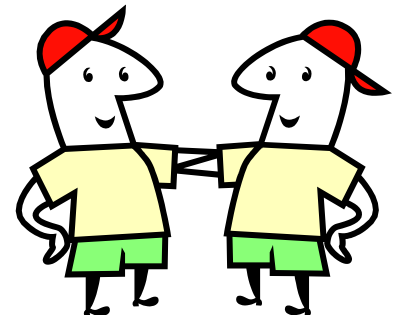# COMP2000

Lecture 4

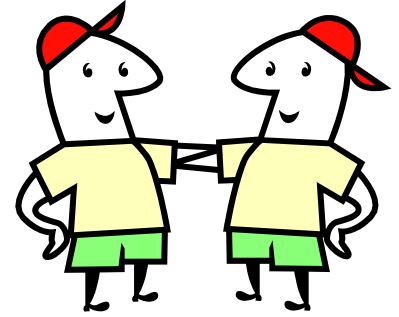**Logic: treasures, mysteries, All and NOT**

Lab tomorrow!

- The lab is tomorrow (but you can do it any time)
- It is posted from the main page (and mine, too)
- Let's [go over the lab](#) before we start the lecture

Twins puzzle

- There are two identical twin brothers, Dave and Jim.

- One of them always lies; another always tells the truth (like knights and knaves).

- Suppose you see one of them and you want to find out his name.

- How can you learn if you met Dave or Jim by asking just one short yes-no question? You don't know which one of them is the liar.
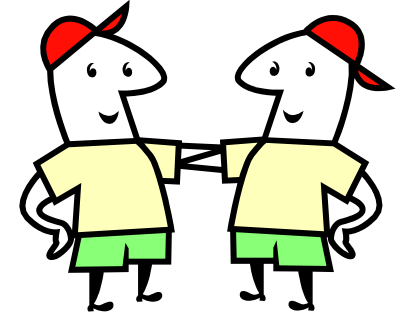
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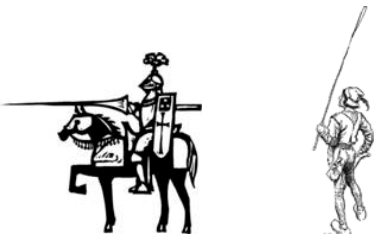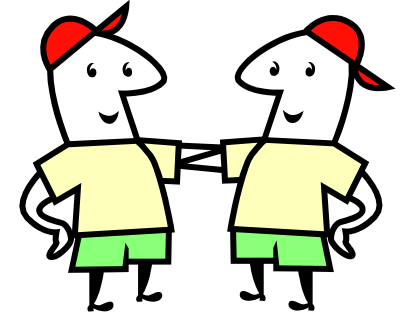| This is Jim	Jim is a liar				
Yes	Yes				
Yes	No				
No	Yes				
No	No				

Twins puzzle

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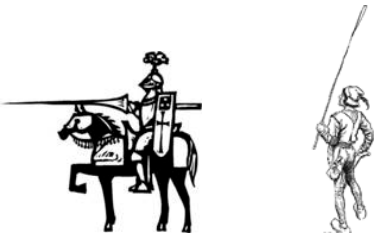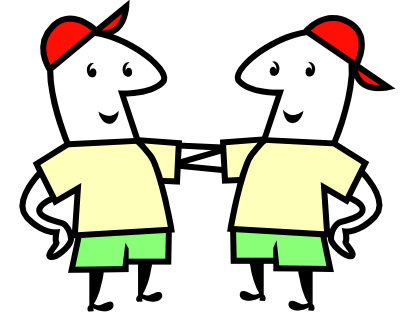| This is Jim	Jim is a liar	This is a liar			
Yes	Yes	Yes			
Yes	No	No			
No	Yes	No			
No	No	Yes			

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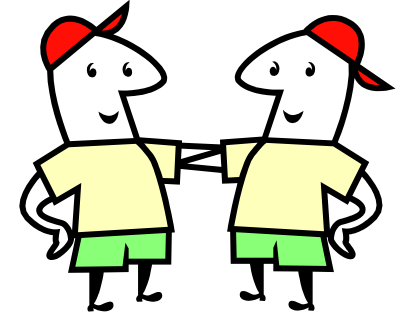| This is Jim	Jim is a liar	This is a liar	Are you Jim?		
Yes	Yes	Yes	No		
Yes	No	No	Yes		
No	Yes	No	No		
No	No	Yes	Yes		

Twins puzzle

- There are two identical twin brothers, Dave and Jim.
- One of them always lies; another always tells the truth (like knights and knaves).
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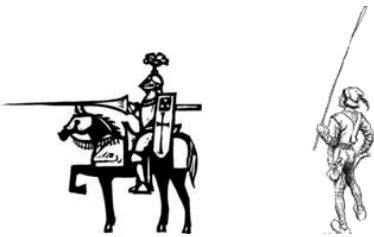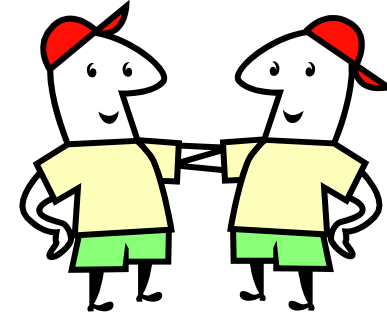| This is Jim	Jim is a liar	This is a liar	Are you Jim?	Is 2+2=4?	
Yes	Yes	Yes	No	No	
Yes	No	No	Yes	Yes	
No	Yes	No	No	Yes	
No	No	Yes	Yes	No	

Twins puzzle

- There are two identical twin brothers, Dave and Jim.
- One of them always lies; another always tells the truth (like knights and knaves).
- Suppose you see one of them and you want to find out his name.
- How can you learn if you met Dave or Jim by asking just one short yes-no question? You don't know which one of them is the liar.

