

AN ACCIDENTAL MATHEMATICIAN:
STORIES OF A JOURNEY THROUGH
STEM-LAND AS A MINORITY

JUAN C. MEZA
PROFESSOR, APPLIED MATHEMATICS
<https://juancmeza.com>

PROLOGUE

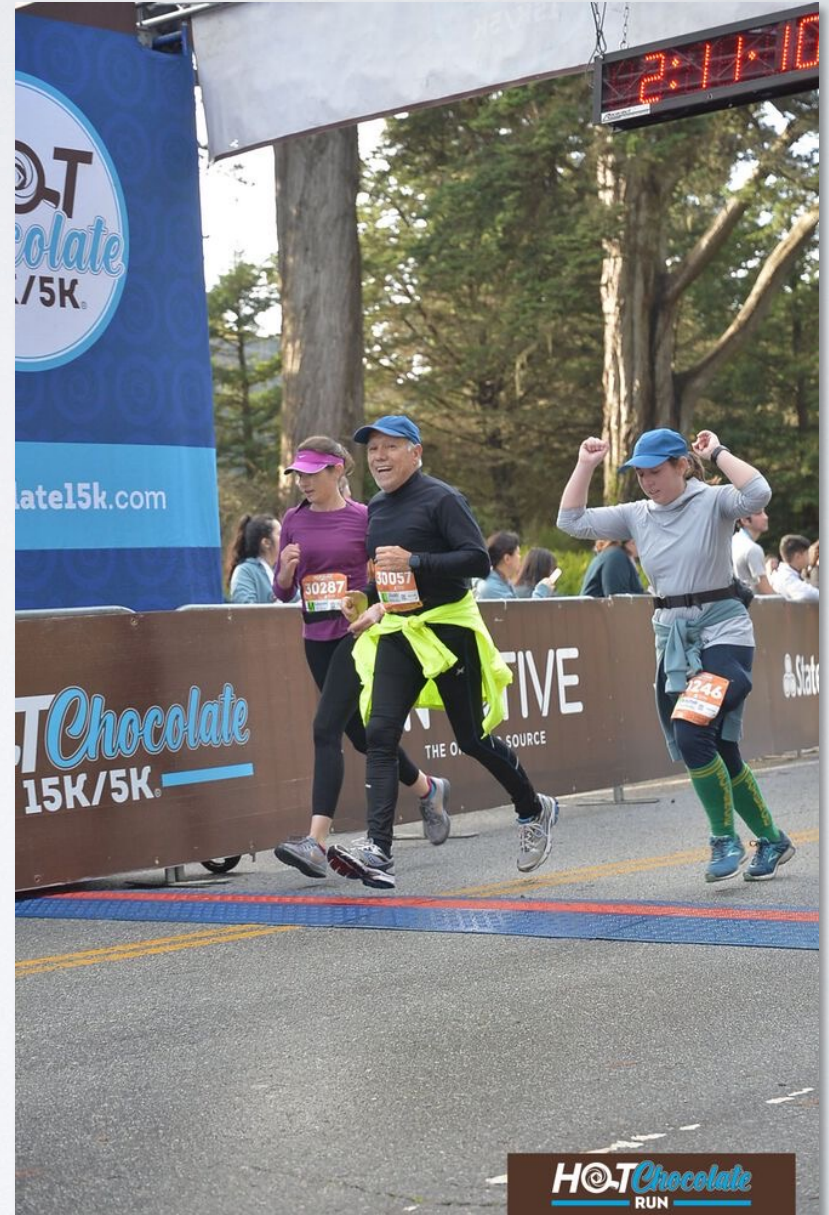
PAN COMIDO
(PIECE OF CAKE)

A LITTLE ABOUT ME

- BORN IN HOUSTON
- MOVED TO MEXICO WHEN I WAS 6
- RETURNED TO HOUSTON WHEN I WAS 9



ON THE MORE FUN SIDE



ACT I

SEEDS OF DOUBT

FACTORS ASSOCIATED WITH TEST SCORES

	FACTOR	YES	No
	HIGHLY EDUCATED PARENTS		X
	HIGH SOCIOECONOMIC STATUS		X
	MOTHER OVER 30 AT TIME OF 1 ST CHILD		X
	PARENTS SPEAK ENGLISH AT HOME		X
	NORMAL BIRTH WEIGHT	X	
	CHILD NOT ADOPTED	X	
	PARENTS INVOLVED IN PTA		X
	MANY BOOKS IN HOME		X

SO HOW EXACTLY DID I GET HERE?

- BY ALMOST ANY PREDICTIVE MEASURE I SHOULDN'T HAVE FINISHED COLLEGE
- MUCH LESS GOTTEN A PHD
- OR BE A PROFESSOR AT THE UNIVERSITY OF CALIFORNIA ...

