Studying and Conducting Research

EC Mentoring Workshop, 2024

Speaker: Bo Waggoner, University of Colorado

Outline

0. Intro

1. Personal maintenance and development

2. Learning and studying

3. Exploring the frontier

Not discussed:

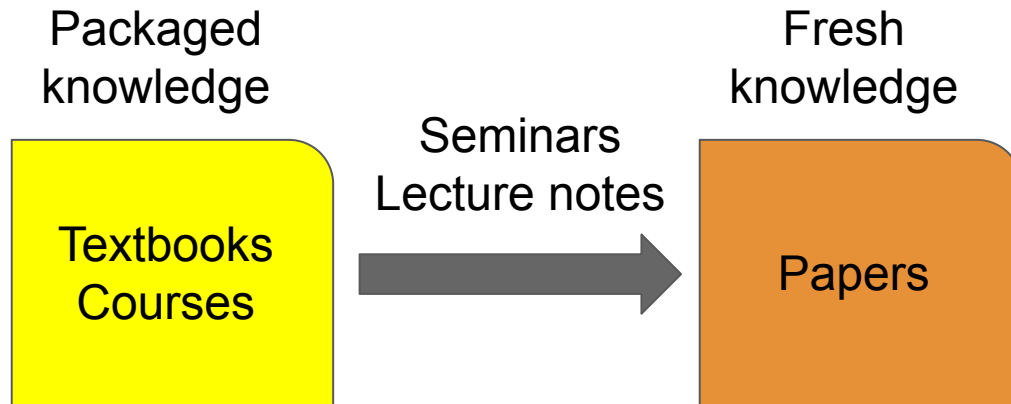- **Collaboration** - see How-To talk #3 today!

