

From Basic Science to Commercial Technology

—

A personal journey and view

Ping Yeh, Google, Inc.

中研院物理所90周年紀念研討會 2018-11-09

The beginning

Computational Physics summer course by Simon C. C. Lin before my senior year

Numerical methods, Monte Carlo, C language, etc

My first "research-y" problem

$$\nabla^2 \phi = 0$$

Laplace's equation on a 2D lattice

Senior year advisor: Simon C. C. Lin

Thanks for allowing me to explore so many things with computing resources of Academia Sinica!

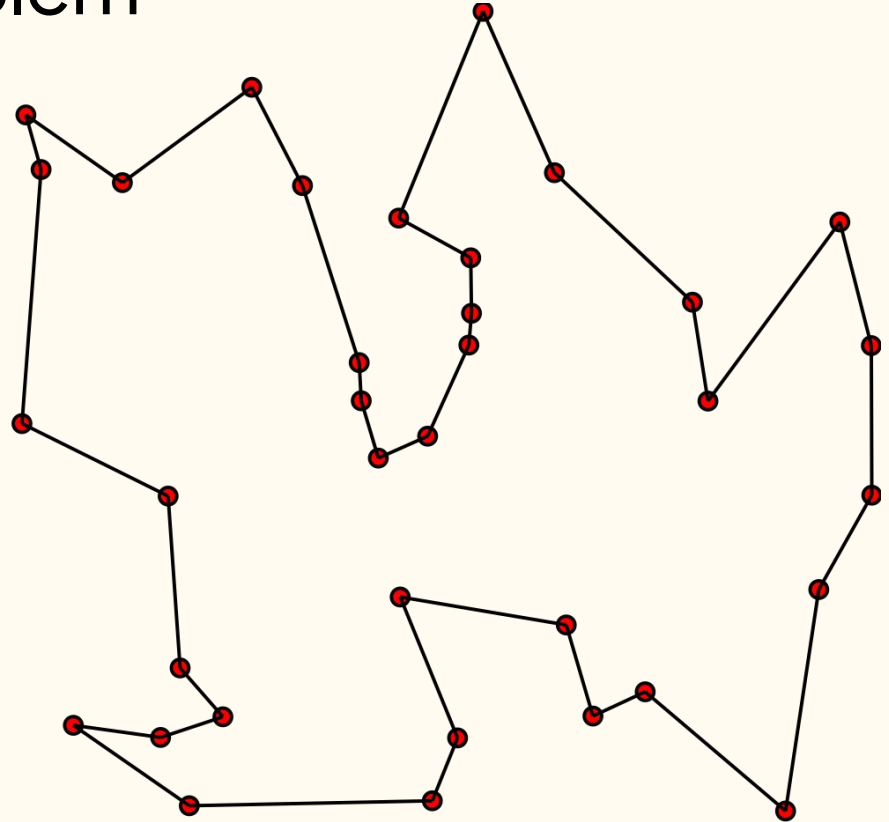
Travelling Salesman Problem

Initialized with space-filling curve

My second research problem

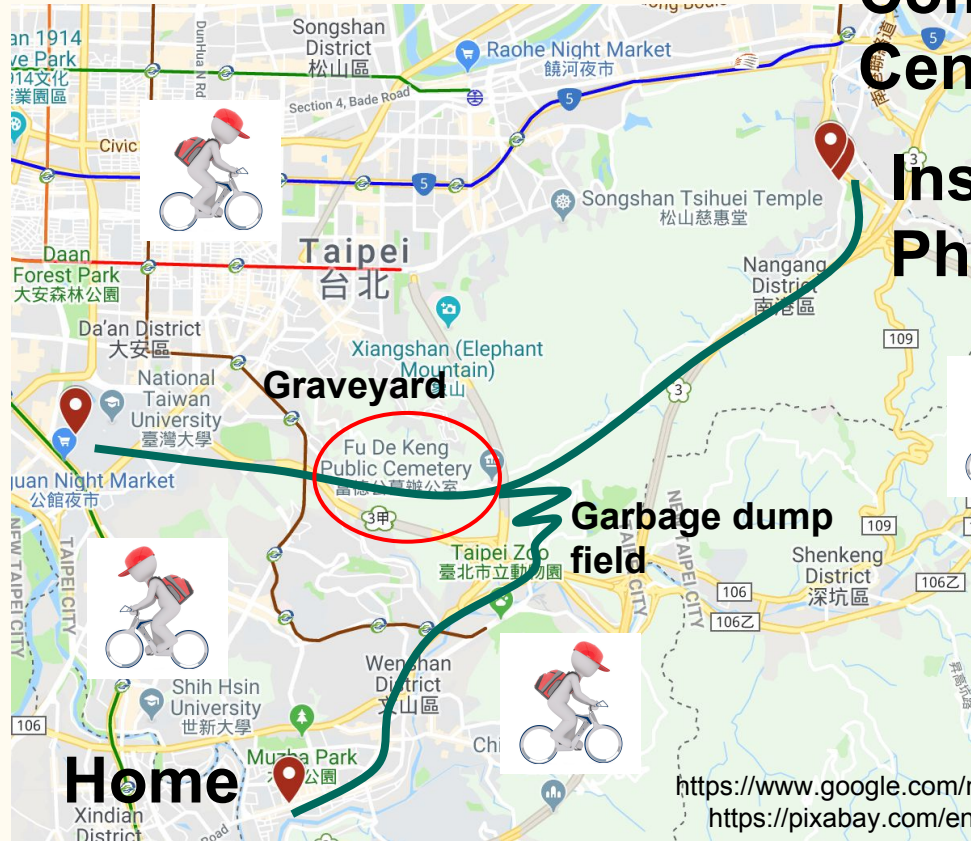
Advisor: Simon C. C. Lin

Location: computing center



Traveling student problem

**National
Taiwan
University**



**Computing
Center**

**Institute of
Physics**

**Garbage dump
field**

My first full time job

Research assistant in Institute of Physics, Academia Sinica.

