

Taller de Inferencia de Tipos

Machete

Paradigmas de Lenguajes de Programación

1 Algoritmo de inferencia

- $\mathbb{W}(x) \stackrel{\text{def}}{=} \{x : s\} \triangleright x : s$, s variable fresca
- $\mathbb{W}(\theta) \stackrel{\text{def}}{=} \emptyset \triangleright \theta : nat$
- $\mathbb{W}(true) \stackrel{\text{def}}{=} \emptyset \triangleright true : bool$
- $\mathbb{W}(false) \stackrel{\text{def}}{=} \emptyset \triangleright false : bool$
- $\mathbb{W}(succ(U)) \stackrel{\text{def}}{=} S\Gamma \triangleright S\ succ(M) : nat$ donde
 - $\mathbb{W}(U) = \Gamma \triangleright M : \tau$
 - $S = MGU\{\tau \doteq nat\}$
- $\mathbb{W}(pred(U)) \stackrel{\text{def}}{=} S\Gamma \triangleright S\ pred(M) : nat$ donde
 - $\mathbb{W}(U) = \Gamma \triangleright M : \tau$
 - $S = MGU\{\tau \doteq nat\}$
- $\mathbb{W}(iszero(U)) \stackrel{\text{def}}{=} S\Gamma \triangleright S\ iszero(M) : bool$ donde
 - $\mathbb{W}(U) = \Gamma \triangleright M : \tau$
 - $S = MGU\{\tau \doteq nat\}$
- $\mathbb{W}(if\ U\ then\ V\ else\ W) \stackrel{\text{def}}{=} S\Gamma_1 \cup S\Gamma_2 \cup S\Gamma_3 \triangleright S(if\ M\ then\ P\ else\ Q) : S\sigma$ donde
 - $\mathbb{W}(U) = \Gamma_1 \triangleright M : \rho$
 - $\mathbb{W}(V) = \Gamma_2 \triangleright P : \sigma$
 - $\mathbb{W}(W) = \Gamma_3 \triangleright Q : \tau$
 - $S = MGU\{\sigma \doteq \tau, \rho \doteq bool\} \cup \{\sigma_1 \doteq \sigma_2 \mid x : \sigma_1 \in \Gamma_i, x : \sigma_2 \in \Gamma_j, i \neq j\}$
- $\mathbb{W}(\lambda x.U) \stackrel{\text{def}}{=} \Gamma' \triangleright \lambda x : \tau'. M : \tau' \rightarrow \rho$ donde
 - $\mathbb{W}(U) = \Gamma \triangleright M : \rho$
 - $\tau' = \begin{cases} \alpha & \text{si } x : \alpha \in \Gamma \\ s & \text{con } s \text{ variable fresca en otro caso} \end{cases}$
 - $\Gamma' = \Gamma \ominus \{x\}$
- $\mathbb{W}(U\ V) \stackrel{\text{def}}{=} S\Gamma_1 \cup S\Gamma_2 \triangleright S(M\ N) : St$ donde
 - $\mathbb{W}(U) = \Gamma_1 \triangleright M : \tau$
 - $\mathbb{W}(V) = \Gamma_2 \triangleright N : \rho$
 - t variable fresca
 - $S = MGU\{\tau \doteq \rho \rightarrow t\} \cup \{\sigma_1 \doteq \sigma_2 \mid x : \sigma_1 \in \Gamma_1, x : \sigma_2 \in \Gamma_2\}$

2 Código auxiliar

2.1 Expresiones

```
data Exp a = VarExp Symbol |
            ZeroExp |
            SuccExp (Exp a) |
            PredExp (Exp a) |
            IsZeroExp (Exp a) |
            TrueExp |
            FalseExp |
            IfExp (Exp a) (Exp a) (Exp a) |
            LamExp Symbol a (Exp a) |
            AppExp (Exp a) (Exp a)
```

```
type Symbol = String
type PlainExp = Exp ()
type AnnotExp = Exp Type
```

2.2 Tipos

```
data Type = TVar Int | TNat | TBool | TFun Type Type
```

2.3 Contexto

```
emptyEnv :: Env
extendE :: Env -> Symbol -> Type -> Env
removeE :: Env -> Symbol -> Env
evalE :: Env -> Symbol -> Type
joinE :: [Env] -> Env
domainE :: Env -> [Symbol]
```

2.4 Sustituciones

```
emptySubst :: Subst
extendS :: Int -> Type -> Subst -> Subst
```

```
class Substitutable a where
  (<.>) :: Subst -> a -> a
  instance Substitutable Type -- subst <.> t
  instance Substitutable Env -- subst <.> env
  instance Substitutable Exp -- subst <.> e
```

2.5 Unificación

```
type UnifGoal = (Type, Type)
data UnifResult = UOK Subst | UError Type Type
mgu :: [UnifGoal] -> UnifResult
```