

Semantic Rules for WLP4

CS 241

Syntactic Categories

$E \in \{\text{expr, term, factor, lvalue}\}$ $T \in \{\text{test}\}$ $S \in \{\text{statement, statements}\}$ $\tau \in \{\text{int, int*}\}$

Type Derivation Rules

[Literals and identifiers]	$\frac{}{NUM : int}$	$\frac{}{NULL : int*}$	$\frac{\langle id, \tau \rangle \in \text{decls}}{id : \tau}$
[Parenthesized expressions]	$\frac{E : \tau}{(E) : \tau}$		
[Pointers]	$\frac{E : int}{\&E : int*}$	$\frac{E : int*}{*E : int}$	$\frac{E : int}{\text{new int } [E] : int*}$
[Addition]	$\frac{E_1 : int \quad E_2 : int}{E_1 + E_2 : int}$	$\frac{E_1 : int * \quad E_2 : int}{E_1 + E_2 : int*}$	$\frac{E_1 : int \quad E_2 : int*}{E_1 + E_2 : int*}$
[Subtraction]	$\frac{E_1 : int \quad E_2 : int}{E_1 - E_2 : int}$	$\frac{E_1 : int * \quad E_2 : int}{E_1 - E_2 : int*}$	$\frac{E_1 : int * \quad E_2 : int*}{E_1 - E_2 : int}$
[Multiplication and division]	$\frac{E_1 : int \quad E_2 : int}{E_1 * E_2 : int}$	$\frac{E_1 : int \quad E_2 : int}{E_1 / E_2 : int}$	$\frac{E_1 : int \quad E_2 : int}{E_1 \% E_2 : int}$
[Procedure calls]	$\frac{\langle f, (\tau_1, \dots, \tau_n) \rangle \in \text{function-decls} \quad E_1 : \tau_1 \quad \dots \quad E_n : \tau_n}{f(E_1, \dots, E_n) : int}$		

Type Correctness Rules

[Comparisons]	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 == E_2)}$	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 != E_2)}$	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 < E_2)}$
	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 <= E_2)}$	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 > E_2)}$	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 >= E_2)}$
[Control flow]	$\frac{\text{well-typed}(T) \quad \text{well-typed}(S)}{\text{well-typed}(\text{while } (T) \{ S \})}$	$\frac{\text{well-typed}(T) \quad \text{well-typed}(S_1) \quad \text{well-typed}(S_2)}{\text{well-typed}(\text{if } (T) \{ S_1 \} \text{ else } \{ S_2 \})}$	
	[Deallocation]	$\frac{E : \text{int}^*}{\text{well-typed}(\text{delete } [] E ;)}$	
	[Printing]	$\frac{E : \text{int}}{\text{well-typed}(\text{println } E ;)}$	
	[Assignment]	$\frac{E_1 : \tau \quad E_2 : \tau}{\text{well-typed}(E_1 = E_2 ;)}$	
	[Sequencing]	$\frac{}{\text{well-typed}(\varepsilon)}$	$\frac{\text{well-typed}(S_1) \quad \text{well-typed}(S_2)}{\text{well-typed}(S_1 S_2)}$
[Decl'ns]	$\frac{}{\text{well-typed}(\varepsilon)}$	$\frac{\text{well-typed}(dcls)}{\text{well-typed}(dcls \text{ int } id = NUM ;)}$	$\frac{\text{well-typed}(dcls)}{\text{well-typed}(dcls \text{ int}^* id = NULL ;)}$
	[Procedure]	$\frac{decl_2 : \text{int} \quad \text{well-typed}(dcls) \quad \text{well-typed}(S) \quad E : \text{int}}{\text{well-typed}(\text{int wain}(decl_1, decl_2) \{ dcls S \text{ return } E ; \})}$	
		$\frac{\text{well-typed}(dcls) \quad \text{well-typed}(S) \quad E : \text{int}}{\text{well-typed}(\text{int id}(params) \{ dcls S \text{ return } E ; \})}$	