Session and Session Type

Frans Simanjuntak

Session Type

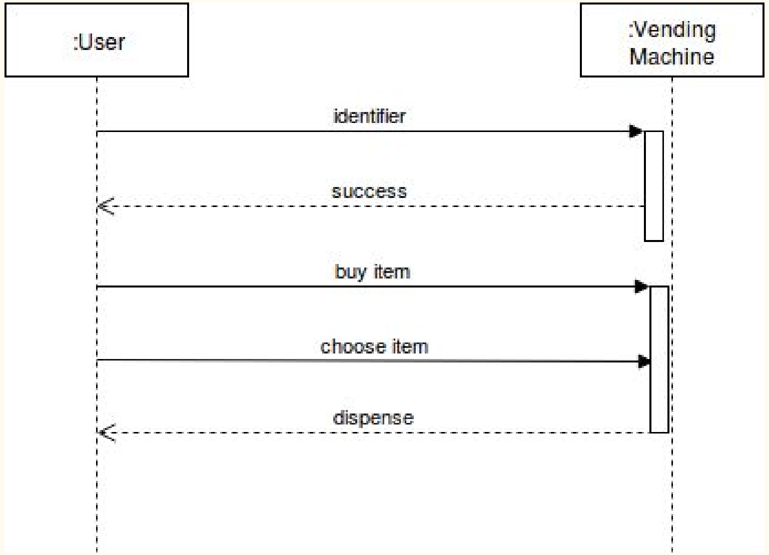
Notations

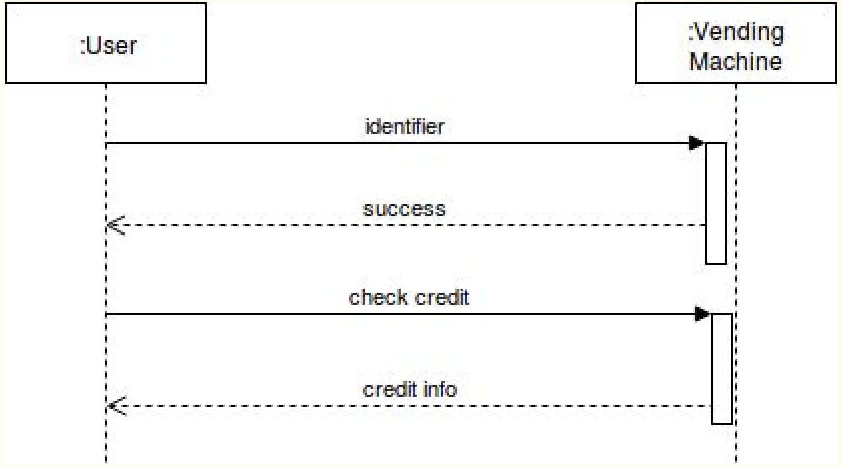
- !
- ?
- &
- ⊕

