```
#!/usr/bin/perl
# $Id: haversine.perl,v 1.4 2017-05-23 15:58:34-07 - - $

# Find distance between two airports using the haversine formula.
# http://andrew.hedges.name/experiments/haversine/
# Airport database is in prolog syntax.

use strict;
use warnings;
$0 =~ s|.*/||;

my $PI = 3.14159265358979323846264338327950288419;
my $EARTH_RADIUS_MILES = 3961;

my $database_name = ".score/database.pl";

my %database;
open DATABASE, "<$database_name" or die "$0: $database_name: $!";
while (<DATABASE>) {
   next unless m/airport\(\s*(.*?),\s*'(.*?)',\s*
                  degmin\(\s*(\d+),\s*(\d+)\s*\),\s*
                  degmin\(\s*(\d+),\s*(\d+)\s*\)\s*\)/x;
   my ($airport, $name, $nlatdeg, $nlatmin, $wlondeg, $wlonmin)
         = ($1, $2, $3, $4, $5, $6);
   $airport = uc $airport;
   $database{$airport} = [$name, $nlatdeg, $nlatmin,
                                  $wlondeg, $wlonmin];
}
close DATABASE;

sub radians ($$) {
   # Convert degrees and minutes of arc to radians.
   my ($degrees, $minutes) = @_;
   return ($degrees + $minutes / 60) * $PI / 180;
}

sub print_location(@) {
   my ($deg, $min, $dir) = @_;
   printf " %3d°%2d'%s (%6.2f°, %6.4fr)",
          $deg, $min, $dir, $deg + $min / 60, radians ($deg, $min);
}

sub print_airport($$) {
   my ($airport, $data) = @_;
   printf "%-3s (%-16s)", $airport, $$data[0];
   print_location @$data[1,2], "N";
   print_location @$data[3,4], "W";
   printf "\n";
}

for my $airport (sort keys %database) {
   print_airport $airport, $database{$airport};
}

```

```
55:
56: my $circumference = 2 * $PI * $EARTH_RADIUS_MILES;
57: printf "Earth radius:        %7.1f miles\n", $EARTH_RADIUS_MILES;
58: printf "Earth circumference: %7.1f miles\n", $circumference;
59: printf "Earth 1 degree arc:  %7.1f miles\n", $circumference / 360;
60: printf "Earth 1 minute arc:  %7.1f miles\n", $circumference / 360 / 60;
61: printf "Earth 1 radian arc:  %7.1f miles\n", $circumference / $PI / 2;
62:
63: sub haversine_distance ($$$$) {
64:    # Latitude1, longitude1 in radians.
65:    # Latitude2, longitude2 in radians.
66:    my ($lat1, $lon1, $lat2, $lon2) = @_;
67:    my $dlon = $lon2 - $lon1;
68:    my $dlat = $lat2 - $lat1;
69:    my $tmpa = (sin ($dlat / 2)) ** 2
70:             + cos ($lat1) * cos ($lat2) * (sin ($dlon / 2)) ** 2;
71:    my $unit_distance = 2 * atan2 (sqrt ($tmpa), sqrt (1 - $tmpa));
72:    my $distance_miles = $EARTH_RADIUS_MILES * $unit_distance;
73:    return $distance_miles;
74: }
75:
76: while (@ARGV >= 2) {
77:    my $airport1 = shift; $airport1 = uc $airport1;
78:    my $airport2 = shift; $airport2 = uc $airport2;
79:    my $data1 = $database{$airport1};
80:    my $data2 = $database{$airport2};
81:    warn "$0: $airport1, $airport2: invalid airport\n" and next
82:          unless $data1 && $data2;
83:    my $lat1 = radians ($data1->[1], $data1->[2]);
84:    my $lon1 = radians ($data1->[3], $data1->[4]);
85:    my $lat2 = radians ($data2->[1], $data2->[2]);
86:    my $lon2 = radians ($data2->[3], $data2->[4]);
87:    my $distance = haversine_distance ($lat1, $lon1, $lat2, $lon2);
88:    print "\nDistance:\n";
89:    print_airport $airport1, $data1;
90:    print_airport $airport2, $data2;
91:    printf "%.0f miles\n", $distance;
92: }
```

```
    1: Script started on Tue 23 May 2017 03:59:26 PM PDT
    2:
    3: bash-2$ haversine.perl lax sfo sjc nyc sfo sea
    4: ATL (Atlanta         )  33°39'N ( 33.65°, 0.5873r)  84°25'W ( 84.42°, 1.
