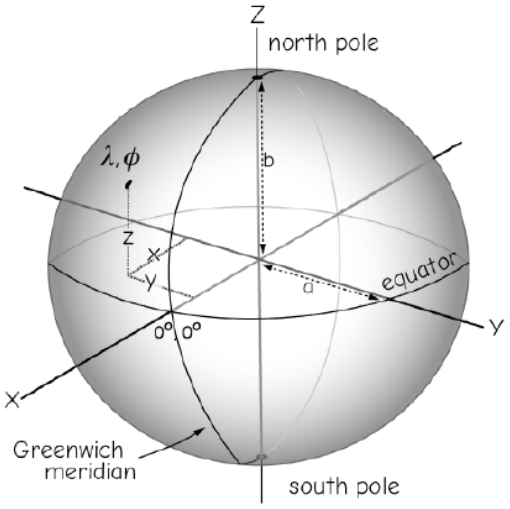
Geographic to 3D Cartesian Coordinate Conversion
Create a spreadsheet to calculate the x, y, and z coordinates for the points from last week:

St. Paul (44.9537N, 93.0900W)
Chicago, Illinois: 41.8781N, 87.6298W
New York, New York: 40.7128N, 74.0059W
Reykjavik, Iceland: 64.1265N, 21.8174W
Paris, France: 48.8566N, 2.3522 E
Buenos Aires, Argentina: 34.6037S, 58.3816W

Assume an ellipsoidal earth, using the formula shown in lecture:

Conversion Between Ellipsoidal and 3-D Cartesian Coordinates



3-D Cartesian from known latitude (ϕ), longitude (λ)

a = earth semi-major axis, b = earth semi-minor axis

h = height above ellipsoid

$$e^2 = \frac{a^2 - b^2}{a^2} \qquad \nu = \frac{a}{(1 - e^2\sin^2(\phi))^{0.5}}$$

$$X = (\nu + h) \cdot \cos(\phi) \cdot \cos(\lambda)$$

$$Y = (\nu + h) \cdot \cos(\phi) \cdot \sin(\lambda)$$

$$Z = (\nu \cdot (1 - e^2) + h) \cdot \sin(\phi)$$

Latitude, longitude from known 3-D Cartesian

ν defined as above

$$p = (x^2 + y^2)^{0.5} \qquad e'^2 = \frac{a^2 - b^2}{b^2}$$

$$\psi = \tan^{-1}\left(\frac{a \cdot Z}{b \cdot p}\right)$$

$$\text{longitude} = \tan^{-1}(y/x)$$

$$\text{latitude} = \tan^{-1}\left(\frac{Z + b \cdot e'^2 \cdot \sin^3(\psi)}{p - a \cdot e^2 \cdot \cos^3(\psi)}\right)$$

$$h = \frac{p}{\cos(\phi)} - \nu$$

As a check on your work, please also include two columns that use the inverse formulas to give latitude longitude from x, y, z.

Use a semi-major axis (a, equatorial radius) of 6,378,137 meters
Use a semi-minor axis (b, polar radius) of 6,356,752 meters
Use a height, h, of 100m

Please show the values of e and e' that you calculate

Please turn in this spreadsheet via Canvas.