Session Initiation

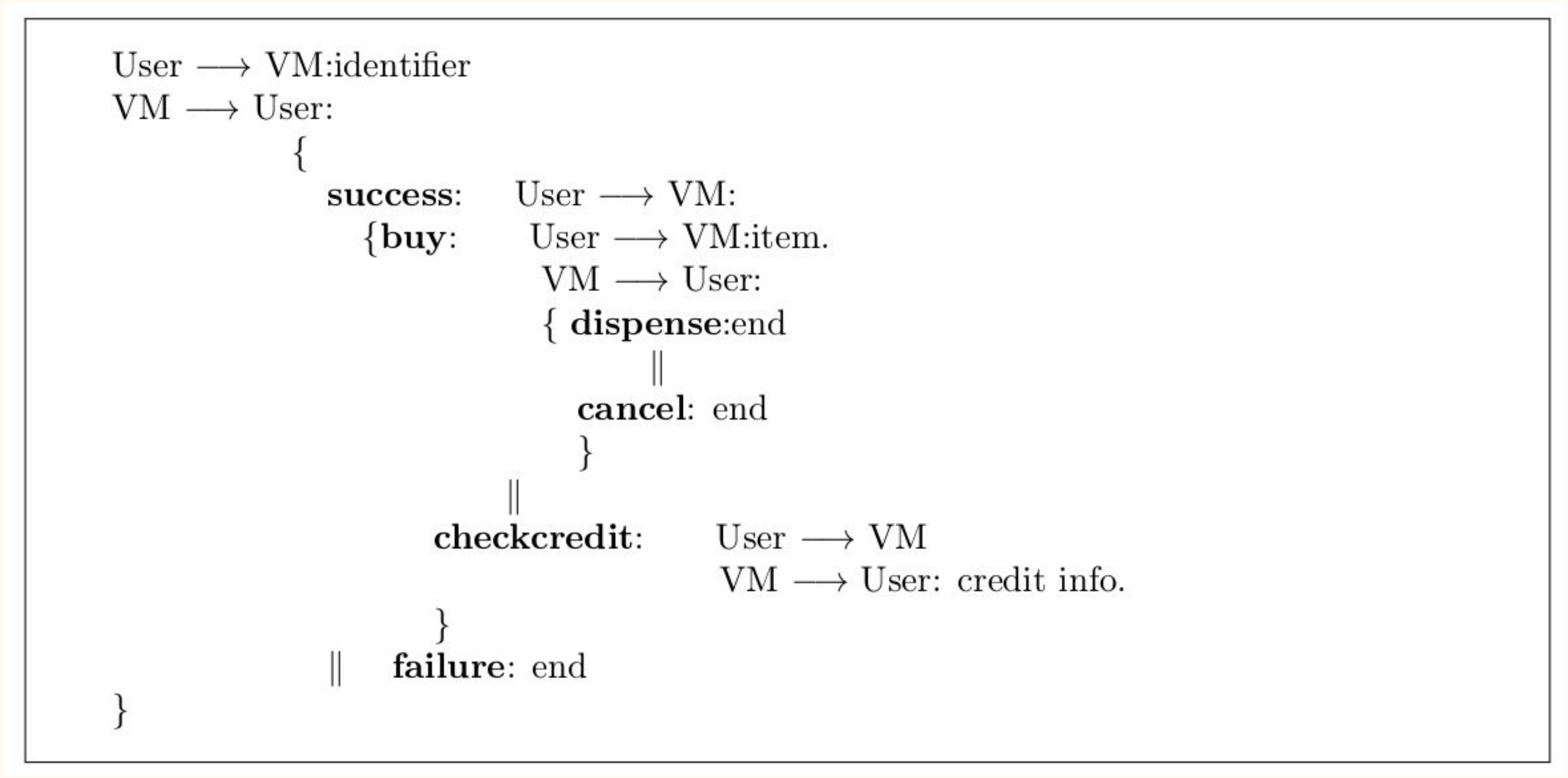
$$\begin{tikzcd} & \text{a (h)} \arrow[dl] \arrow[dr] & \\ \text{name} & & \text{channel} \end{tikzcd}$$

