# Semantics – Exercises (All Answers)

Exercises for Chapter 4 of Steinhart, E. (2017) *More Precisely: The Math You Need to Do Philosophy.* Broadview Press. Copyright (C) 2017 Eric Steinhart. Non-commercial educational use encouraged! All others uses prohibited. (Version 2)

Model 0

Each circle is a world containing some things in some relations. The relations are indicated by arrows. Triangular bodies are female; square bodies are male. Robots have square eyes; humans have round eyes. The heart is love the skull and bones is hate. A dotted line connecting two things indicates that they are counterparts.
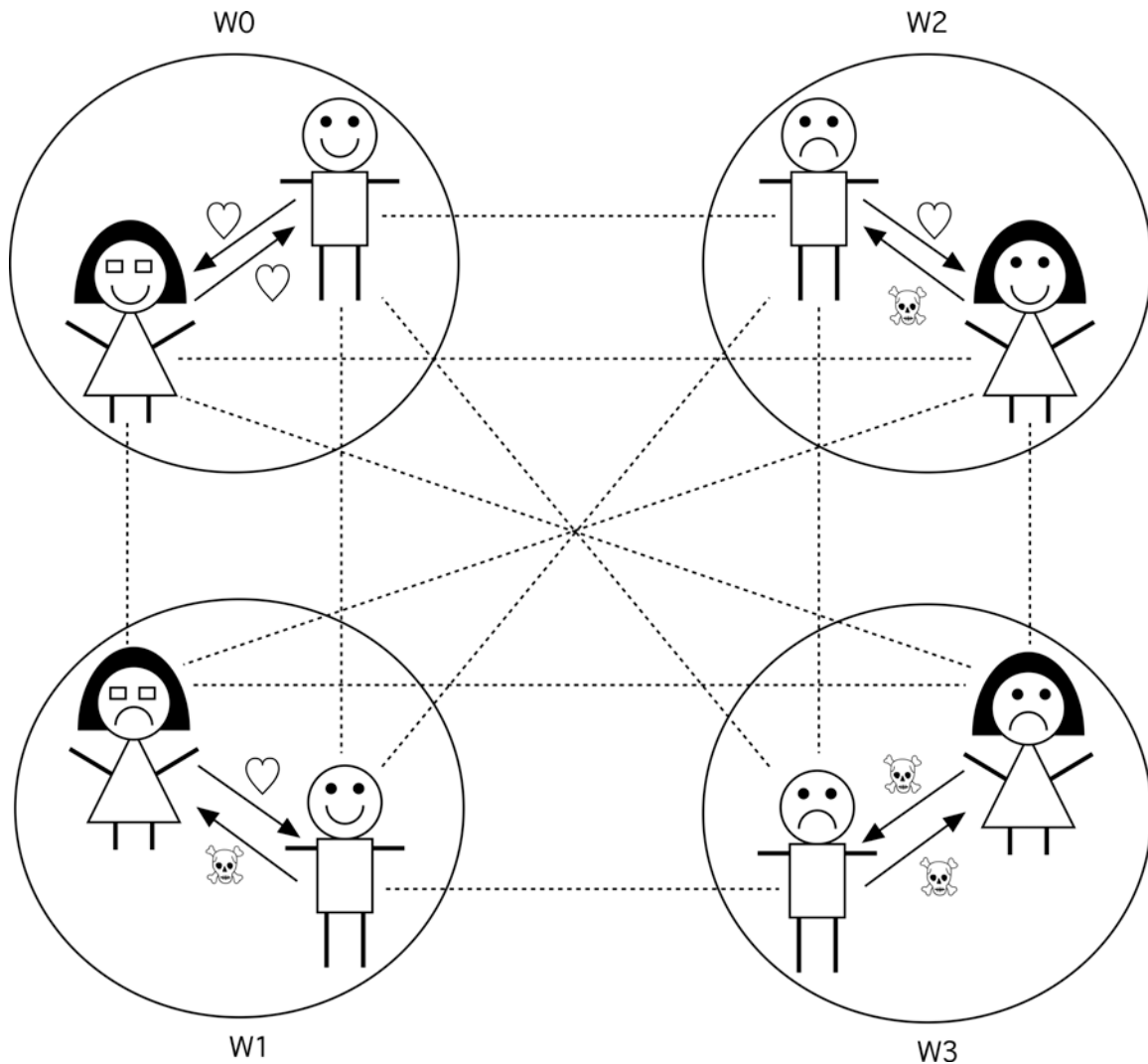
Propositions and their Worlds (Fill in the table with true/false)

