Academic-Industrial Synergy: Stories, Pitfalls, & Advice

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August 2020 @ Google Computer Architecture & Deep Learning Workshop

Outline: Setup, 4 Success Stories, & 3 Co-Pitfalls

Key: Dialectic
Where I’m “Coming From”

A professor who deliberate engaged industry

- 25+ years of industrial affiliate meetings
- 20+ years of industrial consulting
- Three industrial sabbaticals ← high cost; high reward
- Recipient of many industrial donations
- Internships: ugrad, grad, & for many students
- Gave talks & actively sought out industrial views

I have NOT experienced an industrial career
I hope these perspectives are shared in Q&A
Co-Pitfall 3:
For Academics: The end is papers
• If people don't read your papers, their loss
For Industry: The end is optimal products
• Let’s execute, not look for direction change

Instead: Academic-Industrial Synergy ⇒ Success!

*The end of computer architecture research is industrial impact.*
--Paraphrasing Dave Patterson’s advice, mid-1980s

Academic papers are an incomplete means
What about for Industry?
The processes that are key to the success of established companies are the very processes that reject disruptive technologies: listening carefully to customers; tracking competitors’ actions carefully; and investing resources to design and build higher performance, higher-quality products that will yield greater profit. These are the reasons why great firms stumbled or failed when confronted with disruptive technological change. ... First, disruptive products are simpler and cheaper; ... lower margins, ... Second, ... first commercialized in emerging or insignificant markets. And third, leading firms’ most profitable customers generally don’t want ... Need ideas, not just execution! Academia a source TPU? Systolic, decoupled access/exec, & RISC/CISC
Question from a practice talk:
*Is there “An Innovator's Dilemma” for academics?*

My Answer: Yes and No but Yes

**Yes:** Can fall prey to follow-on paper after follow-on paper, generalizing & polishing a very smooth stone

**No:** Don’t go out of business, have tenure, experience enough to get some students & grants

**Yes:** Often destined for mediocre, not great, career
Story 1: Coherence Microarch.

1995 Sabbatical & Consulting for Sun Micro

- Co-architected **product** to link together multiple SMPs [WildFire, HPCA 1998]
- Aided system-level memory consistency & virtual memory SW & HW

Inspired Research

- From MESI ⇒ Coherence microarchitecture
Story 2: Record-Replay Insight

@ Mid-2000s UW Computer Arch. Affiliates Mtg
- Deterministic replay of multicore execution
- Wanted smaller log for longer recording
- “Minimize chip area, as often not recording”

Insight for “Rerun” Research
- Smaller HW & smaller log
- Great pubs, including CACM
- Industry hired the students!
2018 Sabbatical for Google Silicon

- “Make Multi-Accelerator design more scientific”
- Reaction: Gasp! How to make progress?
- Gable’s Roofline model [HPCA 2018]
- Choose & initially config IPs prior to simulation
- Perturbed product group

Inspired in-progress work realizing more general Accelerator Level Parallelism
Accelerator Level Parallelism (t) = #IPs concurrently active at time t

What are programming models, software infrastructure, & placement/scheduling techniques needed to use multiple accelerators beyond smartphones to applications in transportation, health, & human (virtual) interaction?

Disclaimer: Made up Data
Co-Pitfall 1:

Academics: Interact with industry only for money
- They have lots & you want some

Industry: Interact with academia only for students
- They have lots & you want some

Go beyond self-serving to building relationships
- This costs time & effort
- Reaps better work on both sides: non-zero sum
- Talks, affiliate meetings, interns, & sabbaticals
Co-Pitfall 2:

**Academics**: Ignore product people: few papers
- Papers are deep; products are compromises

**Industry**: Ignore academics: no products
- Products: value to people; papers: superficial

I’ve been evaluated this way!

me as N dim vector projection (naive)

Cross product: new direction from different inputs!
Book learning + practice ⇒ productive *dialectic*

A *discourse between two or more people holding different points of view about a subject but wishing to establish the truth through reasoned methods of argumentation.* --Wikipedia

Seek virtuous spiral w/ practice informing book learning to unify & clarify to influence practice

- Industry has (sometime unrecognized) **problems** that can inspire research ⇒ my 3 sabbaticals
- Academia has **ideas** that can enhance products (but not all academics pick good problems)
Story 4: GP-GPU Consistency

2011 Sabbatical & Consulting for AMD Research
GP-GPU data & synchronization writes are often visible to a subset of GPU & CPU threads
- Much GPU & GPU-CPU work

Back→UW but PhD grad→AMD
- “Scope” abstraction & corresponding memory model
- Used by AMD first and later standards & Nvidia

Insights AMD <===> UW
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Recap: Seek a **Dialectic**
Time ⇒ Respect ⇒ Synergy ⇒ Success!
Two Photos and Q&A

Let’s make this a dialectic with collaboration perspectives from industry. Any takers?