

# Review of Extensional Logics (contrasted with intensional ones)

**Selmer Bringsjord**

Rensselaer AI & Reasoning (RAIR) Lab  
Department of Cognitive Science  
Department of Computer Science  
Lally School of Management & Technology  
Rensselaer Polytechnic Institute (RPI)  
Troy, New York 12180 USA

*Intermediate Formal Logic & AI (IFLAI2)*  
9/8/2020



**Mechanics ...**

**Mechanics ...**

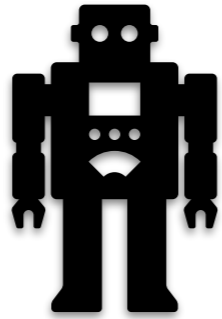
# Mechanics ...

Questions? ...

# Extensional vs Intensional Logics in a Nutshell Example

...

Blinky



1

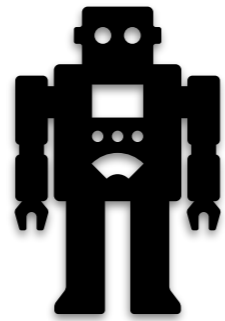


2



3

Blinky



1



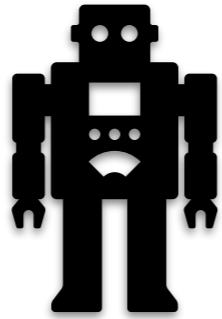
2



3



Blinky



1



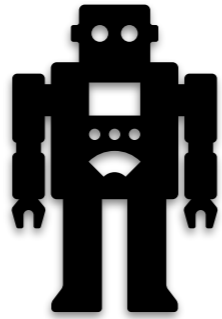
2



3



Blinky



1

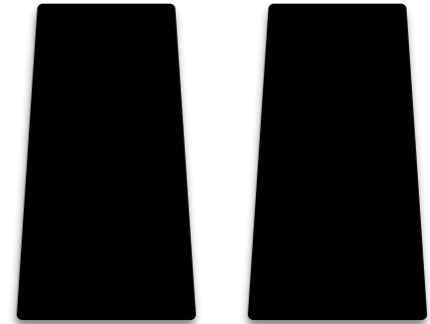
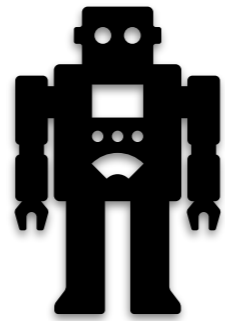


2



3

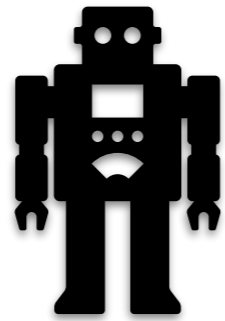
Blinky



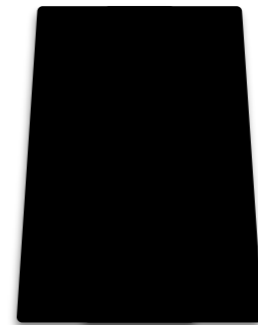
2

3

Blinky



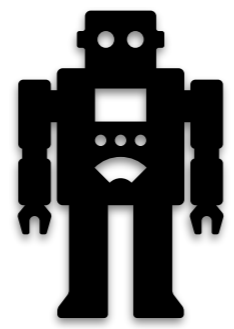
1



2

3

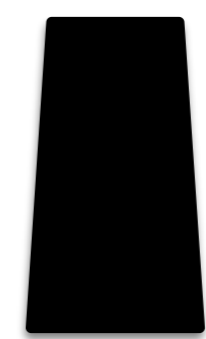
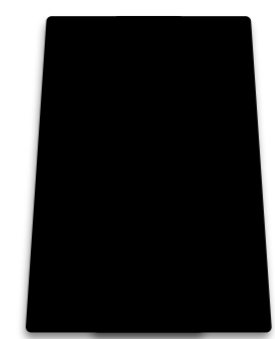
Blinky



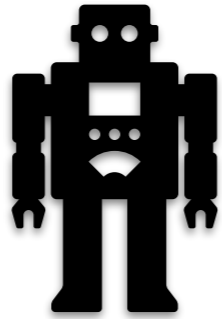
1

2

3



Blinky



1

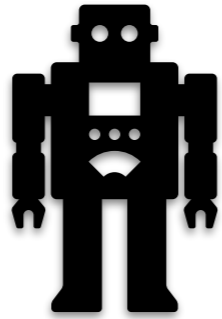


2



3

Blinky



1

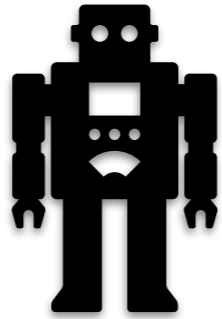


2



3

Blinky



1



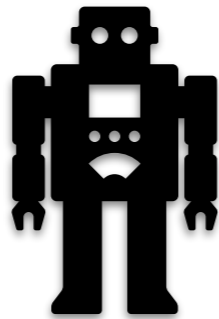
2



3

The ball is in the cup at location #1.

Blinky



1



2



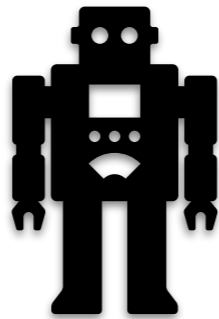
3



The ball is in the cup at location #1.

Loc(ball,1)

Blinky



1



2



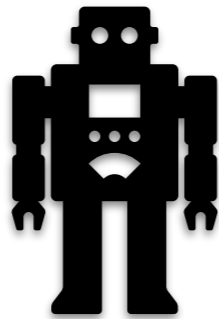
3

The ball is in the cup at location #1.

Loc(ball,1)

(Loc ball 1)

Blinky



1



2



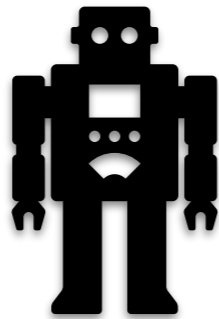
3

The ball is in the cup at location #1.

**FALSE** Loc(ball,1)

(Loc ball 1)

Blinky



1



2

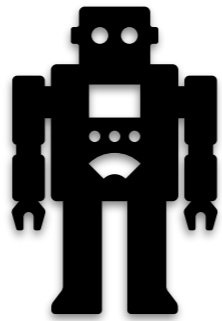


3

**FALSE** Loc(ball,1)

(Loc ball 1)

Blinky



1



2

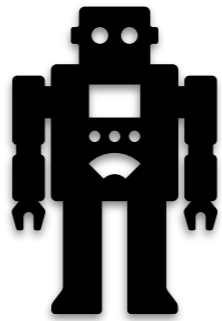


3

FALSE

(Loc ball 1)

Blinky



1



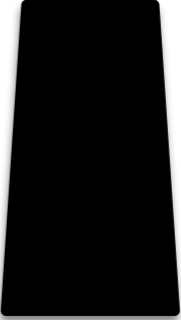
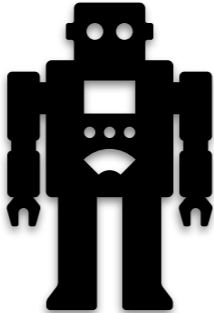
2



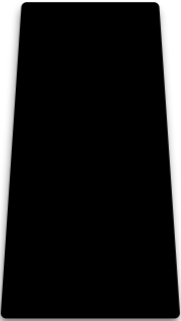
3

(Loc ball 1)

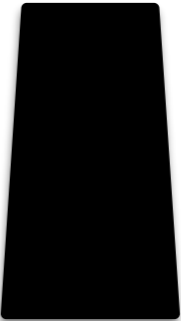
Blinky



1

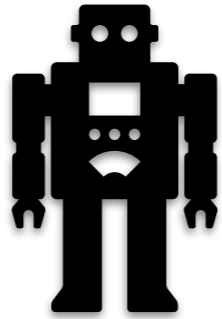


2



3

Blinky



1



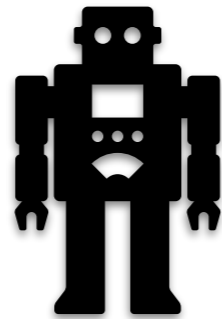
2



3

The ball is in the cup at location #1 or the ball is at location #3.

Blinky



1



2



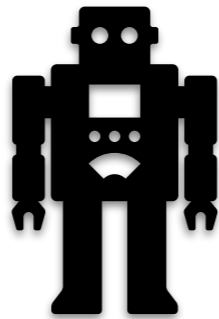
3



The ball is in the cup at location #1 or the ball is at location #3.

$\text{Loc}(\text{ball},1) \vee \text{Loc}(\text{ball},3)$

Blinky



1



2



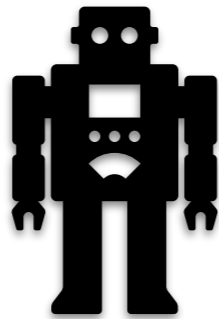
3

The ball is in the cup at location #1 or the ball is at location #3.

$\text{Loc}(\text{ball},1) \vee \text{Loc}(\text{ball},3)$

(or (Loc ball 1) (Loc ball 3))

Blinky



1



2



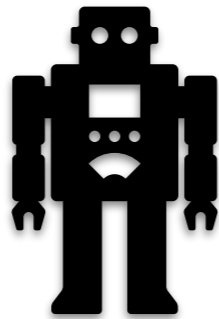
3

The ball is in the cup at location #1 or the ball is at location #3.

