Hero Net Interpreter

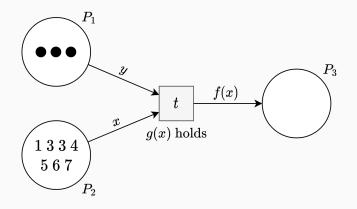
Final presentation

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Hero net foundations

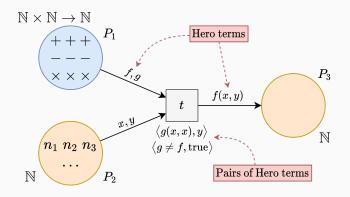
From Predicate nets...



- How to model and execute **Hero nets**?
- Started with a library for Predicate Nets

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... to Hero nets



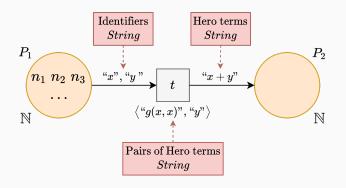
• Token: set of values

• Transition arc: multiset of Hero terms

• Guard: set of pairs of Hero terms

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Alpine integration with Hero nets



- Token: set of values (Values)
- Inbound arc: set of variable identifiers (String)
- Outbound arc: set of Hero terms (String)
- Guard: set of pairs of Hero terms (String, String)

Alpine interpreter modifications

- Input expression:
 - Ex: "f(x, g(y)) or y"
 - Type: String
- Input binding:
 - \bullet Ex: {"f" -> and, "g" -> not, "x" -> true, "y" -> false}
 - Type: [String: Value]
- Output: evaluation of the expression after substitutions
 - Ex: true
 - Type: Value

Evaluation (1/2)

- 1. Parse the input expression into an untyped AST
 - "f", "g", "x" and "y" are Ident nodes
- 2. Substitute the Ident nodes with AST nodes extracted from values
- 3. Create the scopes and symbols to be associated with the AST nodes
- 4. Bind symbols to their respective scope
- 5. Find constraints over symbol types and solve them
- 6. Evaluate the typed AST with the corresponding evaluation contexts

Evalution (2/2)

- Value's type can be a:
 - <u>Built-in one</u>: Bool, Int, Real, String, ([Any]) -> Any
 - Tuple: (Tuple, [Value])
 - Func: (Func, EvaluationContext)
- Tuple and Func are AST nodes, associated with a module, symbols and scopes

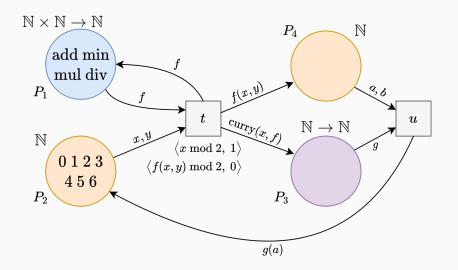


Difficulties

- Little to no experience with Swift
- At first no clear understanding of the different sub-steps
- Explored up some bad leads (e.g. making Scope, Symbol and every AST nodes conform to NSCopying)
- The evaluation context maps symbols to values, while the runSema() part works with scopes and symbols
- The module associated with scopes and every AST nodes was being deinitialized after the evaluation

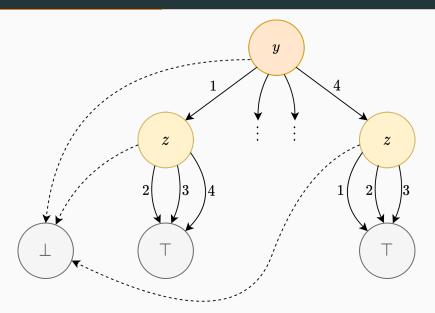


Operational Hero net interpreter

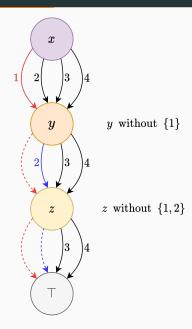


Efficient Hero net interpreter

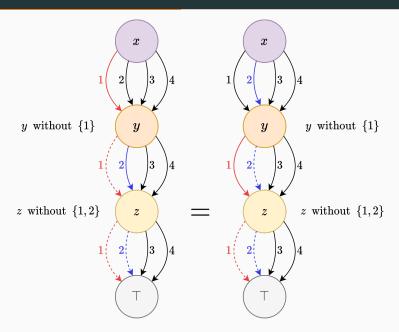
MFDD bindings



MFDD bindings: new method (1/2)



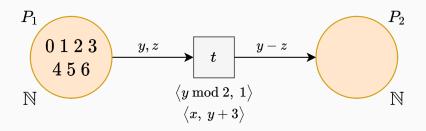
MFDD bindings: new method (2/2)



