Hazel Assistant Calculus WIP

Andrew Blinn
University of Michigan, USA
blinnand@umich.edu

Cyrus Omar
University of Michigan, USA
comar@umich.edu

Abstract

The hazelnut assistant calculus provides an extensible framework for type- and value-directed completion and refactoring support in a structured editing context.

CCS Concepts: • **Software and its engineering → General programming languages**.

Keywords: live programming, code completion, refactoring, GUIs

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wazzzzzaaaaaaaaaaaaaaaaaaaaa

1 Assistant Calculus

blah blah blah types

TODOs:

- ~~get cursor icons from hazelnut paper~~
- ~~get right arrow for bidi~~
- ~~basic zipper cases~~
- remaining zipper cases
- ~~var + varapp~~
- NOTE: we basically need a construct expression action for varapp
- ~~proj~~ NOT SURE THIS IS QUITE RIGHT...
- ~~base case for hole~~
- ~~base cases for non-empty holes, incld:~~
- ~~delete + act for general hexps~~
- ~~simple wrap for exprs incld. non-empty-holes~~
- complex (n-ary) wraps
- iterated wraps? with cutoffs? (:jean-shorts-emoji)
- are there non-empty-hole suggests distinct from arbitrary expr suggests?

$\boxed{\Gamma \vdash \hat{e} \Rightarrow \tau \curvearrowright \mathrm{A}}$ e synthesizes τ, suggesting actions A

$\boxed{\Gamma \vdash \hat{e} \Leftarrow \tau \curvearrowright \mathrm{A}}$ e analyzes against τ, suggesting actions A

$$\frac{\Gamma \vdash e \Leftarrow \tau_2 \qquad \Gamma \vdash \hat{e} \Leftarrow \tau_1 \curvearrowright \mathrm{A}}{\Gamma \vdash (\hat{e}, e) \Rightarrow \tau_1 \times \tau_2 \curvearrowright \mathrm{A}}$$

$$\frac{\Gamma \vdash \hat{e} \Rightarrow \tau_1 \curvearrowright \mathrm{A} \qquad \tau_1 \blacktriangleright_{\rightarrow} \tau_2 \rightarrow \tau \qquad \Gamma \vdash e \Leftarrow \tau_2}{\Gamma \vdash \hat{e}(e) \Rightarrow \tau \curvearrowright \mathrm{A}}$$

$$\frac{\tau \blacktriangleright_{\rightarrow} \tau_1 \rightarrow \tau_2 \qquad \Gamma \vdash \hat{e} \Leftarrow \tau \curvearrowright \mathrm{A}}{\Gamma \vdash \lambda x.\hat{e} \Leftarrow \tau \curvearrowright \mathrm{A}}$$

Figure 1. Suggestion Zipper Cases

Suggest Hole Analytic

$$\frac{\mathsf{Intros}(\tau) \curvearrowright \mathrm{A}_{intros} \qquad \mathsf{Elims}(\Gamma, \tau) \curvearrowright \mathrm{A}_{elims}}{\Gamma \vdash \triangleright(\!|\,|\!)\triangleleft \Leftarrow \tau \curvearrowright \mathrm{A}_{intros} \cup \mathrm{A}_{elims}}$$

Suggest Expr Analytic

$$\frac{\mathsf{Wraps}(e, \tau) \curvearrowright \mathrm{A}_{wraps} \qquad \mathsf{Replaces}(\Gamma, \tau) \curvearrowright \mathrm{A}_{replaces}}{\Gamma \vdash \triangleright e \triangleleft \Leftarrow \tau \curvearrowright \mathrm{A}_{wraps} \cup \mathrm{A}_{replaces}}$$

Replacement

$$\frac{\Gamma \vdash \triangleright(\!|\,|\!)\triangleleft \Leftarrow \tau \curvearrowright \mathrm{A}}{\mathsf{Replaces}(\Gamma, \tau) \curvearrowright \{\mathtt{del}\ ;\ \alpha \mid \alpha \in \mathrm{A}\}}$$

Wrapping (simple)

$$\frac{\Gamma \vdash e \Rightarrow \tau'}{\mathsf{Wraps}(e, \tau) \curvearrowright \{\mathtt{construct}\ f(e) \mid f : \tau' \rightarrow \tau \in \Gamma\}}$$