Not one paid by an NSC grant like typical RAs, but one paid by the institute, taking up one slot that can be used to hire a full time researcher.

Prof. Pauchy Hwang recruited me, Dr. Shih-Chang Lee and Dr. P. K. Teng went to great lengths to make that happen.

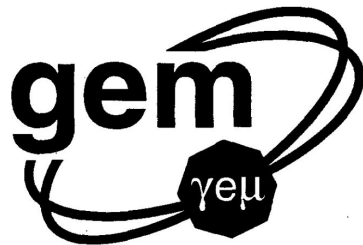
I took care of HP / IBM / Sun workstations and made one of the first web sites in Taiwan for HEP group in 1992.





Superconducting Supercollider

<https://commons.wikimedia.org/wiki/File:Sscmap1.jpg>
<http://lss.fnal.gov/archive/other/ssc/ssc-gem-tn-92-000063.pdf>
<http://lss.fnal.gov/archive/other/ssc/ssc-gem-tn-93-408.pdf>



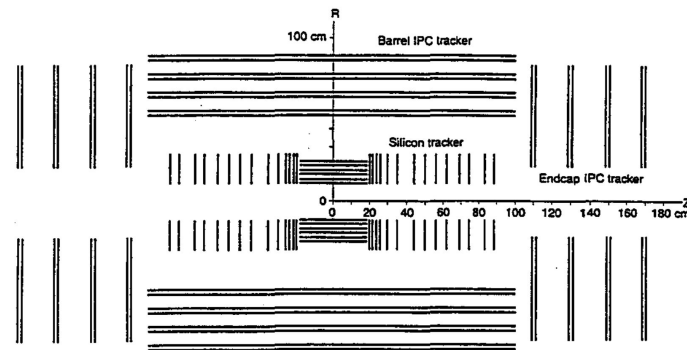
GEM TN-92-63

GEM Central Tracker: A Progress Report

Central Tracking Group

March 1992

Geant3 Simulation



New Groups

Rutgers University

P. Jacques, M. Kalekar, R.J. Plano, P. Stamer, G.B. Word

Academia Sinica, Taiwan, R.O.C.

