

Suppose that in the country of Knights and Knaves you meet three individuals, A, B, and C. You discover that at least one of them is a Knight and at least one of them is a Knave.

A says "B or C is a Knight" and B says "A or C is a Knight."

Which of them are Knights and which are Knaves?

THE BOOLEAN CONNECTIVES Friday, 3 September

1.4.

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Note: SameSize(¬a, b) is NOT a sentence.

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 \neg (Cube(a) \land a=b) \lor (Larger(b, c) $\lor \neg$ Medium(b))

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 <u>Well-formed sentences</u> are

 (a) intelligible in the formal language;
 (b) produced in the right way by the sentencebuilding rules (functions, predicates, constants, etc.);
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 (b) produced in the right way by the sentencebuilding rules (functions, predicates, constants, etc.);
 (c) these sentence-building rules are recursive.
- <u>Boolean connectives</u> are one way of turning atomic sentences into complex sentences.
- If Φ is a sentence and Ψ is a sentence then $(\Phi \lor \Psi)$ is a sentence, etc.

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 Each complex sentence has exactly one <u>main</u> <u>connective</u>.

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Contractions a second a Constant

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- A ∨ (B ∧ C) is a disjunction the ∨ is the m.c.
 A and (B ∧ C) are called the disjuncts
 (A ∨ B) ∧ C is a conjunction the ∧ is the m.c.
 (A ∨ B) and C are the conjuncts
 Parentheses are used to determine the order of the
 - connectives and disambiguate sentences.

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$\neg(A \lor (B \land \neg C)) \land (\neg(D \land E) \lor F)$

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F

 $(A \lor (B \land \neg C)) \qquad \neg (D \land E)$

MAIN CONNECTIVES

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MAIN CONNECTIVES



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FALSE	TRUE

Long And Block of the a Constant

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FALSE	TRUE	FALSE
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- 'And' in English can link two names or properties.
 For example, Sam and Sarah had breakfast; Sam had breakfast and went to the park.
 In FOL, conjunction only links two sentences.
- In English, 'and' is often used to imply causation or a temporal sequence.

'And' does not have this implication in FOL.

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- The sentence A ∨ B is true iff A is true or B is true or both A and B are true.
- Truth table for disjunction:

Α	В	$A \lor B$
TRUE	TRUE	TRUE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE

 In English, 'A or B' is often used to mean that either A is true, or B is true, but not both (exclusive or).

In FOL, exclusive or (exactly one of) could be expressed as $(A \lor B) \land \neg(A \land B)$

The simple disjunction $(A \lor B)$ is always the inclusive or (at least one of and maybe both).

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Alice is at the party and Bill is at the party

The Lord And Block and a Con-

Alice is at the party and Bill is at the party $P(a) \land P(b)$

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 For a sentence like Cube(a) ∧ Cube(b) to be a good translation of 'Both a and b are cubes' implies that in every possible world created in Tarski's World (some where a is medium, some large, some with a block c, some not, etc.) if 'Both a and b are cubes' is true then 'Cube(a) ∧ Cube(b)' is true and it is false in all other cases.

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