

# Developing community norms for proof

Forum discussions of the nature and  
import of proof

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JMM Baltimore



# The Course

- ½ semester Intro to Proofs course
- About 16 students
- Meets 3 times a week for 65 minutes
- Required for math major (sophomores)
- Also taken by math/science concentrators from elementary education, some CS majors
- Christian liberal arts college

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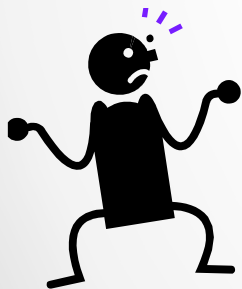


# Course content

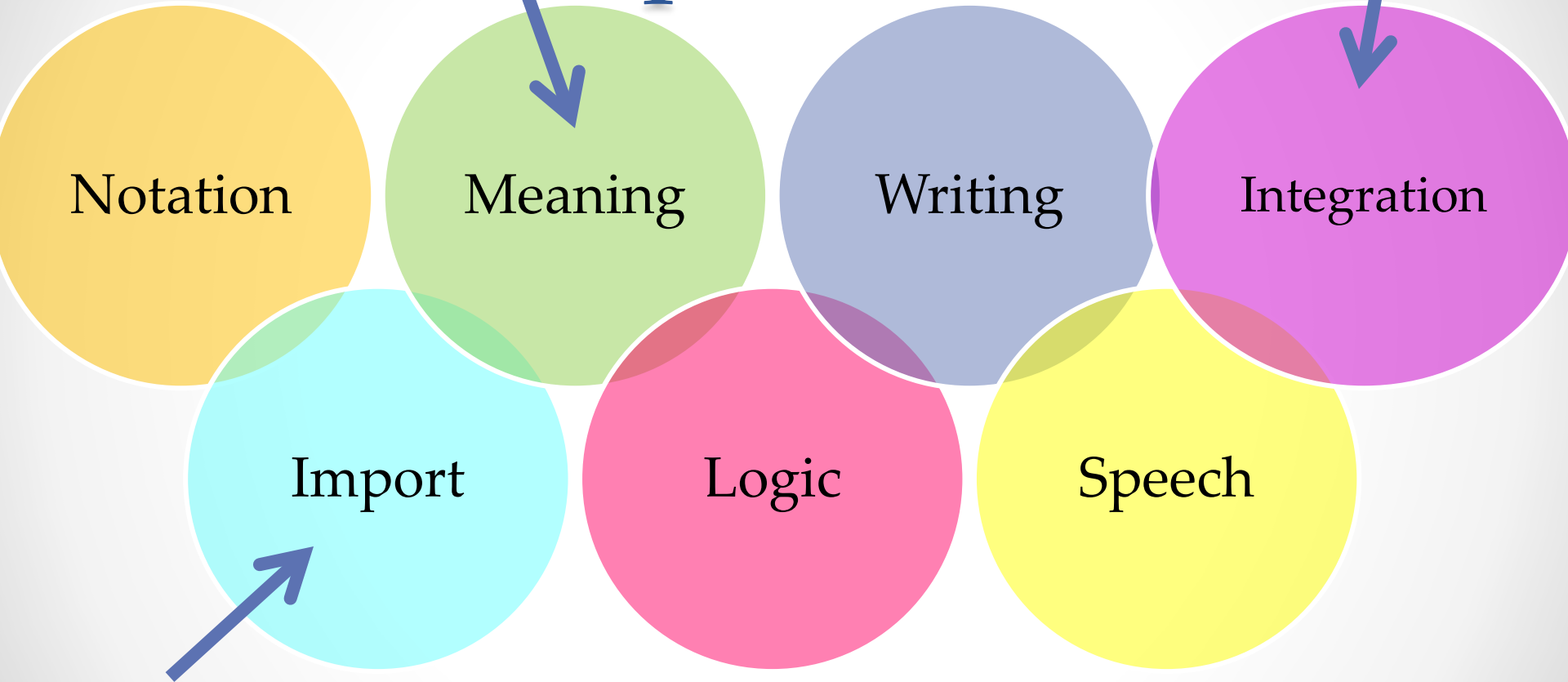
- Logic & quantifiers
- Direct proof, proof by contrapositive and contradiction, induction
- Typical context of sets and functions



