Introduction to Logic

PHIL 170

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Instructor Information

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Office Hours: MW 12:00 - 12:50

Teaching Staff: Michael McCourt

Office: Skinner 1118C

Email: mmccour2@umd.edu

Office Hours: M 2:30 - 4:30

Teaching Staff: Xuan Wang

Office: Skinner 1110C

Office Hours: MW 12-1pm

Email: xuanwang@umd.edu

Course Information

Course Website: `https://myelms.umd.edu/courses/1154637`

Room: LEF 2205

Lectures: MW: 11:00am - 11:50am

Textbook: Logic & Proofs

- Register for an account (Go to the ELMS site, Open the "Online Textbook" module and select "Logic & Proofs")

  myelms.umd.edu/courses/1154637/modules/items/8163995
- Cost: $80
- Course Key: **umd-phil170**
- Use a supported browser (IE, Firefox, Safari)
- Interactive quizzes/tutorials/labs

Grades

Attendance & Quizzes	(10%)
Problem Sets (Labs)	(25%)
3 Midterms	(45%)
Final Exam	(20%)

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- Consult the online course syllabus for the due dates. **Late assignments will not be accepted.**

Schedule

Topics	Chapters	Dates
Introduction	1, 2	8/31 - 9/11
Propositional Logic: Syntax & Semantics	3, 4	9/14 - 10/2
Propositional Logic: Derivations	5, 6, 7	10/5 - 10/30
Firt-Order Logic: Syntax & Semantics	9, 10	11/2 - 11/16
Firt-Order Logic: Derivations	11, 12	11/8 - 12/5

Schedule

Material that will be skipped

- Argument Diagramming (there are some labs/quizzes on argument diagramming)
- Chapter 8: Elementary Metamathematics
- Chapter 13: Identity and Functions
- Chapter 14: Aristotelian Logic

Schedule

Additional material (time permitting!)

- Basic Probability Theory
- Preview: What do Logicians study? (Proof Theory, Model Theory, Applied Logic, Set Theory, Foundations of Math, Game Theory, . . .)
- Preview: Other cool logics (Modal Logic, Default/Non-Monotonic Logic, Higher-Order Logic, Substructural Logic, . . .)
- . . .

Advice

- Take advantage of the interactive material in the textbook. Many opportunities to work on practice problems. Answer all the "Did I get this" questions. (I'll use your online work to help plan my lectures).
- Attend the lectures and sections. (Attendance will be taken in the sections). You are responsible for any announcements made in class or on the website.
- Pay attention to the deadlines. Check the course website and syllabus regularly.
- Ask questions. (in class, online discussion, office hours, sections, free tutoring, fellow students)

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- ...a description of how people ought to think?
- ...a collection of strategies to win arguments, or to persuade or convince others?
- ...a slick Mac app for producing music?

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Is logic...

- ...a description of how people think? (This is a psychological question.)
- ...a description of how people ought to think? (This is a question for epistemologists.)
- ...a collection of strategies to win arguments, or to persuade or convince others? (This is a question of rhetoric/debate.)
- ...a slick Mac app for producing music? (Logic Pro X)

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- "Logic is the study of reasoning; and mathematical logic is the study of the type of reasoning done by mathematicians" (Shoenfeld)

What is logic?

"If it was so, it might be, and if it were so, it would be , but since it isn't it ain't. That's logic."

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"Logic is many things: a science, an art, a toy, a joy, and sometimes a tool."

- Dorothy Grover and Nuel Belnap

What can we do with logic?

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Logic is used in computer science ("on the unusual effectiveness of logic in computer science"), mathematics, philosophy, linguistics, cognitive science, game theory, ...

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Logic is used in computer science ("on the unusual effectiveness of logic in computer science"), mathematics, philosophy, linguistics, cognitive science, game theory, ...

- What *is* a mathematical proof?
- Are there *limits* to what a computer can do?
- Can we *automate* reasoning in various domains (e.g., mathematics, epistemology, ethics, game theory, grammar, ...)?
- Can we identify interesting *patterns* of reasoning and/or behavior?
- ...

