

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 now 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?

ADMINISTRATIVE

- Course website:

<http://courses.cit.cornell.edu/jdv55/teaching/2310/>

- Assignment 1 is posted (due Mon, Set 6th)
- If you are not registered for the class, you must give me your email address to receive announcements

ATOMIC SENTENCES

Friday, 27 August

SENTENCES IN FOL

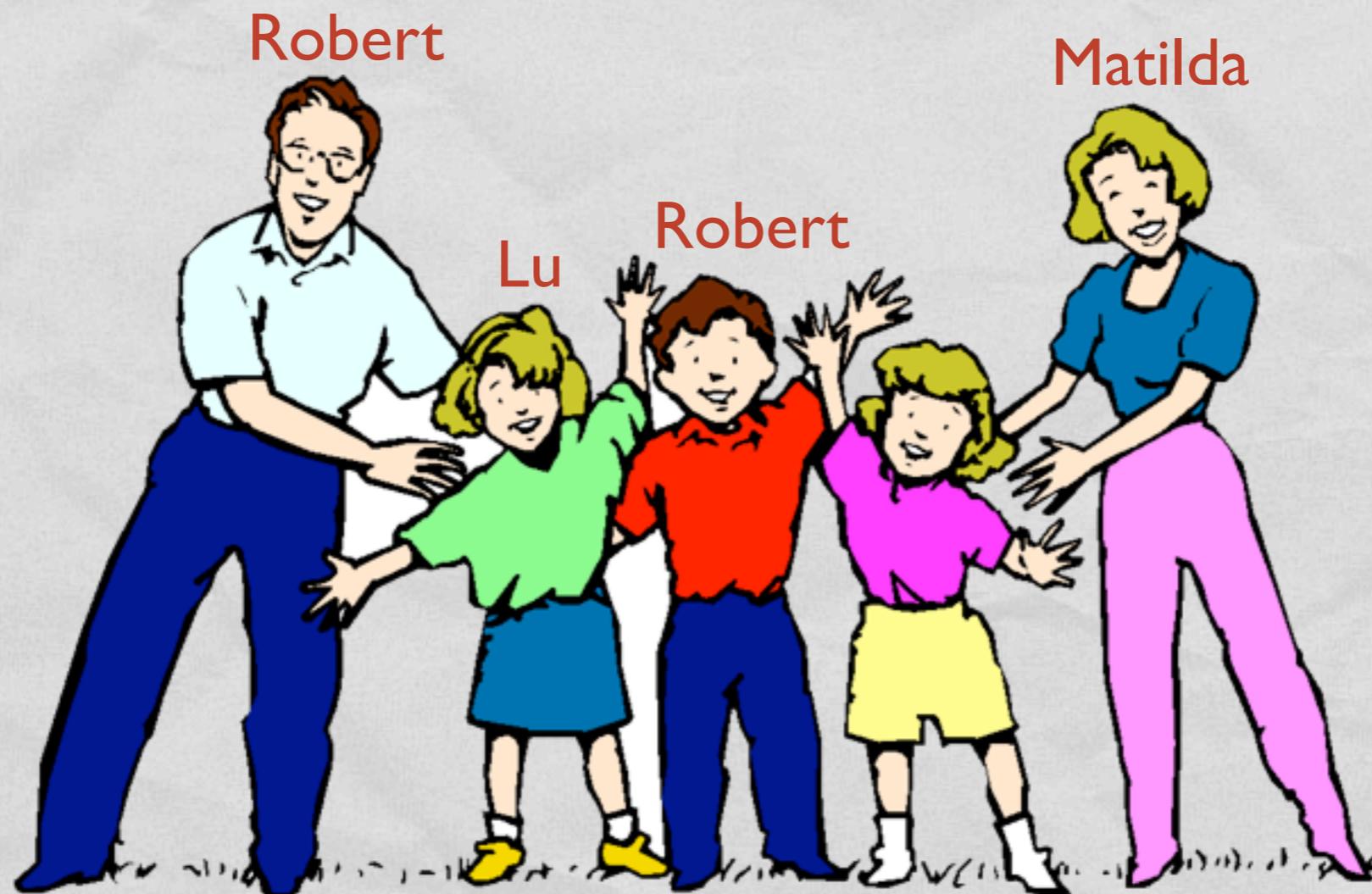
- Sentences in FOL are either true or false in any particular world (model).
- All sentences are either atomic or complex.
- Complex sentences (like Alice and Bob went to the party) have component parts that are sentences.
- Atomic sentences (like Alice went to the party) don't - but they do have parts.

