

**SCIENCE  
COMMUNICATION**  
Carnegie Mellon University

Ardon Shorr, Ph.D.

What do we mean by  
science communication?

Who are we talking to?

What are we hoping to achieve?

What happens when this goes well?

What happens when this goes poorly?

How do we learn  
science communication?

How **might** we learn instead?

# There's momentum for formal training

## GRADSCICOMM REPORT AND RECOMMENDATIONS

*Mapping the Pathways to Integrate  
Science Communication Training into  
STEM Graduate Education*

### RECOMMENDATIONS

#### RECOMMENDATION 1: EXPAND TRAINING ACCESS

*Provide access to formal communication training opportunities for all STEM graduate students.*

While most graduate education programs target the cognitive and technical skills required in STEM disciplines, emotional and communication skills are gaining wider recognition for their contributions to leadership and career success. Although associated traits like charisma and innate abilities vary from person to person, communication skills can be improved with a combination of training, feedback, and practice (Silva and Bultitude 2009; Berkhof et al. 2011). Training is particularly important since people tend to chronically overestimate their communication effectiveness (Keysar and Henly 2002; Kruger et al. 2005; Keysar 2007), and not only does communication ability not improve with time and experience alone (Moore et al. 2013), it may even degrade (Ha et al. 2010).

Our snapshot of communication trainings and courses suggests that graduate students encounter wildly variable access to communication resources depending on their department, discipline, university, and geographic location. While not all students require or will take advantage of the expertise and coaching available to them, all students should have the ability to enroll in graduate-level coursework and/or professional development programming.

# There's momentum for formal training

## GRADSCICOMM

### REPORT AND RECOMMENDATIONS

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***Provide access to formal communication training opportunities for all STEM graduate students.***

only does communication ability not improve with time and experience alone (Moore et al. 2013), it may even degrade (Ha et al. 2010).

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# We have a lot to gain

## **Within our field**

Grants, papers, adoption of your findings

Teaching

Recruiting the best students

Crossing the last 10 feet at conferences

## **Outside our field**

Expanded career options

Recruiting collaborators

Forming interdisciplinary teams

# Fewer than 8 out of 100 grad students will take a faculty job

**Life Sciences\***



**Engineering**



**Physical Sciences**



**Mathematical Sciences**



**Computer Science**



## So Many Degrees, So Little Demand

The number of **graduates** with technical majors (shown: bachelor, master and Ph.D. degrees awarded in 2015-16) tends to outpace **job openings** (shown: 2014-24 projections, annualized). Computer science is the exception.

**How are we preparing  
for non-academic jobs?**

\*Does not include health care occupations.

What do you want to see?

What do you *not* want to see?

# Structuring Presentation

Presentations are **boring**

Why?

**Presentations are overwhelming**

**Why?**

# Expertise creates an expert blindspot

## Expert Blind Spot: When Content Knowledge Eclipses Pedagogical Content Knowledge

*Mitchell J. Nathan<sup>1</sup>, Kenneth R. Koedinger<sup>2</sup> and Martha W. Alibali<sup>3</sup>*

<sup>1</sup>*University of Colorado, nathanm@stripe.colorado.edu*

<sup>2</sup>*Carnegie Mellon University*    <sup>3</sup>*University of Wisconsin-Madison*

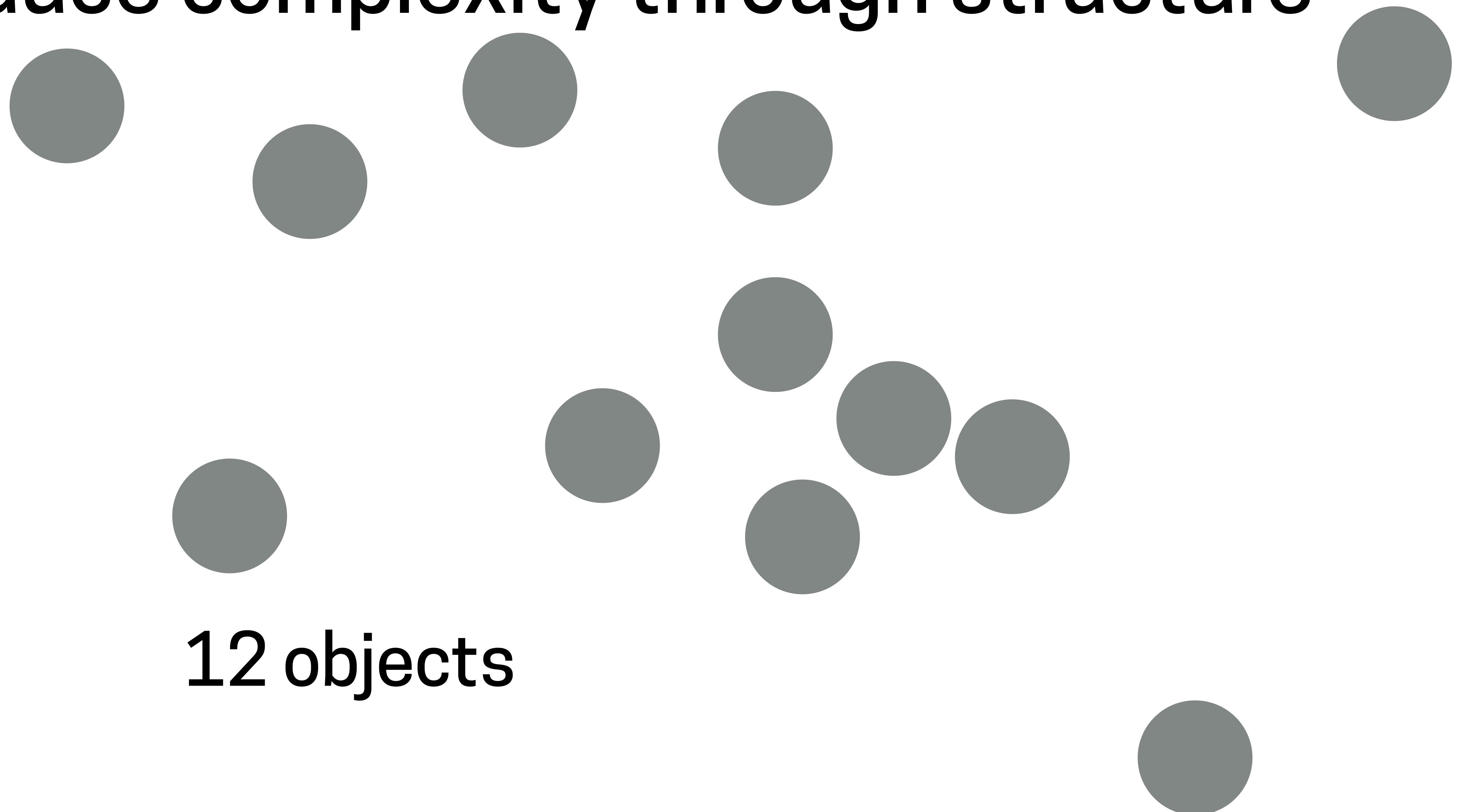
# Reframing the challenge of presentation

Presentations are boring because they're  
**overwhelming**

Presentations are overwhelming because  
we have an **expert blindspot**

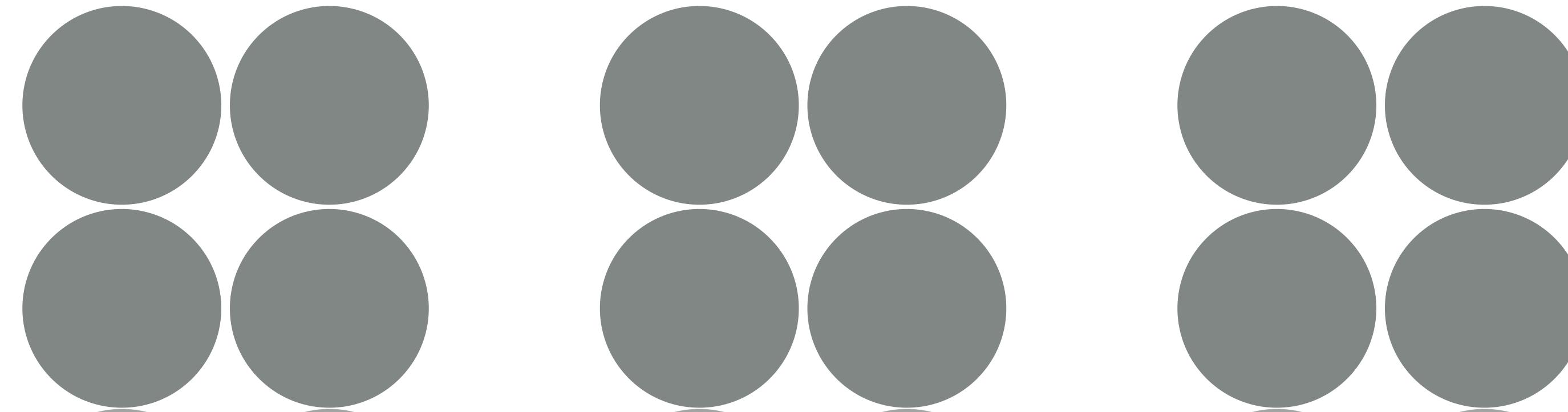
Our goal today:  
Reduce complexity through structure

# Reduce complexity through structure



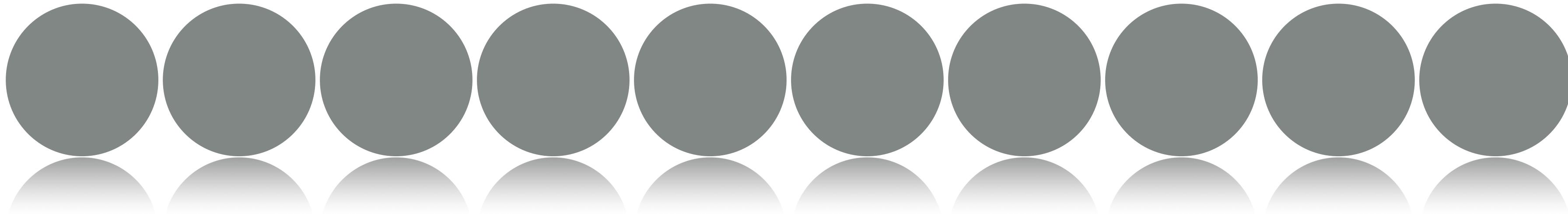
12 objects

# Reduce complexity through structure

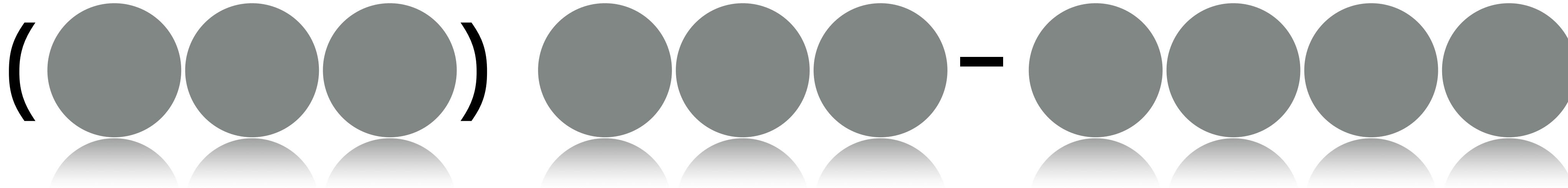


3 groups

# Reduce complexity through structure



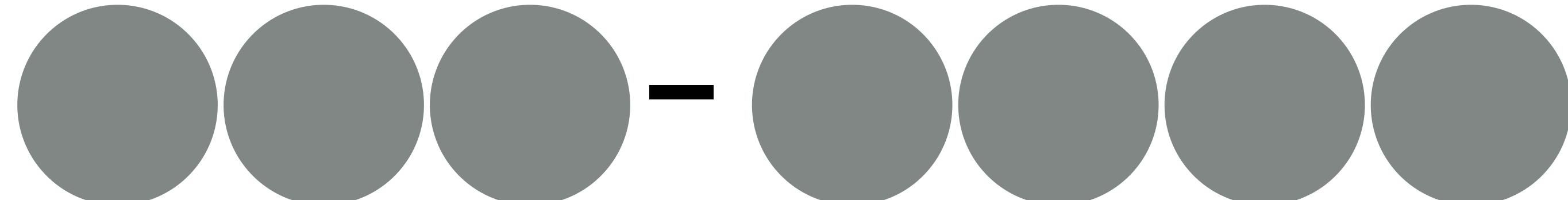
# Reduce complexity through structure



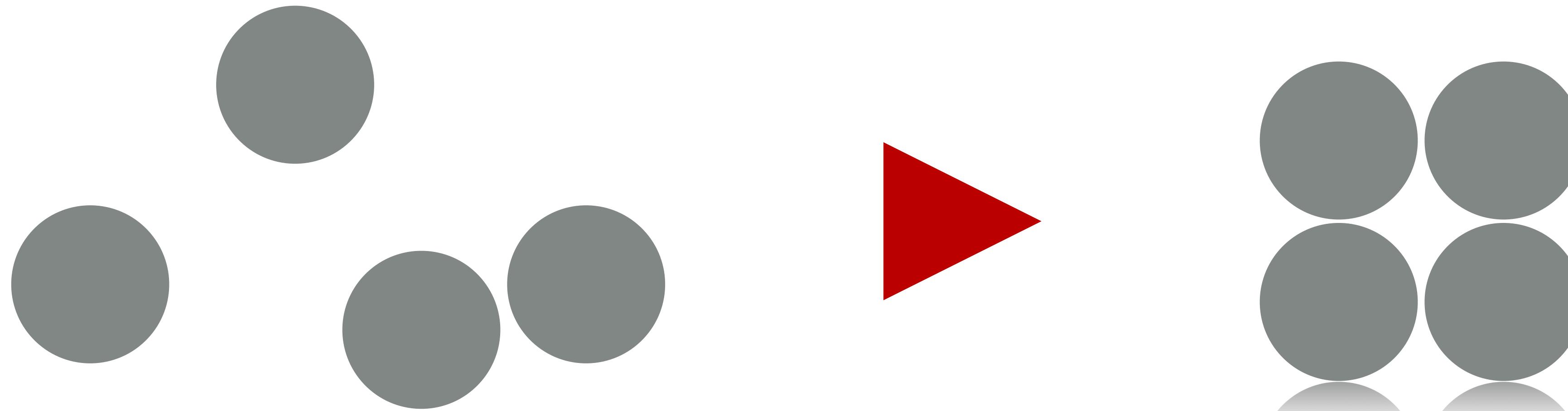
# Reduce complexity through structure

Pittsburgh

( 4 1 2 )



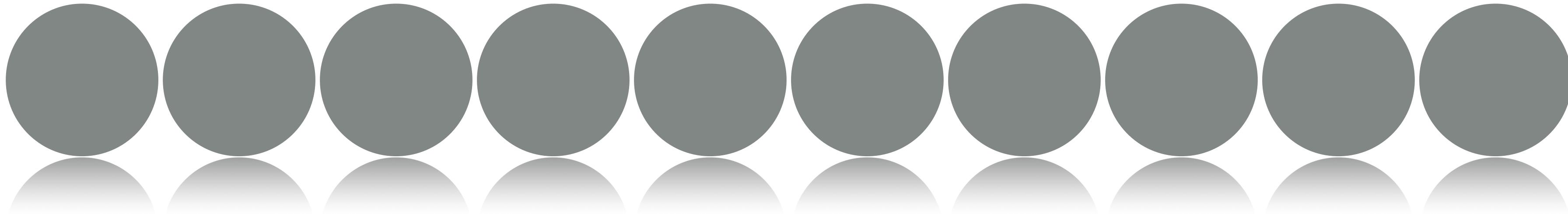
Chunking reduces complexity  
by treating several objects as one group



