Assignment 1

1. The distance between two points on the Earth's surface can be calculated using the Haversine formula. The formula is:

\[ d = 2r \arcsin \left( \sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos \phi_1 \cos \phi_2 \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)} \right) \]

where:
- \( d \) is the distance between the two points.
- \( r \) is the radius of the Earth (approximately 6,371 km).
- \( \phi_1, \phi_2 \) are the latitudes of the two points.
- \( \lambda_1, \lambda_2 \) are the longitudes of the two points.

For example, to calculate the distance between two points with coordinates (40.7128°, -74.0060°) and (34.0522°, -118.2437°), you would substitute the values into the formula:

\[ d = 2 \times 6371 \arcsin \left( \sqrt{\sin^2\left(\frac{34.0522° - 40.7128°}{2}\right) + \cos 40.7128° \cos 34.0522° \sin^2\left(\frac{-118.2437° + 74.0060°}{2}\right)} \right) \]

2. The area of a circle can be calculated using the formula:

\[ A = \pi r^2 \]

where \( A \) is the area and \( r \) is the radius of the circle.

3. The volume of a sphere can be calculated using the formula:

\[ V = \frac{4}{3} \pi r^3 \]

where \( V \) is the volume and \( r \) is the radius of the sphere.

4. The distance between two points on the Earth's surface can also be calculated using the Vincenty formula, which is more accurate than the Haversine formula for long distances. The Vincenty formula is given by:

\[ d = \sqrt{a^2 - \cos \phi_1 \cos \phi_2 \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)} \]

where:
- \( a \) is the semi-major axis of the Earth.
- \( \phi_1, \phi_2 \) are the latitudes of the two points.
- \( \lambda_1, \lambda_2 \) are the longitudes of the two points.

5. The area of a triangle can be calculated using the formula:

\[ A = \frac{1}{2} \sin \theta \]

where \( \theta \) is the angle between the two sides of the triangle.

6. The distance between two points on the Earth's surface can also be calculated using the Great Circle Distance formula, which is the shortest distance between two points on a sphere. The formula is:

\[ d = \sqrt{a^2 - \cos \phi_1 \cos \phi_2 \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)} \]

where:
- \( a \) is the radius of the Earth.
- \( \phi_1, \phi_2 \) are the latitudes of the two points.
- \( \lambda_1, \lambda_2 \) are the longitudes of the two points.

7. The area of a triangle can be calculated using the formula:

\[ A = \frac{1}{2} \sin \theta \]

where \( \theta \) is the angle between the two sides of the triangle.

8. The distance between two points on the Earth's surface can also be calculated using the Spherical Law of Cosines formula, which is a simpler formula for calculating the distance between two points on a sphere. The formula is:

\[ d = \arcsin \left( \sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos \phi_1 \cos \phi_2 \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)} \right) \]

where:
- \( \phi_1, \phi_2 \) are the latitudes of the two points.
- \( \lambda_1, \lambda_2 \) are the longitudes of the two points.

9. The area of a triangle can be calculated using the formula:

\[ A = \frac{1}{2} \sin \theta \]

where \( \theta \) is the angle between the two sides of the triangle.

10. The distance between two points on the Earth's surface can also be calculated using the Spherical Law of Cosines formula, which is a simpler formula for calculating the distance between two points on a sphere. The formula is:

\[ d = \arcsin \left( \sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos \phi_1 \cos \phi_2 \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)} \right) \]

where:
- \( \phi_1, \phi_2 \) are the latitudes of the two points.
- \( \lambda_1, \lambda_2 \) are the longitudes of the two points.