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.

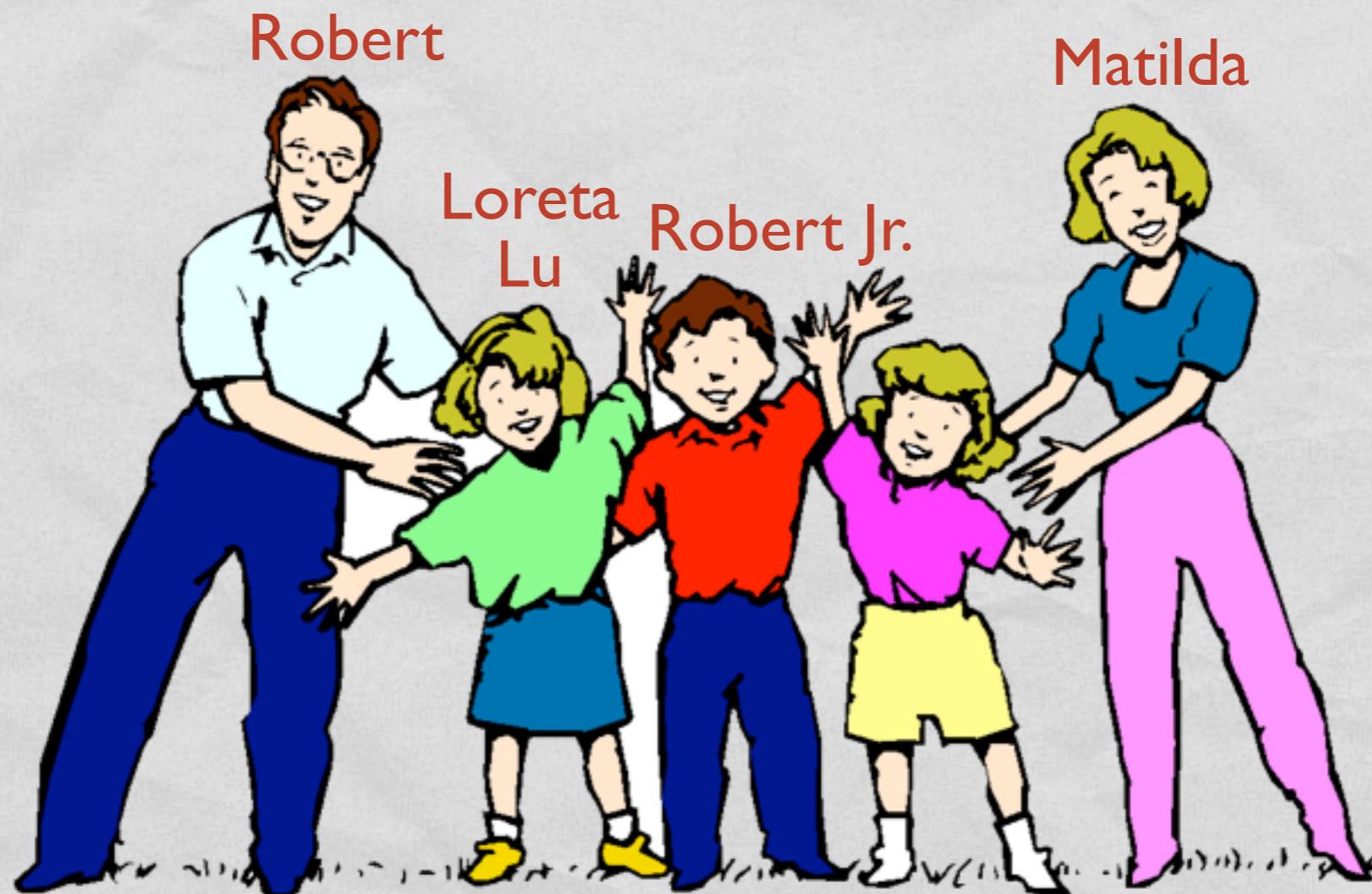
CONSTANTS

Which of these names could be constants?



CONSTANTS

Which of these names could be constants?



PREDICATES

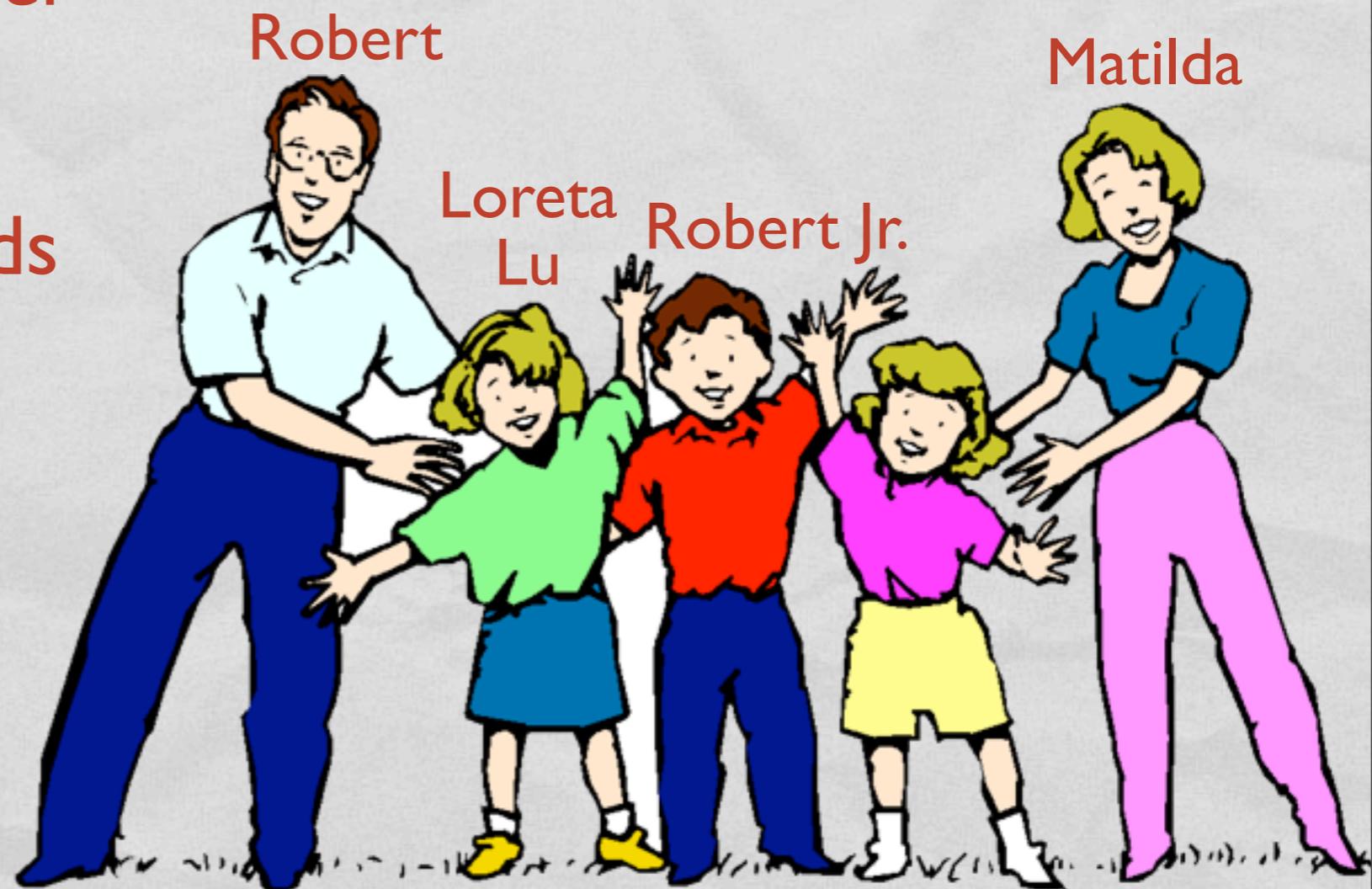
- Predicates are symbols used to ascribe properties or relations to objects in our universe.
- Each predicate takes a fixed number of objects; this is called its arity (unary, binary, ternary, etc.)
- All predicates in FOL express determinate properties and relations.