Y.C. Chen, T.L. Chu, S.C. Lee, P.K. Teng, M.J. Wang, P. Yeh

University of Oregon

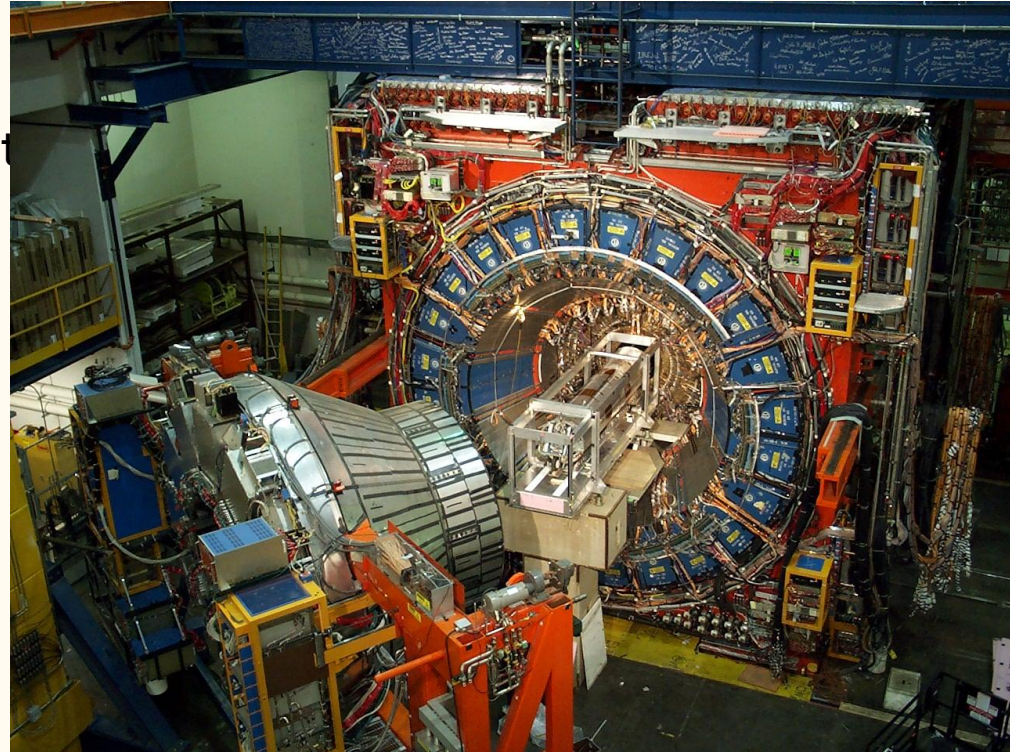
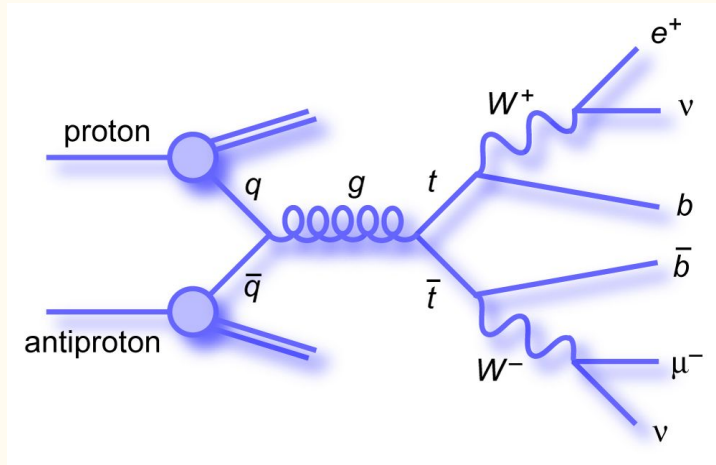
Anatoli Arodzero, Jim Brau, Ray Frey, Koichiro Furuno, David Strom

University of Albany

M.S. Alam, I.J. Kim, B. Neman, John O'Neill, Horst Severini, C.R. Sun, Ling Zhichao

CDF (Collider Detector at Fermilab)

Ph.D. thesis: top quark mass in di-lepton



My three wise men

I have 3 advisors:

- An advisor in university: university paperworks
- An advisor in Academia Sinica: income & work
- An advisor in Fermilab: my obligatory contributions to the collaboration (data production) and analyses

That covers everything, right?



My thesis

Set in a hallway conversation in CDF trailers, half year before the soft graduation deadline set by Ministry of Education.

Thanks to Jaroslav's many discussions that brought the light to this underconstrained problem.



During the year, Jaroslav Antos (安徒斯) and Ping Yeh (葉平) obtained the top mass employing the dilepton top quark events of CDF, using a method they developed earlier. Ping had his thesis finished and successfully defended in June. He served in the Military for three months, joined us again after the compulsory military service, and was elected one of the ten Academia Sinica Fellows. Their analysis of the top quark mass is expected to be published in 1997.

