`salt0`: Straight Line Programs

`CS392-M1`: *Rust, In Practice and in Theory*

Syntax

$$
\begin{aligned}
&x && \text{(variables, } \mathcal{V}\text{)} \\
&n && \text{(integers, } \mathbb{Z}\text{)} \\
e &::= \texttt{()} \mid n \mid x \mid e \;\texttt{+}\; e && \text{(expressions, } \mathcal{E}\text{)} \\
s &::= \texttt{let}\; x \;\texttt{=}\; e && \text{(statements, } \mathcal{S}\text{)} \\
p &::= e \mid s \;\texttt{;}\; p && \text{(programs, } \mathcal{P}\text{)}
\end{aligned}
$$

Typing

$$t ::= \texttt{()} \mid \texttt{i32} \qquad \text{(types, } \mathcal{T}\text{)}$$

$$\Gamma \in \mathcal{V} \mapsto \mathcal{T} \qquad \text{(contexts)}$$

$$\Gamma \vdash e : t \qquad \text{(expressions)}$$

$$\Gamma \vdash s \dashv \Gamma \qquad \text{(statments)}$$

$$\Gamma \vdash p : t \qquad \text{(programs)}$$

$$\frac{}{\Gamma \vdash \texttt{()} : \texttt{()}} \text{(unit)}$$

$$\frac{n \in \mathbb{Z}}{\Gamma \vdash n : \texttt{i32}} \text{(int)}$$

$$\frac{(x \mapsto t) \in \Gamma}{\Gamma \vdash x : t} \text{(var)}$$

$$\frac{\Gamma \vdash e_1 : \texttt{i32} \qquad \Gamma \vdash e_2 : \texttt{i32}}{\Gamma \vdash e_1 \texttt{ + } e_2 : \texttt{i32}} \text{(add)}$$

$$\frac{x \notin \mathsf{dom}(\Gamma) \qquad \Gamma \vdash e : t}{\Gamma \vdash \texttt{let } x \texttt{ = } e \dashv \Gamma[x \mapsto t]} \text{(let)}$$

$$\frac{\Gamma_1 \vdash s \dashv \Gamma_2 \qquad \Gamma_2 \vdash p : t}{\Gamma_1 \vdash s \texttt{ ; } p : t} \text{(prog)}$$

Evaluation

$$v ::= \texttt{()} \mid n \qquad \text{(values, } \mathbb{V}\text{)}$$

$$S \in \mathcal{V} \mapsto \mathbb{V} \qquad \text{(store)}$$

$$\begin{aligned}
&\langle\, S \,,\, e \,\rangle \Downarrow v && \text{(expressions)}\\
&\langle\, S \,,\, s \,\rangle \Downarrow S && \text{(statements)}\\
&\langle\, S \,,\, p \,\rangle \Downarrow v && \text{(programs)}
\end{aligned}$$

$$\frac{}{\langle\, S \,,\, \texttt{()} \,\rangle \Downarrow \texttt{()}}\ \text{(unit)}$$

$$\frac{n \in \mathbb{Z}}{\langle\, S \,,\, n \,\rangle \Downarrow n}\ \text{(int)}$$

$$\frac{}{\langle\, S \,,\, x \,\rangle \Downarrow S(x)}\ \text{(var)}$$

$$\frac{\langle\, S \,,\, e_1 \,\rangle \Downarrow v_1 \qquad \langle\, S \,,\, e_2 \,\rangle \Downarrow v_2}{\langle\, S \,,\, e_1 \,\texttt{+}\, e_2 \,\rangle \Downarrow v_1 + v_2}\ \text{(add)}$$

$$\frac{\langle\, S \,,\, e \,\rangle \Downarrow v}{\langle\, S \,,\, \texttt{let}\ x \,\texttt{=}\, e \,\rangle \Downarrow S[x \mapsto v]}\ \text{(let)}$$

$$\frac{\langle\, S_1 \,,\, s \,\rangle \Downarrow S_2 \qquad \langle\, S_2 \,,\, p \,\rangle \Downarrow v}{\langle\, S_1 \,,\, s \,\texttt{;}\, p \,\rangle \Downarrow v}\ \text{(prog)}$$