MFDD: fusion

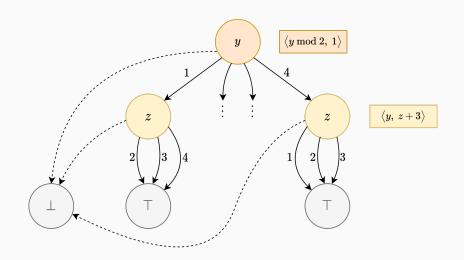
Algorithm 1: Combining MFDDs representing permutations Input: lhs, rhs Output: Fusion of lhs and rhs **Function** fusion(*lhs. rhs*): if lhs = one then return rhs else if rhs = one then return lhs **if** *lhs.key* > *rhs.key* **then** return fusion(rhs, lhs) return node(lhs.key, lhs.take.mapValue { fusion(\$0, rhs) } zero)

Guards: simple strategy



- 1. Explore the MFDD until we find all the needed variables
- 2. Evaluate the two expressions with the resulting binding
- 3. Prune node if not equal

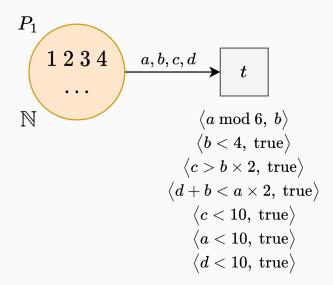
Guards: example



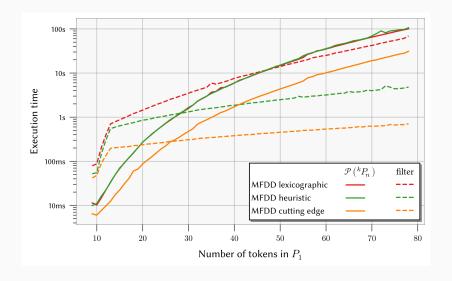
Several improvements

- Add a cache mechanism to
 - Fusion
 - Guard filtering
 - Alpine evalution
- Variable and guard ordering
 - Variables appearing in guards are put at the top
 - Of these variables, those in the guards with the smallest number of different variables have the smallest index
 - Guards featuring the fewest number of variables with the smallest indexes are checked first

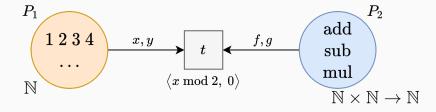
Benchmark: lots of conditions (1/2)



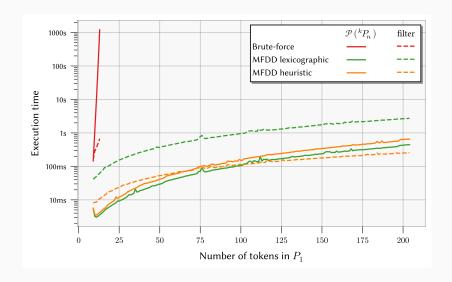
Benchmark: lots of conditions (2/2)



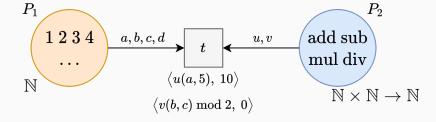
Benchmark: simple Hero net (1/2)



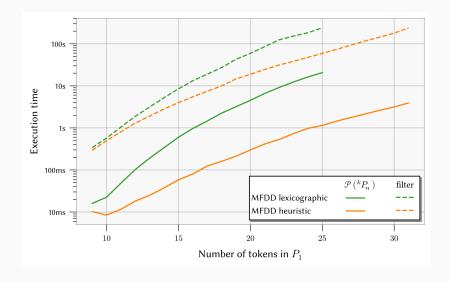
Benchmark: simple Hero net (2/2)



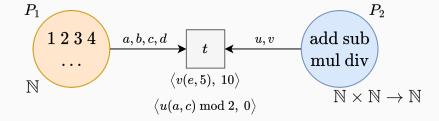
Benchmark: in order (1/2)



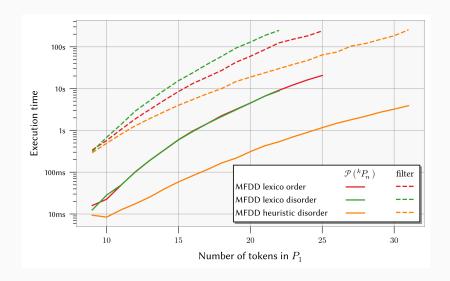
Benchmark: in order (2/2)



Benchmark: in disorder (1/2)



Benchmark: in disorder (2/2)



There is room for improvement!

- Clean the code
- Better caching mechanisms (especially with Alpine)
- Better variable ordering
- Better guard filtering (parse ASTs)
- Combine MFDD initial construction and guard filtering

Thank you!