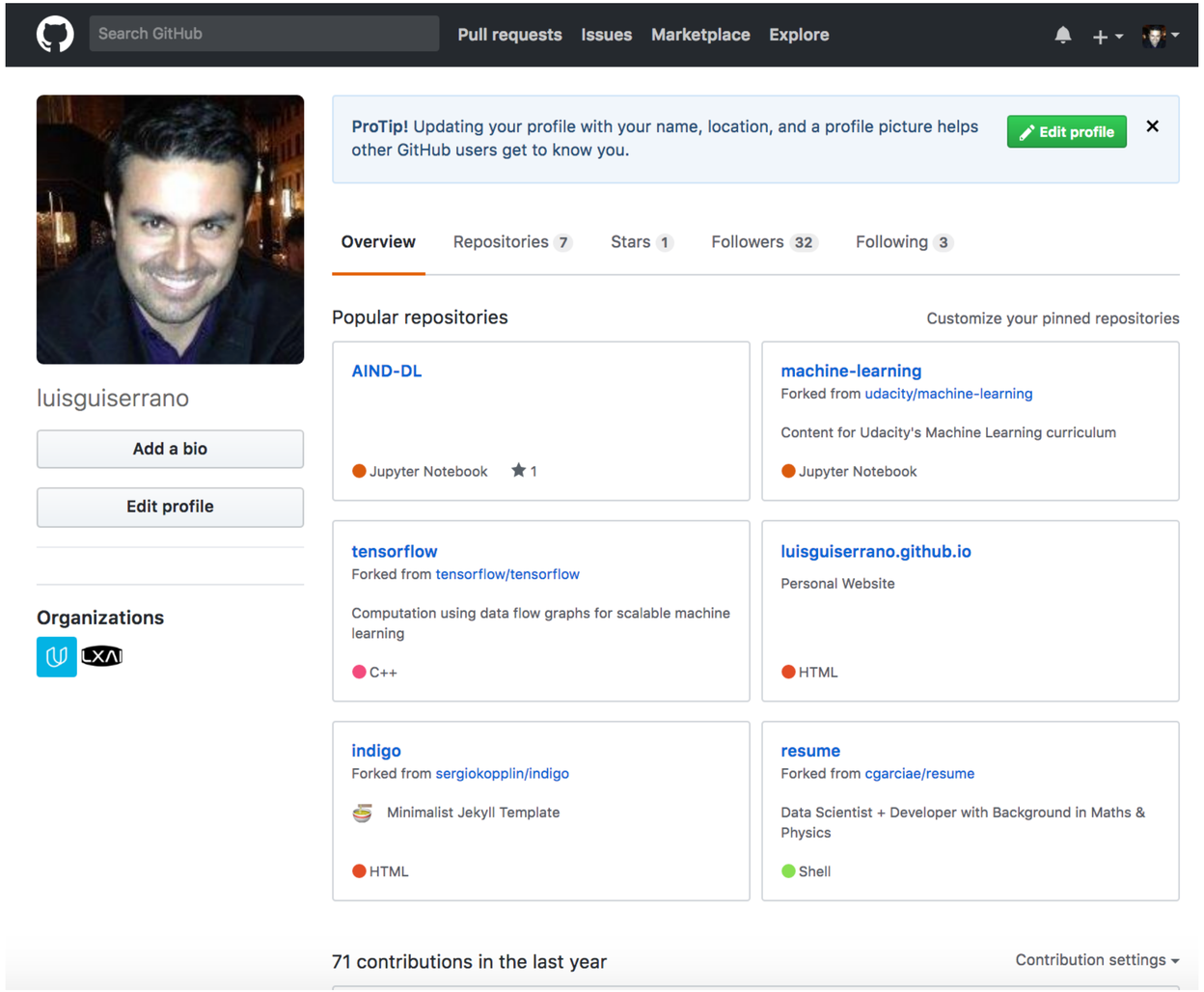
# hackerrank.com



# Bootcamps

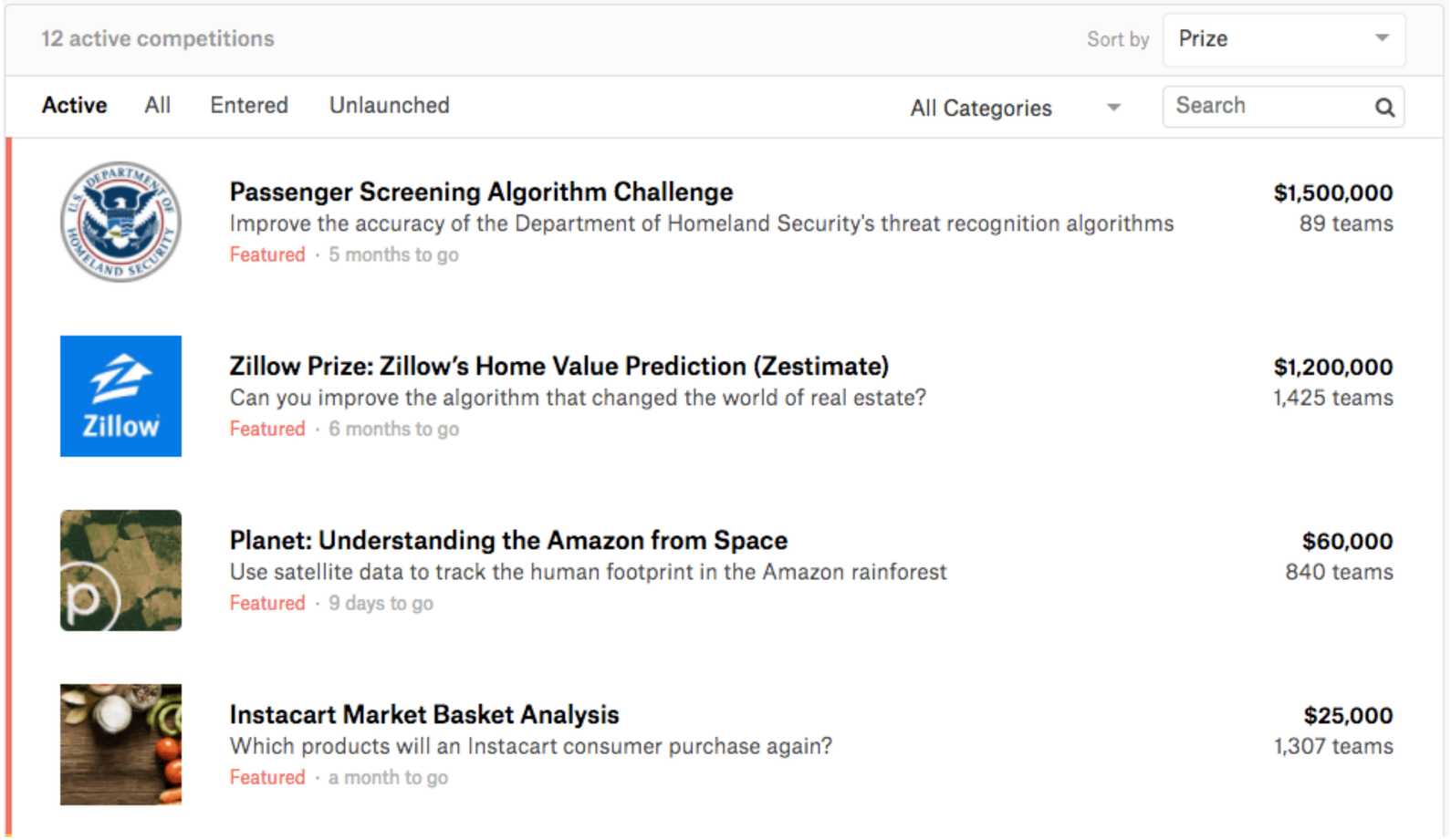

insightfellows.com

# Github is the new resume

