A Full Ott Spec

vars, *n*, *a*, *x*, *y*, *z*, *w*, *m*, *o*
ivar, *i*, *k*, *j*, *l*
const, *b*

A, B, C	::=	
	|	B
	|	I
	|	$A \otimes B$
	|	$A \multimap B$
	|	FX
X, Y, Z	::=	
	|	B
	|	1
	|	$X \times Y$
	|	$X \to Y$
	|	GA
T	::=	
	|	A
	|	X
p	::=	
	|	$\star$
	|	x
	|	u
	|	$*$
	|	$p \otimes p'$
	|	$p \times p'$
	|	Fp
	|	Gp
s	::=	
	|	x
	|	b
	|	$*$
	|	let $s_1 : T$ be p in s_2
	|	let $t : T$ be p in s
	|	$s_1 \otimes s_2$
	|	$\lambda x : A.s$
	|	app s_1 s_2
	|	derelict t
	|	(s) S
	|	Ft

$$
\begin{array}{lll}
t & ::= & \\
& | & x \\
& | & b \\
& | & \mathsf{u} \\
& | & \mathsf{let}\, t_1 : X\, \mathsf{be}\, p\, \mathsf{in}\, t_2 \\
& | & t_1 \times t_2 \\
& | & \lambda x : X.t \\
& | & \mathsf{app}\, t_1\, t_2 \\
& | & (t_1, t_2) \\
& | & \mathsf{fst}(t) \\
& | & \mathsf{snd}(t) \\
& | & (t) \qquad\qquad \mathsf{S} \\
& | & \mathsf{G}s
\end{array}
$$

$$
\begin{array}{lll}
\Phi,\ \Psi & ::= & \\
& | & \cdot \\
& | & \Phi_1, \Phi_2 \\
& | & x : X \\
& | & (\Phi) \qquad\qquad \mathsf{S}
\end{array}
$$

$$
\begin{array}{lll}
\Gamma,\ \Delta & ::= & \\
& | & \cdot \\
& | & x : A \\
& | & \Phi \\
& | & \Phi; \Gamma \\
& | & \Gamma_1, \Gamma_2 \\
& | & (\Gamma) \qquad\qquad \mathsf{S}
\end{array}
$$

$\boxed{\Phi \vdash_C t : X}$

$$\frac{}{\Phi, x : X \vdash_C x : X}\ \text{T\_ID}$$

$$\frac{}{\Phi \vdash_C \mathsf{u} : 1}\ \text{T\_1I}$$

$$\frac{\Phi \vdash_C t_1 : X \quad \Phi \vdash_C t_2 : Y}{\Phi \vdash_C (t_1, t_2) : X \times Y}\ \text{T\_PRODI}$$

$$\frac{\Phi \vdash_C t : X \times Y}{\Phi \vdash_C \mathsf{fst}(t) : X}\ \text{T\_PRODE1}$$

$$\frac{\Phi \vdash_C t : X \times Y}{\Phi \vdash_C \mathsf{snd}(t) : Y}\ \text{T\_PRODE2}$$

$$\frac{\Phi, x : X \vdash_C t : Y}{\Phi \vdash_C \lambda x : X.t : X \to Y}\ \text{T\_IMPI}$$

$$\frac{\Phi \vdash_C t_1 : X \to Y \quad \Phi \vdash_C t_2 : X}{\Phi \vdash_C \mathsf{app}\, t_1\, t_2 : Y}\ \text{T\_IMPE}$$

$$\frac{\Phi \vdash_{\mathcal{L}} s : A}{\Phi \vdash_C \mathsf{G}s : \mathsf{G}A}\ \text{T\_GI}$$

$$\frac{\Phi \vdash_C t_1 : X \quad x : X, \Phi \vdash_C t_2 : Y}{\Phi \vdash_C [t_1/x]t_2 : Y} \ \text{T\_SUB}$$

$\boxed{\Gamma \vdash_{\mathcal{L}} s : A}$

$$\frac{}{\Phi; x : A \vdash_{\mathcal{L}} x : A} \ \text{S\_ID}$$

$$\frac{\Phi; \Gamma \vdash_{\mathcal{L}} s_1 : A \quad \Phi; \Delta \vdash_{\mathcal{L}} s_2 : B}{\Phi; \Gamma, \Delta \vdash_{\mathcal{L}} s_1 \otimes s_2 : A \otimes B} \ \text{S\_TENI}$$

$$\frac{\Phi; \Gamma \vdash_{\mathcal{L}} s_1 : A \otimes B \quad \Phi; \Delta, x : A, y : B \vdash_{\mathcal{L}} s_2 : C}{\Phi; \Gamma, \Delta \vdash_{\mathcal{L}} \mathsf{let}\, s_1 : A \otimes B\, \mathsf{be}\, x \otimes y\, \mathsf{in}\, s_2 : C} \ \text{S\_TENE}$$

$$\frac{}{\Phi \vdash_{\mathcal{L}} * : \mathrm{I}} \ \text{S\_II}$$

$$\frac{\Phi; \Gamma \vdash_{\mathcal{L}} s_1 : \mathrm{I} \quad \Phi; \Delta \vdash_{\mathcal{L}} s_2 : A}{\Phi; \Gamma, \Delta \vdash_{\mathcal{L}} \mathsf{let}\, s_1 : \mathrm{I}\, \mathsf{be}\, *\, \mathsf{in}\, s_2 : A} \ \text{S\_IE}$$

$$\frac{\Phi; \Gamma, x : A \vdash_{\mathcal{L}} s : B}{\Phi; \Gamma \vdash_{\mathcal{L}} \lambda x : A.s : A \multimap B} \ \text{S\_IMPI}$$

$$\frac{\Phi; \Gamma \vdash_{\mathcal{L}} s_1 : A \multimap B \quad \Phi; \Delta \vdash_{\mathcal{L}} s_2 : A}{\Phi; \Gamma, \Delta \vdash_{\mathcal{L}} \mathsf{app}\, s_1\, s_2 : B} \ \text{S\_IMPE}$$

$$\frac{\Phi \vdash_C t : X}{\Phi \vdash_{\mathcal{L}} \mathsf{F}t : \mathsf{F}X} \ \text{S\_FI}$$

$$\frac{\Phi; \Gamma \vdash_{\mathcal{L}} s_1 : \mathsf{F}X \quad \Phi, x : X; \Delta \vdash_{\mathcal{L}} s_2 : A}{\Phi; \Gamma, \Delta \vdash_{\mathcal{L}} \mathsf{let}\, s_1 : \mathsf{F}X\, \mathsf{be}\, \mathsf{F}\, x\, \mathsf{in}\, s_2 : A} \ \text{S\_FE}$$

$$\frac{\Phi \vdash_C t : \mathsf{G}A}{\Phi \vdash_{\mathcal{L}} \mathsf{derelict}\, t : A} \ \text{S\_GE}$$

$$\frac{\Phi \vdash_C t : X \quad x : X, \Phi; \Gamma \vdash_{\mathcal{L}} s : A}{\Phi; \Gamma \vdash_{\mathcal{L}} [t/x]s : A} \ \text{S\_SUB1}$$

$$\frac{\Phi; \Gamma \vdash_{\mathcal{L}} s_1 : A \quad \Phi; x : A, \Delta \vdash_{\mathcal{L}} s_2 : B}{\Phi; \Gamma, \Delta \vdash_{\mathcal{L}} [s_1/x]s_2 : B} \ \text{S\_SUB2}$$