

# PUZZLE

Three guests are sitting at a table. The waitress asks: “Does everyone want coffee?” The first guest says: “I don’t know.” The second guest then says: “I don’t know.” Then the third guest says: “No, not everyone wants coffee.” The waitress comes back and gives the right people their coffees. How?

# PHIL 2310: LOGIC

Wednesday, 15 January  
Joel Velasco

# COURSE INFORMATION

- **Joel Velasco**  
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2-3pm Tue, Thu,  
or email for appointments
- **Course Requirements**  
30% Homework  
20% x 2 for exams  
30% Final
- **Language, Proof and Logic (2nd edition)**  
Barker-Plummer, Barwise  
and Etchemendy
- **Software**  
Tarski's World, Fitch,  
Boole, and Submit

# COURSE INFORMATION

- **Hamed Shirmohammadi**  
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# HOMework

- **Assignments**

posted online one week before due date: Everything is posted at: <http://joelvelasco.net/teaching/2310/>

- **Submission**

online: Grade Grinder  
written: bring to class  
typically due Friday  
No Late Work


- **Collaboration**

discuss anything you want - we encourage working in groups!

- complete/submit your work without consulting others or group work

# GRADE GRINDER

Submit 2.5



**1**

## Submit Files to be Graded

Registration ID   
E.g., L11-1234567

Your Name   
E.g., Alfred Tarski

Your Email Address   
E.g., al@logika.ilpan.waw.pl

Instructor's Name   
E.g., Frederic Brenton Fitch

Instructor's Email Address   
E.g., freddie@logic.yale-university.edu

**2**   **3**

World Submit Me 1.wld

Welcome to Submit

# WHAT IS LOGIC?

- logic as good reasoning
- In this view, logic is about the difference between valid and invalid arguments
- In a valid argument, the conclusion *follows* from the premises. *IF* all of the premises are true, then the conclusion is (must be, would be...) true.
- Equivalently: It is impossible for all of the premises to be true and the conclusion false.

PENGUINS ARE BLACK AND WHITE.  
SOME OLD TV SHOWS ARE BLACK AND WHITE.  
THEREFORE, SOME PENGUINS ARE OLD TV SHOWS.



**Logic: another thing that  
penguins aren't very good at.**

# Recognizing versus Diagnosing Bad Reasoning



# VALIDITY AND ARGUMENTS

(1) If our currency loses value then our trade deficit will narrow.

$P \rightarrow Q$

(2) Our trade deficit will narrow

$Q$

Conclusion: Our currency will lose value.

$P$

INVALID

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---

Q

VALID

# VALIDITY AND ARGUMENTS

(1) If the continuum hypothesis is true then the set theoretic universe is constructible

$P \rightarrow Q$

(2) The continuum hypothesis is true

$P$

---

$Q$

Conclusion: The set theoretic universe is constructible

VALID

# VALIDITY

- From these examples we can see that validity as a property of arguments is:

(1) topic neutral

(2) independent of actual truth and falsity

We didn't need to know any economics, advanced mathematics, or any facts about the world to judge the validity of the previous two arguments.

# WHAT IS LOGIC?

- logic as good reasoning versus logic as a system
- First-Order Logic (FOL)
- computers and programming languages
- differences between FOL and natural language and the role of formal logic
- logical consequence and methods of proof

# THIS COURSE

- Learn two systems of FOL:  
propositional logic and predicate logic
- Convert natural language arguments into FOL
- Create and assess proofs in FOL
- Keep in mind  
advantages of FOL; possible limitations of FOL;  
relationship between FOL and natural language

# SENTENCES IN FOL

- Sentences in FOL are either true or false in any particular world (model).
- All sentences are either atomic or complex.
- Complex sentences (like Alice and Bob went to the party) have component parts that are sentences.
- Atomic sentences (like Alice went to the party) don't - but they do have parts.

