LAB ASSIGNMENT 1B

1. For each of the following expressions, what must \( f \) be in order for the evaluation of the expression to succeed, without causing an error? For each expression, give a definition of \( f \) such that evaluating the expression will not cause an error, and say what the expression’s value will be, given your definition.

\[
\begin{align*}
f &= \text{expression} \\
(f) &= \text{expression} \\
(f 3) &= \text{expression} \\
(((f)) &= \text{expression} \\
(((f)) 3) &= \text{expression}
\end{align*}
\]

2. Write a procedure \texttt{substitute} that takes three arguments: a sentence, an \textit{old} word, and a \textit{new} word. It should return a copy of the sentence, but with every occurrence of the old word replaced by the new word. For example:

\[
\texttt{>(substitute '(she loves you yeah yeah yeah) 'yeah 'maybe)}
\]

\[
\texttt{(she loves you maybe maybe maybe)}
\]

3. Find the values of the expressions

\[
\begin{align*}
((t s) 0) &= \text{expression} \\
((t (t s)) 0) &= \text{expression} \\
(((t t) s) 0) &= \text{expression}
\end{align*}
\]

where \( s \) is defined as \texttt{(define (s x) (+ 1 x))}, and \( t \) is defined as follows:

\[
\texttt{(define (t f)} \\
\texttt{  \ (lambda (x) (f (f (f x)))) )}
\]

Work this out yourself before you try it on the computer!

4. Consider a Scheme function \( g \) for which the expression

\[
((g) 1)
\]

returns the value 3 when evaluated. Determine how many arguments \( g \) has. In one word, also describe as best you can the \textit{type} of value returned by \( g \).

5. Write and test the \texttt{make-tester} procedure. Given a word \( w \) as argument, \texttt{make-tester} returns a procedure of one argument \( x \) that returns true if \( x \) is equal to \( w \) and false otherwise. Examples:

\[
\texttt{>(make-tester 'hal) 'hal)}
\]

\[
\texttt{#t}
\]

\[
\texttt{>(make-tester 'hal) 'cs61a)}
\]

\[
\texttt{#f}
\]

\[
\texttt{>(define sicp-author-and-astronomer? (make-tester 'gerry))}
\]

\[
\texttt{>(sicp-author-and-astronomer? 'hal)}
\]

\[
\texttt{#f}
\]

\[
\texttt{>(sicp-author-and-astronomer? 'gerry)}
\]

\[
\texttt{#t}
\]