Circle placement in a half-circle

Solve the following optimization problem

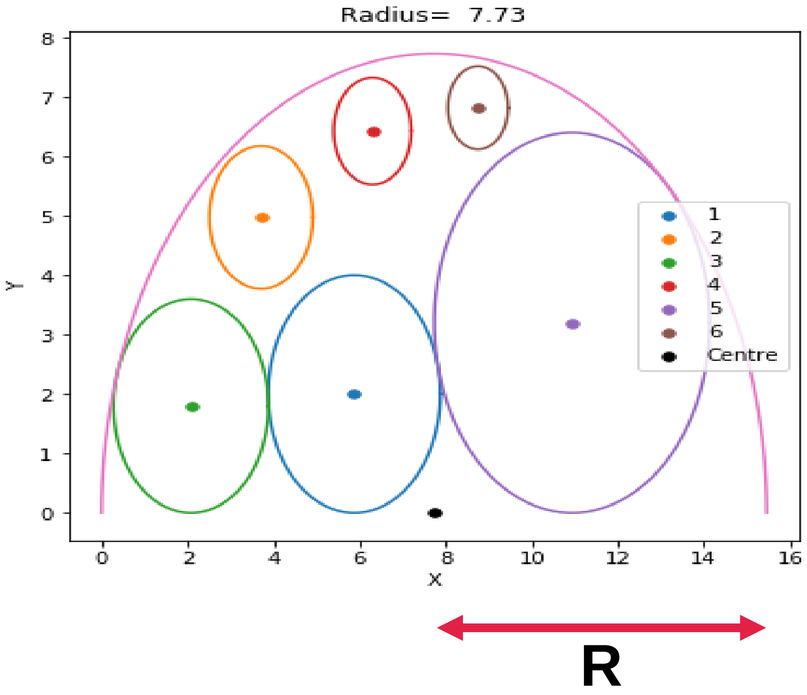
Allocate N circles with known radiuses in a half circle without overlapping each other

$$\min R$$

$$\forall_{i,j} \quad (x_i - x_j)^2 + (y_i - y_j)^2 \geq (r_i + r_j)^2$$

$$\forall_i \quad (x_i - R)^2 + (y_i - 0)^2 \leq (R - r_i)^2$$

$$\forall_i \quad r_i \leq y_i$$



Ex33B