Dipper: A LARS-Based Stream Reasoner

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WHY LARS?

- Declarative and expressive rule-based logic
- Flexible abstraction from time
How to extend LARS

• Only ground cases
• Partition-based window
• Fixed size windows
New LARS Fragment

- LARS Variables
- Time Variables
- Constant Variables
- Predicate-based window
- Variable-size windows
Non-ground LARS example

\[ \text{head}(X, Z) \leftarrow \bigoplus_{t}^{1,1,1} p(X, Y) \land \bigoplus_{\#}^{1,0} q(Y, Z) \]
New LARS Fragment

- Operators with variables as argument
Variables in Operators

example

\[\text{head}(X, Z) \leftarrow \bigoplus_t^1,1,1 \diamond p(X, Y) \land \bigoplus_#^{1,0} \diamond q(Y, Z)\]

\[\text{head}(X, Z) \leftarrow \bigoplus_t^{T,1,1} \diamond p(X, Y) \land \bigoplus_#^{1,0} \diamond q(Y, Z)\]

\[@_T\text{head}(X, Z) \leftarrow \bigoplus_t^{T,T',1} \diamond p(X, Y) \land \bigoplus_#^{1,0} \diamond q(Y, Z) \land T == T'\]

\[@_{T''}\text{head}(X, Z) \leftarrow \bigoplus_t^{T,T',1} \diamond p(X, Y) \land \bigoplus_#^{1,0} @_{T''} \diamond q(Y, Z) \land T == T'\]
Variables in Operators

eexample 2

\[ \@_T \text{head}(X, Z) \leftarrow \bigotimes^T_{t} 1,1 \diamond p(T, Y) \land \bigotimes^1_{\#} 0 \diamond q(Y, Z) \]

\[ \text{head}(X, Y) \leftarrow \bigotimes^1_{t} 1,1 \diamond p(T) \land \bigotimes^T_{t} 0,0 \diamond q(X, Y) \]
Predicate Window Operator

- Partition-based window is too complex/unclear
- Predicate-based window captures tuples with specific predicate
Predicate Window Operator
Example

\[
time(T) \leftarrow \bigoplus_{p}^{x} \bigoplus_{#}^{1,0} @_{T} x
\]

\[
Ok \leftarrow \bigoplus_{t}^{T,0,1} \Diamond z \land time(T)
\]
Open World Assumption

&

Negation

\[ \text{head}(X, Z) \leftarrow \bigoplus_t^{1,1,1} p(X, Y) \land \bigoplus_\#^{1,0} \neg q(Y, Z) \]
Open World Assumption
&
Negation (our solution)

\[
head(X, Z) \leftarrow \bigoplus_{t}^{1,1,1} p(X, Y) \land \bigoplus_{\#}^{1,0} \neg q(Y)
\]
Open World Assumption
&
Disjunction

\[ \text{head}(X, Z) \leftarrow \square_t^{1,1,1} \Diamond p(X, Y) \lor \square_\#^{1,0} \Diamond q(Y, Z) \]
Open World Assumption
&
Disjunction

• We do not allow non-ground disjunction
Current/Future Work

- A basic proof-of-concept of the new LARS
- More formal definition of semantics
- Parallel/Distributed implementation
- Performance/Scalability evaluation