# Seminar on Axiomatic Metaphysics
# Lecture 1
# Introduction

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# Topics for the Lectures

| Date | Time | Lecture | Title | Room |
|---|---|---|---|---|
| Mo, 27.5 | 10–12 | Lecture 01 | Introduction | Library/Statistics, Ludwigstr. 33/II |
| Di, 28.5 | 10–12 | Lecture 02 | An Exact Science | Library/Statistics, Ludwigstr. 33/II |
| Mi, 29.5 | 10–12 | Lecture 03 | Logical Objects | Library/Statistics, Ludwigstr. 33/II |
| Do, 30.5 | | Holiday | No class | |
| Fr, 31.5 | 10–12 | Lecture 04 | Situations and Possible Worlds | Library/Statistics, Ludwigstr. 33/II |
| Mo, 03.6 | 10–12 | Lecture 05 | Routley Star and Possibilities | Library/Statistics, Ludwigstr. 33/II |
| Di, 04.6 | 10–12 | Lecture 06 | Impossible Worlds and Leibnizian Concepts | Library/Statistics, Ludwigstr. 33/II |
| Mi, 05.6 | 10–12 | Lecture 07 | Leibnizian Modal Metaphysics | Library/Statistics, Ludwigstr. 33/II |
| Do, 06.6 | 10–12 | Lecture 08 | Fregean Senses | Library/Statistics, Ludwigstr. 33/II |
| Fr, 07.6 | 10–12 | Lecture 09 | Frege Numbers I | Library/Statistics, Ludwigstr. 33/II |
| Mo, 10.6 | 10–12 | Lecture 10 | Frege Numbers II | Library/Statistics, Ludwigstr. 33/II |
| Di, 11.6 | 10–12 | Lecture 11 | Philosophy of Mathematics I | Library/Statistics, Ludwigstr. 33/II |
| Mi, 12.6 | 10–12 | Lecture 12 | Philosophy of Mathematics II | Library/Statistics, Ludwigstr. 33/II |

## Some Abstract Entities (and their Endorsers)

- *Mathematical objects and relations*. (Quine)
  Required by the quantifiers in our best scientific theories.
- *Relations*, *Properties*, *Propositions* (Russell)
  To explain predication, bearers of truth value, objects of belief.
- *Forms* (Plato)
  To explain predication and mathematics.
- *Concepts* and *Senses* (Leibniz, Frege)
  To explain predication, truth, identity, belief.
- *Course of Values*, *Extensions*, and *Truth Values* (Frege)
  Logical objects and mathematics.
- *Possible worlds* (Leibniz, Kripke, Lewis)
  To interpret ordinary modal beliefs, necessity, possibility, etc.
- *Nonexistent objects* (Meinong)
  To analyze discourse about fictions, dreams, etc.

# Quine and Carnap

- Quine (1948) accepted some mathematical objects, namely, sets. But given naturalism, the principles of set theory become revisable in principle, subject to the tribunal of experience.
- Logical positivists rejected abstract entities, as part of their rejection of metaphysics, but Carnap (1950) seems to think one can "use a language referring to abstract entities without embracing a Platonist ontology" (206).
  - Relativize discourse to linguistic frameworks; distinguish internal vs. external questions of existence for each framework; treat external existence questions as strict nonsense.
  - However, the external question of existence is a practical question about whether to adopt the linguistic framework when doing science.
- What is missing: a principle that guarantees the existence of the objects of each linguistic framework, without which the internal existence question would be 'no'.