**FALSE**  $\text{Loc}(\text{ball},1) \vee \text{Loc}(\text{ball},3)$

(or (Loc ball 1) (Loc ball 3))

Blinky



1



2

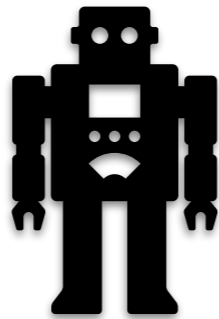


3

**FALSE**  $\text{Loc}(\text{ball},1) \vee \text{Loc}(\text{ball},3)$

(or (Loc ball 1) (Loc ball 3))

Blinky



1



2

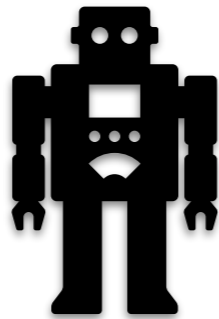


3

**FALSE**

(or (Loc ball 1) (Loc ball 3))

Blinky



1



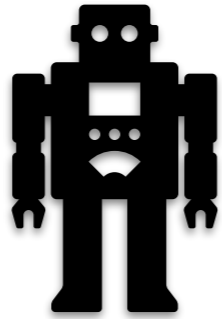
2



3

FALSE

Blinky



1

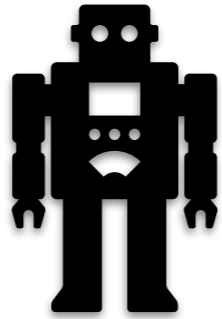


2



3

Blinky



1



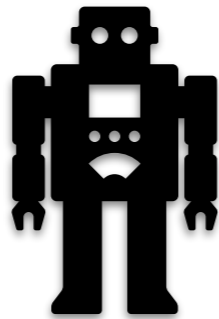
2



3

Blinky believes that the ball is in the cup at location #1.

Blinky



1



2



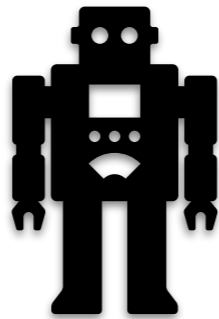
3



Blinky believes that the ball is in the cup at location #1.

$B(\text{blinky}, \text{Loc}(\text{ball}, 1))$

Blinky



1



2



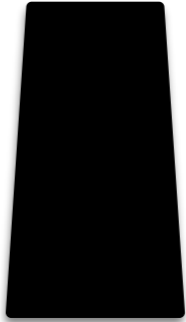
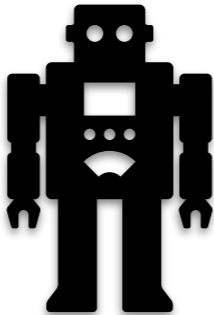
3

Blinky believes that the ball is in the cup at location #1.

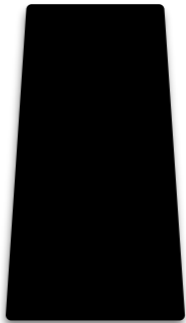
$B(\text{blinky}, \text{Loc}(\text{ball}, 1))$

`(bel Blinky (Loc ball 1))`

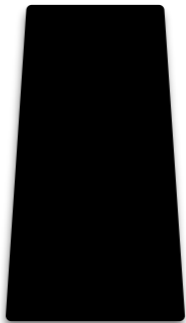
Blinky



1



2



3

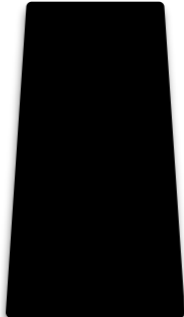
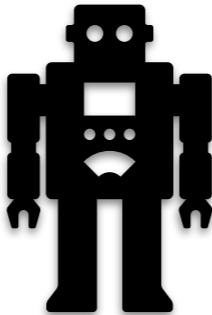
Blinky believes that the ball is in the cup at location #1.

???

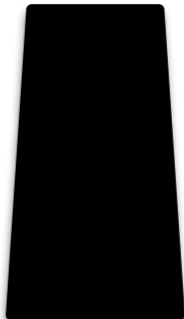
B(blinky, Loc(ball,1))

(bel Blinky (Loc ball 1))

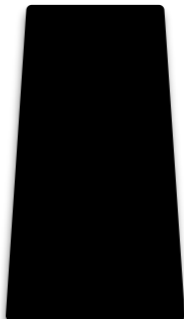
Blinky



1



2



3

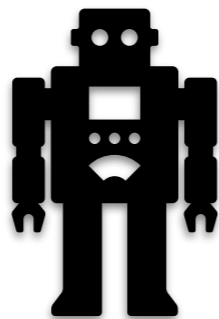
Blinky believes that the ball is in the cup at location #1.

???

B(blinky, Loc(ball,1))

(bel Blinky (Loc ball 1))

Blinky



1



2



3

In extensional logics, what is denoted is conflated with meaning (the latter being naively compositional), and intensional attitudes like *believes*, *knows*, *hopes*, *fears*, etc cannot be represented and reasoned over smoothly (e.g. without fear of inconsistency rising up).

# Layman Allen Committee Problem ...

“Well, if your AI is so smart, let me see it do my taxes for me, and for a company too.”

# THE UNIVERSITY OF CHICAGO LAW REVIEW

VOLUME 25

AUTUMN 1957

NUMBER 1

---

---

## TOWARD A MORE SYSTEMATIC DRAFTING AND INTERPRETING OF THE INTERNAL REVENUE CODE: EXPENSES, LOSSES AND BAD DEBTS

LAYMAN E. ALLEN\* AND GABRIEL ORECHKOFF†

**S**UPPOSE that you, as a reasonable man, are asked whether the following two sets of rules mean exactly the same thing. If they do and if you intend to communicate your message as effectively as possible, which of the two sets would you choose to state the organizational rules of your law school?

Set 1

- A. The financial committee shall be chosen from among the general committee.
- B. No one shall be a member of both the general and library committees unless he is also on the financial committee.
- C. No member of the library committee shall be on the financial committee.<sup>1</sup>

Set 2

- A. The financial committee shall be chosen from among the general committee.
- B. No member of the general committee shall be on the library committee.

We suspect that most readers will have little difficulty in deciding the second question; but even after careful reading of the two sets of rules, they will remain a little puzzled as to whether both sets say the same thing. We further suspect that lawyers waste a great deal of their mental energy by using inadequate and inappropriate intellectual tools to figure out similar logical problems in their everyday work. A symbolic logician could quickly ascertain that the two sets of rules are equivalent and relieve his mind to focus on the more important problem of deciding which is the more appropriate choice. Since law

\* Social Science Research Council Fellow, Yale Law School. Member Connecticut Bar.

† Member, New York Bar.

<sup>1</sup> This example is given in Berkeley, *The Algebra of States and Events*, 78 *Scientific Monthly* 232 (1954).

# THE UNIVERSITY OF CHICAGO LAW REVIEW

VOLUME 25

AUTUMN 1957

NUMBER 1

---

---

## TOWARD A MORE SYSTEMATIC DRAFTING AND INTERPRETING OF THE INTERNAL REVENUE CODE: EXPENSES, LOSSES AND BAD DEBTS

LAYMAN E. ALLEN\* AND GABRIEL ORECHKOFF†

**S**UPPOSE that you, as a reasonable man, are asked whether the following two sets of rules mean exactly the same thing. If they do and if you intend to communicate your message as effectively as possible, which of the two sets would you choose to state the organizational rules of your law school?

Set 1

- A. The financial committee shall be chosen from among the general committee.
- B. No one shall be a member of both the general and library committees unless he is also on the financial committee.
- C. No member of the library committee shall be on the financial committee.<sup>1</sup>

Set 2

- A. The financial committee shall be chosen from among the general committee.
- B. No member of the general committee shall be on the library committee.

We suspect that most readers will have little difficulty in deciding the second question; but even after careful reading of the two sets of rules, they will remain a little puzzled as to whether both sets say the same thing. We further suspect that lawyers waste a great deal of their mental energy by using inadequate and inappropriate intellectual tools to figure out similar logical problems in their everyday work. A symbolic logician could quickly ascertain that the two sets of rules are equivalent and relieve his mind to focus on the more important problem of deciding which is the more appropriate choice. Since law

\* Social Science Research Council Fellow, Yale Law School. Member Connecticut Bar.

† Member, New York Bar.

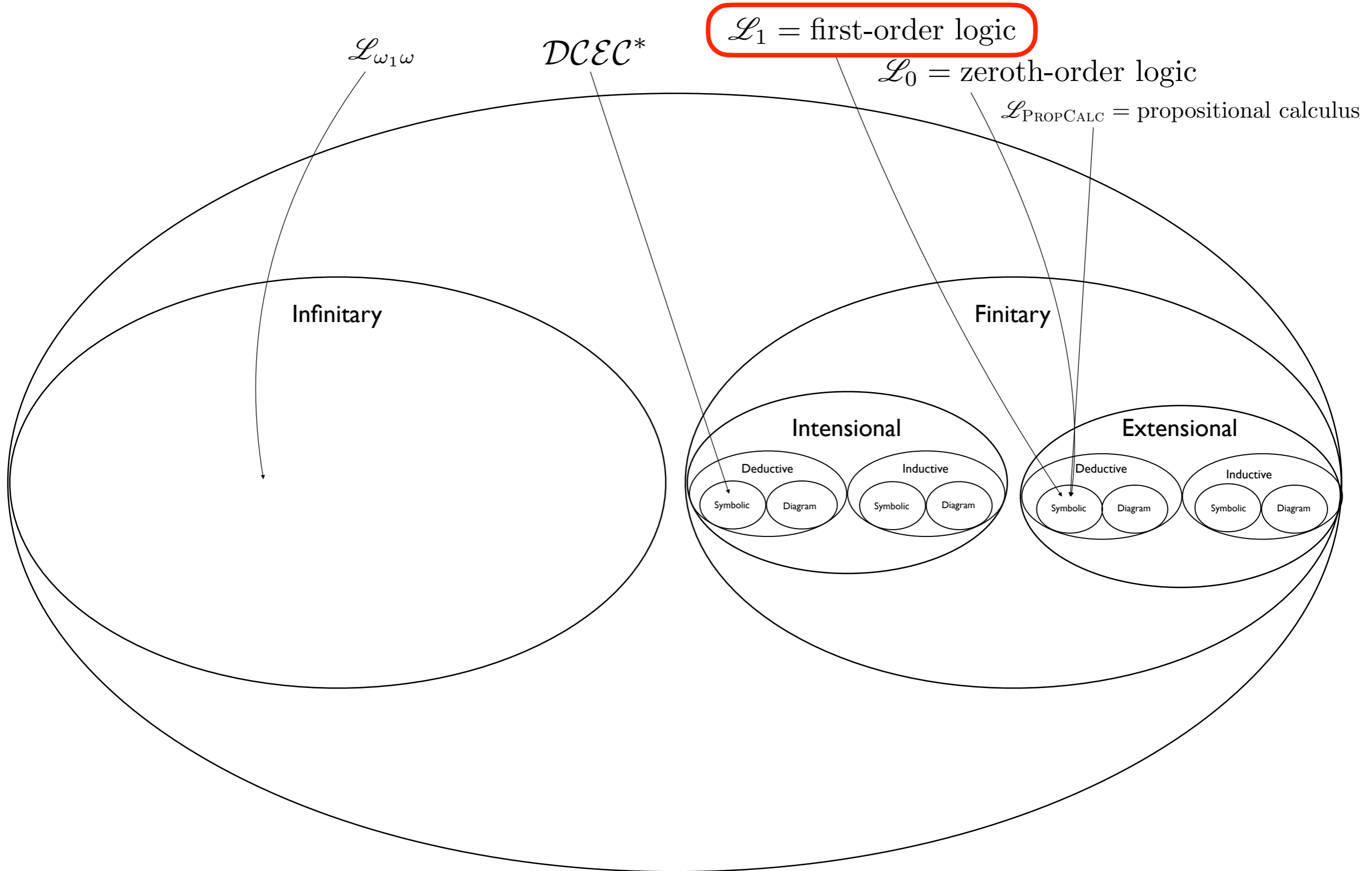
<sup>1</sup> This example is given in Berkeley, *The Algebra of States and Events*, 78 *Scientific Monthly* 232 (1954).