Restaurant Example

In a restaurant, Ann ordered Fish, Bob ordered Vegetarian and Charles ordered Meat. Out of the kitchen comes some new person carrying the three plates. What will happen?

The waiter asks a first question, say "Who ordered the meat?", and puts that plate in front of Charles. Then he asks a second question "Who ordered the fish?", and puts that plate in front of Ann.

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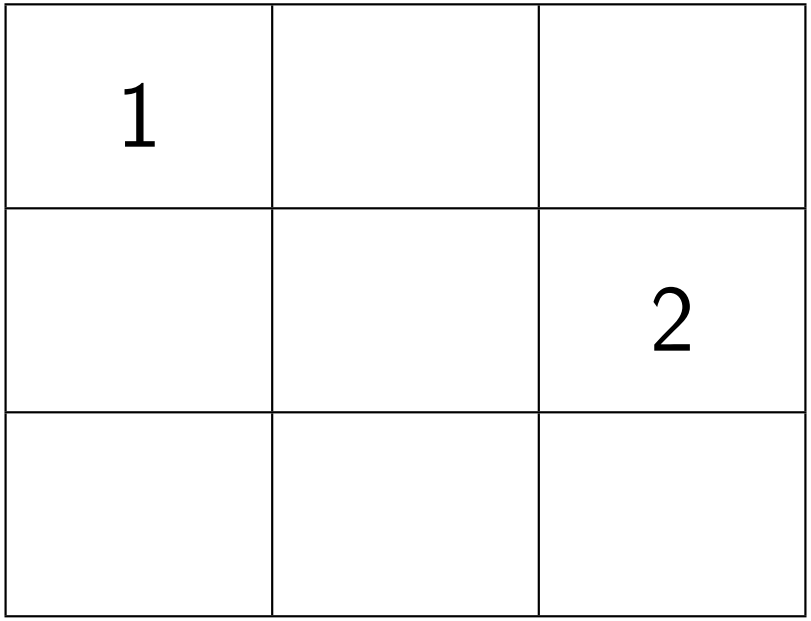
Meat or Vegetarian or Fish, not Fish, not Meat $\Longrightarrow$ Vegetarian

Sudoku



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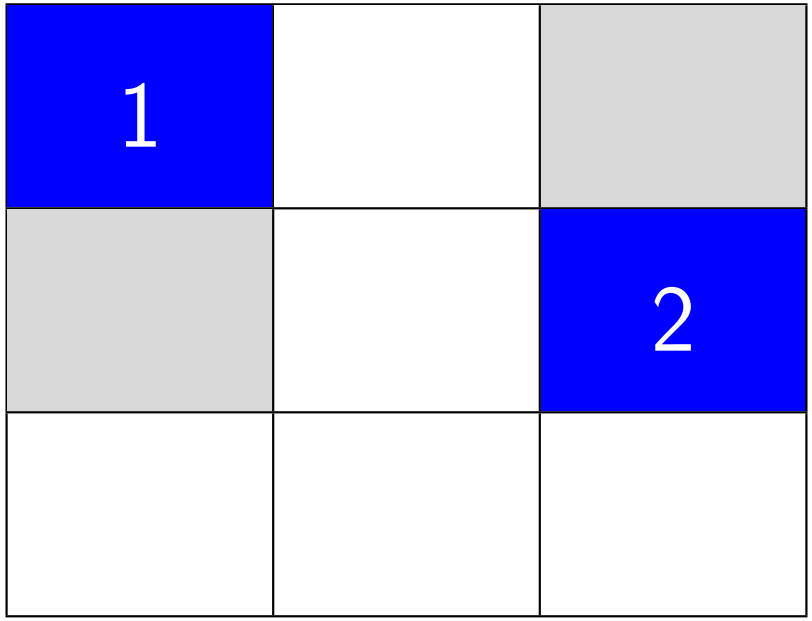