# Mathematical Community



# Community norms for proof



# The Forum process



- Instructor
- Posted by Friday

- Selected students
- 200-300 words
- By Monday

- Rest of class
- Two 100 words each
- By next Friday

**Goal: Class discussion**



# Grading

7.5% of grade

5	4	3
<b>Post follows instructions and shows thoughtful consideration of the assigned topic in a way that prompts discussion.</b>	Post follows instructions and shows thoughtful consideration of the assigned topic.	Post slightly misses the mark, but nonetheless shows evidence of thought and effort.
<b>4, plus additional thoughtful comments or comments which spur discussion .</b>	Two thoughtful comments are posted.	Two comments are given, but they are perfunctory OR One thoughtful comment is given.

*Average of 4 is a B, 4.5 is an A*





# Prompt topics

- What is a proof?
- How is a proof communicated? (Proofs without words)
- Proof & Truth, Part I
- Proof & Truth, Part II
- Math talks
- Math & Beauty

Reinforced in reflection in end of course Proof portfolio







# Sample prompt

For this forum assignment, I want you to reflect on the nature and importance of proofs in the discipline of mathematics. I strongly encourage you to consider your own experience with proof throughout your life as well as some of the examples we have seen in class and your own writing of the domino and chessboard problem. Here are some questions to guide your reflection, though you do not need to answer all of them:

- What is the purpose of a proof?
- One definition of a proof is “a convincing communication that answers why” (Henderson). What do you think this means? Do you agree or disagree with this definition?
- What do you think are the elements of a good proof, and why are these important?
- What are the potential difficulties you foresee yourself having to overcome in the process of learning to write good proofs?





# Goal

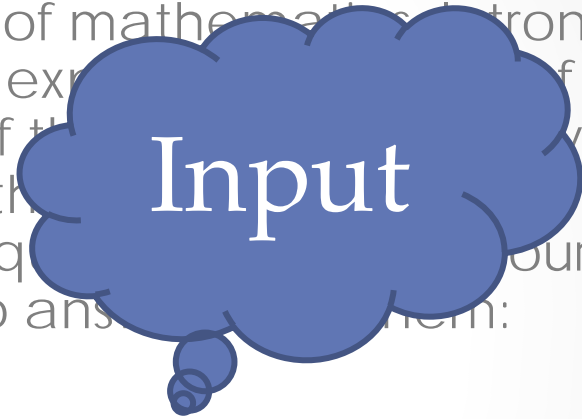
# Sample prompt

For this forum assignment, I want you to **reflect on the nature and importance of proofs in the discipline of mathematics**. I strongly encourage you to consider your own experience with proof throughout your life as well as some of the examples we have seen in class and your own writing of the domino and chessboard problem. Here are some questions to guide your reflection, though you do not need to answer all of them:

- What is the purpose of a proof?
- One definition of a proof is “a convincing communication that answers why” (Henderson). What do you think this means? Do you agree or disagree with this definition?
- What do you think are the elements of a good proof, and why are these important?
- What are the potential difficulties you foresee yourself having to overcome in the process of learning to write good proofs?

# Sample prompt

For this forum assignment, I want you to reflect on the nature and importance of proofs in the discipline of mathematics. I strongly encourage you to consider your own experience of learning mathematics throughout your life as well as some of the examples we have seen in class and your own writing of the proof for the chessboard problem. Here are some questions to guide your reflection, though you do not need to answer all of them:



- What is the purpose of a proof?
- **One definition of a proof is "a convincing communication that answers why" (Henderson).** What do you think this means? Do you agree or disagree with this definition?
- What do you think are the elements of a good proof, and why are these important?
- What are the potential difficulties you foresee yourself having to overcome in the process of learning to write good proofs?

# Sample prompt

For this forum assignment, I want you to reflect on the nature and importance of proofs in the discipline of mathematics. I strongly encourage you to **consider your own experience with proof throughout your life as well as some of the examples we have seen in class and your own writing** of the domino and chessboard problem. Here are some questions to guide your reflection. You do not need to answer all of them:

- What is a proof?
- What is a "convincing communication that demonstrates a truth" (your own definition). What do you think this means? Do you agree with this definition?
- What do you think are the elements of a good proof, and why are these important?
- What are the **potential difficulties** you foresee yourself having to overcome in the process of learning to write good proofs?