User and Vending Machine



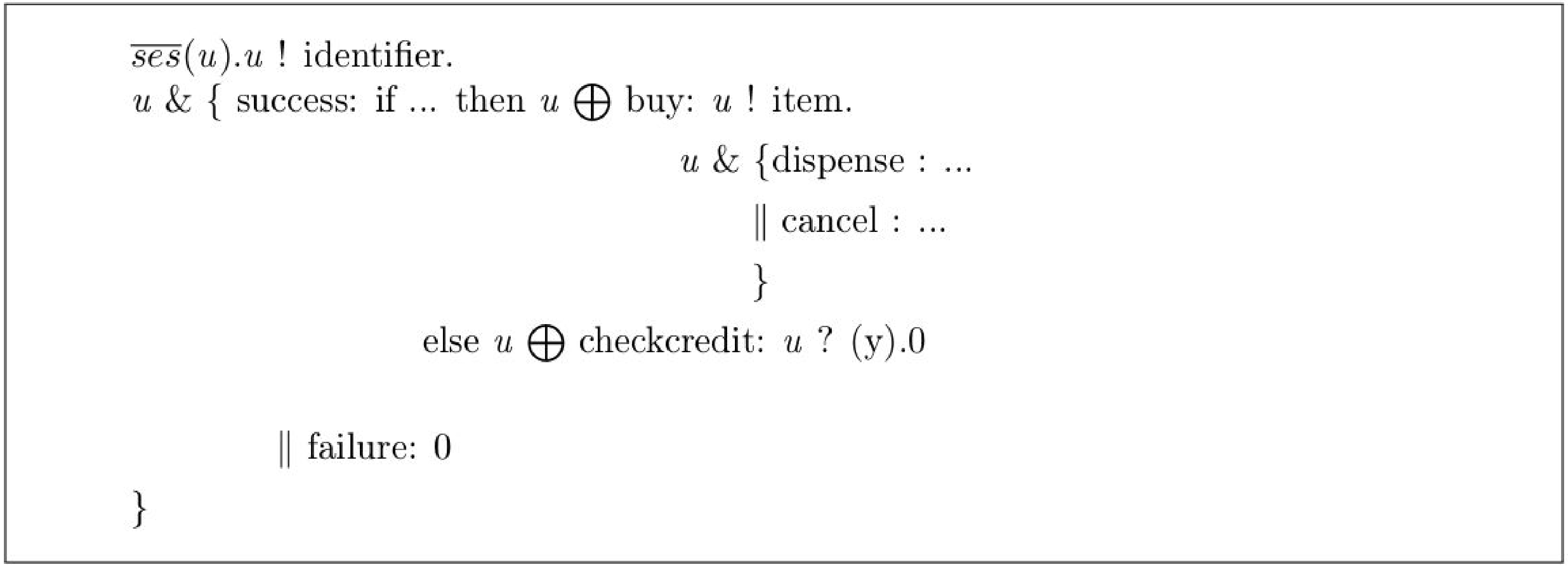


Global Description



```
User ⟶ VM:identifier
VM ⟶ User:
            {
              success:    User ⟶ VM:
                {buy:       User ⟶ VM:item.
                             VM ⟶ User:
                             { dispense:end
                                      ||
                               cancel: end
                               }
                        ||
                  checkcredit:     User ⟶ VM
                                   VM ⟶ User: credit info.
                  }
            ||   failure: end
}
```

