



A Sequent

bags of channels  $\Gamma \vdash \Delta$  Visually

e.g.  $Z, Z \vdash B$

Building Graphs

Identity/Axiom  $A \vdash A$  single channel

Cut  $\frac{\Gamma \vdash \Delta, A \quad A, \Gamma' \vdash \Delta'}{\Gamma, \Gamma' \vdash \Delta, \Delta'}$  single channel

We want no loops!

$o_1, i_1$ : producer must provide  $\sim B$

$o_2, i_2$ : consumer must provide  $\sim B$

What if A needs  $o_2$  before sending on  $o_1$  and B needs  $i_1$  before sending on  $o_2$ ? **Deadlock!**

How to bundle channels and still prevent loops?

$A \otimes B$  represents

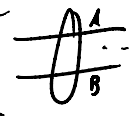
separated  $\otimes$  connected

Rules for  $\otimes$

$\frac{\Gamma \vdash \Delta, A \quad \Gamma' \vdash \Delta'}{\Gamma, \Gamma' \vdash \Delta, A \otimes B, \Delta'}$

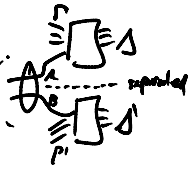
$\frac{A, B, \Gamma \vdash \Delta}{A \otimes B, \Gamma \vdash \Delta}$

Reverse of  $\otimes$

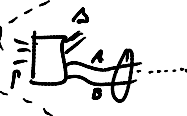
corrected:  separated

$A \otimes B$

Rules for  $\otimes$

$$\frac{\Gamma, A \vdash \Delta \quad B, \Gamma' \vdash \Delta'}{\Gamma, A \otimes B, \Gamma' \vdash \Delta, \Delta'}$$


$$\frac{\Gamma \vdash \Delta, A, B}{\Gamma \vdash \Delta, A \otimes B}$$

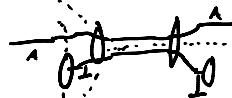
corrected: 

The Multiplicative Units

$\frac{}{1}$ $\frac{\Gamma \vdash \Delta}{1, \Gamma \vdash \Delta}$	$1 \vdash$ $\frac{\Gamma \vdash \Delta}{\Gamma \vdash \Delta, 1}$
--	--

Practice:

$\frac{}{1}$	$\frac{A \vdash A}{A \vdash A, 1}$	$\frac{A \vdash A \quad 1 \vdash}{A \otimes 1 \vdash A}$
--------------	------------------------------------	--



Can't Prove

$\frac{\frac{A \vdash A \quad B \vdash B}{A, B \vdash A, B} \parallel \text{ (conclusion)}}{A, B \vdash A \otimes B}$	$\frac{\frac{A \vdash A \quad B \vdash B}{A \otimes B \vdash A, B} \quad \frac{A \vdash A \quad B \vdash B}{A, B \vdash A \otimes B}}{A \otimes B \vdash A \otimes B} \text{ (not provable)}$
---	---

Can't Prove

$\frac{\frac{}{1}}{1 \vdash 1}$	$\frac{1 \vdash \quad 1 \vdash}{1 \vdash 1} \text{ (empty cut)}$
---------------------------------	--