Game Design
Car Parking Game

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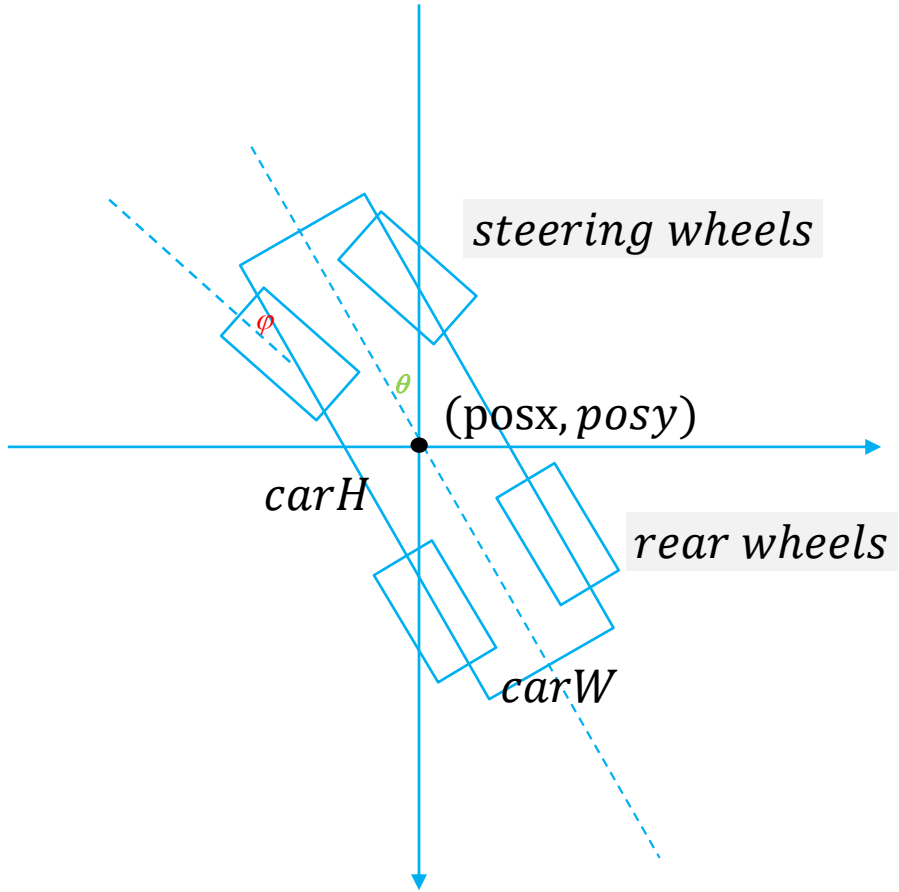
Outline

- Analysis
- Turn left
- Turn right
- Forward
- Backward
- Get the car boundaries
- Parking

Car

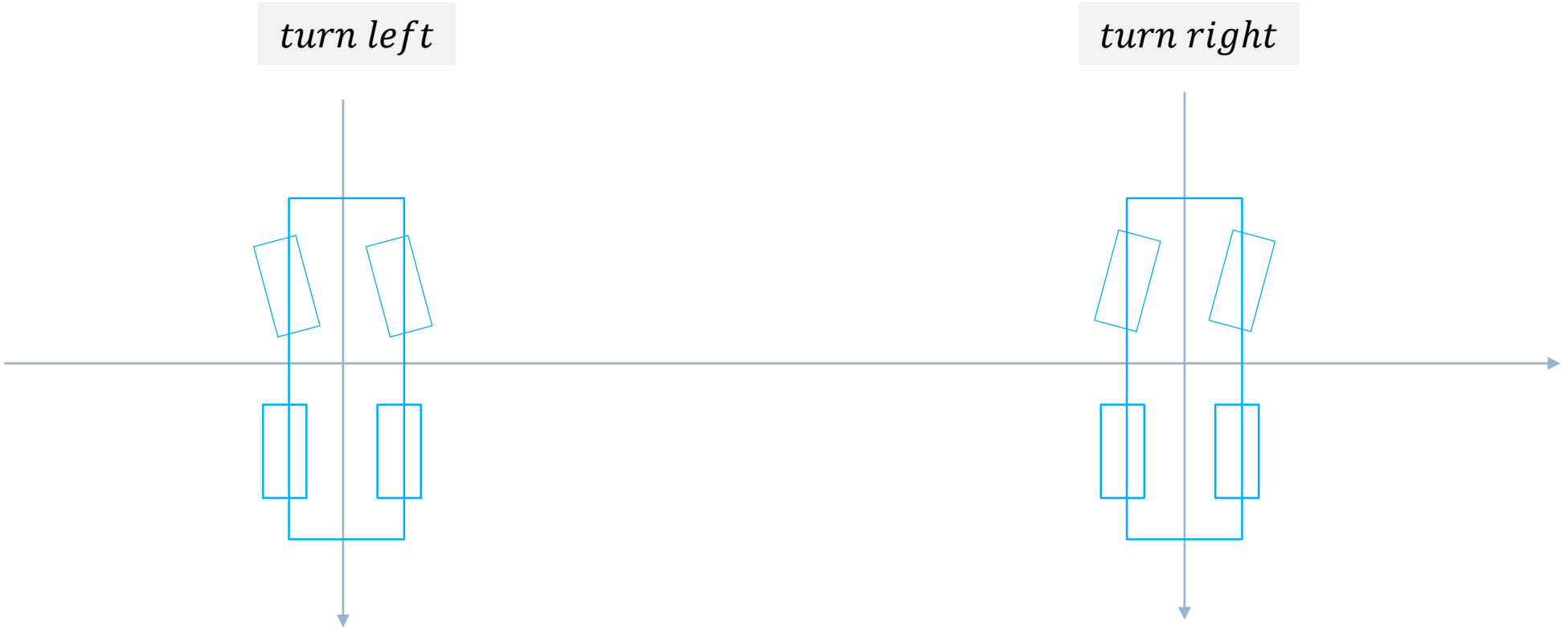
- CarSystem (posx, posy, Wdir, Cdir, carW, carH)
  - width of the car: carW
  - height of the car: carH
  - position of the car: posx, posy
  - car direction: θ
  - wheel direction
    - steering wheels: $\theta + \varphi$
    - rear wheels: θ

