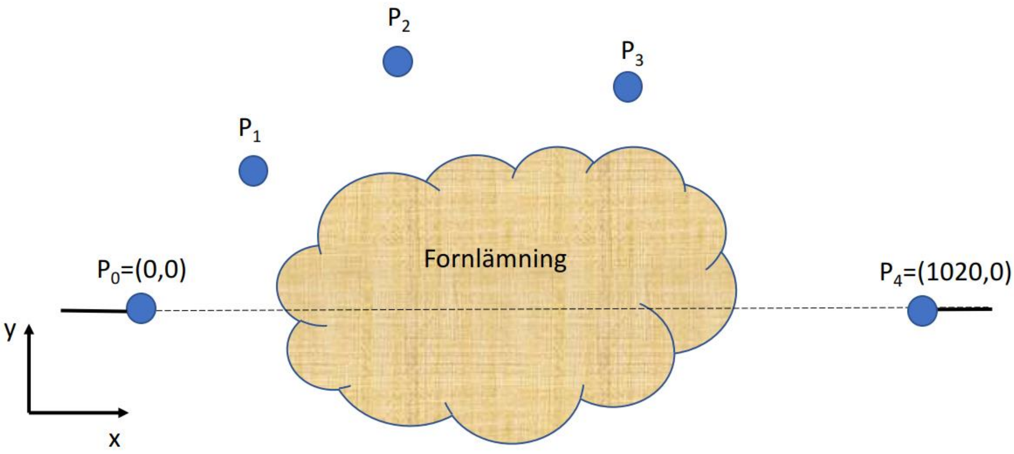

The coordinates of P0 = (0, 0) and of P4 = (1020, 0) are known but the coordinates of the points P1, P2 and P3 must be determined.

To determine the coordinates of a point P, measure the distances from P = (xP, yP) to two points with known coordinates, A = (xA, yA) and B = (xB, yB).

If we call the distances between P and A and P and B LA and LB respectively, we get the following equation system where the equations describe two circles with centers in A and B and with radii given by LA and LB.

$$\sqrt{(x_P - x_A)^2 + (y_P - y_A)^2} = L_A \tag{1}$$
$$\sqrt{(x_P - x_B)^2 + (y_P - y_B)^2} = L_B. \tag{2}$$

This system of equations has two solutions (intersection points) where there are two points, P and Q, which are both at the same distance from points A and B. In this case it is point P, the right intersection we are interested in. See Figure 2.

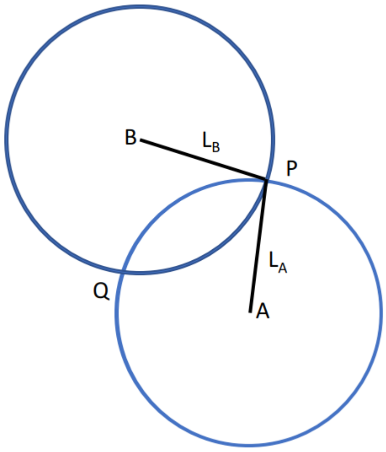

Figure 2: Determination of coordinates for the point P with binding. The coordinates of the points A and B and the lengths LA and LB are known.

1a) Start by determining the coordinates (with the appropriate tolerance) for points P1, P2 and P3 using binding. For each point, a non-linear system of equations must correspond (1) - (2) is solved by Newton's method. Initial values are determined by drawing the circles.

The table below shows points A and B with known coordinates and measured distances between A and P and B and P for points P1, P2 and P3.

The coordinates are given in meters from the point (0, 0).

The program should not use code repetition. Use a **for-loop** for the three points. **Report the coordinates and that Newton's method converges squarely.**

P	$A = (x_A, y_A)$	$B = (x_B, y_B)$	L_A [m]	L_B [m]
P_1	(175, 950)	(160, 1008)	60	45
P_2	(410, 2400)	(381, 2500)	75	88
P_3	(675, 1730)	(656, 1760)	42	57

1b) Determine the fourth degree polynomial, p (x), which passes through the five points P0, P1, P2, P3 and P4. **Draw the path (graph of the polynomial) for x ∈ (0, 1020). Also draw the five the interpolation points and mark them with 'o'. Report the coefficients in the polynomial and the figure with the plotted path and the interpolation points.**

1c) Calculate the length of the new road from the point (0, 0) to the point (1020, 0). Use the trapezoidal rule with the appropriate step length. **Report the length of the road and that your implementation of the trapezoidal rule has an accuracy order 2. Tip: how do you calculate the arc length of a curve?**

1d) Assume the lengths LA and LB have an uncertainty of ± 5 m. **Calculate the uncertainty length on the road with experimental disturbance calculation. Report the uncertainty in the length calculation.**

Tip: For the experimental disturbance count, the code that solves a) -c) is packaged in a "**black box** "(a Matlab function) that takes LA and LB for the three points that input and gives the length of the path as output.