POW 1257: Given point P inside blue triangle with sides L_i, and angles θ_i between red rays, compute red ray lengths r_i i=1,2,3.

https://math.stackexchange.com/questions/1965002/calculate-position-based-on-angles-between-three-known-points

Cyclically permute indices (i,j,k)=(1,2,3) in the following equations, to get three circles that intersect at point P inside blue triangle.

$R_i = L_i / (2*\cos(\theta_i - \pi/2))$, the radius of circle through points P, v_j, v_k, centered at point O_i.

$D_i = -(L_i/2)/\tan(\theta_i)$, the signed shortest distance from point O_i to triangle leg of length L_i.

$b_i = \mathrm{acos}((L_j^2 + L_k^2 - L_i^2)/(2*L_j*L_k))$, interior angle at vertex v_i of blue triangle.

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v1 = [0;0]
v2 = L3*[1, 0]
v3 = L2*[cos(b1), sin(b1)]
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Let $J = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$

then 3 green circle centers are: $O_i = (v_j+v_k)/2 + D_i*J*(v_j-v_k)/L_i$

Three equations for three green circles that intersect at point P: $\| P - O_i \|^2 = R_i^2$

Expand these three equations to get: $\|P\|^2 - 2*O_i^T*P + \|O_i\|^2 = R_i^2$

Subtract pairs of 3 quadratics to get 2 linear equations: $2*(O_j-O_i)^T*P + \|O_i\|^2 - \|O_j\|^2 = R_i^2 - R_j^2$

Put these two linear equations for two components of P, into a matrix equation:

$$2*[O_1-O_2, O_2-O_3]^T*P = \begin{bmatrix} R_2^2-R_1^2 + \|O_1\|^2-\|O_2\|^2 \\ R_3^2-R_2^2 + \|O_2\|^2-\|O_3\|^2 \end{bmatrix}$$

Solve 2x2 matrix equation for point P, then $r_i = \|P - v_i\|$.

If largest r_i is smaller than sum of other two, then lengths r_1,r_2,r_3 form a new triangle.

Solve for angles of new triangle, using law of cosines.