Case Study on Polymorphic Type Inference using Prolog

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Abstract. A succinct, declarative, and machine executable specification of the Hindley–Milner type system (HM) can be formulated using logic programming languages such as Prolog. Modern functional language implementations such as the Glasgow Haskell Compiler supports more extensive flavors of polymorphism (e.g., type constructor polymorphism, nested datatypes, kind polymorphism) beyond Milner's theory of type polymorphism in late '70s. In this case study, we progressively extends the Prolog specification of HM to include support for more advanced type system features. An interesting development in our series of Prolog specifications is that extending dimensions of polymorphism resulted in a multi-staged solution: resolve the typing relations first, while delaying to resolve kinding relations, and then resolve the delayed kinding relations. We believe our case study provides a motivating example for developing theories and tools in logic programming that provide better support for staged resolution of different relations at different levels.

Keywords: Hindley–Milner, logic programming, Prolog, type inference, unification, type system, polymorphism, algebraic datatype, functional language, nested datatype, GADTs, generalized algebraic datatype

1 Introduction

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1.1 TODO

1.2 TODO

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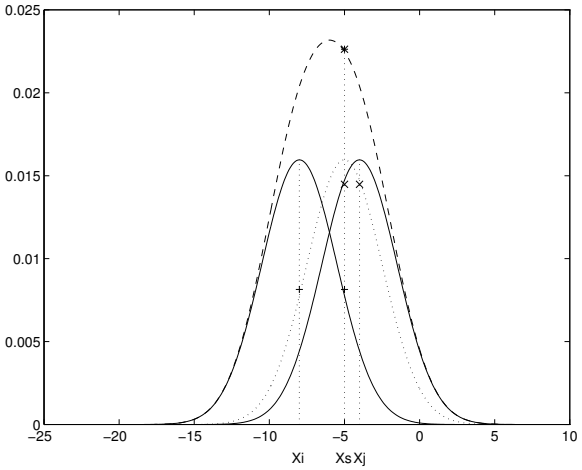

Fig. 1. One kernel at x_s (*dotted kernel*) or two kernels at x_i and x_j (*left and right*) lead to the same summed estimate at x_s. This shows a figure consisting of different types of lines. Elements of the figure described in the caption should be set in italics, in parentheses, as shown in this sample caption.

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$$\psi(u) = \int_o^T \left[\frac{1}{2} \left(\Lambda_o^{-1} u, u \right) + N^*(-u) \right] dt \; . \tag{1}$$

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Program listings or program commands in the text are normally set in typewriter font, e.g., CMTT10 or Courier.

Example of a Computer Program

```
program Inflation (Output)
  {Assuming annual inflation rates of 7%, 8%, and 10%,...
   years};
   const
     MaxYears = 10;
   var
     Year: 0..MaxYears;
     Factor1, Factor2, Factor3: Real;
   begin
     Year := 0;
     Factor1 := 1.0; Factor2 := 1.0; Factor3 := 1.0;
     WriteLn('Year  7% 8% 10%'); WriteLn;
     repeat
       Year := Year + 1;
       Factor1 := Factor1 * 1.07;
       Factor2 := Factor2 * 1.08;
       Factor3 := Factor3 * 1.10;
       WriteLn(Year:5,Factor1:7:3,Factor2:7:3,Factor3:7:3)
     until Year = MaxYears
end.
```

(Example from Jensen K., Wirth N. (1991) Pascal user manual and report. Springer, New York)

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