# Kaggle Competitions

kaggle

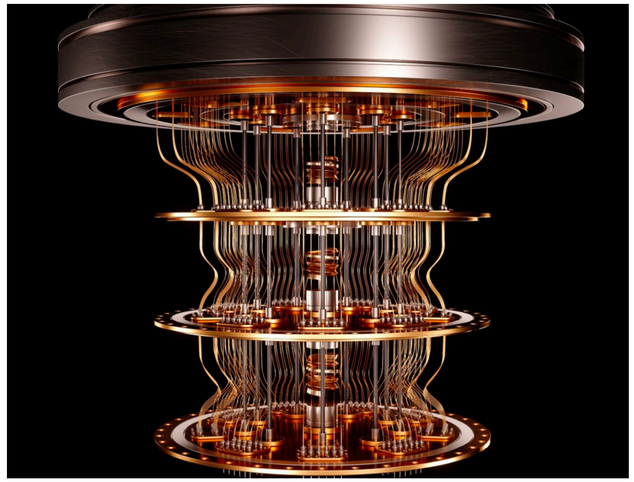


# General Questions

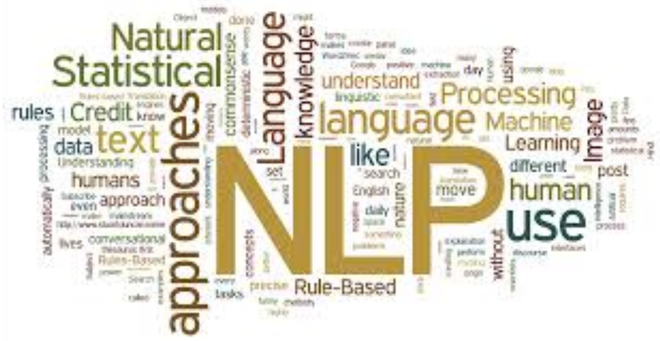
# Can I do research?