4733r)
    5: BOS (Boston-Logan    )  42°22'N ( 42.37°, 0.7394r)  71° 2'W ( 71.03°, 1.
2398r)
    6: CHI (Chicago         )  42° 0'N ( 42.00°, 0.7330r)  87°53'W ( 87.88°, 1.
5339r)
    7: DEN (Denver-Stapleton)  39°45'N ( 39.75°, 0.6938r) 104°52'W (104.87°, 1.
8303r)
    8: DFW (Dallas-Ft.Worth )  32°54'N ( 32.90°, 0.5742r)  97° 2'W ( 97.03°, 1.
6936r)
    9: LAX (Los Angeles     )  33°56'N ( 33.93°, 0.5922r) 118°24'W (118.40°, 2.
0665r)
   10: MIA (Miami           )  25°49'N ( 25.82°, 0.4506r)  80°17'W ( 80.28°, 1.
4012r)
   11: NYC (New York City   )  40°46'N ( 40.77°, 0.7115r)  73°59'W ( 73.98°, 1.
2913r)
   12: SEA (Seattle-Tacoma  )  47°27'N ( 47.45°, 0.8282r) 122°18'W (122.30°, 2.
1345r)
   13: SFO (San Francisco   )  37°37'N ( 37.62°, 0.6565r) 122°23'W (122.38°, 2.
1360r)
   14: SJC (San Jose        )  37°22'N ( 37.37°, 0.6522r) 121°56'W (121.93°, 2.
1281r)
   15: Earth radius:         3961.0 miles
   16: Earth circumference: 24887.7 miles
   17: Earth 1 degree arc:     69.1 miles
   18: Earth 1 minute arc:      1.2 miles
   19: Earth 1 radian arc:   3961.0 miles
   20:
   21: Distance:
   22: LAX (Los Angeles     )  33°56'N ( 33.93°, 0.5922r) 118°24'W (118.40°, 2.
0665r)
   23: SFO (San Francisco   )  37°37'N ( 37.62°, 0.6565r) 122°23'W (122.38°, 2.
1360r)
   24: 339 miles
   25:
   26: Distance:
   27: SJC (San Jose        )  37°22'N ( 37.37°, 0.6522r) 121°56'W (121.93°, 2.
1281r)
   28: NYC (New York City   )  40°46'N ( 40.77°, 0.7115r)  73°59'W ( 73.98°, 1.
2913r)
   29: 2552 miles
   30:
   31: Distance:
   32: SFO (San Francisco   )  37°37'N ( 37.62°, 0.6565r) 122°23'W (122.38°, 2.
1360r)
   33: SEA (Seattle-Tacoma  )  47°27'N ( 47.45°, 0.8282r) 122°18'W (122.30°, 2.
1345r)
   34: 680 miles
   35:
   36: bash-3$ exit
   37:
   38: Script done on Tue 23 May 2017 03:59:44 PM PDT
```

```
 1: /* $Id: database.pl,v 1.1 2016-11-08 15:52:34-08 - - $ */
 2:
 3: /*
 4: * Airport Database.
 5: * For each airport:
 6: * - three-letter airport code
 7: * - name of city
 8: * - north latitude: degrees and minutes
 9: * - west longitude: degrees and minutes
10: * North latitudes and West longitudes are in degrees, minutes.
11: */
12:
13: airport( atl, 'Atlanta         ', degmin(  33,39 ), degmin(  84,25 ) ).
