section *homestay* **parents** *standard_toolkit*

Contents

1 General

section *general* **parents** *homestay*

We want to have a few basic types here. We need to know general information about all of the users in the system:

- Email address, this is the unique identifier in the system
- Password, this has restrictions:
  - At least 8 characters in length
  - 1 digit
  - 1 uppercase character
  - 1 lowercase character
- First name, should be non-empty
- Last name, should be non-empty

$$[Email, Password, FirstName, LastName]$$

$$\begin{aligned} Month ::= & \ January \\ & \mid February \\ & \mid March \\ & \mid April \\ & \mid May \\ & \mid June \\ & \mid July \\ & \mid August \\ & \mid September \\ & \mid October \\ & \mid November \\ & \mid December \\ Day == & \ \mathbb{N} \\ Year == & \ \mathbb{N} \end{aligned}$$

We want to know whether or not the user is an admin or not. This is used so that they get access to certain features in the application.

$$\begin{aligned} AdminFlag ::= & \\ & Admin \\ & \mid NotAdmin \end{aligned}$$

Using these basic types we construct more complex types in the system. The applicant is the user of the system. Password tokens are used to reset the password.

$$Applicant == Email \times Password \times FirstName \times LastName \times AdminFlag$$
$$PToken == \mathbb{N} \times Email$$
$$Date == Month \times Day \times Year$$

We need to be able to notify the user of what is happening in the application. So, we enumerate the possible responses from actions taken.

$$\begin{aligned} Response ::= \\ &InvalidToken \\ &| \ PasswordResetSuccessful \\ &| \ LoginSuccessful \\ &| \ InvalidAvailability \\ &| \ ValidAvailability \end{aligned}$$

Our initial state is just a bunch of empty sets.

HomestayInitial

$$\begin{aligned} &Applicants : \mathbb{P}\, Applicant \\ &Emails : \mathbb{P}\, Email \\ &Passwords : \mathbb{P}\, Password \\ &Valid, Invalid : \mathbb{P}\, PToken \\ \hline &Applicants = \varnothing \\ &Emails = \varnothing \\ &Passwords = \varnothing \\ &Valid = Invalid = \varnothing \end{aligned}$$

In the database we need to ensure that there is each email address is unique, and that the password tokens are either valid or invalid.

HomestayDatabase

$$\begin{aligned} &HomestayInitial \\ \hline &\forall\, e_0, e_1 : Email;\ p_0, p_1 : Password;\ fn_0, fn_1 : FirstName;\ ln_0, ln_1 : LastName \bullet \\ &\qquad e_0 = e_1 \Rightarrow (p_0 = p_1 \land fn_0 = fn_1 \land ln_0 = ln_1) \\ &Valid \cap Invalid = \varnothing \end{aligned}$$

1.1 General Operators

It gets kind of silly to have to rewrite these operators and functions each time, so we have some helpers here.

We want an easy way to update an applicant. This helper function updates the applicant in the set of all applicants, identified by the email address.

function 42 **leftassoc** $(\_ \otimes \_)$

$$
\begin{array}{|l}
\_ \otimes \_ : \mathbb{P}\, Applicant \times Applicant \to \mathbb{P}\, Applicant \\
\hline
\forall\, a_1 : Applicant;\ as : \mathbb{P}\, Applicant \bullet \\
\quad \exists\, p_0, p_1 : Password; \\
\quad fn_0, fn_1 : FirstName; \\
\quad ln_0, ln_1 : LastName; \\
\quad ad_0, ad_1 : AdminFlag; \\
\quad e : Email; \\
\quad a_0 : Applicant \mid \\
\qquad a_1 = (e, p_1, fn_1, ln_1, ad_1) \land (a_0 = (e, p_0, fn_0, ln_0, ad_0) \in as) \bullet \\
\qquad\quad as \otimes a_1 = (as \setminus \{a_0\}) \cup \{a_1\}
\end{array}
$$

