1 Fun Syntax

K	$:=$	$\texttt{Nil}, \texttt{Cons}, \texttt{Tup}$	*Constructors*
D	$:=$	$\texttt{hd}, \texttt{tl}, \texttt{fst}, \texttt{snd}$	*Destructors*
F	$:=$	$\textbf{def } f(\overline{x}; \overline{\alpha}) := t$	*Definitions*
t	$:=$		*Terms*
		x	*Variables*
		$\ulcorner n \urcorner$	*Literals*
		$t \odot t$	*Binary Operations*
		$\textbf{ifz}(t, t, t)$	*Zero Conditional*
		$\textbf{let } x := t \textbf{ in } t$	*Let-Bindings*
		$f(\bar{t}; \overline{\alpha}) := t$	*Top-Level Calls*
		$K(\bar{t})$	*Constructors*
		$\textbf{case } t \textbf{ of } \{\overline{K(\overline{x}) \Rightarrow t}\}$	*Case Expressions*
		$t.D(\bar{t})$	*Destructors*
		$\textbf{cocase}\{\overline{D(\overline{x}) \Rightarrow t}\}$	*Cocase Expressions*
		$\lambda x.t$	*Lambda-Abstractions*
		$t\ t$	*Function Applications*
		$\textbf{label } \alpha\ \{t\}$	*Labels*
		$\textbf{Goto}(t; \alpha)$	*Goto*

2 AxCore Syntax

K	$:=$	$\texttt{Nil}, \texttt{Cons}, \texttt{Tup}$	*Constructors*
D	$:=$	$\texttt{hd}, \texttt{tl}, \texttt{fst}, \texttt{snd}, \texttt{ap}$	*Destructors*
F	$:=$	$\textbf{def } f(\overline{x}; \overline{\alpha}) := s$	*Definitions*
p	$:=$		*Producers*
		x	*Variables*
		$\ulcorner n \urcorner$	*Literals*
		$\mu\alpha.s$	*$\mu -$ Abstractions*
		$K(\overline{p}; \overline{c})$	*Constructors*
		$\textbf{cocase}\{\overline{D(\overline{x}; \overline{\alpha})) \Rightarrow s}\}$	*Cocase expressions*
c	$:=$		*Consumers*
		α	*Covariables*
		$\tilde{\mu}x.s$	*$\tilde{\mu} -$ Abstractions*
		$D(\overline{p}; \overline{c})$	*Destructors*
		$\textbf{case}\{\overline{C(\overline{x}; \overline{\alpha}) \Rightarrow s}\}$	*Case-Expressions*
s	$:=$		*Statements*
		$\langle p \mid c \rangle$	*Cuts*
		$\odot(p, p; c)$	*Binary Operations*
		$\textbf{ifz}(p; s, s)$	*Zero Conditional*
		$f(\overline{p}; \overline{c})$	*Top-level Calls*
		$\textbf{Done}$	*End of computation*