COMBINATION OF SKILLS & FORTUNATE EVENTS

- STARTED WITH PARENTS
- HARD WORK
- COMMUNICATION SKILLS
- GREAT MENTORSHIP
- SOME LUCKY BREAKS



CARMEN MEZA

MILBY HIGH SCHOOL



FIRST BIG BREAK



- ADMITTED TO RICE – ONE OF TWO STUDENTS FROM MILBY
- STARTED IN ELECTRICAL ENGINEERING
- EVENTUALLY SWITCHED TO MATH IN GRADUATE SCHOOL

ANOTHER LUCKY BREAK

- AT THE HEIGHT OF THE APOLLO MISSION
- ALSO BEGINNINGS OF THE APOLLO-SOYUZ MISSIONS
- EYE-OPENING EXPERIENCE WITH INCREDIBLE RESOURCES AND HISTORY



SEEDS OF DOUBT CYCLE

- YOU'RE THE ONLY URM IN THE GROUP/DEPT/COMPANY
- YOU START TO FEEL THAT EVERYBODY IS WATCHING YOU
- DON'T TAKE **ANY** CHANCE THAT MIGHT LEAD TO FAILURE



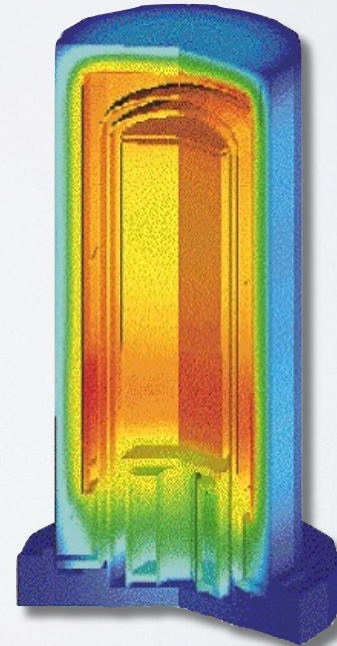
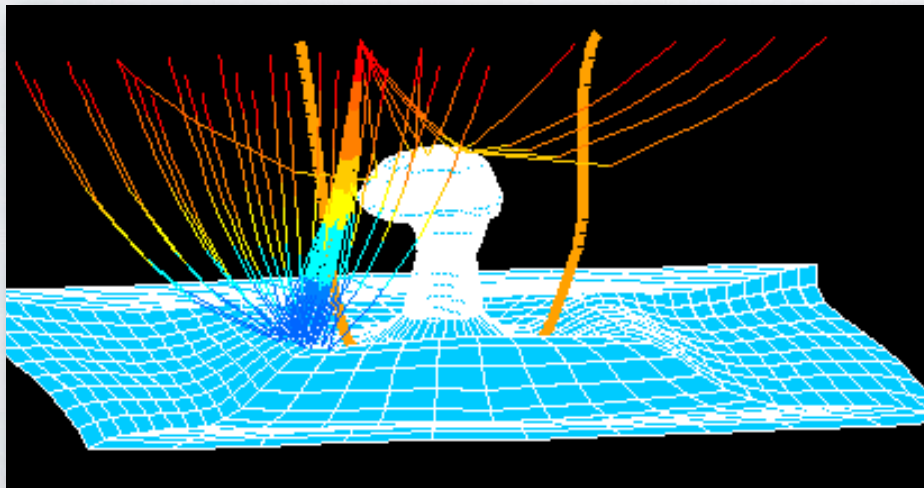
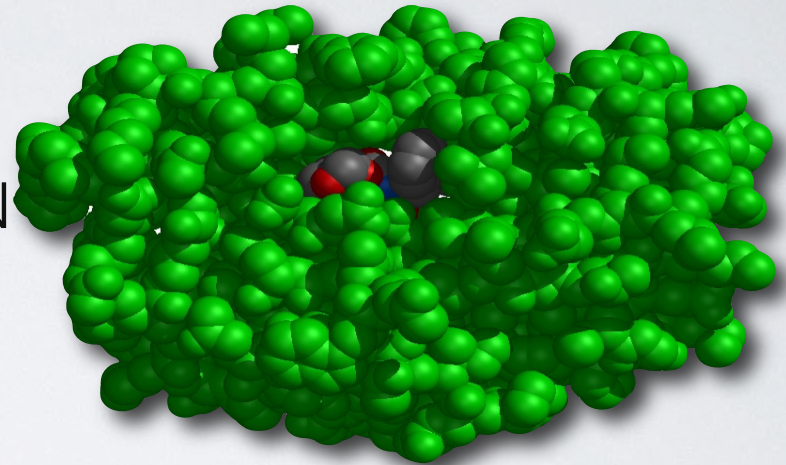
ACT II

