PHIL 50 – INTRODUCTION TO LOGIC

FINAL PREPARATION

The final is scheduled for June 6th, 2014 from 9:30 to 11:30 AM in building 200, room 303. The final will consists of **two parts**:

The **first part** will consist of 10 questions selected from the questions below. This part will be worth 50 points.

The **second part** will consist of at least one of the following tasks: checking the truth of some formulas relative to a given model, checking validity or invalidity, constructing a derivation, analyzing an argument in natural language, solving a puzzle, proving a claim using set theory, etc. To get an idea of what might be in the second part of the final exam, please **carefully review all the homework assignments and their solutions**. This part will be worth 50 points. *See the other document on the preparation for the second part of the final exam.*

WEEK 5 – SYLLOGISTIC LOGIC

MONDAY SLIDES

1. What is a syllogism? Give the definition.
2. Give an example of a valid syllogism and an example of an invalid syllogism. Explain.
3. What is a universal statement? What is an affirmative statement? Give examples.
4. What is Russell's paradox?

WEDNESDAY SLIDES

5. Why is Russell's paradox a problem if we are trying to check the validity of a syllogism using set theory?
6. How can the problem raised by Russel's paradox be fixed?
7. What kind of infinite regress did we discuss in class?

8. Give examples of how one can translate a syllogism into the language of set theory. Give one example using the subset relation and one example using the intersection operation.
9. How can you check that a syllogism is valid with set theory? Give two examples.
10. How can you check that a syllogism is invalid with set theory? Give an example.

FRIDAY SLIDES

11. What is the square of oppositions? Draw the diagram and label the different types of statements in the diagram.
12. Why cannot two contradictory statements both be true? Can they be both false?
13. What's the difference between contrary and contradictory statements?
14. What are the consequences of assuming that predicates refer to non-empty sets as far as the square of oppositions is concerned?
15. Give an example of a BARBARA type syllogism? Where does the acronym BARBARA come from?
16. Do the same as in the previous question with CELARENT.
17. Write the square of oppositions in the language of set theory.

WEEK 6 — INTRODUCTION TO PREDICATE LOGIC

MONDAY SLIDES

18. What are the ingredients of the language of predicate logic?
19. What is the difference between constant and variable symbols? Give examples.
20. What is the difference between constant and predicate symbols? Give examples.
21. What is the difference between the universal quantifier and the existential quantifier?
22. How can you translate the four statements in the square of oppositions using the language of predicate logic?

WEDNESDAY SLIDES

23. Translate into predicate logic the statement *Every farmer owns a donkey*. Explain your translation.
24. Translate into predicate logic the statement *All houses in Santorini are colorful*. Explain your translation.
25. What is the relationship between universal quantifier and implication? Explain with an example.
26. What is the relationship between the existential quantifier and conjunction? Explain with an example.
27. What is the difference in meaning between $\forall x(Px \to Fx)$ and $\forall x(Px \wedge Fx)$?

FRIDAY SLIDES

28. Which innovations did predicate logic bring?
29. Who contributed to the development of predicate logic?
30. When are two quantifiers nested?
31. Why is predicate logic more expressive than syllogistic logic and propositional logic? Give an example of a statement that cannot be expressed in propositional or syllogistic logic, but that can be expressd in predicate logic.
32. What is Frege's microscope metaphor? What is it supposed to suggest?
33. What's the point of translating statements from natural language into the language of predicate logic?

WEEK 7 – SYNTAX AND SEMANTICS OF PREDICATE LOGIC

MONDAY SLIDES

34. What is a model in predicate logic?
35. What is a domain?
36. What is an interpretation function?

37. As far as their interpretation is concerned, what is the difference between constant symbols, one place predicate symbols, and two place predicate symbols?

38. What are the truth conditions for formulas containing constant symbols and predicate symbols, both one-place and two-place predicate symbols?