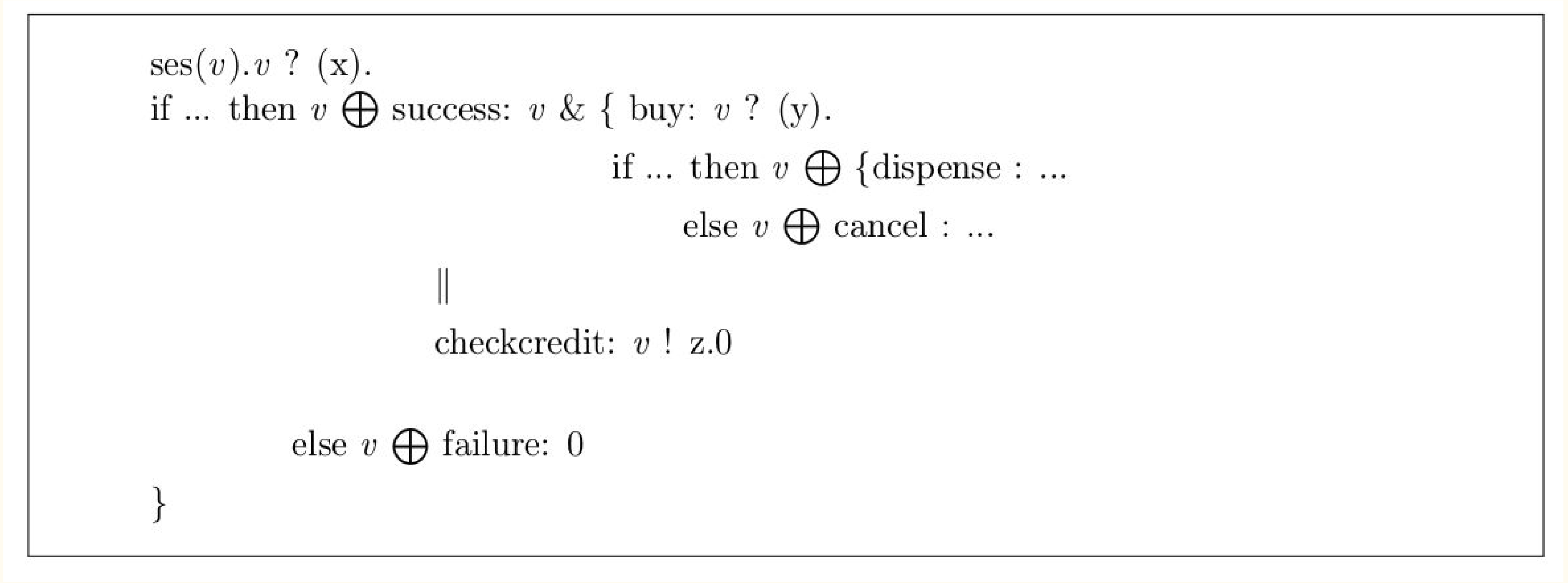
User Agent



```
$\overline{ses}(u).u$ ! identifier.
$u$ & { success: if ... then $u \oplus$ buy: $u$ ! item.
                                          $u$ & {dispense : ...
                                              || cancel : ...
                                              }
                     else $u \oplus$ checkcredit: $u$ ? (y).0

          || failure: 0
}
```

