Where do ideas come from?

Ohad Kammar

4th Logic Mentoring Workshop
Thirty-Fourth Annual ACM/IEEE Symposium on Logic in Computer Science (LICS)
Vancouver 22 June 2019
Dear Hongseok,

I hope you are well, that the remainder of the Concurrency Workshop went smoothly, and that you are safely back home.

Thank you for taking the time to explain to me about your current work on probabilistic programming and Bayesian inference. This is a subject I'm recently trying to get my head around, though mostly from the computational effects side of the coin. An ex-undergrad of mine is working in the area and recently started getting interested in monadic programming to this end and we were chatting for a bit, and I tried to direct him towards effect handlers. We ended up submitting a HOPE talk proposal (attached), which he'll be presenting in Vancouver. Understanding this from a more semantic perspective is in fact quite appealing to me. Hopefully I can help!

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Yours, Ohad.
from: Ohad Kammar to: Hongseok Yang  2015-07-17
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Concurrency Workshop 2015
Imperial College

Gardner, Donaldson, Wickerson, Raad
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Particle Gibbs with ancestor sampling for probabilistic programs

van de Meent, Yang, Mansinghka, Wood
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Ideas business

- Generate ideas
- Manage ideas

My goal

- **Conceptualise** research ideas
- Suggest **exercises**:
  - this week
  - beyond
Talk structure

- About me
- Research questions & answers
- Managing ideas

Warning

- Conflicting advice
- sampling and survivorship biases
About me

BA CS, Open University of Israel. 1999–2005
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Royal Society University Research Fellow, LFCS, University of Edinburgh. 2019–2024
3 failed lectureship applications, 1 failed fellowship application.

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Forms of research questions

Examples:

▶ Fill a gap:
  Gödel’s incompleteness theorems

▶ Bridge seemingly unrelated areas:
  *From parametricity to conservation laws, via Noether’s theorem*,
  Robert Atkey

▶ Extend knowledge in a new direction:
  Cook-Levin theorem and polynomial time reductions

▶ Shed new light on old ideas:
  *Quantum channels as a categorical completion*,
  Mathieu Huot and Sam Staton

Tues 10:30am
Room A

Ohad Kammar <ohad.kammar@ed.ac.uk>
Forms of research questions

**Exercises**

Goal: recognise and taxonomise research forms.

1. Think about your past/current research.
   - What form of contribution is it?
   - Was it always of this form?

2. You’re going to see many talks this week.
   - What form of contribution is each?
   - Discuss your opinions with others.
   - Discuss your opinions with the **authors**:
     - was the contribution always clearly of this form?
Who cares?

Synthetic/internal:
questions and answers that
- interested in
- care about
- find useful/important
- want to understand

Analytic/external:
others

non-standard terminology, but Kant, Frege, Carnap, and co don't agree either

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Who cares? (Synthetic-analytic distinction)

Example

Algebraic foundations for effect-dependent optimisations
with Gordon Plotkin

Synthetic
Q: What are the semantics of effect systems?
A: A (category theoretic) construction: conservative restriction.

Analytic
Q: How to justify more compiler optimisations?
A: Use an effect-system and its denotational semantics.

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Who cares? (Synthetic-analytic distinction)

Consequences

Q: S
A: S

Rev. C: I don’t see the point.
Next step: Look for applications.

S = Synthetic
A = Analytic
N = Neither
Who cares? (Synthetic-analytic distinction)

Consequences

Q: S A
A: S S
Rev. C: Quickly degenerates to definitions and theorems.
Next step: Look for alternative (additional) proofs
Consequences

Q: S  A  A
A: S  S  A

Rev. C: Best paper award!
Next step: Why are you doing this?
Who cares? (Synthetic-analytic distinction)

Consequences

Q: S A A N
A: S S A S/A

S = Synthetic
A = Analytic
N = Neither

Exercises
Goal: use this taxonomy to guide research

1. Consider the other combinations.
2. Where does your project lie?
   Are you content with this position?
   If not, what would you do to change it?

exercises/workout exploratory research.
Who cares? (Synthetic-analytic distinction)

dynamic distinction!

Synthetic

- changing interests
- break into new areas / learn new techniques
- changing goals

Analytic

- Government/industrial interest or funding.
- Charismatic figureheads.
- Different communities

---

modular Bayesian inference implementation

validation

implementation

POPL’18

ICFP’18

Ohad Kammar <ohad.kammar@ed.ac.uk>
Who cares? (Synthetic-analytic distinction)

Exercises
Goal: assess your relationship to your research community. Review the difference, if any, between your synthetic Q&A and the analytic Q&A in your research group, department, and workshops/conferences.

1. Where do you find a close fit?
2. Where do you find the largest difference?
3. Have your synthetic Q&A changed over time?

Ohad Kammar <ohad.kammar@ed.ac.uk>
Managing ideas

intellectual capital

- non-blocked
- suspended

Where do ideas come from?
Managing ideas

- **intellectual capital**: non-blocked suspended
- **work-in-progress**: non-blocked ongoing

Where do ideas come from?

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Managing ideas

intellectual capital: non-blocked suspended
work-in-progress: non-blocked ongoing
track record: completed

Where do ideas come from?

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Managing ideas

intellectual capital: non-blocked suspended
work-in-progress: non-blocked ongoing
track record: completed
dead ends: blocked

Where do ideas come from?
Managing ideas

Generating ic and de with wip

calculate, prove, program, verify, experiment!

\[ \bullet \rightarrow \bullet \rightarrow \bullet \rightarrow \bullet \rightarrow \bullet \rightarrow \text{ic} \]

\[ \text{de} \]

\[ \bullet \rightarrow \bullet \rightarrow \bullet \]

\[ \text{ic} \]

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Managing ideas

Generating ic

- wip
- collaboration, esp. 1:1
- networking
- sparks of inspiration
- technical reading (papers/books/grants)
  - reading groups
  - reviewing
- taking courses summer schools
- writing notes and papers
- giving talks/seminars
- teaching
- going to talks/seminars
  - detailed and technical (seminars, tutorials, workshops)
  - high-level (conferences, invited talks)
- supervising researchers
  - students
  - interns
  - postdocs
- writing grants & project proposals
Managing ideas

Consuming IC

- intellectual capital

- supervising researchers
  - students
  - interns
  - postdocs

- writing grants & project proposals

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Managing ideas

A small and focussed:

- Quicker completion
- Higher-quality ic

Completion criteria:

- communicability
- usability
- substantiality
- self-contained
- published/shared/executed/used.

“Go for the most-publishable unit.”
Peter Sewell

“Publication is a form of attainment.”
Gordon Plotkin
Managing ideas

Role of track record

- You’re doing great work!
- evidence-based sense of achievement
- confidence building
  - you in yourself
  - others in you:
    - peers
    - students, interns, postdocs
    - potential funders
    - governments
- Reputation \( \rightsquigarrow \) generated ic
- also builds your cv

Role of dead ends

- asking hard questions (in seminars, in person)
- writing survey papers
- reviewing papers
- identify breakthroughs
- taking advantage of new developments
- Identifying analytic questions
Exercise
Goal: take stock and ownership of your ideas pipeline

1. Work out your ic, wip, and tr (de might be too much!).
2. What is limiting your ic generating abilities?
   Is it necessary?
   Is it necessary now?
3. What new activities can you try to generate ic?
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Forms of research

- Research Q&A
  - Synthetic-Analytic distinction

- Managing the ideas pipeline

intellectual capital → work in progress → track record → dead ends, open problems

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