HOW TO WRITE PAPERS AND GIVE TALKS THAT PEOPLE CAN FOLLOW
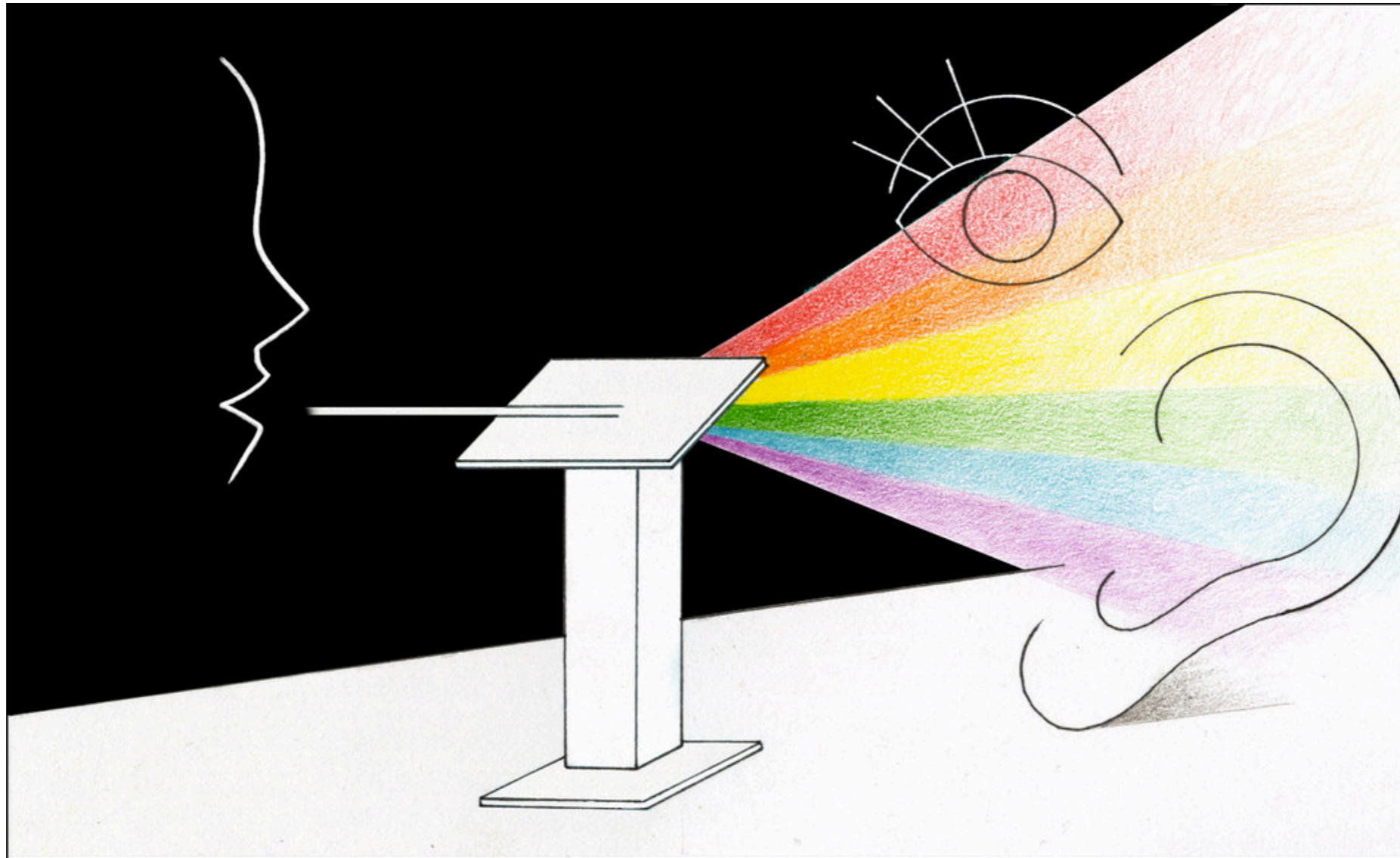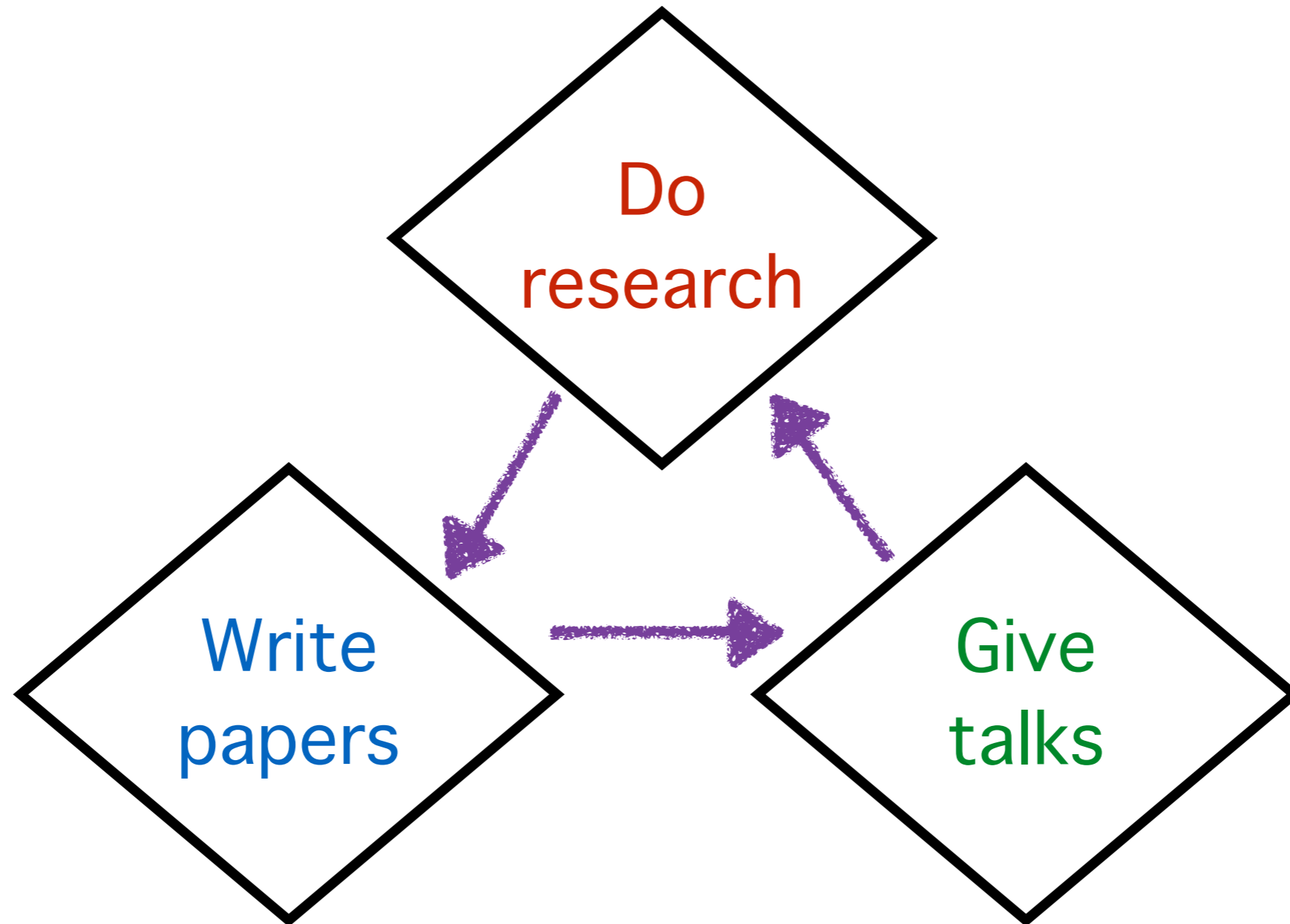

