On Applying Program Transformation to Implement Suspension-Based Tabling in Prolog

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Tabling Implementations

- The common approach used to include tabling support into existing Prolog systems is to modify and **extend the low-level engine**.
  - More efficient implementations.
  - Not easily portable to other Prolog systems (requires changing important components of the system).

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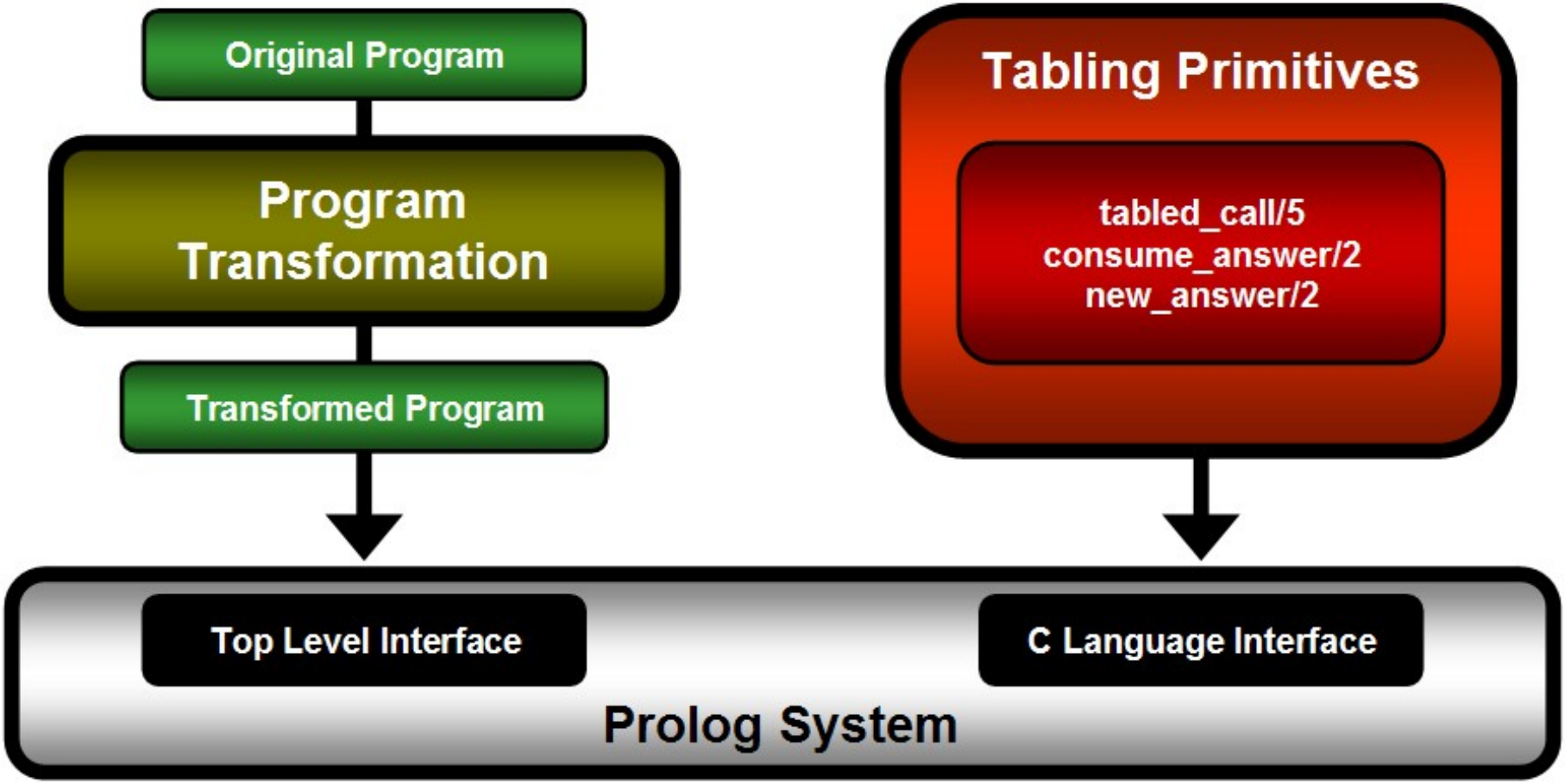
- A different approach is to **apply source level transformations** to a tabled program and then use **external tabling primitives** to implement tabled evaluation.
  - Source level transformations can be written in Prolog.
  - Tabling primitives can be implemented using the C language interface available in most Prolog systems.
  - Less efficient implementations.

Our Approach

- A suspension-based tabling mechanism based on program transformation with tabling primitives implemented in C.



Our Approach

- The program transformation module is fully **written in Prolog**.
- The tabling primitives module uses the C language interface of the Yap Prolog system. It implements a **local scheduling** search strategy and uses **tries** to implement the table space.
- Suspension is implemented by leaving the **continuation call** for the current computation in the table entry corresponding to the variant call being suspended. During this process and as further new answers are found, they are stored in their tables and returned to all variant calls by calling the previously stored continuation calls.

Program Transformation

```
% original tabled predicate
p(X,Z) :- e(X,Y), p(Y,Z).
p(X,Z) :- e(X,Z).


% transformed predicate
p(X,Z) :- tabled_call(p(X,Z),Sid,_,p0,true),
          consume_answer(p(X,Z),Sid).

p0(p(X,Z),Sid) :- e(X,Y), tabled_call(p(Y,Z),Sid,[X,Z,Y],p0,p1).
p1(p(Y,Z),Sid,[X,Z,Y]) :- new_answer(p(X,Z),Sid).

p0(p(X,Z),Sid) :- e(X,Z), new_answer(p(X,Z),Sid).
```

Experimental Results

- We ran our approach against the YapTab system that implements tabling support at the low-level engine. YapTab also implements a suspension-based mechanism, uses tries to implement the table space and is implemented on top of Yap.

Predicate	Binary Tree			Cycle			Grid		
	12	14	16	200	300	400	10x10	15x15	20x20
p_right_first/2	4.00	3.73	3.62	4.36	3.99	3.89	7.75	6.41	6.11
p_right_last/2	3.73	3.59	3.70	4.56	4.00	3.98	8.55	6.27	6.42
p_left_first/2	**2.65**	**2.39**	**2.34**	**3.05**	**2.65**	**2.26**	**3.11**	**2.46**	**2.12**
p_left_last/2	5.00	4.31	4.25	5.13	4.34	4.24	5.67	4.73	4.15
p_doubly_first/2	8.13	7.72	7.68	10.45	11.57	11.22	10.34	9.66	10.40
p_doubly_last/2	15.05	13.96	13.68	20.36	22.23	21.72	19.74	18.25	19.53

Overheads over the YapTab running times

Concluding Remarks

- As expected, YapTab outperformed our mechanism in all programs tested. Best performance was achieved for left recursive tabled predicates with the recursive clause first, with an average overhead between 2 and 3.
- Considering that Yap and YapTab are two of the fastest Prolog and tabling engines currently available, these results are very interesting and very promising.
- We thus argue that our approach is a good alternative to incorporate tabling into other Prolog systems with a C language interface. Currently, we have already a port of our implementation running as a module of the Ciao Prolog system [CICLOPS 2007].