Annual Report of
I.o.P., A.S., July 1997

Particle Physics
Summer School
@ Bombay
(i.e., Mumbai)



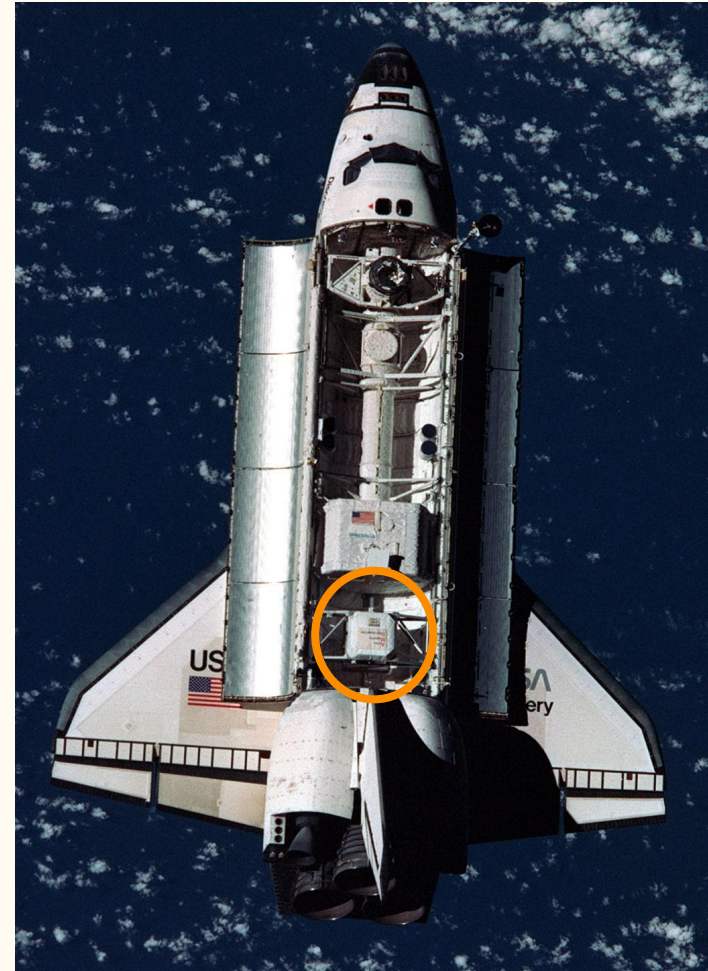
Fermilab @
Chicago

Berkeley

Alpha Magnetic Spectrometer

Contributions to the pilot flight:

- Event display using Root framework, done in the first week onboard.
- Part of onboard data acquisition software
- Particle back-tracing in geomagnetic field



Project management and deadline

Launch date as a deadline

Count days backwards for milestone deadlines



But we were physicists, not engineers...

Naturally, we found bugs in onboard software *late*

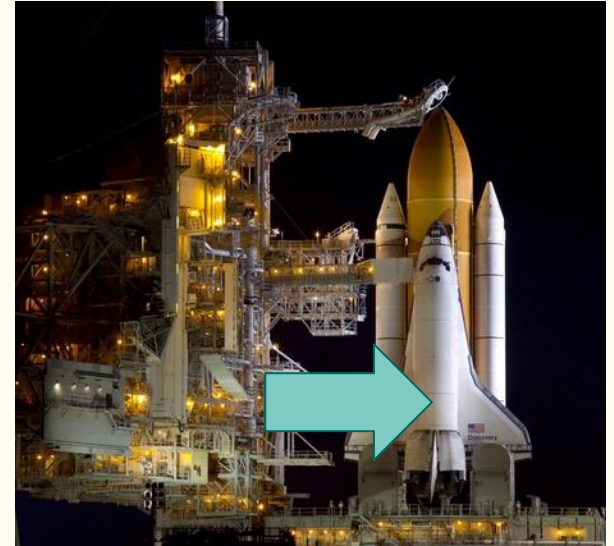
Deadline means deadline in NASA

If you miss it, you'd better be dead! (just kidding)

How late? The shuttle was already on launchpad!

Sam Ting had to persuade NASA director: "If you don't let us upgrade the software, we won't have an experiment!"

