WELCOME!

Prof. Albert R Meyer
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*me
Stellar Web site

https://stellar.mit.edu/S/course/6/sp14/6.042/

• notes, handouts
• class calendar
• course organization
• problem submission
6.042r Website has videos, slides, online questions (link on Stellar). Register online by Friday midnight for team assignment.
Session/Table changes

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Quick Summary

1. Fundamental Concepts of Discrete Mathematics (sets, relations, proof methods, ...)
2. Discrete Mathematical Structures (numbers, graphs, trees, counting...)
3. Discrete Probability Theory
Vocabulary

Quickie:
What does “discrete” mean? (≠ “discreet”)
Reading Assignment

For Friday:

• Courseinfo on web page
• Text Chapter 1; slides/videos

Next week: slides/videos &

• Ch. 2 parts for Monday
• Ch. 3 parts for Wed, Fri
Reading Assignment

Specific readings and due dates in class calendar on Stellar
How the Class Works

Active learning in Teams

MWF 1.5 hour sessions:

- 5-10 min overview by team coach, then
- team problem-solving
How the Class Works

• required attendance
• miniquizzes most Mondays 15 min.
• psets due most Fridays
• videos, online problems most days
• 3 midterms, 80 min. each
• comments in Piazza (optional)
Teamwork

The *good* about teams:

- an efficient way to learn
- fun
- like professional organizations
- cope with diversity
- learn to communicate

*USUALLY*
Teamwork

The bad about teams:

- must be there prepared!
- unremitting
  and sometimes:
  - geniuses are slowed down
  - extremely weak left behind
  - deal with unpleasant people
Teamwork

Your team coach will be working to bring out the **good** and control the **bad**
(your instructor too)

Albert R. Meyer, 2014

February 5, 2014
Active Lectures

Say “hello” to your neighbors—you’ll be working with them
Active Lectures

Quickie question:
Where was your neighbor born?
Getting started: Pythagorean theorem

\[ a^2 + b^2 = c^2 \]

Familiar? Yes!
Obvious? No!
A Cool Proof

Rearrange into:
(i) \( a \times c \times c \) square, and then
(ii) an \( a \times a \) & a \( b \times b \) square
A Cool Proof
A Cool Proof
A Cool Proof

\[ (b-a) + a \]
A Cool Proof

\[ \begin{align*}
\text{a} & \quad \text{b} \\
\text{a} & \quad \text{b-a} \\
\text{b} & \quad \text{a}
\end{align*} \]
A False Proof: Getting Rich By Diagram
A False Proof: Getting Rich By Diagram

Profit!
Getting Rich

The bug:

\[ \begin{align*}
1 & \quad 1 \\
1 & \quad 1
\end{align*} \]

are not right triangles!

So the top and bottom line of the “rectangle” is not straight!
Another False Proof

Theorem: Every polynomial, \( ax^2 + bx + c \) has two roots over \( \mathbb{C} \).

Proof (by calculation). The roots are:

\[
\begin{align*}
 r_1 & := \frac{-b + \sqrt{b^2 - 4ac}}{2a} \\
 r_2 & := \frac{-b - \sqrt{b^2 - 4ac}}{2a}
\end{align*}
\]
Another False proof

Counter-examples:

\[ 0x^2 + 0x + 1 \] has 0 roots
\[ 0x^2 + 1x + 1 \] has 1 root

The bug: divide by zero error
The fix: require \( a \neq 0 \)
Another false proof

Counter-example:

\[1x^2 + 0x + 0\] has 1 root.

The bug: \[r_1 = r_2\]

The fix: require \(D \neq 0\) where

\[D ::= b^2 - 4ac\]
Another false proof

What if $D < 0$?

$x^2 + 1$ has roots $i$, $-i$

--ambiguous which is $r_1$

and which is $r_2$?
1 = -1 ?

Ambiguity can cause problems:

\[1 = \sqrt{1} = \sqrt{(-1)(-1)} = \sqrt{-1} \sqrt{-1} = (\sqrt{-1})^2 = -1\]

**Moral:**

1. Be sure rules are properly applied.
2. Calculation is a risky substitute for understanding.
$1 = -1$ ?

pictures are not the only source of false proofs

$$1 = \sqrt{1} = \sqrt{(-1)(-1)} = \sqrt{-1} \sqrt{-1} = (\sqrt{-1})^2 = -1$$

**Moral:**

1. Calculation is a risky substitute for understanding.
2. Be sure you know the rules.
Consequences of \( 1 = -1 \)

\[ \frac{1}{2} = -\frac{1}{2} \quad \text{(multiply by} \ \frac{1}{2}) \]

\[ 2 = 1 \quad \text{(add} \ \frac{3}{2}) \]

“Since I and the Pope are clearly 2,
we conclude that I and the Pope are 1.
That is, I am the Pope.”

-- Bertrand Russell
Consequences of \[ 1 = -1 \]

Bertrand Russell (1872 - 1970)

(Picture source: http://www.users.drew.edu/~jlenz/brs.html)
Team Problems

Problems

1–3