4 objects

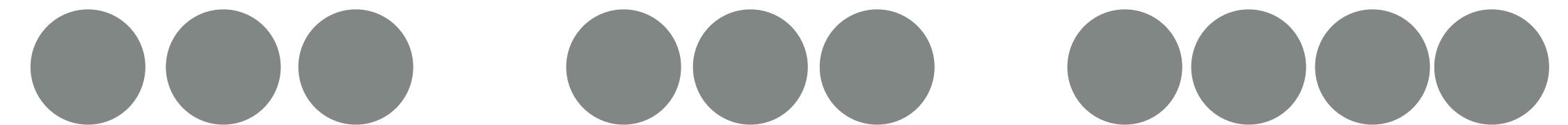
1 group

# Presentations can be chunked



# Presentations can be chunked

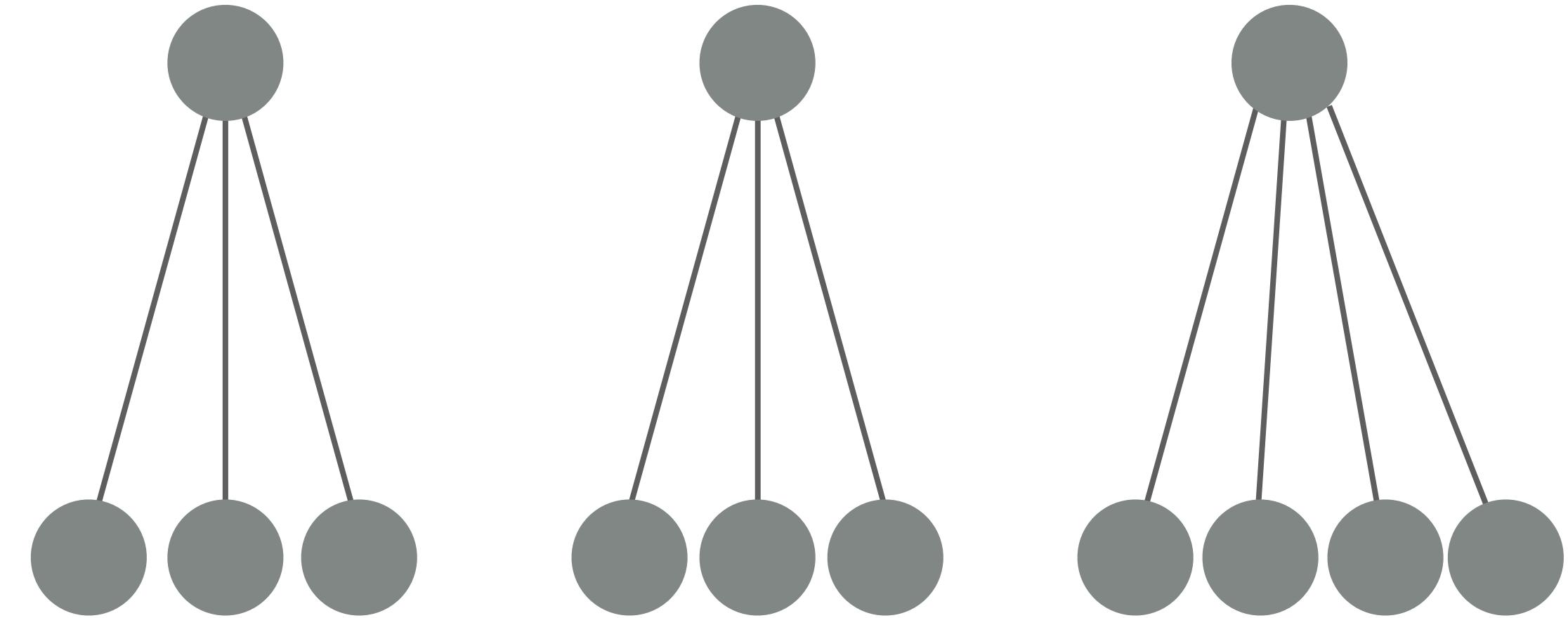
Slides



# Presentations can be chunked

# Sections

# Slides

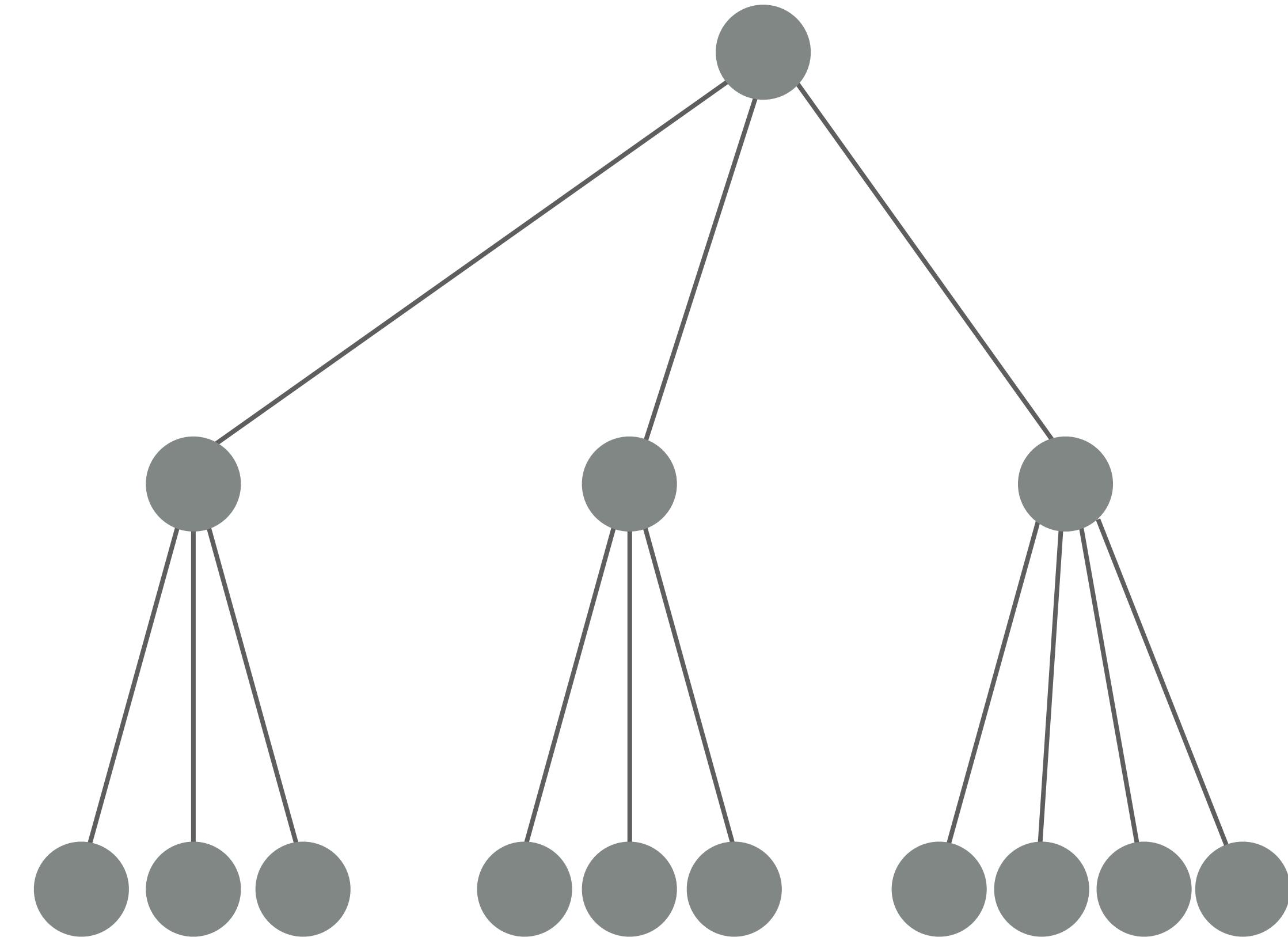


# Presentations can be chunked

Main message

Sections

Slides

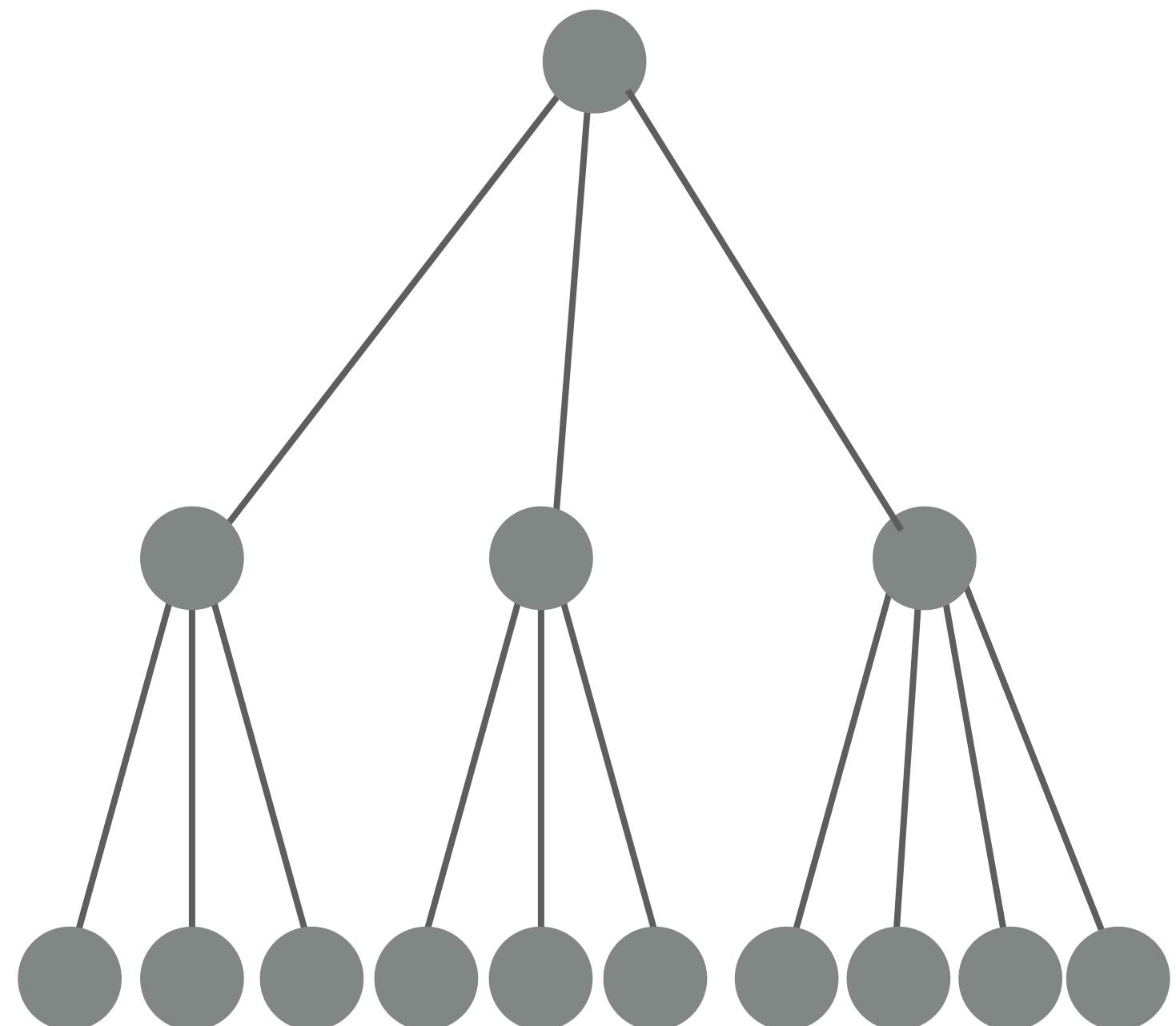


# Structuring Presentation

## Reframing the challenge

Presentations are boring  
because they're overwhelming  
because we have an expert blindspot