Computer Vision

Autonomous Systems
(Reinforcement learning)



Quantum computing
Quantum AI




Natural language Processing

# Can I teach?


UDACITY


coursera


edX

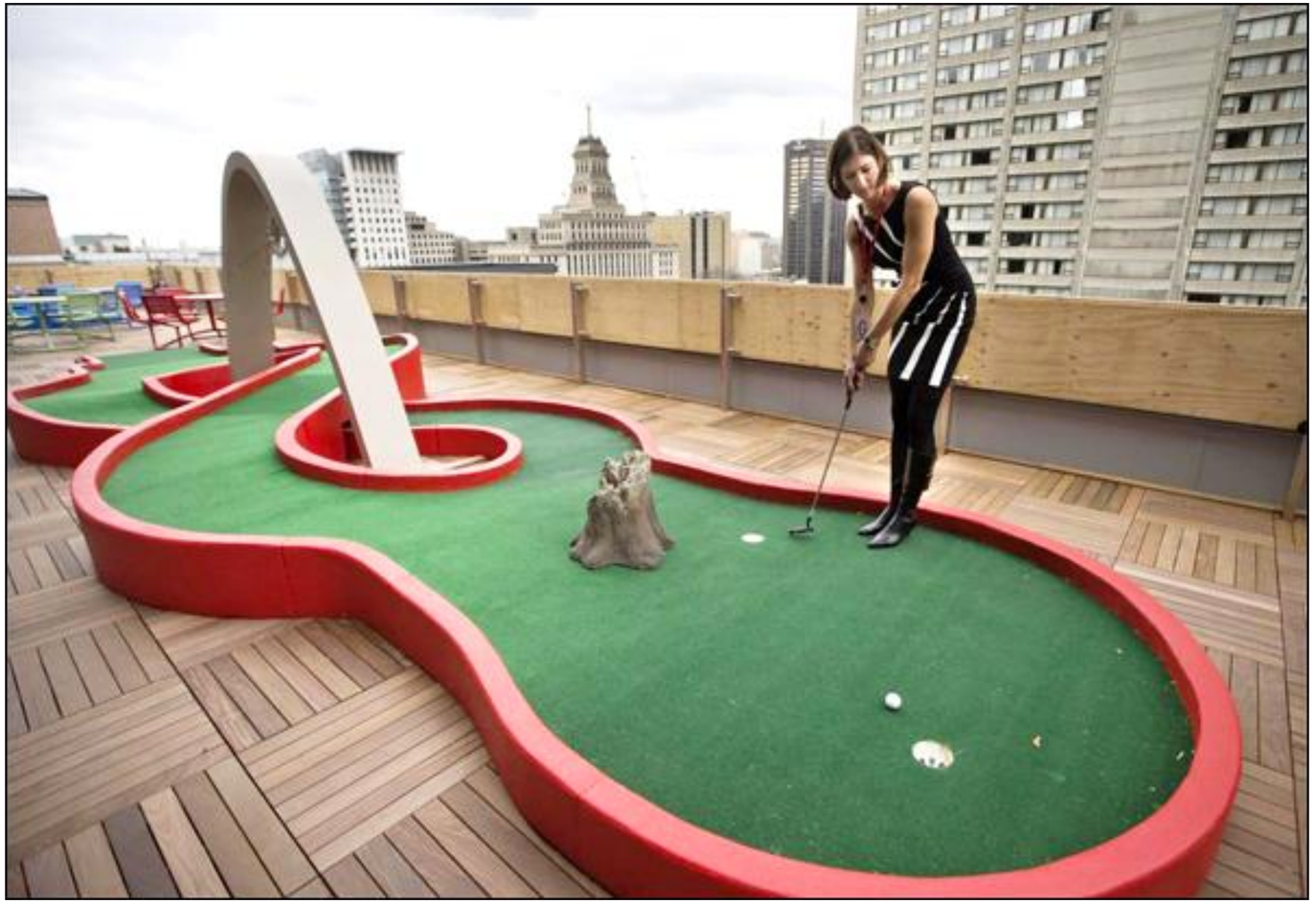

fast.ai


udemy


GA
GENERAL
ASSEMBLY


galvanize

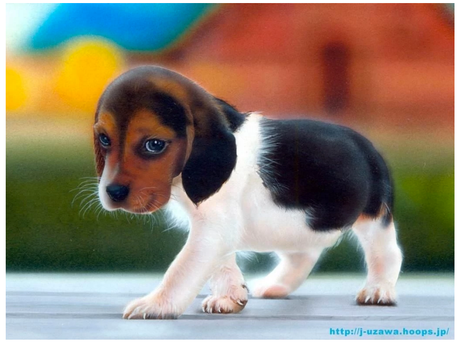
# Why did I leave Google?