Derek Dreyer, MPI-SWS

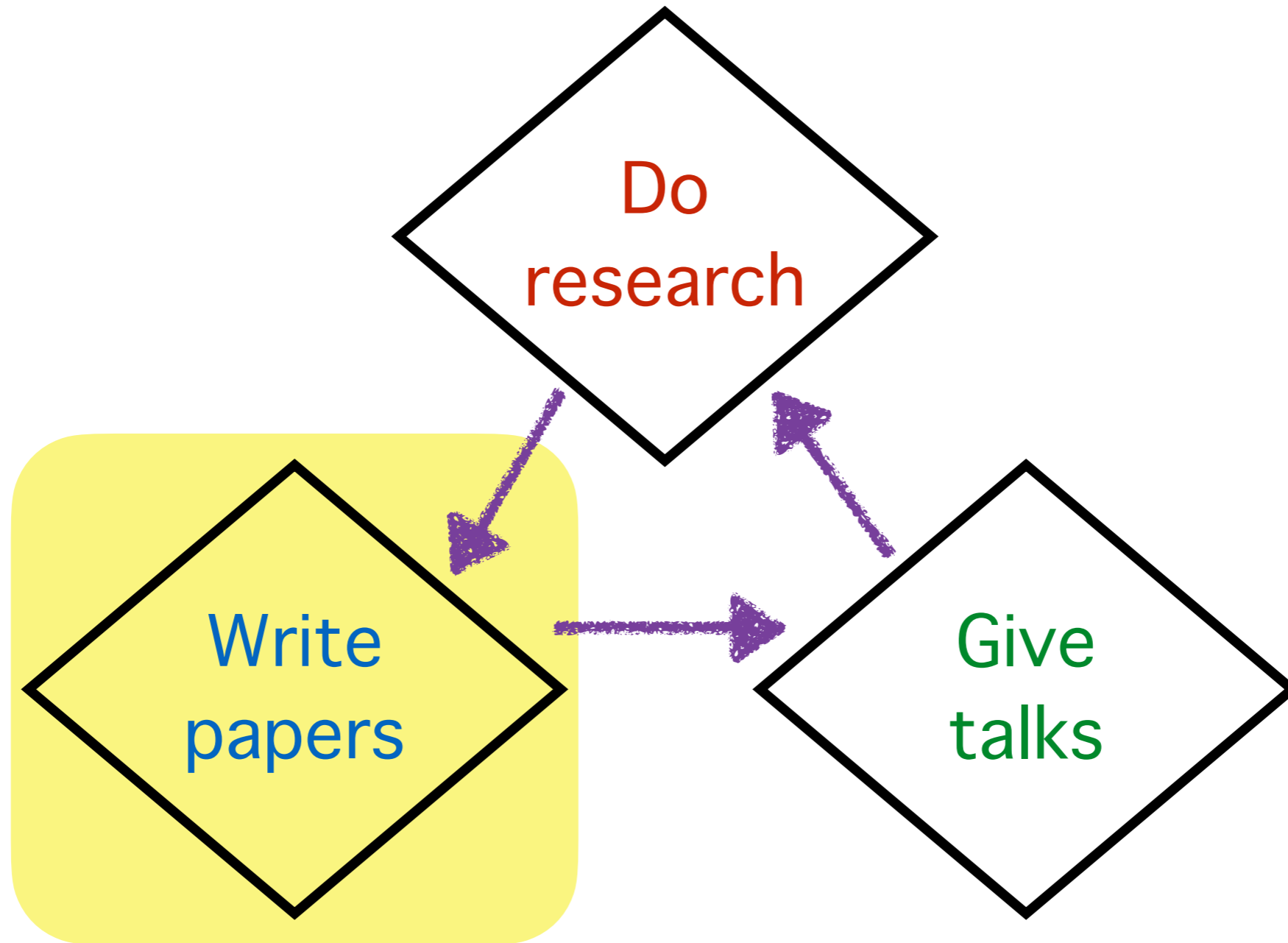PLMW@ICFP 2022

My job as a researcher

My job as a researcher

My job as a researcher

Have you read any research papers lately?

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- You may think you just lack the technical sophistication to understand them.

Have you read any research papers lately?

- You may think you just lack the technical sophistication to understand them.

- But in fact, many papers are **poorly written**.

So if you can write clear, accessible papers…

- People will **enjoy** reading them!

- People will **learn** something from them!

- They will get **accepted** to top conferences!

So if you can write clear, accessible papers…

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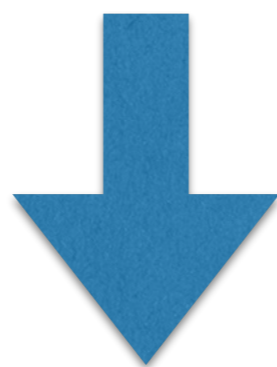
- They will get **accepted** to top conferences!

Writer

A piece of research

Reader

The good news

- There are **principles** you can follow that will help you write clearer, more readable prose

  – Based on how readers process information

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? "Be clear"

"Omit needless words"

…
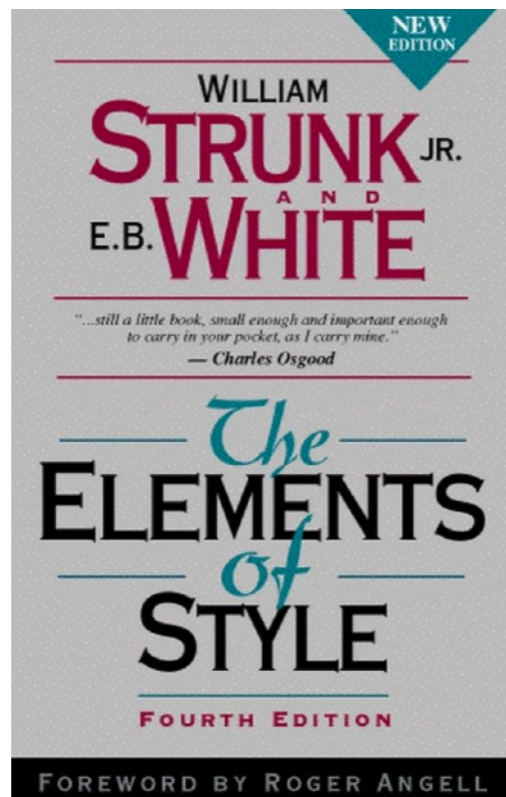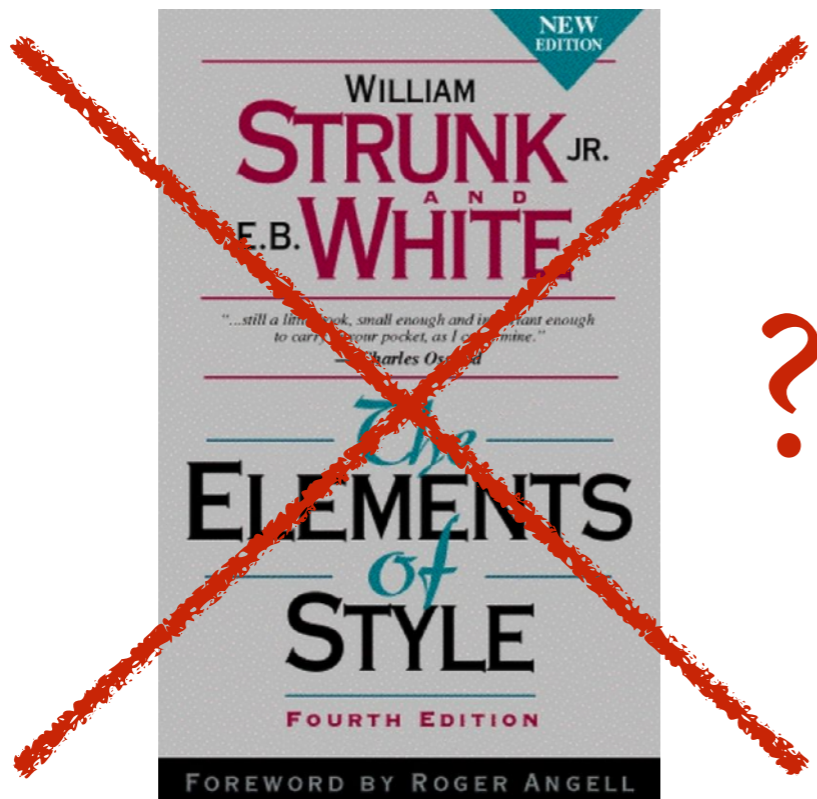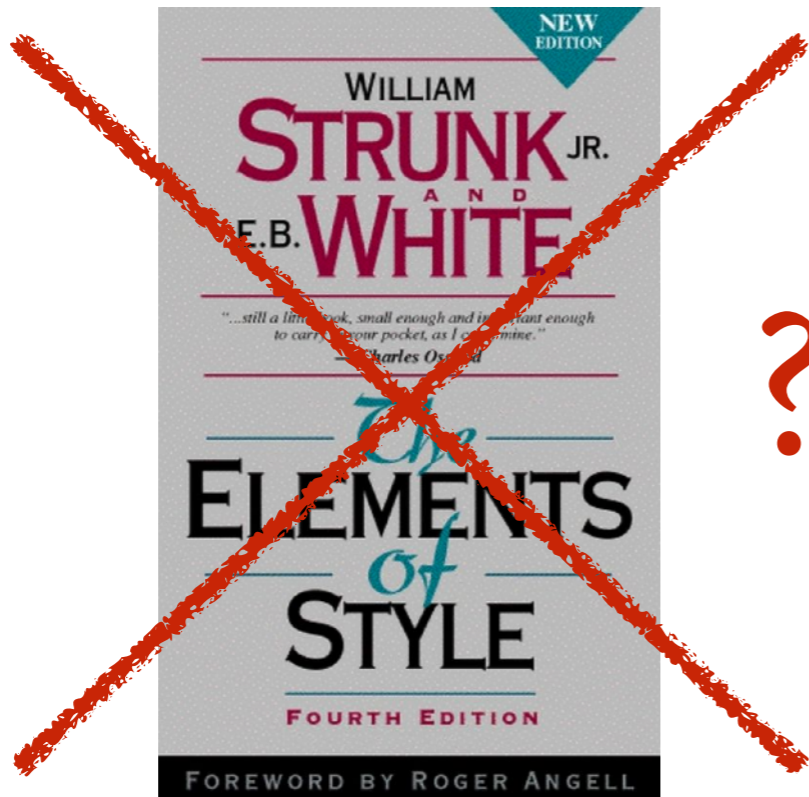
The good news