THE REAL WORLD

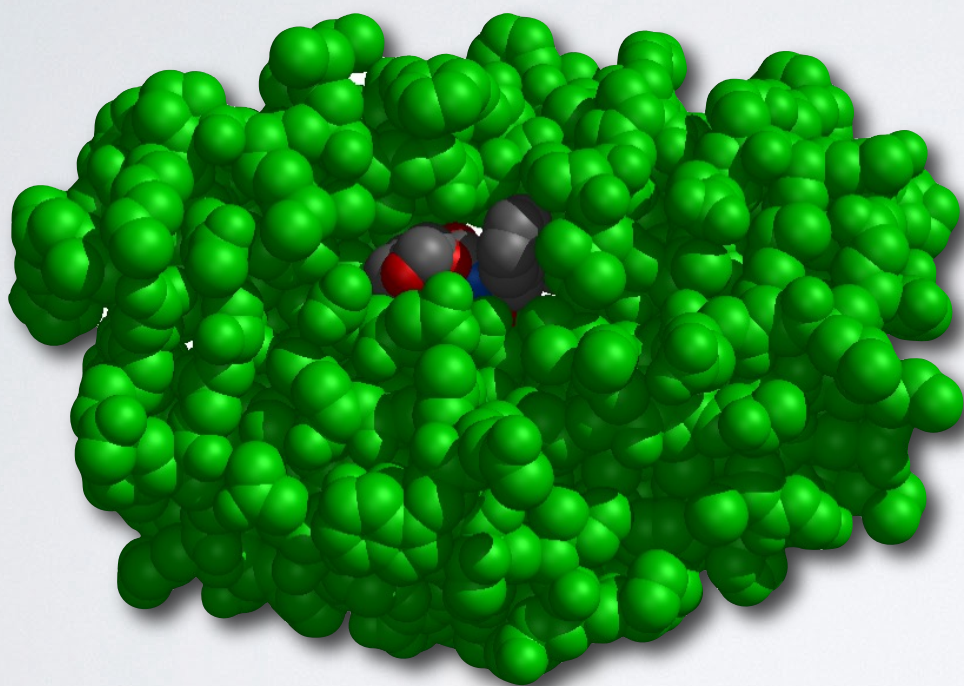
*IN THEORY THERE IS NO DIFFERENCE BETWEEN THEORY AND
PRACTICE — BUT IN PRACTICE THERE IS!*

