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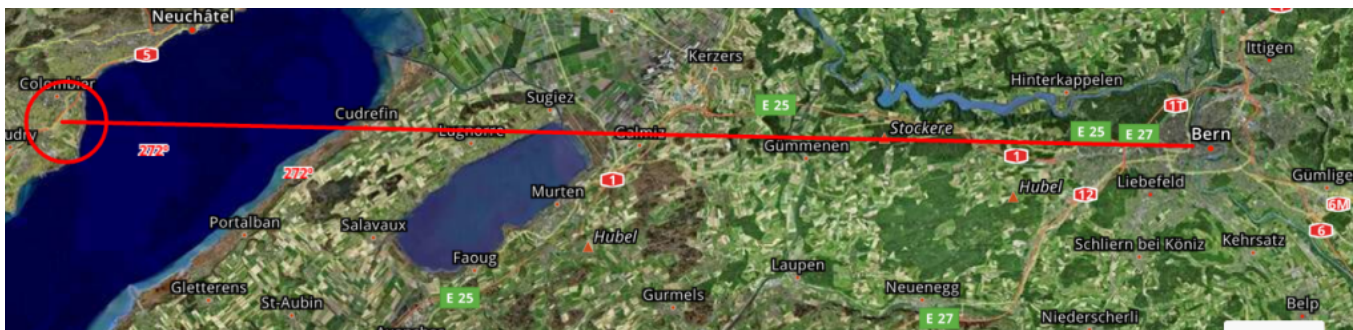
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## Air Distance and Bearing

As part of a unit on Trigonometry, we review compass and true bearings before working with bearings in Trigonometry problems.

To start this review lesson, we looked at some images from Google Earth.



Bearing 272° Switzerland Neuchatel Airport .- Distance 23.9 Nautical Miles

It is very important in aviation to have knowledge of the nearby airports at any time in flight. The task is the following:

**Determine the distance and bearing from an Airplane to the 20 nearest Airports whenever requested. Use the non-commercial data from [openflights.org airports.dat](https://openflights.org/airports.dat) as reference.**

A request comes from an airplane at position ( latitude, longitude ): ( 46.94797, 7.44745 ). This is the place where the famous Zytglogge Tower (Clock Tower) at Bern Capital of Switzerland is.

```
{"png":"https://mainfacts.com/media/images/coats_of_arms/ch.png", "svg":"https://
```

**Latitude and Longitude** are the units that represent the *coordinates at*

*geographic coordinate system.*

## Task Solution

Your report should contain the following information from table airports.dat (column shown in brackets below):

ICAO Distance Bearing Country Airport

. . .

```
LSZB 2.9 135 Switzerland Bern Belp Airport
//46.914100647,7.497149944309999
LSZP 10.6 323 Switzerland Biel-Kappelen Airport
LSZW 13.1 151 Switzerland Thun Airport
LSZG 14.1 355 Switzerland Grenchen Airport
// "ZHI", "LSZG", 47.181599, 7.41719, 1411, 1, "E", "Europe/Zurich", ts
LSGE 19.1 233 Switzerland Ecuwillens Airport
```

Name(2), Country(4), ICAO(6), Distance and Bearing calculated from Latitude(7) and Longitude(8).

```
procedure FindNearest(var testKoor:tDst_Bear;cntAirports,cntNearest:Integer);
var i: Int32;
begin
  Init_MinSol(cntNearest);
  For i:= 0 to cntAirports-1 do Begin
    testKoor.Koor2:= AirPorts[i].Sol_Koor;
    Calc_Dist_bear(testKoor);
    Insert_Sol(testKoor,i);
  end;
end;
```

Distance is measured in nautical miles (NM). Resolution is 0.1 NM.

Bearing is measured in degrees ( $^{\circ}$ ).  $0^{\circ} = 360^{\circ} =$  north then clockwise  $90^{\circ} =$  east,  $180^{\circ} =$  south,  $270^{\circ} =$  west. Resolution is  $1^{\circ}$ .

```
procedure Out_MinSol;
var
```



```

i: integer;
begin
writeln(' ICAO Distance Bearing Country      Airport');
writeln(' -----');
  For i:= 0 to minSols.actidx do
    with AirPorts[minSols.sols[i].AirportIdx] do
      writeln(Format(' %4s %8.1f %7.0f %-14s  %-35s',
                    [Sol_ICAO,
                     Sol_dist_dir.distance*DiaEarth,
                     Sol_dist_dir.bearing*cRadToDeg,
                     Sol_Country,Sol_Name]));
    end;
  writeln('');
  writeln(itoa(cntInserts)+' inserts to find them');
end;

```

The output shows distance and bearing from the point of view, in our example the Zytglogge-Tower. Bearing is the angle to the next airport:



LSZB 2.9 135 Switzerland Bern Belp Airport

3469 ms for reading airports.dat

30531 ms for searching 100 times of 20 nearest out of 7698 airports

202 inserts to find them

Nearest to latitude 46.94797,longitude 7.44745 degrees



1676,"Bern Belp Airport","Bern","Switzerland","BRN","LSZB",46.914100647,7.497149944309999,1674,1,"E"

That's what the image detector (apilayer) from the map sees:

URL\_APILAY = [https://api.apilayer.com/image\\_to\\_text/url?url=%s](https://api.apilayer.com/image_to_text/url?url=%s);

```
{
  "lang": "und",
  "all_text": "Coordinates\n50 m\n605101, 195119\n46.90716,\n7.50559\n32\nplatzstrasse\n\n...\nP",
  "annotations": [
    "Coordinates",
    "50",
    "m",
    "605101",
    ",",
    "195119",
    "46.90716",
    ",",
    "7.50559",
    "32",
    "platzstrasse",
    ",",
    "...",
    "P"
  ]
}
```

On the other side of the runway you see 14 that means  $32 - 18 = 14$  or  $140^\circ$  in the opposite direction (reciprocal calculation).

