Exercise
Neural-symbolic Integration

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Task 1
Consider some logical theories formulated in NeSy frameworks like KBANN, DeepProbLog, LTN, NeurASP, LNN etc.:

a) Take those logical theories that are listed on the lecture slides.

b) Take those logical theories that you have provided for solutions to previous exercises.

Reformulate these logical theories in ULLER. Are there parts that cannot be expressed in the ULLER syntax? (See slide 39 for the ULLER syntax and slides 9, 14 and 17 for some examples.)

Task 2
Consider the semantics of logical theories in KBANN, DeepProbLog, LTN, NeurASP, LNN. Do these correspond to some of the three ULLER semantics, or are there differences that remain?

Task 3
Consider the implementation of the distribution monad in `distribution_monad.py`.

a) Run the examples

b) Modify the die to a biased die where the 6 is three times more likely than the other numbers. What are the outcomes? (Hint: use `weighted`)

c) Reformulate a modification of Example 4 in `distribution_monad.py` using the ULLER syntax. The modification is as follows: instead of returning the sum of the two dice rolls, test whether the sum is 12.

d) The code implements the unit η and a `bind` operation. How does this relate to lifting?