Figure 2. Suggestion base cases

References

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$$\textsc{IntrosTriv}\ \frac{}{\mathsf{Intros}(1) \curvearrowright \{\texttt{construct triv}\}}$$

$$\textsc{IntrosProd}\ \frac{}{\mathsf{Intros}(\tau_1 \times \tau_2) \curvearrowright \{\texttt{construct pair}\}}$$

$$\textsc{IntrosArrow}\ \frac{}{\mathsf{Intros}(\tau_1 \to \tau_2) \curvearrowright \{\texttt{construct lam x}\}}$$

$$\textsc{IntrosSum}\ \frac{}{\mathsf{Intros}(\tau_1 + \tau_2) \curvearrowright \texttt{construct inj L}, \texttt{construct inj R}}$$

Figure 3. Introduction suggestions

$$\textsc{Suggest Elims}\ \frac{\begin{array}{cc}\mathsf{ElimCase} \curvearrowright \mathrm{A}_{case} & \mathsf{Var}(\Gamma,\tau) \curvearrowright \mathrm{A}_{var} \\ \mathsf{VarApp}(\Gamma,\tau) \curvearrowright \mathrm{A}_{varapp} & \mathsf{Proj}(\Gamma,\tau) \curvearrowright \mathrm{A}_{proj}\end{array}}{\mathsf{Elims}(\Gamma,\tau) \curvearrowright \mathrm{A}_{case} \cup \mathrm{A}_{var} \cup \mathrm{A}_{varapp} \cup \mathrm{A}_{proj}}$$

$$\textsc{ElimCase}\ \frac{}{\mathsf{ElimCase} \curvearrowright \{\texttt{construct case x y}\}}$$

$$\textsc{Var}\ \frac{}{\mathsf{Var}(\Gamma,\tau) \curvearrowright \{\texttt{construct var x} \mid x : \tau \in \Gamma\}}$$

$$\textsc{VarApp}\ \frac{}{\mathsf{VarApp}(\Gamma,\tau) \curvearrowright \{\texttt{construct e} \mid \Gamma, x : \tau \vdash x \rightsquigarrow e \Leftarrow \tau\}}$$

$$\textsc{Proj}\ \frac{}{\mathsf{Proj}(\Gamma,\tau) \curvearrowright \{\texttt{construct e} \mid \Gamma, x : \tau \vdash x \twoheadrightarrow e \Leftarrow \tau\}}$$

Figure 4. Elimination suggestions

$$\boxed{\Gamma \vdash e \rightsquigarrow e' \Leftarrow \tau}$$

e, applied to 0 or more holes, yields an expr analyzing to τ

$$\boxed{\Gamma \vdash e \twoheadrightarrow e' \Leftarrow \tau}$$

e, projected 0 or more times, yields an expr analyzing to τ

$$\textsc{VarApp1}\ \frac{\Gamma \vdash e \Rightarrow \tau}{\Gamma \vdash e \rightsquigarrow e \Leftarrow \tau}$$

$$\textsc{VarApp2}\ \frac{\Gamma \vdash e \Rightarrow \_ \to \_ \qquad \Gamma \vdash e(\langle\!|\rangle) \rightsquigarrow e' \Leftarrow \tau}{c}$$

$$\textsc{Proj1}\ \frac{\Gamma \vdash e \Rightarrow \tau}{\Gamma \vdash e \twoheadrightarrow e \Leftarrow \tau} \qquad \textsc{Proj2}\ \frac{\Gamma \vdash e \Rightarrow \tau \times \tau' \qquad \Gamma \vdash \pi_1 e \twoheadrightarrow e' \Leftarrow \tau}{\Gamma \vdash e \twoheadrightarrow e' \Leftarrow \tau}$$

$$\textsc{Proj3}\ \frac{\Gamma \vdash e \Rightarrow \tau' \times \tau \qquad \Gamma \vdash \pi_2 e \twoheadrightarrow e' \Leftarrow \tau}{\Gamma \vdash e \twoheadrightarrow e' \Leftarrow \tau}$$

Figure 5. Supporting elimination judgments