grammars

main structure

$$
\begin{array}{rcl}
\mathit{program} & \rightarrow & [\mathit{constDecl}]\ [\mathit{varDecl}]\ \{[\mathit{func}1] \mid [\mathit{func}2]\}\ \mathit{main} \\
\mathit{constDecl} & \rightarrow & \textbf{const}\ \mathit{constDef}\ ;\ \{\textbf{const}\ \mathit{constDef}\ ;\} \\
\mathit{constDef} & \rightarrow & \textbf{int}\ \mathit{id} = \mathit{num}\ \{,\ \textbf{int}\ \mathit{id} = \mathit{num}\} \\
 & \mid & \textbf{char}\ \mathit{id} = \mathit{chr}\ \{,\ \textbf{char}\ \mathit{id} = \mathit{chr}\} \\
\mathit{varDecl} & \rightarrow & \mathit{varDef}\ ;\ \{\mathit{varDef}\ ;\} \\
\mathit{varDef} & \rightarrow & \mathit{type}\ (\mathit{id} \mid \mathit{id}\ [\mathit{num}])\ \{,\ (\mathit{id} \mid \mathit{id}\ [\mathit{num}])\} \\
\mathit{func}1 & \rightarrow & \mathit{type}\ \mathit{id}\ \textbf{(}\ \mathit{args}\ \textbf{)}\ \mathit{block} \\
\mathit{func}2 & \rightarrow & \mathit{void}\ \mathit{id}\ \textbf{(}\ \mathit{args}\ \textbf{)}\ \mathit{block} \\
\mathit{main} & \rightarrow & \textbf{void main ( )}\ \mathit{block} \\
\mathit{block} & \rightarrow & \{\ [\mathit{constDecls}]\ [\mathit{varDecls}]\ \mathit{stmts}\ \} \\
\mathit{stmts} & \rightarrow & \mathit{stmts}\ \mathit{stmt} \mid \epsilon \\
\mathit{stmt} & \rightarrow & \mathit{condition} \mid \mathit{loop} \mid \{\ \mathit{stmts}\ \} \\
 & \mid & \mathit{call}1 \mid \mathit{call}2 \\
 & \mid & \mathit{assign} \mid \mathit{read} \mid \mathit{write} \mid \mathit{return} \mid \epsilon \\
\mathit{assign} & \rightarrow & \mathit{loc} = \mathit{expr} \mid \mathit{loc}\ [\ \mathit{expr}\ ] = \mathit{expr} \\
\mathit{condition} & \rightarrow & \textbf{if (}\ \mathit{bool}\ \textbf{)}\ \mathit{stat}\ [\ \textbf{else}\ \mathit{stat}\ ] \\
\mathit{loop} & \rightarrow & \textbf{while (}\ \mathit{bool}\ \textbf{)}\ \mathit{stmt} \\
 & \mid & \textbf{do}\ \mathit{stmt}\ \textbf{while (}\ \mathit{bool}\ \textbf{)} \\
 & \mid & \textbf{for (}\ \mathit{assign}\ ;\ \mathit{condition}\ ;\ \mathit{assign}\ \textbf{)}\ \mathit{stmt} \\
\mathit{call}1 & \rightarrow & \mathit{id}\ \textbf{(}\mathit{values}\textbf{)} \\
\mathit{call}2 & \rightarrow & \mathit{id}\ \textbf{(}\mathit{values}\textbf{)}
\end{array}
$$

expression

$$
\begin{array}{rcl}
\mathit{bool} & \rightarrow & \mathit{bool} \mid\mid \mathit{join} \mid \mathit{join} \\
\mathit{join} & \rightarrow & \mathit{join}\ \&\&\ \mathit{equality} \mid \mathit{equality} \\
\mathit{equality} & \rightarrow & \mathit{equality}\ \ == \ \ \mathit{rel} \mid \mathit{equality}\ ! = \mathit{rel} \mid \mathit{rel} \\
\mathit{rel} & \rightarrow & \mathit{expr} < \mathit{expr} \mid \mathit{expr} <= \mathit{expr} \mid \mathit{expr} >= \mathit{expr} \mid \mathit{expr} > \mathit{expr} \mid \mathit{expr} \\
\mathit{expr} & \rightarrow & \mathit{expr} + \mathit{term} \mid \mathit{expr} - \mathit{term} \mid \mathit{term} \\
\mathit{term} & \rightarrow & \mathit{term} * \mathit{factor} \mid \mathit{term}/\mathit{factor} \mid \mathit{factor} \\
\mathit{factor} & \rightarrow & \textbf{num} \mid (\mathit{expr})
\end{array}
$$

basic block

$$
\begin{array}{rcl}
\mathit{values} & \rightarrow & \mathit{expr}\ \{,\ \mathit{expr}\}\mid\epsilon \\
\mathit{args} & \rightarrow & \mathit{type}\ \mathit{id}\ \{,\ \mathit{type}\ \mathit{id}\}\mid\epsilon \\
\mathit{read} & \rightarrow & \mathit{scanf}\ \textbf{(}\ \mathit{id}\ \{,\mathit{id}\}\textbf{)} \\
\mathit{write} & \rightarrow & \mathit{printf}\textbf{(}\ \mathit{str}\ \textbf{,}\ \mathit{expr}\ \textbf{)} \\
 & \mid & \mathit{printf}\textbf{(}\ \mathit{str}\ \textbf{)} \\
 & \mid & \mathit{printf}\textbf{(}\ \mathit{expr}\ \textbf{)} \\
\mathit{return} & \rightarrow & \mathit{return}\ [\ \textbf{(}\ \mathit{expr}\ \textbf{)}\ ] \\
\mathit{id} & \rightarrow & \mathit{letter}\ \{\mathit{letter}\mid\mathit{digit}\} \\
\mathit{type} & \rightarrow & \mathit{type}\ [\ \textbf{num}\ ]\mid\textbf{basic} \\
\mathit{letter} & \rightarrow & \_\mid\textbf{a}\mid\cdots\mid\textbf{z}\mid\textbf{A}\mid\cdots\mid\textbf{Z} \\
\mathit{digit} & \rightarrow & \textbf{1}\mid\textbf{2}\mid\cdots\mid\textbf{9}
\end{array}
$$