$$
\begin{array}{|l}
[X, Y, Z] \\
\hline
firstOf3 == \lambda\, x : X;\ y : Y;\ z : Z \bullet x \\
secondOf3 == \lambda\, x : X;\ y : Y;\ z : Z \bullet y \\
thirdOf3 == \lambda\, x : X;\ y : Y;\ z : Z \bullet z \\
\hline
\end{array}
$$

$$
\begin{array}{|l}
[X, Y, Z] \\
\hline
updateFirstOf3 : (X \times Y \times Z) \times X \to X \times Y \times Z \\
\hline
\forall\, xyz : X \times Y \times Z;\ x : X \bullet \\
\quad \exists\, x_0 : X;\ y : Y;\ z : Z \mid xyz = (x_0, y, z) \bullet \\
\qquad updateFirstOf3(xyz, x) = (x, y, z) \\
\hline
\end{array}
$$

$$
\begin{array}{|l}
[X, Y, Z] \\
\hline
updateSecondOf3 : (X \times Y \times Z) \times Y \to X \times Y \times Z \\
\hline
\forall\, xyz : X \times Y \times Z;\ y : Y \bullet \\
\quad \exists\, x : X;\ y_0 : Y;\ z : Z \mid xyz = (x, y_0, z) \bullet \\
\qquad updateSecondOf3(xyz, y) = (x, y, z) \\
\hline
\end{array}
$$

$$[X, Y, Z]$$

$$updateThirdOf3 : (X \times Y \times Z) \times Z \to X \times Y \times Z$$

$$\forall\, xyz : X \times Y \times Z;\ z : Z \bullet$$
$$\exists\, x : X;\ y : Y;\ z_0 : Z \mid xyz = (x, y, z_0) \bullet$$
$$updateThirdOf3(xyz, z) = (x, y, z)$$

We're going to Greenspun up some stuff.

$$Ord ::= LT \mid EQ \mid GT$$

$$month2Nat : Month \to \mathbb{N}$$

$$month2Nat\ January = 1 \land$$
$$month2Nat\ February = 2 \land$$
$$month2Nat\ March = 3 \land$$
$$month2Nat\ April = 4 \land$$
$$month2Nat\ May = 5 \land$$
$$month2Nat\ June = 6 \land$$
$$month2Nat\ July = 7 \land$$
$$month2Nat\ August = 8 \land$$
$$month2Nat\ September = 9 \land$$
$$month2Nat\ October = 10 \land$$
$$month2Nat\ November = 11 \land$$
$$month2Nat\ December = 12$$

2 Login

section *login* **parents** *general*

When we go to create a new account, we need some information from the user. We update all of our sets to reflect the new addition. After they have successfully created an account, they are taken to the main menu.

A person can create either a user account, or they can create an admin account. The idea is that the admin account isn't something that you can specify, but you must be given a link to sign up for. The link you follow gives the admin flag.

$$CreateAccount == CreateUserAccount \lor CreateAdminAccount$$

CreateUserAccount

$$\Delta HomestayDatabase$$
$$E? : Email$$
$$FN? : FirstName$$
$$LN? : LastName$$
$$P? : Password$$

$$E? \notin Emails$$
$$Emails' = Emails \cup \{E?\}$$
$$Passwords' = Passwords \cup \{P?\}$$
$$Applicants' = Applicants \cup \{(E?, P?, FN?, LN?, NotAdmin)\}$$
$$Valid' = Valid$$
$$Invalid' = Invalid$$

CreateAdminAccount

$$\Delta HomestayDatabase$$
$$E? : Email$$
$$FN? : FirstName$$
$$LN? : LastName$$
$$P? : Password$$
$$AD? : AdminFlag$$

$$E? \notin Emails$$
$$AD? = Admin$$
$$Emails' = Emails \cup \{E?\}$$
$$Passwords' = Passwords \cup \{P?\}$$
$$Applicants' = Applicants \cup \{(E?, P?, FN?, LN?, AD?)\}$$
$$Valid' = Valid$$
$$Invalid' = Invalid$$

To login, a user needs to enter their email and password. At this point they are taken to the main menu.

