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#!/usr/bin/perl
# $Id: haversine.perl,v 1.7 2018-02-28 16:40:07-08 - - $

# 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°,%6.4f)",
          $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};
}

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55:
56: my $circumference = 2 * $PI * $EARTH_RADIUS_MILES;
57: printf "\n";
58: printf "Earth radius:        %7.1f miles\n", $EARTH_RADIUS_MILES;
59: printf "Earth circumference: %7.1f miles\n", $circumference;
60: printf "Earth 1 degree arc:  %7.1f miles\n", $circumference / 360;
61: printf "Earth 1 minute arc:  %7.1f miles\n", $circumference / 360 / 60;
62: printf "Earth 1 radian arc:  %7.1f miles\n", $circumference / $PI / 2;
63:
64: sub haversine_distance ($$$$) {
65:    # Latitude1, longitude1 in radians.
66:    # Latitude2, longitude2 in radians.
67:    my ($lat1, $lon1, $lat2, $lon2) = @_;
68:    my $dlon = $lon2 - $lon1;
69:    my $dlat = $lat2 - $lat1;
70:    my $tmpa = (sin ($dlat / 2)) ** 2
71:             + cos ($lat1) * cos ($lat2) * (sin ($dlon / 2)) ** 2;
72:    my $unit_distance = 2 * atan2 (sqrt ($tmpa), sqrt (1 - $tmpa));
73:    my $distance_miles = $EARTH_RADIUS_MILES * $unit_distance;
74:    return $distance_miles;
75: }
76:
77: while (@ARGV >= 2) {
78:    my $airport1 = shift; $airport1 = uc $airport1;
79:    my $airport2 = shift; $airport2 = uc $airport2;
80:    my $data1 = $database{$airport1};
81:    my $data2 = $database{$airport2};
82:    warn "$0: $airport1, $airport2: invalid airport\n" and next
83:          unless $data1 && $data2;
84:    my $lat1 = radians ($data1->[1], $data1->[2]);
85:    my $lon1 = radians ($data1->[3], $data1->[4]);
86:    my $lat2 = radians ($data2->[1], $data2->[2]);
87:    my $lon2 = radians ($data2->[3], $data2->[4]);
88:    my $distance = haversine_distance ($lat1, $lon1, $lat2, $lon2);
89:    print "\nDistance:\n";
90:    print_airport $airport1, $data1;
91:    print_airport $airport2, $data2;
92:    printf "%.0f miles\n", $distance;
93: }
```

```
 1: COMMAND: haversine.perl lax sfo sjc nyc sfo sea
 2:
 3: ATL (Atlanta          )  33°39'N( 33.65°,0.5873)  84°25'W( 84.42°,1.4733)
 4: BOS (Boston-Logan     )  42°22'N( 42.37°,0.7394)  71° 2'W( 71.03°,1.2398)
 5: CHI (Chicago          )  42° 0'N( 42.00°,0.7330)  87°53'W( 87.88°,1.5339)
 6: DEN (Denver-Stapleton)  39°45'N( 39.75°,0.6938) 104°52'W(104.87°,1.8303)
 7: DFW (Dallas-Ft.Worth )  32°54'N( 32.90°,0.5742)  97° 2'W( 97.03°,1.6936)
 8: LAX (Los Angeles      )  33°56'N( 33.93°,0.5922) 118°24'W(118.40°,2.0665)
 9: MIA (Miami            )  25°49'N( 25.82°,0.4506)  80°17'W( 80.28°,1.4012)
10: NYC (New York City    )  40°46'N( 40.77°,0.7115)  73°59'W( 73.98°,1.2913)
11: SEA (Seattle-Tacoma   )  47°27'N( 47.45°,0.8282) 122°18'W(122.30°,2.1345)
12: SFO (San Francisco    )  37°37'N( 37.62°,0.6565) 122°23'W(122.38°,2.1360)
13: SJC (San Jose         )  37°22'N( 37.37°,0.6522) 121°56'W(121.93°,2.1281)
14:
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°,0.5922) 118°24'W(118.40°,2.0665)
23: SFO (San Francisco    )  37°37'N( 37.62°,0.6565) 122°23'W(122.38°,2.1360)
24: 339 miles
25:
26: Distance:
27: SJC (San Jose         )  37°22'N( 37.37°,0.6522) 121°56'W(121.93°,2.1281)
28: NYC (New York City    )  40°46'N( 40.77°,0.7115)  73°59'W( 73.98°,1.2913)
29: 2552 miles
30:
31: Distance:
32: SFO (San Francisco    )  37°37'N( 37.62°,0.6565) 122°23'W(122.38°,2.1360)
33: SEA (Seattle-Tacoma   )  47°27'N( 47.45°,0.8282) 122°18'W(122.30°,2.1345)
34: 680 miles
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