LEARNING TO OPTIMIZE REAL-WORLD PROBLEMS

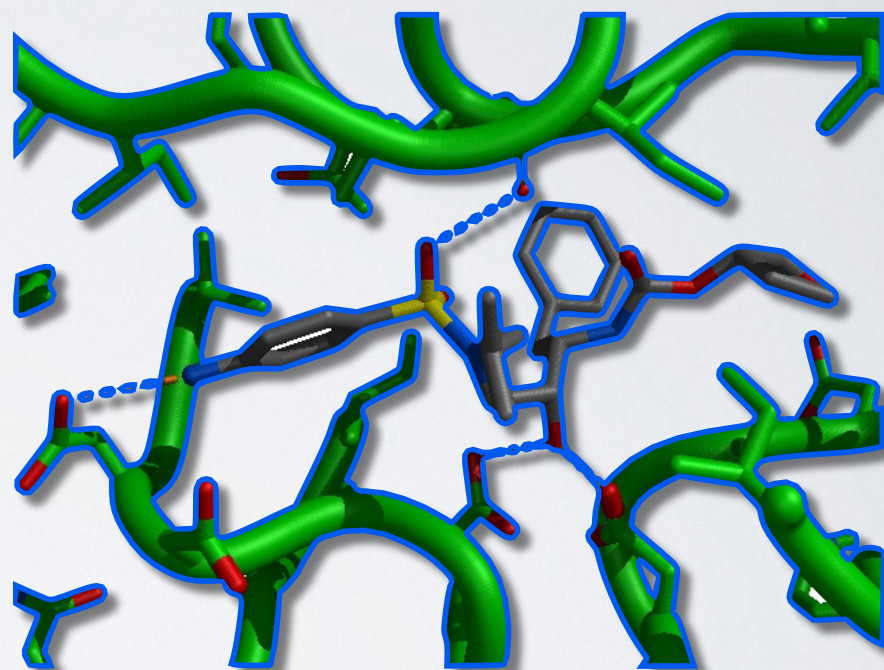
- RAY TRACING
- MOLECULAR CONFORMATION PROBLEMS
- CVD OPTIMIZATION



OPTIMIZATION METHODS CAN BE USED TO HELP IN DRUG DESIGN



DRUGS ARE TYPICALLY SMALL
MOLECULES THAT BIND TO AND
INHIBIT A TARGET RECEPTOR

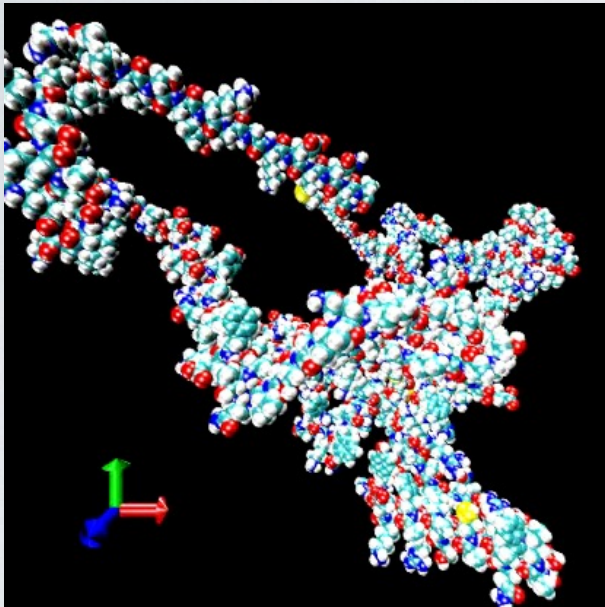


*HIV-1 Protease Complexed with
Vertex drug VX-478*

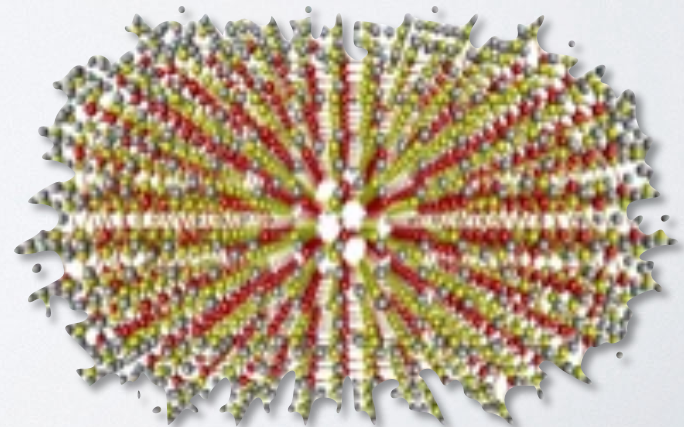
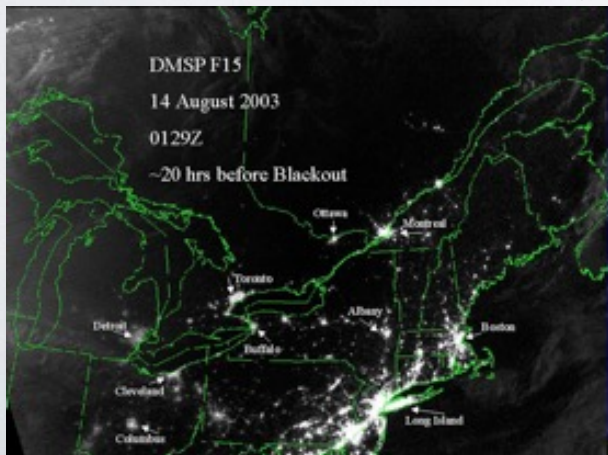
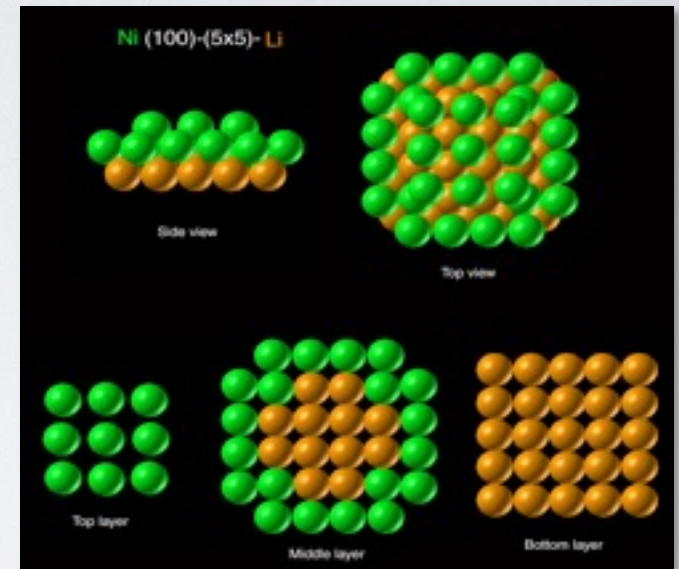
**MOVING TO BERKELEY:
2002-2008**

**TRADING IN MY TIE FOR SOME
BIRKENSTOCKS**

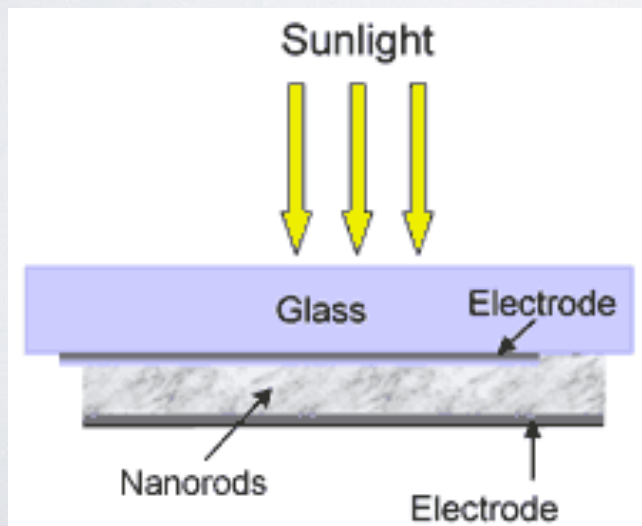
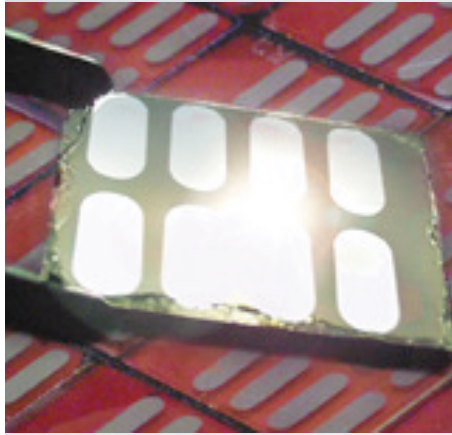
THE MOVE TO SCIENCE APPLICATIONS