Chunking reduces complexity  
and can be applied at many levels



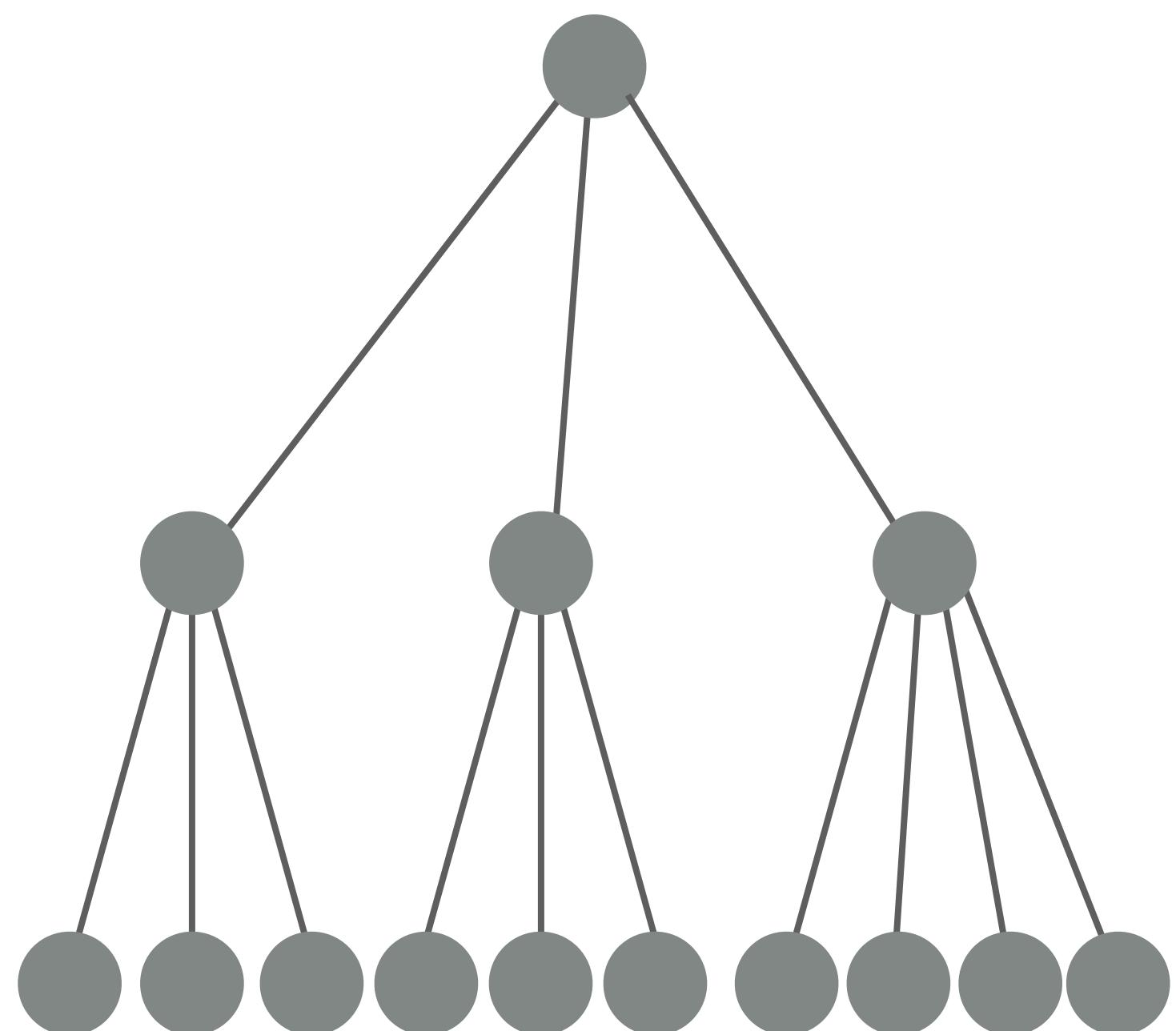
# Structuring Presentation

## Reframing the challenge

Chunking slides

Chunking sections

Chunking presentations



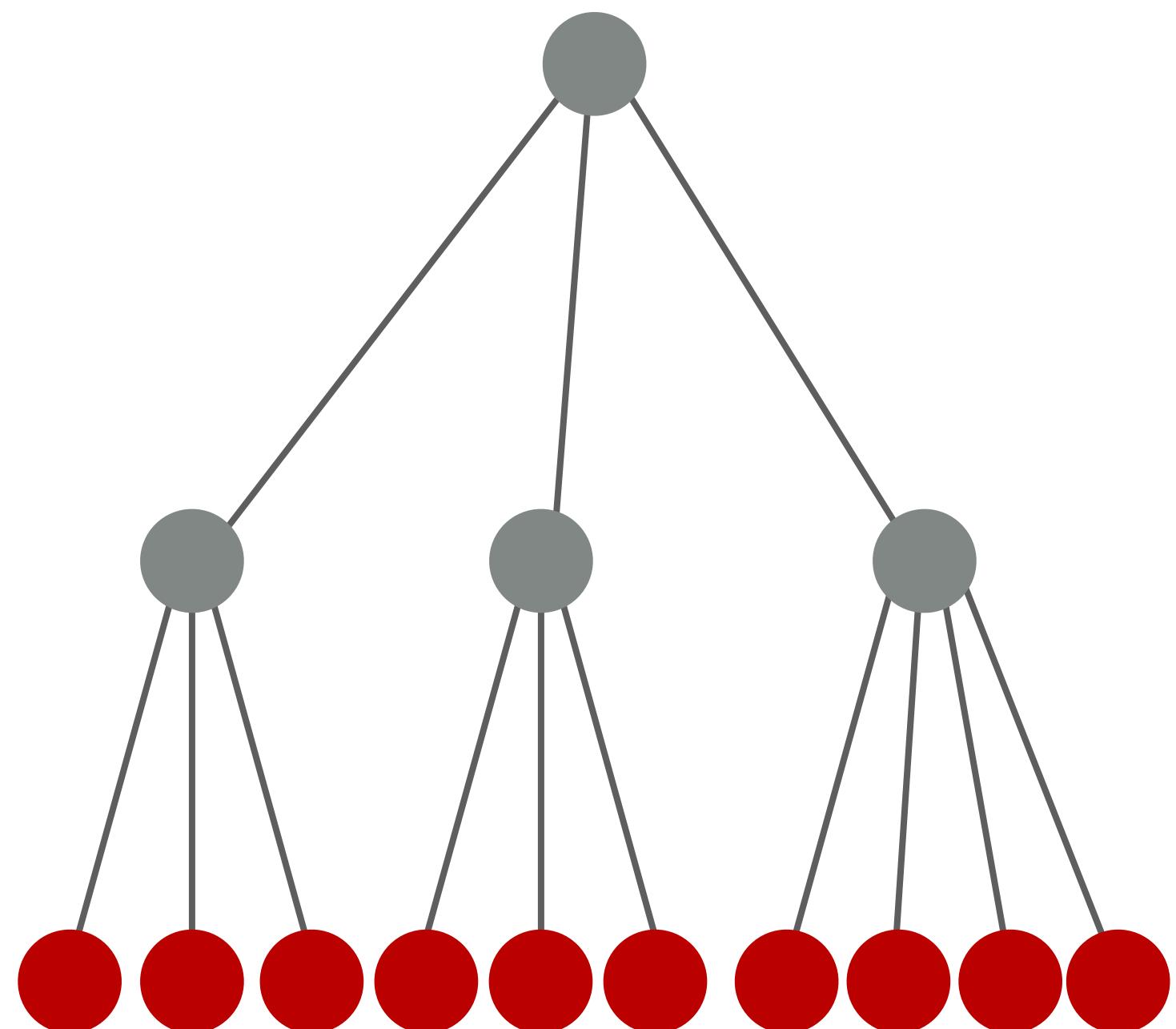
# Structuring Presentation

Reframing the challenge

Chunking slides

Chunking sections

Chunking presentations



# Survey results

**What should this course cover?**

% respondents



# Students are interested in many topics in writing

**What should this course cover?**

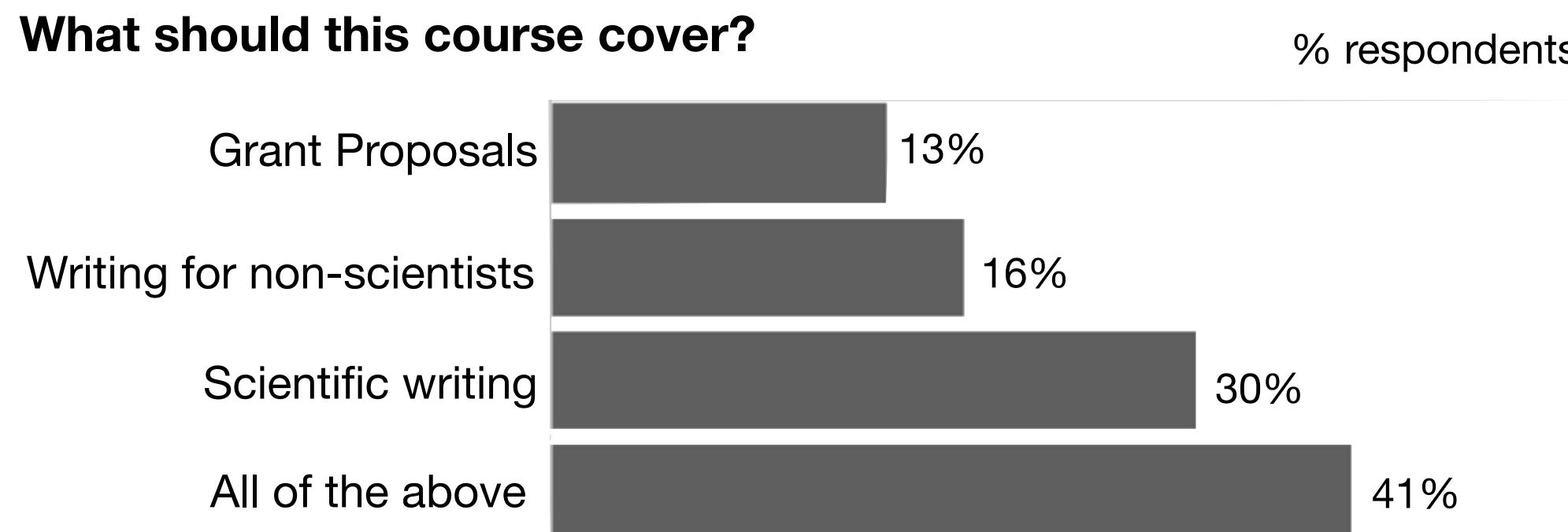
% respondents



# Sentence titles state the point, not just the topic

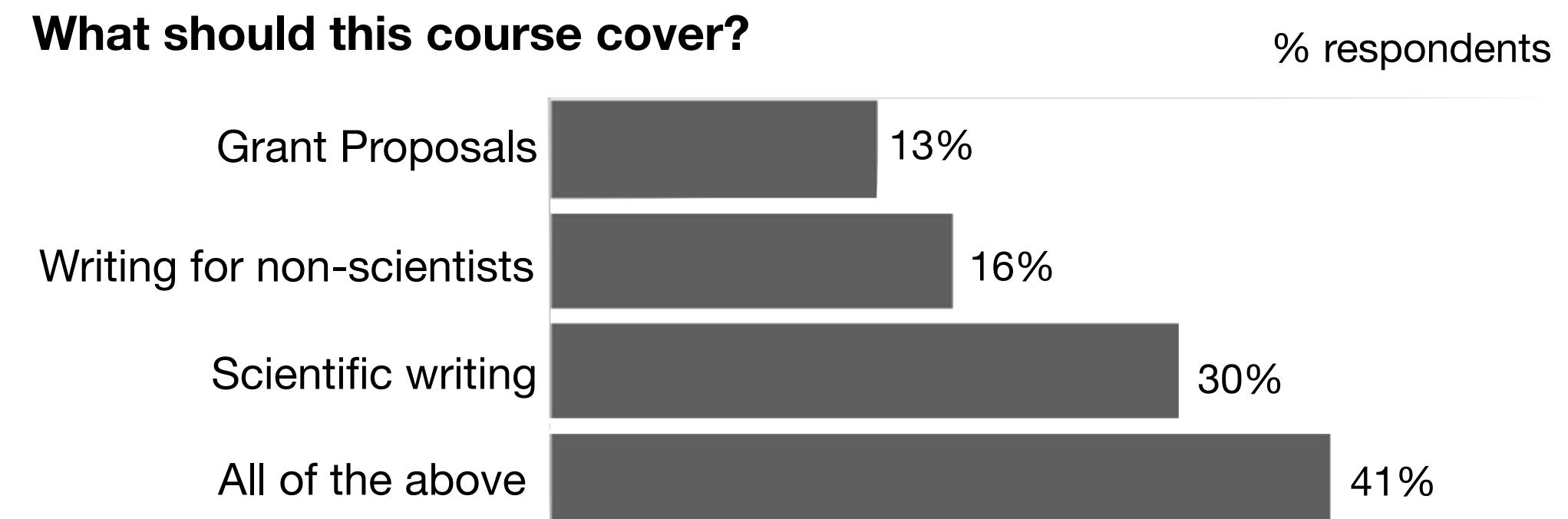
## Point

Students are interested in many topics in writing



## Topic

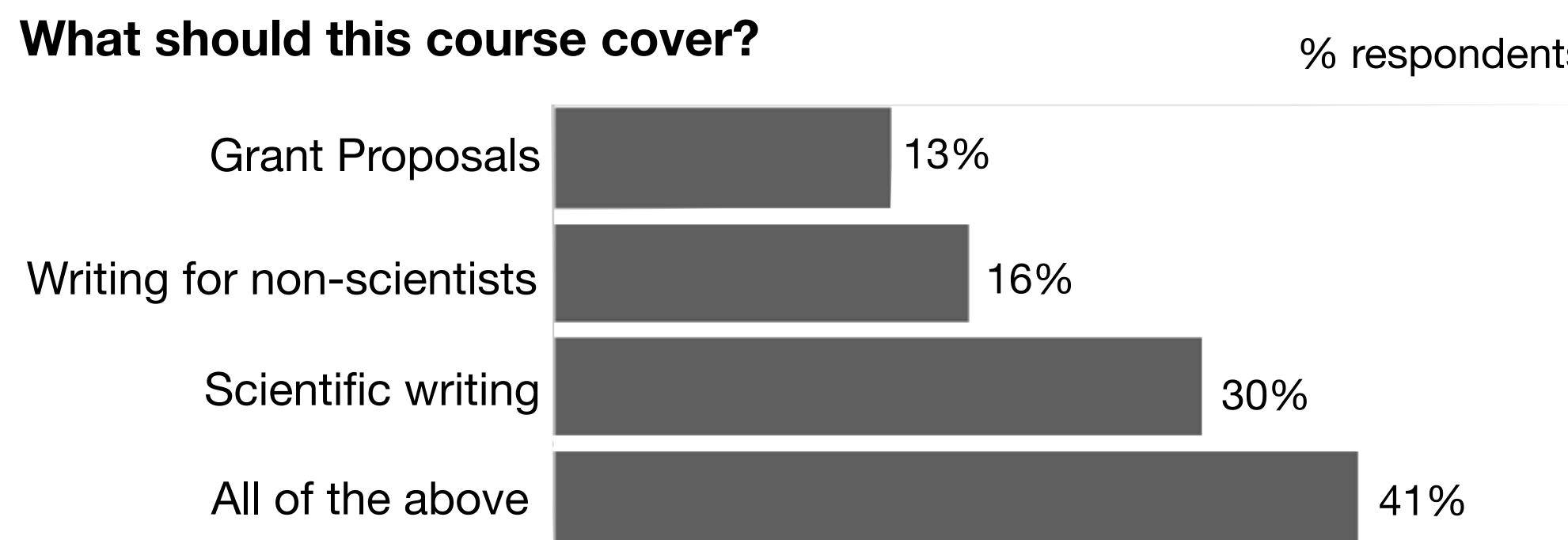
Survey results



# Sentence titles are critical because information has many interpretations

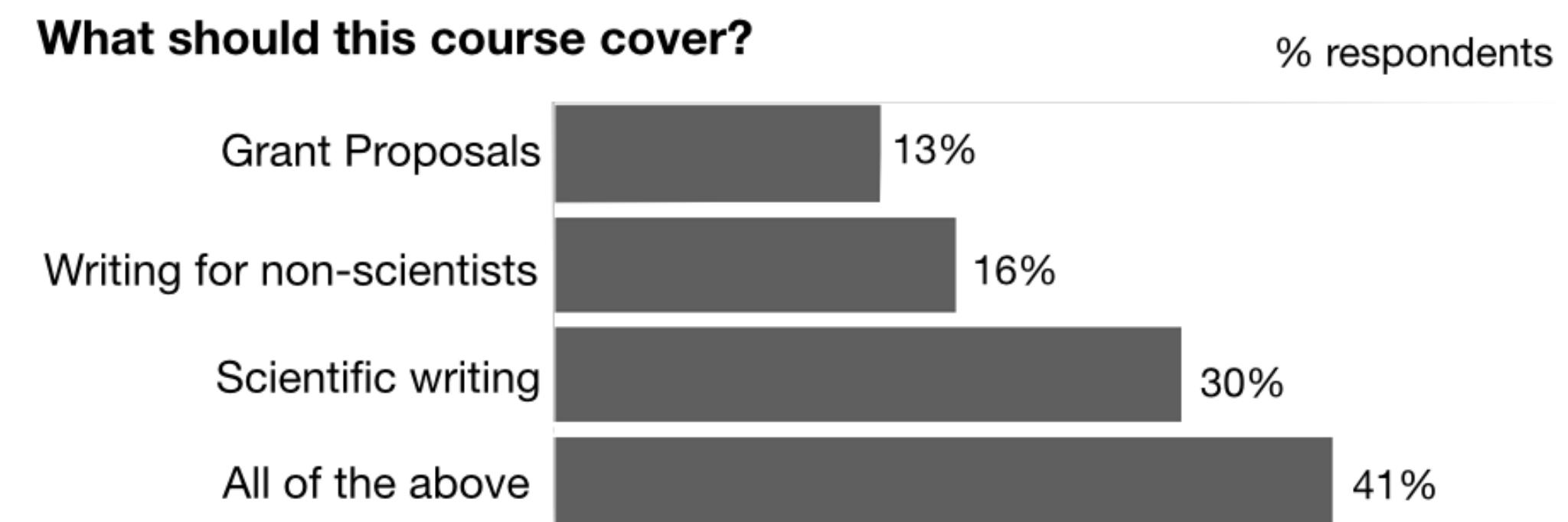
## Your point

Students are interested in many topics in writing



## Equally viable point

Most students don't care about grant proposals



# Your slide's message goes in the title

Supporting evidence goes here

Assertion-evidence approach  
Alley 2006

# Sometimes that message is complex

$$\min_A ||XA||_* + \gamma \text{Tr}\{A^T W A\}$$

subject to  $A_i \in \{0, 1\}$

$$\sum_j A_{i,j} = 1$$

$$\sum_i A_{i,j} \geq 1$$

# Equations can be chunked

$$\min_A ||XA||_*$$

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$$\min_A \|\mathbf{X}\mathbf{A}\|_*$$

Find A such that  $\mathbf{X}\mathbf{A}$   
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A has to have the  
following structure

# Equations can be chunked

$$\min_A \underbrace{\|XA\|_*}_{\text{Find } A \text{ such that } XA \text{ has a certain property}} + \gamma \underbrace{\text{Tr}\{A^T W A\}}_{\text{Ideally } A \text{ also satisfies this requirement as much as possible}}$$