Proposition	W0	W1	W2	W3
Bob is human	true	true	true	true
Bob is a robot	false	false	false	false
Sue is human	false	false	true	true
Sue is a robot	true	true	false	false
Bob is joyful	true	true	false	false
Bob is sad	false	false	true	true
Sue is joyful	true	false	true	false
Sue is sad	false	true	false	true
Bob loves Sue	true	false	true	false
Bob hates Sue	false	true	false	true
Sue loves Bob	true	true	false	false
Sue hates Bob	false	false	true	true

Properties Distributed across Worlds (Fill in the cell with things that have the property at the world; for relations, use ordered pairs.)

	World W0	**World W1**	**World W2**	**World W3**
human	Bob0	Bob1	Bob2, Sue2	Bob3, Sue3
robot	Sue0	Sue1		
joyful	Bob0, Sue0	Bob1	Sue2	
sad		Sue1	Bob2	Bob3, Sue3
loves	Bob0 → Sue0 Sue0 → Bob0	Sue1 → Bob1	Bob2 → Sue2	
hates		Bob1 → Sue1	Sue2 → Bob2	Bob3 → Sue3 Sue3 → Bob3

Questions (True or false, unless asking for a list of worlds).

"Bob loves Sue" at W2 (True)

"Sue is a joyful robot" at W1 (False)

"Sue hates a sad human" at W3 (True)

It is possible that Bob is a robot. (False; Bob is not a robot at any world)

It is possible that Bob loves a joyful robot. (True, due to W0)

It is possible that everybody is sad. (True, due to W3)

It is necessary that Sue is a robot. (False, due to W2 and W3)

It is necessary that somebody is loved. (False, due to W3)
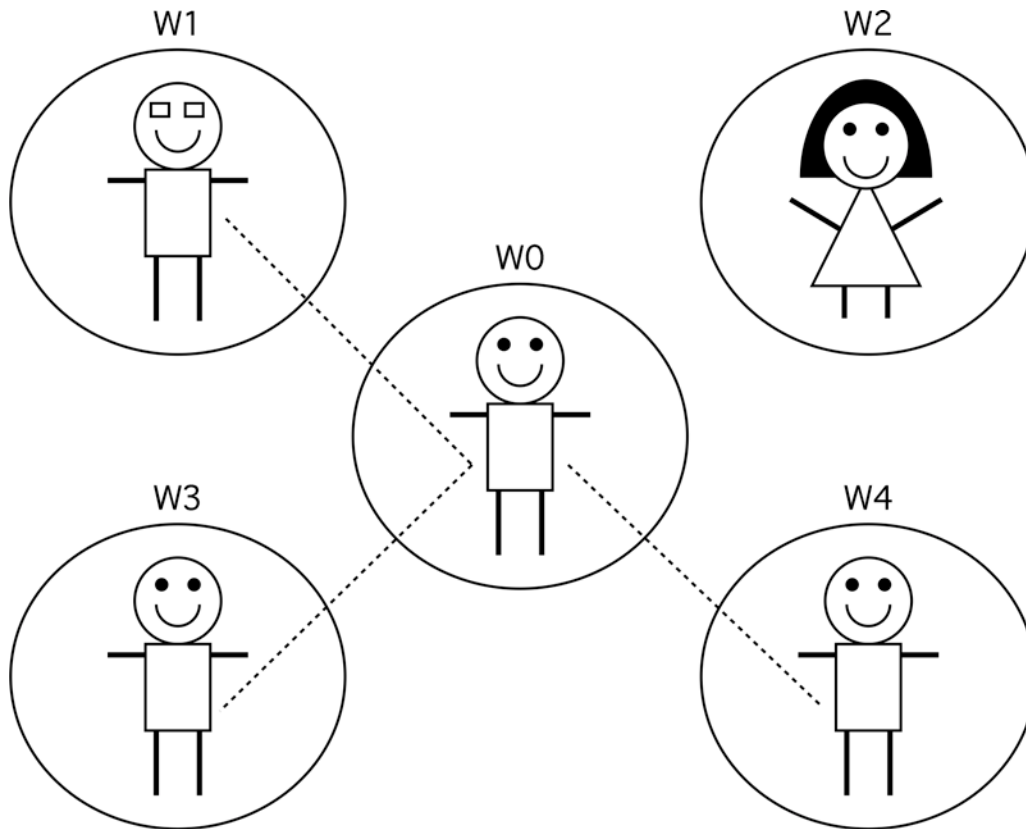
Necessarily, Sue loves a happy human. (False, due to W2 and W3)

Necessarily, if Bob is loved, then he is loved by some robot. (True)

List the worlds at which some robot loves somebody: (W0 and W1)

It is necessary for robots to love. (True)

Model 1 (Same conventions as Model 0)

In this model, John exists at world W0.