Login

$\Xi HomestayDatabase$
$E? : Email$
$P? : Password$
$FN : FirstName$
$LN : LastName$
$AD : AdminFlag$
$Resp! : Response$

$E? \in Emails$
$P? \in Passwords$
$(E?, P?, FN, LN, AD) \in Applicants$
$Resp! = LoginSuccessful$

Users can reset their password if they forget it. We take an email address, generate a password token, then dish that off to the email address. The user then finds the email with the reset token/link and proceeds to reset their password.

This is supposed to be one more step of indirection so that the user wont have their password reset at random. Of course, if the email address is already compromised, it doesn't make much difference.

ForgotPassword

$\Delta HomestayDatabase$
$E? : Email$
$T! : PToken$
$ID : \mathbb{N}$
$P : Password$
$FN : FirstName$
$LN : LastName$
$AD : AdminFlag$

$E? \in Emails$
$(E?, P, FN, LN, AD) \in Applicants$
$ID = \# Valid + \# Invalid + 1$
$T! = ID \mapsto E?$
$Valid' = Valid \cup \{ T! \}$
$Invalid' = Invalid$

Once the user has the password token, they can enter their new password. We let them know that the reset was successful.

ResetPassword

$\Delta HomestayDatabase$
$P?, P : Password$
$T? : PToken$
$Resp! : Response$
$ID : \mathbb{N}$
$E : Email$
$FN : FirstName$
$LN : LastName$
$AD : AdminFlag$
$App_0, App_1 : Applicant$

$T? \in Valid$
$E = second\ \ T?$
$Valid' = Valid \setminus \{T?\}$
$Invalid' = Invalid \cup \{T?\}$
$App_0 = (E, P, FN, LN, AD) \in Applicants$
$App_1 = (E, P?, FN, LN, AD)$
$Applicants' = Applicants \otimes App_1$
$Resp! = PasswordResetSuccessful$

3 Student

section *student* **parents** *general*

4 Host

section *host* **parents** *general*

The host section allows the user to view and modify preferences specific to hosting a location. There are some general preferences for each host, e.g. smoking, and pets. Then there are preferences for each host location, e.g. price and availability.

$$Smoking ::= EnjoysSmoking \mid NonSmoking$$
$$Pets ::= NoPets \mid YesPets$$

$$Price == \mathbb{N}$$
$$Availability == Date \times Date$$
$$HostPreference == Applicant \times Smoking \times Pets$$

EditHostSmoking

$$H?, H! : HostPreference$$
$$S? : Smoking$$
$$H! = updateSecondOf3(H?, S?)$$

EditHostPets

$$H?, H! : HostPreference$$
$$P? : Pets$$
$$H! = updateThirdOf3(H?, P?)$$

$$EditHostPreferences == EditHostSmoking \lor EditHostPets$$

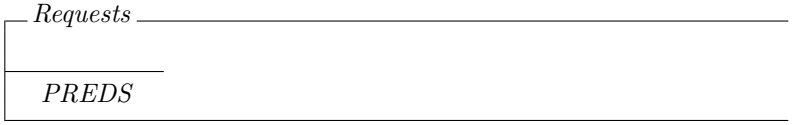
ValiDate

$A? : Availability$
$Resp! : Response$
$Start, End : Date$
$Y_0, Y_1 : Year$
$M_0, M_1 : Month$
$D_0, D_1 : Day$

$((M_0, D_0, Y_0), (M_1, D_1, Y_1)) = A?$
$(Y_0 < Y_1) \lor$
$\quad (Y_0 = Y_1 \land month2Nat\ M_0 < month2Nat\ M_1) \lor$
$\quad (Y_0 = Y_1 \land M_0 = M_1 \land D_0 < D_1)$
$Resp! = ValidAvailability$

5 Administrator

section *admin* **parents** *general*



6 Group Chat

section $group_chat$ **parents** $general$

7 Profile

section *profile* **parents** *general*