

$\boxed{\Psi \vdash e : \sigma}$	$\Psi ::= \emptyset \mid \Psi, x : \sigma$	
<b>S-T-VAR</b> $\frac{x : \sigma \in \Psi}{\Psi \vdash x : \sigma}$	<b>S-T-ABS</b> $\frac{\Psi, x : \sigma_1 \vdash e : \sigma_2}{\Psi \vdash \lambda x.e : \sigma_1 \rightarrow \sigma_2}$	<b>S-T-APP</b> $\frac{\Psi \vdash e_1 : \sigma_2 \rightarrow \sigma \quad \Psi \vdash e_2 : \sigma_2}{\Psi \vdash e_1(e_2) : \sigma}$
<b>S-T-STRINGIN-I</b> $\frac{s \in \mathcal{L}\{r\}}{\Psi \vdash \text{rstr}[s] : \text{stringin}[r]}$	<b>S-T-CONCAT</b> $\frac{\Psi \vdash e_1 : \text{stringin}[r_1] \quad \Psi \vdash e_2 : \text{stringin}[r_2]}{\Psi \vdash \text{rconcat}(e_1; e_2) : \text{stringin}[r_1 \cdot r_2]}$	
<b>S-T-CASE</b> $\frac{\Psi \vdash e_2 : \sigma \quad \Psi, x : \text{stringin}[\text{head}(r)], y : \text{stringin}[\text{tail}(r)] \vdash e_3 : \sigma}{\Psi \vdash \text{rstrcase}(e_1; e_2; x, y, e_3) : \sigma}$		
<b>S-T-REPLACE</b> $\frac{\Psi \vdash e_1 : \text{stringin}[r_1] \quad \Psi \vdash e_2 : \text{stringin}[r_2] \quad \text{lreplace}(r; r_1; r_2) = r'}{\Psi \vdash \text{rreplace}[r](e_1; e_2) : \text{stringin}[r']}$		
<b>S-T-SAFECOERCE</b> $\frac{\Psi \vdash e : \text{stringin}[r'] \quad \mathcal{L}\{r'\} \subseteq \mathcal{L}\{r\}}{\Psi \vdash \text{rcoerce}[r](e) : \text{stringin}[r]}$		
<b>S-T-CHECK</b> $\frac{\Psi \vdash e_0 : \text{stringin}[r_0] \quad \Psi, x : \text{stringin}[r] \vdash e_1 : \sigma \quad \Psi \vdash e_2 : \sigma}{\Psi \vdash \text{rcheck}[r](e_0; x, e_1; e_2) : \sigma}$		

$\boxed{e \Downarrow v}$		
<b>S-E-ABS</b> $\lambda x.e \Downarrow \lambda x.e$	<b>S-E-APP</b> $\frac{e_1 \Downarrow \lambda x.e_3 \quad e_2 \Downarrow v_2 \quad [v_2/x]e_3 \Downarrow v}{e_1(e_2) \Downarrow v}$	<b>S-E-RSTR</b> $\text{rstr}[s] \Downarrow \text{rstr}[s]$
<b>S-E-CONCAT</b> $\frac{e_1 \Downarrow \text{rstr}[s_1] \quad e_2 \Downarrow \text{rstr}[s_2]}{\text{rconcat}(e_1; e_2) \Downarrow \text{rstr}[s_1 s_2]}$	<b>S-E-CASE-<math>\epsilon</math></b> $\frac{e_1 \Downarrow \text{rstr}[e] \quad e_2 \Downarrow v_2}{\text{rstrcase}(e_1; e_2; x, y, e_3) \Downarrow v_2}$	
<b>S-E-CASE-CONCAT</b> $\frac{e_1 \Downarrow \text{rstr}[a.s] \quad [\text{rstr}[a], \text{rstr}[s]/x, y]e_3 \Downarrow v_3}{\text{rstrcase}(e_1; e_2; x, y, e_3) \Downarrow v_3}$		
<b>S-E-REPLACE</b> $\frac{e_1 \Downarrow \text{rstr}[s_1] \quad e_2 \Downarrow \text{rstr}[s_2] \quad \text{subst}(r; s_1; s_2) = s}{\text{rreplace}[r](e_1; e_2) \Downarrow \text{rstr}[s]}$	<b>S-E-SAFECOERCE</b> $\frac{e \Downarrow \text{rstr}[s]}{\text{rcoerce}[r](e) \Downarrow \text{rstr}[s]}$	
<b>S-E-CHECK-OK</b> $\frac{e \Downarrow \text{rstr}[s] \quad s \in \mathcal{L}\{r\} \quad [\text{rstr}[s]/x]e_1 \Downarrow v}{\text{rcheck}[r](e; x, e_1; e_2) \Downarrow v}$		
<b>S-E-CHECK-NOTOK</b> $\frac{e \Downarrow \text{rstr}[s] \quad s \notin \mathcal{L}\{r\} \quad e_2 \Downarrow v}{\text{rcheck}[r](e; x, e_1; e_2) \Downarrow v}$		