Polls

- **Stage of career:** pre-PhD / early PhD / mid-late PhD / post-PhD

- **Research experience:** have read papers / have written a paper

- **Field of study:** Computer Science / Econ / other
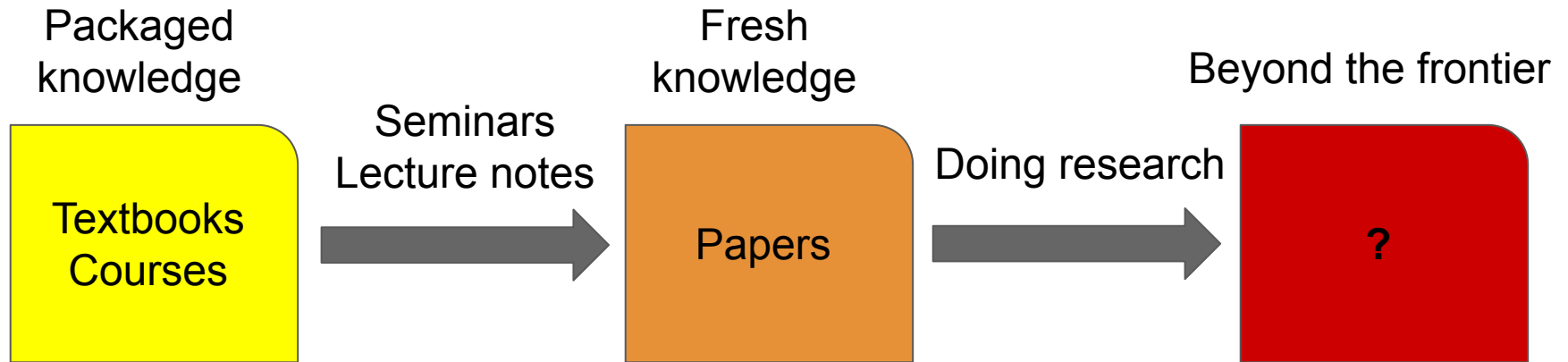
Production of knowledge
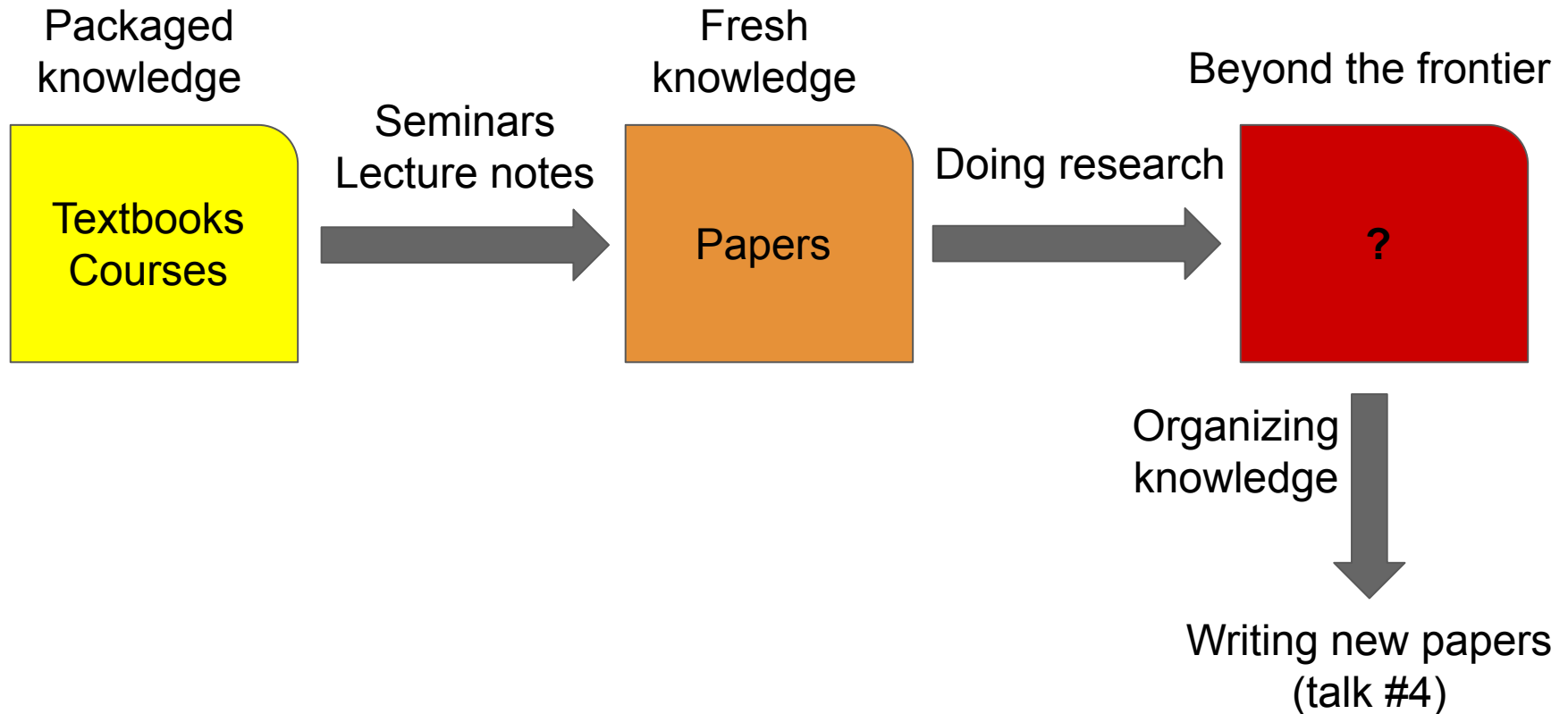
Packaged
knowledge