- PROTEIN FOLDING
- NANOSTRUCTURE SURFACE DETERMINATIONS
- DETECTING VULNERABILITIES IN THE POWER GRID
- COMPUTING PROPERTIES OF NANOSTRUCTURES



PHOTOVOLTAIC SOLAR CELLS



- SOLAR CELLS BASED ON INORGANIC NANORODS AND SEMICONDUCTING POLYMERS
- NANORODS CAN BE MADE OF CdSe , A SEMICONDUCTING MATERIAL
- NANORODS ACT LIKE WIRES, ABSORBING LIGHT AND GENERATING HOLE-ELECTRON PAIRS
- BIGGEST CHALLENGE IS COST, ~ 30 CENTS/KWH

DENSITY FUNCTIONAL THEORY AND THE KOHN-SHAM EQUATIONS

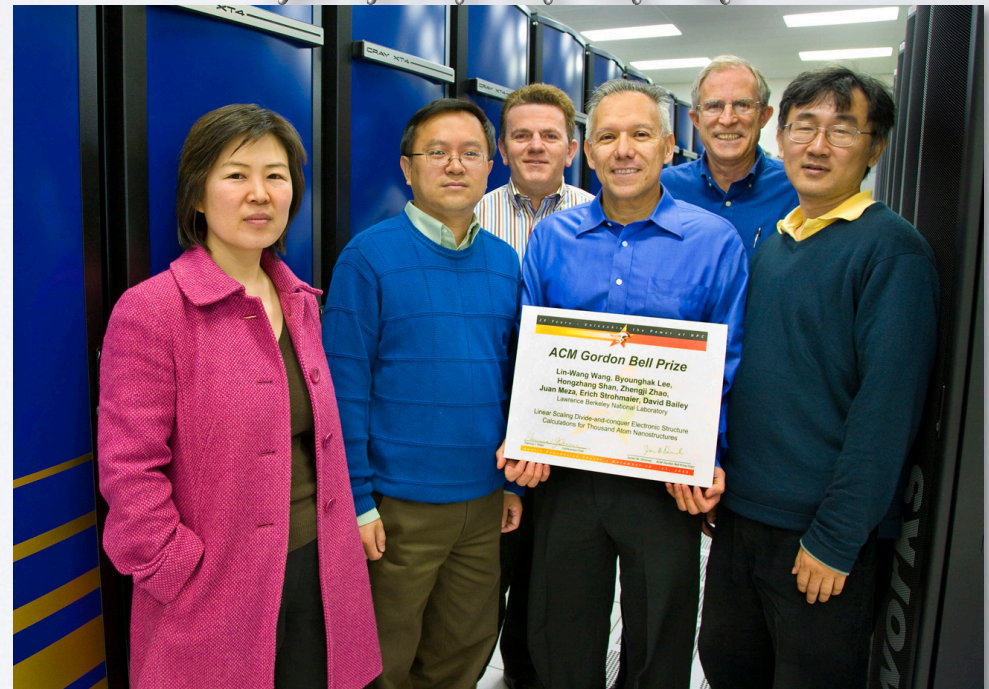
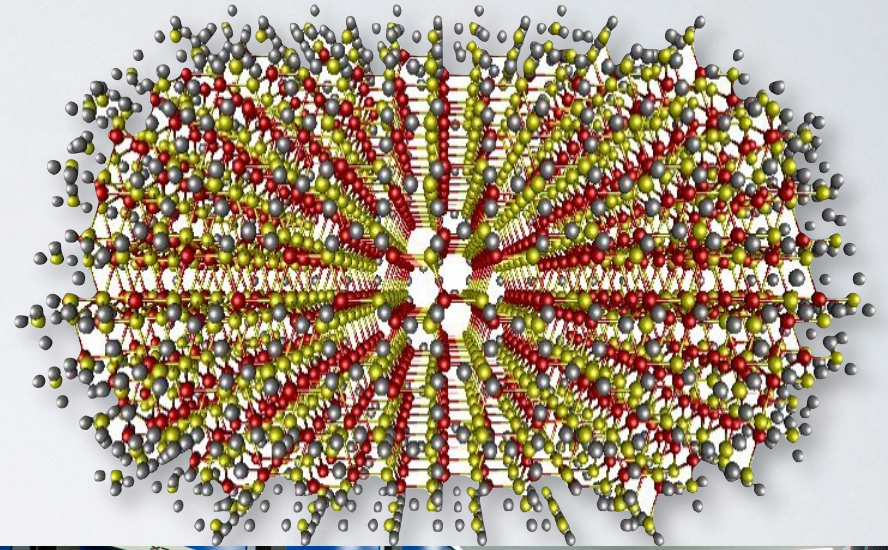
$$E_{total}[\{\psi_i\}] = \frac{1}{2} \sum_{i=1}^{n_e} \int_{\Omega} |\nabla \psi_i|^2 + \int_{\Omega} V_{ext} \rho$$
$$+ \frac{1}{2} \int_{\Omega} \frac{\rho(r)\rho(r')}{|r-r'|} dr dr' + E_{xc}(\rho),$$

