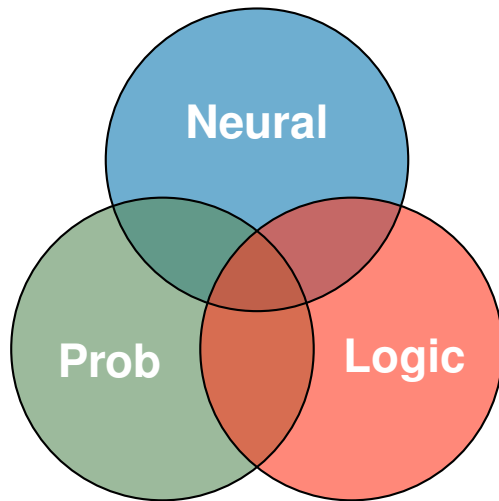


An Online Interpreter for

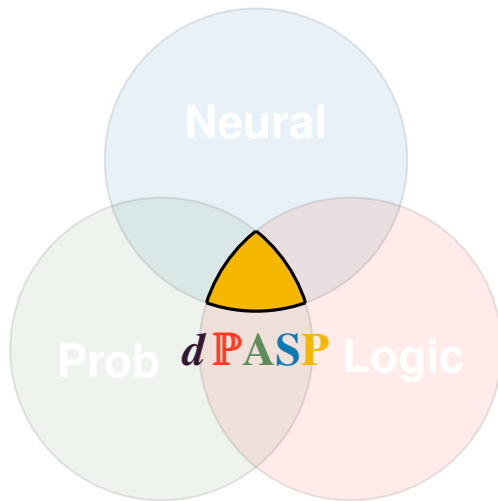
d **P** **A** **S** **P**

Differentiable Probabilistic Answer Set Programming
For Neurosymbolic Learning and Reasoning

Renato Lui Geh, Jonas Gonçalves, Igor Cataneo Silveira,
Denis Deratani Mauá, Fabio Gagliardi Cozman

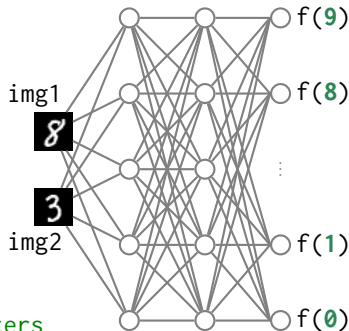


d **PASP** for Neurosymbolic Learning and Reasoning

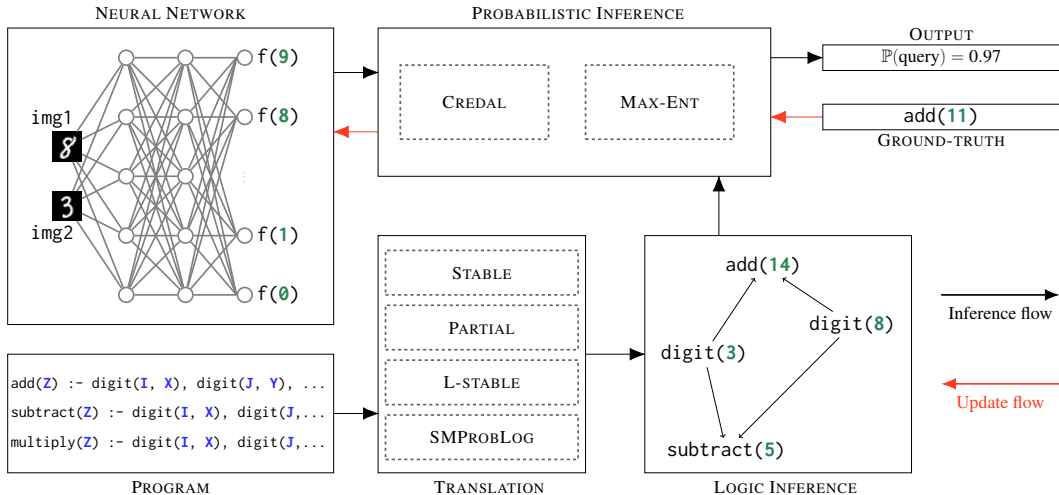


Example: Parsing arithmetic expressions, e.g. $X + Y = f(\text{8}) + f(\text{3}) = ?$

```
% neural rule
?::digit(Image, {0..9}) :- data(Image).
% data loaders -- interact with Python code
data(img1) ~ test(@mnist_test), train(@mnist_train).
data(img2) ~ test(@mnist_test), train(@mnist_train).
% prob. answer set program
add(Z) :- digit(I, X), digit(J, Y), Z = X + Y.
subtract(Z) :- digit(I, X), digit(J, Y), Z = X - Y.
multiply(Z) :- digit(I, X), digit(J, Y), Z = X * Y.
% learn the program end-to-end and pass learning parameters
#learn @mnist_sum, lr = 1., niters = 5, ..., batch = 1000.
% inference: what is the probability of  $X + Y = 14$  given  $X = 8$ ?
#query add(11) | digit(img1, 8).
```



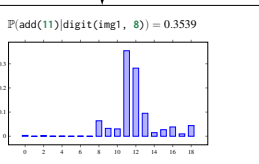
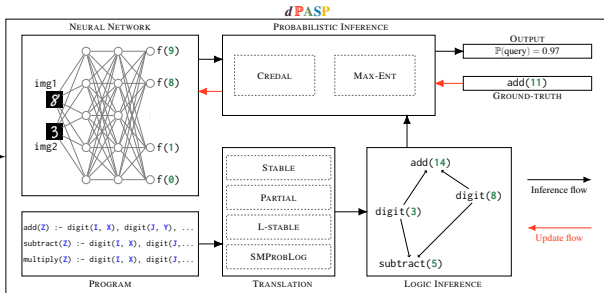
Semantics



An Online Editor and Interpreter for $d\mathbb{PASP}$

EDITOR

```
% neural rule
?::digit(Image, {0..9}) as @digit_net :- data(Image).
% data loaders -- interact with Python code
data(img1) ~ test(@mnist_test), train(@mnist_train).
data(img2) ~ test(@mnist_test), train(@mnist_train).
% prob. answer set program
add(Z) :- digit(I, X), digit(J, Y), Z = X + Y.
subtract(Z) :- digit(I, X), digit(J, Y), Z = X - Y.
multiply(Z) :- digit(I, X), digit(J, Y), Z = X * Y.
% learn the program end-to-end and pass learning parameters
#learn @mnist_sum, lr = 1., niters = 5, ..., batch = 1000.
% inference: what is the probability of X + Y = 14 given X = 8?
#query add(11) | digit(img1, 8).
```



OUTPUT

An Online Interpreter for

d **P** **A** **S** **P**

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