- There are **principles** you can follow that will help you write clearer, more readable prose

    - Based on how readers process information

- These principles are **constructive**:

    - Easy to check if your text satisfies these principles

    - If not, principles suggest improvements

Inspirations for this talk

- **Joseph M. Williams.** *Style: Toward clarity and grace.* 1990. (book)

- **Norman Ramsey.** *Learn technical writing in two hours per week.* (course notes)

  - http://www.cs.tufts.edu/~nr/pubs/two.pdf

- **Simon Peyton Jones.** *How to write a great research paper.* (talk)

  - https://www.microsoft.com/en-us/research/video/how-to-write-a-great-research-paper-3/
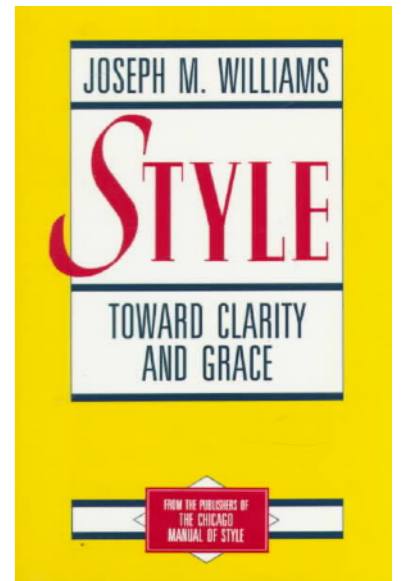
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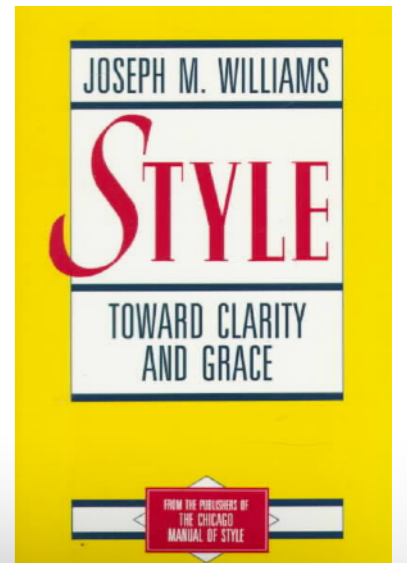
Talk developed jointly with
Rose Hoberman
@ MPI-SWS

- **Simon Peyton Jones.** *How to write a great research paper.* (talk)

  – https://www.microsoft.com/en-us/research/video/how-to-write-a-great-research-paper-3/

Sentences & paragraphs

Flow

It should be clear how each sentence and paragraph relates to **the adjacent ones**

Does this text flow?

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Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. The game-playing technique, originally proposed by Jones et al., follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games. This is a general design principle for cryptographic proofs to ease their management.

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Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. The game-playing technique, originally proposed by Jones et al., follows a code-based approach

What does this game-playing technique have to do with what came before?

Old to new

- Begin sentences with old info

  - Creates link to earlier text

- End sentences with new info

  - Creates link to the text that follows

  - Also places new info in position of **emphasis**

Applying old-to-new

New information

Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. The game-playing technique, originally proposed by Jones et al., follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games. This is a general design principle for cryptographic proofs to ease their management.
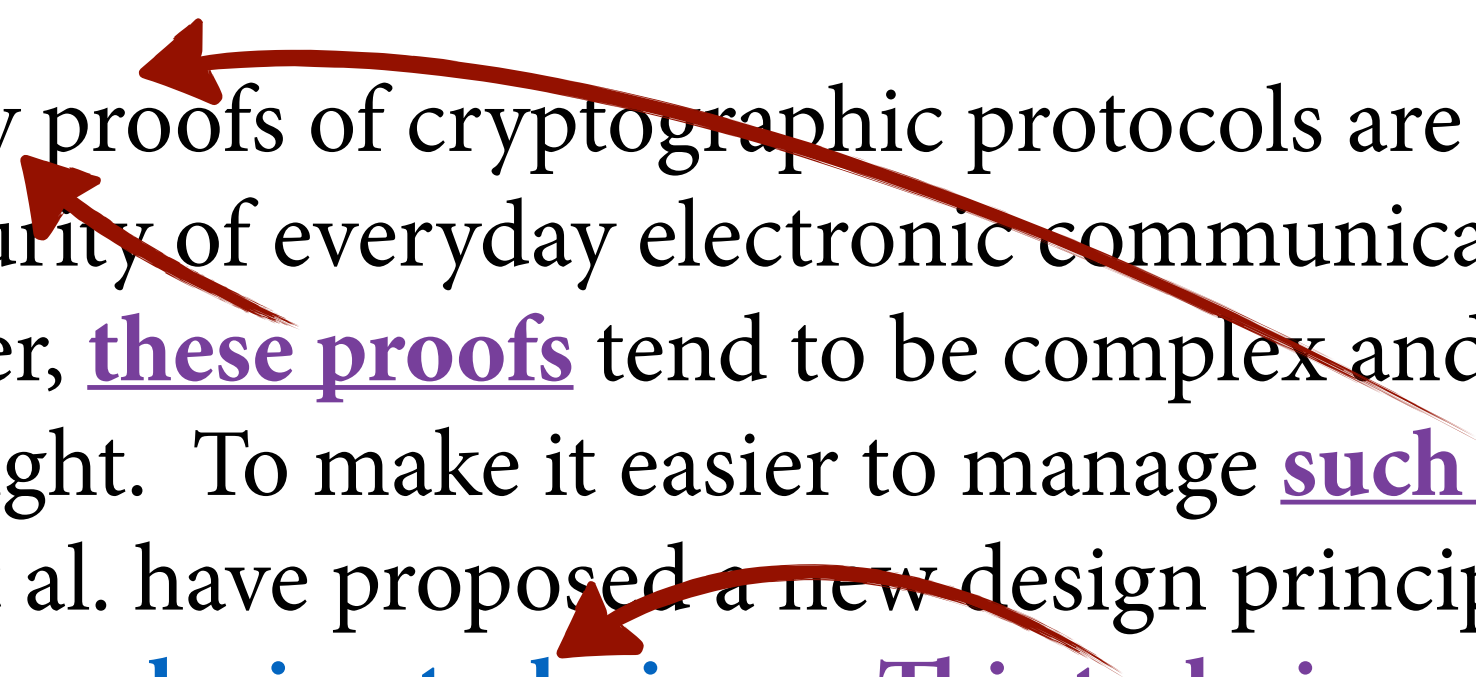
Applying old-to-new

Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. To make it easier to manage such proofs, Jones et al. have proposed a new design principle, called the game-playing technique. This technique follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games.

Old-to-new satisfied

Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, **these proofs** tend to be complex and difficult to get right. To make it easier to manage **such proofs**, Jones et al. have proposed a new design principle, called the **game-playing technique**. **This technique** follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games.

But flow is not enough!

What about this text?

Lions and tigers are some of the most dramatic and awe-inspiring species of cats. Most of these large cats, however, are currently facing extinction. A smaller cat that has been more evolutionarily successful is the house cat. Although house cats are currently the most popular pet in the world, they are in many ways anti-social. It would therefore be interesting to study whether house cats can be trained to be more sociable.

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Has great flow, but is incoherent!

Coherence

It should be clear how each sentence and paragraph relates to **the big picture**

One paragraph, one point

- A paragraph should have one main point, expressed in a single **point sentence**

- **Typically** the point sentence should appear **at or near the beginning of the paragraph**

Get to the **point!**

No point sentence

Lions and tigers are some of the most dramatic and awe-inspiring species of cats. Most of these large cats, however, are currently facing extinction. A smaller cat that has been more evolutionarily successful is the house cat. Although house cats are currently the most popular pet in the world, they are in many ways anti-social. It would therefore be interesting to study whether house cats can be trained to be more sociable.

Point sentence up front

There appears to be a negative correlation between the charisma of a species and its ability to survive. Lions and tigers, for instance, are among the most majestic creatures in the animal kingdom, yet they are currently facing extinction. In contrast, the house cat is evolutionarily quite successful, even though it is mostly known for stupid pet tricks.