Figures 3 and 4: Typing Rules and Big step semantics for  $\lambda_{RS}$

$\langle \sigma \rangle ::= \frac{\sigma \rightarrow \sigma}{\text{stringin}[r]}$	source types
$\langle e \rangle ::= \begin{array}{l} x \\ \lambda x.e \\ e(e) \\ \text{rstr}[s] \\ \text{rconcat}(e; e) \mid \text{rstrcase}(e; e; x, y, e) \\ \text{rreplace}[r](e; e) \\ \text{rcoerce}[r](e) \mid \text{rcheck}[r](e; x, e; e) \end{array}$	source terms $s \in \Sigma^*$
$\langle v \rangle ::= \lambda x.e \mid \text{rstr}[e] \mid s$	source values
$\langle \tau \rangle ::= \frac{\tau \rightarrow \tau}{\text{string} \mid \text{regex}}$	target types
$\langle \iota \rangle ::= \begin{array}{l} x \\ \lambda x.\iota \\ \iota(\iota) \\ \text{str}[s] \\ \text{rx}[r] \mid \text{concat}(\iota; \iota) \mid \text{strcase}(\iota; \iota; x, y, \iota) \mid \text{replace}(\iota; \iota; \iota) \mid \text{check}(\iota; \iota; \iota) \end{array}$	target terms
$\langle \dot{v} \rangle ::= \lambda x.\iota \mid \text{str}[s] \mid \text{rx}[r]$	target values

Figures 2 and 5: Syntax of  $\lambda_{RS}$  and  $\lambda_P$ .

$\boxed{\Theta \vdash \iota : \tau}$	$\Theta ::= \emptyset \mid \Theta, x : \tau$	
<b>P-T-VAR</b> $\frac{x : \tau \in \Theta}{\Theta \vdash x : \tau}$	<b>P-T-ABS</b> $\frac{\Theta, x : \tau_1 \vdash \iota_2 : \tau_2}{\Theta \vdash \lambda x.\iota_2 : \tau_1 \rightarrow \tau_2}$	<b>P-T-APP</b> $\frac{\Theta \vdash \iota_1 : \tau_2 \rightarrow \tau \quad \Theta \vdash \iota_2 : \tau_2}{\Theta \vdash \iota_1(\iota_2) : \tau}$
<b>P-T-STRING</b> $\Theta \vdash \text{str}[s] : \text{string}$	<b>P-T-REGEX</b> $\Theta \vdash \text{rx}[r] : \text{regex}$	<b>P-T-CONCAT</b> $\frac{\Theta \vdash \iota_1 : \text{string} \quad \Theta \vdash \iota_2 : \text{string}}{\Theta \vdash \text{concat}(\iota_1; \iota_2) : \text{string}}$
<b>P-T-CASE</b> $\frac{\Theta \vdash \iota_1 : \text{string} \quad \Theta \vdash \iota_2 : \tau \quad \Theta, x : \text{string}, y : \text{string} \vdash \iota_3 : \tau}{\Theta \vdash \text{strcase}(\iota_1; \iota_2; x, y, \iota_3) : \tau}$		
<b>P-T-REPLACE</b> $\frac{\Theta \vdash \iota_1 : \text{regex} \quad \Theta \vdash \iota_2 : \text{string} \quad \Theta \vdash \iota_3 : \text{string}}{\Theta \vdash \text{replace}(\iota_1; \iota_2; \iota_3) : \text{string}}$		
<b>P-T-CHECK</b> $\frac{\Theta \vdash \iota_r : \text{regex} \quad \Theta \vdash \iota_1 : \text{string} \quad \Theta \vdash \iota_2 : \sigma \quad \Theta \vdash \iota_3 : \sigma}{\Theta \vdash \text{check}(\iota_r; \iota_1; \iota_2; \iota_3) : \sigma}$		

