Geographic Distance TEST

About

Calculates in bulk distances between two points in geographical coordinates (ϕ,λ) using:

- [Haversine formula](https://en.wikipedia.org/wiki/Haversine_formula)

- Geodesic distance using WGS84 ellipsoid

Getting started

- Install:

[Python](https://www.python.org/downloads/),

[Pandas](https://pypi.org/project/pandas/),

[pyproj](https://pypi.org/project/pyproj/)

- Insert coordinates into input.xlsx

- Run L3 Harris - Technical Task.py

THE HAVERSINE FORMULA

The **haversine formula** determines the great-circle distance between two points on a sphere given their longitudes and latitudes. Important in navigation, it is a special case of a more general formula in spherical trigonometry, the **law of haversines**, that relates the sides and angles of spherical triangles.

The first table of haversines in English was published by James Andrew in 1805,but Florian Cajori credits an earlier use by José de Mendoza y Ríos in 1801. The term haversine was coined in 1835 by James Inman.These names follow from the fact that they are customarily written in terms of the

haversine function, given by $$\mathrm{hav}(\theta) = \sin^2(\tfrac{\theta}{2})$$

The formulas could equally be written in terms of any multiple of the haversine, such as the older versine function (twice the haversine). Prior to the advent of computers, the elimination of division and multiplication by factors of two proved convenient enough that tables of haversine values and logarithms were included in 19th- and early 20th-century navigation and trigonometric texts.

These days, the haversine form is also convenient in that it has no coefficient in front of the $\sin^2$ function.
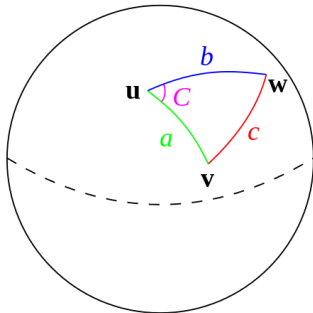
Spherical triangle solved by the law of haversines

THE WORLD GEODETIC SYSTEM

The latest revision is **WGS 84** (also known as **WGS 1984** ensemble: EPSG:4326 for 2D coordinate reference system (CRS), EPSG:4979 for 3D CRS and EPSG:4978 for geocentric 3D CRS), established and maintained by the United States National Geospatial-Intelligence Agency since 1984, and last revised in January 2021 (G2139 frame realization).] WGS 84 ensemble is static, while frame realisations have an epoch. Earlier schemes included WGS 72, WGS 66, and WGS 60. WGS 84 is the reference coordinate system used by the Global Positioning System.

As CRS standard, and expressing by URN, `urn:ogc:def:crs:EPSG::4326`, it is composed of:a standard reference ellipsoid model,named `urn:ogc:def:ellipsoid:EPSG::7030;`

- and this ellipsoid is located a standard horizontal datum, named `urn:ogc:def:datum:EPSG::6326`.

Not all frame realisations (such as G1762', 29 January 2017, GPS week 1934) are in EPSG under WGS 84, but under IGS14. G1762' was the first time IGS14 was used.
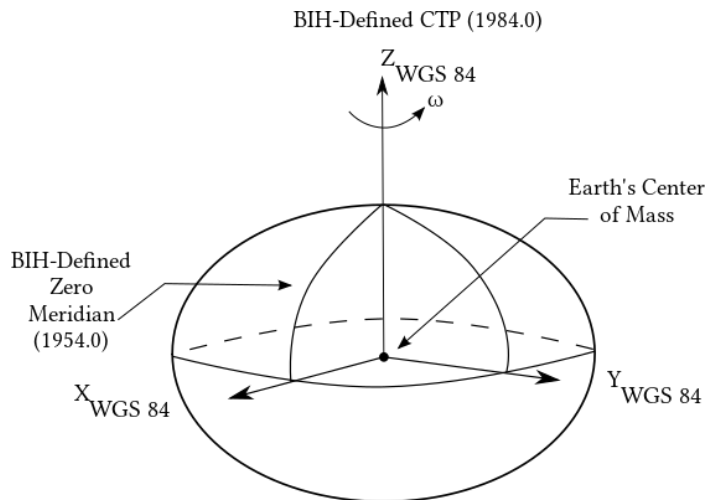