Flow & coherence

Create **flow** with **old to new**

Create **coherence** with
one paragraph, one point

Two other principles

- **Name your baby**:

  - Give unique names to things and use them consistently

- **Just in time**:

  - Give information precisely when it is needed, not before

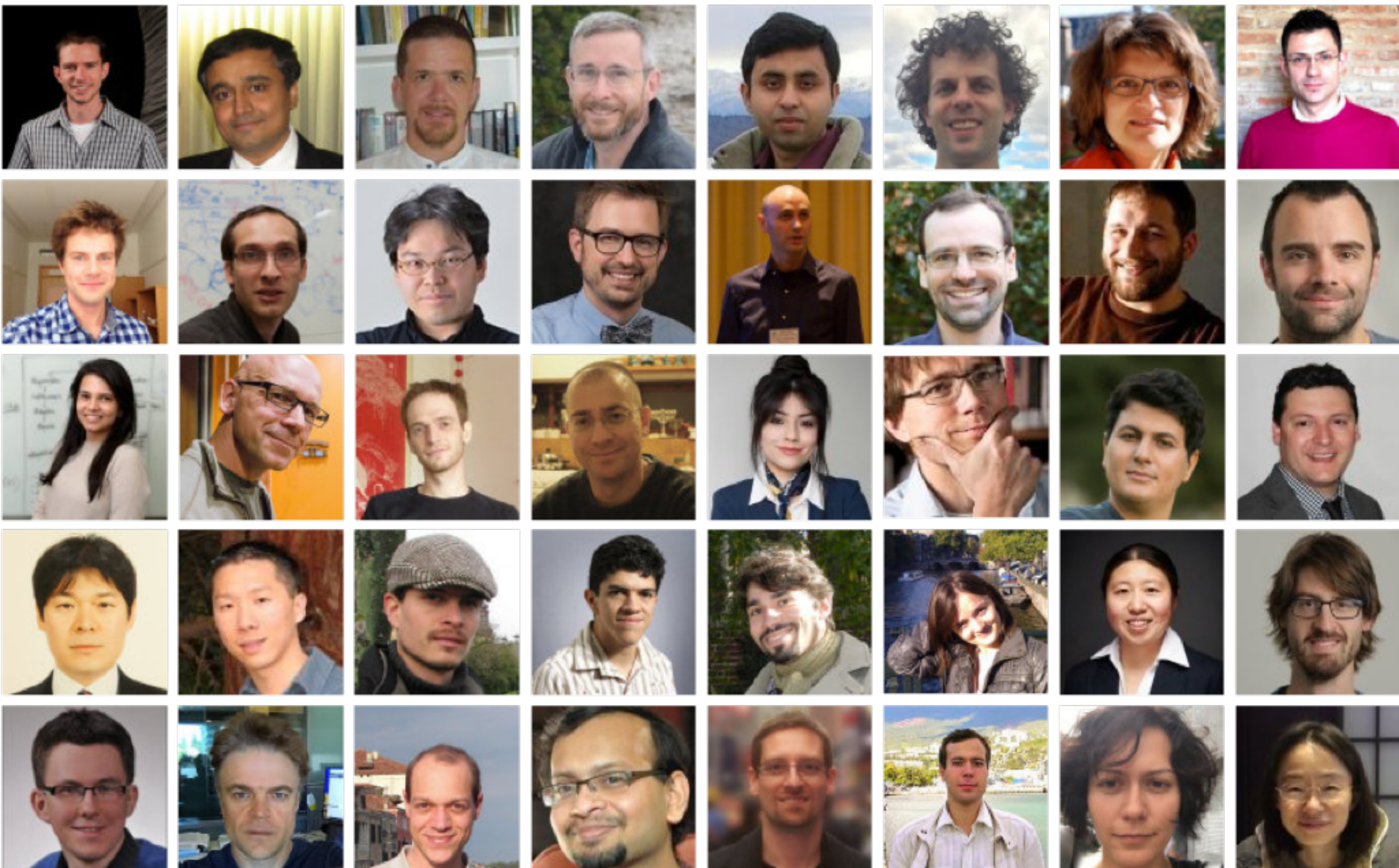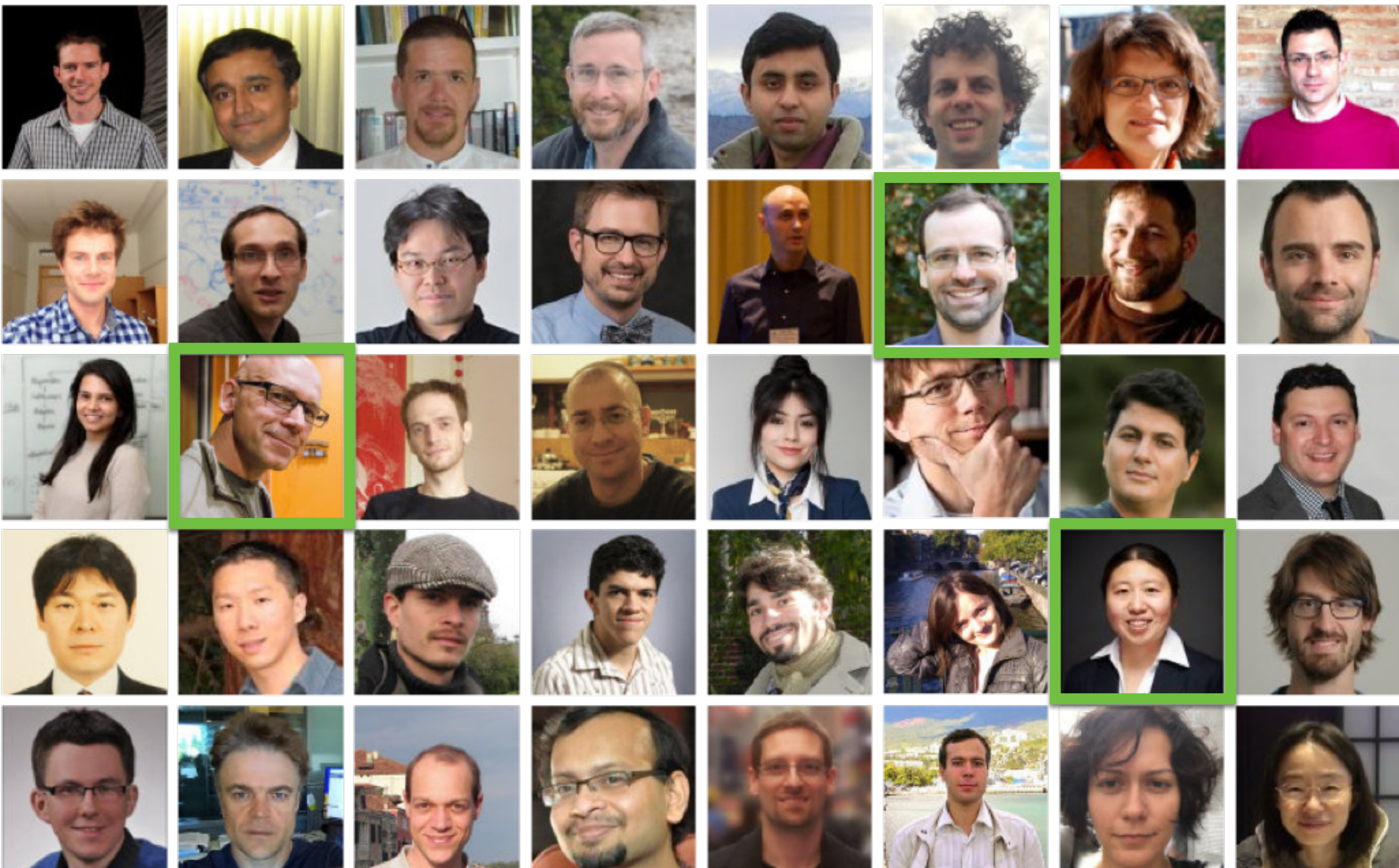# Three other principles

Bonus principle from Rose

Short subjects:
Subject of sentence should be
at most 8 words long

– Give information precisely
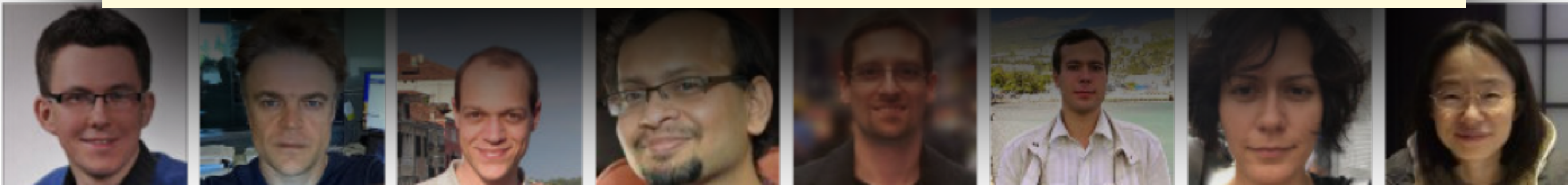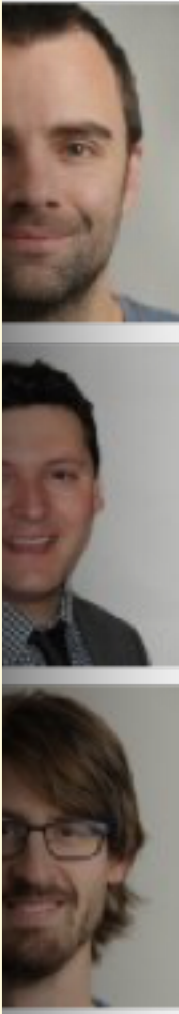when it is needed, not before

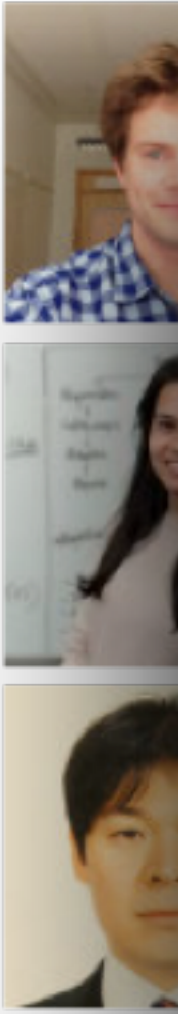# Structure of a research paper

Program committee (PC) is diverse:
- Your reviewers may not be "experts"

Review period is short (~2 months):
- ~10-20 papers per PC member
- Often < 1 day to review each paper

Overarching Principle #1

TOP-DOWN

Explain your work at multiple levels of abstraction, starting at a high level (accessible to non-experts) and getting progressively more detailed

Overarching Principle #2

Tell them what they want to know

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Tell them what they want to know

- ☑ How is your work **important**?
- ☑ How is your work **novel**?
- ☑ How is your work **interesting**?