Front-wheel drive



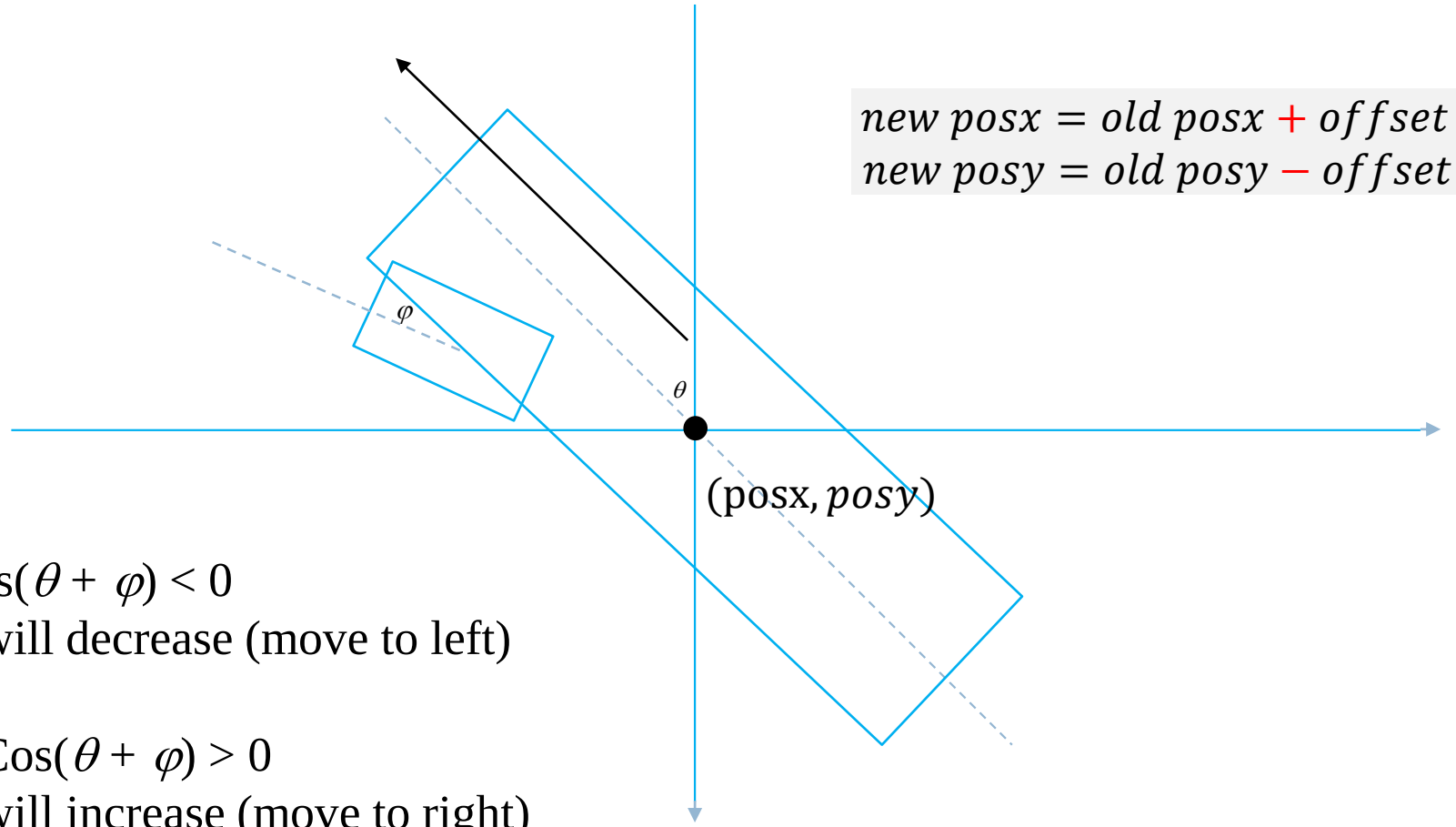
Turn left / right

- wheel direction is changed, but car direction isn't changed



Forward

- posx and posy are changed



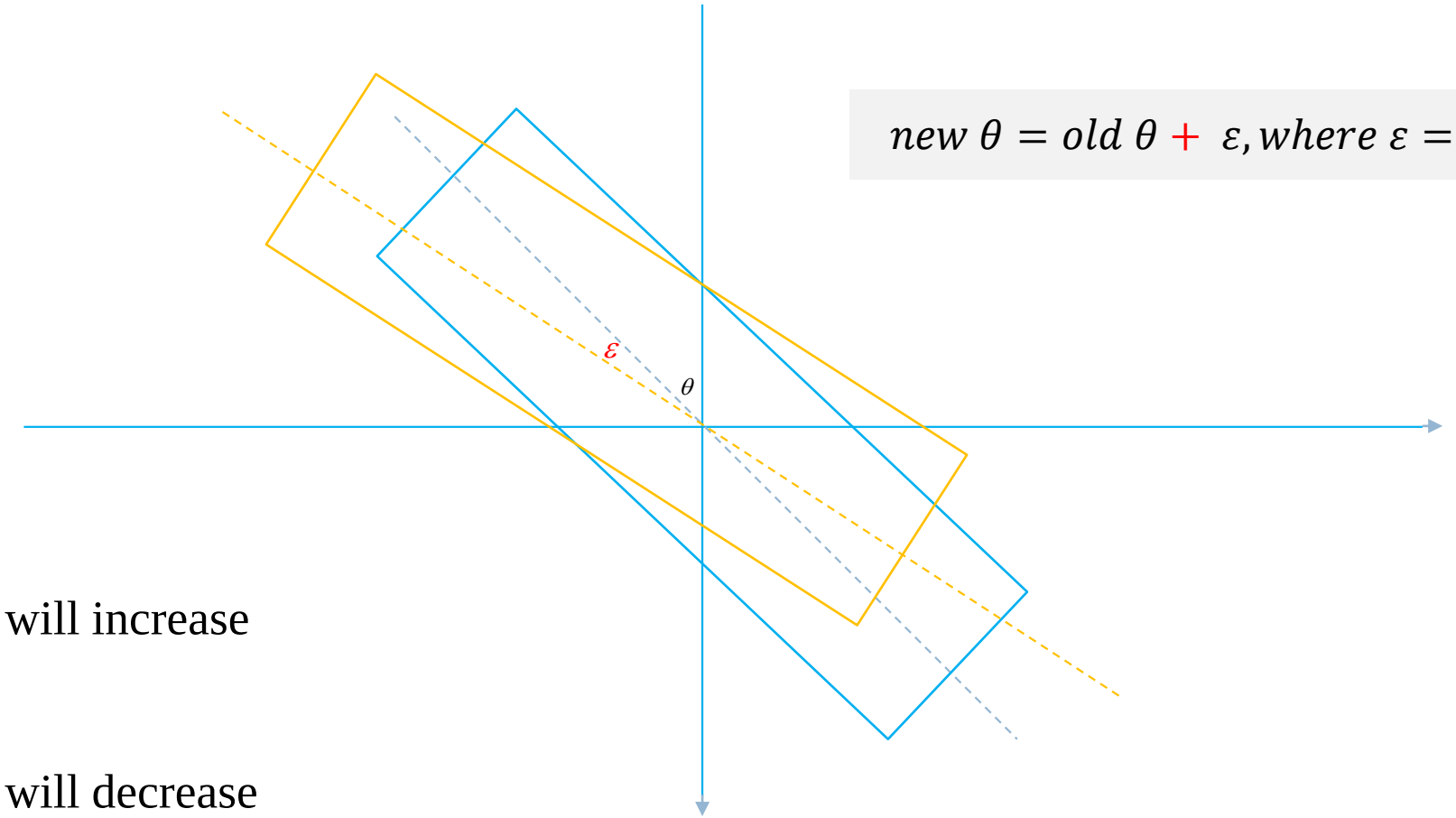
$$new\ posx = old\ posx + offset * \cos(\theta + \varphi)$$
$$new\ posy = old\ posy - offset * \sin(\theta + \varphi)$$

Turn left: $\theta + \varphi > 90°$, $\text{Cos}(\theta + \varphi) < 0$
Therefore, the new posx will decrease (move to left)

Turn right: $\theta + \varphi < 90°$, $\text{Cos}(\theta + \varphi) > 0$
Therefore, the new posx will increase (move to right)

Forward (cont'd)

- car direction is also changed (related to φ)



