Review:

Orientation (heading) is the direction the robot is facing, measured counter-clockwise from the x-axis (typically). This is denoted by theta (θ) and the subscript 'r' is for robot (θ_r).

Distance is equal to the amount of rotation of a wheel times the wheel's radius.

$$S = \theta_r \, r_{wheel}$$

Linear velocity measures the speed in a line:

$$speed = \frac{distance}{time} = linear\ velocity$$

Angular velocity measures the speed of rotation (noted by greek letter omega [ω]):

$$speed\ of\ rotation = \frac{angular\ displacement}{time} = angular\ velocity$$

We can equate linear and angular velocities by dividing our distance equation by time (t)

$$\frac{\theta}{t} = \frac{S \div t}{r}$$

$$\omega = v \div r \quad \text{or} \quad \omega \cdot r = v$$

Using these concepts we can determine our new position based on our starting position (x_0,y_0) and our initial heading θ_0.

$$x_t = x_0 + \omega_{w,avg} \, r_w \, t \cos(\theta_r)$$

$$y_t = y_0 + \omega_{w,avg} \, r_w \, t \sin(\theta_r)$$

$$\omega_{w,avg} = \frac{\omega_{right} + \omega_{left}}{2}$$

$$\theta_{r,t} = \theta_{r,0} + \frac{r_w}{L}(\omega_{right} - \omega_{left})t$$

These equations are only valid for small time steps since θ is changing.

- For slow moving robots 0.1-1 second may be sufficient
- For high speed aircraft 0.1-1 millisecond may be required

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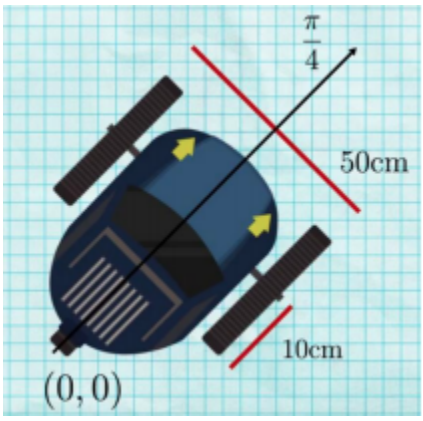
Challenge Questions:

Imagine you have a robot that is **50**cm wide, with **10**cm radius wheels. The robot starts out at (**0**,**0**) with an initial orientation of $\pi/4$.

If the robot drives both wheels at a constant speed of 1 radian per second for 10 seconds -what is the robot's final position and orientation?



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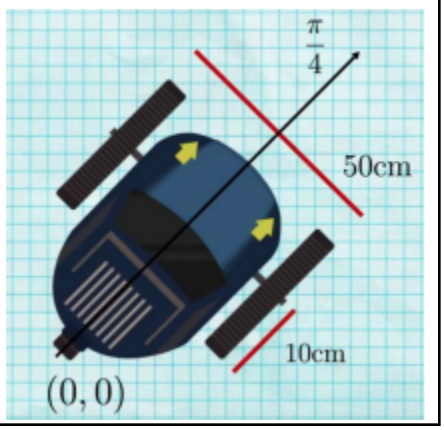
Imagine you have a robot that is **50**cm wide, with **10**cm radius wheels. The robot starts out at (**0**,**0**) with an initial orientation of $\pi/4$.
The robot runs the right wheel at 1 radian per second and the left wheel at 1.5 radians per second. What is the robot's orientation after 1 sec of motion?



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