

Hazel Assistant Calculus WIP

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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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wazzzzzaaaaaaaaaaaaaaaaaaaaaa

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? don't think so
- for all: change type to type consistency

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

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

$$\frac{\Gamma \vdash e_1 \Leftarrow \tau_2 \quad \Gamma \vdash \hat{e}_2 \Leftarrow \tau_1 \curvearrowright A}{\Gamma \vdash (\hat{e}_1, e_2) \Rightarrow \tau_1 \times \tau_2 \curvearrowright A}$$

$$\frac{\Gamma \vdash \hat{e} \Rightarrow \tau_1 \curvearrowright A \quad \tau_1 \blacktriangleright \tau_2 \rightarrow \tau \quad \Gamma \vdash e_2 \Leftarrow \tau_2}{\Gamma \vdash \hat{e}_1(e_2) \Rightarrow \tau \curvearrowright A}$$

$$\frac{\tau \blacktriangleright \tau_1 \rightarrow \tau_2 \quad \Gamma \vdash \hat{e} \Leftarrow \tau \curvearrowright A}{\Gamma \vdash \lambda x. \hat{e} \Leftarrow \tau \curvearrowright A}$$

Figure 1. Suggestion Zipper Cases

- for all: add numerical subscripts to types where missing
- fig 4: make it consistency not equal
- fig 5: change proj judgement to analysis
- fig 4: change varapp proj to have x in gamma, not gamma comma x
- consider matched product, matched arrow to suggest for unknown types
- above: not sure i want matched arrow type in fig 5? feels weirder to suggest an unknown typed var for fn than value...
- rankings:
- privilege more specific types
- read contextual modal types

References

$$\begin{array}{c}
\text{Suggest Hole Analytic} \\
\frac{\text{Intros}(\tau) \rightsquigarrow A_{\text{intros}} \quad \text{Elims}(\Gamma, \tau) \rightsquigarrow A_{\text{elims}}}{\Gamma \vdash \text{hole} \Leftarrow \tau \rightsquigarrow A_{\text{intros}} \cup A_{\text{elims}}} \\
\\
\text{Suggest Expr Analytic} \\
\frac{\text{Wraps}(e, \tau) \rightsquigarrow A_{\text{wraps}} \quad \text{Replaces}(\Gamma, \tau) \rightsquigarrow A_{\text{replaces}}}{\Gamma \vdash e \Leftarrow \tau \rightsquigarrow A_{\text{wraps}} \cup A_{\text{replaces}}} \\
\\
\text{Replacement} \\
\frac{\Gamma \vdash \text{hole} \Leftarrow \tau \rightsquigarrow A}{\text{Replaces}(\Gamma, \tau) \rightsquigarrow \{\text{del} ; \alpha \mid \alpha \in A\}} \\
\\
\text{Wrapping (simple)} \\
\frac{\Gamma \vdash e \Rightarrow \tau_e \quad \tau_e \sim \tau'}{\text{Wraps}(e, \tau) \rightsquigarrow \{\text{construct } f(e) \mid f : \tau' \rightarrow \tau \in \Gamma\}}
\end{array}$$

Figure 2. Suggestion base cases

$$\begin{array}{c}
\text{IntrosTriv} \\
\frac{\tau \sim 1}{\text{Intros}(\tau) \rightsquigarrow \{\text{construct triv}\}} \\
\\
\text{IntrosProd} \\
\frac{\tau \sim \tau_1 \times \tau_2}{\text{Intros}(\tau) \rightsquigarrow \{\text{construct pair}\}} \\
\\
\text{IntrosArrow} \\
\frac{\tau \sim \tau_1 \rightarrow \tau_2}{\text{Intros}(\tau) \rightsquigarrow \{\text{construct lam } x\}} \\
\\
\text{IntrosSum} \\
\frac{\tau \sim \tau_1 + \tau_2}{\text{Intros}(\tau) \rightsquigarrow \{\text{construct inj L, construct inj R}\}}
\end{array}$$

Figure 3. Introduction suggestions

$$\begin{array}{c}
\text{Suggest Elims} \\
\frac{\text{ElimCase} \rightsquigarrow A_{\text{case}} \quad \text{Var}(\Gamma, \tau) \rightsquigarrow A_{\text{var}} \quad \text{AppProj}(\Gamma, \tau) \rightsquigarrow A_{\text{varapp}}}{\text{Elims}(\Gamma, \tau) \rightsquigarrow A_{\text{case}} \cup A_{\text{var}} \cup A_{\text{varapp}} \cup A_{\text{proj}}} \\
\\
\text{ElimCase} \\
\frac{}{\text{ElimCase} \rightsquigarrow \{\text{construct case } x \ y\}} \\
\\
\text{Var} \\
\frac{\tau \sim \tau'}{\text{Var}(\Gamma, \tau) \rightsquigarrow \{\text{construct var } x \mid x : \tau' \in \Gamma\}} \\
\\
\text{AppProj} \\
\frac{\tau \sim \tau'}{\text{VarApp}(\Gamma, \tau) \rightsquigarrow \{\text{construct } e \mid x : \tau' \in \Gamma \wedge \Gamma \vdash x \rightsquigarrow e \Leftarrow \tau\}}
\end{array}$$

Figure 4. Elimination suggestions

$$\begin{array}{c}
\boxed{\Gamma \vdash e \rightsquigarrow e' \Leftarrow \tau} \text{ } e, \text{ applied to 0 or more holes, and projected 0 or more times,} \\
\text{yields an expr analyzing to } \tau \\
\frac{\text{AppProjBase} \quad \Gamma \vdash e \Leftarrow \tau}{\Gamma \vdash e \rightsquigarrow e \Leftarrow \tau} \\
\\
\text{App} \\
\frac{\Gamma \vdash e \Rightarrow \tau' \quad \tau' \triangleright_{\rightarrow} _ \rightarrow _ \quad \Gamma \vdash e(\text{hole}) \rightsquigarrow e' \Leftarrow \tau}{\Gamma \vdash e \rightsquigarrow e' \Leftarrow \tau} \\
\\
\text{Proj1} \\
\frac{\Gamma \vdash e \Rightarrow \tau' \quad \tau' \triangleright_{\times} \tau \times _ \quad \Gamma \vdash \pi_1 e \rightsquigarrow e' \Leftarrow \tau}{\Gamma \vdash e \rightsquigarrow e' \Leftarrow \tau} \\
\\
\text{Proj2} \\
\frac{\Gamma \vdash e \Rightarrow \tau' \quad \tau' \triangleright_{\times} _ \times \tau \quad \Gamma \vdash \pi_2 e \rightsquigarrow e' \Leftarrow \tau}{\Gamma \vdash e \rightsquigarrow e' \Leftarrow \tau}
\end{array}$$

Figure 5. Supporting elimination judgments