CS320 Programming Languages
Homework #10

Due : 3 June 2019 before 2:30PM

Student id: _____ Name: _____

Rewrite the following code using explicit annotation of polymorphic types with `tyfun` and `@` to replace all the occurrences of `?` with types and to make function calls to take explicit type arguments.

$$\frac{\Gamma[\alpha] \vdash e : \tau}{\Gamma \vdash \texttt{[tyfun [}\alpha\texttt{]}\ e\texttt{]} : (\forall \alpha\ \tau)} \qquad \frac{\Gamma \vdash \tau_0 \quad \Gamma \vdash e : (\forall \alpha\ \tau_1)}{\Gamma \vdash \texttt{[@}\ e\ \tau_0\texttt{]} : \tau_1[\alpha \leftarrow \tau_0]}$$

$$\frac{\Gamma[\alpha] \vdash \tau}{\Gamma \vdash (\forall \alpha\ \tau)} \qquad [\ldots \alpha \ldots] \vdash \alpha$$

```
{with {f : ? {fun {g : ?} {fun {v : ?} {g v}}}}
      {with {g : ? {fun {x : ?} x}}
            {{f g} 10}}}
```

```
{with {f : {^alpha ^beta ((alpha -> beta) -> (alpha->beta))}
      {tyfun {alpha}
             {tyfun {beta}
                    {fun {g : (alpha -> beta)}
                         {fun {v : alpha} {g v}}}}}}
{with {g : {^alpha (alpha -> alpha)}
      {tyfun {alpha}
             {fun {x : alpha} x}}}
{{{@ {@ f num} num} {@ g num}} 10}}}
```