1 or 2 or 3, not 1, not 2 $\Longrightarrow$ 3

Sudoku

1		3
3		2

Sudoku

1	2	3
3		2
2		

1 or 2 or 3, not 1, not 3 $\Longrightarrow$ 2

Sudoku

1	2	3
3	1	2
2		1

1 or 2 or 3, not 2, not 3 $\Longrightarrow$ 1

Sudoku

1	2	3
3	1	2
2	3	1

1 or 2 or 3, not 2, not 1 $\Longrightarrow$ 3

Sudoku

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2	3	1

Question

Ann is looking at Bob, and Bob is looking at Charles. Ann is married and Charles is not married.

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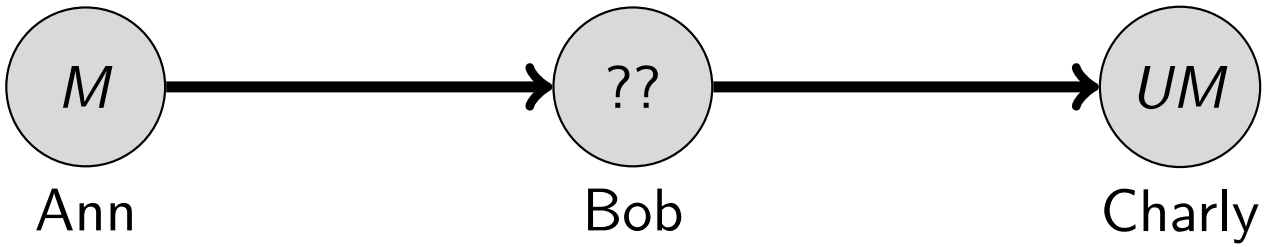

Is it true that a married person is looking at an unmarried person?

1. Yes.
2. No.
3. There is not enough information to answer this question.

Smullyan's Knights and Knaves

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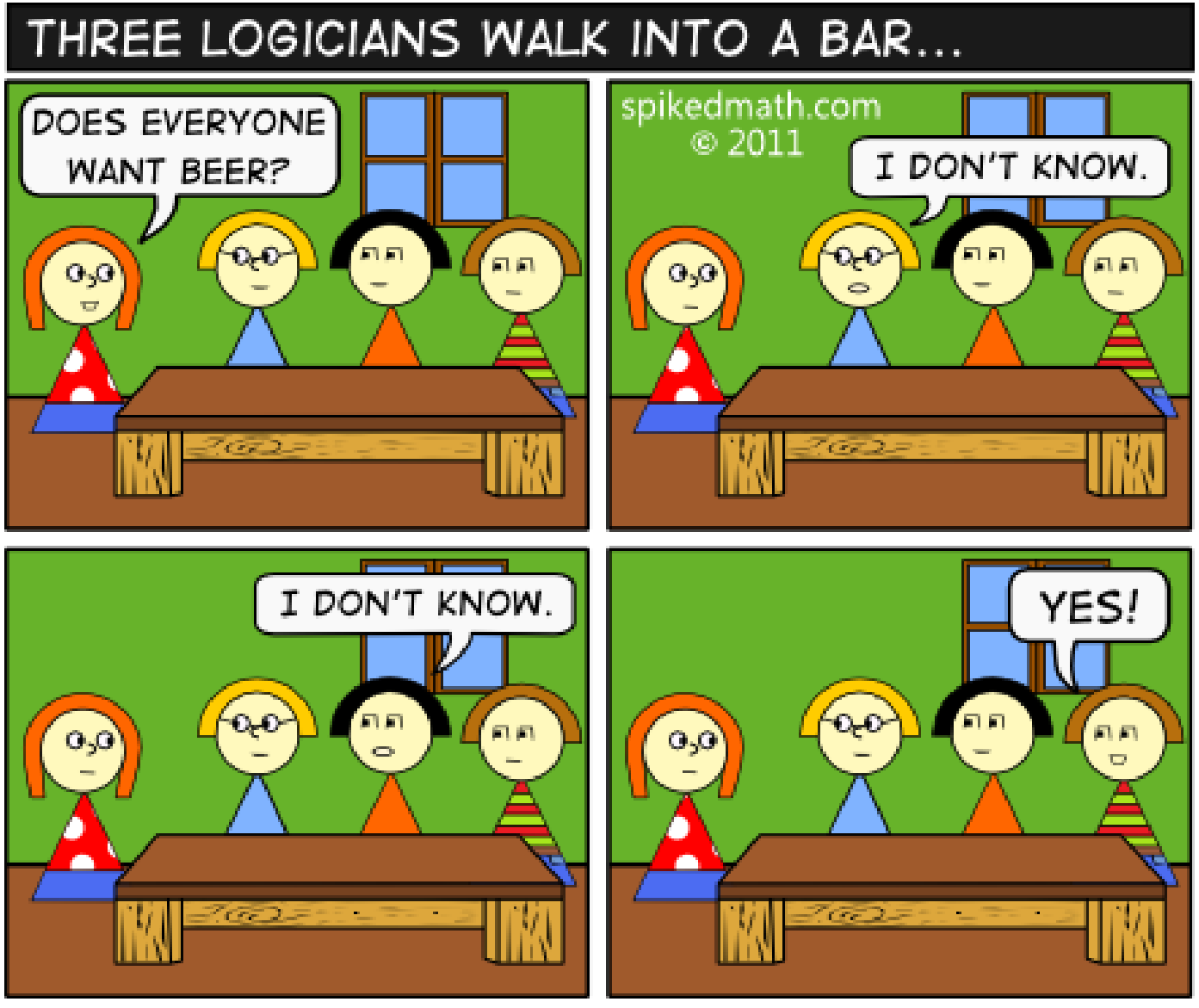
Was C a knight or a knave?