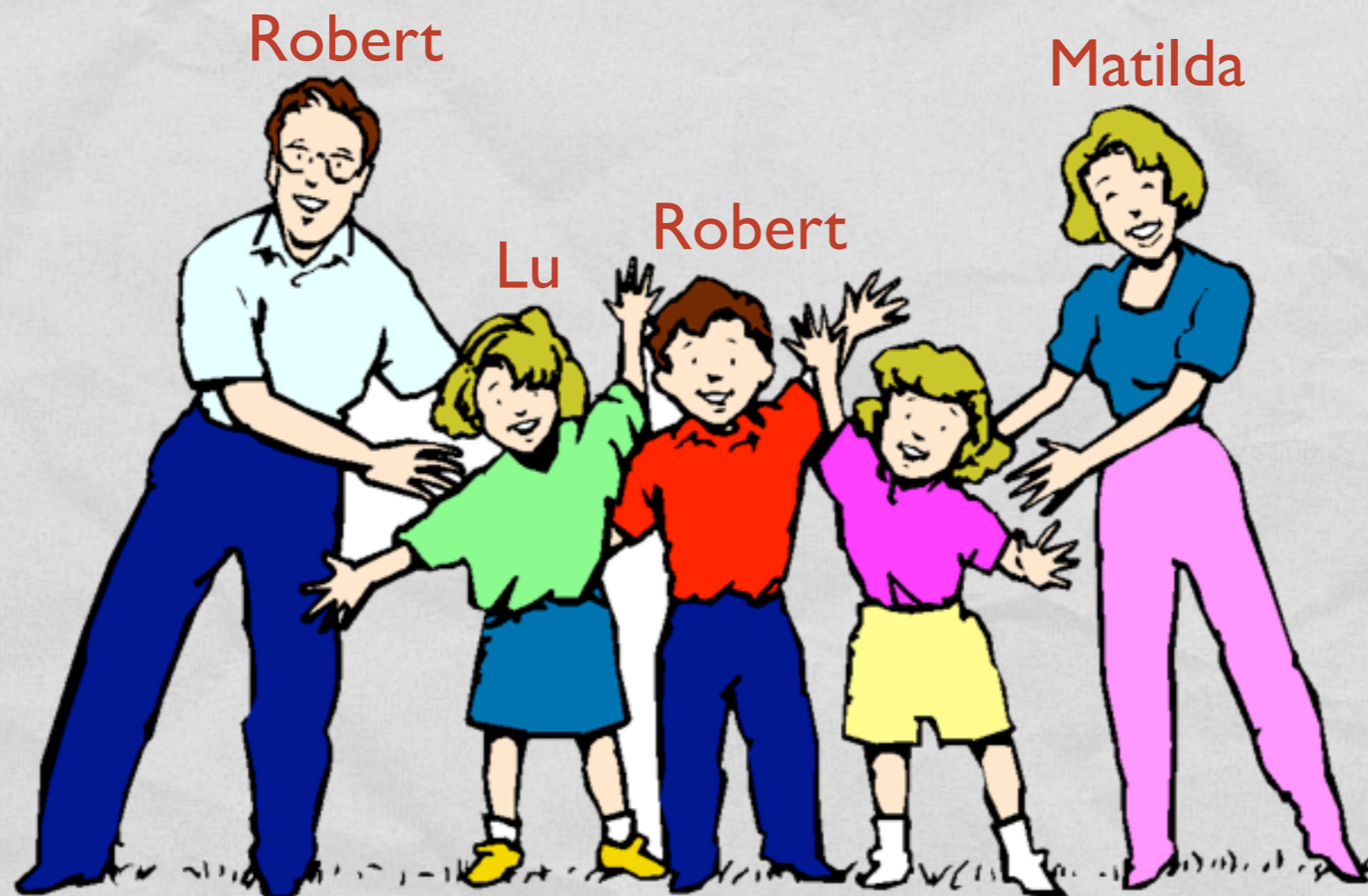


# CONSTANTS

- Constants are symbols that pick out objects in the universe.
- Each constant must name one (and only one) object.
- An object can be referred to by more than one constant, or by no constant at all.