## For the Advanced Student

- *Principia Logico-Metaphysica*
- See: List of the Most Important Theorems (PDF p. 10, numbered p. xvi)
- The axiom system summarized: https://mally.stanford.edu/presentations/2024-blockseminar-system-2nd-order.pdf

# Mally and Predication: I

. . . Im Gedanken “geschlossene ebene Kurve, deren Punkte von *einem* Punkte gleichen Abstand haben” ist etwas gemeint, das die angenommenen Objektive erfüllt, irgendein Individuum oder Ding aus der Klasse der Kreise . . . Was aber im Begriffe unmittelbar gedacht ist, das ist der Gegenstand “geschlossene ebene Kurve, u.s.w.” Dieses begriffliche Abstraktum ist im Begriffe bloß gedacht, nicht auch gemeint. Von ihm ist die Erfüllung der konstitutiven Objektive nicht vorausgesetzt, . . . “*der Kreis*” (in abstracto) *erfüllt* die im Kreisbegriffe angenommenen Objektive *nicht*, . . . er ist nicht ein Kreis; er fällt deshalb auch nicht unter den Umfang des Kreisbegriffes, gehört der Klasse der Kreise nicht an, sondern bestimmt sie nur irgendwie und vertritt sie unserem Erfassen gegenüber: als der *Begriffsgegenstand*, nicht als Zielgegenstand des Begriffes.

(*Gegenstandstheoretische Grundlagen der Logik und Logistik*, 1912, p. 63)

## Mally and Predication: I

… In the thought "closed plane curve, every point of which lies equidistant from *a single* point," something is meant which satisfies these hypothesized objectives, some individual or thing from the class of circles … But what is directly conceived in this concept is the object "closed plane curve, etc." This conceptual abstractum is only conceived in this concept but not meant. That it satisfies the constitutive objectives is not presupposed … "*the circle*" (in abstraction) *does not satisfy* the hypothesized objectives in the circle-concept, … it is not a circle; therefore it isn't in the extension of the circle-concept, it doesn't belong to the class of circles, but determines them in some sense and represents them when we grasp them: as the *concept-object*, not as the intended object of the concept.

# Mally and Predication: II

Nun ist aber "der Kreis" in abstracto doch ein anderer Gegenstand als etwa "das Dreieck" in abstracto. Was die beiden voneinander unterscheidet, sind die Objektive, die wir als ihre konstitutiven oder definierenden Bestimmungen bezeichnen. Also müssen diese Bestimmungen den Begriffsgegenständen doch in irgendeiner Weise zukommen. Wir sagen: der (abstrakte) Gegenstand "Kreis" ist definiert oder determiniert durch die Objektive "eine geschlossene Linie zu sein", "in der Ebene zu liegen", und "nur Punkte zu enthalten, die von *einem* Punkte gleichen Abstand haben"; er ist als *Determinat* dieser Objektive zu bezeichnen, aber nicht als "implizites" (vgl. §30), da er ja die Objektive nicht erfüllt, sondern, wie man vielleicht sagen könnte, als bloß explizites oder als "Formdeterminat" dieser Objektive.

(*Gegenstandstheoretische Grundlagen der Logik und Logistik*, 1912, p. 64)

# Mally and Predication: II

"The circle" in abstraction is a different object, as for example, from "the triangle" in abstraction. What distinguishes one from the other are the objectives which we call their constitutive or defining determinations. Therefore, these determinations have to belong to the concept-object in some sense. We say: the (abstract) object "circle" is defined or determined by the objectives "to be a closed line", "to lie in a plane", and "to contain only points which are equidistant from *a single* point"; we call it the *determinate* of these objectives, but not as an "implicit" one, because it does not satisfy the objectives, but, as one might say, only as an explicit one or as a "formdeterminate" of these objectives.

# Mally and Predication: III

- Findlay 1963 [1933] (110): On the view of Mally, every property determines (*determinieren*) an object, but not every property is satisfied (*erfüllt*) by an object. … the property 'being round and square' determines the abstract object *round square*, but it is not satisfied by any object.
- Zalta 1983: Regiment '$F$ determines $x$' as $xF$ and '$F$ is satisfied by $x$' as $Fx$.
- Russell's famous objections to Meinong's theory of objects don't apply to Mally's theory of abstract objects.
- See also Castañeda 1974, Rapaport 1978, van Inwagen 1983.
- For an in-depth study, see Linsky's "Mally's Anticipation of Encoding" (Linsky 2014).