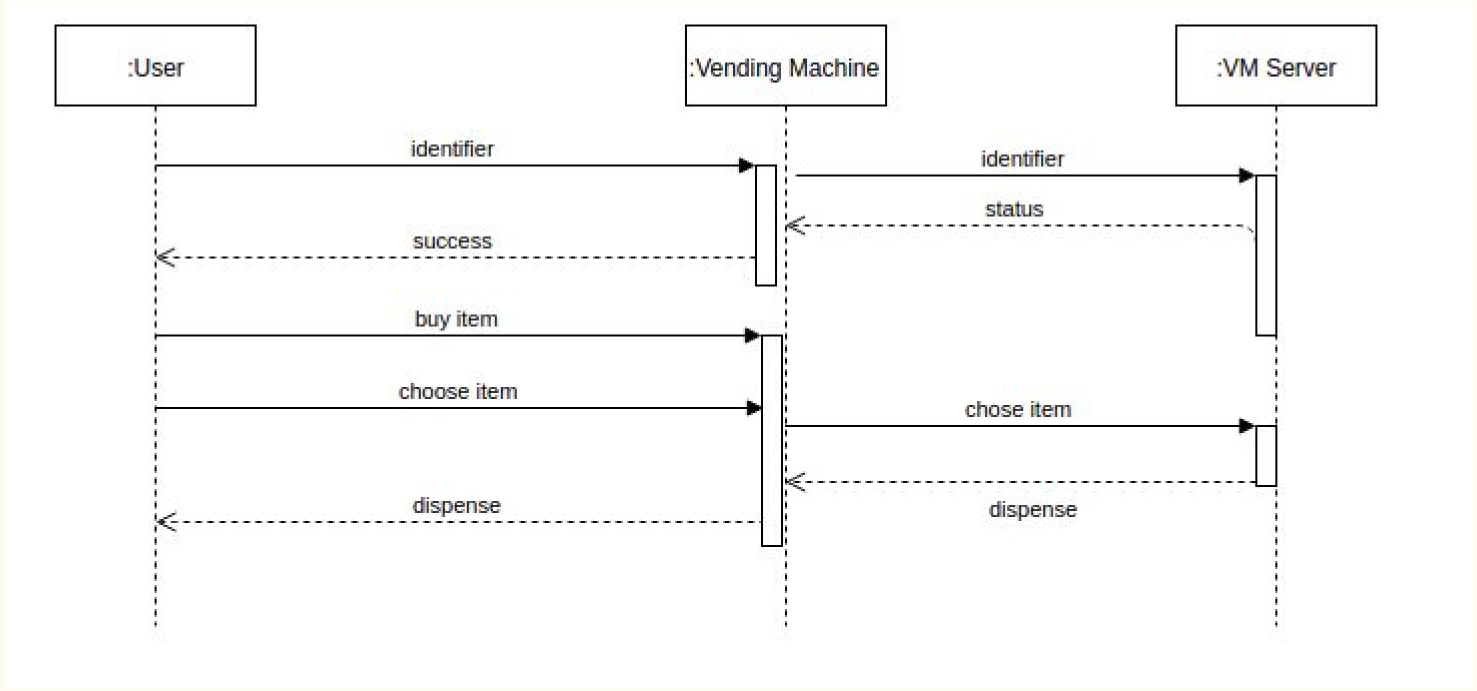
Vending Machine

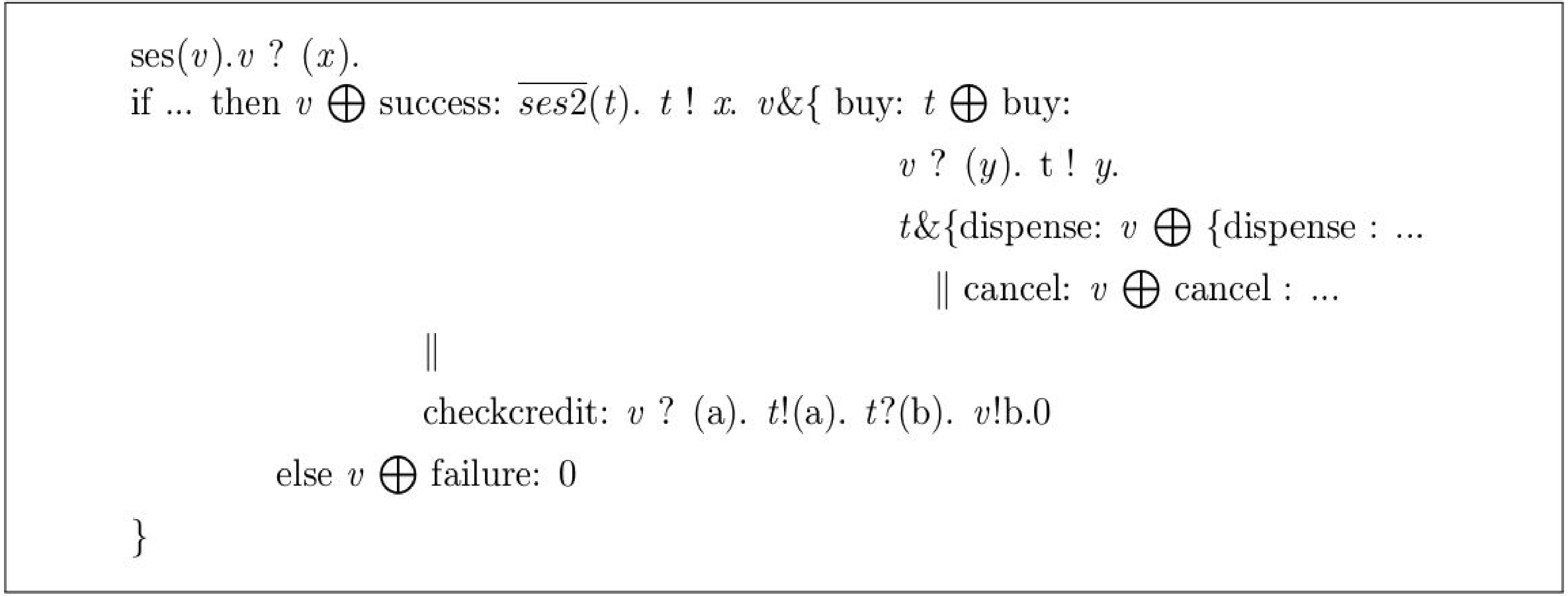


```
ses($v$).$v$ ? (x).
if ... then $v \bigoplus$ success: $v$ & { buy: $v$ ? (y).
                                        if ... then $v \bigoplus$ {dispense : ...
                                            else $v \bigoplus$ cancel : ...
                            ||
                            checkcredit: $v$ ! z.0

          else $v \bigoplus$ failure: 0
}
```