14: airport( bos, 'Boston-Logan    ', degmin(  42,22 ), degmin(  71, 2 ) ).
15: airport( chi, 'Chicago         ', degmin(  42, 0 ), degmin(  87,53 ) ).
16: airport( den, 'Denver-Stapleton', degmin(  39,45 ), degmin( 104,52 ) ).
17: airport( dfw, 'Dallas-Ft.Worth ', degmin(  32,54 ), degmin(  97, 2 ) ).
18: airport( lax, 'Los Angeles     ', degmin(  33,56 ), degmin( 118,24 ) ).
19: airport( mia, 'Miami           ', degmin(  25,49 ), degmin(  80,17 ) ).
20: airport( nyc, 'New York City   ', degmin(  40,46 ), degmin(  73,59 ) ).
21: airport( sea, 'Seattle-Tacoma  ', degmin(  47,27 ), degmin( 122,18 ) ).
22: airport( sfo, 'San Francisco   ', degmin(  37,37 ), degmin( 122,23 ) ).
23: airport( sjc, 'San Jose        ', degmin(  37,22 ), degmin( 121,56 ) ).
24:
25: /*
26: * Flight schedule.
27: * Flight number, departure airport, destination airport,
28: * departure time in hours, minutes.
29: */
30:
31: flight( bos, nyc, time(  7,30 ) ).
32: flight( dfw, den, time(  8, 0 ) ).
33: flight( atl, lax, time(  8,30 ) ).
34: flight( chi, den, time(  8,30 ) ).
35: flight( mia, atl, time(  9, 0 ) ).
36: flight( sfo, lax, time(  9, 0 ) ).
37: flight( sea, den, time( 10, 0 ) ).
38: flight( nyc, chi, time( 11, 0 ) ).
39: flight( sea, lax, time( 11, 0 ) ).
40: flight( den, dfw, time( 11,15 ) ).
41: flight( sjc, lax, time( 11,15 ) ).
42: flight( atl, lax, time( 11,30 ) ).
43: flight( atl, mia, time( 11,30 ) ).
44: flight( chi, nyc, time( 12, 0 ) ).
45: flight( lax, atl, time( 12, 0 ) ).
46: flight( lax, sfo, time( 12, 0 ) ).
47: flight( lax, sjc, time( 12, 0 ) ).
48: flight( nyc, bos, time( 12,15 ) ).
49: flight( bos, nyc, time( 12,30 ) ).
50: flight( den, chi, time( 12,30 ) ).
51: flight( dfw, den, time( 12,30 ) ).
52: flight( mia, atl, time( 13, 0 ) ).
53: flight( sjc, lax, time( 13,15 ) ).
54: flight( lax, sea, time( 13,30 ) ).
55: flight( chi, den, time( 14, 0 ) ).
56: flight( lax, nyc, time( 14, 0 ) ).
57: flight( sfo, lax, time( 14, 0 ) ).
58: flight( atl, lax, time( 14,30 ) ).
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59: flight( lax, atl, time( 15, 0 ) ).
60: flight( nyc, chi, time( 15, 0 ) ).
61: flight( nyc, lax, time( 15, 0 ) ).
62: flight( den, dfw, time( 15,15 ) ).
63: flight( lax, sjc, time( 15,30 ) ).
64: flight( chi, nyc, time( 18, 0 ) ).
65: flight( lax, atl, time( 18, 0 ) ).
66: flight( lax, sfo, time( 18, 0 ) ).
67: flight( nyc, bos, time( 18, 0 ) ).
68: flight( sfo, lax, time( 18, 0 ) ).
69: flight( sjc, lax, time( 18,15 ) ).
70: flight( atl, mia, time( 18,30 ) ).
71: flight( den, chi, time( 18,30 ) ).
72: flight( lax, sjc, time( 19,30 ) ).
73: flight( lax, sfo, time( 20, 0 ) ).
74: flight( lax, sea, time( 22,30 ) ).
75:
```