Types for references

We will pretend that the F# shortcuts are part of the core language

expressions ::= ... | $e_1 := e_2$ | !e | ref e | () | ...

types ::= .... | τ ref | unit | ....

$$\frac{\Gamma \vdash e : \tau}{\Gamma \vdash \text{ref } e : \tau \text{ ref}} \qquad \frac{}{\Gamma \vdash () : \text{unit}}$$

$$\frac{\Gamma \vdash e : \tau \text{ ref}}{\Gamma \vdash !e : \tau} \qquad \frac{\Gamma \vdash e_1 : \tau \text{ ref} \quad \Gamma \vdash e_2 : \tau}{\Gamma \vdash e_1 := e_2 : \text{unit}}$$

let increment (x: int ref): unit = x := !x+1

Γ = x: int ref

$$\frac{\dfrac{\dfrac{}{\Gamma \vdash 1 : \text{int}} \quad \dfrac{\Gamma \vdash x : \text{int ref}}{\Gamma \vdash !x : \text{int}}}{\Gamma \vdash !x+1 : \text{int}} \qquad \dfrac{\Gamma \vdash x : \text{int ref}}{\Gamma \vdash x := !x+1 : \text{unit}}}{\vdash \text{fun } (x : \text{int ref}) \to x := !x+1 : \text{int ref} \to \text{unit}}$$