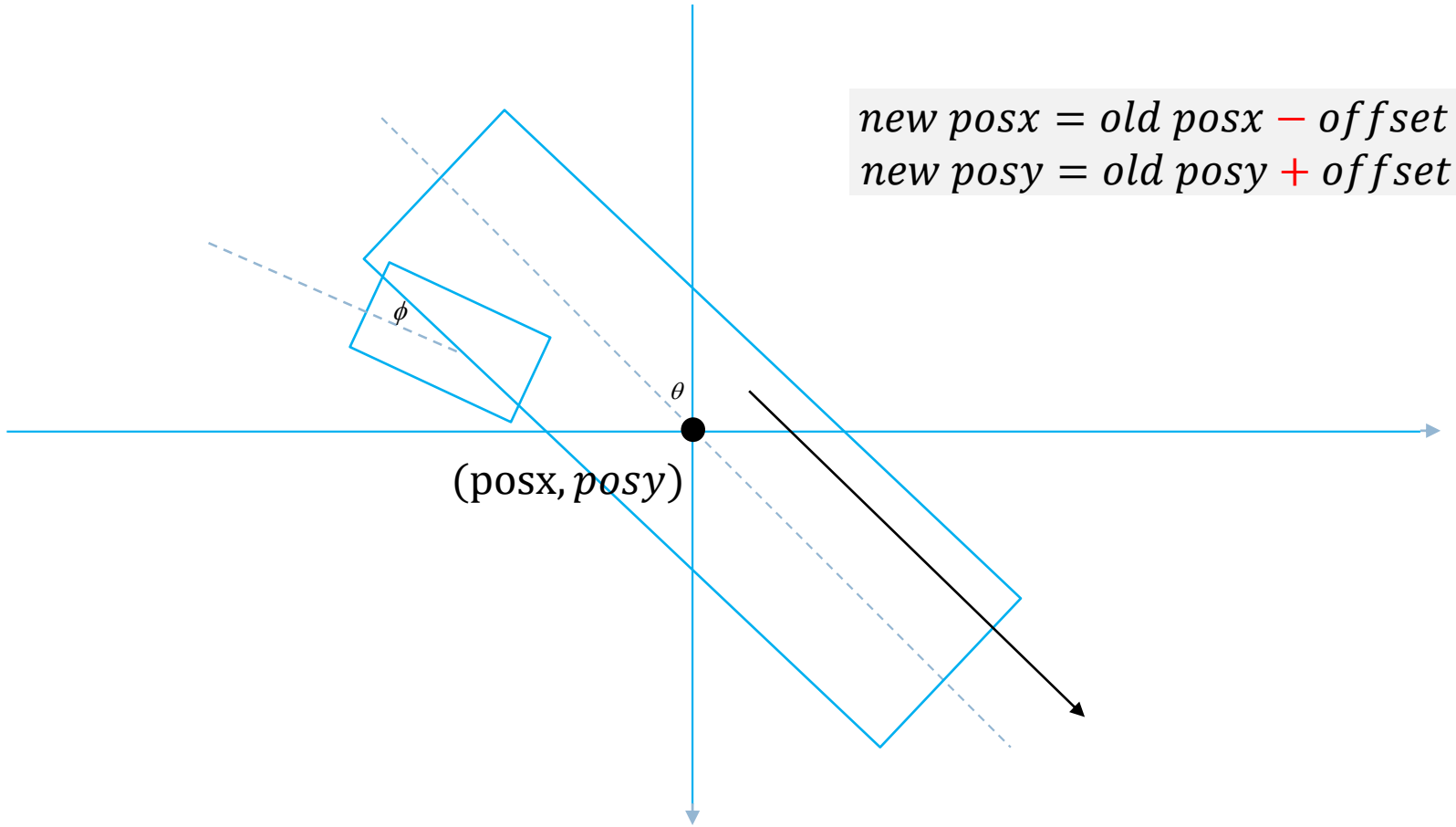
$$new\ \theta = old\ \theta + \varepsilon, where\ \varepsilon = \frac{\varphi}{100}$$

Turn left: $\varepsilon > 0$
Therefore, car direction will increase

Turn right: $\varepsilon < 0$
Therefore, car direction will decrease

Backward (opposite operation of forward)