# Plato and Predication

- Meinwald 1992 (378):

  > I believe that Plato so composed that exercise [the second part of *Parmenides*] as to lead us to recognize a distinction between two kinds of predication, marked in the *Parmenides* by the phrases "in relation to itself" (*pros heauto*) and "in relation to the others" (*pros ta alla*).
  >
  > … A predication of a subject in relation to itself holds in virtue of a relation internal to the subject's own nature, and can so be employed to reveal the structure of that nature. A predication in relation to the others by contrast concerns its subject's display of some feature.

- Meinwald doesn't regiment the distinction.
- Regiment '$x$ is $F$' in one of two ways: $xF$ vs. $Fx$
- Example: If $x$ is The Form of $F$, then $x$ is $F$ in the first sense ($xF$), but not in the second. If $x$ is an ordinary $F$-thing, then $x$ is $F$ in the second sense ($Fx$), but not in the first.

## Frege and Predication

- Boolos 1987 (3):

  > Thus, although a division into two types of entities, concepts and objects, can be found in the *Foundations*, it is plain that Frege uses not one but two instantiation relations, 'falling under' (relating some objects to some concepts) and 'being in' (relating some concepts to some objects), and that both relations sometimes obtain reciprocally.

- Example: The number 1 is an object that falls under the concept *being identical with 1* ($[\lambda x\, x = 1]$), whereas the concept *being identical with 1* is in the number 1.
- Boolos (1987, 5) formulates 'Frege Arithmetic', using $F\eta x$ to represent '$F$ is in $x$':
  - Numbers: $\forall G \exists! x \forall F(F\eta x \equiv F \approx G)$
  - Properties: $\exists F \forall x(Fx \equiv \varphi)$, $\varphi$ has no free xs.
- We shall regiment $x$ is in $F$ as $xF$ instead of $F\eta x$. While Boolos has unrestricted property comprehension and restricted object comprehension, we explore the reverse.

# Kripke and Predication

- Kripke 1973 (Lecture III):

  > But here there is a confusing double usage of predication which can get us into trouble. Well why? Let me give an example. There are two types of predication we can make about Hamlet. Taking 'Hamlet' to refer to a fictional character rather than to be an empty name, one can say 'Hamlet has been discussed by many critics'; or 'Hamlet was melancholy', from which we can existentially infer that there was a fictional character who was melancholy, given that Hamlet is a fictional character. (p. 74)
  >
  > …One will get quite confused if one doesn't get these two different kinds of predication straight. … (p. 75)

- Kripke doesn't regiment the distinction, but we shall.
- Example: Hamlet was discussed by many critics ($Dh$) vs. Hamlet was melancholy ($hM$).

# A Formal System as Background

- Monadic Second-order language:
  - $a, b, \ldots$ and $x, y, \ldots$ (object constants and variables)
  - $P, Q, \ldots,$ and $F, G, \ldots$ (property constants and variables)
- Atomic formulas: $Fx$ ('$x$ exemplifies $F$') and $xF$ ('$x$ encodes $F$')
- The usual molecular formulas: $\neg\varphi$, $\varphi \rightarrow \psi$, $\forall\alpha\varphi$, where $\varphi, \psi$ are any formulas, and $\alpha$ is any variable. The usual defined formulas: $\varphi \,\&\, \psi$, $\varphi \vee \psi$, and $\exists\alpha\varphi$.
- Second-order logic:
  - Classical axioms for propositional logic; Rule MP.
  - Axioms and rules for 2° predicate logic:
    - $\forall\alpha\varphi \rightarrow \varphi^{\tau}_{\alpha}$, provided $\tau$ is substitutable for $\alpha$
    - $\forall\alpha(\varphi \rightarrow \psi) \rightarrow (\forall\alpha\varphi \rightarrow \forall\alpha\psi)$
    - $\varphi \rightarrow \forall\alpha\varphi$, provided $\alpha$ isn't free in $\varphi$
    - Derived Rule GEN: If $\Gamma \vdash \varphi$ and $\alpha$ doesn't occur free in any formula in $\Gamma$, then $\Gamma \vdash \forall\alpha\varphi$.
- (See Enderton 1972.) All the usual natural deduction rules apply.