Overarching Principle #2

Tell them what they want to know

☑ How is your work **important**?

☑ How is your work **novel**?

☑ How is your work **interesting**?

☐ ~~How was your work **challenging**?~~

A structure that works

- **Abstract** (1-2 paragraphs, 1000 readers)

- **Intro** (2-4 pages, 100 readers)

- **Key ideas** (4-6 pages, 50 readers)

- **Technical meat** (8-12 pages, 5 readers)

- **Related work** (1-3 pages, 100 readers)

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The CGI model for an abstract/intro

- **Context**:

  – Set the stage, motivate the general topic

- **Gap**:

  – Explain your specific problem and why existing work does not adequately solve it

- **Innovation**:

  – State what you've done that is new, and explain how it helps fill the gap

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Importance

The CGI model for an abstract/intro

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Importance

Novelty
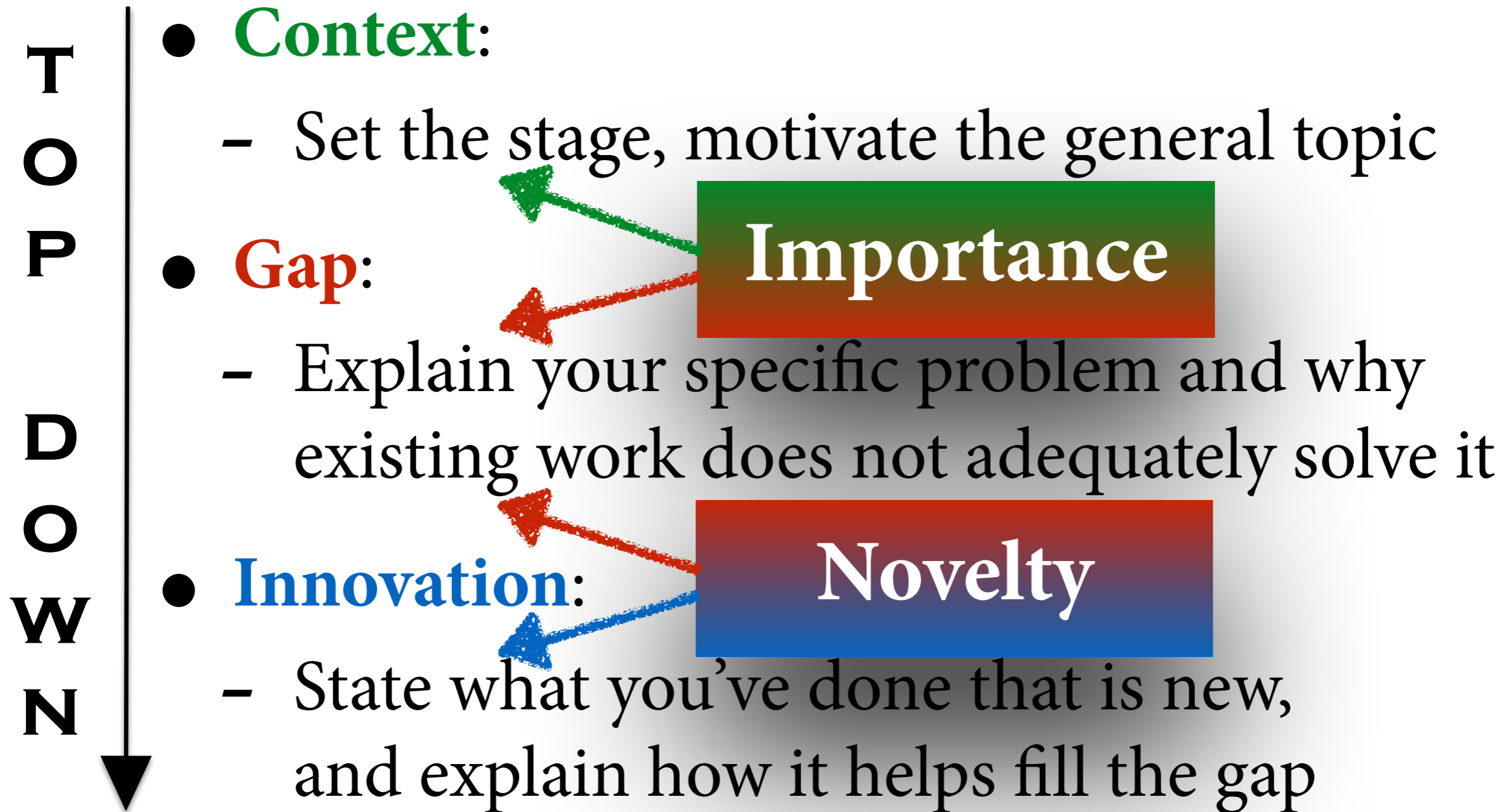
An abstract for this talk

Context

Learning to write well is an essential part of becoming a successful researcher.

Gap

Learning to write well is an essential part of becoming a successful researcher. Unfortunately, many researchers find it very hard to write well because they do not know how to view their text from the perspective of the reader.

Innovation

Learning to write well is an essential part of becoming a successful researcher. Unfortunately, many researchers find it very hard to write well because they do not know how to view their text from the perspective of the reader. In this talk, we present a simple set of principles for good writing, based on an understanding of how readers process information. Unlike such platitudes as "Be clear" or "Omit needless words", our principles are *constructive*: one can easily check whether a piece of text satisfies them, and if it does not, the principles suggest concrete ways to improve it.

Introduction

- Like an expanded version of the abstract

- Alternative approach (SPJ): Eliminate **C**ontext

  - Start with a concrete example, e.g. "Consider this Haskell code…"

  - If this works, it can be effective, but I find it often doesn't work

  - It assumes reader already knows context

A structure that works

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"Key ideas" section

- Use **concrete illustrative examples** and high-level intuition

- Do **not** have to show the general solution (that's what the technical section is for)

Why have a "key ideas" section at all?

1. Forces you to have a **takeaway**, i.e. something **interesting**!

2. Many readers only care about the takeaway, not the technical details

3. For those who want the technical details, the key ideas are still useful as "scaffolding"

A structure that works

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Related work

1. **It goes at the end** of the paper.

    - You can only properly compare to related work once you've explained your own.

2. **Give real comparisons**, not a "laundry list"!

    - Explain in detail how your work fills the **G**ap in a way that related work doesn't.

Summary of principles

- Flow via "old to new"

- Coherence via "one paragraph, one point"