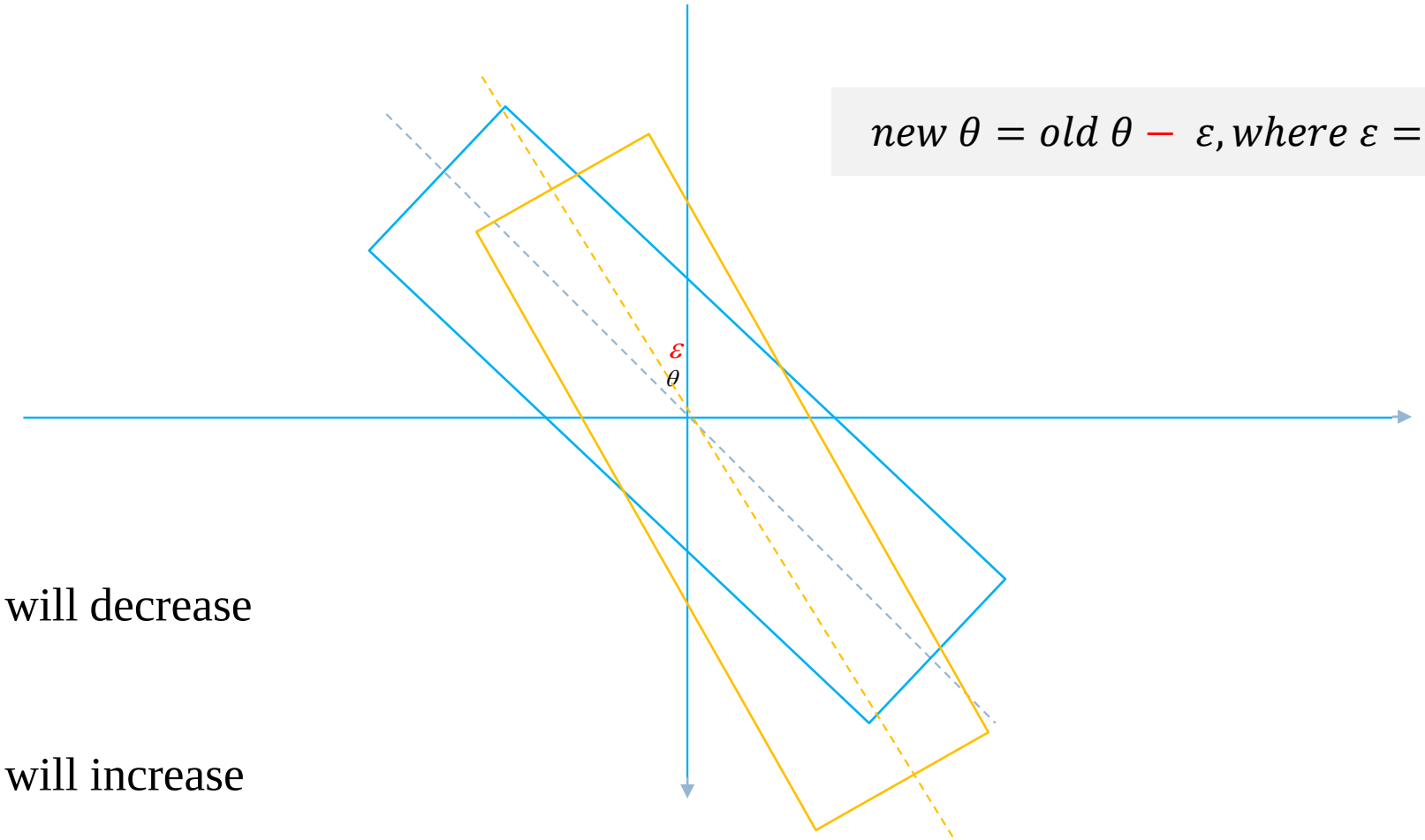
- posx and posy are changed



$$new\ posx = old\ posx - offset * \cos(\theta + \varphi)$$
$$new\ posy = old\ posy + offset * \sin(\theta + \varphi)$$

Backward (cont'd)

- car direction is also changed (related to φ)