# Types of Companies

Large companies → Small companies

Growth time (time to learn)

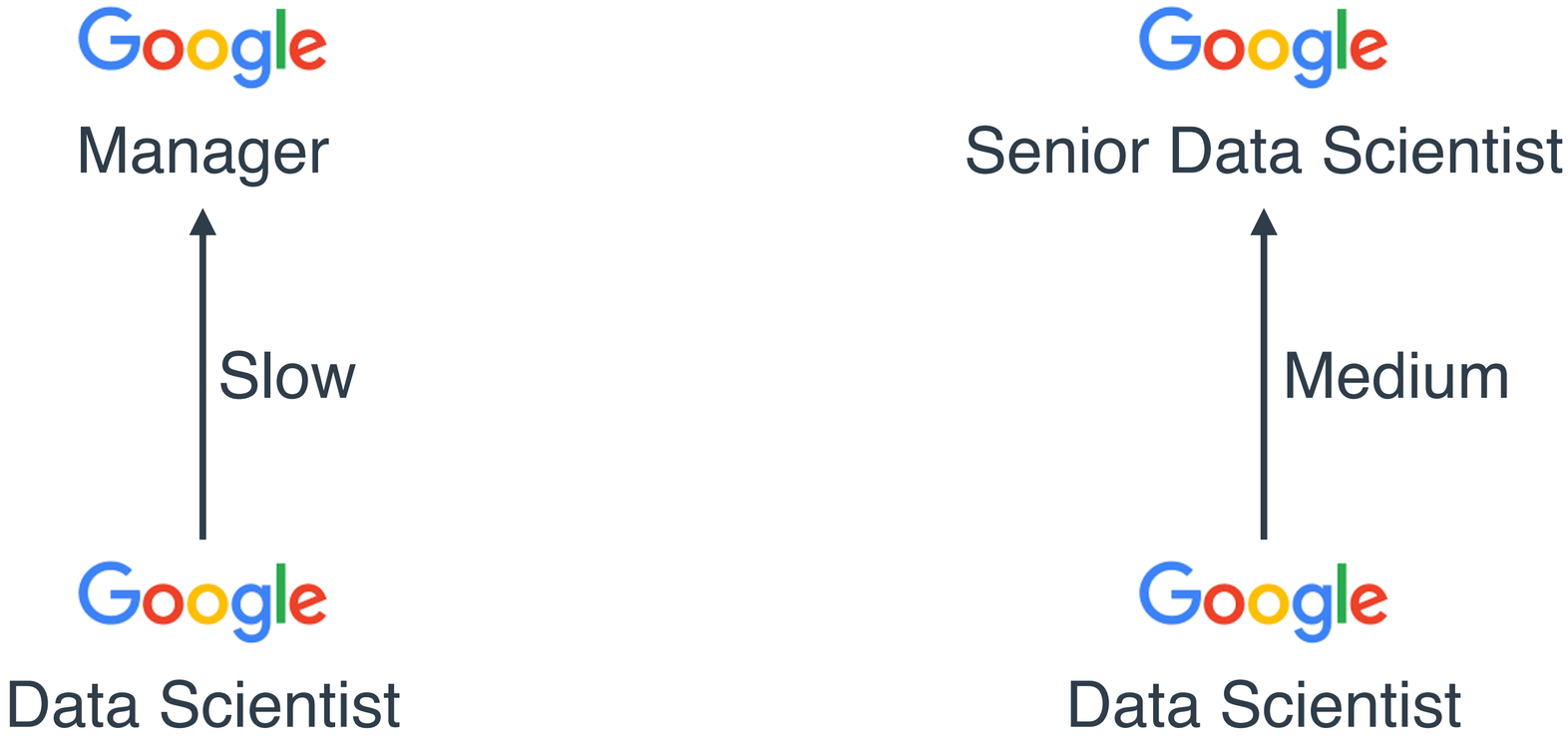



Need to start producing quickly


Less relevant

More relevant

# Growth in Industry



# Growth in Industry

Large companies

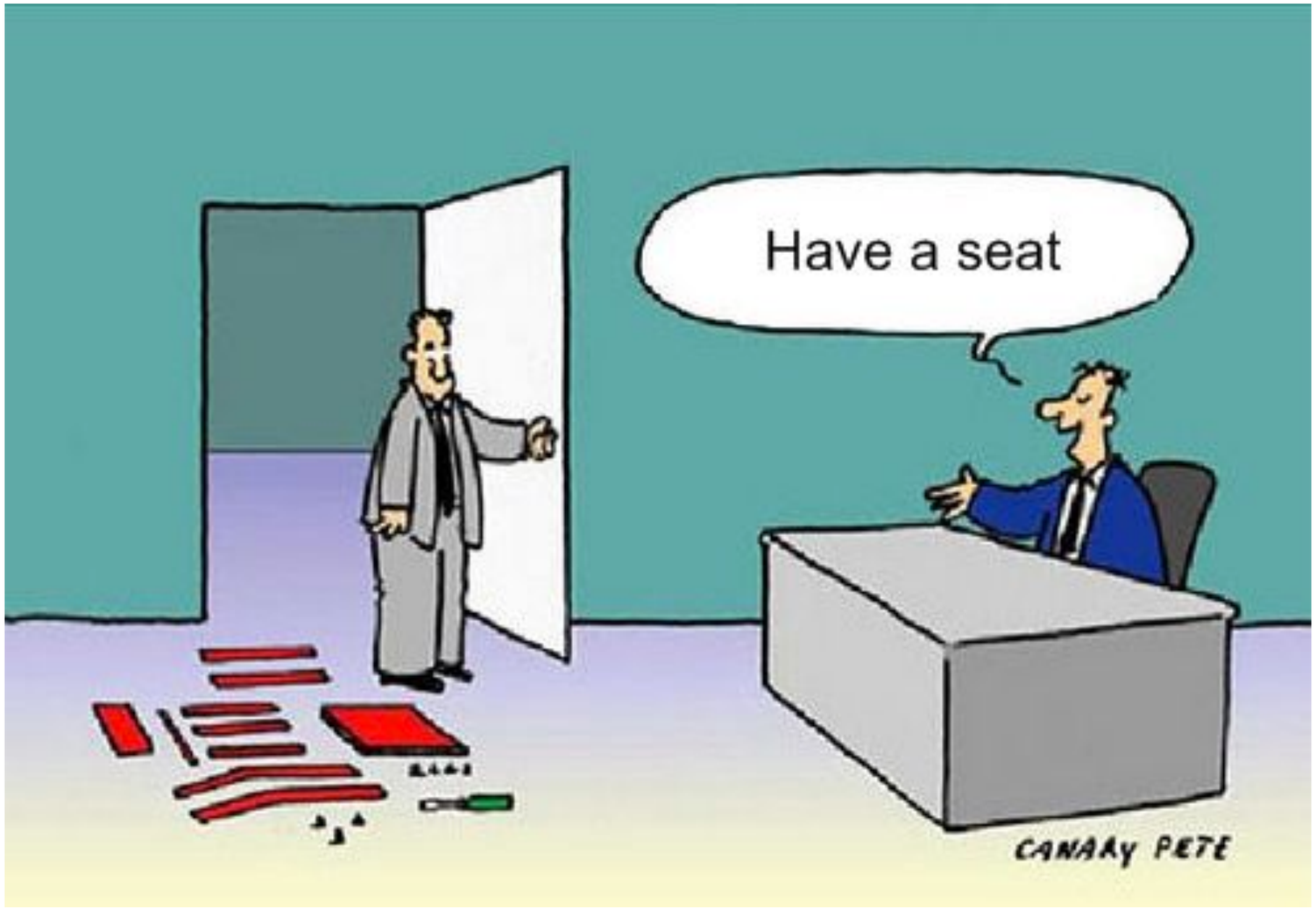
Small companies

Senior Data Scientist

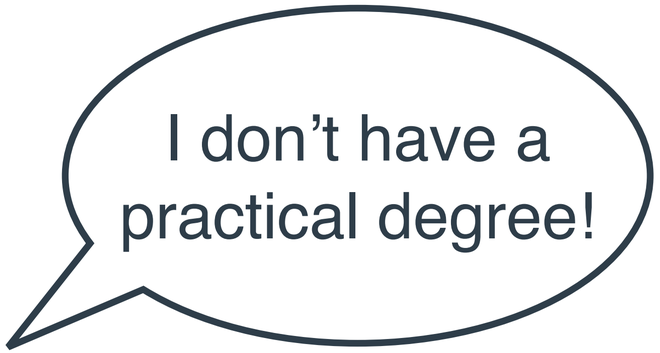
Senior Data Scientist

Data Scientist

# General Interviewing Advice



# General Applying Advice

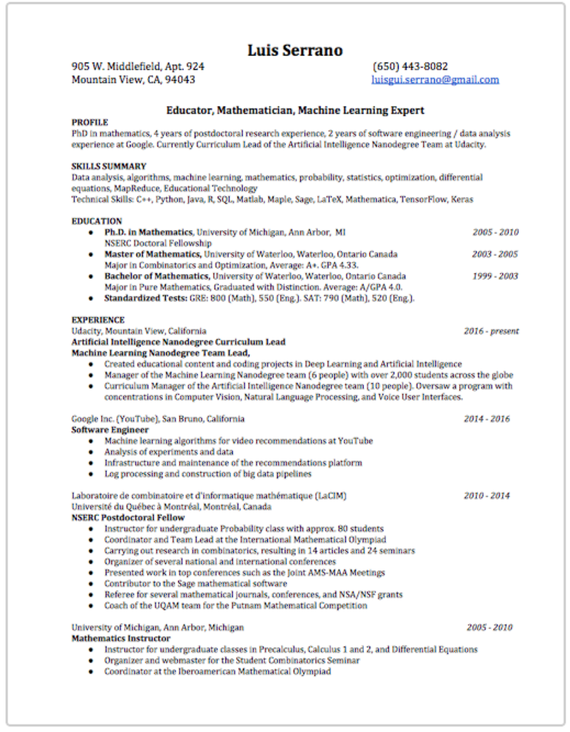



Math (or related) PhD
+
Knowledge

>

Some other degree

# Career Help (resume)



**Luis Serrano**

905 W. Middlefield, Apt. 924
Mountain View, CA, 94043

(650) 443-8082
luisgui.serrano@gmail.com

**Educator, Mathematician, Machine Learning Expert**

**PROFILE**
PhD in mathematics, 4 years of postdoctoral research experience, 2 years of software engineering / data analysis experience at Google. Currently Curriculum Lead of the Artificial Intelligence Nanodegree Team at Udacity.

