Ch.2: Spherical Geometry

§ 2.10 X "out"
§ 2.12 X "out"
§ 2.14 X "out"

Examples: Page 41–44

- Example 2.1 ✓
- Example 2.2 ✓
- Example 2.3 ✓
- Example 2.7 ✓

Exercises: Page 45

Ex 2.1 Helsinki $(\phi_1, \lambda_1) = (60^\circ N, 25^\circ E)$

Seattle $(\phi_2, \lambda_2) = (48^\circ N, 122^\circ W)$

$R_\oplus = 6370\,km$

West $\equiv -$

$$\cos\psi = \sin\phi_1 \sin\phi_2 + \cos\phi_1 \cos\phi_2 \cos(\lambda_1 - \lambda_2)$$

$$= \sin(60^\circ)\sin(48^\circ) + \cos(60^\circ)\cos(48^\circ)\cos\left(25^\circ - (-122^\circ)\right)$$

$$\cos\psi = 0.363$$

$$\Rightarrow \psi \approx 68.7^\circ \cong 1.199\,rad$$

$$\text{distance} = R_\oplus \psi_{[rad]} = (6370\,km)(1.199) = 7640\,km$$

Ex 2.2 This means: $\alpha_{max} = 85^\circ$, $\alpha_{min} = 45^\circ$, find ϕ & δ

using Eq. 2.17:

$$\alpha_{max} = 90^\circ - \phi + \delta \Rightarrow 85^\circ = 90^\circ - \phi + \delta \quad (*)$$

using Eq. 2.18 $\alpha_{min} = \delta + \phi - 90^\circ \Rightarrow 45^\circ = \delta + \phi - 90^\circ \quad (**)$

we solve (*) & (**) to find that

$$\phi = 65^\circ, \ \delta = 70^\circ$$

or $\delta = 70^\circ$ and $\phi = 65^\circ$

Ex 2.5 for SUN on June 1st 1983.

$\alpha = 4h\ 35\ min = 68^\circ 45'$ "we converted to deg"

$\delta = 22^\circ\ 00'$

Find Ecliptic Latitude β and Ecliptic longitude λ.

We use Eq. (2.22) Last line: , $\varepsilon = 23^\circ 26'$

$$\sin\beta = \sin\delta\cos\varepsilon - \cos\delta\sin\varepsilon\sin\alpha$$
$$= \sin(22^\circ)\cos(23^\circ 26') - \cos(22^\circ)\sin(23^\circ 26')\sin(68^\circ 45')$$

$$\sin\beta = 0.003^\circ \approx 0^\circ \Rightarrow \boxed{\beta_\odot \approx 0^\circ}$$

to find λ, we use Eq. 2.22,

$$\cos\lambda\cos\beta = \cos\delta\cos\alpha$$
$$\cos\lambda\cos(0^\circ) = \cos(22^\circ)\cos(68^\circ 45')$$
$$\Rightarrow \cos\lambda = 0.336$$
$$\boxed{\lambda_\odot \approx 70^\circ.4}$$

for Earth "Location of observer"

$$\beta_\oplus = \beta_\odot \cong 0^\circ$$
$$\lambda_\oplus = \lambda_\odot + 180^\circ = 70^\circ.4 + 180^\circ = 250^\circ.4$$