Xudong and I wore cleanroom suits to upgrade software in the shuttle cargo bay on the launchpad.
NASA claimed that nobody had ever done that before!



CERN @
Geneva



NASA @
Orlando, Florida

NASA @
Houston, Texas

What I learned in Academia Sinica

Take initiatives, don't wait for others to make things happen.

Don't be afraid to make mistakes, or you make nothing interesting.

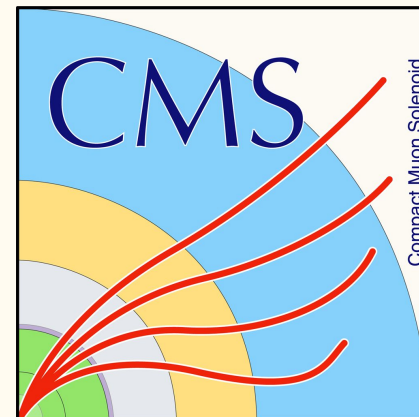
Rules are meant to be broken, with the right reason.

Then I left Academia Sinica for NTU

(don't ask me why)



NuTel



CERN @
Geneva



KEK @ Tsukuba,
Japan

Then Google

Software engineer

projects in Taiwan

- Chinese language search quality for Taiwan, Cloud computing
- (cancelled project), iGoogle (sunsetting), (cancelled project)

project in Mountain View (headquarter)

- Ads attribution

Current project in Santa Barbara

- Quantum Computing



Quick introduction to Google



Fortune's *best company to work for*


- #1: 2017, 2016, 2015, 2014, 2013, 2012, 2008, 2007
- #4: 2011, 2010, 2009

Annual revenue: \$110 billion in 2017

Fulltime employees: 88,110 in 2017

100 offices around the world

Main products: search, maps, gmail (G Suites), YouTube, Android, Chrome, cloud, ads, etc.

A stylized illustration of the Earth from space, showing the Americas and parts of Europe and Africa. A black silhouette of an airplane is shown in flight over the Atlantic Ocean. A light blue curved line represents a flight path, starting from a teal dot in Taipei, curving around the globe to two teal dots in California. The background is a dark, starry space.

Google Taipei

Google HQ @
Mountain View,
California

Google Santa
Barbara

Academia & industry: the technical work



What do you work on?

T. D. Lee (when reviewing GEM projects): uniqueness, impact, (capability?)

When I was a newbie in Fermilab: visibility

Google engineers: complexity, impact, leadership

Start-ups: SWOT = strength, weakness, opportunity, threats

Research vs. Product Development

	Research	Development
Goal / Purpose	understanding	utility
Deliverable	paper	product
Measure of excellence	world-wide community and peers	users & customers

Commerce: satisfy / create people's needs

Maslow's hierarchy of needs (I don't fully agree with it)

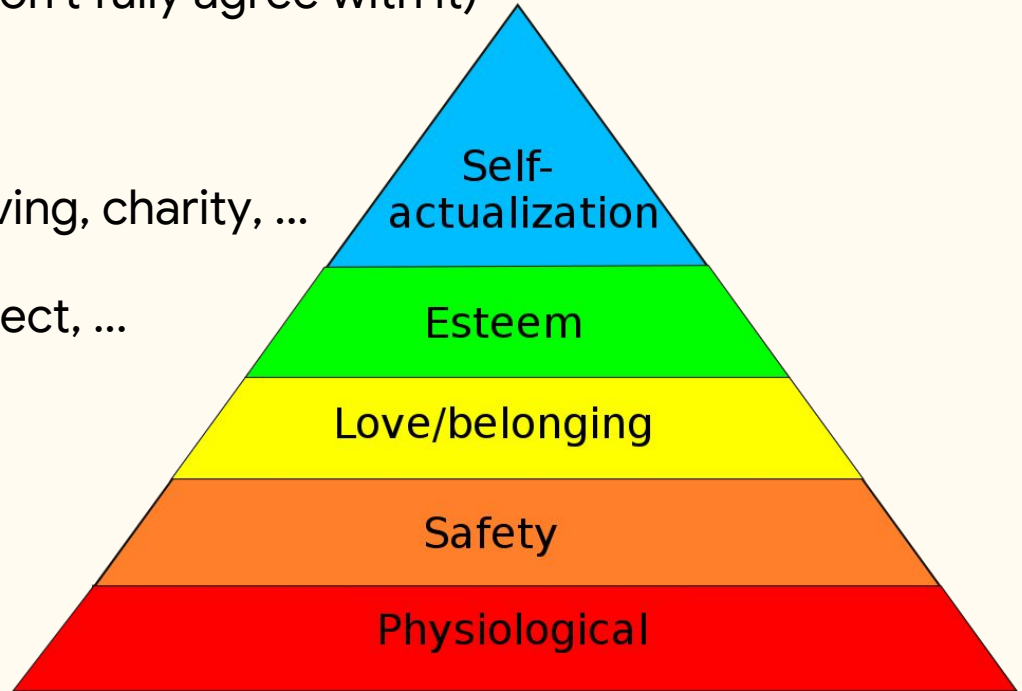
creativity, morality, problem solving, charity, ...