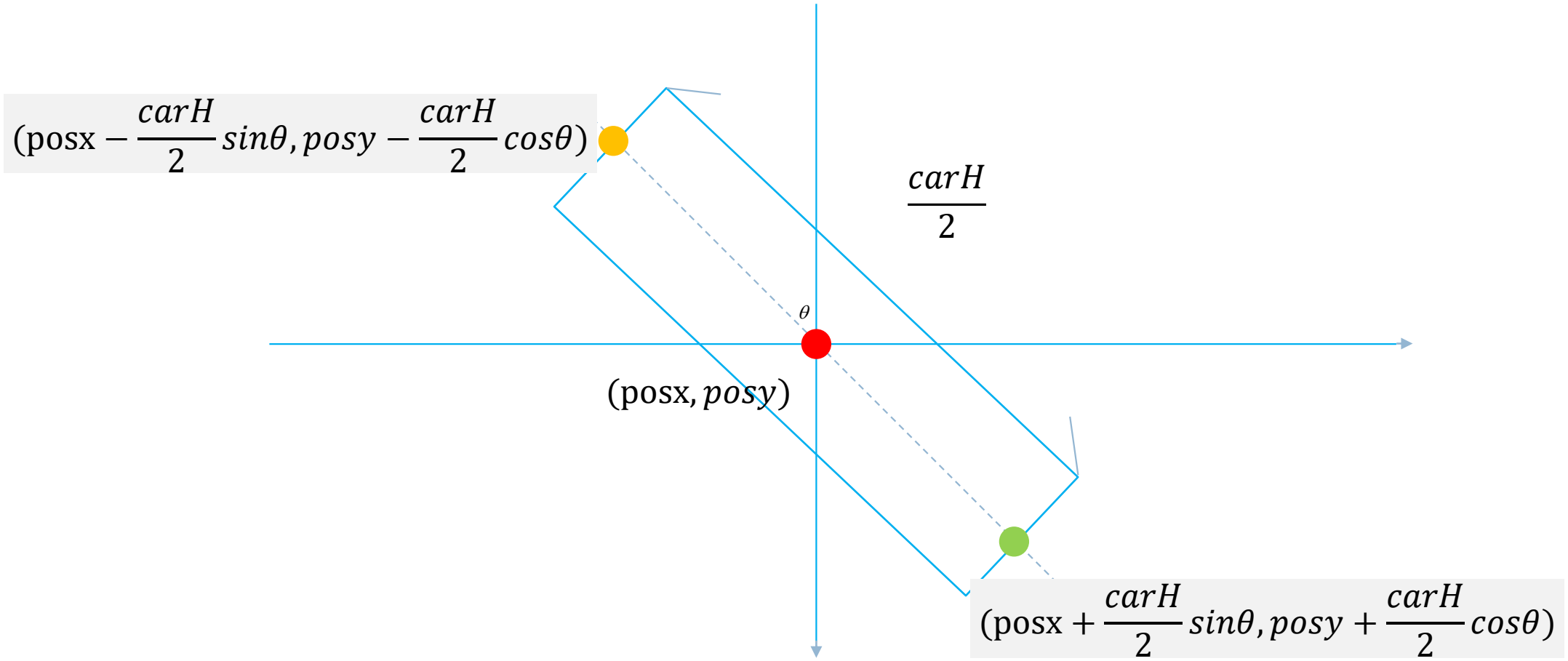


$$new\ \theta = old\ \theta - \varepsilon, where\ \varepsilon = \frac{\varphi}{100}$$

Turn left: $\varepsilon > 0$
Therefore, car direction will decrease

Turn right: $\varepsilon < 0$
Therefore, car direction will increase

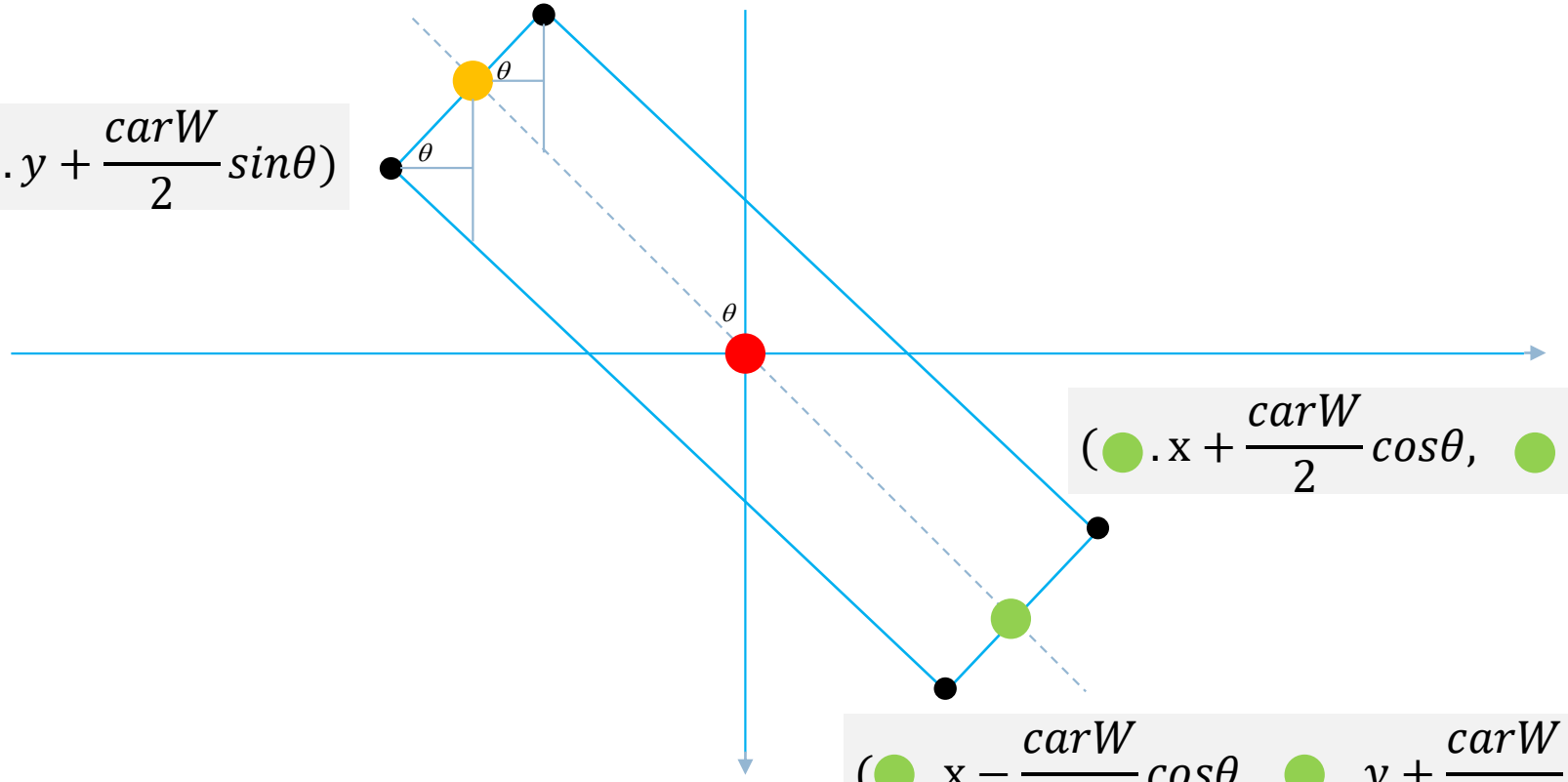
Get boundaries (turn left)