# Fundamental Axioms and Definitions

- **Naive Property Comprehension** ('**NPC**').
  $\exists F \forall x(Fx \equiv \varphi)$, where $F$ is not free in $\varphi$
  - $\exists F \forall x(Fx \equiv \neg Gx)$
  - $\exists F \forall x(Fx \equiv Gx \,\&\, Hx)$
  - $\exists F \forall x(Fx \equiv Gx \vee Hx)$
  - $\exists F \forall x(Fx \equiv \forall y Mxy)$
  - $\exists F \forall x(Fx \equiv E!x \rightarrow Hx)$
- **Naive Object Comprehension** ('**NOC**').
  $\exists x \forall F(xF \equiv \varphi)$, where $x$ is not free in $\varphi$
  - $\exists x \forall F(xF \equiv Fa)$
  - $\exists x \forall F(xF \equiv Fa \,\&\, Fb)$
  - $\exists x \forall F(xF \equiv \forall y(Fy \equiv My))$
  - $\exists x \forall F(xF \equiv$ In the story $s$, $Fh)$
  - $\exists x \forall F(xF \equiv$ In the theory $T$, $F\emptyset)$
- $x = y \ \equiv_{df} \ \forall F(Fx \equiv Fy)$
- $F = G \ \equiv_{df} \ \forall x(Fx \equiv Gx)$

# Paradoxes To Avoid: I

- Clark 1978, Boolos 1987, Kirchner 2017.
- Instance of NPC:
  $\exists F \forall x(Fx \equiv \exists G(xG \,\&\, \neg Gx))$. ‘$K$’
- Instance of NOC:
  $\exists x \forall F(xF \equiv \forall y(Fy \equiv Ky))$ ‘$b$’
- Contradiction. Suppose $Kb$. Then by definition of $K$, there is some property, say $Q$, such that $bQ$ and $\neg Qb$. But from the former, it follows that $\forall y(Qy \equiv Ky)$, by definition of $b$. But from $\neg Qb$, it then follows that $\neg Kb$, contrary to hypothesis. So suppose $\neg Kb$. Then by definition of $K$, it follows that $\forall G(bG \rightarrow Gb)$, and in particular, $bK \rightarrow Kb$. But, by the definition of $b$, we know that $bK \equiv \forall y(Ky \equiv Ky)$. Since the right-hand side of the biconditional is derivable from logic alone, it follows that $bK$. Hence, $Kb$.

## Paradoxes to Avoid: II (McMichael/Zalta 1980, Boolos 1987)

- Suppose you add identity, the complex property (i.e., the haecceity) $[\lambda y\, y = z]$, and $\lambda$-conversion: $\forall x([\lambda y\, \varphi]x \equiv \varphi^x_y)$.
- Instance of NOC:

$$\exists x \forall F(xF \equiv \exists z(F = [\lambda y\, y = z]\ \&\ \neg zF))$$

- Contradiction. Call such an object $b$. Suppose $b[\lambda y\, y = b]$. Then by definition of $b$, it follows that $\exists z([\lambda y\, y = b] = [\lambda y\, y = z]\ \&\ \neg z[\lambda y\, y = b])$. Call such an object $c$. So, $[\lambda y\, y = b] = [\lambda y\, y = c]\ \&\ \neg c[\lambda y\, y = b]$. Note independently that $b = b$ by the laws of identity, from which it follows by $\lambda$-conversion that $[\lambda y\, y = b]b$. Since $[\lambda y\, y = b] = [\lambda y\, y = c]$, it follows that $[\lambda y\, y = c]b$. So by $\lambda$-conversion, it follows that $b = c$. But since $\neg c[\lambda y\, y = b]$, it follows that $\neg b[\lambda y\, y = b]$, contrary to hypothesis. So suppose instead $\neg b[\lambda y\, y = b]$. Then, by definition of $b$ it follows that $\neg\exists z([\lambda y\, y = b] = [\lambda y\, y = z]\ \&\ \neg z[\lambda y\, y = b])$, i.e., $\forall z([\lambda y\, y = b] = [\lambda y\, y = z] \rightarrow z[\lambda y\, y = b])$. By instantiating the universal claim to $b$, we get $[\lambda y\, y = b] = [\lambda y\, y = b] \rightarrow b[\lambda y\, y = b]$. And since the antecedent is true by the laws of identity, it follows that $b[\lambda y\, y = b]$.

