Philosophy 240
Symbolic Logic

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Class #22 - Translation into Predicate Logic I (§3.1)

Business

- Welcome to the second half of the semester!
- Quantificational (or predicate) logic:
  - Monadic predicate logic: **M**
  - Full first-order logic: **F**
    - Relational predicates
    - Identity theory
  - Two small topics, extensions of the language beyond **F**
    - Functions: **FF**
    - Second-order quantification: **S**
- Paper proposals due on November 16
  - Papers due December 4, after Thanksgiving
  - You can do them at any time!
  - Philosophy Friday #5: Infinity
  - Philosophy Friday #6: Truth
  - Philosophy Friday #7: Quantification and Ontological Commitment
- Test #4 on November 6
- Test #5 on November 20
- Test #6 (final) on December 14

Propositional Logic and Predicate Logic

- Propositional Logic
  - The logic of propositions (meanings of sentences) and their relations
  - Contains:
    - Capital English letters for simple statements
    - Five connectives/operators
    - Punctuation (brackets)
  - Compositionality in the five operators
- Predicate Logic
  - Sub-sentential
  - The logic of objects and properties
  - Contains:
    - Complex statements
      - singular terms
      - predicates
    - Quantifiers
    - The same five connectives/operators
    - The same punctuation
  - Compositionality in the operators but also in the way that subjects and predicates combine to form a proposition.

Singular Terms and Predicates

- We represent objects using lower case letters.
  - ‘a, b, c,...u’ stand for specific objects, and are called constants.
  - ‘v, w, x, y, z’ are used as variables.
  - Together, these are called *singular terms*.
- We represent properties of objects using capital letters.
  - Pa: means that object a has property P
    “P of a”
  - These are called ***predicates***
- Examples
  - Pe: Emily is a philosopher
  - He: Emily is happy
    1. Alice is clever.
       Ca
    2. Bobby works hard.
       Wb
    3. Chuck plays tennis regularly.
       Pc
    4. Dan will see Erika on Tuesday at noon in the gym.
       Sd

Two Kinds of Quantifiers

- Existential quantifiers: $(\exists v)$, $(\exists w)$,$(\exists x)$, $(\exists y)$, $(\exists z)$
  - There exists a thing, such that
  - For some thing
  - There is a thing
  - For at least one thing
  - Something
- Universal quantifiers: $(\forall v)$, $(\forall w)$,$(\forall x)$, $(\forall y)$, $(\forall z)$
  - For all x
  - Everything
- The ambiguity of ‘anything’
  - Existential in ‘If anything is missing, you’ll be sorry’
  - Universal in ‘Anything goes’

Translations Using Quantifiers

One predicate

- Something is made in the USA.
  - $(\exists x)Ux$
- Everything is made in the USA.
  - $(\forall x)Ux$
- Nothing is made in the USA.
  - $(\forall x)\sim Ux$

    or
  - $\sim(\exists x)Ux$

Translations Using Quantifiers

More than one predicate

- All persons are mortal.
  - $(\forall x)(Px \supset Mx)$
- Some actors are vain.
  - $(\exists x)(Ax \cdot Vx)$
- Some gods aren't mortal.
  - $(\exists x)(Gx \cdot {\sim}Mx)$
- No frogs are people.
  - $(\forall x)(Fx \supset {\sim}Px)$

    or
  - ${\sim}(\exists x)(Fx \cdot Px)$

Propositions With More Than Two Predicates

- More than one predicate in the subject:
  - Some wooden desks are uncomfortable.

    $(\exists x)[(Wx \cdot Dx) \cdot \sim Cx]$
  - All wooden desks are uncomfortable

    $(\forall x)[(Wx \cdot Dx) \supset \sim Cx]$
- More than one predicate in the attribute:
  - Many applicants are untrained or inexperienced

    $(\exists x)[Ax \cdot (\sim Tx \vee \sim Ex)]$
  - All applicants are untrained or inexperienced

    $(\forall x)[Ax \supset (\sim Tx \vee \sim Ex)]$

‘Only’ as a Quantifier

With Two Predicates

- Only men have been presidents.
  - If something has been a president, it must have been a man.
  - All presidents have been men.
- ‘Only Ps are Qs’ is logically equivalent to ‘all Qs are Ps’.
  - All men have been presidents.
    $(\forall x)(Mx \supset Px)$
  - Only men have been presidents.
    $(\forall x)(Px \supset Mx)$

‘Only’ as a Quantifier with More than Two Predicates

- All intelligent students understand Kant.
  - $(\forall x)[(Ix \bullet Sx) \supset Ux]$
- Only intelligent students understand Kant
  - $(\forall x)[Ux \supset (Ix \bullet Sx)]$
    - Probably not
  - $(\forall x)[(Ux \bullet Sx) \supset Ix)]$
    - Better
- So: ‘Only PQs are R’ is ordinarily the same as ‘All RQs are P’
- But...
- Only famous men have been presidents.
  - $(\forall x)[(Px \supset (Mx \bullet Fx)]$
  - $(\forall x)[(Px \bullet Mx) \supset Fx]$
    - Either could be used.
    - The former is more likely to represent the intentions of the speaker.
- Only hard-working students take logic.
  - $(\forall x)[Lx \supset (Hx \bullet Sx)]$
- So: Sometimes ‘Only PQs are R’ is better as ‘All Rs are Pqs’.
  - There’s no *syntactic* or *grammatical* rule.

The Only

Often just an ‘All’

- The only people who came to the party were late.
  - All people who came to the party were late.
  - $(\forall x)(Cx \supset Lx)$
- The only people who came to the party were Al and Beth.
  - $(\forall x)[Cx \supset (Ax \vee Bx)]$
  - Wait until 3.11 for a translation using constants.
- The only way to know whether you’re translating correctly is to understand the logic of your assertions (and those of other folks) and to understand how **M** and, later, **F** work.
- ‘Only’ can be used in other ways.
  - Interesting more-formal paper topic

More than One Quantifier

- If anything is damaged, then everyone in the house complains.
  - $(\exists x)Dx \supset (\forall x)[(Ix \cdot Px) \supset Cx]$
- Either all the gears are broken, or a cylinder is missing.
  - $(\forall x)(Gx \supset Bx) \vee (\exists x)(Cx \cdot Mx)$
- Some philosophers are realists, while other philosophers are fictionalists.
  - $(\exists x)(Px \bullet Rx) \bullet (\exists x)(Px \bullet Fx)$
- It's not the case that all conventionalists are logical empiricists if and only if some holists are conventionalists.
  - $\sim[(\forall x)(Cx \supset Lx) \equiv (\forall x)(Hx \supset Cx)]$