Find  $A$  such that  $XA$  has a certain property

Ideally  $A$  also satisfies this requirement as much as possible

subject to  $A_i \in \{0, 1\}$

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# Equations can be chunked

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subject to

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# Diagrams can be chunked

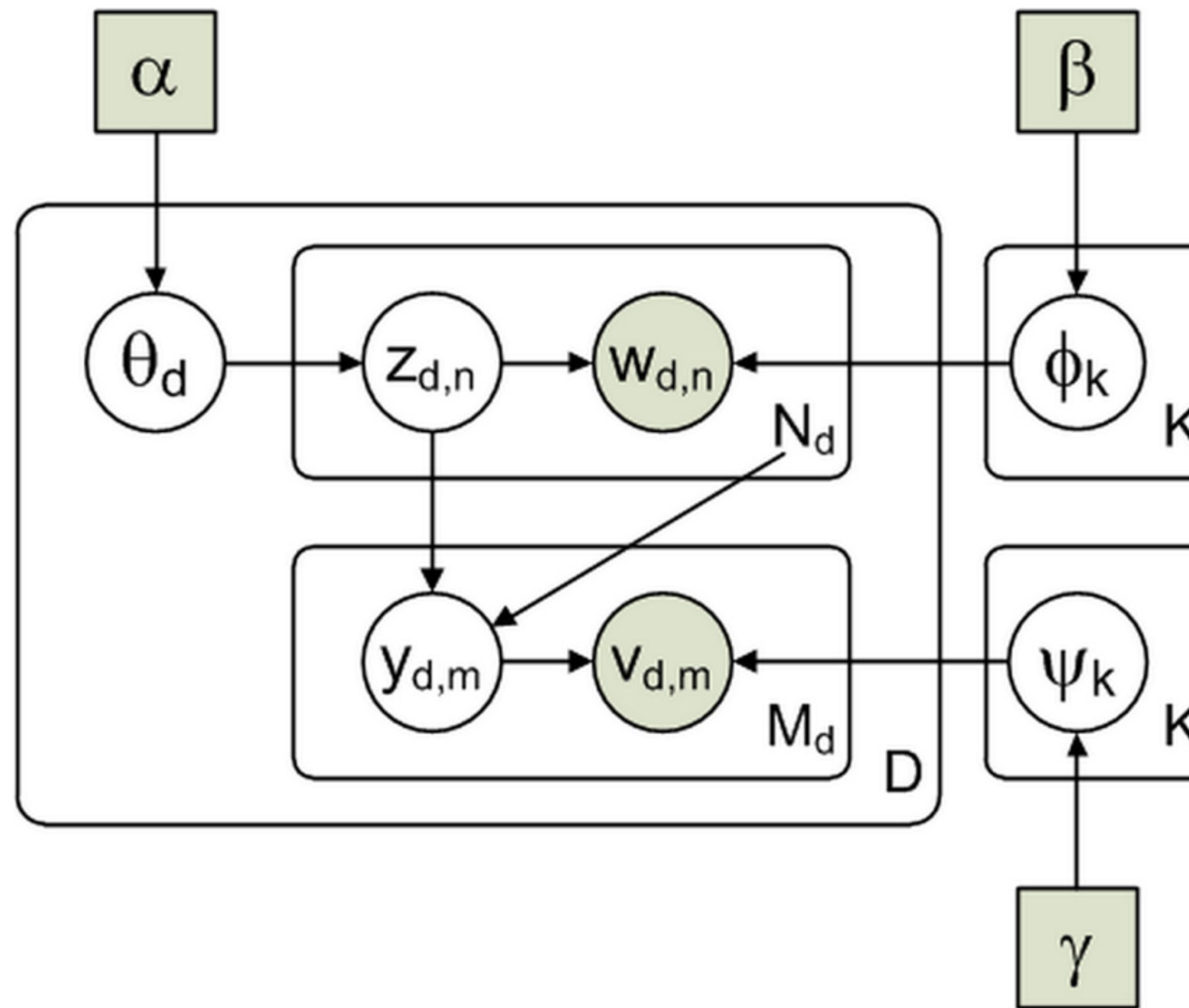


Figure 1 LDAgg Model in Plate Notation

# Diagrams can be chunked

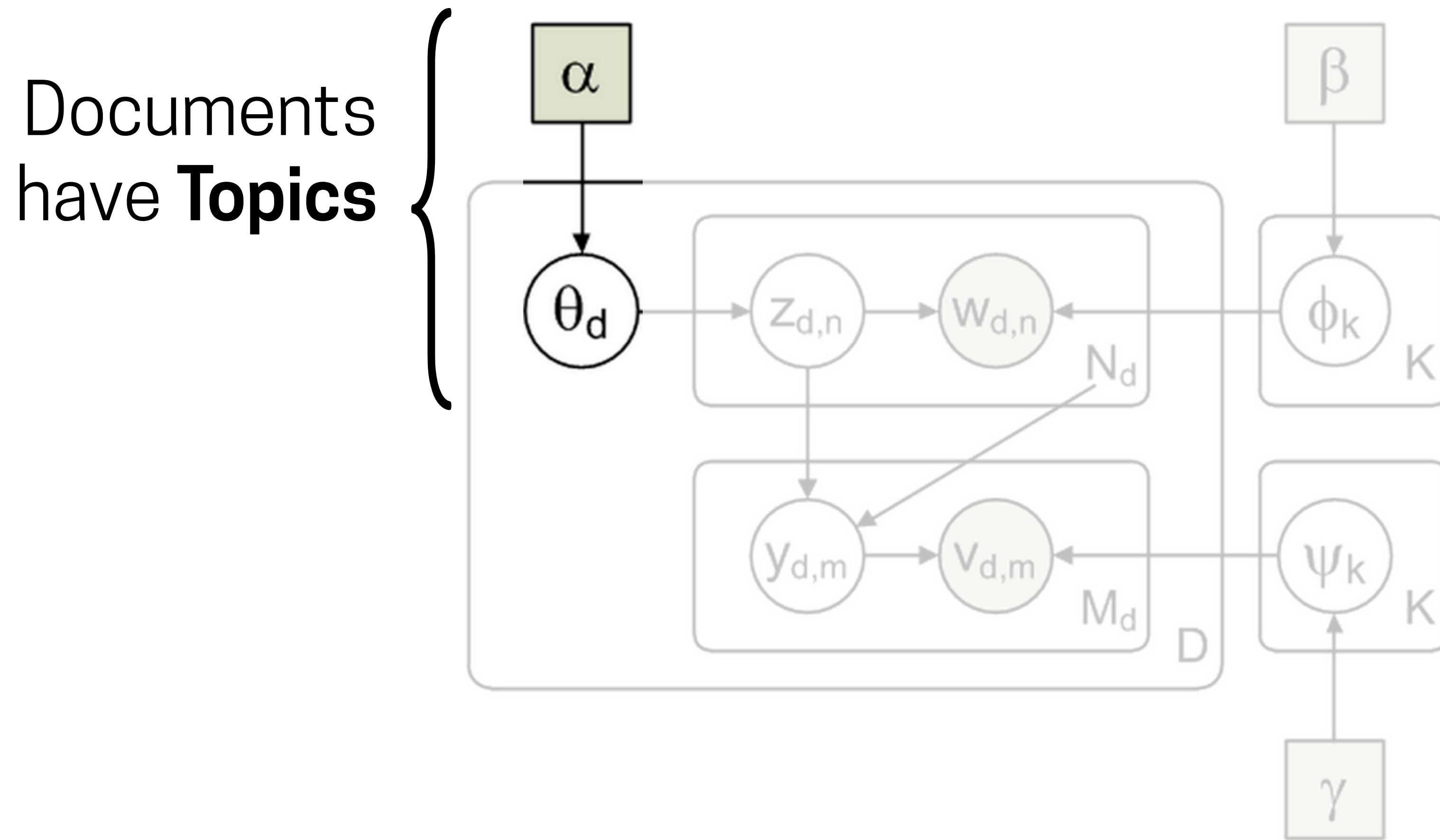
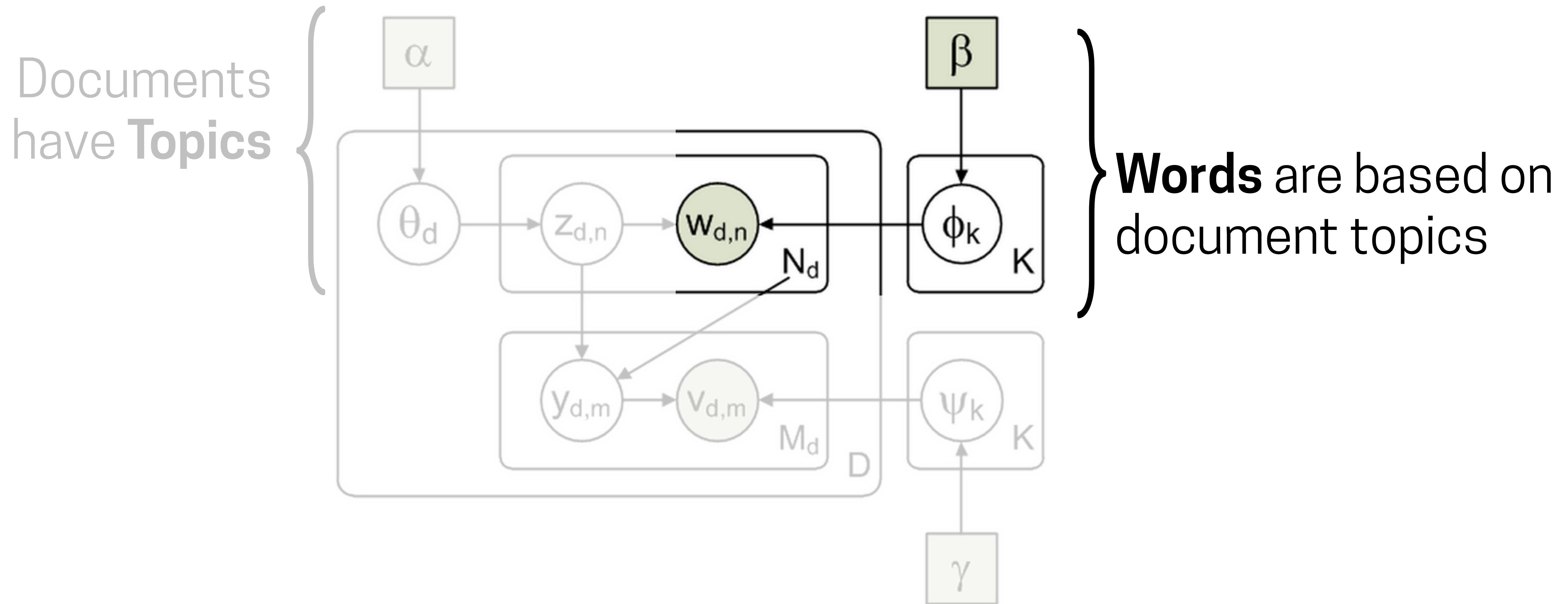
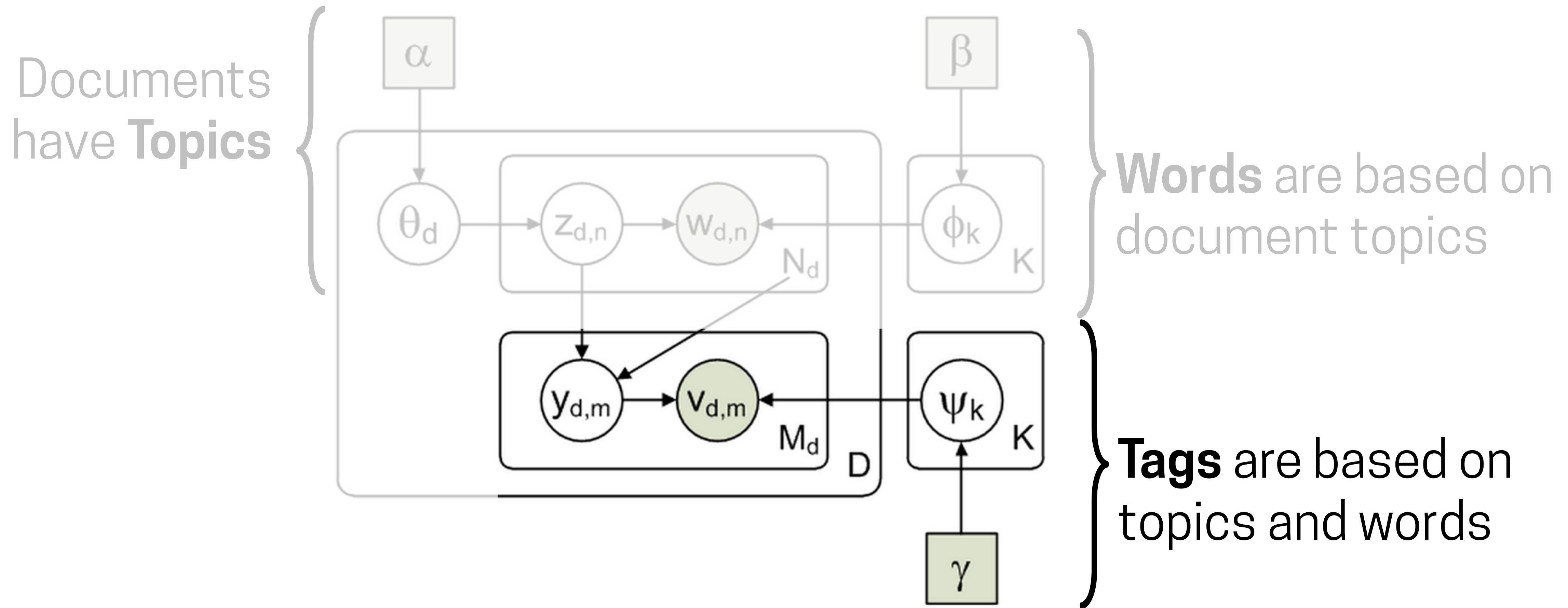


Figure 1 LDAgg Model in Plate Notation

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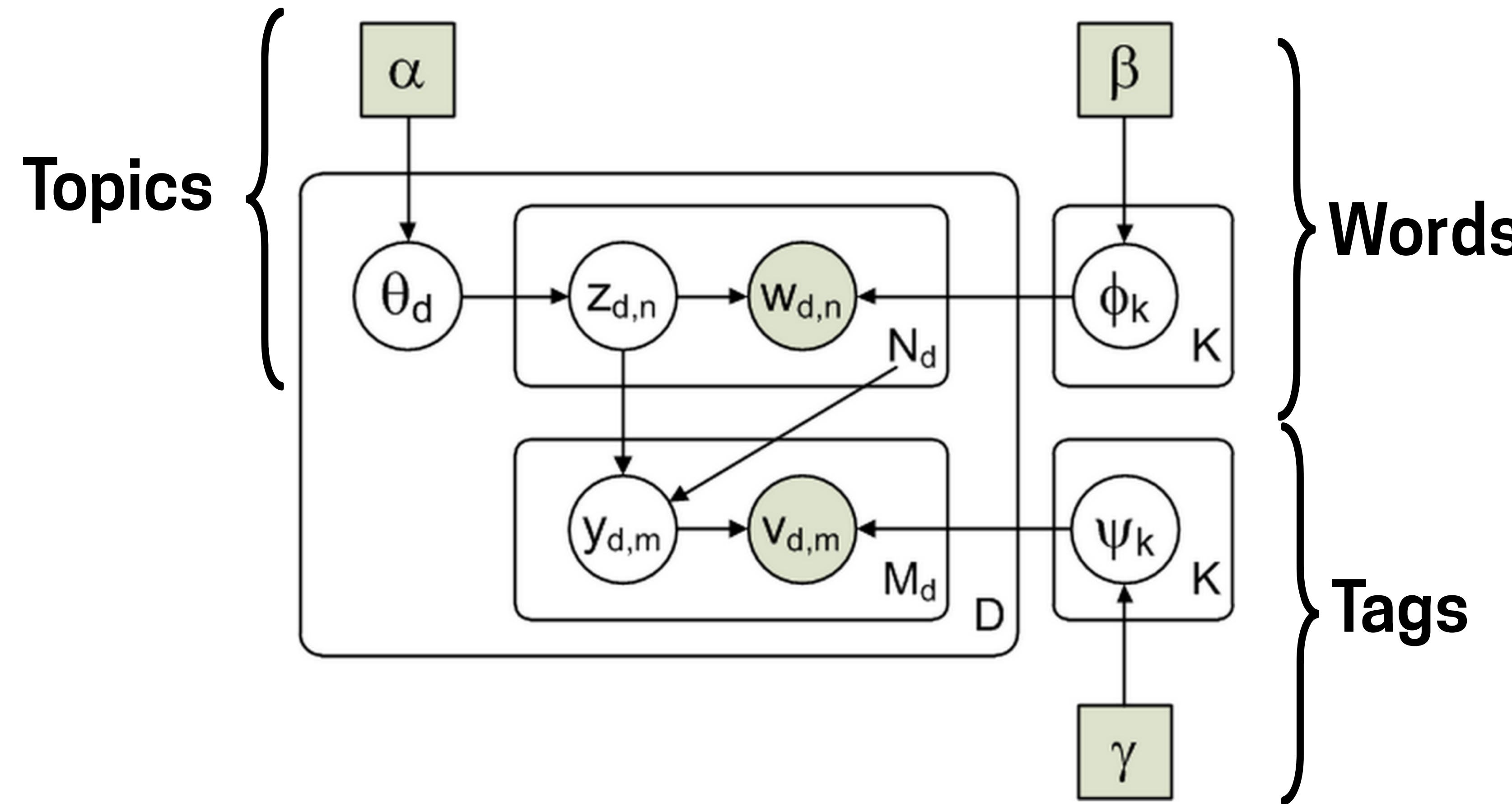