SpecialLlamasDisjunction

...

# The Universe of Logics



# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;

or

there's a thing such that if it's a llama, everything is a llama;

or

there's a thing such that every llama is a non-llama.

# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

Is this disjunction TRUE, FALSE, or UNKNOWN?

# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

Is this disjunction TRUE, FALSE, or UNKNOWN?

(Can you (later, if catching up) build a formal, verifying proof in HyperSlate®!)

# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

Is this disjunction **TRUE**, FALSE, or UNKNOWN?

(Can you (later, if catching up) build a formal, verifying proof in HyperSlate®!)

# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

Is this disjunction TRUE, FALSE, or UNKNOWN?



# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

Is this disjunction **TRUE**, FALSE, or UNKNOWN?

# Special Llamas Disjunction

There's a thing such that it's both a llama and a non-llama;  
or  
there's a thing such that if it's a llama, everything is a llama;  
or  
there's a thing such that every llama is a non-llama.

Is this disjunction **TRUE**, FALSE, or UNKNOWN?

Can you build a formal, verifying proof in HyperSlate®?





# Second-Order Logic and the $k$ -Order Ladder ...



**FOL**

✓ FOL



✓ FOL

Epistemic + FOL  
 $B_d B_v B_d V v$

✓ FOL

Epistemic + FOL (for coverage of “killer” robots, later)  
 $B_d B_v B_d V v$

✓ FOL

✓ Epistemic + FOL (for coverage of “killer” robots, later)  
 $B_d B_v B_d V v$

✓ FOL

✓ Epistemic + FOL (for coverage of “killer” robots, later)  
 $B_d B_v B_d V v$

TOL

$\exists X [X(j) \wedge \neg X(m) \wedge S(X)]$

✓ FOL

✓ Epistemic + FOL (for coverage of “killer” robots, later)  
 $B_d B_v B_d V v$

TOL

$\exists X [X(j) \wedge \neg X(m) \wedge S(X)]$



✓ FOL

✓ Epistemic + FOL (for coverage of “killer” robots, later)  
 $B_d B_v B_d V v$

TOL

?  $\exists X [X(j) \wedge \neg X(m) \wedge S(X)]$



# Double-Minded Man

## The Contemporary Craft of Creating Characters Meets Today's Cognitive Architectures: A Case Study in Expressivity\*

Selmer Bringsjord • John Licato • Alexander Bringsjord

version of 0121161500NY

### Contents

Abstract	2
1 Introduction	1
2 What is Expressivity?	3
3 <i>Double-Minded Man</i> , and Expressivity Challenges Therefrom	5
3.1 Gist of <i>Double-Minded Man</i>	5
3.2 Basic Demands of Movie Outline 3	6
3.3 Harriet, Joseph, and a Pair of Expressivity Challenges	6
4 The “No Way” Category and the Expressivity Challenges	7
5 The “Maybe” Category ACT-R, and the Expressivity Challenges	7
6 CLARION and the Expressivity Challenges	9
6.1 Overview of CLARION	9
6.1.1 NACS — the Non-Action-Centered Subsystem	9
6.2 The Expressivity of CLARION	11
6.2.1 Representing Structured Knowledge in General	11
6.2.2 FOL-level Expressivity in CLARION	12
6.2.3 Challenges (1) and (2) Met	13
7 Concerns & Objections; Replies	14
7.1 Concern 1: “What is the purpose?”	14
7.2 Concern 2: “What exactly are these ‘challenges’?”	16
7.3 Concern 3: “Can CLARION handle <i>Double-Minded Man</i> ?”	16
7.4 Concern 4: “What about the character-centric AI of Mateas et al.?”	16
8 Conclusion	17
References	20

\*We are indebted to two anonymous referees, and editor Jeremy Turner, for insightful suggestions and objections. Any remaining deficiencies are due to our own failings.

The Contemporary Craft of Creating Characters  
 Meets Today's Cognitive Architecture:  
 A Case Study in Expertise\*

Silver Stoppard • John Lewis • Alexander Stoppard  
 volume of EXPERTISE

**Contents**

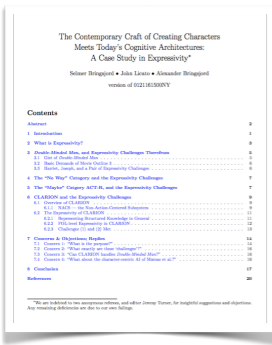
- 1 Introduction 1
- 2 What is Expertise? 2
- 3 Double-Minded Men, and Expertise Challenge Theories 3
  - 3.1 The Double-Minded Man 3
  - 3.2 The Structure of Double-Minded Men 3
  - 3.3 The Double-Minded Man and Expertise Challenge Theories 3
- 4 The "Old Man" Challenge and the Expertise Challenge 4
  - 4.1 The "Old Man" Challenge 4
  - 4.2 The Expertise Challenge 4
- 5 LABOUR and the Expertise Challenge 5
  - 5.1 LABOUR and the Expertise Challenge 5
  - 5.2 The Expertise Challenge 5
  - 5.3 The Expertise Challenge 5
  - 5.4 The Expertise Challenge 5
  - 5.5 The Expertise Challenge 5
  - 5.6 The Expertise Challenge 5
  - 5.7 The Expertise Challenge 5
  - 5.8 The Expertise Challenge 5
  - 5.9 The Expertise Challenge 5
  - 5.10 The Expertise Challenge 5
- 6 Conclusions 6
- 7 Acknowledgements 7
- 8 References 8

\*This work is licensed under a Creative Commons Attribution 4.0 International License. For more information, see <http://creativecommons.org/licenses/by/4.0/>.

# Double-Minded Man



# Double-Minded Man

A screenshot of a movie outline software interface. The window title is "Movie Outline - Double-Minded\_Man\_010316.mvo". The interface includes a toolbar with various editing tools, a font and size selection area (Arial, 12), and a scene heading dropdown (Scene Heading). Below the toolbar is a tabbed interface with tabs for Outline, Script, Notes, Characters, FeelFactor, Reference, Library, PowerView, Step Cards, and Story Tasks. The "Outline" tab is active, showing a list of scenes on the right and a detailed script for scene 1, "TWIRL - DAY", in the main area. The script text is as follows:

68-year-old Harriet Smith sits with two wrinkled hands firmly on the wheel of her rust-eaten Subaru wagon, staring straight ahead through the top level of bifocals as she waits serenely at a red light.

Harriet is alone in the car. To her right is another vehicle, also waiting, in this case to make a right turn; it's a sleek, low-slung, black Camaro.

We are inside the cabin with Harriet. The Subaru's sound system softly plays choral music. Harriet's lips move slightly as she internally sings along, mouthing a slow aria. Her head weaves slightly side to side, in the rhythm with the music.

Things are calm as can be here inside the car with Harriet. There are a pair of well-worn Bibles on the empty passenger seat beside her, one with a gold-lettered 'Harriet' on its leather front cover, the other with a matching 'Joseph' on its front cover.

Harriet's eyes swivel up to the light: still red. We wait with her.

Suddenly there is a piercing SCREECH outside. Harriet jerks her head to the right and we follow her line of sight.

A sleek motorcycle has swerved out of its lane and is now streaking straight for the right side of the Camaro beside Harriet's car.

The bike slams with CLANG into the side of the Camaro. Its rider is flung up and forward into the air, twirling passed Harriet's windshield.

We now watch from Harriet's POV, in slow motion. The black-leather-clad motorcyclist sails by Harriet's windshield, airborne. We see a man's face, clearly: His elephant-hide skin tells us that he is well beyond middle-age. Yet thick, black curls of youthful hair emerge from under his helmet. The rider has only one half of a black, bushy, swept-out, waxed mustache. His eyes are weary and grey, and appear to lock with Harriet's for an instant.

We return to normal speed. The body is now lying on the incoming lane to the left of Harriet's Subaru, perfectly still on the blacktop, the head twisted into an impossible angle. Blood seeps from a nostril. Beside the lifeless head, a BMW medallion lies on the pavement, glinting in the sunlight.

At the bottom of the window, the text "1. TWIRL - DAY" is visible on the left, and "Step 1 of 3" is visible on the right.