Four boundaries of the car (turn left)

$$(\text{●}.x + \frac{carW}{2}cos\theta,\ \ \text{●}.y - \frac{carW}{2}sin\theta)$$

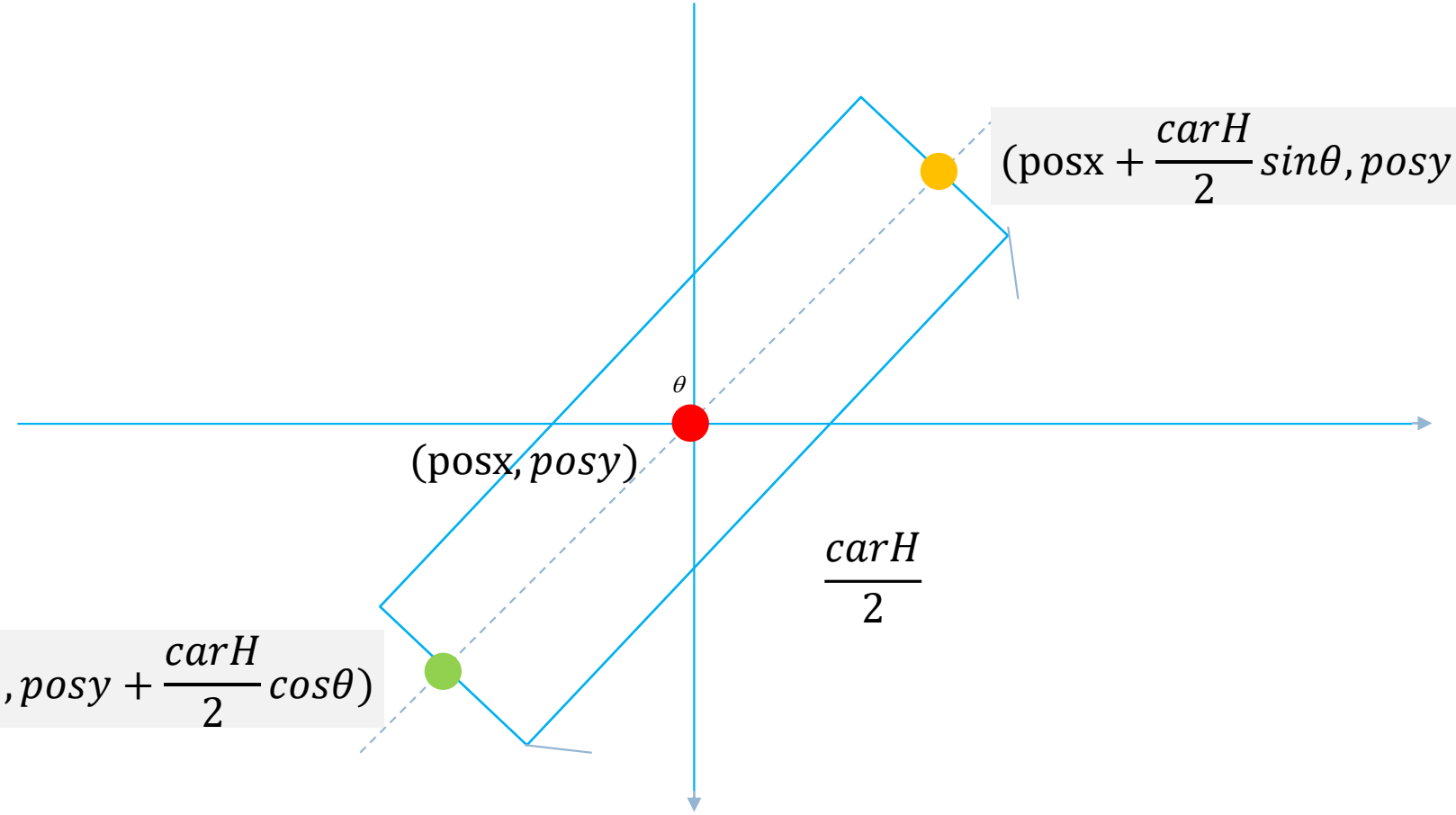
$$(\text{●}.x - \frac{carW}{2}cos\theta,\ \ \text{●}.y + \frac{carW}{2}sin\theta)$$



$$(\text{●}.x + \frac{carW}{2}cos\theta,\ \ \text{●}.y - \frac{carW}{2}sin\theta)$$

$$(\text{●}.x - \frac{carW}{2}cos\theta,\ \ \text{●}.y + \frac{carW}{2}sin\theta)$$