Figure 1 LDAgg Model in Plate Notation

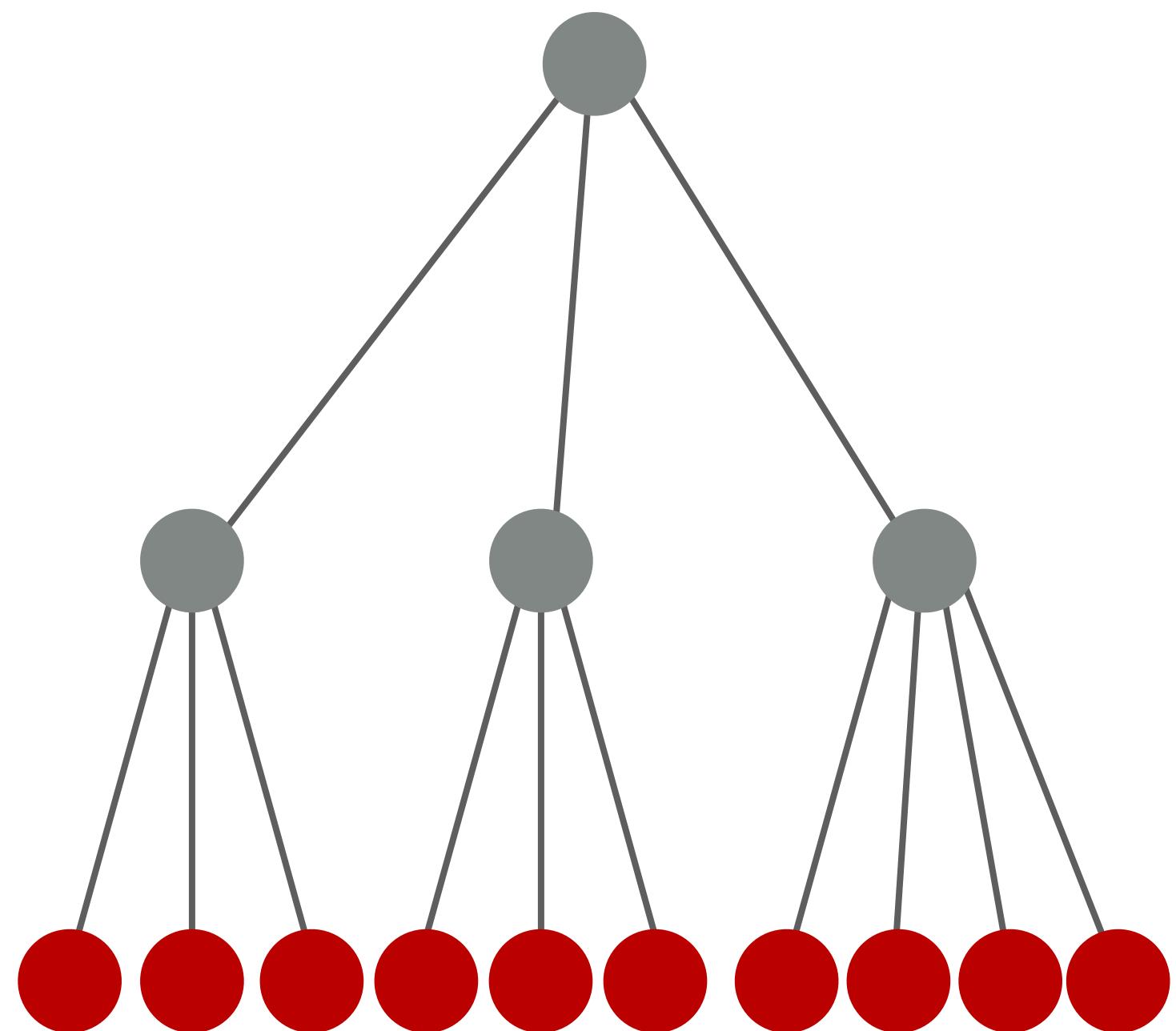
# Structuring Presentation

Reframing the challenge

Chunking slides

Chunking sections

Chunking presentations



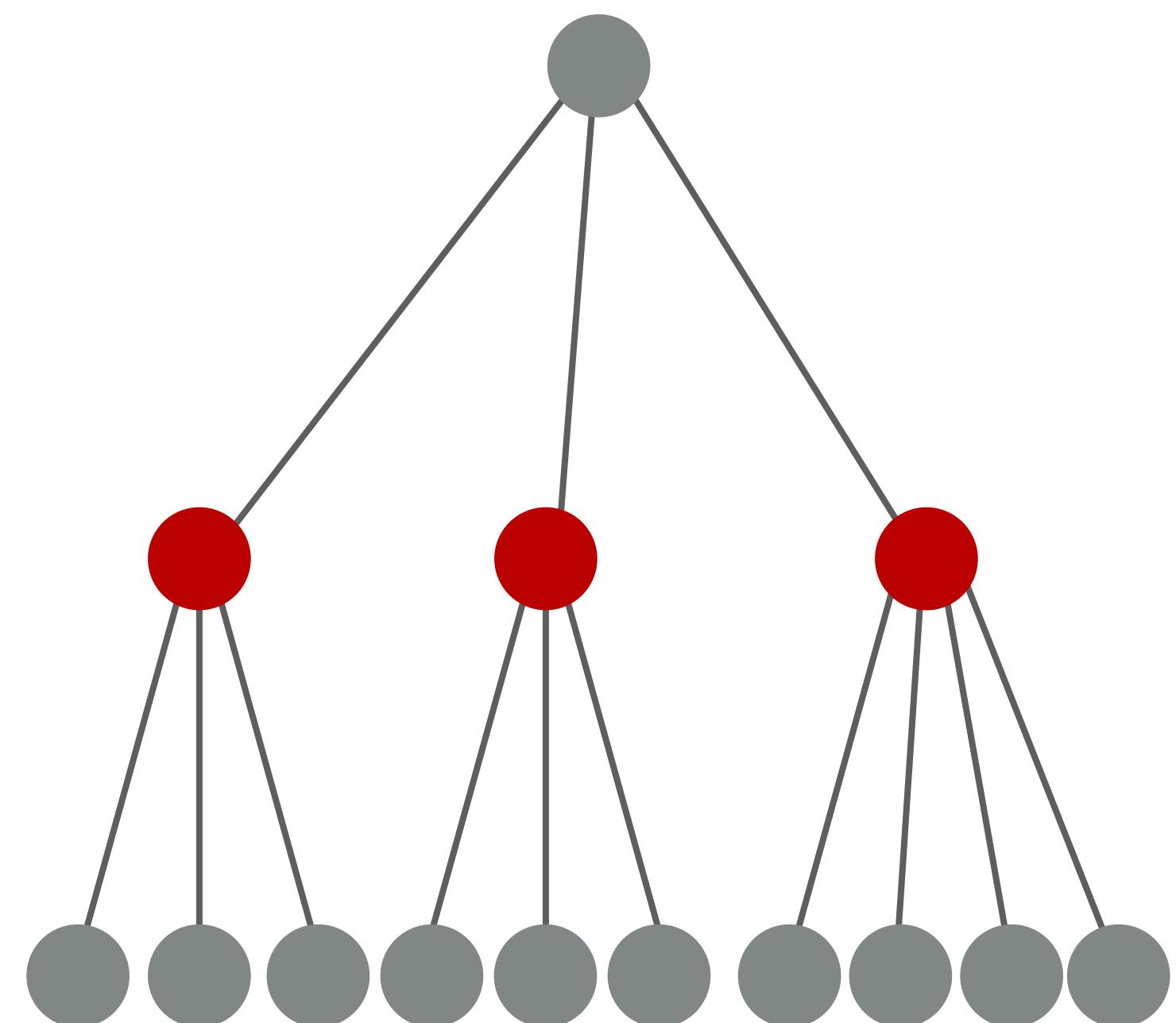
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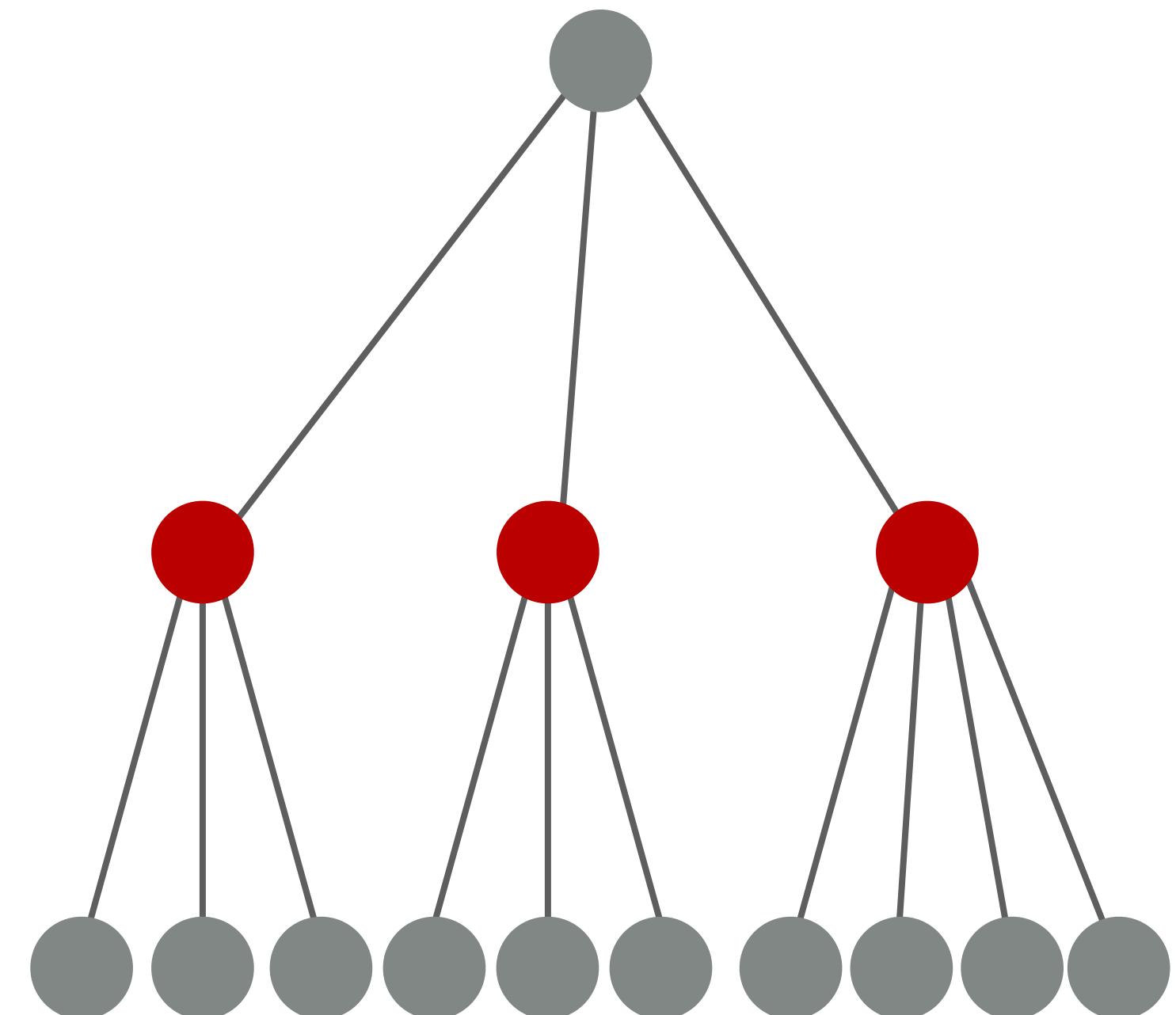
# An outline slide shows structure

Your presentation

Section 1

Section 2

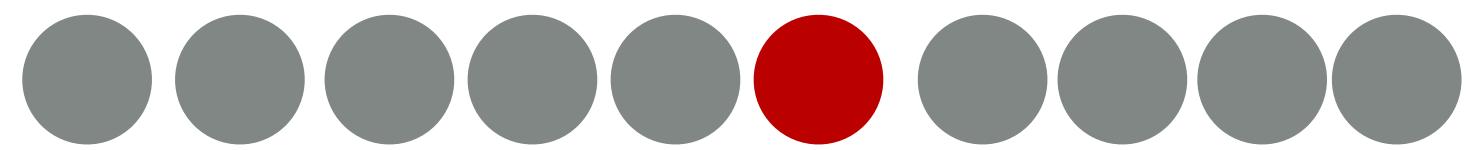
Section 3



# But the memory fades



...slide 34...