The Contemporary Craft of Creating Characters  
Meets Today's Cognitive Architecture:  
A Case Study in Expertise\*  
Selmer Bringsjord & Alexander Bringsjord  
version of 02/16/2016

Contents

- 1 Introduction
- 2 What is Expertise?
- 3 Double-Minded Men, and Expertise Challenge Theories
- 4 The "Two-Step" Change and the Expertise Challenge
- 5 The "Single-Step" Change and the Expertise Challenge
- 6 LABOUR and the Expertise Challenge
- 7 The "Two-Step" Change and the Expertise Challenge
- 8 The "Single-Step" Change and the Expertise Challenge
- 9 The "Two-Step" Change and the Expertise Challenge
- 10 The "Single-Step" Change and the Expertise Challenge
- 11 The "Two-Step" Change and the Expertise Challenge
- 12 The "Single-Step" Change and the Expertise Challenge
- 13 The "Two-Step" Change and the Expertise Challenge
- 14 The "Single-Step" Change and the Expertise Challenge
- 15 The "Two-Step" Change and the Expertise Challenge
- 16 The "Single-Step" Change and the Expertise Challenge
- 17 The "Two-Step" Change and the Expertise Challenge
- 18 The "Single-Step" Change and the Expertise Challenge
- 19 The "Two-Step" Change and the Expertise Challenge
- 20 The "Single-Step" Change and the Expertise Challenge
- 21 The "Two-Step" Change and the Expertise Challenge
- 22 The "Single-Step" Change and the Expertise Challenge
- 23 The "Two-Step" Change and the Expertise Challenge
- 24 The "Single-Step" Change and the Expertise Challenge
- 25 The "Two-Step" Change and the Expertise Challenge
- 26 The "Single-Step" Change and the Expertise Challenge
- 27 The "Two-Step" Change and the Expertise Challenge
- 28 The "Single-Step" Change and the Expertise Challenge
- 29 The "Two-Step" Change and the Expertise Challenge
- 30 The "Single-Step" Change and the Expertise Challenge
- 31 The "Two-Step" Change and the Expertise Challenge
- 32 The "Single-Step" Change and the Expertise Challenge
- 33 The "Two-Step" Change and the Expertise Challenge
- 34 The "Single-Step" Change and the Expertise Challenge
- 35 The "Two-Step" Change and the Expertise Challenge
- 36 The "Single-Step" Change and the Expertise Challenge
- 37 The "Two-Step" Change and the Expertise Challenge
- 38 The "Single-Step" Change and the Expertise Challenge
- 39 The "Two-Step" Change and the Expertise Challenge
- 40 The "Single-Step" Change and the Expertise Challenge
- 41 The "Two-Step" Change and the Expertise Challenge
- 42 The "Single-Step" Change and the Expertise Challenge
- 43 The "Two-Step" Change and the Expertise Challenge
- 44 The "Single-Step" Change and the Expertise Challenge
- 45 The "Two-Step" Change and the Expertise Challenge
- 46 The "Single-Step" Change and the Expertise Challenge
- 47 The "Two-Step" Change and the Expertise Challenge
- 48 The "Single-Step" Change and the Expertise Challenge
- 49 The "Two-Step" Change and the Expertise Challenge
- 50 The "Single-Step" Change and the Expertise Challenge
- 51 The "Two-Step" Change and the Expertise Challenge
- 52 The "Single-Step" Change and the Expertise Challenge
- 53 The "Two-Step" Change and the Expertise Challenge
- 54 The "Single-Step" Change and the Expertise Challenge
- 55 The "Two-Step" Change and the Expertise Challenge
- 56 The "Single-Step" Change and the Expertise Challenge
- 57 The "Two-Step" Change and the Expertise Challenge
- 58 The "Single-Step" Change and the Expertise Challenge
- 59 The "Two-Step" Change and the Expertise Challenge
- 60 The "Single-Step" Change and the Expertise Challenge
- 61 The "Two-Step" Change and the Expertise Challenge
- 62 The "Single-Step" Change and the Expertise Challenge
- 63 The "Two-Step" Change and the Expertise Challenge
- 64 The "Single-Step" Change and the Expertise Challenge
- 65 The "Two-Step" Change and the Expertise Challenge
- 66 The "Single-Step" Change and the Expertise Challenge
- 67 The "Two-Step" Change and the Expertise Challenge
- 68 The "Single-Step" Change and the Expertise Challenge
- 69 The "Two-Step" Change and the Expertise Challenge
- 70 The "Single-Step" Change and the Expertise Challenge
- 71 The "Two-Step" Change and the Expertise Challenge
- 72 The "Single-Step" Change and the Expertise Challenge
- 73 The "Two-Step" Change and the Expertise Challenge
- 74 The "Single-Step" Change and the Expertise Challenge
- 75 The "Two-Step" Change and the Expertise Challenge
- 76 The "Single-Step" Change and the Expertise Challenge
- 77 The "Two-Step" Change and the Expertise Challenge
- 78 The "Single-Step" Change and the Expertise Challenge
- 79 The "Two-Step" Change and the Expertise Challenge
- 80 The "Single-Step" Change and the Expertise Challenge
- 81 The "Two-Step" Change and the Expertise Challenge
- 82 The "Single-Step" Change and the Expertise Challenge
- 83 The "Two-Step" Change and the Expertise Challenge
- 84 The "Single-Step" Change and the Expertise Challenge
- 85 The "Two-Step" Change and the Expertise Challenge
- 86 The "Single-Step" Change and the Expertise Challenge
- 87 The "Two-Step" Change and the Expertise Challenge
- 88 The "Single-Step" Change and the Expertise Challenge
- 89 The "Two-Step" Change and the Expertise Challenge
- 90 The "Single-Step" Change and the Expertise Challenge
- 91 The "Two-Step" Change and the Expertise Challenge
- 92 The "Single-Step" Change and the Expertise Challenge
- 93 The "Two-Step" Change and the Expertise Challenge
- 94 The "Single-Step" Change and the Expertise Challenge
- 95 The "Two-Step" Change and the Expertise Challenge
- 96 The "Single-Step" Change and the Expertise Challenge
- 97 The "Two-Step" Change and the Expertise Challenge
- 98 The "Single-Step" Change and the Expertise Challenge
- 99 The "Two-Step" Change and the Expertise Challenge
- 100 The "Single-Step" Change and the Expertise Challenge

\*This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

# Double-Minded Man

Double-Minded Man  
by  
S Bringsjord & A Bringsjord

DRAFT #5  
© June 30 2016

Selmer.Bringsjord@gmail.com

Contents

Introduction	1
1. What is Expertise?	1
2. Double-Minded Men, and Expertise Challenge Theories	1
3. The Role of Cognitive Architecture	1
4. The "Old" Theory of Expertise and the Expertise Challenge	1
5. The "New" Theory of Expertise and the Expertise Challenge	1
6. LABOUR and the Expertise Challenge	1
7. The Role of Cognitive Architecture	1
8. The Role of Cognitive Architecture	1
9. The Role of Cognitive Architecture	1
10. The Role of Cognitive Architecture	1
11. The Role of Cognitive Architecture	1
12. The Role of Cognitive Architecture	1
13. The Role of Cognitive Architecture	1
14. The Role of Cognitive Architecture	1
15. The Role of Cognitive Architecture	1
16. The Role of Cognitive Architecture	1
17. The Role of Cognitive Architecture	1
18. The Role of Cognitive Architecture	1
19. The Role of Cognitive Architecture	1
20. The Role of Cognitive Architecture	1
21. The Role of Cognitive Architecture	1
22. The Role of Cognitive Architecture	1
23. The Role of Cognitive Architecture	1
24. The Role of Cognitive Architecture	1
25. The Role of Cognitive Architecture	1
26. The Role of Cognitive Architecture	1
27. The Role of Cognitive Architecture	1
28. The Role of Cognitive Architecture	1
29. The Role of Cognitive Architecture	1
30. The Role of Cognitive Architecture	1
31. The Role of Cognitive Architecture	1
32. The Role of Cognitive Architecture	1
33. The Role of Cognitive Architecture	1
34. The Role of Cognitive Architecture	1
35. The Role of Cognitive Architecture	1
36. The Role of Cognitive Architecture	1
37. The Role of Cognitive Architecture	1
38. The Role of Cognitive Architecture	1
39. The Role of Cognitive Architecture	1
40. The Role of Cognitive Architecture	1
41. The Role of Cognitive Architecture	1
42. The Role of Cognitive Architecture	1
43. The Role of Cognitive Architecture	1
44. The Role of Cognitive Architecture	1
45. The Role of Cognitive Architecture	1
46. The Role of Cognitive Architecture	1
47. The Role of Cognitive Architecture	1
48. The Role of Cognitive Architecture	1
49. The Role of Cognitive Architecture	1
50. The Role of Cognitive Architecture	1
51. The Role of Cognitive Architecture	1
52. The Role of Cognitive Architecture	1
53. The Role of Cognitive Architecture	1
54. The Role of Cognitive Architecture	1
55. The Role of Cognitive Architecture	1
56. The Role of Cognitive Architecture	1
57. The Role of Cognitive Architecture	1
58. The Role of Cognitive Architecture	1
59. The Role of Cognitive Architecture	1
60. The Role of Cognitive Architecture	1
61. The Role of Cognitive Architecture	1
62. The Role of Cognitive Architecture	1
63. The Role of Cognitive Architecture	1
64. The Role of Cognitive Architecture	1
65. The Role of Cognitive Architecture	1
66. The Role of Cognitive Architecture	1
67. The Role of Cognitive Architecture	1
68. The Role of Cognitive Architecture	1
69. The Role of Cognitive Architecture	1
70. The Role of Cognitive Architecture	1
71. The Role of Cognitive Architecture	1
72. The Role of Cognitive Architecture	1
73. The Role of Cognitive Architecture	1
74. The Role of Cognitive Architecture	1
75. The Role of Cognitive Architecture	1
76. The Role of Cognitive Architecture	1
77. The Role of Cognitive Architecture	1
78. The Role of Cognitive Architecture	1
79. The Role of Cognitive Architecture	1
80. The Role of Cognitive Architecture	1
81. The Role of Cognitive Architecture	1
82. The Role of Cognitive Architecture	1
83. The Role of Cognitive Architecture	1
84. The Role of Cognitive Architecture	1
85. The Role of Cognitive Architecture	1
86. The Role of Cognitive Architecture	1
87. The Role of Cognitive Architecture	1
88. The Role of Cognitive Architecture	1
89. The Role of Cognitive Architecture	1
90. The Role of Cognitive Architecture	1
91. The Role of Cognitive Architecture	1
92. The Role of Cognitive Architecture	1
93. The Role of Cognitive Architecture	1
94. The Role of Cognitive Architecture	1
95. The Role of Cognitive Architecture	1
96. The Role of Cognitive Architecture	1
97. The Role of Cognitive Architecture	1
98. The Role of Cognitive Architecture	1
99. The Role of Cognitive Architecture	1
100. The Role of Cognitive Architecture	1