ICAO Distance Bearing Country Airport

**LSZB 2.9 135 Switzerland Bern Belp Airport**

LSZP 10.6 323 Switzerland Biel-Kappelen Airport

LSZW 13.1 151 Switzerland Thun Airport

LSZG 14.1 355 Switzerland Grenchen Airport

LSGE 19.1 233 Switzerland Ecuwillens Airport

LSZJ 20.3 314 Switzerland Courtelary Airport

LSGR 22.2 155 Switzerland Reichenbach Air Base

LSMP 22.7 254 Switzerland Payerne Air Base

**LSGN 23.9 272 Switzerland Neuchatel Airport**

LSMI 24.1 132 Switzerland Interlaken Air Base

LSTS 27.1 183 Switzerland St Stephan Airport

LSGC 28.0 287 Switzerland Les Eplatures Airport



LSGK 28.8 196 Switzerland Saanen Airport

LSMM 29.8 114 Switzerland Meiringen Airport

LSPO 29.9 37 Switzerland Olten Airport

LSPN 30.7 57 Switzerland Triengen Airport

LSZQ 31.7 328 Switzerland Bressaucourt Airport

LSZO 34.2 65 Switzerland Luzern-Beromunster Airport

LSMA 34.3 90 Switzerland Alpnach Air Base

LSGY 36.0 252 Switzerland Yverdon-les-Bains Airport

202 inserts to find them

mX4 executed: 23/02/2023 13:26:09 Runtime: 0:0:36.103 Memload: 44% use

```
OpenWeb('https://www.latlong.net/c/?lat='+flots(myKoor.lat/cDegToRad)+
'&long='+flots(myKoor.lon/cDegToRad));
```

Data: [openflights.org/data](https://openflights.org/data): Airport, airline and route data

The screenshot shows the maXbox4 ScriptStudio interface. The main editor displays Pascal code for a script named '1189\_Distance\_and\_Bearing\_Bordcomputer.pas'. The code includes constants for rounds and cntNearest, variable declarations for testKoor, myKoor, and i, and a main procedure that checks for the existence of '1189\_airports.dat' and attempts to read it. The terminal window at the bottom shows the output of the script, displaying the nearest airports to a specific latitude and longitude.

```
298 const
299   rounds = 100;
300   cntNearest = 20;//128;//8000;
301 var
302   T1,T0: Int64;
303   testKoor: tDst_Bear;
304   myKoor: tLatLon;
305   i,cntAirports: integer;
306
307 begin // @main
308   T0 := icsGettickcount64;
309   processmessagesOFF;
310   if not fileExists(exepath+'1189_airports.dat') then begin
311     wGetX2(AIRDatSource, exepath+'1189_airports.dat');
312     ShowmessageBig('airports.dat download starts..., please confirm!');
313   end;
314   IF NOT (ReadAirports(AirDatFile)) then
315     writeln('1189_airports.dat not found HALT(129)');
316
```

Interface List: 1189\_Distance\_and\_Bearing\_Bordcomputer

```
*****
procedure GetSolData(const One: TOneSol; var Sol: TOneSol);
function ReadAirports(afile: string): boolean;
procedure Out_MinSol;
procedure Int_MinSol(MaxSolCount: integer; var Sol: TOneSol);
procedure Insert_Sol(var sol: TOneSol; Dst: TDst_Bear);
procedure Calc_Dist_bear(var Dst: TDst_Bear; var Sol: TOneSol);
procedure FindNearest(var testKoor: TDst_Bear; var Sol: TOneSol);
Locs: 347 - code blocks: 7
```

Row: 303 --- Col: 3 Sel: 8295 S

```
Nearest to latitude 46.94797,longitude 7.44745 degrees
ICAO Distance Bearing Country Airport
-----
LSZB 2.9 135 Switzerland Bern Belp Airport
LSZP 10.6 323 Switzerland Biel-Kappelen Airport
LSZW 13.1 151 Switzerland Thun Airport
LSZG 14.1 355 Switzerland Grenchen Airport
LSGE 19.1 233 Switzerland Ecuwillens Airport
LSZJ 20.3 314 Switzerland Courtelary Airport
LSGR 22.2 155 Switzerland Reichenbach Air Base
```

Script: 1189\_Distance\_and\_Bearing\_Bordcomputer.pas Compiled done: 23/02/2023 13:25:35

A good discussion to start thinking about bearings, how they fit into 360°, how standards are used around the world and why true bearings are often used rather than compass bearings and what's the difference to heading.

**Heading is the direction the airplane is pointed, whereas track is the actual direction of the airplane tracking across the ground. Bearing is the angle between any two points, whereas course is your intended path of travel to your destination.**

<https://airplaneacademy.com/heading-track-bearing-and-course-explained/>

[You might also want to read [How Runways Are Designated](#)

Max Kleiner, 23/02/2023

[https://i.ytimg.com/vi/AusL233-E6E/hq720\\_2.jpg?sqp=-oaymwEdCJUDENAFSFXyq4qpAw8IARUAAIhCcAHAAQbQAQE=&rs=AOOn4CLA5MqpJNN8pTuo4XUyCyUn-vta2tA](https://i.ytimg.com/vi/AusL233-E6E/hq720_2.jpg?sqp=-oaymwEdCJUDENAFSFXyq4qpAw8IARUAAIhCcAHAAQbQAQE=&rs=AOOn4CLA5MqpJNN8pTuo4XUyCyUn-vta2tA)

GIS

Geocoding

Flight

Navigation

Maxbox4


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