# Return to the outline to reorient

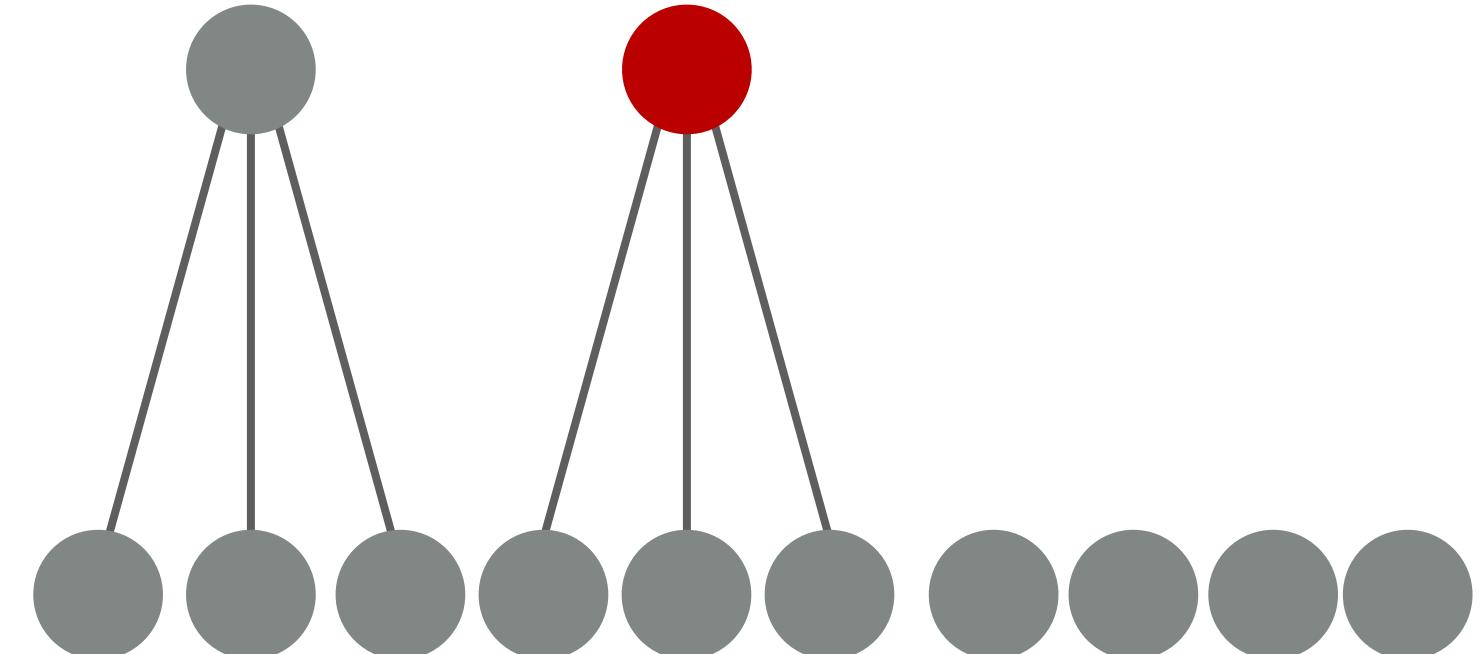
Your presentation

Section 1

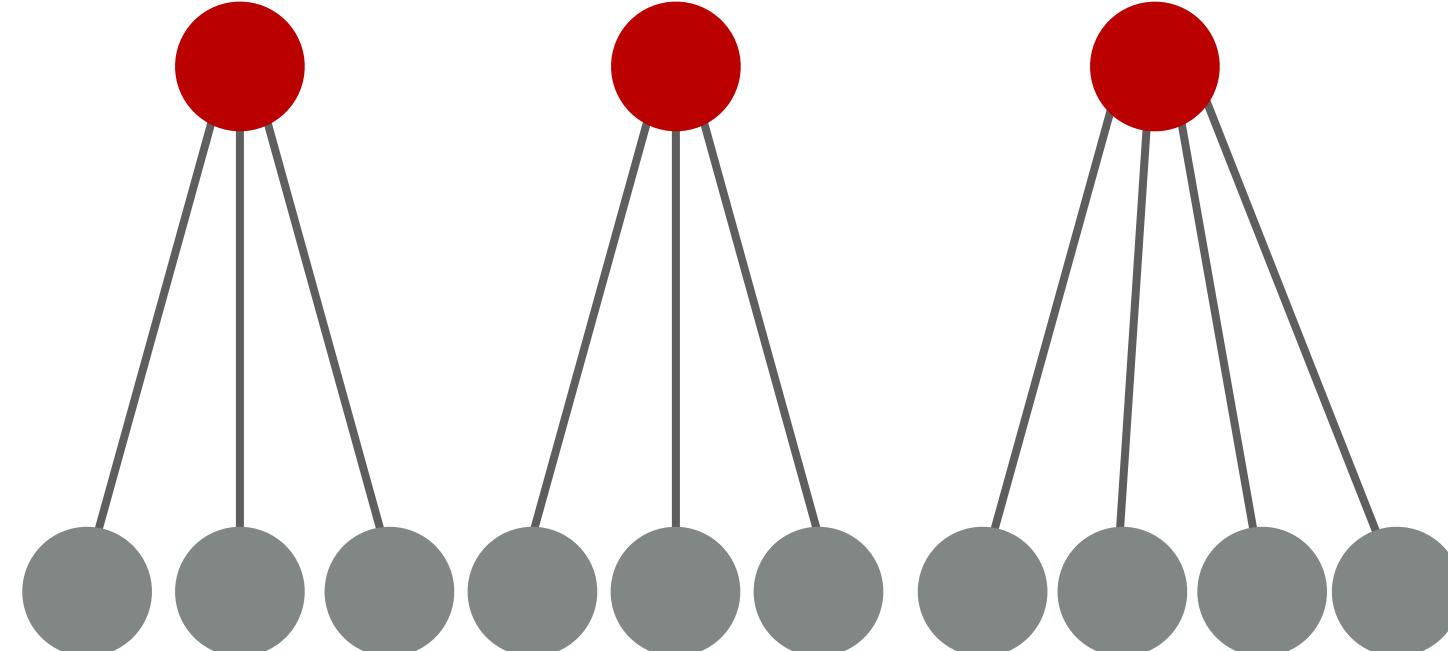
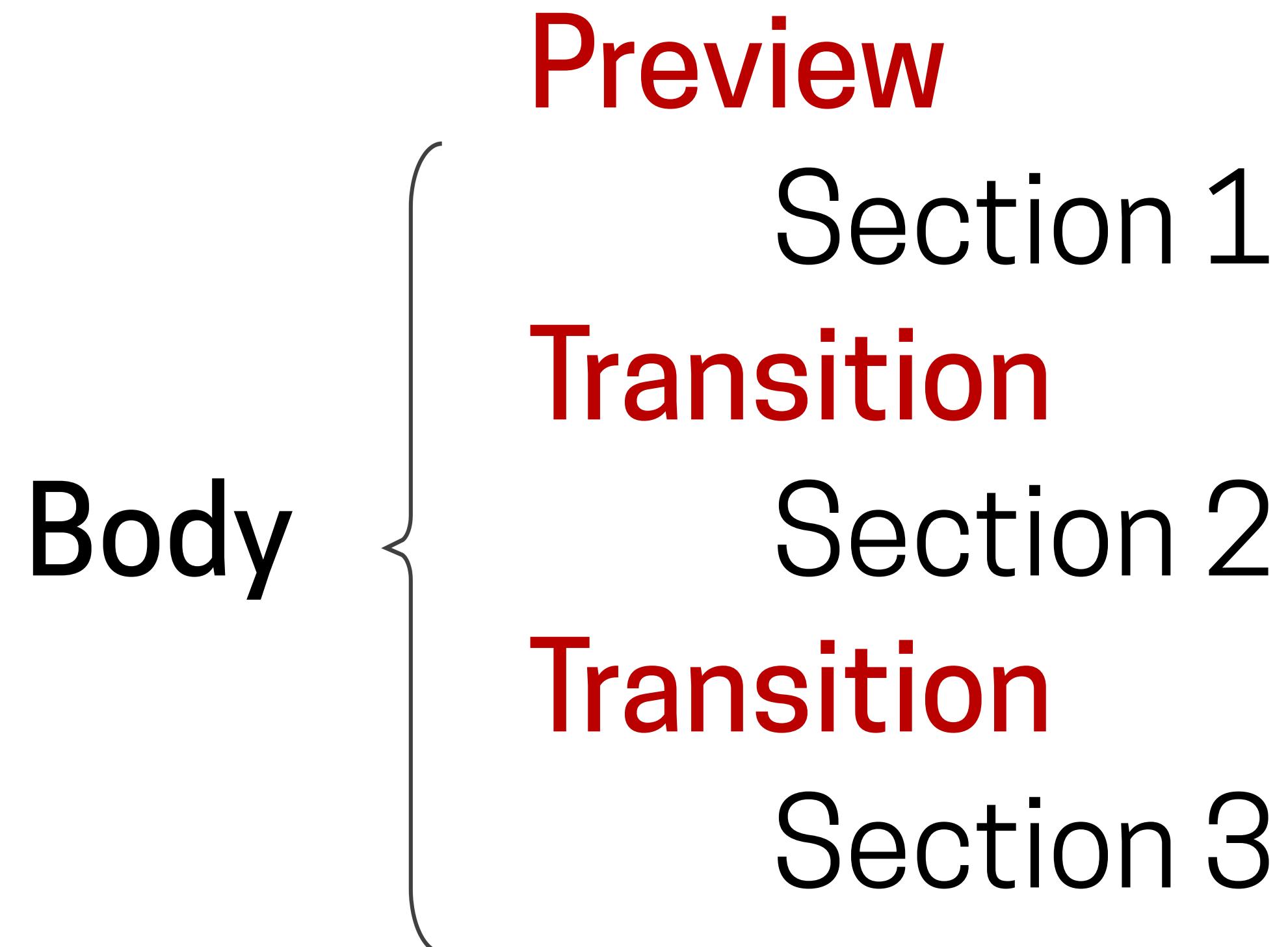
Section 2

Section 3

Places points in context  
Summarize and review  
Reentry point  
Allows section chunking



# Sections and transitions form the body of the presentation



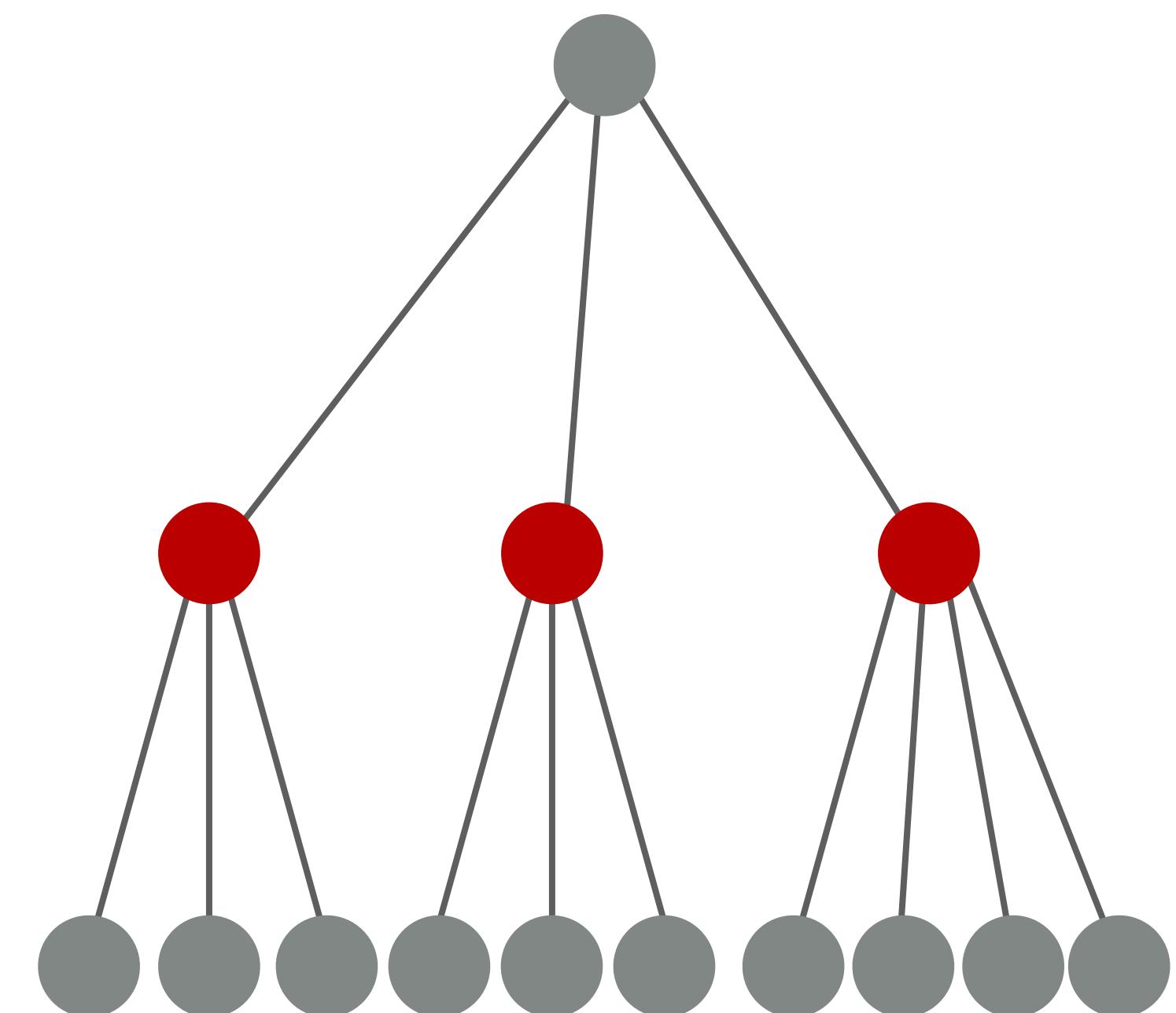
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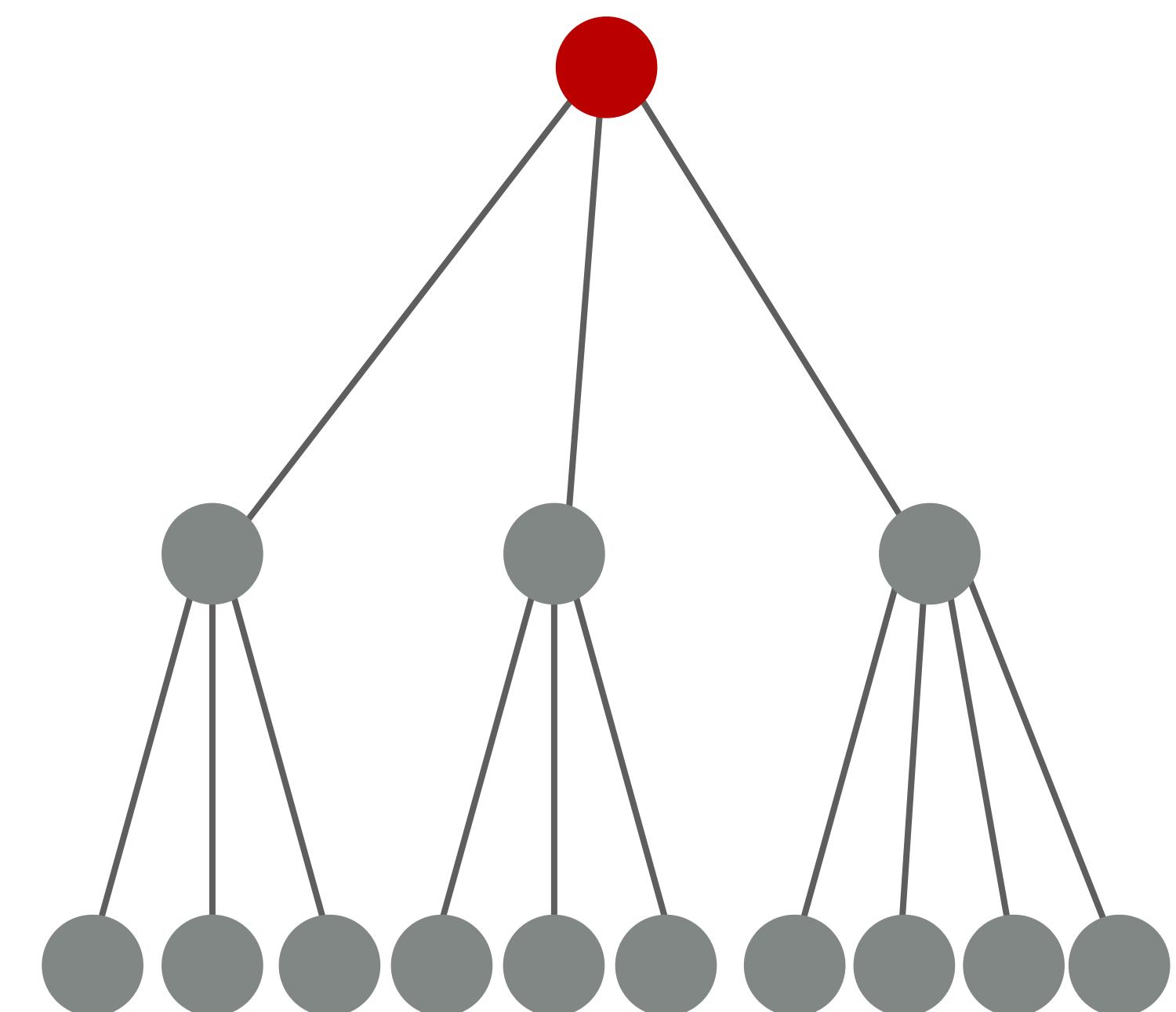
# Structuring Presentation

Reframing the challenge

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# The problem with most presentations is the lack of a clear explicit goal

## Definition of Biometrics

### Types of Biometrics

- 1) Physical
  - ▶ Fingerprints
  - ▶ Facial characteristics
  - ▶ Hand geometry
  - ▶ Iris scanning
  - ▶ Retina scanning
  - ▶ Vascular patterns
  - ▶ DNA analysis
  - ▶ Earprints

### Implementation factors

- ▶ Location
- ▶ Security
- ▶ Task( identification, verification)
- ▶ Number of users
- ▶ Circumstances(user's)
- ▶ Existing data

What did  
you learn?