# A Solution Sketch

- Distinguish concrete objects from abstract objects: add the distinguished predicate '$A!$' to our background system.
- Reconceive **NOC** as a principle governing abstract objects:

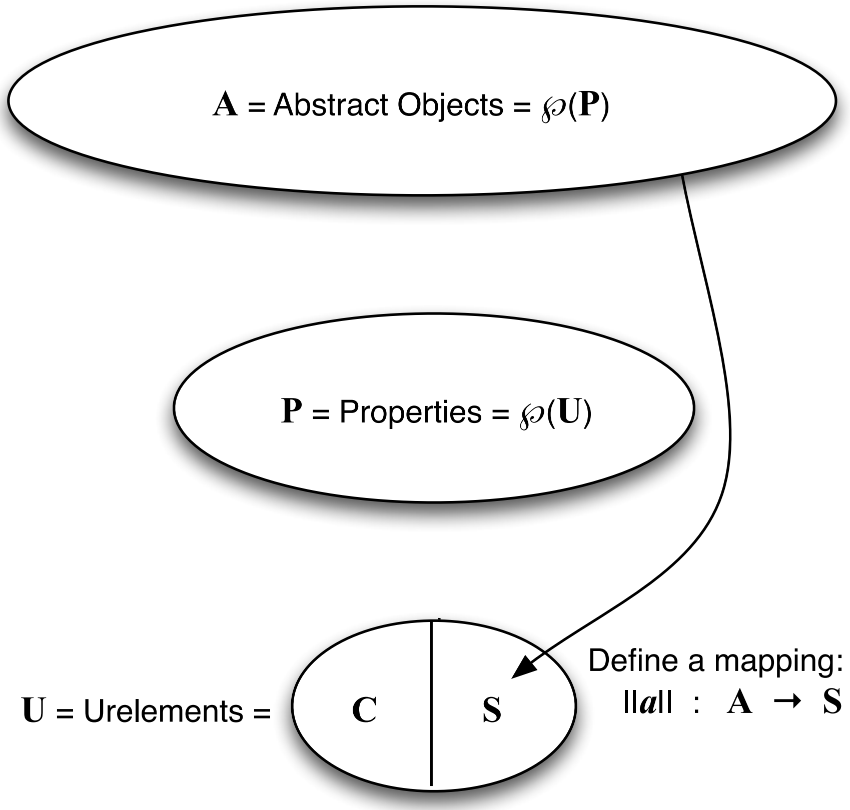
  **OC**: $\exists x(A!x \,\&\, \forall F(xF \equiv \varphi))$, where $\varphi$ has no free $x$s
- Disallow encoding subformulas from $\varphi$ used in **NPC**:

  **PC**: $\exists F \forall x(Fx \equiv \varphi)$, where $\varphi$ has no free $F$s and $x$ is not a primary term in encoding position anywhere in $\varphi$
- Identity is defined:
  - Identity for abstract objects: indiscernibility with respect to encoded properties.
    $x =_A y \equiv_{df} A!x \,\&\, A!y \,\&\, \forall F(xF \equiv yF)$
  - Identity for non-abstract objects: indiscernibility with respect to exemplified properties.
    $x =_E y \equiv_{df} \neg A!x \,\&\, \neg A!y \,\&\, \forall F(Fx \equiv Fy)$
  - $x = y \equiv_{df} x =_A y \vee x =_E y$
  - $F = G \equiv_{df} \forall x(xF \equiv xG)$