# Double-Minded Man

Contents

1 Introduction	1
2 What is Expertise?	2
3 Double-Minded Man, and Expertise Challenge Theories	3
4 The "Two" Challenge and the Expertise Challenge	4
5 The "Two" Challenge and the Expertise Challenge	5
6 The "Two" Challenge and the Expertise Challenge	6
7 The "Two" Challenge and the Expertise Challenge	7
8 The "Two" Challenge and the Expertise Challenge	8
9 The "Two" Challenge and the Expertise Challenge	9
10 The "Two" Challenge and the Expertise Challenge	10
11 The "Two" Challenge and the Expertise Challenge	11
12 The "Two" Challenge and the Expertise Challenge	12
13 The "Two" Challenge and the Expertise Challenge	13
14 The "Two" Challenge and the Expertise Challenge	14
15 The "Two" Challenge and the Expertise Challenge	15
16 The "Two" Challenge and the Expertise Challenge	16
17 The "Two" Challenge and the Expertise Challenge	17
18 The "Two" Challenge and the Expertise Challenge	18
19 The "Two" Challenge and the Expertise Challenge	19
20 The "Two" Challenge and the Expertise Challenge	20
21 The "Two" Challenge and the Expertise Challenge	21
22 The "Two" Challenge and the Expertise Challenge	22
23 The "Two" Challenge and the Expertise Challenge	23
24 The "Two" Challenge and the Expertise Challenge	24
25 The "Two" Challenge and the Expertise Challenge	25
26 The "Two" Challenge and the Expertise Challenge	26
27 The "Two" Challenge and the Expertise Challenge	27
28 The "Two" Challenge and the Expertise Challenge	28
29 The "Two" Challenge and the Expertise Challenge	29
30 The "Two" Challenge and the Expertise Challenge	30
31 The "Two" Challenge and the Expertise Challenge	31
32 The "Two" Challenge and the Expertise Challenge	32
33 The "Two" Challenge and the Expertise Challenge	33
34 The "Two" Challenge and the Expertise Challenge	34
35 The "Two" Challenge and the Expertise Challenge	35
36 The "Two" Challenge and the Expertise Challenge	36
37 The "Two" Challenge and the Expertise Challenge	37
38 The "Two" Challenge and the Expertise Challenge	38
39 The "Two" Challenge and the Expertise Challenge	39
40 The "Two" Challenge and the Expertise Challenge	40
41 The "Two" Challenge and the Expertise Challenge	41
42 The "Two" Challenge and the Expertise Challenge	42
43 The "Two" Challenge and the Expertise Challenge	43
44 The "Two" Challenge and the Expertise Challenge	44
45 The "Two" Challenge and the Expertise Challenge	45
46 The "Two" Challenge and the Expertise Challenge	46
47 The "Two" Challenge and the Expertise Challenge	47
48 The "Two" Challenge and the Expertise Challenge	48
49 The "Two" Challenge and the Expertise Challenge	49
50 The "Two" Challenge and the Expertise Challenge	50
51 The "Two" Challenge and the Expertise Challenge	51
52 The "Two" Challenge and the Expertise Challenge	52
53 The "Two" Challenge and the Expertise Challenge	53
54 The "Two" Challenge and the Expertise Challenge	54
55 The "Two" Challenge and the Expertise Challenge	55
56 The "Two" Challenge and the Expertise Challenge	56
57 The "Two" Challenge and the Expertise Challenge	57
58 The "Two" Challenge and the Expertise Challenge	58
59 The "Two" Challenge and the Expertise Challenge	59
60 The "Two" Challenge and the Expertise Challenge	60
61 The "Two" Challenge and the Expertise Challenge	61
62 The "Two" Challenge and the Expertise Challenge	62
63 The "Two" Challenge and the Expertise Challenge	63
64 The "Two" Challenge and the Expertise Challenge	64
65 The "Two" Challenge and the Expertise Challenge	65
66 The "Two" Challenge and the Expertise Challenge	66
67 The "Two" Challenge and the Expertise Challenge	67
68 The "Two" Challenge and the Expertise Challenge	68
69 The "Two" Challenge and the Expertise Challenge	69
70 The "Two" Challenge and the Expertise Challenge	70
71 The "Two" Challenge and the Expertise Challenge	71
72 The "Two" Challenge and the Expertise Challenge	72
73 The "Two" Challenge and the Expertise Challenge	73
74 The "Two" Challenge and the Expertise Challenge	74
75 The "Two" Challenge and the Expertise Challenge	75
76 The "Two" Challenge and the Expertise Challenge	76
77 The "Two" Challenge and the Expertise Challenge	77
78 The "Two" Challenge and the Expertise Challenge	78
79 The "Two" Challenge and the Expertise Challenge	79
80 The "Two" Challenge and the Expertise Challenge	80
81 The "Two" Challenge and the Expertise Challenge	81
82 The "Two" Challenge and the Expertise Challenge	82
83 The "Two" Challenge and the Expertise Challenge	83
84 The "Two" Challenge and the Expertise Challenge	84
85 The "Two" Challenge and the Expertise Challenge	85
86 The "Two" Challenge and the Expertise Challenge	86
87 The "Two" Challenge and the Expertise Challenge	87
88 The "Two" Challenge and the Expertise Challenge	88
89 The "Two" Challenge and the Expertise Challenge	89
90 The "Two" Challenge and the Expertise Challenge	90
91 The "Two" Challenge and the Expertise Challenge	91
92 The "Two" Challenge and the Expertise Challenge	92
93 The "Two" Challenge and the Expertise Challenge	93
94 The "Two" Challenge and the Expertise Challenge	94
95 The "Two" Challenge and the Expertise Challenge	95
96 The "Two" Challenge and the Expertise Challenge	96
97 The "Two" Challenge and the Expertise Challenge	97
98 The "Two" Challenge and the Expertise Challenge	98
99 The "Two" Challenge and the Expertise Challenge	99
100 The "Two" Challenge and the Expertise Challenge	100

# Double-Minded Man

## 1. TWIRL - DAY

68-year-old Harriet Smith sits with two wrinkled hands firmly on the wheel of her rust-eaten Subaru wagon, staring straight ahead through the top level of bifocals as she waits serenely at a red light.

Harriet is alone in the car. To her right is another vehicle, also waiting, in this case to make a right turn; it's a sleek, low-slung, black Camaro.

We are inside the cabin with Harriet. The Subaru's sound system softly plays choral music. Harriet's lips move slightly as she internally sings along, mouthing a slow aria. Her head weaves slightly side to side, in the rhythm with the music.

Things are calm as can be here inside the car with Harriet. There are a pair of well-worn Bibles on the empty passenger seat beside her, one with a gold-lettered 'Harriet' on its leather front cover, the other with a matching 'Joseph' on its front cover.

Harriet's eyes swivel up to the light: still red. We wait with her.

Suddenly there is a piercing SCREECH outside. Harriet jerks her head to the right and we follow her line of sight.

A sleek motorcycle has swerved out of its lane and is now streaking straight for the right side of the Camaro beside Harriet's car.

The bike slams with CLANG into the side of the Camaro. Its rider is flung up and forward into the air, twirling passed Harriet's windshield.

We now watch from Harriet's POV, in slow motion. The black-leather-clad motorcyclist sails by Harriet's windshield, airborne. We see a man's face, clearly: His elephant-hide skin tells us that he is well beyond middle-age. Yet thick, black curls of youthful hair emerge from under his helmet. The rider has only one half of a black, bushy, swept-out, waxed mustache. His eyes are weary and grey, and appear to lock with Harriet's for an instant.

We return to normal speed. The body is now lying on the incoming lane to the left of Harriet's Subaru, perfectly still on the blacktop, the head twisted into an impossible angle. Blood seeps from a nostril. Beside the lifeless head, a BMW medallion lies on the pavement, glinting in the sunlight.

The Contemporary Craft of Creating Characters  
Meets Today's Cognitive Architecture:  
A Case Study in Expertise\*