$$\rho = \sum_{i=1}^{n_e} |\psi_i(r)|^2, \int_{\Omega} \psi_i \psi_j = \delta_{i,j}$$

$$\left[-\frac{1}{2} \nabla^2 + V_{ext}(r) + \int \frac{\rho}{|r-r'|} + V_{xc}(\rho) \right] \psi_i = \epsilon_i \psi_i$$

SUCCESS! DIPOLE MOMENT CALCULATION

- CALCULATED DIPOLE MOMENT OF A 2633 ATOM CDSE QUANTUM ROD, $\text{Cd}_{961}\text{Se}_{724}\text{H}_{948}$
- USING 2560 PROCESSORS AT NERSC THE CALCULATION TOOK ABOUT 30 HOURS
- LED TO ACM GORDON BELL AWARD FOR ALGORITHM INNOVATION 2008



FORGET THE AWARD - THIS IS WHAT COUNTS



ACT III

MOVING TO HIGHER ED:
THE (NOT SO) CHANGING LANDSCAPE

MOVED TO UC MERCED

- OPPORTUNITY TO LEAD THE SCHOOL OF NATURAL SCIENCES
- FIRST AMERICAN RESEARCH UNIVERSITY IN THE 21ST CENTURY
- LOCATED IN THE CENTRAL VALLEY OF CALIFORNIA WITH A HIGH NUMBER OF URM STUDENTS



THE CHANGING LANDSCAPE

California Latinos surpass whites in freshman UC admission offers



California high school seniors faced a tougher time winning a freshman spot at most of the UC campuses for the fall, with their chances at UCLA and UC Berkeley now fewer than one in five. UC Berkeley's Wheeler Hall is pictured. (Francine Orr / Los Angeles Times)

- 28.8% OF THOSE ADMITTED TO AT LEAST ONE UC CAMPUS WERE LATINO, COMPARED WITH 26.8% WHITE... BLACKS FROM CALIFORNIA WERE JUST 4.2%
- AT UCM 52.3% OF OUR UG STUDENTS ARE LATINO/A

OR IS IT?

UC STEM FACULTY FALL 2013

Area	African-American	Hispanic/Latino	White
Life Sciences	1.2	4.8	78.8
Physical Sciences	0.8	3.4	79.5
Math	0.3	2.2	67.6
Engr & CS	0.9	4.8	64.1