Textbooks
Courses

Production of knowledge
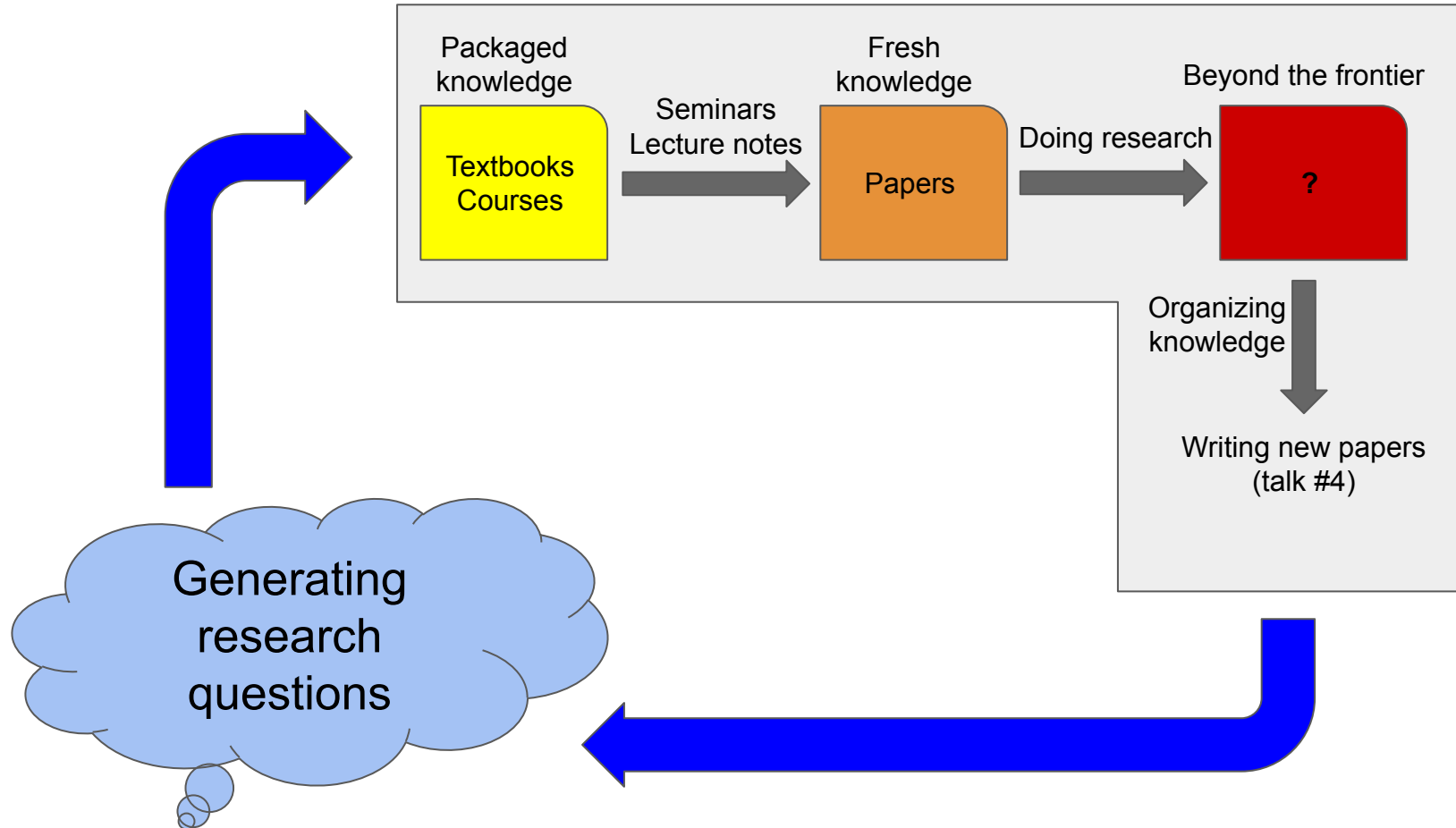
Packaged
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Fresh
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Seminars
Lecture notes

Textbooks
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→

Papers

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Doing research

Beyond the frontier

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**Textbooks
Courses**

Papers

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Organizing
knowledge

Writing new papers
(talk #4)

Life cycle of contributions

Packaged knowledge

Textbooks Courses

Seminars Lecture notes

Fresh knowledge

Papers

Doing research

Beyond the frontier

?

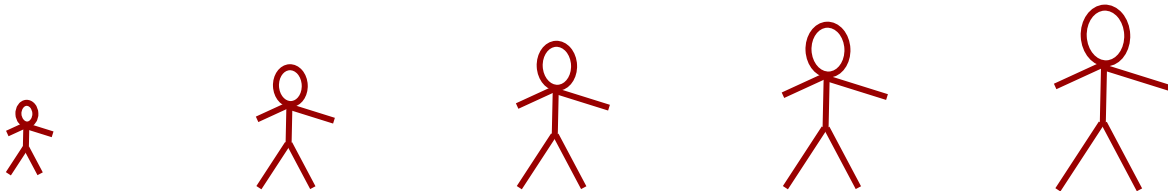Organizing knowledge

Writing new papers (talk #4)