Experience



# Sample prompt

For this forum assignment, I want you to reflect on the nature and importance of proofs in the discipline of mathematics. I strongly encourage you to consider your own experience with proof throughout your life as well as some of the examples we have seen in class and your own writing of the domino and chessboard problem. Here are some questions to guide your reflection, though you do not need to answer all of them:

- **What is the purpose of a proof?**
- One definition of a proof is “a convincing communication that answers why” (Henderson). **What do you think this means? Do you agree or disagree with this definition?**
- **What do you think** are the examples of proofs and why are these important?
- What are the potential difficulties in writing and having to overcome in the process of writing proofs?



Open-ended  
questions

# Student input

Support  
each  
other

Connect  
to course  
material

Outside  
connections

Agree &  
disagree

Personalize

Build  
on  
prompt  
input



# Discussion synopsis

- Discussion in class
  - Follow-up in later prompts
  - Proof portfolio
    - Requires reflection on the nature and importance of proof
    - Further coursework for most – not final closure!
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# Does it make a difference?

- Overall **positive attitude** to the forum. I think this transferred to the class.
- Knew others had expressed areas that needed growth and worked to **encourage** each other.
- Drew on examples from class and in the process **reflected on the concepts** they were learning.
- Made **comparisons** to other areas of study, putting mathematical proof in context.
- Used **their own words** to reflect on the importance and nature of proof.
- Gave **additional examples** of proof to reflect on.
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# Does it make a difference?

*"I really enjoyed this reading as it helped me put some of my own struggles in perspective..."*

*"It seems that there are different kinds of beauty in proofs. They can be aesthetically pleasing, or mathematically pleasing, or their implications could be what make them beautiful. "*

*"There are many reasons to be a mathematician, and one of them is the same reason a painter paints a picture."*





# This is only the beginning!

## Capstone

- Historical exposure
- Focus on communication, with more comparisons
- Problem solving
- MSC
- “inside jokes”
  - Math genealogy project
  - “Finite Simple Group of Order 2” song

## Department activities

- Weekly Math & CS tea with problem
- Math Club
- Problem solving contests
- Conferences



# Questions?

Syllabus language, prompts, and sample extracts will be available on the website for the session:

<http://www.framingham.edu/~smabrouk/Maa/jmm2014/bridge/>

And on my personal webpage:

<http://campus.houghton.edu/webs/employees/kcameng/a/teachers.htm>

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# Prompt topics

Week 1: What is a proof?

- Goal: reflect on nature and importance of proof in math
- Input: Definition: "A convincing communication that answers 'why?'" (Henderson)

Week 2: How is a proof communicated?

- Goal: have students react to varied accepted proofs and identify what elements they think are important.
- Input: Three proofs of  $\sum_{i=1}^n i = \frac{n(n+1)}{2}$ , including two proofs without words





# Prompt topics

## Week 3: Proof & Truth, Part I

- Goal: Exposure to another definition of proof, some false examples & start discussion on math & faith
- Input: First half of the Mathematics Through the Eyes of Faith chapter, Proof & Truth

## Week 4: Proof & Truth, Part II

- Goal: Relate math to faith, especially in the area of proof, with some foreshadowing of vocation
- Input: Second half of the Mathematics Through the Eyes of Faith chapter, Proof & Truth





# Prompt topics

## Week 5: Math talks

- Goal: compare oral and written communication of mathematics
- Input: Students attend a math talk

## Week 6: Math & Beauty

- Goal: ponder the aesthetics of proof
- Input: Students posters share proofs they find appealing (instructor helps with sources)





# What makes a (mathematical) community?

McMillan & Chavis (1986) define "sense of community" as having four parts:

- Membership
- Influence
- Integration & fulfillment
- Shared emotional connection

**TWO communities:  
learning community and  
professional community**



# Building Community

## Learning

- All members
- Opportunity to influence through discussion
- Benefit from mutual support
- Shared experience

## Professional

- Introduction to some ideas from professionals
  - Discussion of norms and comparison to personal
  - Introduction to campus resources
  - Reactions
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