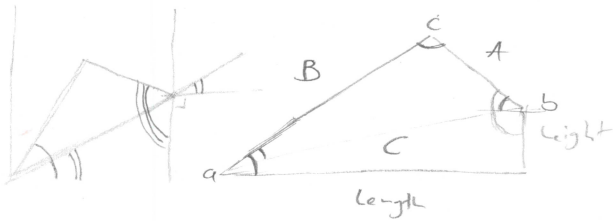


Maintaining Constant Height while changing length



known: (A, B)

measurable: a, c, b (if y) a = angle from line B to floor
 y = angle from line a to floor in interior

desired: length, height

target: C

Law of Sines & Cosines

known: A, B

measured: a, c, b (possibly)

finding: C

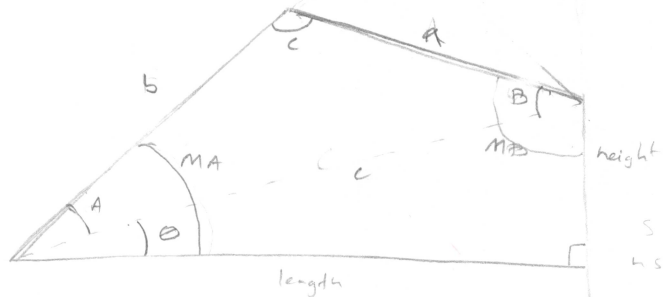
$$\frac{\sin A}{a} = \frac{\sin C}{c} \Rightarrow \frac{A}{a} = \frac{C}{c}$$

$$C = \sin C \cdot \frac{A}{\sin A}$$

finding b

$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

$$b = \sin^{-1} \left(B \cdot \frac{\sin A}{a} \right)$$



$$\text{length of } C = \sqrt{\text{height}^2 + \text{length}^2} \text{ or } C = \frac{\text{height}}{\sin \theta}$$

$$\text{or } C = \frac{\text{length}}{\cos \theta}$$

$$\text{Target angle } MA = \tan^{-1} \left(\frac{\text{height}}{\text{length}} \right) + a$$

Finding Target angles:

MA given target height & length, lengths A & B

$$MA = \theta + \alpha \quad \theta = \tan^{-1} \left(\frac{\text{height}}{\text{length}} \right)$$

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

given target height & length, $C = \sqrt{\text{height}^2 + \text{length}^2}$

finding angle C : SAS

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$C = \cos^{-1} \left(\frac{a^2 + b^2 - (\text{height}^2 + \text{length}^2)}{2a \cdot b} \right)$$

$$\cos A = \left(\frac{b^2 + c^2 - a^2}{2bc} \right)$$

known: b, c (length, height)
 known: a (length)
 unknown: A (angle)

$$MA = \tan^{-1} \left(\frac{\text{height}}{\text{length}} \right) + \cos^{-1} \left(\frac{b^2 + \text{height}^2 + \text{length}^2 - a^2}{2 \cdot b \cdot \sqrt{\text{height}^2 + \text{length}^2}} \right)$$

$$MB = \tan^{-1} \left(\frac{\text{length}}{\text{height}} \right) + \cos^{-1} \left(\frac{\text{height}^2 + \text{length}^2 + a^2 - b^2}{2 \cdot a \cdot \sqrt{\text{height}^2 + \text{length}^2}} \right)$$

$$\text{target angle } C = \cos^{-1} \left(\frac{a^2 + b^2 - (\text{height}^2 + \text{length}^2)}{2 \cdot a \cdot b} \right)$$

Now to put this into code