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

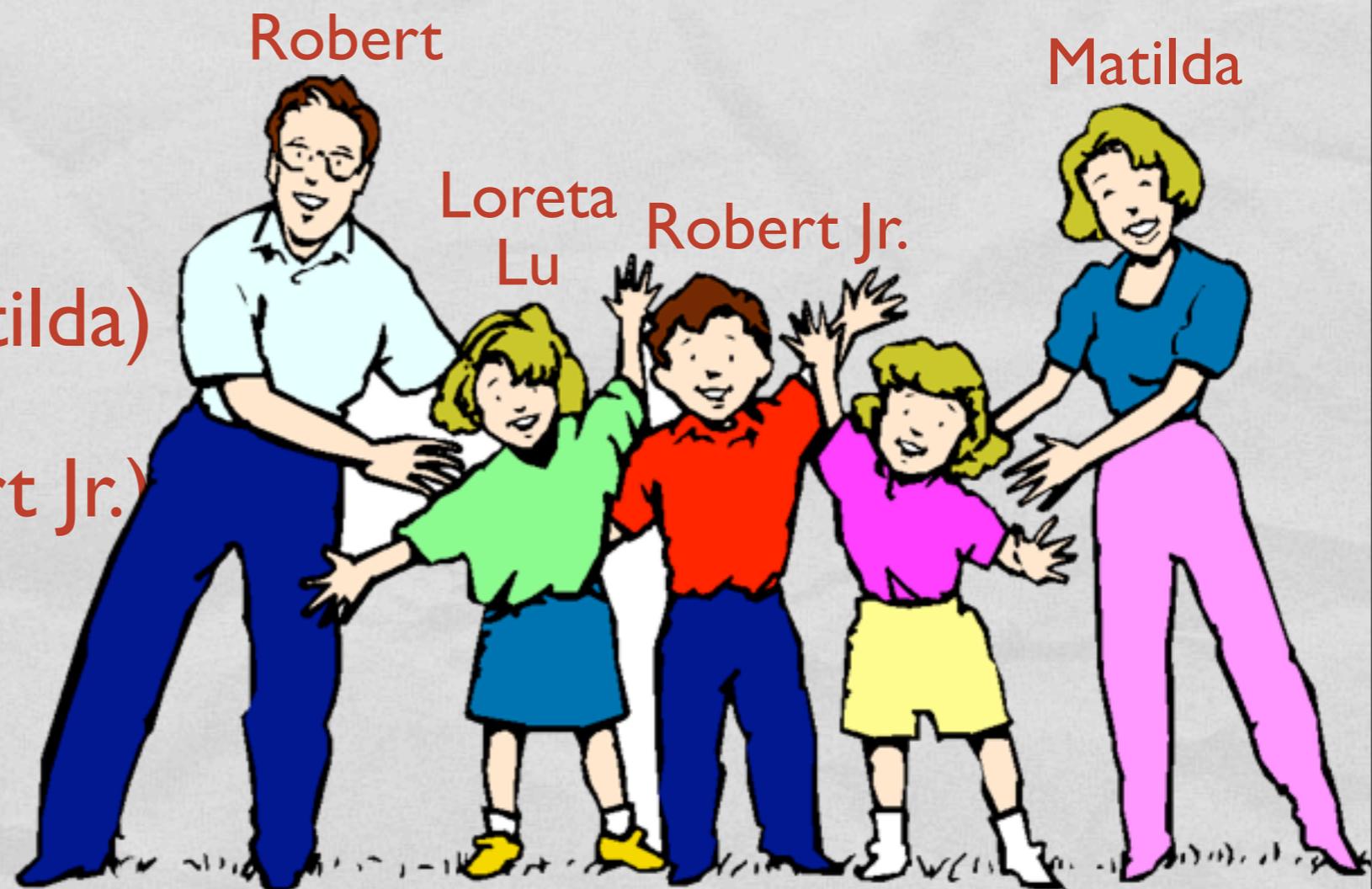
Male(Loreta): Loreta is male.

