Type Rules (1)

$$\frac{(\mathrm{x}:\ \mathrm{T}) \in \Gamma}{\Gamma \vdash \mathrm{x}:\ \mathrm{T}}$$ variable

$$\frac{}{\mathrm{IntConst(k)}:\ \mathrm{Int}}$$ constant

$$\frac{\Gamma \vdash e_1 : T_1 \ \ldots\ \Gamma \vdash e_n : T_n \qquad \Gamma \vdash f : (T_1 \times \cdots \times T_n \to T)}{\Gamma \vdash f(e_1, \ldots, e_n) : T}$$ function application

$$\frac{\Gamma \vdash e_1 :\ \mathrm{Int} \qquad \Gamma \vdash e_2 :\ \mathrm{Int}}{\Gamma \vdash (e_1 + e_2) :\ \mathrm{Int}}$$ plus $$\frac{\Gamma \vdash e_1 :\ \mathrm{String} \qquad \Gamma \vdash e_2 :\ \mathrm{String}}{\Gamma \vdash (e_1 + e_2) :\ \mathrm{String}}$$

$$\frac{\Gamma \vdash \mathrm{b}:\ \mathrm{Boolean} \qquad \Gamma \vdash e_1 :\ \mathrm{T} \qquad \Gamma \vdash e_2 :\ \mathrm{T}}{\Gamma \vdash (\mathrm{if(b)}\ e_1\ \mathrm{else}\ e_2) :\ \mathrm{T}}$$ if

$$\frac{\Gamma \vdash \mathrm{b}:\ \mathrm{Boolean} \qquad \Gamma \vdash \mathrm{s}:\ \mathrm{void}}{\Gamma \vdash (\mathrm{while(b)\ s}):\ \mathrm{void}}$$ while

$$\frac{(\mathrm{x},\ \mathrm{T}) \in \Gamma \qquad \Gamma \vdash \mathrm{e}:\ \mathrm{T}}{\Gamma \vdash (\mathrm{x{=}e}):\ \mathrm{void}}$$ assignment

Type Rules (2)

$$\frac{\Gamma \vdash \text{e}: \text{T}}{\Gamma \vdash \{\text{e}\}: \text{T}} \qquad \frac{}{\Gamma \vdash \{\}: \text{void}}$$

$$\frac{\Gamma \oplus \{(x, T_1)\} \vdash \{t_2; \ \ldots \ ; t_n\}: \text{T}}{\Gamma \vdash \{\text{var } x : T_1; t_2; \ \ldots \ ; t_n\}: \text{T}}$$

$$\frac{\Gamma \vdash s_1: \text{void} \qquad \Gamma \vdash \{t_2; \ \ldots \ ; t_n\}: \text{T}}{\Gamma \vdash \{s_1; t_2; \ \ldots \ ; t_n\}: \text{T}}$$

block

$$\frac{\Gamma \vdash \text{a}: \text{Array(T)} \qquad \Gamma \vdash \text{i}: \text{Int}}{\Gamma \vdash \text{a[i]}: \text{T}}$$

array use

$$\frac{\Gamma \vdash \text{a}: \text{Array(T)} \qquad \Gamma \vdash \text{i}: \text{Int} \qquad \Gamma \vdash \text{e}: \text{T}}{\Gamma \vdash \text{a[i]} = \text{e}}$$

array assignment

Type Rules (3)

Γ^c - top-level environment of class C

```
class C {
  var x: Int;
  def m(p: Int): Boolean = {…}
}
```

Γ^c = { (x, Int), (m, C $\times$ Int $\rightarrow$ Boolean)}

$$\frac{\Gamma \vdash e : C \quad \Gamma^C \vdash m : T \times T_1 \times \ \ldots \ \times T_n \rightarrow T_{n+1} \qquad \Gamma \vdash e_i : T_i \quad 1 \leq i \leq n}{\Gamma \vdash e.m(e_1, \ \ldots \ , e_n) : T_{n+1}}$$

method invocation

$$\frac{\Gamma \vdash \text{e: C} \qquad \Gamma^C \vdash \text{f: T}}{\Gamma \vdash \text{e.f: T}}$$

field use

$$\frac{\Gamma \vdash \text{e: C} \qquad \Gamma^C \vdash \text{f: T} \qquad \Gamma \vdash \text{x: T}}{\Gamma \vdash (\text{e.f} = \text{x}): \text{ void}}$$

field assignment