

# COMP 2049 Languages and Computation Coursework:

## Statements in programming languages

### Task 1

- $V_2 = \{S_2, E, O\}$
- $T_2 = \{\text{while}, (, ), \text{exp}, \text{stmt}\}$
- $P_2$  is defined as:

$$\begin{aligned} S_2 &\rightarrow \text{while}(E)S \\ S &\rightarrow S_2 \mid O \\ E &\rightarrow \text{exp} \\ O &\rightarrow \text{stmt} \end{aligned}$$

#### Description::

- **S2** is the start symbol representing the while statement.
- **S** denotes a statement.
- **E** denotes an expression.
- **O** is a statement that is not a while statement
- $S_2 \rightarrow \text{while}(E)S$ : A while statement consists of the keyword **while**, followed by an expression  $E$  in parentheses, and then a statement  $S$  (which can be a while statement or any other statement).
- $S \rightarrow S_2 \mid O$ : A statement  $S$  can be a while statement  $S_2$  or another type of statement  $O$ .
- $E \rightarrow \text{exp}$ : An expression  $E$  is represented by **exp**.
- $O \rightarrow \text{stmt}$ : A non-while statement is represented by **stmt**.

### Task 2

$$\begin{aligned} V_3 &= \{S_3, E, O, \text{init}, \text{update}\} \\ T_3 &= \{\text{for}, (, ), \text{init}, \text{update}, \text{exp}, \text{stmt}\} \\ P_3 &\text{ is defined as:} \\ S_3 &\rightarrow \text{for}(\text{init}; E; \text{update})S \\ \text{init} &\rightarrow \text{exp}; |; \\ \text{update} &\rightarrow \text{exp}; |; \\ S &\rightarrow S_3 \mid O \\ E &\rightarrow \text{exp} \\ O &\rightarrow \text{stmt} \end{aligned}$$

#### Description::

- **S3** is the start symbol representing the for statement.
- **S** denotes a statement.
- **E** denotes an expression.

- $O$  is a statement that is not a for statement
- $S_3 \rightarrow \text{for}(\text{init}; E; \text{update}) S$ : A for-loop consists of the **for** keyword, followed by an optional initialization *init*, an expression *E*, an optional update *update*, and a statement *S*.
- $\text{init} \rightarrow \text{exp} \mid \varepsilon$ : The *init* part can either be an initialization (**init**) or empty ( $\varepsilon$  for optional).
- $\text{update} \rightarrow \text{exp} \mid \varepsilon$ : The *update* part can be an update (**update**) or empty ( $\varepsilon$  for optional).
- $E \rightarrow \text{exp}$ : An expression *E* is **exp**.
- $S \rightarrow S_3 \mid O$ : A statement *S* can be a for-statement ( $S_3$ ) or another type of statement *O*.
- $O \rightarrow \text{stmt}$ : A non-for statement is represented by **stmt**.

### Task 3

$V$	=	$\{S, E, O, S_1, S_2, S_3, \text{init}, \text{update}\}$
$T$	=	$\{\text{if}, \text{else}, \text{while}, \text{for}, (, ), \text{exp}, \text{stmt}, ;, \text{init}, \text{update}\}$
$P_3$	is defined as:	
$S$	$\rightarrow$	$S_1 \mid S_2 \mid S_3 \mid O$
$S_1$	$\rightarrow$	$\text{if}(E) S \mid \text{if}(E) S \text{ else } S$
$S_2$	$\rightarrow$	$\text{while}(E) S$
$S_3$	$\rightarrow$	$\text{for}(F; E; F) S$
<i>init</i>	$\rightarrow$	$\text{exp};$
<i>update</i>	$\rightarrow$	$\text{exp};$
<i>E</i>	$\rightarrow$	$\text{exp}$
<i>O</i>	$\rightarrow$	$\text{stmt}$

### Description:

- **S** represents a statement, which can be either an if-statement, while-statement, for-statement, or other types of statements.
- **S1** represents an if-statement. It can either have an else part or not.
- **S2** represents a while-statement.
- **S3** represents a for-statement, which includes optional initialization, expression, and update parts.
- **E** denotes an expression.
- **O** is a statement that is not an if, while, or for statement.
- $S \rightarrow S_1 \mid S_2 \mid S_3 \mid O$ : A statement *S* can be an **if**, **while**, **for**, or other non-**if**, **while**, or **for** statement.
- $S_1 \rightarrow \text{if}(E) S \mid \text{if}(E) \text{ else } S$ : The **if** statement with optional **else**.
- $S_2 \rightarrow \text{while}(E) S$ : The while loop.
- $S_3 \rightarrow \text{for}(F; E; F) S$ : The for loop.
- $F \rightarrow \text{init} \mid \text{update} \mid \varepsilon$ : For-initialization or update is optional in the for loop.
- $E \rightarrow \text{exp}$ : An expression *E* is **exp**.
- $O \rightarrow \text{stmt}$ : A non-**if**, non-**while**, and non-**for** statement is represented by **stmt**.