- Name your baby, just in time, short subjects

- CGI model for abstract/intro

- Layer presentation with "key ideas" section

- Detailed related work section goes at the end

My job as a researcher
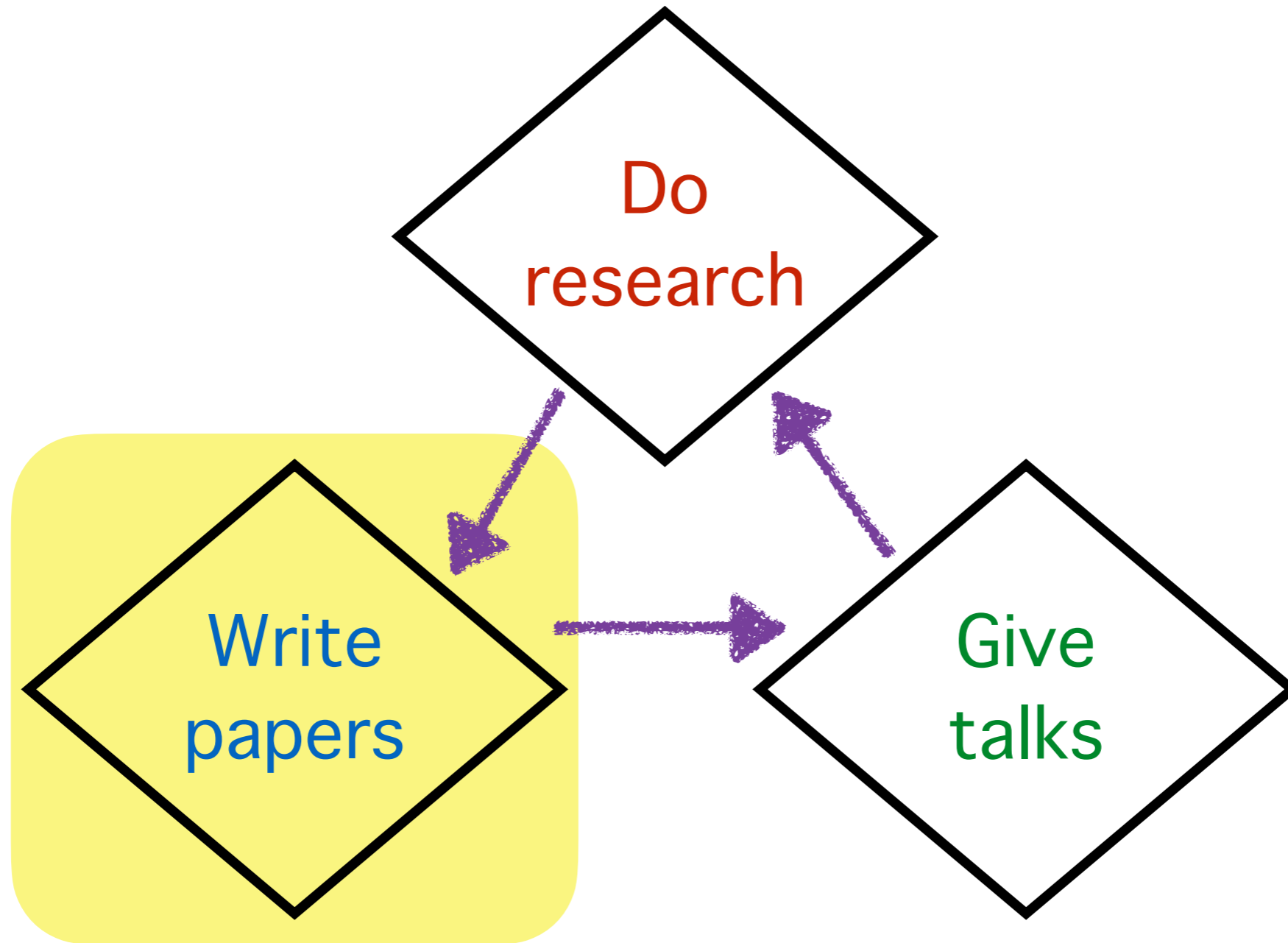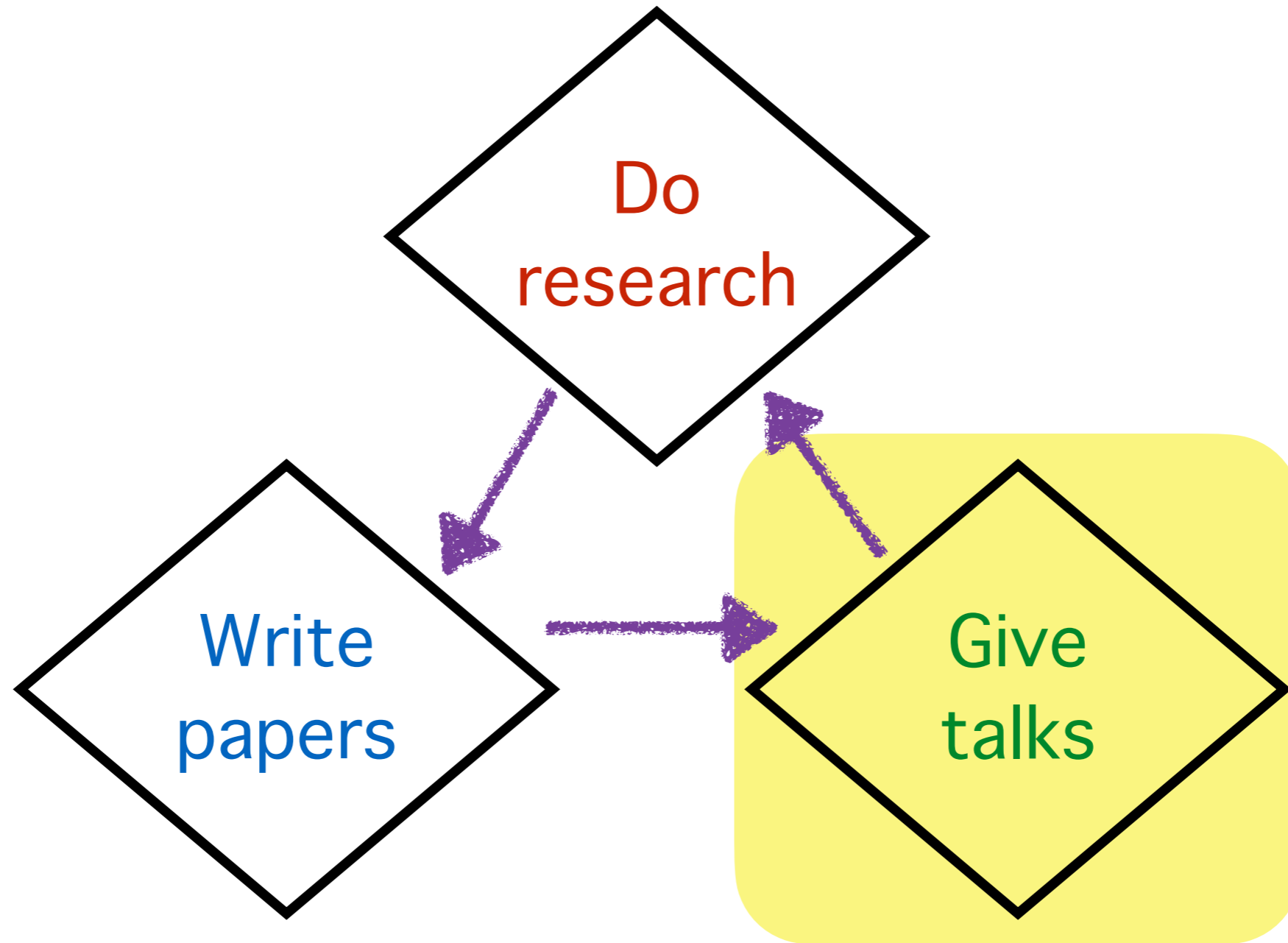
My job as a researcher

Entertain your audience!

- **Simon Peyton Jones.** *How to give a great research talk.* (MSR Summer School, 2016)

  - "Your mission is to **wake them up**!"
  - "Your most potent weapon, by far, is **your enthusiasm**!"

- **John Hughes.** *Unaccustomed as I am to public speaking.* (PLMW, 2016)

  - "**Put on a show**!"

Entertain your audience!

- **Simon Peyton Jones.** *How to give a great research talk.* (MSR Summer School, 2016)

Good advice, <u>but</u> I don't know how to teach people to be entertaining…

- **John Hughes.** *Unaccustomed as I am to public speaking.* (PLMW, 2016)
  - "**Put on a show**!"

What is your main goal in giving a conference talk?

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Get people to read your paper?

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Get people to read your paper?

No! Talk ≠ Paper

What is your main goal in giving a conference talk?

Give people positive feelings about you and your work!

How is a conference talk different from a paper?

Conference talks

On the plus side:

✓ Great advertising for you and your work!

On the minus side:

Conference talks

On the plus side:

✓ Great advertising for you and your work!

On the minus side:

✗ You can't say much.

✗ The audience may or may not care.

✗ Even those who care will easily get lost.

✗ Slides are a visual medium.

Conference talks

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A paper structure that works

- **Abstract**

- **Intro**

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- **Technical meat**

- **Related work**

A ~~paper~~ **talk** structure that works

- ~~Abstract~~
- Intro
- Key ideas
- ~~Technical meat~~
- ~~Related work~~

A ~~paper~~ talk structure that works

- **Intro** (8 minutes)

- **Key ideas** (11 minutes)

A ~~paper~~ **talk** structure that works

- **Intro** (8 minutes)

- **Key ideas** (11 minutes)

- **What else is in the paper** (1 minute)