**SKILLS SUMMARY**
Data analysis, algorithms, machine learning, mathematics, probability, statistics, optimization, differential equations, MapReduce, Educational Technology
Technical Skills: C++, Python, Java, R, SQL, Matlab, Maple, Sage, LaTeX, Mathematica, TensorFlow, Keras

**EDUCATION**

- **Ph.D. in Mathematics**, University of Michigan, Ann Arbor, MI — *2005 - 2010*
  NSERC Doctoral Fellowship
- **Master of Mathematics**, University of Waterloo, Waterloo, Ontario Canada — *2003 - 2005*
  Major in Combinatorics and Optimization, Average: A+. GPA 4.33.
- **Bachelor of Mathematics**, University of Waterloo, Waterloo, Ontario Canada — *1999 - 2003*
  Major in Pure Mathematics, Graduated with Distinction. Average: A/GPA 4.0.
- **Standardized Tests:** GRE: 800 (Math), 550 (Eng.). SAT: 790 (Math), 520 (Eng.).

**EXPERIENCE**

Udacity, Mountain View, California — *2016 - present*
**Artificial Intelligence Nanodegree Curriculum Lead**
**Machine Learning Nanodegree Team Lead,**

- Created educational content and coding projects in Deep Learning and Artificial Intelligence
- Manager of the Machine Learning Nanodegree team (6 people) with over 2,000 students across the globe
- Curriculum Manager of the Artificial Intelligence Nanodegree team (10 people). Oversaw a program with concentrations in Computer Vision, Natural Language Processing, and Voice User Interfaces.

Google Inc. (YouTube), San Bruno, California — *2014 - 2016*
**Software Engineer**

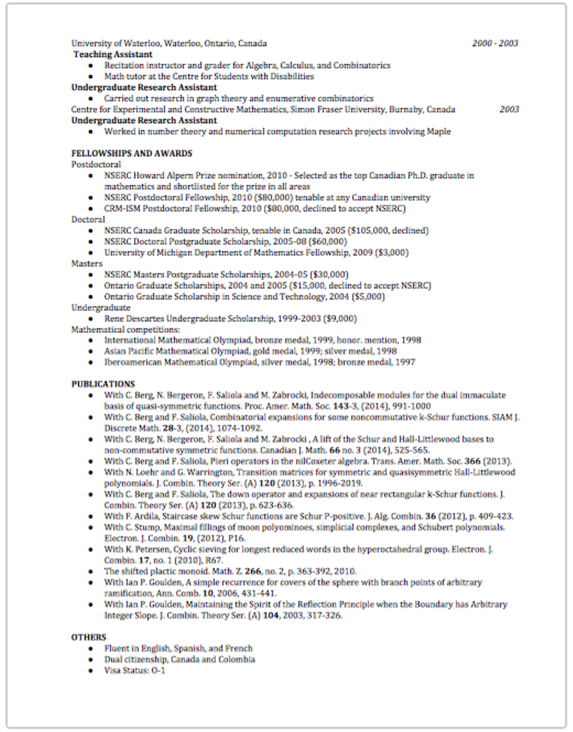
- Machine learning algorithms for video recommendations at YouTube
- Analysis of experiments and data
- Infrastructure and maintenance of the recommendations platform
- Log processing and construction of big data pipelines

Laboratoire de combinatoire et d'informatique mathématique (LaCIM) — *2010 - 2014*
Université du Québec à Montréal, Montréal, Canada
**NSERC Postdoctoral Fellow**

- Instructor for undergraduate Probability class with approx. 80 students
- Coordinator and Team Lead at the International Mathematical Olympiad
- Carrying out research in combinatorics, resulting in 14 articles and 24 seminars
- Organizer of several national and international conferences
- Presented work in top conferences such as the Joint AMS-MAA Meetings
- Contributor to the Sage mathematical software
- Referee for several mathematical journals, conferences, and NSA/NSF grants
- Coach of the UQAM team for the Putnam Mathematical Competition

University of Michigan, Ann Arbor, Michigan — *2005 - 2010*
**Mathematics Instructor**

- Instructor for undergraduate classes in Precalculus, Calculus 1 and 2, and Differential Equations
- Organizer and webmaster for the Student Combinatorics Seminar
- Coordinator at the Iberoamerican Mathematical Olympiad



University of Waterloo, Waterloo, Ontario, Canada — *2000 - 2003*
**Teaching Assistant**

- Recitation instructor and grader for Algebra, Calculus, and Combinatorics
- Math tutor at the Centre for Students with Disabilities

**Undergraduate Research Assistant**

- Carried out research in graph theory and enumerative combinatorics

Centre for Experimental and Constructive Mathematics, Simon Fraser University, Burnaby, Canada — *2003*
**Undergraduate Research Assistant**

- Worked in number theory and numerical computation research projects involving Maple