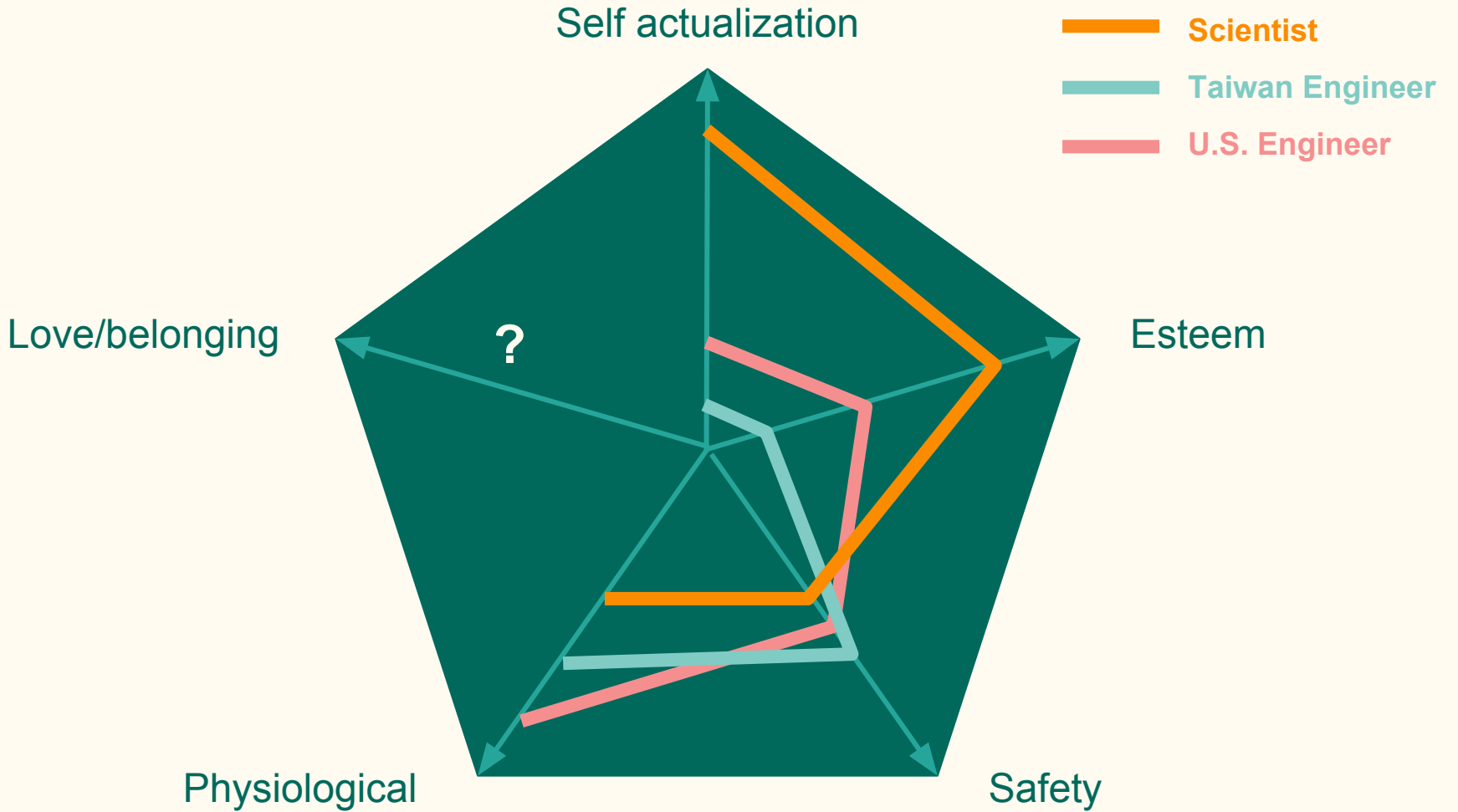
confidence, achievements, respect, ...

family, friend, lover, ...

housing, job, health, crimes, ...

food, water, sleep, ...