Silver Stripling • John Linn • Alexander Stripling  
Volume 4 ISSUE 1

Contents

Introduction	1
What is Expertise?	2
Double-Minded Men, and Expertise Challenge Theories	3
1.1 The Double-Minded Man	3
1.2 The Double-Minded Man and Expertise Challenge Theories	4
1.3 The Double-Minded Man and Expertise Challenge Theories	5
1.4 The Double-Minded Man and Expertise Challenge Theories	6
1.5 The Double-Minded Man and Expertise Challenge Theories	7
1.6 The Double-Minded Man and Expertise Challenge Theories	8
1.7 The Double-Minded Man and Expertise Challenge Theories	9
1.8 The Double-Minded Man and Expertise Challenge Theories	10
1.9 The Double-Minded Man and Expertise Challenge Theories	11
1.10 The Double-Minded Man and Expertise Challenge Theories	12
1.11 The Double-Minded Man and Expertise Challenge Theories	13
1.12 The Double-Minded Man and Expertise Challenge Theories	14
1.13 The Double-Minded Man and Expertise Challenge Theories	15
1.14 The Double-Minded Man and Expertise Challenge Theories	16
1.15 The Double-Minded Man and Expertise Challenge Theories	17
1.16 The Double-Minded Man and Expertise Challenge Theories	18
1.17 The Double-Minded Man and Expertise Challenge Theories	19
1.18 The Double-Minded Man and Expertise Challenge Theories	20
1.19 The Double-Minded Man and Expertise Challenge Theories	21
1.20 The Double-Minded Man and Expertise Challenge Theories	22
1.21 The Double-Minded Man and Expertise Challenge Theories	23
1.22 The Double-Minded Man and Expertise Challenge Theories	24
1.23 The Double-Minded Man and Expertise Challenge Theories	25
1.24 The Double-Minded Man and Expertise Challenge Theories	26
1.25 The Double-Minded Man and Expertise Challenge Theories	27
1.26 The Double-Minded Man and Expertise Challenge Theories	28
1.27 The Double-Minded Man and Expertise Challenge Theories	29
1.28 The Double-Minded Man and Expertise Challenge Theories	30
1.29 The Double-Minded Man and Expertise Challenge Theories	31
1.30 The Double-Minded Man and Expertise Challenge Theories	32
1.31 The Double-Minded Man and Expertise Challenge Theories	33
1.32 The Double-Minded Man and Expertise Challenge Theories	34
1.33 The Double-Minded Man and Expertise Challenge Theories	35
1.34 The Double-Minded Man and Expertise Challenge Theories	36
1.35 The Double-Minded Man and Expertise Challenge Theories	37
1.36 The Double-Minded Man and Expertise Challenge Theories	38
1.37 The Double-Minded Man and Expertise Challenge Theories	39
1.38 The Double-Minded Man and Expertise Challenge Theories	40
1.39 The Double-Minded Man and Expertise Challenge Theories	41
1.40 The Double-Minded Man and Expertise Challenge Theories	42
1.41 The Double-Minded Man and Expertise Challenge Theories	43
1.42 The Double-Minded Man and Expertise Challenge Theories	44
1.43 The Double-Minded Man and Expertise Challenge Theories	45
1.44 The Double-Minded Man and Expertise Challenge Theories	46
1.45 The Double-Minded Man and Expertise Challenge Theories	47
1.46 The Double-Minded Man and Expertise Challenge Theories	48
1.47 The Double-Minded Man and Expertise Challenge Theories	49
1.48 The Double-Minded Man and Expertise Challenge Theories	50
1.49 The Double-Minded Man and Expertise Challenge Theories	51
1.50 The Double-Minded Man and Expertise Challenge Theories	52
1.51 The Double-Minded Man and Expertise Challenge Theories	53
1.52 The Double-Minded Man and Expertise Challenge Theories	54
1.53 The Double-Minded Man and Expertise Challenge Theories	55
1.54 The Double-Minded Man and Expertise Challenge Theories	56
1.55 The Double-Minded Man and Expertise Challenge Theories	57
1.56 The Double-Minded Man and Expertise Challenge Theories	58
1.57 The Double-Minded Man and Expertise Challenge Theories	59
1.58 The Double-Minded Man and Expertise Challenge Theories	60
1.59 The Double-Minded Man and Expertise Challenge Theories	61
1.60 The Double-Minded Man and Expertise Challenge Theories	62
1.61 The Double-Minded Man and Expertise Challenge Theories	63
1.62 The Double-Minded Man and Expertise Challenge Theories	64
1.63 The Double-Minded Man and Expertise Challenge Theories	65
1.64 The Double-Minded Man and Expertise Challenge Theories	66
1.65 The Double-Minded Man and Expertise Challenge Theories	67
1.66 The Double-Minded Man and Expertise Challenge Theories	68
1.67 The Double-Minded Man and Expertise Challenge Theories	69
1.68 The Double-Minded Man and Expertise Challenge Theories	70
1.69 The Double-Minded Man and Expertise Challenge Theories	71
1.70 The Double-Minded Man and Expertise Challenge Theories	72
1.71 The Double-Minded Man and Expertise Challenge Theories	73
1.72 The Double-Minded Man and Expertise Challenge Theories	74
1.73 The Double-Minded Man and Expertise Challenge Theories	75
1.74 The Double-Minded Man and Expertise Challenge Theories	76
1.75 The Double-Minded Man and Expertise Challenge Theories	77
1.76 The Double-Minded Man and Expertise Challenge Theories	78
1.77 The Double-Minded Man and Expertise Challenge Theories	79
1.78 The Double-Minded Man and Expertise Challenge Theories	80
1.79 The Double-Minded Man and Expertise Challenge Theories	81
1.80 The Double-Minded Man and Expertise Challenge Theories	82
1.81 The Double-Minded Man and Expertise Challenge Theories	83
1.82 The Double-Minded Man and Expertise Challenge Theories	84
1.83 The Double-Minded Man and Expertise Challenge Theories	85
1.84 The Double-Minded Man and Expertise Challenge Theories	86
1.85 The Double-Minded Man and Expertise Challenge Theories	87
1.86 The Double-Minded Man and Expertise Challenge Theories	88
1.87 The Double-Minded Man and Expertise Challenge Theories	89
1.88 The Double-Minded Man and Expertise Challenge Theories	90
1.89 The Double-Minded Man and Expertise Challenge Theories	91
1.90 The Double-Minded Man and Expertise Challenge Theories	92
1.91 The Double-Minded Man and Expertise Challenge Theories	93
1.92 The Double-Minded Man and Expertise Challenge Theories	94
1.93 The Double-Minded Man and Expertise Challenge Theories	95
1.94 The Double-Minded Man and Expertise Challenge Theories	96
1.95 The Double-Minded Man and Expertise Challenge Theories	97
1.96 The Double-Minded Man and Expertise Challenge Theories	98
1.97 The Double-Minded Man and Expertise Challenge Theories	99
1.98 The Double-Minded Man and Expertise Challenge Theories	100
1.99 The Double-Minded Man and Expertise Challenge Theories	101
2.00 The Double-Minded Man and Expertise Challenge Theories	102

\*This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. For a full list of terms, see <https://creativecommons.org/licenses/by-nc-sa/4.0/>

# Double-Minded Man

## 1. TWIRL - DAY

68-year-old Harriet Smith sits with two wrinkled hands firmly on the wheel of her rust-eaten Subaru wagon, staring straight ahead through the top level of bifocals as she waits serenely at a red light.

Harriet is alone in the car. To her right is another vehicle, also waiting, in this case to make a right turn; it's a sleek, low-slung, black Camaro.

We are inside the cabin with Harriet. The Subaru's sound system softly plays choral music. Harriet's lips move slightly as she internally sings along, mouthing a slow aria. Her head weaves slightly side to side, in the rhythm with the music.

Things are calm as can be here inside the car with Harriet. There are a pair of well-worn Bibles on the empty passenger seat beside her, one with a gold-lettered 'Harriet' on its leather front cover, the other with a matching 'Joseph' on its front cover.

Harriet's eyes swivel up to the light: still red. We wait with her.

Suddenly there is a piercing SCREECH outside. Harriet jerks her head to the right and we follow her line of sight.

A sleek motorcycle has swerved out of its lane and is now streaking straight for the right side of the Camaro beside Harriet's car.

The bike slams with CLANG into the side of the Camaro. Its rider is flung up and forward into the air, twirling passed Harriet's windshield.

We now watch from Harriet's POV, in slow motion. The black-leather-clad motorcyclist sails by Harriet's windshield, airborne. We see a man's face, clearly: His elephant-hide skin tells us that he is well beyond middle-age. Yet thick, black curls of youthful hair emerge from under his helmet. The rider has only one half of a black, bushy, swept-out, waxed mustache. His eyes are weary and grey, and appear to lock with Harriet's for an instant.

We return to normal speed. The body is now lying on the incoming lane to the left of Harriet's Subaru, perfectly still on the blacktop, the head twisted into an impossible angle. Blood seeps from a nostril. Beside the lifeless head, a BMW medallion lies on the pavement, glinting in the sunlight.

The Contemporary Craft of Creating Characters  
 Meets Today's Cognitive Architecture:  
 A Case Study in Expertise\*  
 Silver Stripling • John Lewis • Alexander Stripling  
 volume of EXPERTISE

Contents

- 1 Introduction
- 2 What is Expertise?
- 3 Double-Mindedness and Expertise: Challenge Theories
- 4 The "Two-Step" Change and the Expertise Challenge
- 5 The "Single-Step" Change and the Expertise Challenge
- 6 CLARION and the Expertise Challenge
- 7 The "Two-Step" Change and the Expertise Challenge
- 8 The "Single-Step" Change and the Expertise Challenge
- 9 Challenge (1) and (2)
- 10 Challenge (3) and (4)
- 11 Conclusion
- 12 Acknowledgments
- 13 References

\*This work is licensed under a Creative Commons Attribution 4.0 International License. For more information, see <http://creativecommons.org/licenses/by/4.0/>.

# Double-Minded Man

## 1. TWIRL - DAY

68-year-old Harriet Smith sits with two wrinkled hands firmly on the wheel of her rust-eaten Subaru wagon, staring straight ahead through the top level of bifocals as she waits serenely at a red light.

Harriet is alone in the car. To her right is another vehicle, also waiting, in this case to make a right turn; it's a sleek, low-slung, black Camaro.

We are inside the cabin with Harriet. The Subaru's sound system softly plays choral music. Harriet's lips move slightly as she internally sings along, mouthing a slow aria. Her head weaves slightly side to side, in the rhythm with the music.

Things are calm as can be here inside the car with Harriet. There are a pair of well-worn Bibles on the empty passenger seat beside her, one with a gold-lettered 'Harriet' on its leather front cover, the other with a matching 'Joseph' on its front cover.

Harriet's eyes swivel up to the light: still red. We wait with her.

Suddenly there is a piercing SCREECH outside. Harriet jerks her head to the right and we follow her line of sight.

A sleek motorcycle has swerved out of its lane and is now streaking straight for the right side of the Camaro beside Harriet's car.

The bike slams with CLANG into the side of the Camaro. Its rider is flung up and forward into the air, twirling passed Harriet's windshield.

We now watch from Harriet's POV, in slow motion. The black-leather-clad motorcyclist sails by Harriet's windshield, airborne. We see a man's face, clearly: His elephant-hide skin tells us that he is well beyond middle-age. Yet thick, black curls of youthful hair emerge from under his helmet. The rider has only one half of a black, bushy, swept-out, waxed mustache. His eyes are weary and grey, and appear to lock with Harriet's for an instant.

