Homework Assignment 8

Any automatically graded answer may be manually graded by the instructor. Submissions are expected to only use functions taught in the course. If a submission uses a disallowed function, that exercise can get zero points. Excluding promises, *all functions that mutate values are disallowed* (mutable functions usually have a **!** in their name).

Translating SimpleJS into LambdaJS

1. Implement the following translation function from SimpleJS into LambdaJS.

$$
\begin{aligned}
\mathsf{J}\llbracket x.y \rrbracket &\stackrel{\text{def}}{=} (\texttt{deref}\ \mathsf{x})[\texttt{"y"}] \\
\mathsf{J}\llbracket x.y := e \rrbracket &\stackrel{\text{def}}{=} \texttt{let}\ \mathsf{data} = \llbracket e \rrbracket\ \texttt{in} \\
&\quad \texttt{let}\ \mathsf{o} = (\texttt{deref}\ \mathsf{x})\ \texttt{in} \\
&\qquad \mathsf{x} := (\mathsf{o}[\texttt{"y"}] \leftarrow \mathsf{data}); \\
&\qquad \mathsf{data} \\
\mathsf{J}\llbracket x.y(e\cdots)] \rrbracket &\stackrel{\text{def}}{=} \texttt{let}\ \mathsf{m} = (\texttt{deref}\ \mathsf{x})[\texttt{"y"}]\ \texttt{in} \\
&\quad \texttt{let}\ \mathsf{f} = (\texttt{deref}\ \mathsf{m})[\texttt{"\$code"}]\ \texttt{in} \\
&\qquad \mathsf{f}(\mathsf{x}, \llbracket e\cdots \rrbracket) \\
\mathsf{J}\llbracket \texttt{function}(x\cdots)\ \{e\} \rrbracket &\stackrel{\text{def}}{=} \texttt{alloc}\ \{\texttt{"\$code"} : \lambda(\mathsf{this}, \mathsf{x}\cdots).\llbracket e \rrbracket, \texttt{"prototype"} : \texttt{alloc}\ \{\}\} \\
\mathsf{J}\llbracket \texttt{new}\ e_f(e\cdots) \rrbracket &\stackrel{\text{def}}{=} \texttt{let}\ \mathsf{ctor} = \texttt{deref}\ \llbracket e_f \rrbracket\ \texttt{in} \\
&\quad \texttt{let}\ \mathsf{obj} = \texttt{alloc}\ \{\texttt{"\$proto"} : \mathsf{ctor}[\texttt{"prototype"}]\}\ \texttt{in} \\
&\qquad \texttt{let}\ \mathsf{f} = \mathsf{ctor}[\texttt{"\$code"}]\ \texttt{in} \\
&\qquad\quad \mathsf{f}(\mathsf{obj}, \mathsf{J}\llbracket e \rrbracket\cdots); \\
&\qquad\quad \mathsf{obj} \\
\mathsf{J}\llbracket c \rrbracket &\stackrel{\text{def}}{=} c \\
\mathsf{J}\llbracket x \rrbracket &\stackrel{\text{def}}{=} \mathsf{x} \\
\mathsf{J}\llbracket \texttt{let}\ x = e_1\ \texttt{in}\ e_2 \rrbracket &\stackrel{\text{def}}{=} \texttt{let}\ \mathsf{x} = \llbracket e_1 \rrbracket\ \texttt{in}\ \llbracket e_2 \rrbracket
\end{aligned}
$$