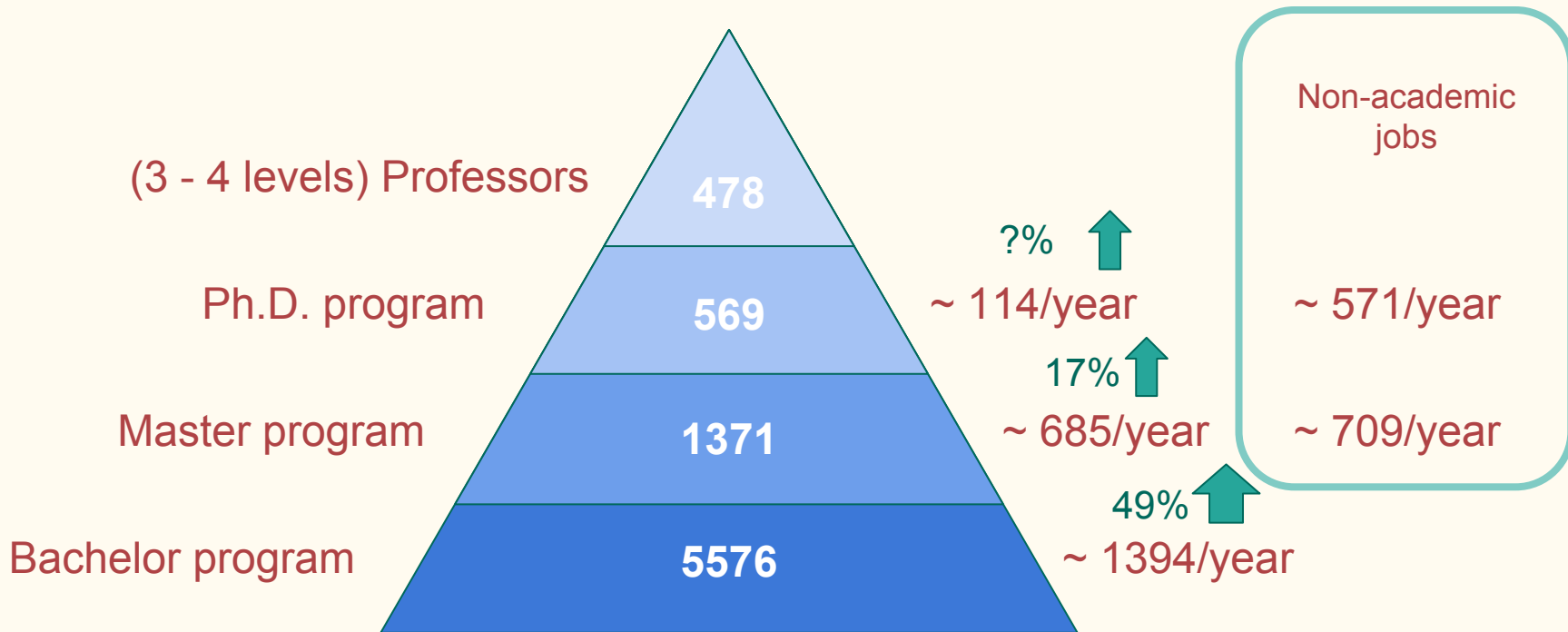




Academia & Google: the human factor

based on my experiences, not to generalize it to all institutes or industries.