That chart explained the Quantum Hall Effect.  
Now, if you'll bear with me for a moment, this next graph shows rainfall over the Amazon Basin...

# Your slide's message goes in the title

Supporting evidence goes here

Assertion-evidence approach  
Alley 2006

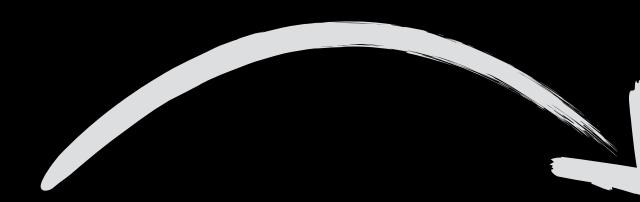
# Your entire talk should also have a message

Your slide's message  
goes in the title

Your slide's message  
goes in the title

Your slide's message  
goes in the title

Supporting evidence goes here



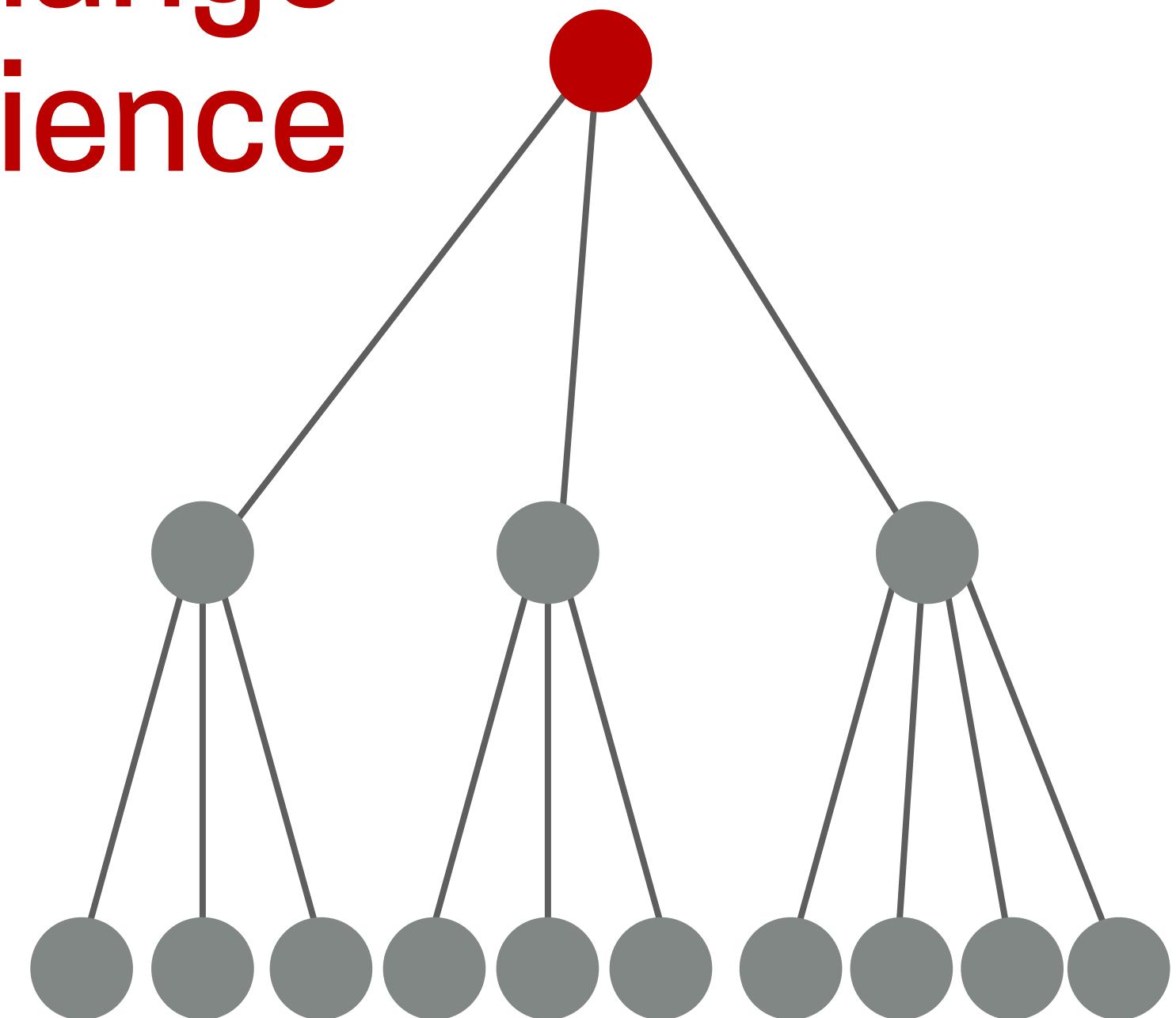
Your main point

# Developing a message and a talk is a reciprocal process



# How do you choose the right goal?

Strong goals describe a **change**  
in the **audience**



# There are common pitfalls in choosing goals

*“I want my audience to be impressed with my work.”*

**Problem:** This goal is not about the audience

**Consider:** What is it about your work  
that you want them to be impressed with?

**Perhaps:** The audience should be persuaded  
to use this method / read future papers / fund me

# There are common pitfalls in choosing goals

*“I don’t have a goal. I don’t want to bias the audience.”*

**Problem:** In order to evaluate an argument,  
they must at least know what that argument is

**Consider:** Is your conclusion “we don’t know”?  
Why were you asked to talk in the first place?

**Perhaps:** The audience should fund a follow-up study  
They should treat this as a risky decision  
They should think of this as a known unknown

# There are common pitfalls in choosing goals

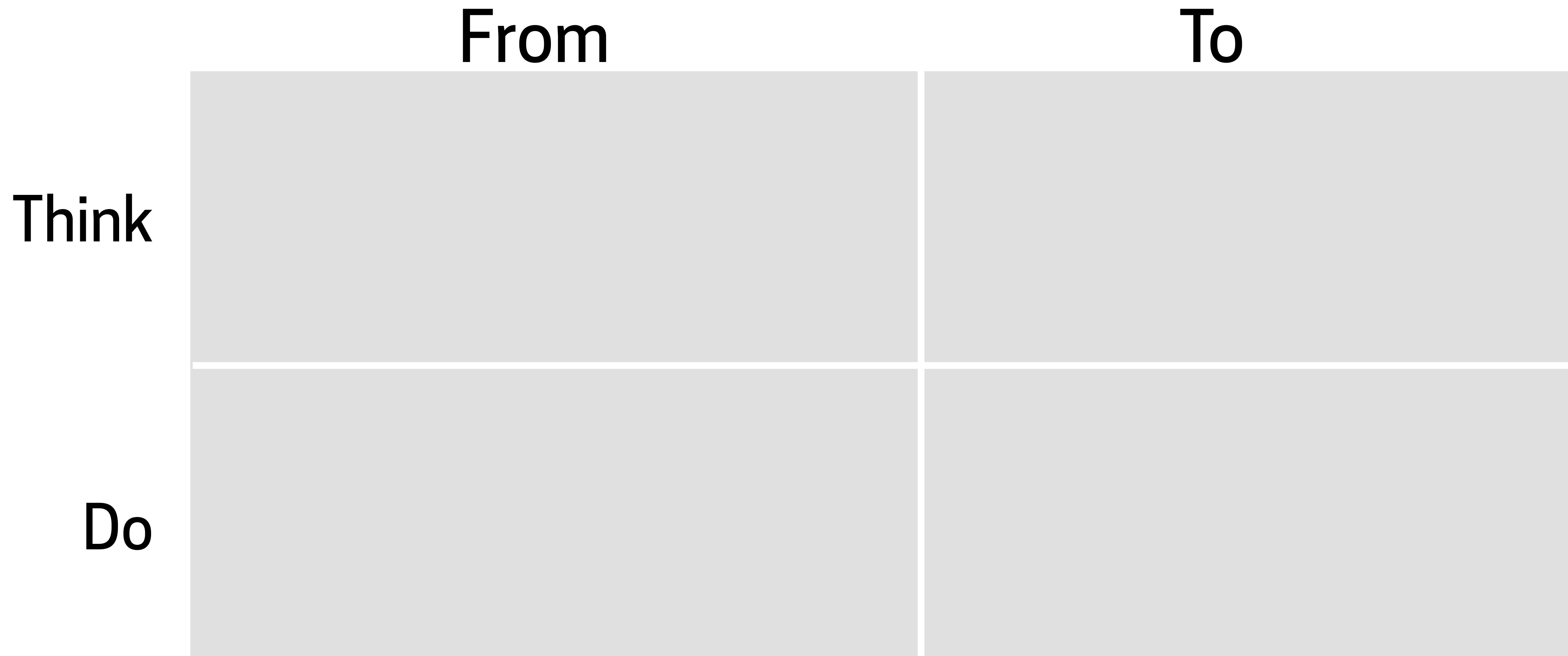
*“I want my audience to understand how this works.”*

**Problem:** Unclear how the audience will change

**Consider:** Why should they understand how it works?  
What will they be able to do differently?  
How will their (academic) lives be better?

**Perhaps:** They should be able to implement this method  
The next time they [situation] they should [action]

A tool to articulate goals  
that focus on a change in the audience:



# A tool to articulate goals

example: my Ph.D. thesis

From

Think

Gravity is negligible in cell biology

What's microfluidics?

Do

Avoid using microfluidic devices

Read papers with skepticism

To

Gravity affects gene & protein expression

Microfluidics is a powerful form of custom automation

Start new collaborations with mechanical engineering

Seek out papers in the field

# A tool to articulate goals

example: improve sentiment on self-driving cars

Think

From

Self-driving cars are dangerous

Their biggest problem is ethics

They will kill me to save pedestrians

Do

Avoid using

Oppose adoption

To

They're already safer than humans

Their biggest problem is unpredictable circumstances

Ride in self-driving cars

Endorse regulations allowing them on the road

# A tool to articulate goals

Your turn

Think

From

Self-driving cars are dangerous

Their biggest problem is ethics

They will kill me to save pedestrians

Do

Avoid using

Oppose adoption

To

They're already safer than humans

Their biggest problem is unpredictable circumstances

Ride in self-driving cars

Endorse regulations allowing them on the road

“Give me six hours to chop down a tree  
and I will spend the first four  
sharpening the axe.

# Five critical points orient the audience

Need  
why?

Gap between what we want  
and what we have

Task  
what?

What you did to address the need

Approach  
how?

How you approached the task

Results

What you found in the process

Conclusions

What the results mean for the audience

# Five critical points orient the audience

**Audience**

Need  
why?

Gap between what we want  
and what we have

Task  
what?

What you did to address the need

You      Approach  
          how?

How you approached the task

Results

What you found in the process

**Audience**

Conclusions

What the results mean for the audience

# Five critical points orient the audience

**Audience**

Need  
why?

A big goal in the field is X.  
But that requires Y.

Task  
what?

To find Y, I performed proteomic screens

You

Approach  
how?

Here's how I did it

Results

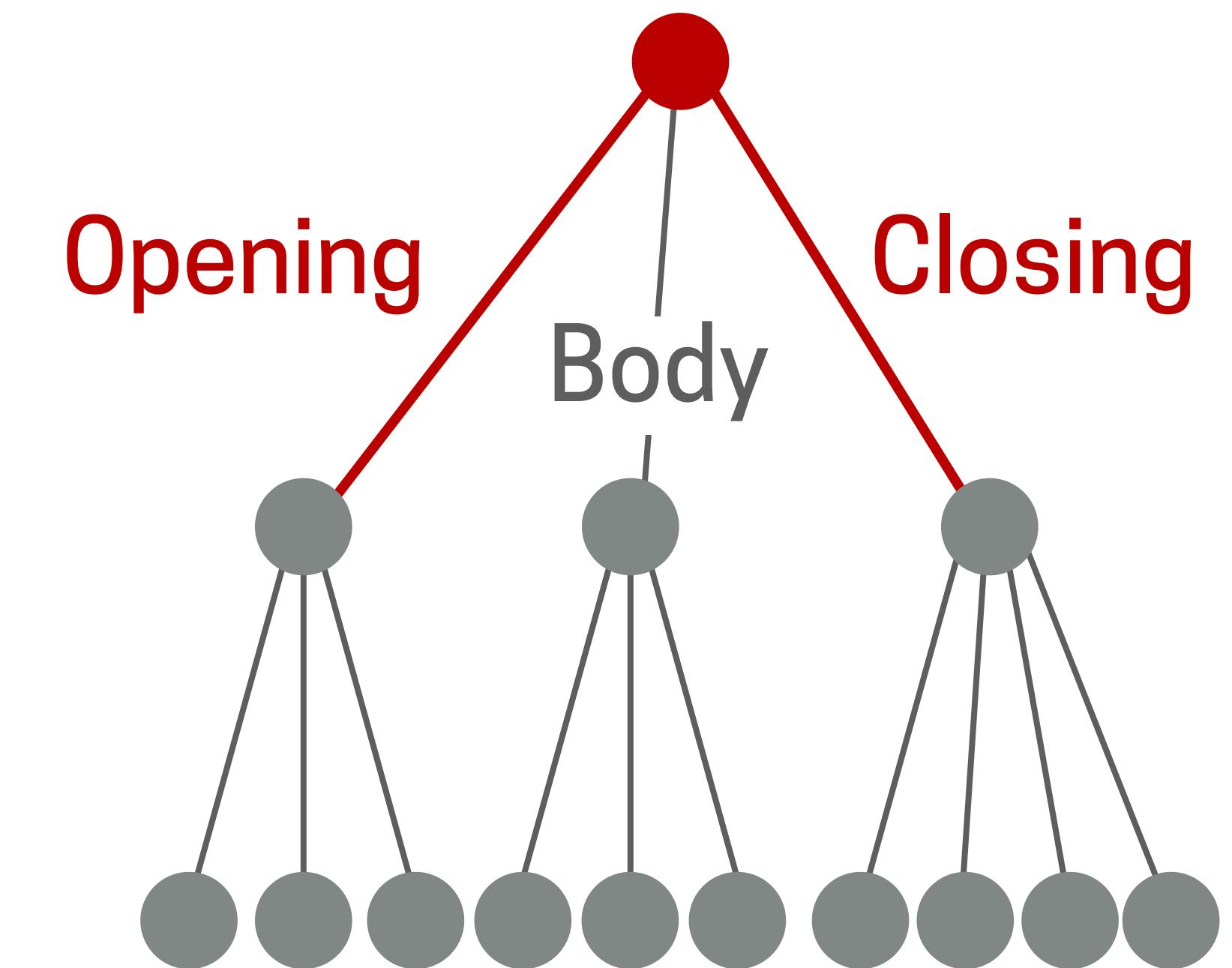
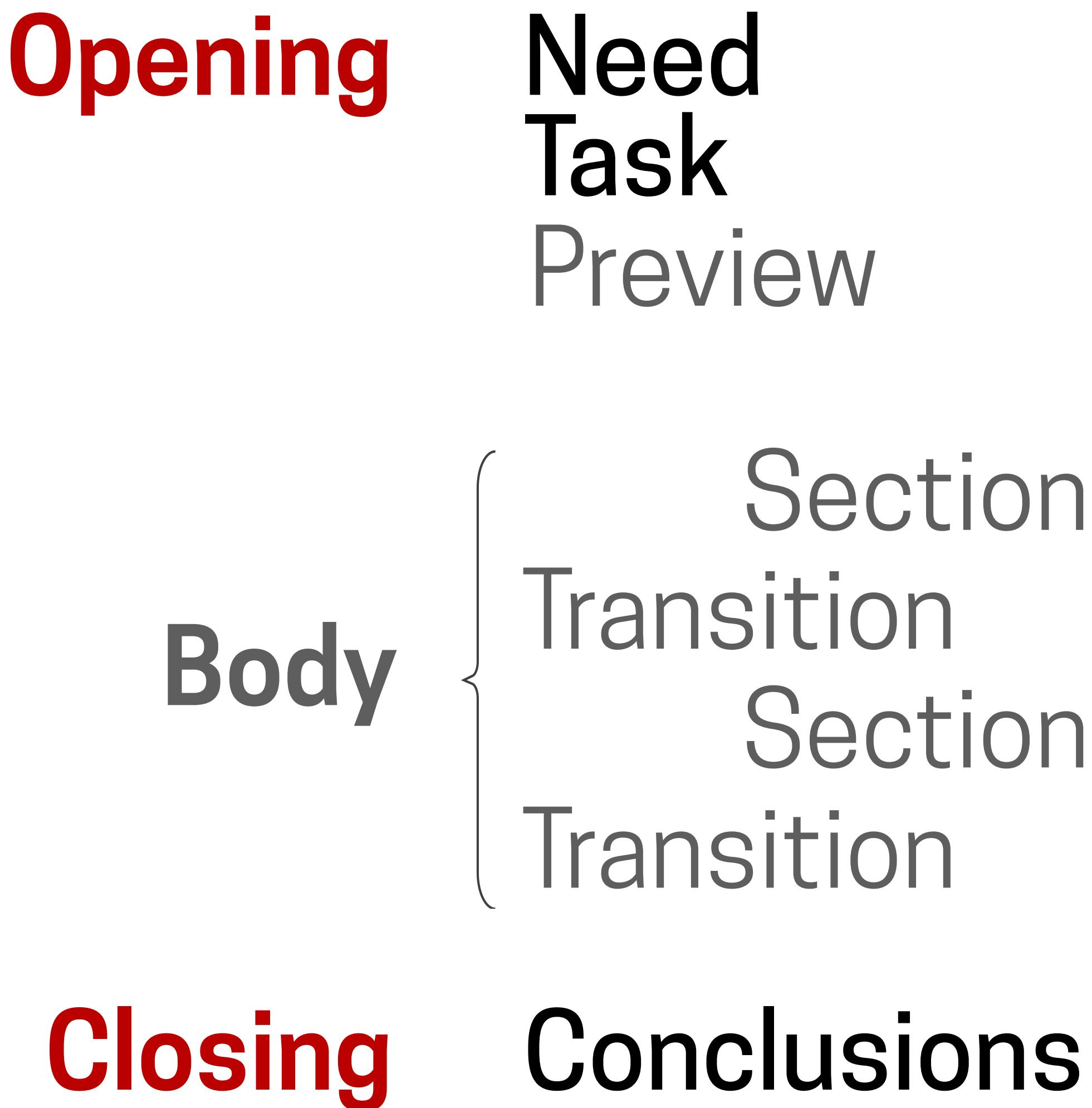
Here's what happened