WEDNESDAY SLIDES

39. What is the difference between $g(x)$ and $g_{[x:=d]}(x)$?

40. What is the difference between the value of $g(y)$ and $g_{[x:=d]}(y)$?

41. Why do we need a modified variable assignment of the form $g_{[x:=d]}(x)$?

42. What is the truth condition for an existentially quantified formula? State the condition and give an example.

43. What does it mean that an existentially quantified formula is like a disjunction?

44. What is the truth condition for a universally quantified formula? State the condition and give an example.

45. What does it mean that a universally quantified formula is like a conjunction?

46. Why cannot we eliminate universally quantified formulas from our language?

FRIDAY SLIDES

47. What are the truth conditions for formulas containing the connectives?

48. What is the difference between language and meta-language?

49. How is the difference between language and meta-language used in the truth conditions for formulas of predicate logic?

50. Why do some of the truth conditions look completely circular? How is the alleged circularity avoided?

51. In what sense do the truth conditions for formulas in predicate logic give you a definition of truth?

52. Why do the truth conditions for formulas in predicate logic form a recursive or inductive definition of truth?

WEEK 8 – DERIVATIONS IN PREDICATE LOGIC

MONDAY SLIDES

53. What are the derivation rules for the universal quantifier? Simply state the derivation rules with the appropriate restrictions.
54. State the derivation rule $\forall I$. Give an example of a correct application for $\forall I$ and an example of an incorrect application of $\forall I$.
55. Which restrictions govern $\forall I$? What is their rationale?
56. Illustrate the rule $\forall I$ by using a proof from Euclid's *Elements*.
57. What is an arbitrary triangle? In which cases do we reason about arbitrary objects?
58. State the derivation rule $\forall E$ and give an illustrative example.

WEDNESDAY SLIDES

59. What are the derivation rules for the existential quantifier. State the derivation rules with the appropriate restrictions.
60. State the derivation rule $\exists I$. Given an example of a derivation involving $\exists I$.
61. Which restrictions govern $\exists E$? What is their rationale?
62. Construct a correct derivation and an incorrect derivation, each involving $\exists E$.

FRIDAY SLIDES

63. How can we express that there are exactly three objects in predicate logic?
64. How can we express that all is one in predicate logic?
65. What are the truth conditions for formulas containing the identity symbol?
66. Give a derivation of $\neg\forall x P(x) \to \exists x \neg P(x)$.
67. Give a derivation of $\exists x \neg x P(x) \to \neg\forall x P(x)$.
68. What is the transformative power of negation with respect to the quantifiers?
69. What is the transformative power of negation with respect to $\wedge$ and $\vee$?

70. Using the transformative power of negation, show that $\neg\forall x(A(x) \to B(x))$ is equivalent to $\exists x(A(x) \wedge \neg B(x))$.
71. Give a definition of $\vdash \varphi$ and of $\models \varphi$. What is the difference between the two?
72. What is the difference between $\vdash \varphi$ and $\psi_1, \psi_2, \ldots, \psi_k \vdash \varphi$?
73. State completeness of predicate logic.
74. State soundness of predicate logic.
75. How can you show that $\varphi \models \psi$? Is it a finite or an infinite task?
76. How can you show that $\varphi \not\models \psi$? Is it a finite or an infinite task?
77. What is the difference between $M \models \varphi$ and $\varphi \models \psi$?

WEEK 9 (WEDNESDAY) – MODAL LOGIC

78. What does $\Box\varphi$ mean? What are its truth conditions?
79. In modal logic what is the difference between $\models \varphi$ and $M, w \models \Box\varphi$?
80. What does a model look like in (predicate) modal logic?
81. Give a definition of $\models \varphi$ in predicate modal logic?
82. What is the Barcan formula? Why is it controversial?
83. What is the difference between $\forall x\Box\varphi(x)$ and $\Box\forall x\varphi(x)$?

WEEK 10 (MONDAY ONLY) – PROBABILITY LOGIC

84. What are the axioms of probability theory?
85. Prove that $P(\neg\varphi) = 1 - P(\varphi)$.
86. Prove that $P(\varphi) = P(\varphi|\psi)P(\psi) + P(\varphi|\neg\psi)P(\neg\psi)$.
87. What does it mean to say that probability theory has an underlying logic?
88. What is the difference between probability logic and deductive logic?
89. Can there be a probabilistic derivation rule just like $\wedge I$? Why not?