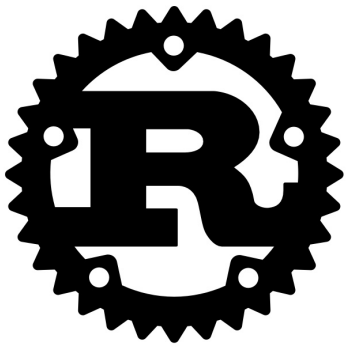
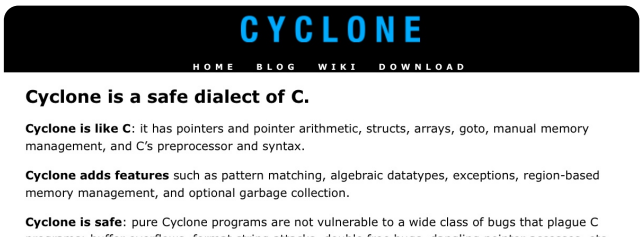
LINEAR (AND SUBSTRUCTURAL) TYPES!





$$\Psi \vdash \phi$$

INTU.

$$\frac{A \to B \quad A \to C}{A \vdash B \wedge C}$$

LINEAR

$$\frac{A \multimap B \quad A \multimap C}{A \not\vdash B \otimes C}$$

$$A \multimap B,\ A \multimap C,\ A, A \vdash B \otimes C$$

$$H, H, O \multimap H_2O$$

$A, A \multimap B \otimes B \vdash B \otimes B$

$A, A, A \multimap B \otimes B \vdash B \otimes B \otimes A$

$$\phi ::= A \mid \phi \multimap \psi \mid \phi \otimes \psi \mid \phi \oplus \psi$$

$$\frac{}{\phi \vdash \phi}\ \text{AXIOM} \qquad \frac{\Gamma, \phi \vdash \psi}{\Gamma \vdash \phi \multimap \psi} \multimap I$$

$$\frac{\Gamma \vdash \phi \multimap \psi \qquad \Gamma' \vdash \phi}{\Gamma, \Gamma' \vdash \psi} \multimap E$$

(Γ over Γ'; Γ' over ϕ; Γ, Γ' over ψ)

$$\frac{\Gamma \vdash \phi \qquad \Gamma' \vdash \psi}{\Gamma, \Gamma' \vdash \phi \otimes \psi} \otimes I$$

$$\frac{\Gamma \vdash \phi \otimes \psi \qquad \Gamma', \phi, \psi \vdash \chi}{\Gamma, \Gamma' \vdash \chi}\ \otimes E$$

$$\frac{\Gamma \vdash \phi}{\Gamma \vdash \phi \oplus \psi}\ \oplus I1 \qquad \frac{\Gamma \vdash \psi}{\Gamma \vdash \phi \oplus \psi}\ \oplus I2$$

$$\frac{\Gamma \vdash \phi \oplus \psi \qquad \Gamma', \phi \vdash \chi \qquad \Gamma', \psi \vdash \chi}{\Gamma, \Gamma' \vdash \chi}$$

STRUCTURAL (INTU.)

LINEAR

$$\frac{\Gamma \vdash \phi}{\Gamma, \psi \vdash \phi}$$

WEAKENING

$$\frac{\Gamma, \Delta \vdash \phi}{\Delta, \Gamma \vdash \phi}\ \text{EXCHANGE}$$

LINEAR

$$\frac{\Gamma, \psi, \psi \vdash \phi}{\Gamma, \psi \vdash \phi}\ \text{CONTRACTION}$$

$$e ::= x \mid \lambda x{:}\tau.\, e \mid e_1\ e_2$$

$$\tau ::= b \mid \tau_1 \multimap \tau_2$$

b: int | unit

$$\frac{}{x:\tau \vdash x:\tau}$$

$x:\tau$

$\{(x, \tau)\}$

```
sys.stdin.read()
```

```
let p = malloc 4 in
store p ((load p) + 38);
free p
```