Figure 1.1   WGS 84 Reference Frame

id	x1	y1	x2	y2
1	18,59019892	-33,94923969	52,342611	0,772939
2	18,59019892	-33,94923969	52,628611	-3,153333
3	18,59019892	-33,94923969	52,072222	-0,616667
4	18,59019892	-33,94923969	51,668056	-2,056944
5	18,59019892	-33,94923969	50,331667	-5,1775
6	18,59019892	-33,94923969	50,001167	-5,230833
7	18,59019892	-33,94923969	50,835556	-0,297222
8	18,59019892	-33,94923969	53,394256	-1,388486
9	18,59019892	-33,94923969	51,4775	-0,461389
10	18,59019892	-33,94923969	50,734444	-3,413889
11	18,59019892	-33,94923969	51,874722	-0,368333
12	18,59019892	-33,94923969	54,048911	-1,252747
13	18,59019892	-33,94923969	58,215556	-6,331111
14	18,59019892	-33,94923969	51,323889	-0,8475
15	18,59019892	-33,94923969	51,404811	-3,43575
16	18,59019892	-33,94923969	57,649386	-3,560636
17	18,59019892	-33,94923969	51,187167	-1,0335
18	18,59019892	-33,94923969	52,090833	0,131944
19	18,59019892	-33,94923969	53,719667	-0,566333
20	18,59019892	-33,94923969	53,248097	-4,535339
21	18,59019892	-33,94923969	54,6575	-6,215833
22	18,59019892	-33,94923969	52,453856	-1,748028
23	18,59019892	-33,94923969	53,178056	-2,977778
24	18,59019892	-33,94923969	52,811744	-4,123575
25	18,59019892	-33,94923969	56,4635	-5,399667
26	18,59019892	-33,94923969	53,865897	-1,660569
27	18,59019892	-33,94923969	53,104167	-4,340278
28	18,59019892	-33,94923969	51,439083	-2,286389
29	18,59019892	-33,94923969	52,648353	0,550692
30	18,59019892	-33,94923969	52,369722	-1,479722
31	18,59019892	-33,94923969	51,721667	0,154167
32	18,59019892	-33,94923969	52,607778	-1,031944
33	18,59019892	-33,94923969	55,437222	-5,686389
34	18,59019892	-33,94923969	51,234139	-0,942825
35	18,59019892	-33,94923969	51,682167	-1,790028
36	18,59019892	-33,94923969	53,093014	-0,166014
37	18,59019892	-33,94923969	53,307778	-0,550833
38	18,59019892	-33,94923969	51,505278	0,055278
39	18,59019892	-33,94923969	53,834333	-1,1955

Оutput

Output_

id	y1	x1	y2	x2	d (Haversine formula)	d WGS84
1	-33.94923969	18.59019892	0.7729389999999999	52.342611	5226781.533908981	4807546.987488277
2	-33.94923969	18.59019892	-3.153333	52.628611	4914795.167826824	4625104.652245458
3	-33.94923969	18.59019892	-0.6166670000000001	52.072222	5088238.99990639	4714549.035059443
4	-33.94923969	18.59019892	-2.056944	51.668056	4936654.282630527	4609680.376597708
5	-33.94923969	18.59019892	-5.1775	50.331667	4577221.350988201	4347559.891121887
6	-33.94923969	18.59019892	-5.230833	50.001167	4548545.782039958	4319502.274052754
7	-33.94923969	18.59019892	-0.29722200000000004	50.835556	5028953.020577921	4646038.155940728
8	-33.94923969	18.59019892	-1.3884859999999999	53.394256	5118252.315643509	4770094.529360104
9	-33.94923969	18.59019892	-0.46138900000000005	51.4775	5059552.884675162	4681245.04000307
10	-33.94923969	18.59019892	-3.413889	50.734444	4754502.435498527	4469904.69226413
11	-33.94923969	18.59019892	-0.368333	51.874722	5095542.707330541	4713931.031525729
12	-33.94923969	18.59019892	-1.252747	54.048911	5177669.532516209	4825135.147486676
13	-33.94923969	18.59019892	-6.331111	58.215556	5099183.22090502	4943331.86329327
14	-33.94923969	18.59019892	-0.8475	51.323889	5015481.47179488	4649596.160631051
15	-33.94923969	18.59019892	-3.43575	51.404811	4801318.9430387365	4518638.415386685
16	-33.94923969	18.59019892	-3.560636	57.649386	5266301.04643929	5002979.372303058
17	-33.94923969	18.59019892	-1.0335	51.187167	4989840.917795221	4629930.502193366
18	-33.94923969	18.59019892	0.131944	52.090833	5153817.371631303	4755791.738257282
19	-33.94923969	18.59019892	-0.5663330000000001	53.719667	5211007.830925093	4834973.042334501
20	-33.94923969	18.59019892	-4.5353390000000005	53.248097	4847834.935693326	4606315.81822547
21	-33.94923969	18.59019892	-6.215833	54.6575	4822895.988371736	4645293.339764213
22	-33.94923969	18.59019892	-1.748028	52.453856	5019534.706620176	4682950.092874911
23	-33.94923969	18.59019892	-2.977778	53.178056	4970089.830306357	4675486.037796356
24	-33.94923969	18.59019892	-4.123575	52.811744	4848465.551380593	4591725.36286026
25	-33.94923969	18.59019892	-5.399667	56.4635	5029197.645365503	4830182.93463194