# Foundations of a Coherent Science?

- Is the object calculus + **OC** + **PC** consistent?
  **OC**: $\exists x(A!x \,\&\, \forall F(xF \equiv \varphi))$
  **PC**: $\exists F \forall x(Fx \equiv \varphi)$, $F$ not free in $\varphi$ and $x$ isn't in encoding position in $\varphi$
- The 'natural' model construction:
  Assume ZF + **U** (= Urelements). Take the domain of properties ('**P**') to be $\wp(\mathbf{U})$. Let the variables $F, G, H, \ldots$ range over this set. Take the domain of abstract objects ('**A**') to be $\wp(\mathbf{P})$. Put the elements of **U** and **A** together into one set and let the variable $x$ range over this set, with $A!$ denoting **A**. Define: (a) '$xF$' is true iff $F \in x$, and (b) '$Fx$' is true iff $x \in F$.
- This model construction, however, has a glaring problem. Consider the two theorems:
  - $\exists x(A!x \,\&\, \forall F(xF \equiv F = A!))$
  - $\exists F \exists x(Fx \,\&\, xF)$.
- Say $x_0$ is such that $A!x_0 \,\&\, x_0A!$. By the translation scheme (a) and (b), both $x_0 \in A!$ and $A! \in x_0$ would be true in the model.

# (Extensional) Aczel Models



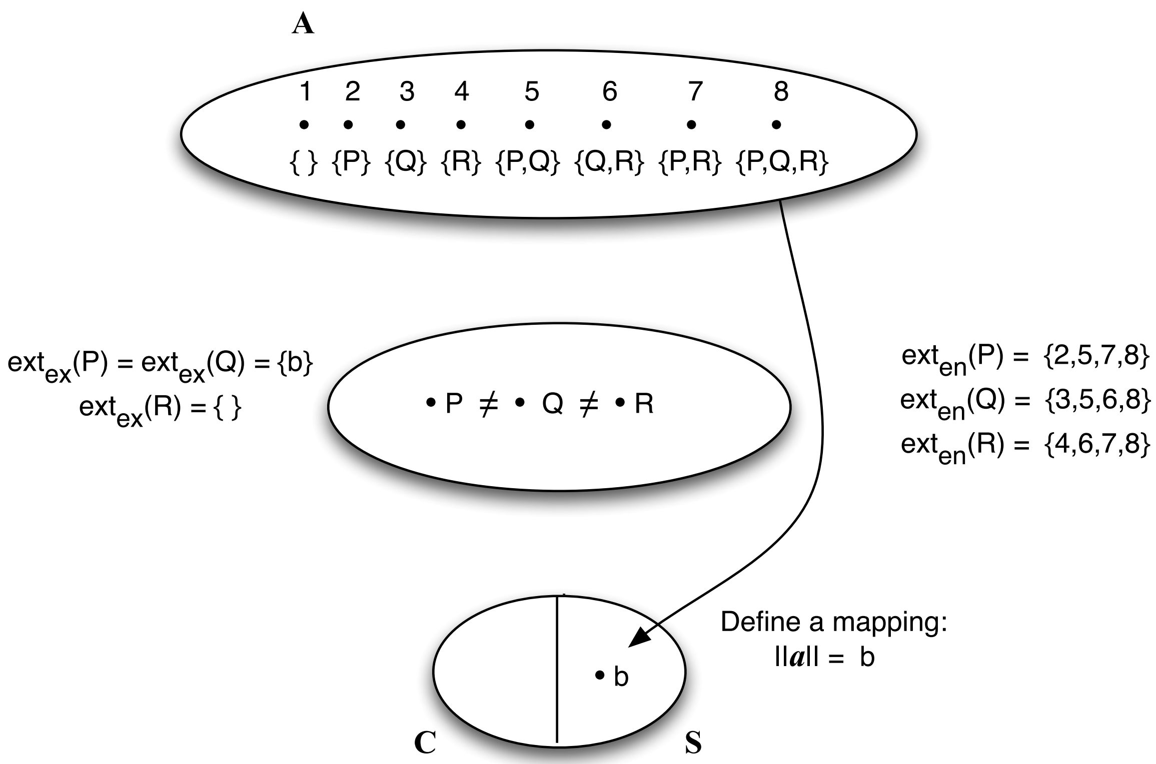

Domain $\mathbf{D} = \mathbf{A} \cup \mathbf{C}$

Define for $o \in \mathbf{D}$, $|o| = \begin{cases} o, \text{ when } o \in \mathbf{C} \\ \|o\|, \text{ when } o \in \mathbf{A} \end{cases}$