We return to normal speed. The body is now lying on the incoming lane to the left of Harriet's Subaru, perfectly still on the blacktop, the head twisted into an impossible angle. Blood seeps from a nostril. Beside the lifeless head, a BMW medallion lies on the pavement, glinting in the sunlight.

$$\exists X [X(joseph) \wedge \neg X(m(harriet, joseph)) \wedge Sleazy(X)]$$



The Contemporary Craft of Creating Characters  
Meets Today's Cognitive Architecture:  
A Case Study in Engineering\*

Silver Stroupel • John Lewis • Alexander Stroupel  
Volume of *COGNITIVE*

Contents

Introduction

1. What is Engineering?

2. Psychological Risk and Responsibility Challenges: Theoretical

3. The "Big" Company and the Responsibility Challenge

4. The "Big" Company and the Responsibility Challenge

5. The "Big" Company and the Responsibility Challenge

6. The "Big" Company and the Responsibility Challenge

7. The "Big" Company and the Responsibility Challenge

8. The "Big" Company and the Responsibility Challenge

9. The "Big" Company and the Responsibility Challenge

10. The "Big" Company and the Responsibility Challenge

11. The "Big" Company and the Responsibility Challenge

12. The "Big" Company and the Responsibility Challenge

13. The "Big" Company and the Responsibility Challenge

14. The "Big" Company and the Responsibility Challenge

15. The "Big" Company and the Responsibility Challenge

16. The "Big" Company and the Responsibility Challenge

17. The "Big" Company and the Responsibility Challenge

18. The "Big" Company and the Responsibility Challenge

19. The "Big" Company and the Responsibility Challenge

20. The "Big" Company and the Responsibility Challenge

21. The "Big" Company and the Responsibility Challenge

22. The "Big" Company and the Responsibility Challenge

23. The "Big" Company and the Responsibility Challenge

24. The "Big" Company and the Responsibility Challenge

25. The "Big" Company and the Responsibility Challenge

26. The "Big" Company and the Responsibility Challenge

27. The "Big" Company and the Responsibility Challenge

28. The "Big" Company and the Responsibility Challenge

29. The "Big" Company and the Responsibility Challenge

30. The "Big" Company and the Responsibility Challenge

31. The "Big" Company and the Responsibility Challenge

32. The "Big" Company and the Responsibility Challenge

33. The "Big" Company and the Responsibility Challenge

34. The "Big" Company and the Responsibility Challenge

35. The "Big" Company and the Responsibility Challenge

36. The "Big" Company and the Responsibility Challenge

37. The "Big" Company and the Responsibility Challenge

38. The "Big" Company and the Responsibility Challenge

39. The "Big" Company and the Responsibility Challenge

40. The "Big" Company and the Responsibility Challenge

41. The "Big" Company and the Responsibility Challenge

42. The "Big" Company and the Responsibility Challenge

43. The "Big" Company and the Responsibility Challenge

44. The "Big" Company and the Responsibility Challenge

45. The "Big" Company and the Responsibility Challenge

46. The "Big" Company and the Responsibility Challenge

47. The "Big" Company and the Responsibility Challenge

48. The "Big" Company and the Responsibility Challenge

49. The "Big" Company and the Responsibility Challenge

50. The "Big" Company and the Responsibility Challenge

51. The "Big" Company and the Responsibility Challenge

52. The "Big" Company and the Responsibility Challenge

53. The "Big" Company and the Responsibility Challenge

54. The "Big" Company and the Responsibility Challenge

55. The "Big" Company and the Responsibility Challenge

56. The "Big" Company and the Responsibility Challenge

57. The "Big" Company and the Responsibility Challenge

58. The "Big" Company and the Responsibility Challenge

59. The "Big" Company and the Responsibility Challenge

60. The "Big" Company and the Responsibility Challenge

61. The "Big" Company and the Responsibility Challenge

62. The "Big" Company and the Responsibility Challenge

63. The "Big" Company and the Responsibility Challenge

64. The "Big" Company and the Responsibility Challenge

65. The "Big" Company and the Responsibility Challenge

66. The "Big" Company and the Responsibility Challenge

67. The "Big" Company and the Responsibility Challenge

68. The "Big" Company and the Responsibility Challenge

69. The "Big" Company and the Responsibility Challenge

70. The "Big" Company and the Responsibility Challenge

71. The "Big" Company and the Responsibility Challenge

72. The "Big" Company and the Responsibility Challenge

73. The "Big" Company and the Responsibility Challenge

74. The "Big" Company and the Responsibility Challenge

75. The "Big" Company and the Responsibility Challenge

76. The "Big" Company and the Responsibility Challenge

77. The "Big" Company and the Responsibility Challenge

78. The "Big" Company and the Responsibility Challenge

79. The "Big" Company and the Responsibility Challenge

80. The "Big" Company and the Responsibility Challenge

81. The "Big" Company and the Responsibility Challenge

82. The "Big" Company and the Responsibility Challenge

83. The "Big" Company and the Responsibility Challenge

84. The "Big" Company and the Responsibility Challenge

85. The "Big" Company and the Responsibility Challenge

86. The "Big" Company and the Responsibility Challenge

87. The "Big" Company and the Responsibility Challenge

88. The "Big" Company and the Responsibility Challenge

89. The "Big" Company and the Responsibility Challenge

90. The "Big" Company and the Responsibility Challenge

91. The "Big" Company and the Responsibility Challenge

92. The "Big" Company and the Responsibility Challenge

93. The "Big" Company and the Responsibility Challenge

94. The "Big" Company and the Responsibility Challenge

95. The "Big" Company and the Responsibility Challenge

96. The "Big" Company and the Responsibility Challenge

97. The "Big" Company and the Responsibility Challenge

98. The "Big" Company and the Responsibility Challenge

99. The "Big" Company and the Responsibility Challenge

100. The "Big" Company and the Responsibility Challenge

# Double-Minded Man

## 1. TWIRL - DAY

68-year-old Harriet Smith sits with two wrinkled hands firmly on the wheel of her rust-eaten Subaru wagon, staring straight ahead through the top level of bifocals as she waits serenely at a red light.

Harriet is alone in the car. To her right is another vehicle, also waiting, in this case to make a right turn; it's a sleek, low-slung, black Camaro.

We are inside the cabin with Harriet. The Subaru's sound system softly plays choral music. Harriet's lips move slightly as she internally sings along, mouthing a slow aria. Her head weaves slightly side to side, in the rhythm with the music.

Things are calm as can be here inside the car with Harriet. There are a pair of well-worn Bibles on the empty passenger seat beside her, one with a gold-lettered 'Harriet' on its leather front cover, the other with a matching 'Joseph' on its front cover.

Harriet's eyes swivel up to the light: still red. We wait with her.

Suddenly there is a piercing SCREECH outside. Harriet jerks her head to the right and we follow her line of sight.

A sleek motorcycle has swerved out of its lane and is now streaking straight for the right side of the Camaro beside Harriet's car.

The bike slams with CLANG into the side of the Camaro. Its rider is flung up and forward into the air, twirling passed Harriet's windshield.

We now watch from Harriet's POV, in slow motion. The black-leather-clad motorcyclist sails by Harriet's windshield, airborne. We see a man's face, clearly: His elephant-hide skin tells us that he is well beyond middle-age. Yet thick, black curls of youthful hair emerge from under his helmet. The rider has only one half of a black, bushy, swept-out, waxed mustache. His eyes are weary and grey, and appear to lock with Harriet's for an instant.

We return to normal speed. The body is now lying on the incoming lane to the left of Harriet's Subaru, perfectly still on the blacktop, the head twisted into an impossible angle. Blood seeps from a nostril. Beside the lifeless head, a BMW medallion lies on the pavement, glinting in the sunlight.



$$\exists X [X(joseph) \wedge \neg X(m(harriet, joseph)) \wedge Sleazy(X)]$$



# Climbing the $k$ -order Ladder

# Climbing the $k$ -order Ladder

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

$Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

$\exists x[Llama(x) \wedge Llama(b) \wedge Likes(x, b) \wedge Llama(fatherOf(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

**FOL**  $\exists x[Llama(x) \wedge Llama(b) \wedge Likes(x, b) \wedge Llama(fatherOf(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x[Llama(x) \wedge Llama(b) \wedge Likes(x, b) \wedge Llama(fatherOf(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.



# Climbing the $k$ -order Ladder

$$\exists x \exists y \exists R [R(x) \wedge R(y) \wedge Likes(x, y) \wedge R(fatherOf(x))]$$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge Likes(x, b) \wedge Llama(fatherOf(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

**SOL**  $\exists x \exists y \exists R [R(x) \wedge R(y) \wedge Likes(x, y) \wedge R(fatherOf(x))]$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge Likes(x, b) \wedge Llama(fatherOf(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property; and,  $x$   $R^2$ s  $y$ , where  $R^2$  is a positive property.

**SOL**  $\exists x \exists y \exists R [R(x) \wedge R(y) \wedge Likes(x, y) \wedge R(fatherOf(x))]$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge Likes(x, b) \wedge Llama(fatherOf(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge Likes(a, b) \wedge Llama(fatherOf(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

$$\exists x, y \exists R, R^2 [R(x) \wedge R(y) \wedge R^2(x, y) \wedge \textit{Positive}(R^2) \wedge R(\textit{fatherOf}(x))]$$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property; and,  $x$   $R^2$ s  $y$ , where  $R^2$  is a positive property.

**SOL** 
$$\exists x \exists y \exists R [R(x) \wedge R(y) \wedge \textit{Likes}(x, y) \wedge R(\textit{fatherOf}(x))]$$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL** 
$$\exists x [Llama(x) \wedge Llama(b) \wedge \textit{Likes}(x, b) \wedge Llama(\textit{fatherOf}(x))]$$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL** 
$$Llama(a) \wedge Llama(b) \wedge \textit{Likes}(a, b) \wedge Llama(\textit{fatherOf}(a))$$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

**TOL**  $\exists x, y \exists R, R^2 [R(x) \wedge R(y) \wedge R^2(x, y) \wedge \textit{Positive}(R^2) \wedge R(\textit{fatherOf}(x))]$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property; and,  $x$   $R^2$ s  $y$ , where  $R^2$  is a positive property.

**SOL**  $\exists x \exists y \exists R [R(x) \wedge R(y) \wedge \textit{Likes}(x, y) \wedge R(\textit{fatherOf}(x))]$

Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge \textit{Likes}(x, b) \wedge Llama(\textit{fatherOf}(x))]$

There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge \textit{Likes}(a, b) \wedge Llama(\textit{fatherOf}(a))$

$a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

**TOL**  $\exists x, y \exists R, R^2 [R(x) \wedge R(y) \wedge R^2(x, y) \wedge \textit{Positive}(R^2) \wedge R(\textit{fatherOf}(x))]$

$\mathcal{L}_3$  Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property; and,  $x$   $R^2$ s  $y$ , where  $R^2$  is a positive property.

**SOL**  $\exists x \exists y \exists R [R(x) \wedge R(y) \wedge \textit{Likes}(x, y) \wedge R(\textit{fatherOf}(x))]$

$\mathcal{L}_2$  Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge \textit{Likes}(x, b) \wedge Llama(\textit{fatherOf}(x))]$

$\mathcal{L}_1$  There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge \textit{Likes}(a, b) \wedge Llama(\textit{fatherOf}(a))$

$\mathcal{L}_0$   $a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

# Climbing the $k$ -order Ladder

⋮

**TOL**  $\exists x, y \exists R, R^2 [R(x) \wedge R(y) \wedge R^2(x, y) \wedge \textit{Positive}(R^2) \wedge R(\textit{fatherOf}(x))]$

$\mathcal{L}_3$  Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property; and,  $x$   $R^2$ s  $y$ , where  $R^2$  is a positive property.