3 Translation

$$\llbracket \cdot \rrbracket : \texttt{Fun} \to \texttt{AxCore}$$

$$\begin{array}{lcr}
\llbracket \textbf{def } f(\overline{x};\overline{\alpha}) \coloneqq t \rrbracket & \coloneqq & \textbf{def } f(\overline{x};\overline{\alpha},\alpha) \coloneqq \langle \llbracket t \rrbracket \mid \alpha \rangle \\
 & & \\
\llbracket x \rrbracket & \coloneqq & x \\
\llbracket n \rrbracket & \coloneqq & n \\
\llbracket t_1 \odot t_2 \rrbracket & \coloneqq & \mu\alpha. \odot (\llbracket t_1 \rrbracket, \llbracket t_2 \rrbracket; \alpha) \\
\llbracket \textbf{ifz}(t_1,t_2,t_3) \rrbracket & \coloneqq & \mu\alpha.\textbf{ifz}(\llbracket t_1 \rrbracket, \langle \llbracket t_2 \rrbracket \mid \alpha \rangle, \langle \llbracket t_3 \rrbracket \mid \alpha \rangle) \\
\llbracket \textbf{let } x \coloneqq t_1 \textbf{ in } t_2 \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t_1 \rrbracket \mid \tilde{\mu}x.\langle \llbracket t_2 \rrbracket \mid \alpha \rangle \rangle \\
\llbracket f(\overline{t_i};\overline{\alpha_j}) \rrbracket & \coloneqq & \mu\alpha.f(\overline{\llbracket t_i \rrbracket};\overline{\alpha_j},\alpha) \\
\llbracket K(\overline{t_i}) \rrbracket & \coloneqq & K(\overline{\llbracket t_i \rrbracket}) \\
\llbracket \textbf{case } t \textbf{ of } \{\overline{K_i(\overline{x_{i,j}}) \Rightarrow t_i}\} \rrbracket & \coloneqq & \mu\alpha \langle \llbracket t \rrbracket \mid \textbf{case } \{\overline{K_i(\overline{x_{i,j}}) \Rightarrow \langle \llbracket t_i \rrbracket \mid \alpha \rangle}\} \rangle \\
\llbracket t.D(\overline{t_i}) \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t \rrbracket \mid D(\overline{\llbracket t_i \rrbracket};\alpha) \rangle \\
\llbracket \textbf{cocase } \{\overline{D_i(\overline{x_{ij}}) \Rightarrow t_i}\} \rrbracket & \coloneqq & \textbf{cocase } \{\overline{D_i(\overline{x_{i,j}};\alpha_i) \Rightarrow \langle \llbracket t_i \rrbracket \mid \alpha_i \rangle}\} \\
\llbracket \lambda x.t \rrbracket & \coloneqq & \textbf{cocase } \{\texttt{ap}(x;\alpha) \Rightarrow \langle \llbracket t \rrbracket \mid \alpha \rangle\} \\
\llbracket t_1\ t_2 \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t_1 \rrbracket \mid \texttt{ap}(\llbracket t_2 \rrbracket;\alpha) \rangle \\
\llbracket \textbf{label } \alpha\{t\} \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t \rrbracket \mid \alpha \rangle \\
\llbracket \textbf{goto}(t;\alpha) \rrbracket & \coloneqq & \mu\beta.\langle \llbracket t \rrbracket \mid \alpha \rangle
\end{array}$$

4 New Translation

$$\llbracket \cdot \rrbracket : \texttt{Fun} \to \texttt{AxCore}$$

$$\begin{array}{lcr}
\llbracket \textbf{def } f(\overline{x};\overline{\alpha}) \coloneqq t \rrbracket & \coloneqq & \textbf{def} f(\overline{x};\overline{\alpha},\alpha) \coloneqq \langle \llbracket t \rrbracket_\alpha \mid \alpha \rangle \\
 & & \\
\llbracket x \rrbracket & \coloneqq & x \\
\llbracket \ulcorner n \urcorner \rrbracket & \coloneqq & \ulcorner n \urcorner \\
\llbracket t_1 \odot t_2 \rrbracket & \coloneqq & \mu\alpha. \odot (\llbracket t_1 \rrbracket_\alpha, \llbracket t_2 \rrbracket_\alpha; \alpha) \\
\llbracket \textbf{ifz}(t_1,t_2,t_3) \rrbracket & \coloneqq & \mu\alpha.\textbf{ifz}(\llbracket t_1 \rrbracket_\alpha, \langle \llbracket t_2 \rrbracket_\alpha) \mid \alpha \rangle, \langle \llbracket t_3 \rrbracket \mid \alpha \rangle) \\
\llbracket \textbf{let } x \coloneqq t_1 \textbf{ in } t_2 \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t_1 \rrbracket_\alpha \mid \tilde{\mu}x.\langle \llbracket t_2 \rrbracket_\alpha \mid \alpha \rangle \rangle \\
\llbracket f(\overline{t_i};\overline{\alpha_j}) \rrbracket & \coloneqq & \mu\alpha.f(\overline{\llbracket t_i \rrbracket_\alpha)};\overline{\alpha_j},\alpha) \\
\llbracket K(\overline{t_i}) \rrbracket & \coloneqq & K(\overline{\llbracket t_i \rrbracket}) \\
\llbracket \textbf{case } t \textbf{ of } \{\overline{K_i(\overline{x_{i,k}}) \Rightarrow t_i}\} \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t \rrbracket_\alpha \mid \textbf{case } \{\overline{K_i(\overline{x_{i,j}}) \Rightarrow \langle \llbracket t_i \rrbracket_\alpha \mid \alpha \rangle}\} \rangle \\
\llbracket t.D(\overline{t_i}) \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t \rrbracket_\alpha \mid D(\overline{\llbracket t_i \rrbracket_\alpha};\alpha) \rangle \\
\llbracket \textbf{cocase } \{\overline{D_i(\overline{x_{i,j}}) \Rightarrow t_i}\} \rrbracket & \coloneqq & \textbf{cocase } \{\overline{D_i(\overline{x_{i,j}};\alpha_i) \Rightarrow \langle \llbracket t_i \rrbracket_{\alpha_i} \mid \alpha_i \rangle}\} \\
\llbracket \lambda x.t \rrbracket & \coloneqq & \textbf{cocase } \{\texttt{ap}(x;\alpha) \Rightarrow \langle \llbracket t \rrbracket_\alpha \mid \alpha \rangle\} \\
\llbracket t_1\ t_2 \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t_1 \rrbracket_\alpha \mid \texttt{ap}(\llbracket t_2 \rrbracket_\alpha;\alpha) \rangle \\
\llbracket \textbf{label } \alpha\ \{t\} \rrbracket & \coloneqq & \mu\alpha.\langle \llbracket t \rrbracket_\alpha \mid \alpha \rangle \\
\llbracket \textbf{goto}(t;\alpha) \rrbracket & \coloneqq & \mu\beta.\langle \llbracket t \rrbracket_\beta \mid \alpha \rangle
\end{array}$$

