
HW 6 – Polymorphic Type Inference

CS 421 – Fall 2015

Revision 1.0

Assigned September 29, 2015

Due October 30, 2015, 23:59 pm

Extension 48 hours (20% penalty)

1 Change Log

1.0 Initial Release.

2 Turn-In Procedure

Answer the problem below, save your work as a PDF (either scanned if handwritten or converted from a program), and hand in the PDF. Your file should be named `hw6-submission.pdf`.

3 Objectives and Background

The purpose of this HW is to test your understanding of how to use typing rules to perform polymorphic type derivations in a functional programming language (here with OCaml syntax). Another purpose of HWs is to provide you with experience answering non-programming written questions of the kind you may experience on the midterms and final.

4 Problems

(22 points) Give a complete type derivation for the following typing judgment.

```
let x = 3 in let id = (fun x -> x) in (id id) x
```

As a suggestion for formatting, you may want to name subtrees of the proof and write them out separately. Note, we are asking for a type derivation not the intermediate states of a type inferencing algorithm.

Solution:

Let

- L stand for the Let-In Rule
- V stand for the Variable Rule,
- C standfor the Constant Rule,
- I stand for the If-Then-Else Rule,
- F stand for the Function Rule,
- A stand for the Application Rule and
- P for the Primitive Operation Rule.

$$\begin{array}{c}
\frac{\frac{\frac{}{\{x:a\} \vdash x:a} V}{\{x:int\} \vdash (fun\ x \rightarrow x): \alpha \rightarrow \alpha} F}{\{ \} \vdash 3:int} C \quad \frac{\frac{\frac{\frac{\frac{}{\{x:int, id:\forall \alpha \rightarrow \alpha\} \vdash id:(int \rightarrow int) \rightarrow (int \rightarrow int)} V}{\{x:int, id:\forall \alpha \rightarrow \alpha\} \vdash id:int \rightarrow int} V}{\{x:int, id:\forall \alpha \rightarrow \alpha\} \vdash (id\ id):int \rightarrow int} A}{\{x:int, id:\forall \alpha \rightarrow \alpha\} \vdash (id\ id)\ x:int} A \quad \frac{\frac{\frac{}{\{x:int, id:\forall \alpha \rightarrow \alpha\} \vdash x:int} V}{\{x:int, id:\forall \alpha \rightarrow \alpha\} \vdash x:int} A}{\{x:int\} \vdash let\ id = (fun\ x \rightarrow x) \text{ in } (id\ id)\ x:int} L \\
\hline
\{ \} \vdash let\ x = 3 \text{ in } let\ id = (fun\ x \rightarrow x) \text{ in } (id\ id)\ x:int \quad L
\end{array}$$