



Logic, Information flow and Argumentation

Homework exercises, Week 6, part b (due Tuesday 20 March).

1. Using the diagrammatic method presented in class, decide whether the following syllogisms are valid or not.

(a)
$$\frac{\begin{array}{l} \text{All students are poor} \\ \text{All poor people are hungry} \end{array}}{\text{Some student is hungry}}$$

(b)
$$\frac{\begin{array}{l} \text{All students are poor} \\ \text{All students are clever} \end{array}}{\text{Some clever person is poor}}$$

(c)
$$\frac{\begin{array}{l} \text{All students are clever} \\ \text{Some teacher is clever} \end{array}}{\text{Some student is a teacher}}$$

(d)
$$\frac{\begin{array}{l} \text{Some easy things are fun} \\ \text{All logic exercises are easy} \end{array}}{\text{Some logic exercises are fun}}$$

(e)
$$\frac{\begin{array}{l} \text{No woman has been president} \\ \text{Some president has lived in the White House} \end{array}}{\text{Some woman has not lived in the White House}}$$

2. Translate the following sentences into predicate logic (stating the translation you use precisely).

- (a) John sleeps.
- (b) Mary is doing a logic exercise.

- (c) John sleeps but Mary doesn't.
- (d) If John is working, Mary is also working.
- (e) It is not the case that both Mary and John are students.

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- (f) Everybody is sleeping.
- (g) Everybody likes Mary.
- (h) Something is flying around.
- (i) John saw somebody.
- (j) John gave something to Mary.

3. Free and bound variables

For each of the following formulas, indicate:

- (a) Whether it is a negation, a conjunction, a disjunction, an implication, a universal formula, or an existential formula (this refers to the main logical expression: connective or quantifier);
- (b) the scope of the quantifiers;
- (c) the free occurrences of variables;
- (d) whether it is an open or closed.
- (e)
 - i. $\exists x(Axy \wedge Bx)$
 - ii. $\exists xAxy \wedge Bx$
 - iii. $\exists x\exists yAxy \rightarrow Bx$
 - iv. $\exists x(\exists yAxy \rightarrow Bx)$
 - v. $\neg\exists x\exists yAxy \rightarrow Bx$
 - vi. $\forall x\neg\exists yAxy$
 - vii. $\neg Bx \rightarrow (\neg\forall y(\neg Axy \vee Bx) \rightarrow Cy)$
 - viii. $\exists x(Axy \vee By)$
 - ix. $\exists xAxx \vee \exists yBy$
 - x. $\exists x(\exists yAxy \vee By)$
 - xi. $\forall x\forall y((Axy \wedge By) \rightarrow \exists wCwx)$
 - xii. $\forall x(\forall yAyx \rightarrow By)$
 - xiii. $\forall x\forall yAyy \rightarrow Bx$