Male(Lu): Lu is male.

Lu = Loreta

Shorter(Robert Jr., Matilda)

Shorter(Matilda, Robert Jr.)



SYNTAX

- Our book uses the following syntax for an atomic sentence:
 - A predicate starts with a capital letter
 - Parentheses surround the constants which are separated by commas

SPECIAL EXCEPTION: IDENTITY

- Identical(a,b) would be an atomic sentence
- As an abbreviation, we use $a=b$ for this sentence
- For technical reasons, we want identity to be a logical relation (always means the same thing in every world)

FIRST-ORDER LANGUAGES

- Different constants and predicates; different sentences can be formed
- Same connectives and quantifiers
- Different degrees of expressiveness

Between Robert Robert Jr. (a)

Between (a, b, c)

TARSKI'S WORLD

Blocks Language

Constants

\wedge	\vee	\neg	\rightarrow	\leftrightarrow	\perp
a	b	c	d	e	f
\forall	\exists	=	\neq	()
x	y	z	u	v	w

Blocks					Pets	Set	Arith
Tet	Small	LeftOf	SameCol	Smaller			
Cube	Medium	RightOf	SameRow	Larger			
Dodec	Large	FrontOf	Between				
SameShape	SameSize	BackOf	Adjoins				

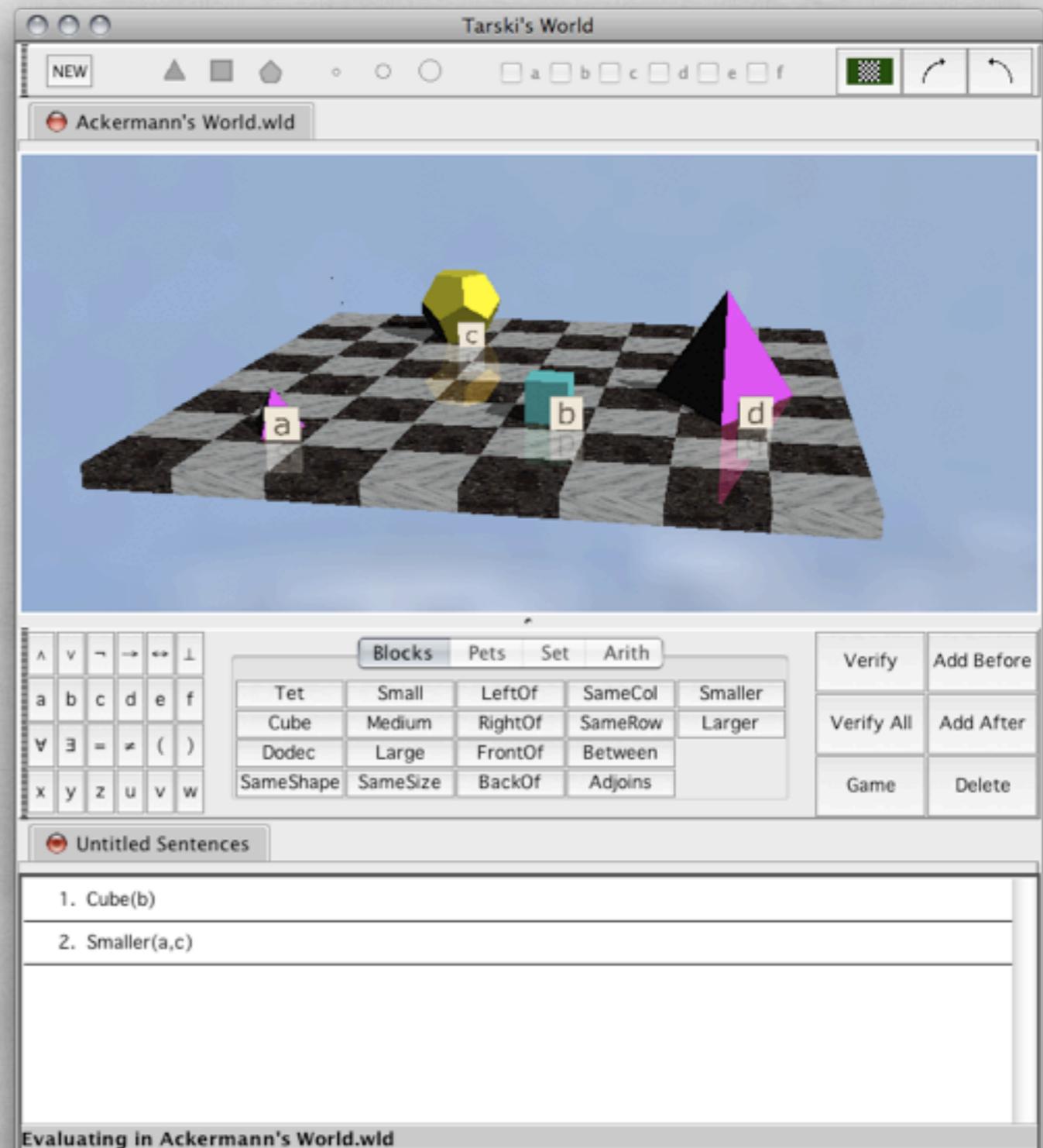
Predicates

TARSKI'S WORLD

Using Tarski's World

World →

Atomic Sentences →



FUNCTION SYMBOLS

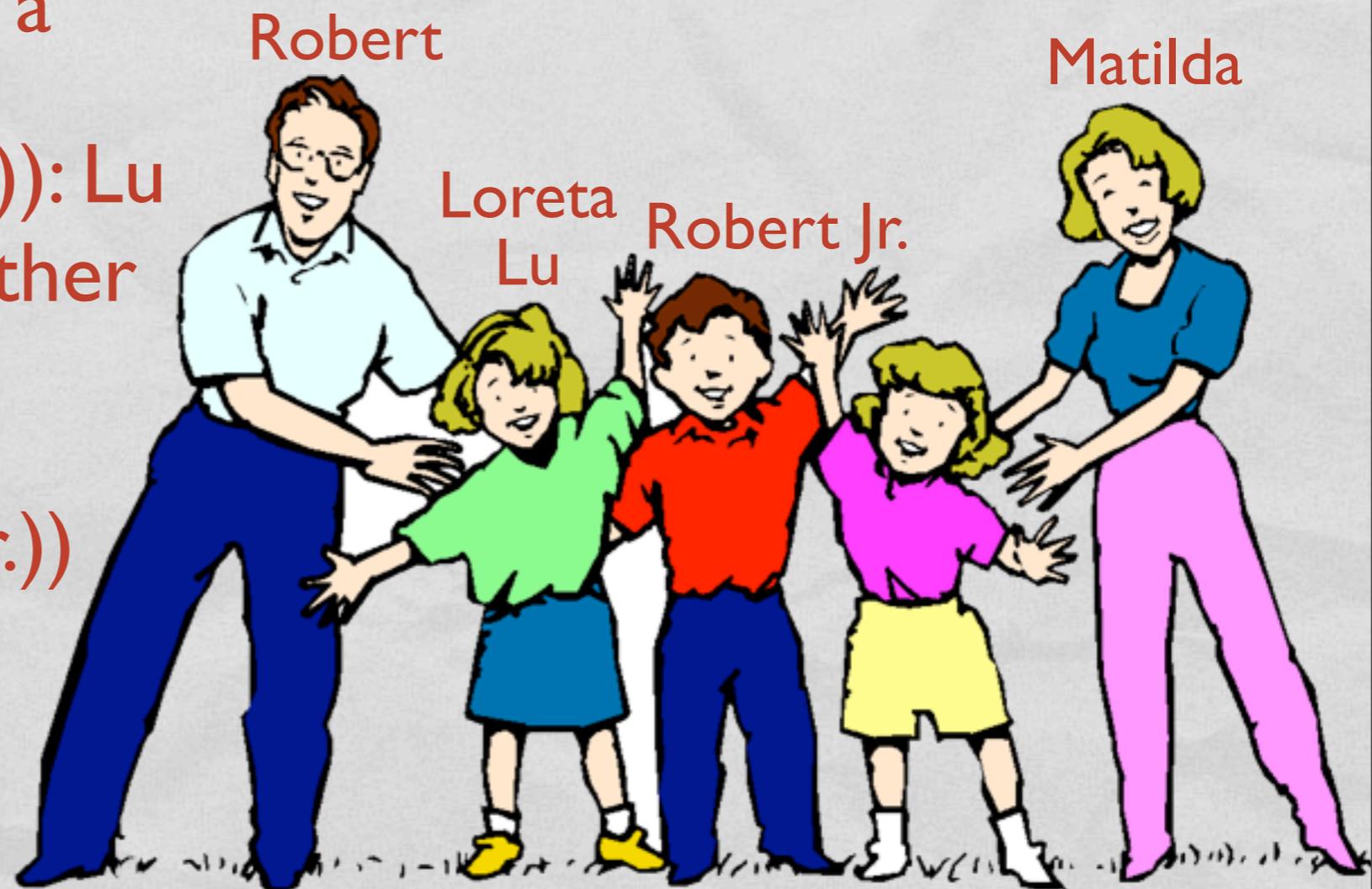
- A constant is a special type of TERM. A function applied to a term (like a constant) yields another term. A function applied to a term refers to exactly one object.
- Like predicates, each function symbol takes a fixed number of objects (has a fixed arity).
- Unlike predicates, when you combine a function with a term, you do not get a sentence but another term.

FUNCTION SYMBOLS

$\text{mother}(a)$: refers to the object that has the property of being the mother of a

$\text{Shorter}(\text{Lu}, \text{mother}(\text{Lu}))$: Lu is shorter than the mother of Lu.

$\text{Male}(\text{mother}(\text{Robert Jr.}))$



ATOMIC VS. SIMPLE

Atomic sentences are sometimes simple - like $P(a)$ but sometimes not like:

Between(mother(Robert), taller(Robert, Lu), father(mother(Anita)))

Or:

The least prime number that is greater than 25 equals the square of the greatest common factor of 102 and 120 minus 7.

Complex sentences include:

Bob and Jane are tall

$5 \neq 7$

WHERE WE ARE

- You should now be able to complete the first part of the homework on atomic sentences (all from Chap I in the book).
- Parts II and III will be from Chapter 2: The Logic of Atomic Sentences (M and W lectures).