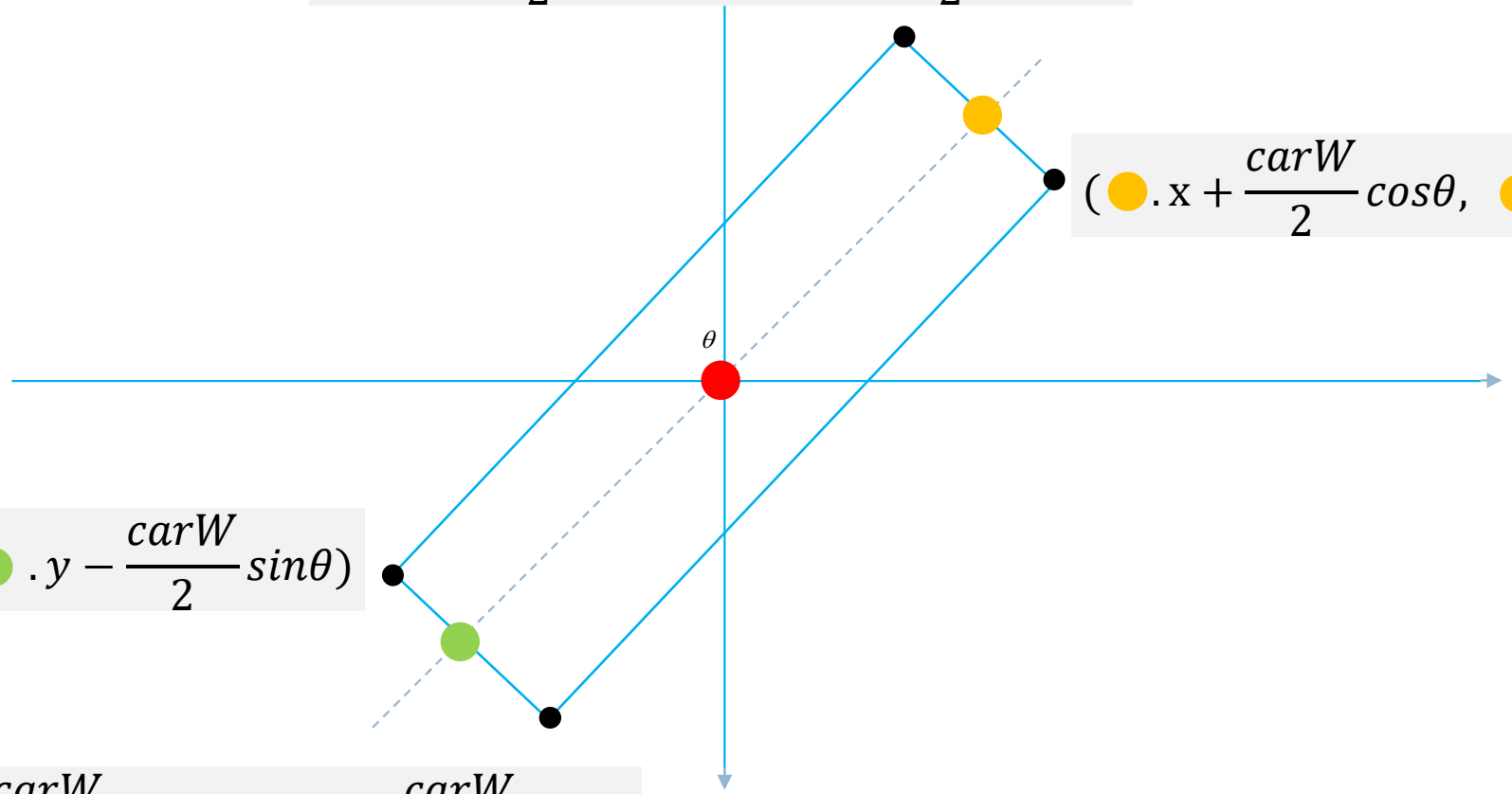
Get boundaries (turn right)



Four boundaries of the car (turn right)

$$(\bullet.\mathrm{x} - \frac{carW}{2}cos\theta,\ \bullet.y - \frac{carW}{2}sin\theta)$$

$$(\bullet.\mathrm{x} + \frac{carW}{2}cos\theta,\ \bullet.y + \frac{carW}{2}sin\theta)$$



$$(\bullet.\mathrm{x} - \frac{carW}{2}cos\theta,\ \bullet.y - \frac{carW}{2}sin\theta)$$

$$(\bullet.\mathrm{x} + \frac{carW}{2}cos\theta,\ \bullet.y + \frac{carW}{2}sin\theta)$$

Parking

- If four boundaries of the car are inside the parking space