

```

1  sig Password {}
2  sig User {
3    var password : set Password
4  }
5  var sig LoggedIn in User {}
6
7  // Guess what is the behavior of this authentication concept!
8  //
9  // To check how many points you have so far you can use the different commands.
10 // The maximum is 5 points.
11
12 pred createUser [u: User, p: Password] {
13   // guard
14   // user does not have password
15   historically no u.password
16   // user is not logged
17   u not in LoggedIn
18
19   // effect
20   // set new password
21   u.password' = u.password + p
22   // there's one more user in Users set
23   User' = User + u
24
25   // frame condition
26   // user is not logged
27   LoggedIn' = LoggedIn + u
28   password' = password + (u->p)
29 }
30
31 pred deleteUser [u: User, p: Password]{
32   //guard
33   // user is logged
34   u in LoggedIn
35   // user has p as their password
36   p = u.password
37
38   //effect
39   // user has no long a password
40   password' = password - (u->p)
41   // user is not logged
42   LoggedIn' = LoggedIn - u
43 }
44
45
46 pred login [u: User, p: Password] {
47   // guard
48   // user is not logged
49   u not in LoggedIn
50   // user has p as password
51   p in u.password
52
53   // effect
54   // user is logged
55   LoggedIn' = LoggedIn + u
56
57   // frame condition
58   // password is the same
59   password' = password
60 }
61
62
63 pred logout [u: User]{
64   // guard
65   // user is logged
66   u in LoggedIn
67
68   // effect
69   // user is not logged
70   LoggedIn' = LoggedIn - u
71

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```

72 // frame condition
73 // password is the same
74 password' = password
75 }
76
77
78 pred changePassword [u : User, p : Password] {
79 //guard
80 // u is logged
81 u in LoggedIn
82 historically p not in u.password
83
84 //effect
85 // u has a new password, deleting old one
86 one o: Password | o in u.password and password' = password - (u -> o) + (u -> p)
87
88 //frame condition
89 LoggedIn' = LoggedIn
90
91 }
92
93 pred stutter {
94   LoggedIn' = LoggedIn
95   password' = password
96   User' = User
97 }
98
99
100 pred behavior {
101 //initial state: there's no logged users & there's no passwords' set
102 historically no LoggedIn
103 historically no password
104
105
106 //transitions
107 always {
108   stutter or
109   (some u : User, p: Password |
110     createUser[u,p] or
111     login[u,p] or
112     logout[u] or
113     deleteUser[u,p] or
114     changePassword[u,p])
115 }
116
117 }

```