**Audience**

Conclusions

Progress towards addressing the need  
How the audience might change

# A template for presentation



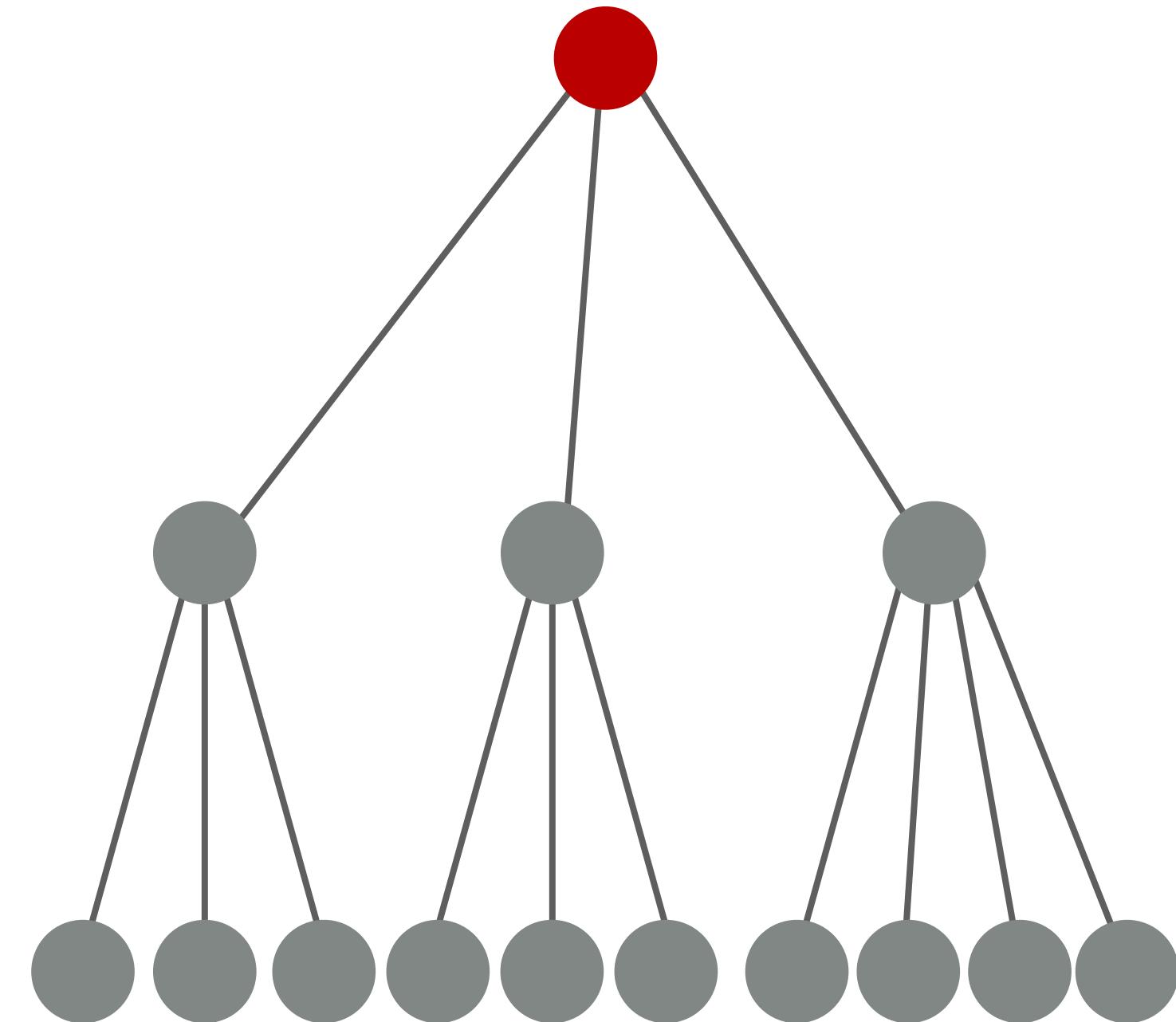
# Define your goals

Goals drive decisions in communication

Focus on a **change** in the **audience**

Define your message at multiple scales:  
presentation, section, and slide

Include critical orienting information:  
**need, task, approach, result, conclusion**



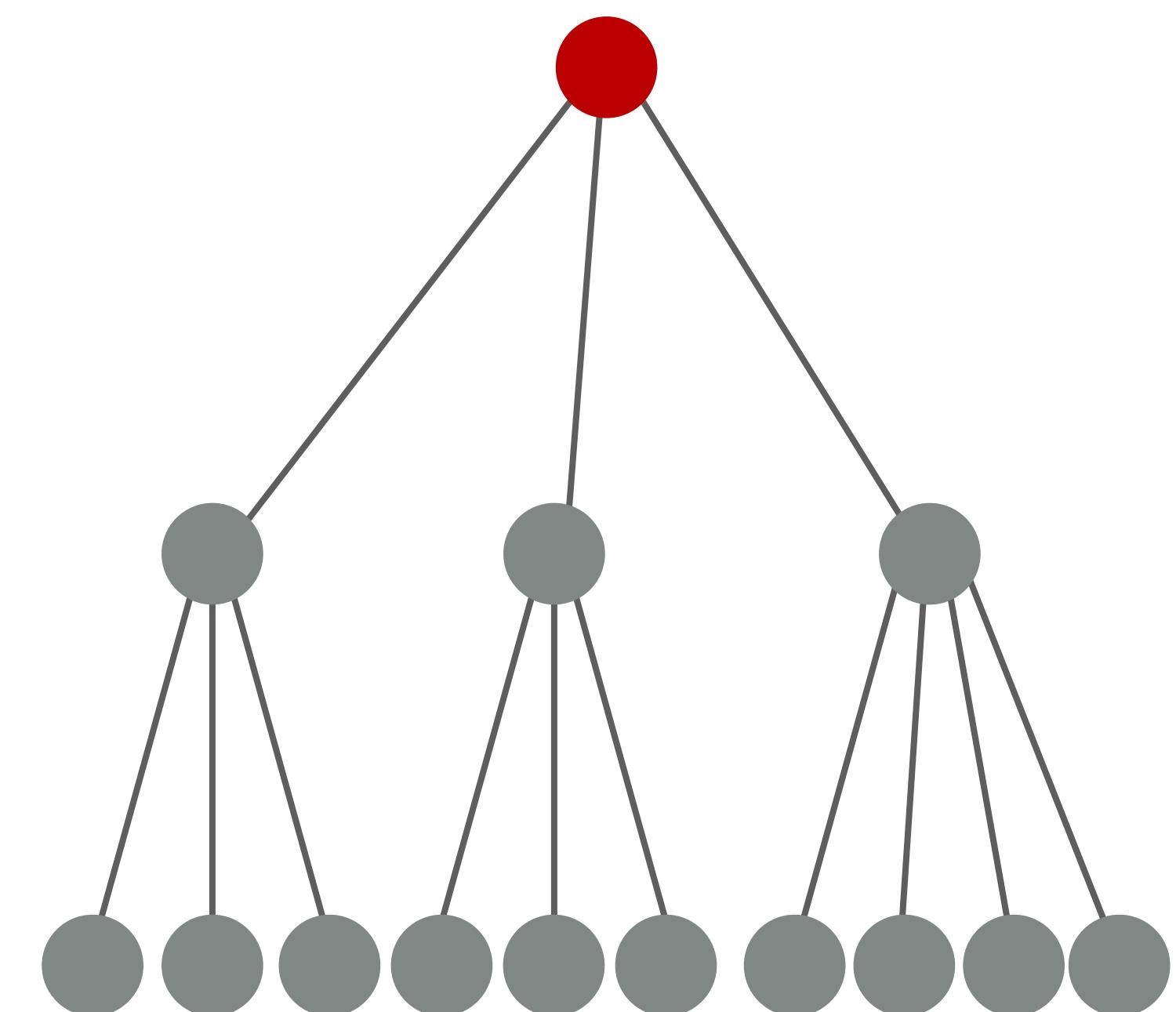
# Structuring Presentation

Reframing the challenge

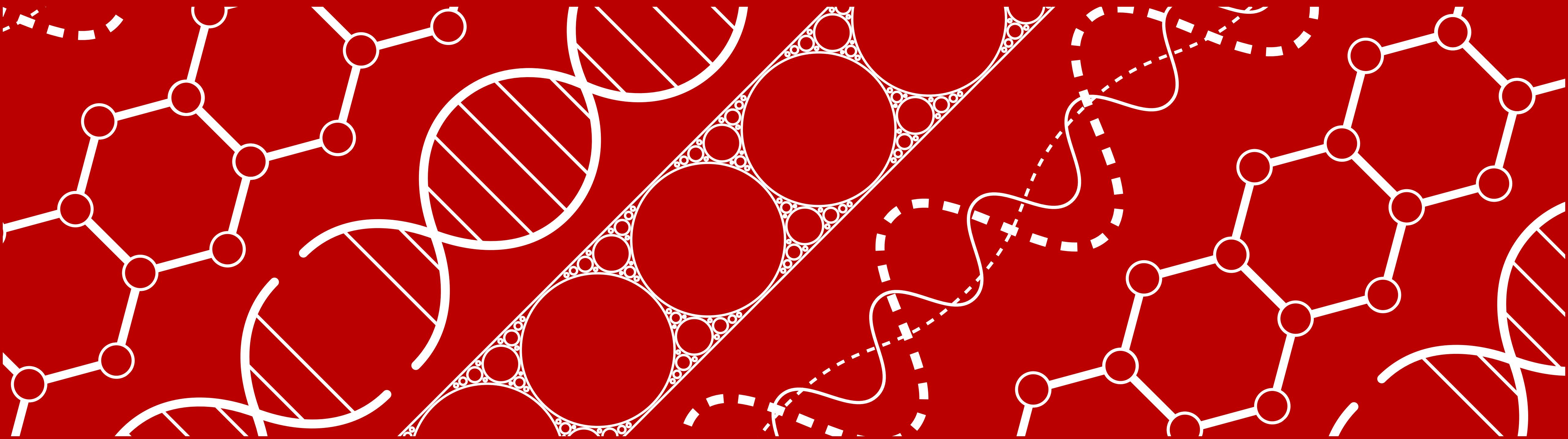
Chunking slides

Chunking sections

Chunking presentations



# Structuring Presentation



**SCIENCE  
COMMUNICATION**  
Carnegie Mellon University

Ardon Shorr, Ph.D.

# Fall Semester

4:30 pm

Tue MI 411

Fri WH 8325

SCIENCE  
COMMUNICATION  
CENTER

Oct 9, 12 Structuring Presentation

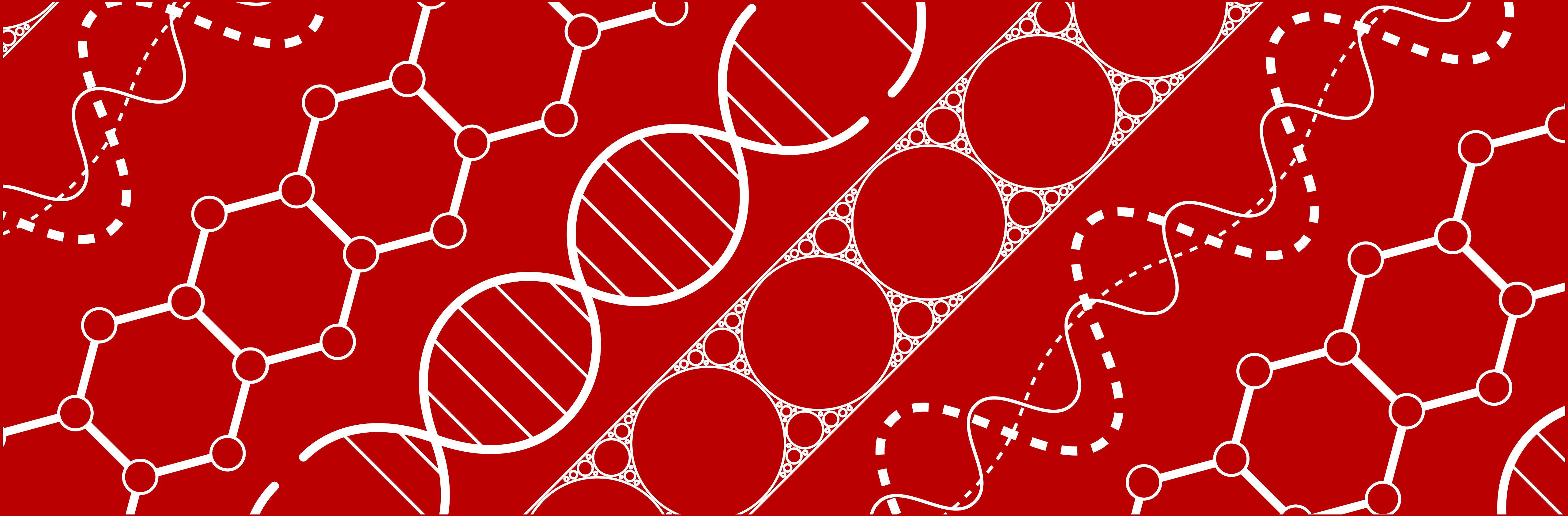
Oct 23, 26 Graphic Design

Nov 6, 9 Distilling Your Message

Nov 13, 16 Telling Science Stories

Nov 27, 30 Crafting Explanation

Dec 4, 7 Vocal Delivery



# SCIENCE COMMUNICATION

Carnegie Mellon University

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[AShorr@andrew.cmu.edu](mailto:AShorr@andrew.cmu.edu)  
Book appointment to visit MI 409G