$\boxed{\iota \Downarrow \dot{v}}$		
<b>P-E-ABS</b> $\lambda x.e \Downarrow \lambda x.e$	<b>P-E-APP</b> $\frac{\iota_1 \Downarrow \lambda x.\iota_3 \quad \iota_2 \Downarrow \dot{v}_2 \quad [\dot{v}_2/x]\iota_3 \Downarrow \dot{v}_3}{\iota_1(\iota_2) \Downarrow \dot{v}_3}$	<b>P-E-STR</b> $\text{str}[s] \Downarrow \text{str}[s]$
<b>P-E-RX</b> $\text{rx}[r] \Downarrow \text{rx}[r]$	<b>P-E-CONCAT</b> $\frac{\iota_1 \Downarrow \text{str}[s_1] \quad \iota_2 \Downarrow \text{str}[s_2]}{\text{concat}(\iota_1; \iota_2) \Downarrow \text{str}[s_1 s_2]}$	<b>P-E-CASE-<math>\epsilon</math></b> $\frac{\iota_1 \Downarrow \text{str}[e] \quad \iota_2 \Downarrow \dot{v}_2}{\text{strcase}(\iota_1; \iota_2; x, y, \iota_3) \Downarrow \dot{v}_2}$
<b>P-E-CASE-CONCAT</b> $\frac{\iota_1 \Downarrow \text{str}[a.s] \quad [\text{str}[a], \text{str}[s]/x, y]\iota_3 \Downarrow \dot{v}}{\text{strcase}(\iota_1; \iota_2; x, y, \iota_3) \Downarrow \dot{v}}$		
<b>P-E-REPLACE</b> $\frac{\iota_1 \Downarrow \text{rx}[r] \quad \iota_2 \Downarrow \text{str}[s_2] \quad \iota_3 \Downarrow \text{str}[s_3] \quad \text{subst}(r; s_2; s_3) = s}{\text{replace}(\iota_1; \iota_2; \iota_3) \Downarrow \text{str}[s]}$		
<b>P-E-CHECK-OK</b> $\frac{\iota_r \Downarrow \text{rx}[r] \quad \iota \Downarrow \text{str}[s] \quad s \in \mathcal{L}\{r\} \quad \iota_1 \Downarrow \dot{v}_1}{\text{check}(\iota_r; \iota; \iota_1; \iota_2) \Downarrow \dot{v}_1}$		
<b>P-E-CHECK-NOTOK</b> $\frac{\iota_r \Downarrow \text{rx}[r] \quad \iota \Downarrow \text{str}[s] \quad s \notin \mathcal{L}\{r\} \quad \iota_2 \Downarrow \dot{v}_2}{\text{check}(\iota_r; \iota; \iota_1; \iota_2) \Downarrow \dot{v}_2}$		

Figures 6 and 7: Typing rules and big step semantics for  $\lambda_P$

$\boxed{\llbracket \sigma \rrbracket = \tau}$	<b>TR-T-STRING</b> $\frac{}{\llbracket \text{stringin}[r] \rrbracket = \text{string}}$	<b>TR-T-ARROW</b> $\frac{\llbracket \sigma_1 \rrbracket = \tau_1 \quad \llbracket \sigma_2 \rrbracket = \tau_2}{\llbracket \sigma_1 \rightarrow \sigma_2 \rrbracket = \tau_1 \rightarrow \tau_2}$
$\boxed{\llbracket \Psi \rrbracket = \Theta}$	<b>TR-T-CONTEXT-EMP</b> $\frac{}{\llbracket \emptyset \rrbracket = \emptyset}$	<b>TR-T-CONTEXT-EXT</b> $\frac{\llbracket \Psi \rrbracket = \Theta \quad \llbracket \sigma \rrbracket = \tau}{\llbracket \Psi, x : \sigma \rrbracket = \Theta, x : \tau}$
$\boxed{\llbracket e \rrbracket = \iota}$	<b>TR-VAR</b> $\frac{}{\llbracket x \rrbracket = x}$	<b>TR-ABS</b> $\frac{\llbracket e \rrbracket = \iota}{\llbracket \lambda x.e \rrbracket = \lambda x.\iota}$
	<b>TR-APP</b> $\frac{\llbracket e_1 \rrbracket = \iota_1 \quad \llbracket e_2 \rrbracket = \iota_2}{\llbracket e_1(e_2) \rrbracket = \iota_1(\iota_2)}$	
	<b>TR-CASE</b> $\frac{\llbracket e_1 \rrbracket = \iota_1 \quad \llbracket e_2 \rrbracket = \iota_2 \quad \llbracket e_3 \rrbracket = \iota_3}{\llbracket \text{rstrcase}(e_1; e_2; x, y, e_3) \rrbracket = \text{strcase}(\iota_1; \iota_2; x, y, \iota_3)}$	<b>TR-STRING</b> $\frac{}{\llbracket \text{rstr}[s] \rrbracket = \text{str}[s]}$
	<b>TR-CONCAT</b> $\frac{\llbracket e_1 \rrbracket = \iota_1 \quad \llbracket e_2 \rrbracket = \iota_2}{\llbracket \text{rconcat}(e_1; e_2) \rrbracket = \text{concat}(\iota_1; \iota_2)}$	<b>TR-SUBST</b> $\frac{\llbracket e_1 \rrbracket = \iota_1 \quad \llbracket e_2 \rrbracket = \iota_2}{\llbracket \text{rreplace}[r](e_1; e_2) \rrbracket = \text{replace}(\text{rx}[r]; \iota_1; \iota_2)}$
<b>TR-SAFECOERCE</b> $\frac{}{\llbracket \text{rcoerce}[r'](e) \rrbracket = \iota}$	<b>TR-CHECK</b> $\frac{\llbracket e \rrbracket = \iota \quad \llbracket e_1 \rrbracket = \iota_1 \quad \llbracket e_2 \rrbracket = \iota_2}{\llbracket \text{rcheck}[r](e; x, e_1; e_2) \rrbracket = \text{check}(\text{rx}[r]; \iota; (\lambda x.\iota_1)(\iota_2)}$	

Figure 8: Translation from source terms ( $e$ ) to target terms ( $\iota$ ).