“PROGRESS” SINCE 2013

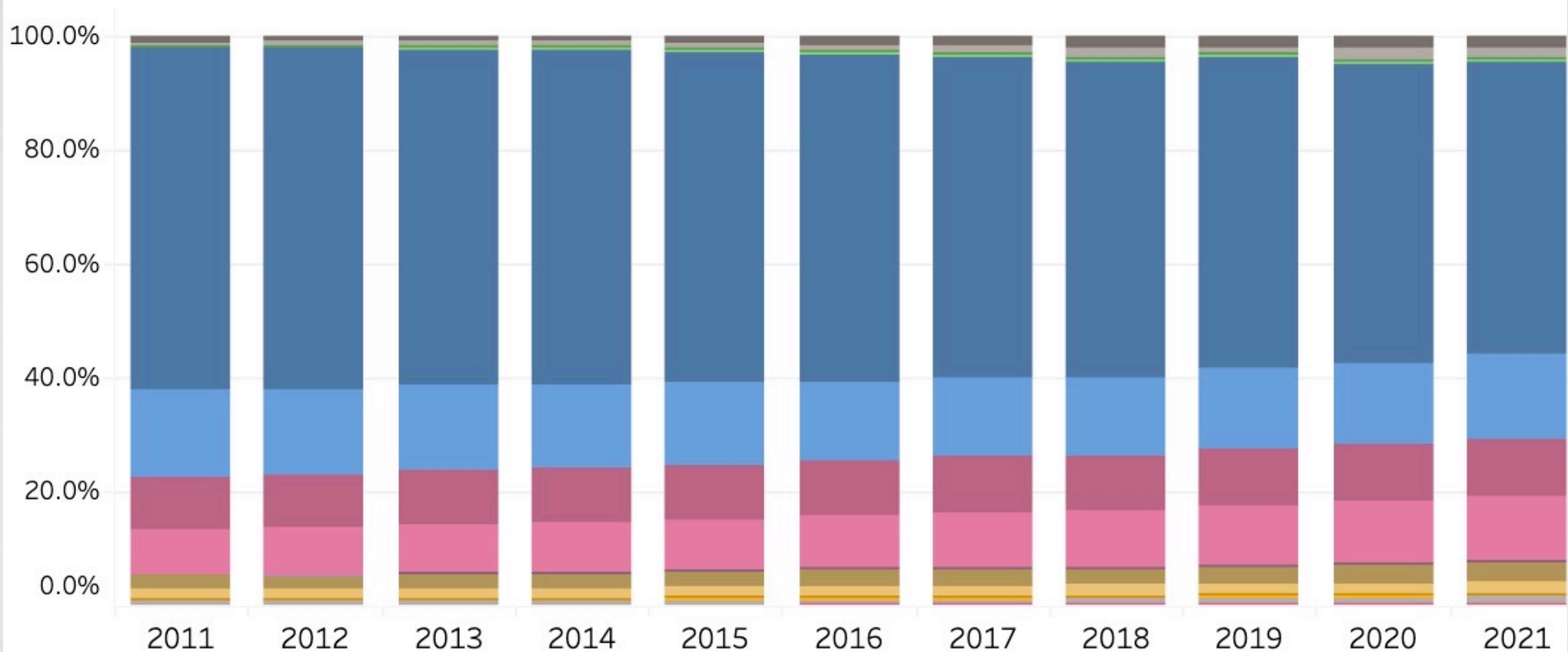
UC STEM FACULTY FALL 2021

Area	African-American	Hispanic/Latino	White
Life Sciences	1.5	6.2	70.2
Physical Sciences	0.6	3.4	79.4
Math	0.5	5.6	57.6
Engr & CS	1.9	5.5	57.3

UC FACULTY 2011-2021

NUMBERS NOT SIGNIFICANTLY DIFFERENT THAN 10 YEARS AGO

Share of headcount by race/ethnicity & citizenship (October)



MOVEMENT ... OF SORTS

- “GLACIAL URM FACULTY AND PROMOTION INCREASES” (NELSON & BRAMMER, 2010)
- RECENT REPORT CONCLUDES THAT THE U.S. STEM WORKFORCE GRADUALLY DIVERSIFIED BETWEEN 2011 AND 2021
- HISPANIC, BLACK, AND AMERICAN INDIAN OR ALASKA NATIVE PERSONS ACCOUNT FOR **37%** OF THE U.S. POPULATION AGES 18–34 IN 2021 AND **16%** OF S&E DOCTORAL DEGREES EARNED BY U.S. CITIZENS AND PERMANENT RESIDENTS IN 2020.



MOVEMENT ... OF SORTS



ACT IV

LESSONS LEARNED AND
OTHER REFLECTIONS

IMPOSTER PHENOMENON

- SEE OURSELVES AS INCOMPETENT AND BELIEVE WE HAVE FOOLED OTHERS INTO SEEING US AS INTELLIGENT AND ACCOMPLISHED.
- OTHERS MAY “HELP” REINFORCE THIS NOTION
- WE NEED TO ACKNOWLEDGE THE FEELING, BUT ALSO DEFEND OURSELVES AGAINST IT

WHITE PRIVILEGE

ARTICLE BY NICHOLAS KRISTOF, “STRAIGHT TALK FOR WHITE MEN”, FEB 21, 2015, NEW YORK TIMES

*MAYBE THAT’S BECAUSE IN A RACE, IT’S EASY NOT TO NOTICE A TAILWIND, AND WHITE MEN OFTEN GO THROUGH LIFE WITH A TAILWIND, **WHILE WOMEN AND PEOPLE OF COLOR MUST PUSH AGAINST A HEADWIND.***

EQUATED BEING A MINORITY WITH
RUNNING WITH A HEADWIND

EXCEPT YOU'RE ALSO RUNNING IN THE DARK!

A man in athletic wear is running on a green field. He has a parachute attached to his back, which is inflated and trailing behind him. The parachute is black and white. The background is a plain, light-colored sky.

EQUATED BEING A MINORITY WITH
RUNNING WITH A HEADWIND



EXCEPT YOU'RE ALSO RUNNING IN THE DARK!

LET'S TURN ON THE LIGHTS!

MENTORING

- MENTORING IS FIRST AND FOREMOST YOUR RESPONSIBILITY
- MAKE IT A GOAL TO GET TO KNOW YOUR PROFESSORS
- START A CONVERSATION ABOUT YOUR CLASS, THEIR RESEARCH, CAREER ADVICE, ETC.