**SOL**  $\exists x \exists y \exists R [R(x) \wedge R(y) \wedge \textit{Likes}(x, y) \wedge R(\textit{fatherOf}(x))]$

$\mathcal{L}_2$  Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

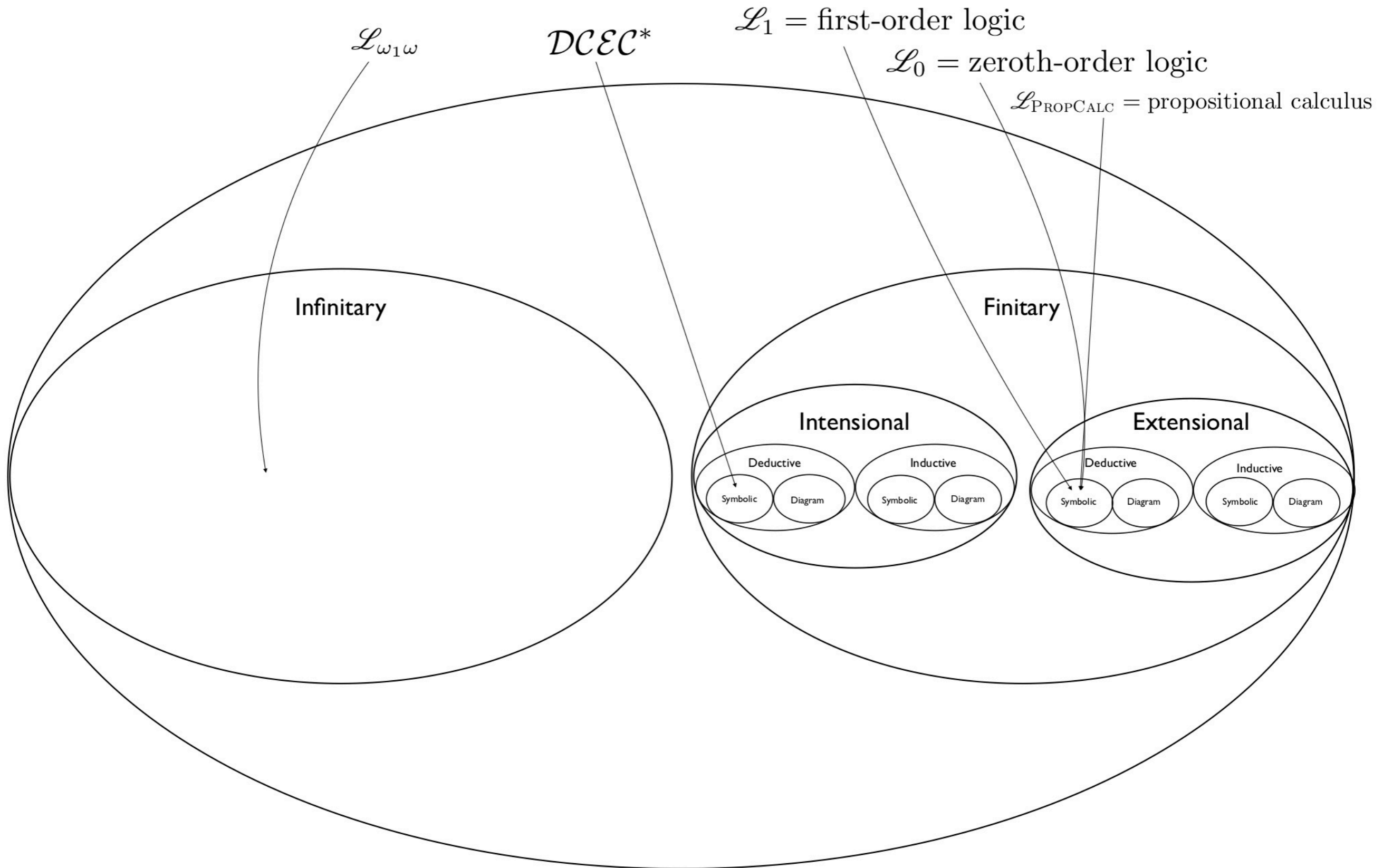
**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge \textit{Likes}(x, b) \wedge Llama(\textit{fatherOf}(x))]$

$\mathcal{L}_1$  There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge \textit{Likes}(a, b) \wedge Llama(\textit{fatherOf}(a))$

$\mathcal{L}_0$   $a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.

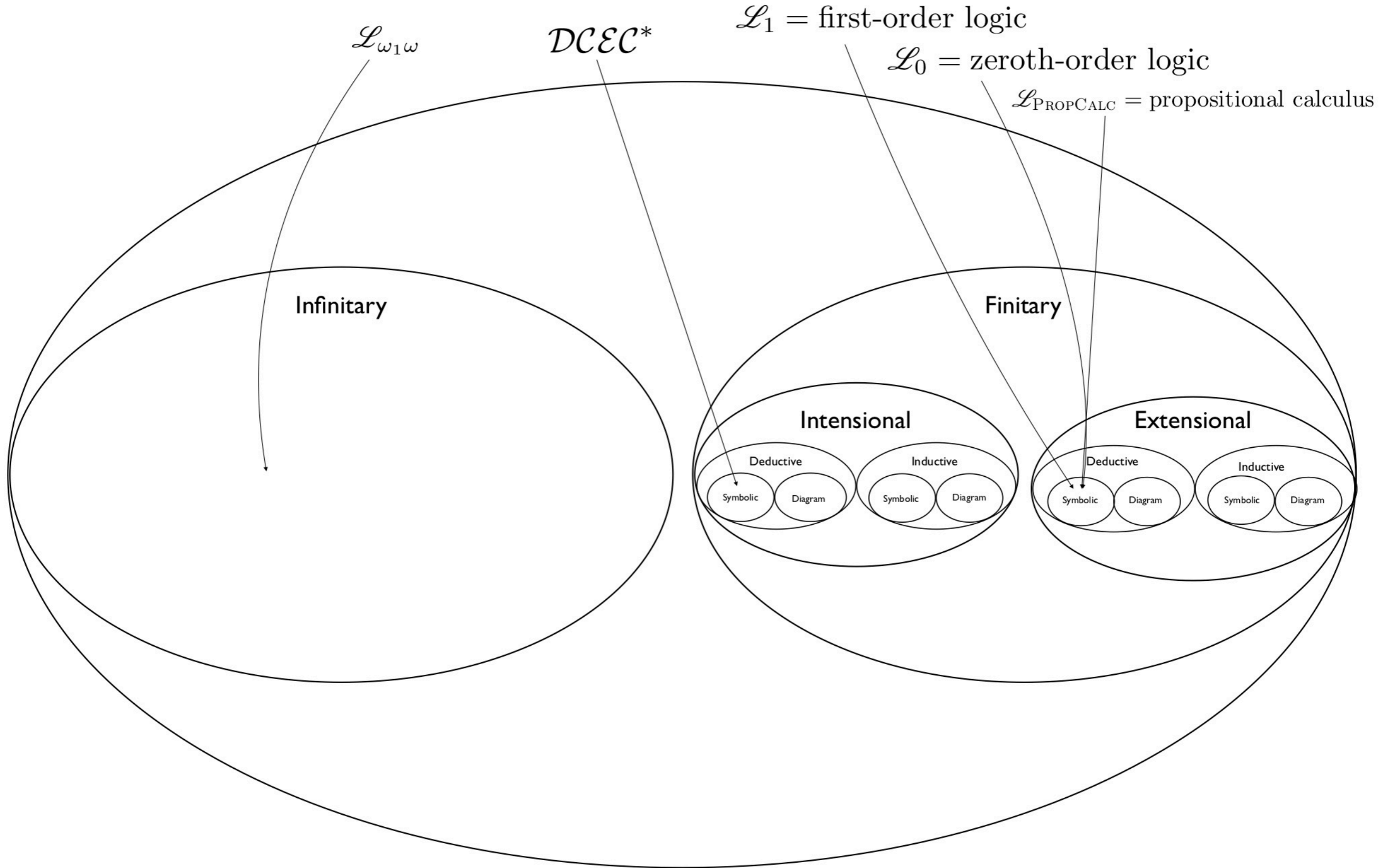
# The Universe of Logics





$\mathcal{L}_3$   
 $\mathcal{L}_2$

# The Universe of Logics



# The Universe of Logics

$\mathcal{L}_3$

$\mathcal{L}_2$

$\mathcal{L}_{\omega_1\omega}$

$\mathcal{DCEC}^*$

$\mathcal{L}_1 =$  first-order logic

$\mathcal{L}_0 =$  zeroth-order logic

$\mathcal{L}_{\text{PROPCALC}} =$  propositional calculus

Infinitary

Finitary

Intensional

Extensional

Deductive

Inductive

Deductive

Inductive

Symbolic

Diagram

Symbolic

Diagram

Symbolic

Diagram

Symbolic

Diagram

# Climbing the $k$ -order Ladder

⋮

**TOL**  $\exists x, y \exists R, R^2 [R(x) \wedge R(y) \wedge R^2(x, y) \wedge \textit{Positive}(R^2) \wedge R(\textit{fatherOf}(x))]$

$\mathcal{L}_3$  Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property; and,  $x$   $R^2$ s  $y$ , where  $R^2$  is a positive property.

**SOL**  $\exists x \exists y \exists R [R(x) \wedge R(y) \wedge \textit{Likes}(x, y) \wedge R(\textit{fatherOf}(x))]$

$\mathcal{L}_2$  Things  $x$  and  $y$ , along with the father of  $x$ , share a certain property (and  $x$  likes  $y$ ).

**FOL**  $\exists x [Llama(x) \wedge Llama(b) \wedge \textit{Likes}(x, b) \wedge Llama(\textit{fatherOf}(x))]$

$\mathcal{L}_1$  There's some thing which is a llama and likes  $b$  (which is also a llama), and whose father is a llama too.

**ZOL**  $Llama(a) \wedge Llama(b) \wedge \textit{Likes}(a, b) \wedge Llama(\textit{fatherOf}(a))$

$\mathcal{L}_0$   $a$  is a llama, as is  $b$ ,  $a$  likes  $b$ , and the father of  $a$  is a llama as well.