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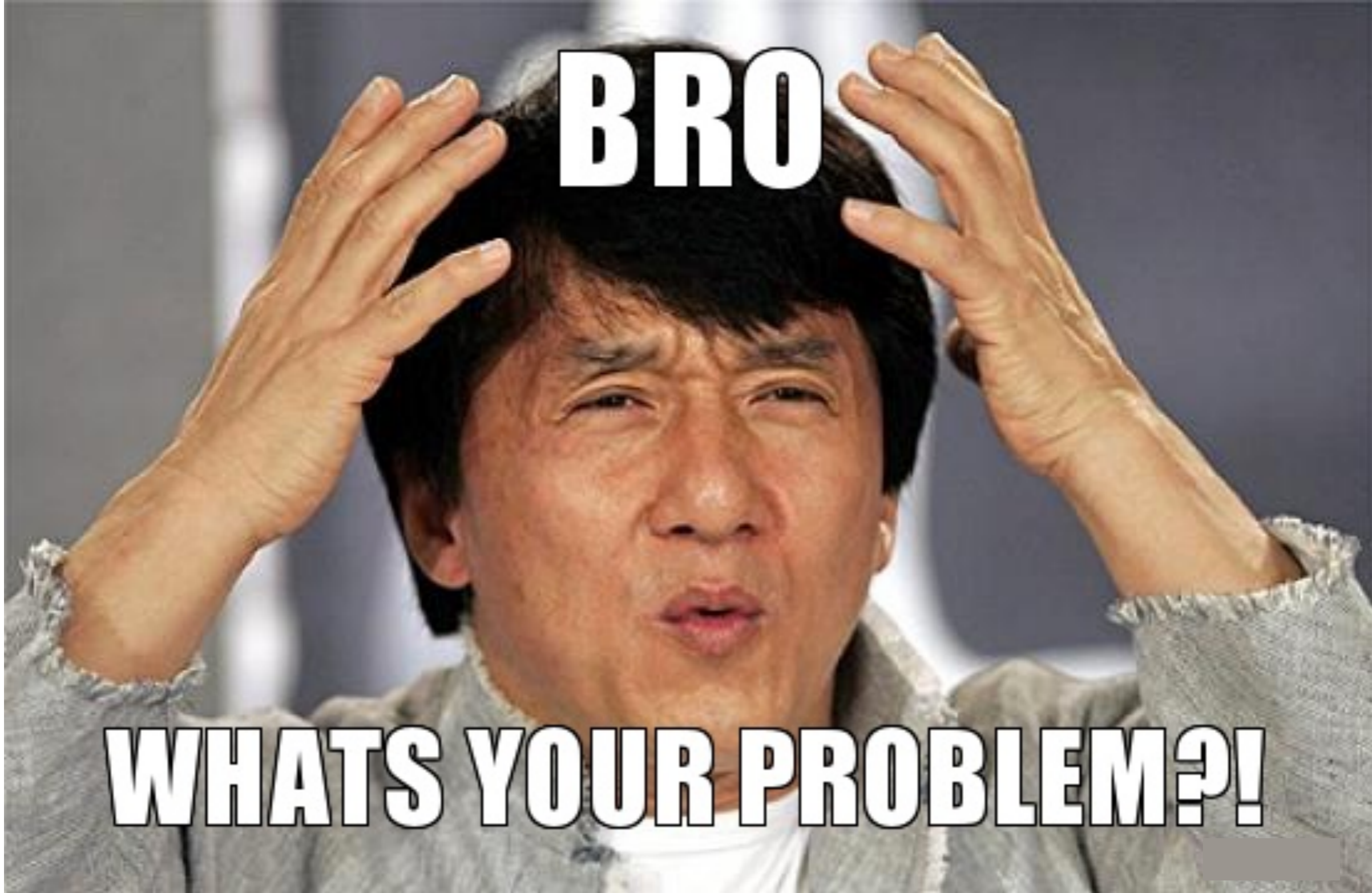
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Stage the motivation

- **First, get to <u>a</u> problem.**

  - Explain a **general** version of your problem (but not too general) **in the first 2 minutes**.

- **Then, get to <u>the</u> problem.**

  - Motivate and **explicitly state** your **specific** problem in the next 4 minutes.
  - Limit discussion of prior work only to what is needed to explain your problem.

WHAT DID YOU DO?!?
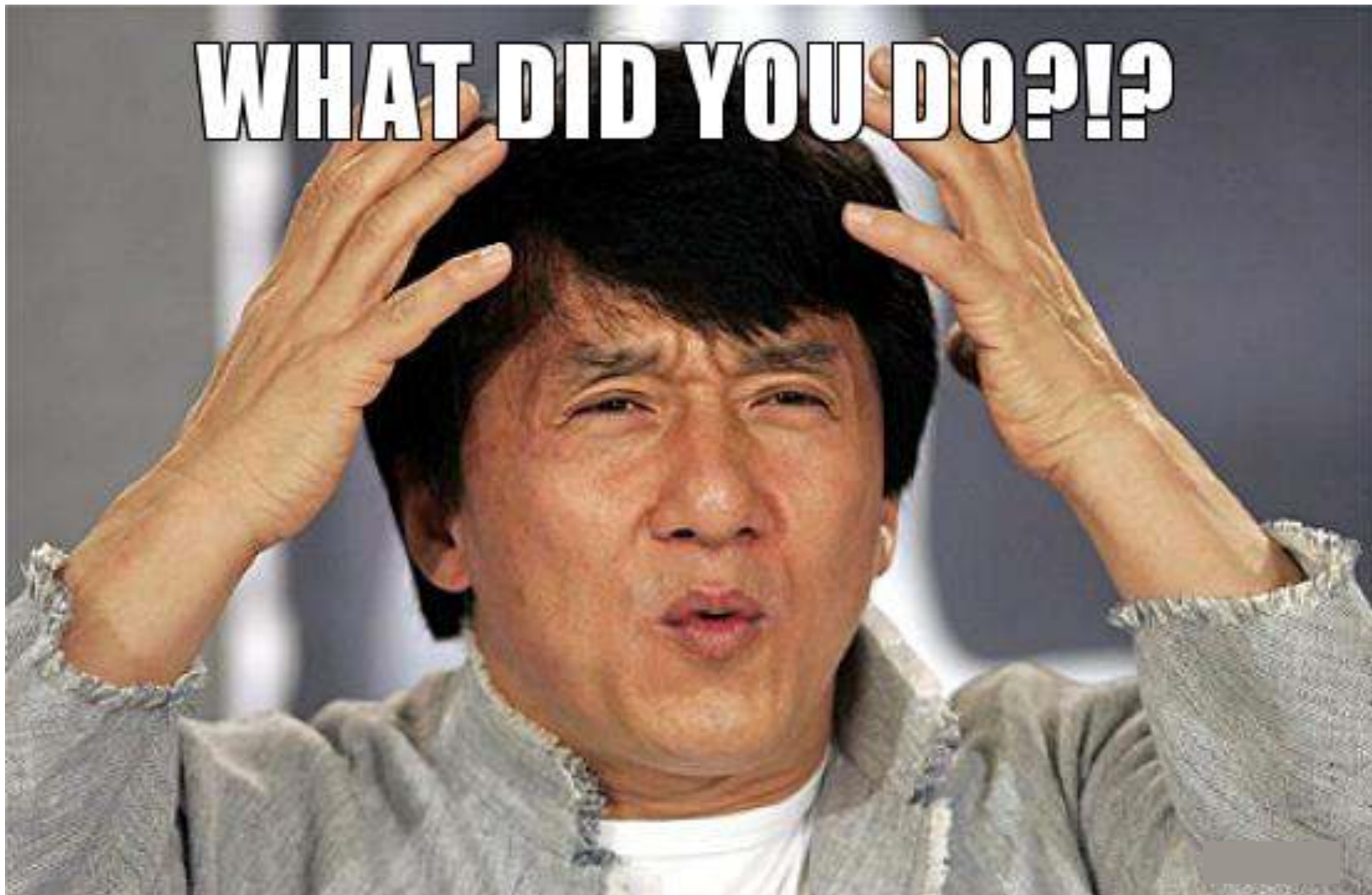
Tell them what you did!

- **Proudly state your contributions.**

  – After the motivation, the audience eagerly wants to hear what you did. Tell them!

- **Follow immediately with a crisp statement of your key idea(s).**

  – It will give audience a take-home message, and give focus to the rest of your talk.

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Flow & coherence

Create **flow** with **old to new**

Create **coherence** with
one paragraph, one point

How do flow & coherence apply in giving talks?

Flow in talks

- **Within** a slide:

  - Script should follow "old to new"

- **Between** slides:

  - Don't just flip to next slide and say, "So…"

  - Plan something to say **during** the transition

Flow & coherence

Create **flow** with **old to new**

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one paragraph, one point

Flow & coherence

Create **flow** with **old to new**

Create **coherence** with
one ~~paragraph~~, one point
slide

Optimization & Concurrency

▪ Compiler performs several optimizations to generate optimized code.
- • >100 optimizations in GCC, LLVM.

Correct optimizations for sequential programs may be incorrect for shared memory concurrency.

State-of-the-Art:

- Compilers are over-conservative;
  * optimization opportunities are lost.
or
- Buggy optimization
  * *"Premature optimization is the root of all evil"* ~ Donald Knuth

Talklets

- **Break long stretches of talk into talklets.**

  - More digestible units of story (2-4 min.)
  - But just having talklets is not enough…

- **Use transitions between talklets to remind the audience of the big picture.**

  - Summarize the point of the last talklet and how it connects to the next one.

