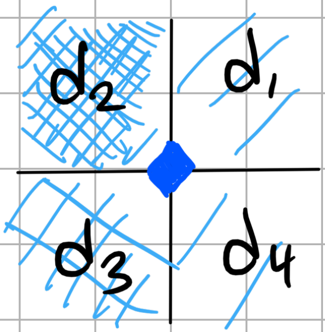
Follower Update Rules

① Go to highest density partition



Ex: Follower agent goes towards d_2 because it has the highest density

u_f: magnitude of linear movement for follower
Lower limit of 0
Upper limit of u_{max}

θ_f: angle relative to global frame that defines follower's movement direction
Limit of $[0, 2\pi)$

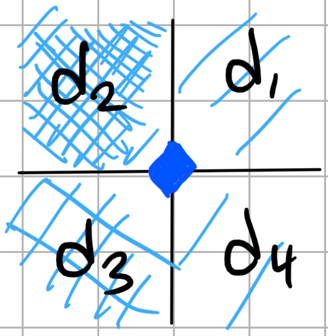
c: tunable constant for how much followers move in response to density measurements

<u>Calculating u_f and θ_f</u> $d_{max} = \max\{d_1, d_2, d_3, d_4\}$

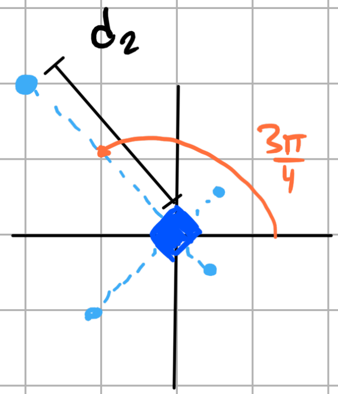
$$u_f = \begin{cases} c \cdot d_{max} & \text{if } c \cdot d_{max} < u_{max} \\ u_{max} & \text{otherwise} \end{cases}$$

$$\theta_f = \begin{cases} \frac{\pi}{4} \text{ if } d_1 \text{ is } d_{max} & \frac{5\pi}{4} \text{ if } d_3 \text{ is } d_{max} \\ \frac{3\pi}{4} \text{ if } d_2 \text{ is } d_{max} & \frac{7\pi}{4} \text{ if } d_4 \text{ is } d_{max} \end{cases}$$

② Go to highest density area accounting for all sensor readings



Switching to a more useful visualization for this method



Now each density sensor reading is represented as a point relative to the agent's position

$$\vec{d}_1 = \langle d_1 \cos\tfrac{\pi}{4}, d_1 \sin\tfrac{\pi}{4} \rangle$$

$$\vec{d}_2 = \langle d_2 \cos\tfrac{3\pi}{4}, d_2 \sin\tfrac{3\pi}{4} \rangle$$

$$\vec{d}_3 = \langle d_3 \cos\tfrac{5\pi}{4}, d_3 \sin\tfrac{5\pi}{4} \rangle$$

$$\vec{d}_4 = \langle d_4 \cos\tfrac{7\pi}{4}, d_4 \sin\tfrac{7\pi}{4} \rangle$$

c: tunable constant

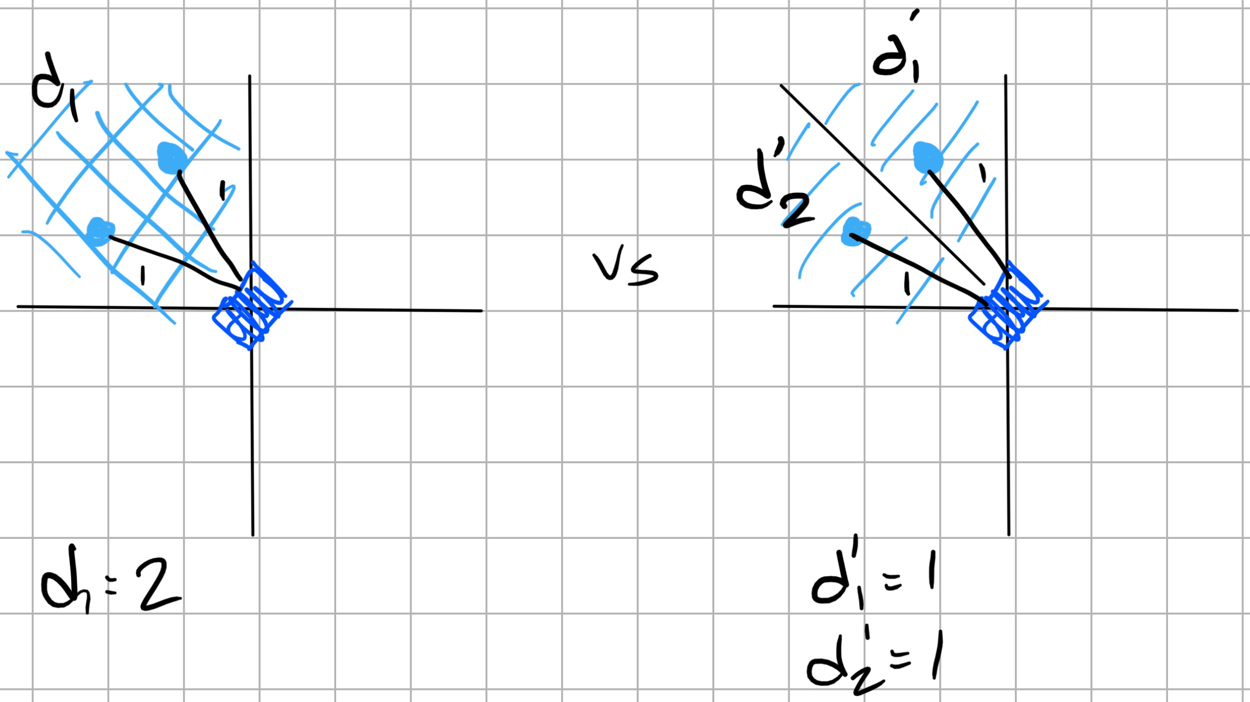
Calculating dx, dy for agent

$$dx = c\left(d_1 \cos\tfrac{\pi}{4} + d_2 \cos\tfrac{3\pi}{4} + d_3 \cos\tfrac{5\pi}{4} + d_4 \cos\tfrac{7\pi}{4}\right)$$

$$dy = c\left(d_1 \sin\tfrac{\pi}{4} + d_2 \sin\tfrac{3\pi}{4} + d_3 \sin\tfrac{5\pi}{4} + d_4 \sin\tfrac{7\pi}{4}\right)$$

Notes

(1) Why we don't normalize according to number of partitions



As we add more partitions, each partition becomes less powerful in its sensing capabilities, and thus has less influence on any calculations

(2) $\langle d_x, d_y \rangle$ (cartesian coordinates) and $\langle u, \theta \rangle$ (polar coordinates) represent the same information. Still deciding what the actual action space in the simulator should be, but in the meanwhile I just use whichever notation is most convenient here.