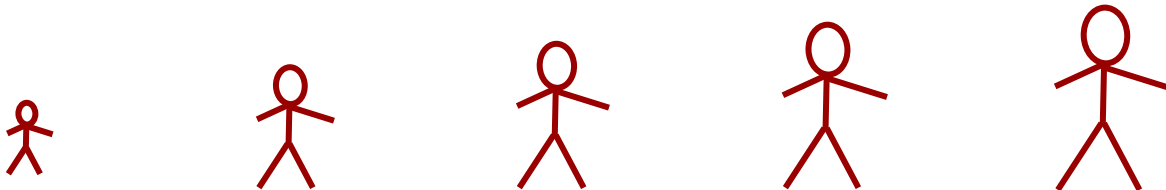Generating research questions

# 1. Personal maintenance and development

"Growth mindset"

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- **Expect to learn and change.**
  - You're *supposed* to not initially know things or be good at stuff…
  - …but you *cannot* believe that is permanent…
  - …nor accept your current limitations.

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- **Examples:**
  - Tools: LaTeX, git, Mathematica, python, LLMs, …
  - Fields of study: Game theory? Real analysis? Spectral graph theory? ML? Etc.
  - Public speaking, writing, organizational skills, …
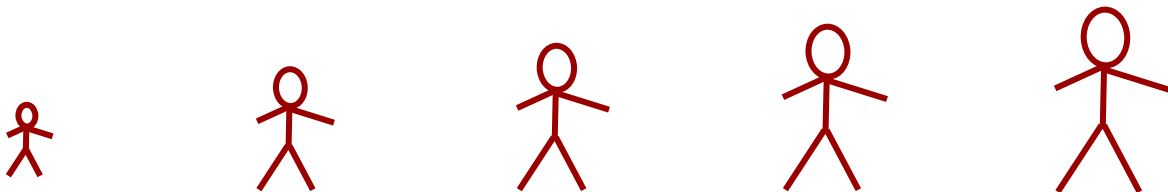
Enjoy what you do

- **To do a PhD, you have to enjoy and care about research.**

  - There are many styles and niches in the research community. Try things.

  - Passion for a field *develops* over time.

  - Be open to possibilities and prepared for serendipity!

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- **Treat yourself like an athlete / chess player / musician / etc**
  - Sleep, nutrition, exercise
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- **Be aware of common challenges**
  - Imposter syndrome
  - Mental and physical health
  - Burnout
  - "Time management" - balance your schedule
  - **The default state in research is "stuck"**

2. Learning and studying

Getting up to speed

- **Stock your toolbox**
  - Take courses
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- **Participate in your local and global research community**
  - Get new ideas, learn, be inspired
  - Discuss your work; get references or suggestions

Deep understanding of the state of the art

- **Fully understand the key tools you need**
  - E.g. be able to reproduce crucial parts of papers (theorem statements/proofs/etc)

- **Teach or explain**
  - Write expository notes or posts
  - Lead reading groups or present papers
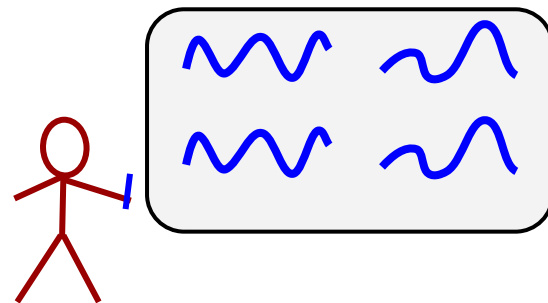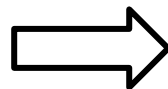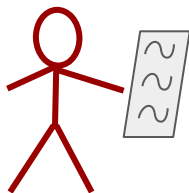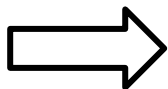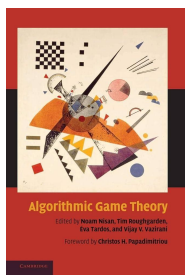
3. Exploring the frontier

Exploring the frontier

- **Balance reliance on prior work with fresh perspective**
    - Give yourself room to play and rediscover…
    - …but don't spend too long unaware of the state of the art

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- **Balance focusing on a problem with exploring the problem space**
    - Get stuck
    - Try a different approach (e.g. simulations instead of theory)
    - Solve examples
    - Talk to people: get ideas, references, keywords, …
    - Go back
    - Go around: change the problem, ask a new question
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- **Learn to ask good research questions … this takes time!**

Questions?

Reach me: Bo Waggoner <bwag@colorado.edu>