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Core Idea of Rust

Unrestricted mutation and aliasing lead to:

- use-after-free errors (dangling references)
- data races
- iterator invalidation

**Mutation
+
Aliasing**

x

y

z

dangling

[0]

[0]

[1]
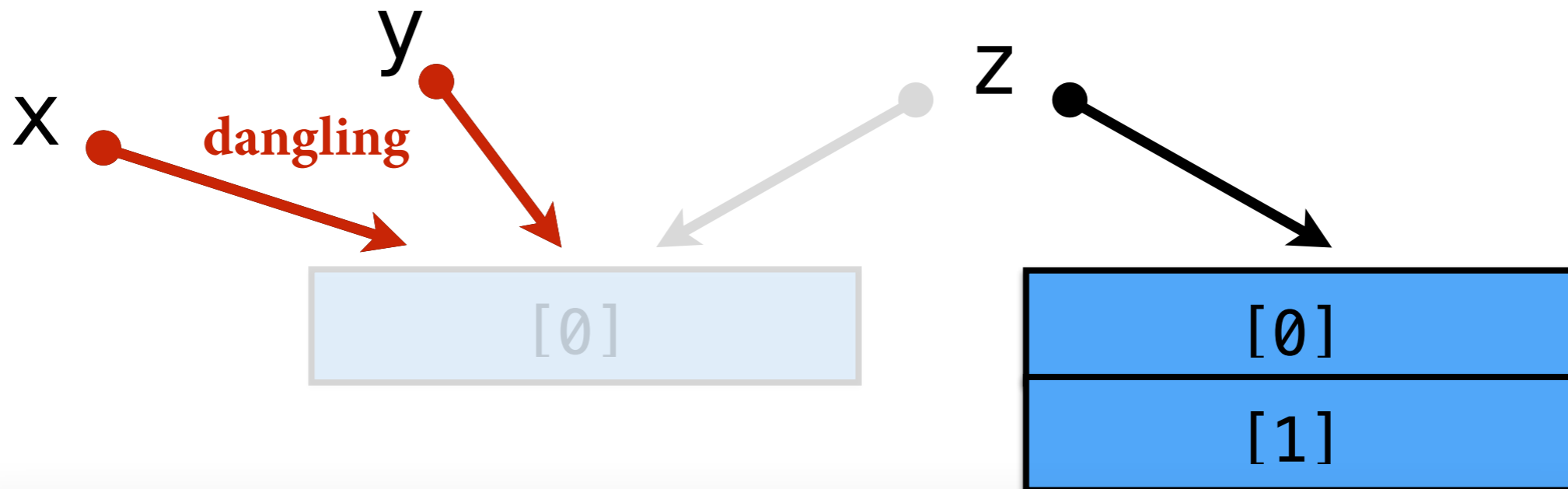
**Rust prevents all these errors using
a sophisticated "ownership" type system**

Make the focus obvious!

(h/t Ranjit Jhala, "How to Design Talks")

Make it clear where to look!

(h/t Ranjit Jhala, "How to Design Talks")

Core Idea of Rust

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Core Idea of Rust

Unrestricted mutation and aliasing lead to:

- use-after-free errors (dangling references)
- data races
- iterator invalidation

One exception to the rule…

Talklets

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Make it clear where to look

DO:

- Build slide visuals incrementally

- Use smooth animations to clarify transitions

DON'T:

- Reveal bullet points one at a time

Slide 5

Access control is inadequate, scenario 2: Facebook timeline

☐ Facebook introduced timeline in 2011 end
- Chronologically order all the information on your profile
- Make them easily searchable for other users

☐ Easier to search Potentially embarrassing older content

☐ Users were afraid of privacy violation

Access control was not changed !

Slide 6

Access control is inadequate, scenario 3: Spokeo

☐ Service aggregating information about individuals
- Each individual information is public content
- E.g., your Facebook profile, address

☐ One can infer new non public information
- ☐ Estimating wealth using address and public property records

☐ Users complain of privacy violation
Access control was not changed !

Slide 7

Access control is inadequate: Summary

☐ User reaction suggests each of the cases violate privacy

☐ However in none of the cases access control is violated

☐ We propose a new model to reason about privacy

Slide 8

Exposure : Definition

☐ We define *Prominence of information I at time t or* $P_I(t)$

$$P_I(t) = \{U | U \text{ is aware of } I \text{ at time } t\}$$

☐ Then E_I ,exposure of I is:

$$E_I = \lim_{t \to \infty} P_I(t)$$

Slide 9
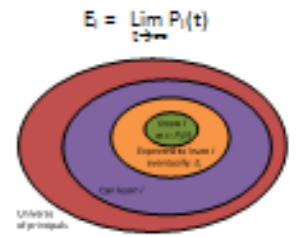
Modeling user privacy using exposure

☐ For each content users have an expected exposure
- How many other users are likely to access the content

☐ We can model privacy violation for an information as
- Large deviation of actual exposure from expected exposure

Slide 10

Revisiting scenario 1: Facebook newsfeed

☐ Before newsfeed was introduced
- Expected exposure: Friends who will visit user's profile
- Actual exposure was same as expected exposure

☐ After newsfeed was introduced
- Actual exposure: All friends to whom the information is pushed
- Actual exposure is much higher than the expected exposure

Slide 11

Revisiting scenario 2: Facebook timeline

☐ Before timeline was introduced
- Expected exposure for older data: Friends who will scroll to find a old content
- Actual exposure for older data was same as expected exposure

☐ After timeline was introduced
- Actual exposure for older data: All friends who visit the profile
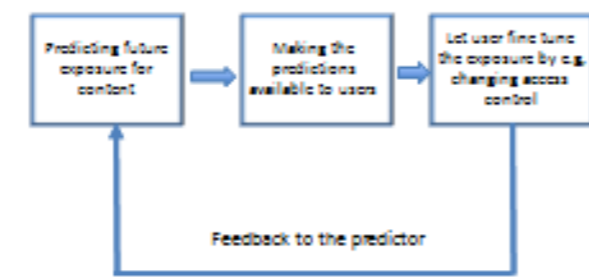- Actual exposure is much higher than the expected exposure

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Slide 12

Revisiting scenario 3: Spokeo

☐ Before spokeo aggregated data
- Expected exposure for new inferred data: Users who dig up each individual pieces of content form different sources
- Actual exposure for older data was same as expected exposure

☐ After spokeo aggregated data
- Actual exposure for new inferred data: All users who visit public spokeo website
- Actual exposure is much higher than the expected exposure

Slide 13

Major Deviation from expected exposure can capture the privacy violations not covered by access control

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Slide 14

Proposed model: managing privacy via exposure

Predicting future exposure for content → Making the predictions available to users → Let user fine tune the exposure by e.g. changing access control

Feedback to the predictor

Slide 15

Key challenge: Predicting future exposure

☐ Huge existing work for predicting growth in content popularity
- Future YouTube views, Facebook likes, Retweets
- Use machine learning, regression techniques
- We can leverage advances in those fields to predict exposure

☐ OSN operators are best positioned to do the predictions
- Empirical data on how information disseminates in their sites
- Facebook or Youtube already provide number of likes or views

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Slide 16

Limitations of our model

☐ Privacy violation by inference using available data
- It is extremely hard to enumerate all possible inference

☐ Privacy violation using cross site prediction
- Prediction across multiple systems
- E.g., posting a picture taken from Facebook in tweeter

53 — Introduction

- Like an expanded version of the abstract
- Alternative approach (SPJ): Eliminate Context
  - Start with a concrete example, e.g. "Consider this Haskell code…"
  - If this works, it can be effective, but I find it often doesn't work
  - It assumes reader already knows context

54 — A structure that works

- Abstract (1-2 paragraphs, 1000 readers)
- Intro (1-2 pages, 100 readers)
- **Key ideas (2-3 pages, 50 readers)**
- Technical meat (4-6 pages, 5 readers)
- Related work (1-2 pages, 100 readers)

55 — "Key ideas" section

- Use **concrete illustrative examples** and high-level intuition
- Do **not** have to show the general solution (that's what the technical section is for)

56 — Why have a "key ideas" section at all?

1. Forces you to have a "takeaway"
2. Many readers only care about the takeaway, not the technical details
3. For those who want the technical details, the key ideas are still useful as "scaffolding"

57 — A confession

I don't always have a key ideas section.

58 — Breadth-first traversal

59
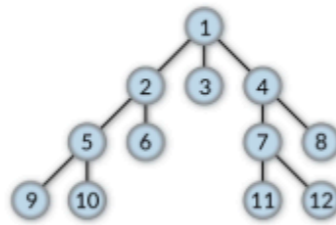
Sometimes breadth-first doesn't work!
e.g., if explaining 3 & 4 requires first explaining subtree rooted at 2

Key ideas:

Technical meat

60
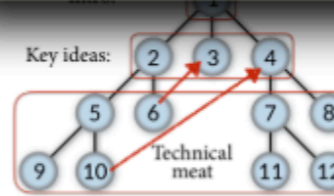
A Promising Semantics for Relaxed-Memory Concurrency

61

62 — Layering the presentation

"The paper is extremely well written."

"The presentation of the semantics is well-motivated and understandable."

- **Section 3-4**: Presented other key ideas and built up to the full semantics incrementally

63 — Layering the presentation

- What if you don't have enough space for such a layered presentation?
  - Move some technical details to appendix
  - Submit to a better conference (i.e. a conference with a higher page limit)

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Key takeaways

- **Avoid PowerPoint-itis**
  - Don't put lots of text on slides just so they are readable independently of the talk

- **Vary the look of the slides**
  - Some text-only slides are fine, but if there are too many in a row, audience falls asleep

Summary of principles

- Talk ≠ Paper

- Intro & key ideas are all you need

- First general problem, then specific problem

- State contributions & follow with key ideas

- Flow via old-to-new

- Coherence via one slide, one point

- Make it clear where to look

- Avoid lots of text & vary the look of slides