This is Jim	Jim is a liar	This is a liar	Are you Jim?	Is 2+2=4?	Is Dave a liar?
Yes	Yes	Yes	No	No	Yes
Yes	No	No	Yes	Yes	Yes
No	Yes	No	No	Yes	No
No	No	Yes	Yes	No	No

Liars on the crossroads

Treasure hunts
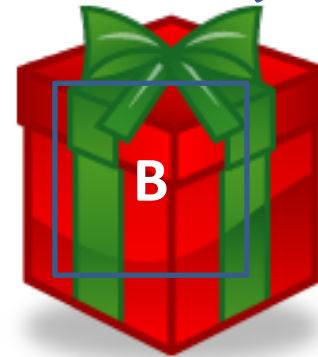
Treasure hunt

- In the back of an old cupboard you discover a note signed by a pirate famous for his bizarre sense of humor and love of logical puzzles. In the note he wrote that he had hidden a treasure somewhere on the property. He listed 5 true statements and challenged the reader to use them to figure out the location of the treasure

Treasure hunt

1. If this house is next to a lake, then a treasure is not in the kitchen
2. If the tree in the font yard is an elm, then the treasure is in the kitchen
3. This house is next to a lake
4. The tree in the front yard is an elm, or the treasure is buried under the flagpole
5. If the tree in the back yard is an oak, then the treasure is in the garage.

Treasure hunt

1. If this house is next to a lake, then a treasure is not in the kitchen
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5. If the tree in the back yard is an oak, then the treasure is in the garage.

Too many variables for a nice truth table…

- A: this house is next to a lake.
- B: the treasure is in the kitchen
- C: The tree in front is elm
- D: the treasure is under the flagpole.
- E: The tree in the back is oak
- F: The treasure is in the garage

1. If A then not B
2. If C then B
3. A
4. C or D
5. If E then F

1. A-> ~B
2. C -> B
3. A
4. C \/ D
5. E -> F

Modus ponens

- A: this house is next to a lake.
- B: the treasure is in the kitchen
- C: The tree in front is elm
- D: the treasure is under the flagpole.
- E: The tree in the back is oak
- F: The treasure is in the garage

1. If A then not B
2. If C then B
3. A
4. C or D
5. If E then F
6. Not B
7. Not C
8. D

- If house is next to the lake then the treasure is not in the kitchen
- The house is next to the lake
- Therefore, the treasure is not in the kitchen.

Murder mystery
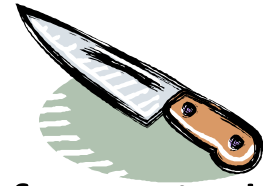
- One evening there was a murder in the home of married couple, their son and daughter. One of these four people murdered one of the others.

- One of the members of the family witnessed the crime.

- The other one helped the murderer.

- These are the things we know for sure:
  - 1. The witness and the one who helped the murderer were not of the same sex.
  - 2. The oldest person and the witness were not of the same sex.
  - 3. The youngest person and the victim were not of the same sex.
  - 4. The one who helped the murderer was older than the victim.
  - 5. The father was the oldest member of the family.
  - 6. The murderer was not the youngest member of the family.

- Who was the murderer?

Four doors of Xanth
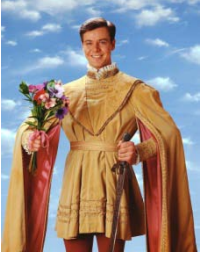
Four doors of Xanth

- Prince Questor is exploring the caves of Xanth. At the end of a tunnel, he finds four doors, he finds a scroll. Here is the message from the scroll. Each door conceals one item. The items are a treasure, a rope, a key, and a lantern. You must find all four items in a particular order to keep the treasure.

- As Questor is reading the scroll, three bats fly in. The first bat says, "You must find the key before you find the rope." The second bat says, "If you find the lantern before you find the rope, the treasure will disappear." The third bat says, "You must find the treasure last."

- As Questor is puzzling over these remark,s three ogres appear. The first one says, "The rope is not behind the 1st or 2nd door." The second ogre says, "The treasure is in the room just to the right of the lantern." The third ogre says, "The key is behind the fourth door." In what order should Questor open the doors to keep the treasure?

Natural deduction vs. Truth tables

- In this puzzle, it was faster to solve it using modus ponens (natural deduction method) than writing a truth table.

- But is it always better?

- The answer is...

Nobody knows!

- And there is a million dollar prize for finding out!

- And solving this problem will solve many other.