Example Application of Logic Programming

It’s Logic, not Magic!
Danger lies before you, while safety lies behind,
Two of us will help you, whichever you would find,
One among us seven will let you move ahead,
Another will transport the drinker back instead,
Two among our number hold only nettle wine,
Three of us are killers, waiting hidden in line.
Choose, unless you wish to stay here forevermore,
To help you in your choice, we give you these clues four:

First, however slyly the poison tries to hide
You will always find some on nettle wine's left side;

Second, different are those who stand at either end,
But if you would move onward, neither is your friend;

Third, as you see clearly, all are different size,
Neither dwarf nor giant holds death in their insides;

Fourth, the second left and second on the right
Are twins once you taste them, though different at first sight.
Constants

• wine, w1, w2, w3
• kill, k1, k2
• forward, f
• backward, b
Relations and Dataset

• bottle
  bottle(f)
bottle(b)
bottle(w1)
bottle(w2)
bottle(w3)
bottle(k1)
bottle(k2)

• function
  function(f,forward)
  function(b,backward)
  function(w1,wine)
  function(w2,wine)
  function(w3,wine)
  function(k1,kill)
  function(k2,kill)
View Definition

valid_assignment(B1,B2,B3,B4,B5,B6,B7):-
    bottle(B1) & bottle(B2) & bottle(B3) & bottle(B4) &
    bottle(B5) & bottle(B6) & bottle(B7)
valid_assignment(B1,B2,B3,B4,B5,B6,B7):-
bottle(B1) & bottle(B2) & bottle(B3) & bottle(B4) &
bottle(B5) & bottle(B6) & bottle(B7) & distinct(B1,B2) &
distinct(B1,B3) & distinct(B1,B4) & distinct(B1,B5) & distinct(B1,B6) &
distinct(B1,B7) & distinct(B2,B3) & distinct(B2,B4) & distinct(B2,B5) &
distinct(B2,B6) & distinct(B2,B7) & distinct(B3,B4) & distinct(B3,B5) &
distinct(B3,B6) & distinct(B3,B7) & distinct(B4,B5) & distinct(B4,B6) &
distinct(B4,B7) & distinct(B5,B6) & distinct(B5,B7) & distinct(B6,B7)
Clue 1

First, however slyly the poison tries to hide
You will always find some on nettle wine's left side;

\[
\text{poison\_to\_left}(X,Y) \leftarrow \text{bottle}(X) \& \text{bottle}(Y) \& \text{function}(X,\text{kill}) \& \text{function}(Y,\text{wine})
\]

\[
\text{poison\_to\_left}(X,Y) \leftarrow \text{bottle}(X) \& \text{bottle}(Y) \& \neg \text{function}(Y,\text{wine})
\]

\[
\text{clue1}(B1,B2,B3,B4,B5,B6,B7):-\]
\[
\text{valid\_assignment}(B1,B2,B3,B4,B5,B6,B7) \&
\text{poison\_to\_left}(B1,B2) \& \text{poison\_to\_left}(B2,B3) \&
\text{poison\_to\_left}(B3,B4) \& \text{poison\_to\_left}(B4,B5) \&
\text{poison\_to\_left}(B5,B6) \& \text{poison\_to\_left}(B6,B7)
\]
Clue 2

• Second, different are those who stand at either end,
  But if you would move onward, neither is your friend;

clue2(B1,B2,B3,B4,B5,B6,B7):-
  clue1(B1,B2,B3,B4,B5,B6,B7) &
  function(B1,A) & function(B7,B) & distinct(A,B) &
  distinct(B1,f) & distinct(B2,f)
Clue 3

• Third, as you see clearly, all are different size,
  Neither dwarf nor giant holds death in their insides;

\[
\text{clue3(B1,B2,B3,B4,B5,B6,B7):-}
\]
\[
\text{clue2(B1,B2,B3,B4,B5,B6,B7) &}
\]
\[
\text{~function(B2,kill) & ~function(B3,kill)}
\]
Clue 4

• Fourth, the second left and second on the right are twins once you taste them, though different at first sight.

clue4(B1,B2,B3,B4,B5,B6,B7):-
  clue3(B1,B2,B3,B4,B5,B6,B7) &
  function(B2,C2) & function(B6,C6) & same(C2,C6)
Answer

answer(C1,C2,C3,C4,C5,C6,C7):-
  clue4(B1,B2,B3,B4,B5,B6,B7) &
  function(B1,C1) & function(B2,C2) & function(B3,C3) &
  function(B4,C4) & function(B5,C5) & function(B6,C6) &
  function(B7,C7)

answer(poison, wine, forward, poison, poison, wine, backward)
Exercise

• What if you did not know the positions of the dwarf and the giant?
  • It is indeed possible to solve this puzzle without the third clue