Most applications of the famous Power Theorem (The \texttt{Wbook}, p. 202) use expansion of tokens in \TeX’s “mouth”, and some primitive commands; the latter (in particular assignments) are done in \TeX’s “stomach” and can influence subsequent expansion.

As an example of \textbf{Lemma 2.} \TeX’s expansion alone is also powerful, the macro \texttt{\Copies} makes any number of copies of an argument by expansion. Here is the definition, to be read when \texttt{Q} is a letter:

\[
\def \befo\#1\fim{\fi\#1}
\def \holve\#1\#2\holve\#1\number\ifcase\#1\or\or\or\or\or\or\or\or\or\else\#1\fi
\ifx\#3:\else\expandafter\holve\number\fi
\def \copies\#1\#2\holve\#1\#2\fi
\def \nocopies\#1\#2\holve\#1\#2\fi
\def \Copies\#1{\befo\#1\Copies\#1\#2}
\def \Copies\#1{\befo\#1-\Copies\#1\#2}
\def \expandafter\nocopies\#1\Copies\#1\#2\fi
\def \Copies\#1\expandafter\nocopies\#1\Copies\#1\#2\fi
\def \number\holve\#1\#2\\befo\#1\#2\holve\#1\#2\fi
\def \nocopies\#1\#2\holve\#1\#2\fi
\def \Copies\#1\expandafter\nocopies\#1\Copies\#1\#2\fi
\begin{verbatim}
1. \def \befo\#1\fim{\fi\#1}
2. \def \holve\#1\#2\holve\#1\number\ifcase\#1\or\or\or\or\or\or\or\or\or\else\#1\fi
3. \ifx\#3:\else\expandafter\holve\number\fi
4. \def \copies\#1\#2\holve\#1\#2\fi
5. \def \nocopies\#1\#2\holve\#1\#2\fi
6. \def \Copies\#1{\befo\#1\Copies\#1\#2}
7. \def \Copies\#1{\befo\#1-\Copies\#1\#2}
8. \def \expandafter\nocopies\#1\Copies\#1\#2\fi
9. \def \Copies\#1\expandafter\nocopies\#1\Copies\#1\#2\fi
10. \def \number\holve\#1\#2\\befo\#1\#2\holve\#1\#2\fi
11. \def \Copies\#1{\befo\#1\Copies\#1\#2}
12. \def \Copies\#1{\befo\#1-\Copies\#1\#2}
13. \def \expandafter\nocopies\#1\Copies\#1\#2\fi
14. \def \Copies\#1\expandafter\nocopies\#1\Copies\#1\#2\fi
15. \def \number\holve\#1\#2\\befo\#1\#2\holve\#1\#2\fi
16. \chardef \n=27 \% or \newcount\n \n= \ldots
17. \edef \asts\n{\Copies\n}
\end{verbatim}

is another solution of the \texttt{\asts} problem, see \texttt{The \TeXbook}, Appendix D, section 1.

\begin{verbatim}
18. \message{\copies 79. -}
\end{verbatim}

makes a row of 79 minus signs on the screen.

\begin{verbatim}
19. $\chardef \n=4 \{1+\sqrt{5} \over 2\}=$
20. \Copies{}{1+\bgrou\n\hsize\,1\ldots}
21. \Copies{}{1+\bgrou\n\hsize\,1\ldots}
\end{verbatim}

displays the continued fraction
\[
\frac{1 + \sqrt{5}}{2} = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \ldots}}}
\]

22. \newcount\n \divi\n \by\bignoskip
23. \advance\n \by\n \n \advance\n \by\n
24. \parshape\n
25. \Copies{\#1}{\opt 0.5\hsize} \opt \hsize
\end{verbatim}
defines a paragraph shape (\texttt{The \TeXbook}, p. 101) which leaves space for a half-column picture of height \texttt{\dimen0}.

26. \Copies{\opt 0.5\hsize} \opt \hsize
\end{verbatim}
keeps \TeX’s jaw muscles busy for a few seconds and expands to 1111111111 copies of nothing.

The general syntax is
\[
\Copies{(\number)}{(\argument)}
\]

or \texttt{\copies{\integer constant}{\argument}} with \texttt{\number} and \texttt{\integer constant} as in \texttt{The \TeXbook}, p. 269. A single-token \texttt{\number} does not need the braces. \texttt{(\argument)} is an argument for an undelimited macro parameter: that is a sequence of tokens in explicit braces, or one token. The \texttt{\number} will be expanded after \texttt{\Copies} has seen it, whereas the \texttt{\integer constant} must be explicit before \texttt{\copies} is expanded. The \texttt{(\argument)} (with braces stripped off as usual) is copied as many times as the \texttt{\number} or \texttt{\integer constant} says; a negative \texttt{\number} counts 0.

Although the macros are hard to read, the way they work is easy to understand. With \texttt{\Copies}, the \texttt{\number} is expanded by \texttt{\number\holve\#1\#2\fi}: (9.1, stepping through the (decimal) digits from left to right and carrying down a 1 for an odd digit (the \texttt{\#1} will always be 0 or 1). In (6.9) \texttt{\befo\#1} removes a \texttt{\fi} (tail recursion, see \texttt{The \TeXbook} p. 219). When \texttt{\number\holve\#1\#2\fi} is complete, \texttt{\copies\#1\#2} expands again. Eventually, \texttt{\ifnum\#1>\opt 8\fi} turns false, and expansion finishes.

"Mouth & stomach" macros are usually simpler and more versatile than "pure expansion" macros. The latter are independent of grouping (20-21) and can work in a context where commands cannot be executed (17, 18, 26). For such rare occasions, \textbf{Lemma 2} can be applied successfully.

\begin{verbatim}
\end{verbatim}

\end{quote}

\begin{verbatim}
27. \Copies{\copies10.1}{\}
\end{verbatim}

\end{quote}