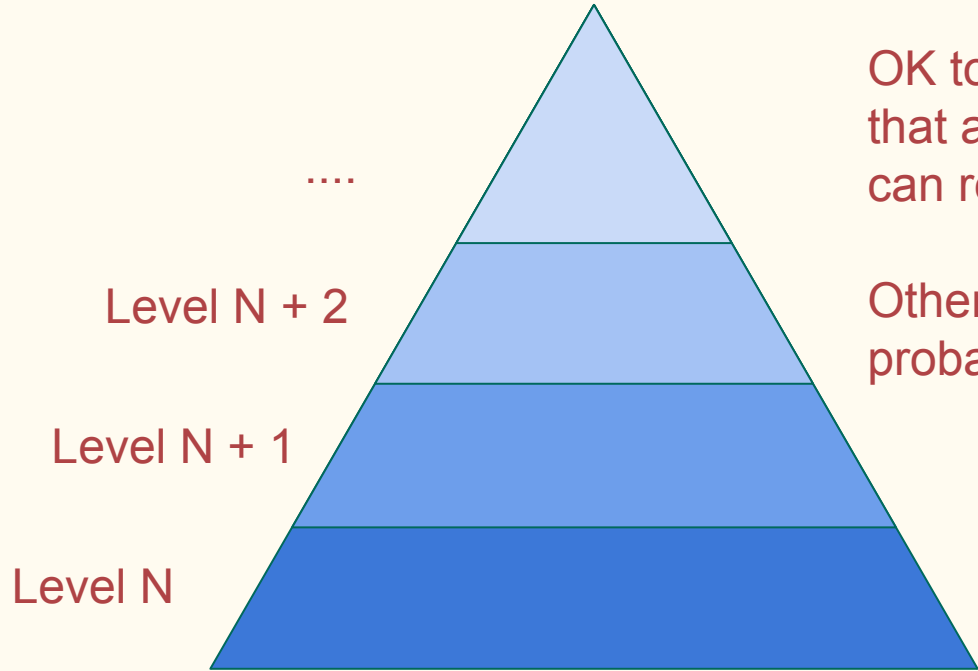
The pyramid of academia



School year 2016-2017, department of physics, applied physics, etc. Data source:

https://depart.moe.edu.tw/ed4500/News_Content.aspx?n=5A930C32CC6C3818&sms=91B3AAE8C6388B96&s=96B1633791CBD94E

The pyramid of tech ladder in industry



OK to retire at certain level that almost every engineer can reach.

Otherwise engineering is probably not for you.

How does one become better?

Google: "help you be the best employee you can be"

- Technical tutorials / self-study guides / technical classes
- Education reimbursement
- Mentor, career coach
- Regular 1 on 1 with direct manager to talk about anything: technical, moral, team, personal goals, how to reach them, etc.
- Peer reviews (1 - 2 times a year)
- Observation of promotion committee meetings



How Google deal with underperformers

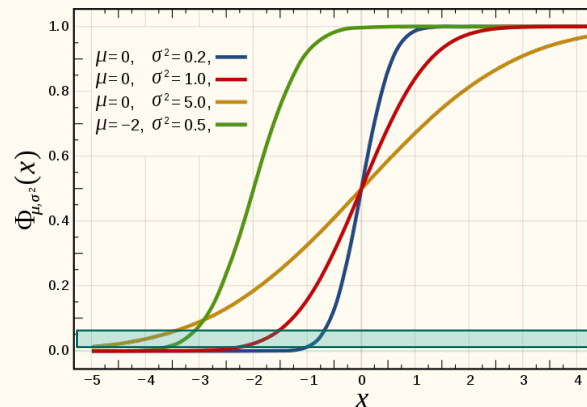
How underperformers are treated shows the character of the organization.

"Stack ranking"

- GE '80s: Fire bottom 10% / year
- Microsoft '00s: Fire bottom X% of each team / 6m

Google: Help bottom 5% company-wide / 3m

- Training and coaching, then
- Change of team, then
- We're sorry.



What I learned in Google

Plan your work in terms of measurable deliverables, not efforts.

- "Codes for feature X checked-in" vs. "develop feature X".

The **value system** (not necessarily \$\$ system) affects people's behavior

- Even the nicest people may do un-nice things just to protect their jobs
- To encourage a behavior, build it into value system. Google: peer bonus

You don't need to be managing people to be a leader.

Taking care of people who work for you.

Useful skills in industry

Technical skills

- Coding and algorithms, Data analysis
- Analog and digital electronics, chip design, communications, etc

Soft skills

- teamwork, leadership, communications
- project planning, management & negotiation
- etc

May all your postdocs / students /
assistants have satisfying careers,
no matter where they go!