**FELLOWSHIPS AND AWARDS**
Postdoctoral

- NSERC Howard Alpern Prize nomination, 2010 - Selected as the top Canadian Ph.D. graduate in mathematics and shortlisted for the prize in all areas
- NSERC Postdoctoral Fellowship, 2010 ($80,000) tenable at any Canadian university
- CRM-ISM Postdoctoral Fellowship, 2010 ($80,000, declined to accept NSERC)

Doctoral

- NSERC Canada Graduate Scholarship, tenable in Canada, 2005 ($105,000, declined)
- NSERC Doctoral Postgraduate Scholarship, 2005-08 ($60,000)
- University of Michigan Department of Mathematics Fellowship, 2009 ($3,000)

Masters

- NSERC Masters Postgraduate Scholarships, 2004-05 ($30,000)
- Ontario Graduate Scholarships, 2004 and 2005 ($15,000, declined to accept NSERC)
- Ontario Graduate Scholarship in Science and Technology, 2004 ($5,000)

Undergraduate

- Rene Descartes Undergraduate Scholarship, 1999-2003 ($9,000)

Mathematical competitions:

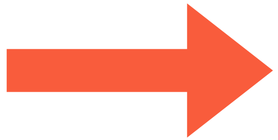
- International Mathematical Olympiad, bronze medal, 1999, honor. mention, 1998
- Asian Pacific Mathematical Olympiad, gold medal, 1999; silver medal, 1998
- Iberoamerican Mathematical Olympiad, silver medal, 1998; bronze medal, 1997

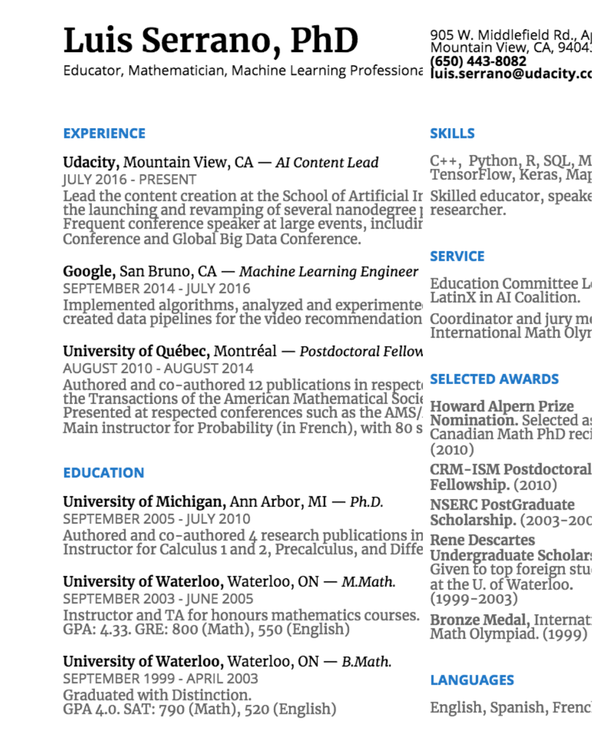
**PUBLICATIONS**

- With C. Berg, N. Bergeron, F. Saliola and M. Zabrocki, Indecomposable modules for the dual immaculate basis of quasi-symmetric functions. Proc. Amer. Math. Soc. **143**-3, (2014), 991-1000
- With C. Berg and F. Saliola, Combinatorial expansions for some noncommutative k-Schur functions. SIAM J. Discrete Math. **28**-3, (2014), 1074-1092.
- With C. Berg, N. Bergeron, F. Saliola and M. Zabrocki , A lift of the Schur and Hall-Littlewood bases to non-commutative symmetric functions. Canadian J. Math. **66** no. 3 (2014), 525-565.
- With C. Berg and F. Saliola, Pieri operators in the nilCoxeter algebra. Trans. Amer. Math. Soc. **366** (2013).
- With N. Loehr and G. Warrington, Transition matrices for symmetric and quasisymmetric Hall-Littlewood polynomials. J. Combin. Theory Ser. (A) **120** (2013), p. 1996-2019.
- With C. Berg and F. Saliola, The down operator and expansions of near rectangular k-Schur functions. J. Combin. Theory Ser. (A) **120** (2013), p. 623-636.
- With F. Ardila, Staircase skew Schur functions are Schur P-positive. J. Alg. Combin. **36** (2012), p. 409-423.
- With C. Stump, Maximal fillings of moon polyominoes, simplicial complexes, and Schubert polynomials. Electron. J. Combin. **19**, (2012), P16.
- With K. Petersen, Cyclic sieving for longest reduced words in the hyperoctahedral group. Electron. J. Combin. **17**, no. 1 (2010), R67.
- The shifted plactic monoid. Math. Z. **266**, no. 2, p. 363-392, 2010.
- With Ian P. Goulden, A simple recurrence for covers of the sphere with branch points of arbitrary ramification, Ann. Comb. **10**, 2006, 431-441.
- With Ian P. Goulden, Maintaining the Spirit of the Reflection Principle when the Boundary has Arbitrary Integer Slope. J. Combin. Theory Ser. (A) **104**, 2003, 317-326.