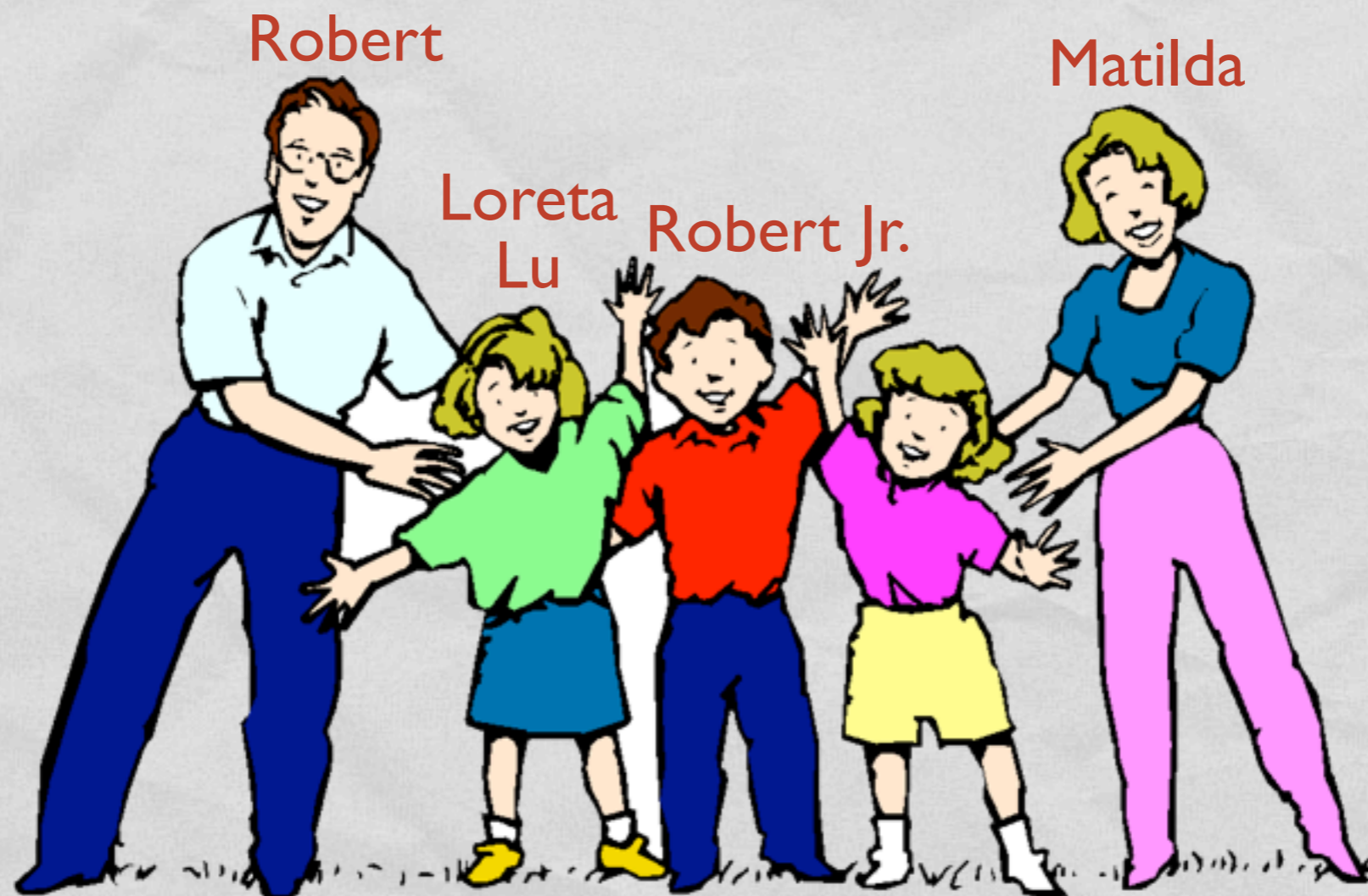
# CONSTANTS

Which of these names could be constants?



# CONSTANTS

Which of these names could be constants?