Delegation


:User
:Vending Machine
:VM Server
identifier
identifier
status
success
buy item
choose item
chose item
dispense
dispense



```
$\text{ses}(v).v\ ?\ (x).$
if ... then $v \bigoplus$ success: $\overline{ses2}(t).\ t\ !\ x.\ v\&\{$ buy: $t \bigoplus$ buy:
                                                        $v\ ?\ (y).$ t ! $y.$
                                                        $t\&\{$dispense: $v \bigoplus \{$dispense : ...
                                                          $\|$ cancel: $v \bigoplus$ cancel : ...
                  $\|$
                  checkcredit: $v\ ?$ (a). $t!$(a). $t?$(b). $v!$b.0
        else $v \bigoplus$ failure: 0
}
$\text{ses}(v).v\ ?\ (x).$
if ... then $v \bigoplus$ success: $\overline{ses2}(t).\ t\ !\ x.\ t\ !\ v.0$
        else $v \bigoplus$ failure: $0$
}
```

Rule - Session Initiation

κ $\qquad$ $p \in \{+, -\}$

$$(\bar{a}(k).P) \mid (a(h).Q) \longrightarrow (\nu\kappa)(P\{\kappa^{+}/k\} \mid Q\{\kappa^{-}/h\}).$$

Rule - Receive and Send Value

$$(\kappa^{p} \; ! \; v.P) \mid (\kappa^{\bar{p}} \; ? \; (x).Q) \longrightarrow P \mid Q\{v/x\}$$

Rule - Select / Branching

$$(\kappa^{p} \oplus \ell_i : P) \mid (\kappa^{\bar{p}} \, \& \{\ell_1 : Q_1 \talloblong \cdots \talloblong \ell_n : Q_n\}) \longrightarrow P \mid Q_i, \qquad (1 \leq i \leq n).$$

Typing System

$$\begin{tikzcd}
 & \Gamma \vdash P \triangleright \Delta \arrow[dl] \arrow[dr] & \\
\text{Sorting} & & \text{Typing}
\end{tikzcd}$$

Rules - Session Initiation

$$\frac{\Gamma, a : [S] \vdash P \triangleright \Delta, k : S}{\Gamma, a : [S] \vdash a(k).P \triangleright \Delta} \qquad \frac{\Gamma, a : [S] \vdash P \triangleright \Delta, k : \overline{S}}{\Gamma, a : [S] \vdash \bar{a}(k).P \triangleright \Delta}$$

Receive and Send Value

$$\frac{\Gamma, x : T \vdash P \triangleright \Delta, k : S'}{\Gamma \vdash k \, ? \, (x).P \triangleright \Delta, k : ?\, T.S'}$$

$$\frac{\Gamma \vdash P \triangleright \Delta, k : S'' \qquad \Gamma \vdash v : T}{\Gamma \vdash k \, ! \, v.P \triangleright \Delta, k : !\, T.S''}$$

Extensions of the Calculus

- Correspondence Assertion
- Multiparty Sessions
- Concurrent Constraint
- Code Mobility
- Exception

Extensions of Typing

- Subtyping
- Bounded Polymorphism
- Progress
- Action Permutation

Implementation

- Functional Programming
  - Haskell
- Object Oriented Programming
  - Sing#
  - SJ
  - Scribble
  - Bica

Questions?