Modula-2

What is a Modula-2 union? [3 marks]

A Modula-2 program includes the following declarations:

\[
\text{TYPE} \\
\begin{align*}
\text{SymbType} & = \{\text{plus, minus, multiply, divide}\}; \\
\text{NodeType} & = \{\text{NumNode, OpNode}\}; \\
\text{NumType} & = \text{RECORD val : CARDINAL END}; \\
\text{PtrToNode} & = \text{POINTER TO Node}; \\
\text{OpType} & = \text{RECORD op : SymbType; f, s : PtrToNode END};
\end{align*}
\]

The objective is to be able to include assignment statements like:

\[
\text{test} := \text{MakeOpNode}\ (\text{multiply}, \text{MakeNumNode}(4), \\
\text{MakeOpNode}\ (\text{minus}, \text{MakeNumNode}(7), \text{MakeNumNode}(2)));
\]

The variable \text{test} is of type \text{Node}, a record in which one field is either of type \text{NumType} or of type \text{OpType}, the latter representing a dyadic operator together with pointers to its two operands.

The procedure \text{MakeNumNode} takes a single \text{CARDINAL} parameter and returns a pointer to a \text{Node} which includes a \text{NumType} field. The procedure \text{MakeOpNode} returns a pointer to a \text{Node} which includes an \text{OpType} field.

The effect of the example assignment statement is to assign to \text{test} a syntax tree which represents the expression \(4 \times (7-2)\).

Provide a suitable declaration for type \text{Node}. [5 marks]

Write the procedures \text{MakeNumNode} and \text{MakeOpNode}. [6 marks each]