# PREDICATES

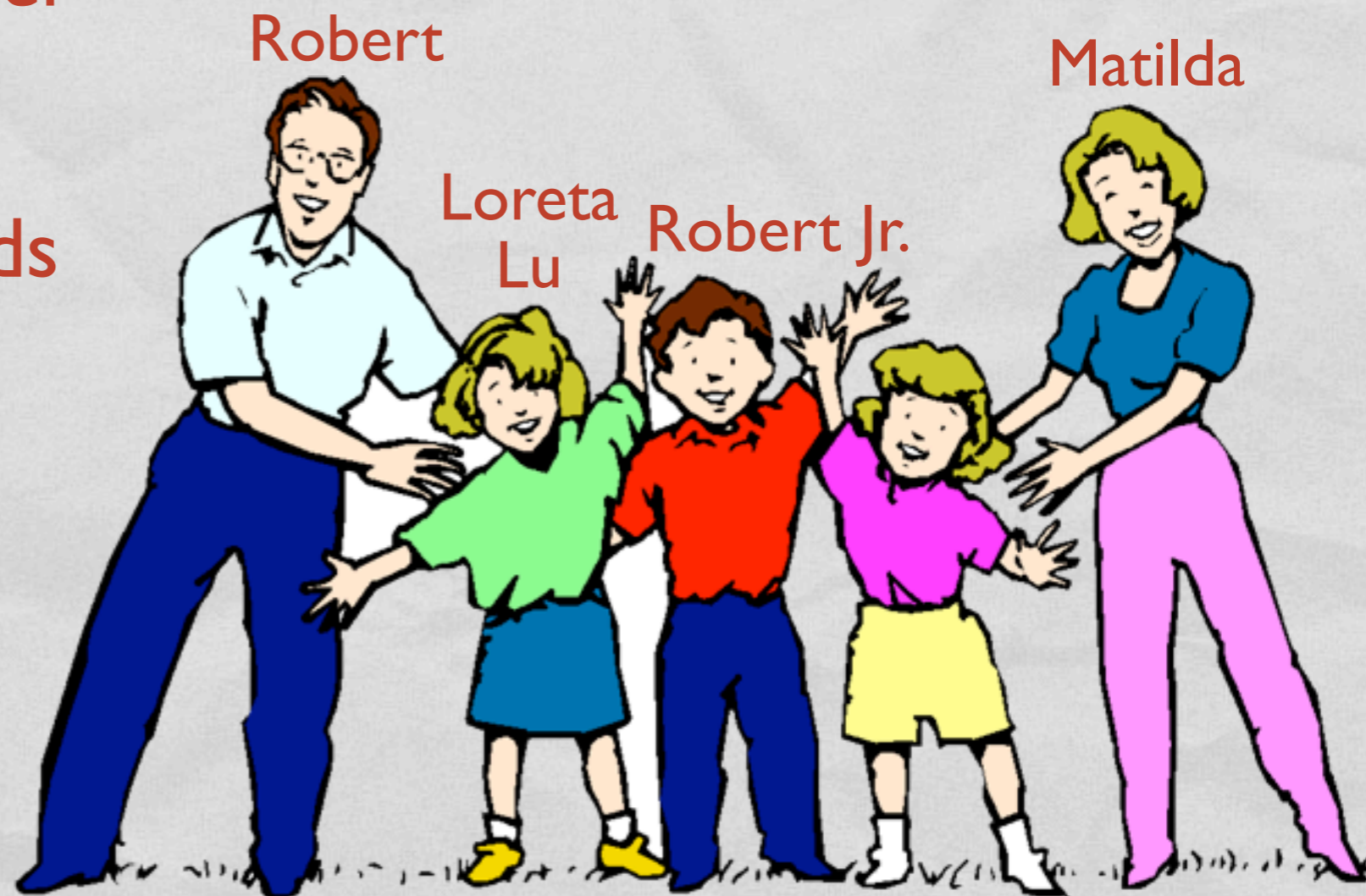
- Predicates are symbols used to ascribe properties or relations to objects in our universe.
- Each predicate takes a fixed number of objects; this is called its arity (unary, binary, ternary, etc.)
- All predicates in FOL express determinate properties and relations.

# PREDICATES

Male(a): a is male.

Shorter(a, b): a is shorter than b.

Between(a, b, c): a stands between b and c.



# ATOMIC SENTENCES

- An atomic sentence is a predicate followed by the appropriate number of names.
- The order of the names is crucial in determining what atomic sentences mean.
- A sentence makes a claim: it is either true or false.

# ATOMIC SENTENCES

Male(Loreta): Loreta is male.

Male(Lu): Lu is male.

Lu = Loreta

Shorter(Robert Jr., Matilda)

Shorter(Matilda, Robert Jr.)