**OTHERS**

- Fluent in English, Spanish, and French
- Dual citizenship, Canada and Colombia
- Visa Status: O-1





**Luis Serrano, PhD**
Educator, Mathematician, Machine Learning Professiona

905 W. Middlefield Rd., A
Mountain View, CA, 9404
**(650) 443-8082**
**luis.serrano@udacity.c**

**EXPERIENCE**

**Udacity,** Mountain View, CA — *AI Content Lead*
JULY 2016 - PRESENT
Lead the content creation at the School of Artificial Ir
the launching and revamping of several nanodegree
Frequent conference speaker at large events, includir
Conference and Global Big Data Conference.

**Google,** San Bruno, CA — *Machine Learning Engineer*
SEPTEMBER 2014 - JULY 2016
Implemented algorithms, analyzed and experimente
created data pipelines for the video recommendation

**University of Québec,** Montréal — *Postdoctoral Fellow*
AUGUST 2010 - AUGUST 2014
Authored and co-authored 12 publications in respect
the Transactions of the American Mathematical Soci
Presented at respected conferences such as the AMS/
Main instructor for Probability (in French), with 80 s

**EDUCATION**

**University of Michigan,** Ann Arbor, MI — *Ph.D.*
SEPTEMBER 2005 - JULY 2010
Authored and co-authored 4 research publications in
Instructor for Calculus 1 and 2, Precalculus, and Diffe

**University of Waterloo,** Waterloo, ON — *M.Math.*
SEPTEMBER 2003 - JUNE 2005
Instructor and TA for honours mathematics courses.
GPA: 4.33. GRE: 800 (Math), 550 (English)

**University of Waterloo,** Waterloo, ON — *B.Math.*
SEPTEMBER 1999 - APRIL 2003
Graduated with Distinction.
GPA 4.0. SAT: 790 (Math), 520 (English)

**SKILLS**

C++, Python, R, SQL, M
TensorFlow, Keras, Map
Skilled educator, speake
researcher.

**SERVICE**

Education Committee L
LatinX in AI Coalition.
Coordinator and jury m
International Math Olyr

**SELECTED AWARDS**

**Howard Alpern Prize Nomination.** Selected a
Canadian Math PhD reci
(2010)
**CRM-ISM Postdoctoral Fellowship.** (2010)
**NSERC PostGraduate Scholarship.** (2003-20
**Rene Descartes Undergraduate Scholar**
Given to top foreign stu
at the U. of Waterloo.
(1999-2003)
**Bronze Medal,** Internat
Math Olympiad. (1999)

**LANGUAGES**

English, Spanish, Frenc

# General Interviewing Advice


You

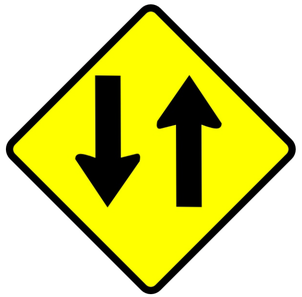
Interviewer

# General Interviewing Advice

You’re enjoying the interview ⟺ Your interviewer is enjoying the interview

The job is for you

# General Interviewing Advice



You are also interviewing the company
(ask good questions)

Interviewer is picturing working with you

# General advice

Learn lots of math aside from yours (diff eq, optimization, statistics)

Learn lots of non-math (programming, economics)

Look for places where you can get teamwork experience

Summer internships

Career Advice, Headhunters, etc.

# General advice

Interviewing is the best way to practice interviewing

Think about what is your passion

Share your knowledge (blog, videos, Github, etc)

Don’t stress!!!

# Probability that I don’t get an industry job

At a company: $p = 0.1$

N companies

Probability of not getting a job:

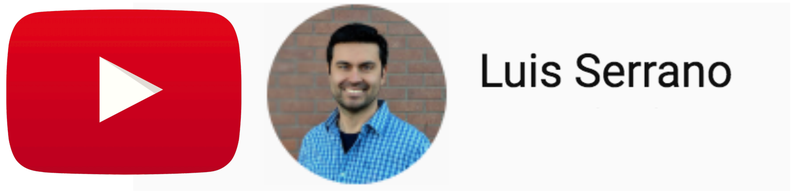
$$(1-p)^{N} \longrightarrow 0$$

□

# Advice for the undecided

Continue doing mathematics without pressure of one day not having a job.
Industry will always have a place for you if your mind (or situation) changes.

## YouTube Channel



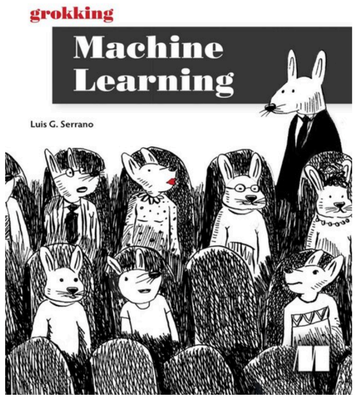

**youtube.com/c/LuisSerrano**

## @luis_likes_math

# Thank you!

luisgui.serrano@gmail.com

## Grokking Machine Learning




https://www.manning.com/books/grokking-machine-learning

40% code: serranopc

## serrano.academy

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