## PC and OC are true in an Aczel Model:

- Sketch: PC is true in an Aczel model because every set of urelements is in the domain of properties.
- Sketch: OC is true in an Aczel model because every set of properties is in the domain of abstract objects.
- Notice that this is a Henkin (general) model, not a standard model, since the domain of properties is *not* the power set of the domain **D** over which the individual variables range.
- Moreover, don't be misled by the model: abstract objects are *not* sets of properties. Abstract objects are *characterized* by the properties they encode. But no set of properties is characterized by the properties which it has as members.

# Smallest (Intensional) Models




Domain $\mathbf{D} = \mathbf{A} \cup \mathbf{C}$

Define for $o \in \mathbf{D}$, $|o| = \begin{cases} o, \text{ when } o \in \mathbf{C} \\ ||o||, \text{ when } o \in \mathbf{A} \end{cases}$

Let $x$ range over $\mathbf{D}$

Define, for assignment to variables $g$,

$g \models Fx$ iff $|g(x)| \in \text{ext}_{ex}(g(F))$

$g \models xF$ iff $g(x) \in \text{ext}_{en}(g(F))$

| **Abstract Object** | **Theoretical Description** The abstract object $x$ that encodes all and only the properties $F$ such that ... | **Theoretical Description Formalized** $\iota x(A!x \mathbin{\&} \forall F(xF \equiv \ldots$ |
|---|---|---|
| The Form of $G$ | ... $G$ necessarily implies $F$ | $\ldots G \Rightarrow F))$ |
| The truth value of proposition $p$ | ... $F$ is a property of the form *being such that q* (where $q$ is materially equivalent to $p$) | $\ldots \exists q(q \equiv p \mathbin{\&} F = [\lambda y\, q])))$ |
| Sherlock Holmes | ... according to the Conan Doyle novels, Holmes has $F$ | $\ldots \mathrm{CD} \models Fh))$ |
| The aether of 19th century physics | ... in 19th century physics, the aether has $F$ | $\ldots \mathrm{XIX} \models F(\text{the aether}) ))$ |
| The actual world | ... $F$ is a property of the form *being such that p* (where $p$ is a true proposition) | $\ldots \exists p(p \mathbin{\&} F = [\lambda y\, p])))$ |
| The Leibnizian concept of Alexander | ... Alexander exemplifies $F$ | $\ldots Fa))$ |
| The natural set of $G$s | ... $F$ is materially equivalent to $G$ | $\ldots \forall x(Fx \equiv Gx)))$ |
| The natural number 0 | ... $F$ is unexemplified | $\ldots \neg\exists uFu))$ |
| The natural number 1 | ... $F$ is uniquely exemplified | $\ldots \exists u[Fu \mathbin{\&} \forall v(Fv \rightarrow v =_E u)]))$ |
| The number of ordinary $G$s | ... $F$ is in 1-1 correspondence to $G$ (on the ordinary objects) | $\ldots F \approx_E G))$ |
| The null set of ZF | ... in Zermelo-Fraenkel set theory, $\emptyset$ has $F$ | $\ldots \mathrm{ZF} \models F\emptyset))$ |
| $\kappa$ of math theory T | ... in theory T, $\kappa$ has $F$ | $\ldots \mathrm{T} \models F\kappa))$ |

## Some Philosophical Issues

- We haven't assumed any mathematical primitives, and in particular, no notions or axioms from set theory.
- Properties, propositions aren't 'creatures of darkness'. They have well-defined, extensional identity conditions despite being intensional entities!
- No Julius Caesar problem.
- There will be numerous interpretations of the formalism: don't get attached to any one particular one. For example, the system can already be interpreted in two completely different manners:
  - Platonism
  - Fictionalism
- We'll see other interpretations: structuralism, inferentialism, formalism, logicism, etc.

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