

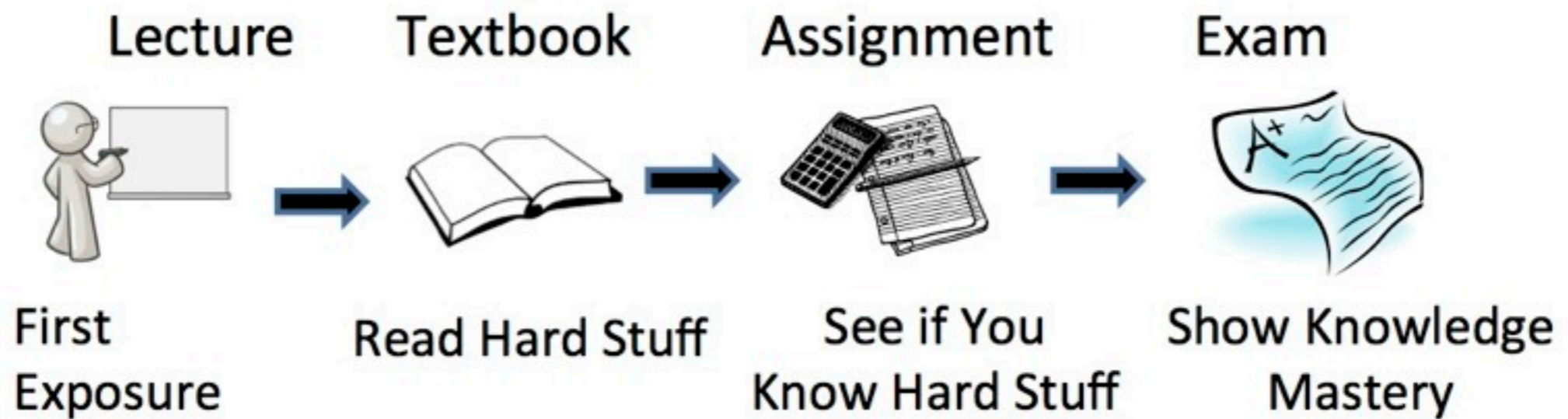
# THE PROBABILISTIC METHOD



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CS49/MATH59  
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# TRADITIONAL LECTURES

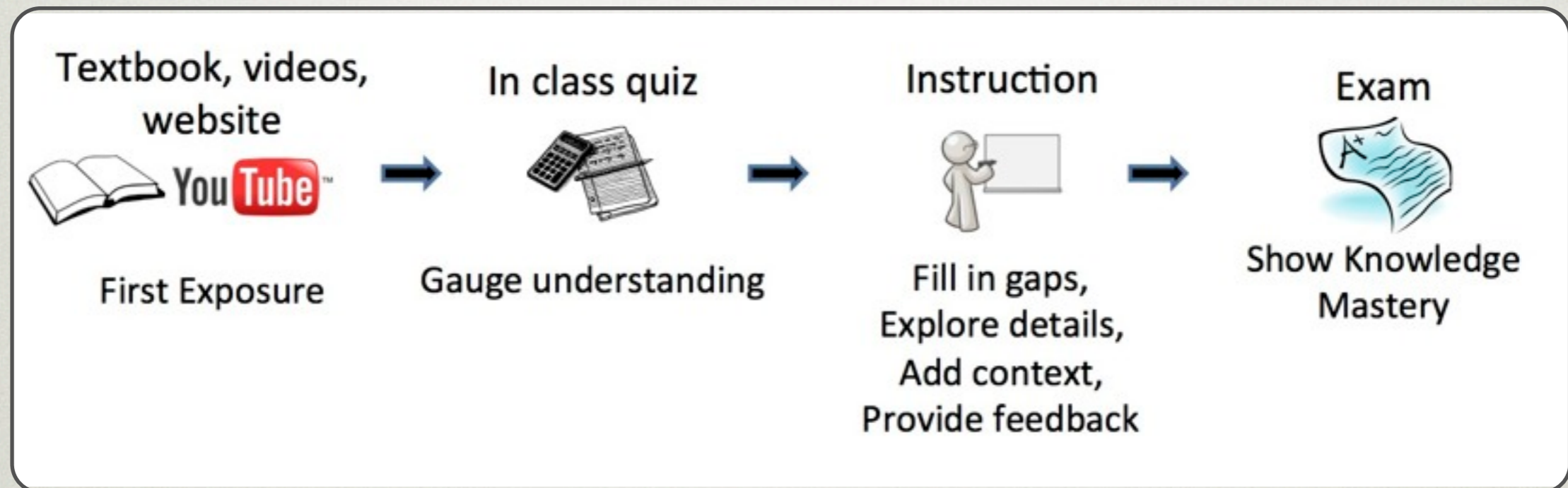
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- Little opportunity for feedback
- Not effective way to learn

# CLICKER LECTURES

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- Research: to learn, you must effectively work with a problem and construct your own understanding.

# CLICKER QUESTION

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Why are you taking CS49 / Math059?

- (A) like probability/randomness, want to know more.
- (B) Math major, course sounded interesting
- (C) CS major, course sounded interesting
- (D) fills requirement
- (E) other

# SYLLABUS HIGHLIGHTS

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- Open home page
- Pre-reqs: CS35, Math029 or permission from instructor
  - no Math029? You must pass entrance exam
- Attendance Mandatory
- Textbook(s) required
  - Alon/Spencer: the book for the Probabilistic Method
  - Shoup: free online, we'll use for probability theory
- Office hours, open door policy
- Piazza -- all content questions go here

# LABS

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- Lab Assignments ~every 2 weeks
  - Mostly problem sets, likely one programming
- Final Project
- Partners encouraged but not required
- 2 late days per semester

# WHAT IS THE PROBABILISTIC METHOD?

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Goal: show some combinatorial object has some nice property.

Approach:

- (1) Pick a random object
- (2) Show that object has nice property **w/prob > 0**
- (3) Conclude *there exists* an object with nice property

# EXAMPLE PROBLEM

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Arithmetic Sequence:

list of numbers  $(a_1, a_2, \dots, a_m)$  where  $a_i = a_{i-1} + k$  for some  $k$

examples:  $(1, 5, 9, 13)$ ,  $(201, 402, 603, 804, 1005)$

Problem: show how to color numbers  $\{1, 2, 3, 4, \dots, 2015\}$  using 4 colors so that no arithmetic sequence is *monochromatic*

Solution: color each number  $1, 2, \dots, 2015$  *randomly*.

# CLICKER QUESTION

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What is the probability that one sequence  $\mathbf{a_1, a_2, \dots, a_{11}}$  is monochromatic?

- (A)  $4^{-11}$
- (B)  $2^{-11}$
- (C)  $2^{-20}$
- (D) depends on the sequence

# WHAT IS THE PROBABILISTIC METHOD?

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What do we learn from Probabilistic Method?

- a nice solution must exist
- good understanding of why nice solution exists?

What don't we learn?

- how to find nice object

# THE PROBABILISTIC METHOD

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- Invented by Paul Erdős [1913-1996]
- 1500+ papers
- 500+ collaborators
- only interested in mathematics
- itinerant 2nd half of life
- Erdős number: publication distance from Erdős



# COURSE OVERVIEW

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1. Why take CS49 / Math059?
2. What is this course about?
3. Course Goals
4. Resources
5. Where we're going

# THE PROBABILISTIC METHOD