THREE LOGICIANS WALK INTO A BAR...
DOES EVERYONE WANT BEER?
spikedmath.com
© 2011
I DON'T KNOW.
I DON'T KNOW.
YES!

Logicians study **arguments**. An argument is a set of **statements**, one of which is singled out as the **conclusion**, the other statements are called **premises**.

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Comedic Interlude

Monty Python's Argument Sketch

(Transcript: `http://www.montypython.net/scripts/argument.php`)

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Sentences express statements

Declarative Sentences

Amsterdam is in The Netherlands.

Helsinki is in Norway.

Textbooks are free in all of my courses.

The Terps won the football game against the Buckeyes.

Indexical Sentences

I have been in LeFrak before.

My computer was stolen.

The dog ate the steak yesterday.

Many sentences can express the same statement

1. I have taken logic before.
2. I took logic.
3. This is not the first time I have taken logic.

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1. There is a cat in the teapot.
2. Hay un gato en la tetera.
3. Il y a un chat dans la théière.
4. Eine Katze ist in der Teekanne.

Statements, Commands, Questions

Attendance is mandatory. (declarative)

Show up to the lectures! (imperative)

Are you coming to class today? (interrogative)

Ambiguity

I saw a man on a hill with a telescope.

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2. There's a man on a hill, who I'm seeing, and he has a telescope.

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3. There's a man, and he's on a hill that also has a telescope on it.
4. I'm on a hill, and I saw a man using a telescope.

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5. There's a man on a hill, and I'm sawing him with a telescope.

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Lily, your iPad is on the table.

1. Lily's iPad is on the table.
2. Take your iPad off the table!

Same statements?

Good food is not cheap. Cheap food is not good.

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- There is no food that is both cheap and good.

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Ann will not have steak.
Ann will have salad.

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- $2 + 2 = 5$. (arithmetic impossibility)
- Eric is from Ohio and Eric is not from Ohio. (logical impossibility)

Argument Diagramming

1. Identify premises and conclusion
2. Do the premises jointly or independently support the conclusion?