Questions (list worlds or answer true/false)

List the worlds where John has counterparts. (W1, W3, and W4)

List the worlds where John has no counterpart. (W2)

It is necessary that John exists. (False – he does not exist at W2)

It is necessary that John is male. (False – "John is male" is not true at W2)

John is necessarily male. (True – he is male at every world at which he exists)

John is essentially male. (True – same as John is necessarily male.)

John is essentially human. (False – he is a robot at W1)

John is contingently human. (True – he is human at some worlds and robotic at others)

John is accidentally human (True – same as John is contingently human.)

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Model 2 (Same conventions as Models 0 and 1)
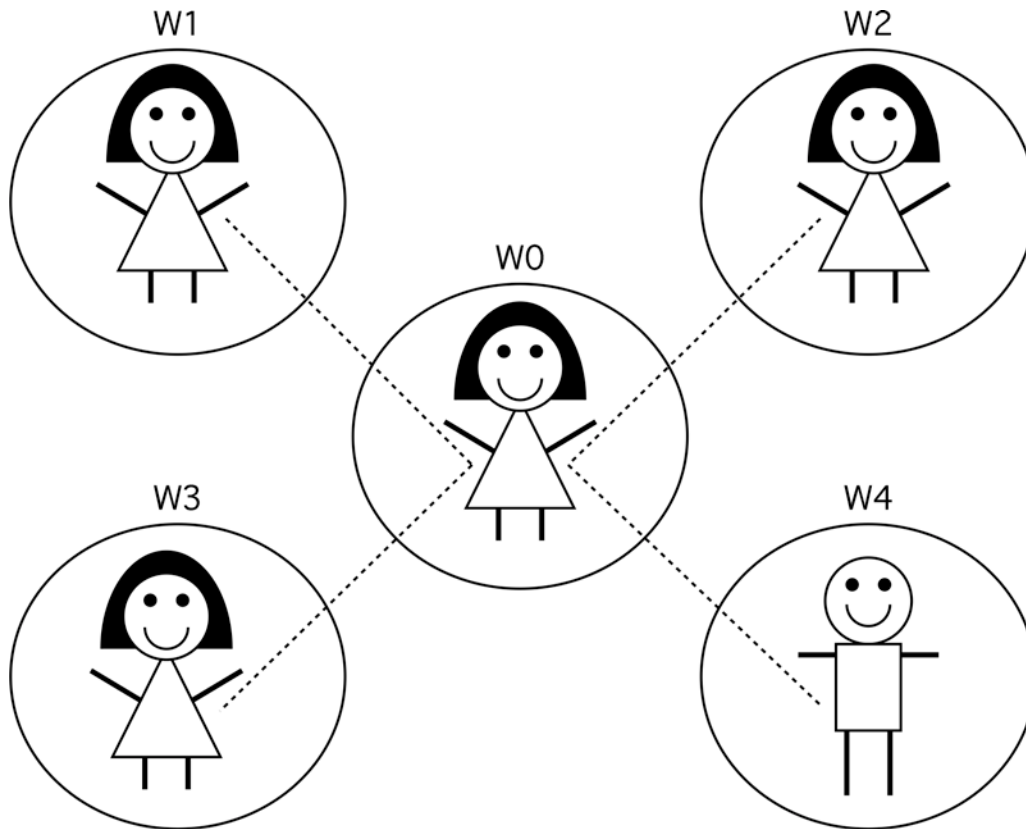
In this model, Sue exists at W0.

Questions (true or false)

Sue has a counterpart at every other world. (True)

It is necessary that Sue exists. (True)

It is necessary that Sue is happy. (True)

It is necessary that Sue is female. (False)

Sue is necessarily female. (False)

Sue is contingently female. (True)

Sue might be male. (True)