$$\llbracket \cdot \rrbracket_{\cdot} : \texttt{Fun} \times \texttt{Covariables} \to \texttt{AxCore}$$

$$
\begin{array}{lcr}
\llbracket x \rrbracket_\alpha & \coloneqq & x \\
\llbracket \ulcorner n \urcorner \rrbracket_\alpha & \coloneqq & \ulcorner n \urcorner \\
\llbracket \odot(t_1, t_2) \rrbracket_\alpha & \coloneqq & \odot(\llbracket t_1 \rrbracket_\alpha, \llbracket t_2 \rrbracket_\alpha, ; \alpha) \\
\llbracket \mathbf{ifz}(t_1, t_2, t_2) \rrbracket_\alpha & \coloneqq & \mathbf{ifz}(\llbracket t_1 \rrbracket_\alpha, \langle \llbracket t_2 \rrbracket_\alpha \mid \alpha \rangle, \langle \llbracket t_3 \rrbracket_\alpha \mid \alpha \rangle) \\
\llbracket \mathbf{let}\ x \coloneqq t_1\ \mathbf{in}\ t_2 \rrbracket_\alpha & \coloneqq & \langle \llbracket t_1 \rrbracket_\alpha \mid \tilde{\mu} x. \langle \llbracket t_2 \rrbracket_\alpha \mid \alpha \rangle \rangle \\
\llbracket f(\overline{t_i}; \overline{\alpha_j}) \rrbracket_\alpha & \coloneqq & f(\overline{\llbracket t_i \rrbracket_\alpha}; \overline{\alpha_j}, \alpha) \\
\llbracket K(\overline{t_i}) \rrbracket_\alpha & \coloneqq & K(\overline{\llbracket t_i \rrbracket_\alpha}) \\
\llbracket \mathbf{case}\ t\ \mathbf{of}\ \{\overline{K_i(\overline{x_{i,j}}) \Rightarrow t_i}\} \rrbracket_\alpha & \coloneqq & \langle \llbracket t \rrbracket_\alpha \mid \mathbf{case}\ \{\overline{K_i(\overline{x_{i,j}}; \alpha_i) \Rightarrow \langle \llbracket t_i \rrbracket_{\alpha_i} \mid \alpha_i \rangle}\} \rangle \\
\llbracket t.D(\overline{t_i}) \rrbracket_\alpha & \coloneqq & \langle \llbracket t \rrbracket_\alpha \mid D(\overline{\llbracket t_i \rrbracket_\alpha}; \alpha) \rangle \\
\llbracket \mathbf{cocase}\ \{\overline{D_i(\overline{x_{i,j}}) \Rightarrow t_i}\} \rrbracket_\alpha & \coloneqq & \mathbf{cocase}\ \{\overline{D_i(\overline{x_{i,j}}; \alpha_i) \Rightarrow \langle \llbracket t_i \rrbracket_{\alpha_i} \mid \alpha_i \rangle}\} \\
\llbracket \lambda x.t \rrbracket_\alpha & \coloneqq & \mathbf{cocase}\ \{\mathtt{ap}(x; \beta) \Rightarrow \langle \llbracket t \rrbracket_\beta \mid \beta \rangle\} \\
\llbracket t_1\ t_2 \rrbracket_\alpha & \coloneqq & \langle \llbracket t_1 \rrbracket_\alpha \mid \mathtt{ap}(\llbracket t_2 \rrbracket_\alpha; \alpha) \rangle \\
\llbracket \mathbf{label}\ \alpha\ \{t\} \rrbracket_\beta & \coloneqq & \langle \llbracket t \rrbracket_\alpha \mid \alpha \rangle \\
\llbracket \mathbf{goto}(t; \alpha) \rrbracket & \coloneqq & \mu \beta. \langle \llbracket t \rrbracket_\beta \mid \alpha \rangle
\end{array}
$$