UCM SACNAS Student Chapter

TAKE RISKS – FAILURE IS A GOOD THING

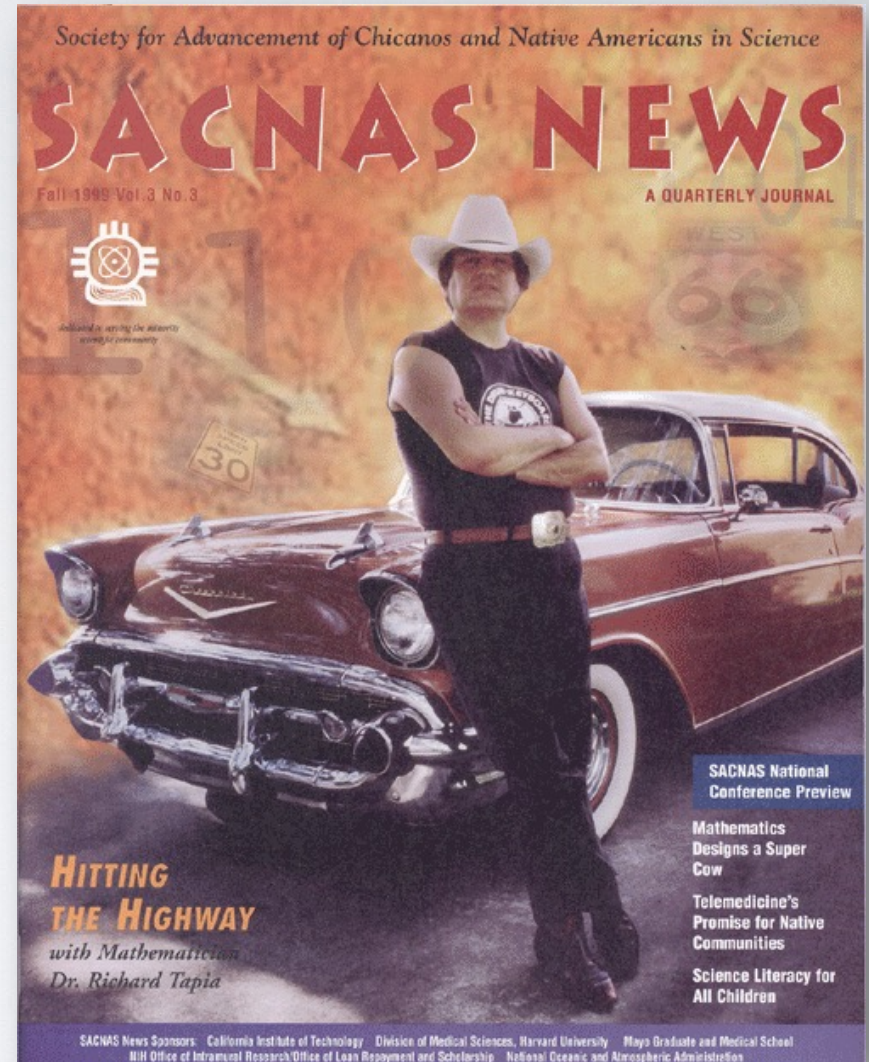
- IF YOU NEVER FAIL, YOU'RE NOT CHALLENGING YOURSELF ENOUGH
- FAILURE IS A PART OF DOING SCIENCE AND RESEARCH
- LEARN SOMETHING NEW EVERY DAY – STEP OUTSIDE YOUR COMFORT ZONE



EDUCATION IS A LIFE-LONG PROCESS

NETWORKING

- DEVELOP A NETWORK OF MENTORS; ADVISORS; CHAMPIONS
- THEY KNOW AND CAN TEACH YOU THE “UNWRITTEN RULES”
- ALSO GOOD TO DEVELOP A NETWORK OF KNOWLEDGEABLE PEERS



EPILOGUE

TRUE UNDERSTANDING COMES
FROM REFLECTING ON YOUR
EXPERIENCES

*“... **We'll restore science to its rightful place,** and wield technology's wonders to raise health care's quality and lower its cost. We will harness the sun and the winds and the soil to fuel our cars and run our factories. And we will transform our schools and colleges and universities to meet the demands of a new age.”*

*President Barack Obama
January 20, 2009*

CAN WE RESTORE SCIENCE TO ITS RIGHTFUL PLACE, WITHOUT FIRST TAKING OUR RIGHTFUL PLACE WITHIN SCIENCE?



*CAN WE RESTORE SCIENCE TO ITS
RIGHTFUL PLACE, WITHOUT FIRST TAKING
OUR RIGHTFUL PLACE WITHIN SCIENCE?*



*CAN WE RESTORE SCIENCE TO ITS
RIGHTFUL PLACE, WITHOUT FIRST TAKING
OUR RIGHTFUL PLACE WITHIN SCIENCE?*

*LET'S TURN OUR SEEDS OF DOUBT
INTO SEEDS OF OPPORTUNITY*

IT'S YOUR TURN NOW!

THANK YOU!



AND I'LL SEE YOU BY THE OCEAN!