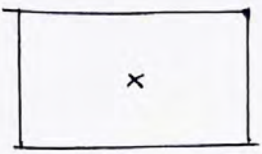
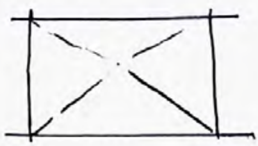
State 01

warm up: perspective grids.

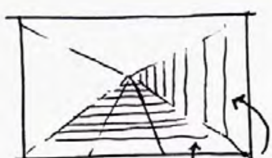


Draw a view port.

Choose a vanishing point.

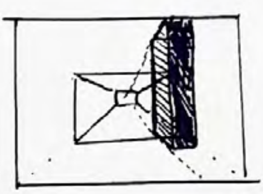


project lines onto the point.



Make a grid.

lines parallel to the viewport stay parallel but get shorter.



place objects.

Today we talk about perspectives. But on data + state.

Before we start: Lab 06
paper prototypes.
→ BOM → order parts.

State: the start of understanding **AI**.

last class was a warmup.

why don't we just "know"?
→ measurement is messy.

instead of trying to simply logic out every possible sensor condition, we build a probability picture.

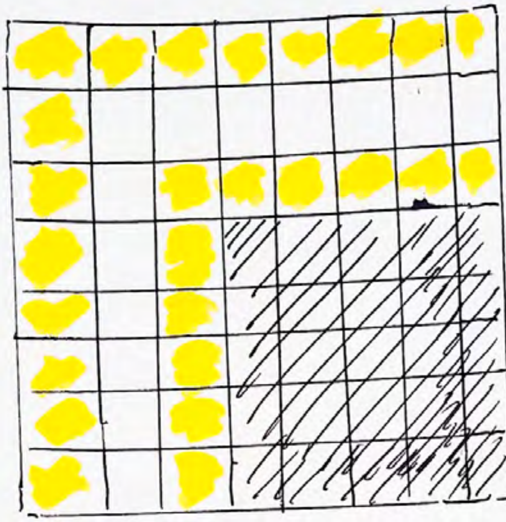
Last time: $P((x, y), \phi)$?

count!

# of x
of (x,y)
of y
of ϕ

← impose a grid.
smaller = more precise

↑ decide what's possible.



all direction distance sensor

$p((x,y) \mid d \leqslant 1)$?

$= \frac{1}{26} \approx 0.038$

front distance sensor only

$p((x,y), \phi) \mid d \leqslant 1)$?

1. Decide on what to count (possible state)

2. Restrict counting to condition.

④

A = pos.
B = sensor

Bayes theorem.

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

$$A = (x=1, y=1, \overset{\phi=}{N}) = (1, 1, N)$$

$B = d \leq 1\text{cm}$
$\sim d \leq 100$

$$P(A) = \frac{1}{39 \times 8}$$

↑ # of squares

↖ # of directions.

$$P(B) = \frac{100}{1024}$$ ← # of sensor possibilities.

$$P(B|A) = \overset{0.98}{\sim 1}$$ experimental, (modulated by noise)

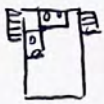
$$P(A|B) = 0.98\,\frac{P(A)}{P(B)} = \frac{\frac{1}{39 \times 8}}{\frac{100}{1024}}$$

$$= \frac{1024}{39 \times 8 \times 100} \cdot 0.98$$

$$= 0.032\ldots$$

careful! bad assumptions can explode your formula.

why so low?
↳ many places our sensor gives f.p.



S_L $\quad$ $p(\text{pos} \mid \text{sensors})$

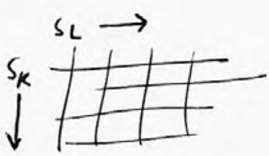
S_R $\quad$?

1.

☆ $p(\text{pos})$. Draw your position possibilities so you can count them.

☆ $P(\text{sensors})$

2. Draw your sensor possibilities so you can count them.

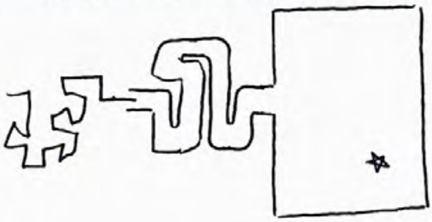


☆ $P(\text{sensors} \mid \text{pos})$ 3. Estimate your sensor noise. Design exp.

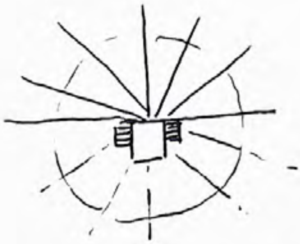
4.

☆ calculate $p(\text{pos} \mid \text{sensors})$

If time: object-tracking



1. Design object-tracking robot.
2. Figure out pos. for object.



1/12 ?

1/24 ?

3. Reason about P(sensor | pos)
   ↳ false pos? false neg? noise?

4. Reason about P(sensor)
   ↳ range?

COGS 300 State 01 Feb 11/24

warm up: draw a perspective grid.

Draw a viewport and vanishing point.

all lines moving "forward" converge at vanishing point

can be off-center
make a grid.

parallel to viewport

objects follow grid lines.

Lab 06: paper prototypes for project
Lee's electronic 26M + Flaxe
BOM

state
=

②

what state am I in (pos)

sensor

prior knowledge (map)

loop

p(red) = 1/6

conditional probability

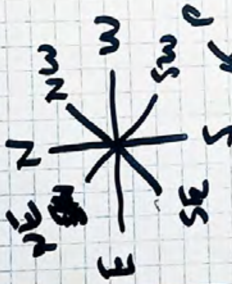
Bayes theorem

$p(x, y, \phi)$

$p(x,y)$?

□ 42   1/42

$p(x,y,\phi)$? $\frac{1}{42 \times 8}$



pos   sensor

p(state | knowledge)

p(pos | sensor)

p(pos | d ≤ 1) ?

1/yellow   1/28

add in direction

Bayes theorem

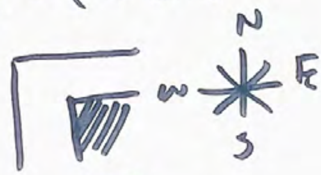
$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

pos

sensor

$$A = (\underline{\underline{x}}=1,\ \underline{\underline{y}}=1,\ \underline{\underline{\phi}}=N) = (1,1,N)$$

$$P(A) = \frac{1}{42\times 8}$$



100

↓

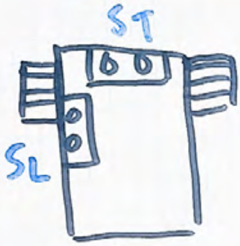
B = sensor readings

$$P(B) = 1/1024 \qquad P(B \leq \tau) = \frac{100}{1024}$$

sensor model

state estimate

$$P(A|B) = \underbrace{P(B|A)}_{\downarrow\ 0.98} \cdot \frac{P(A)}{P(B)}$$



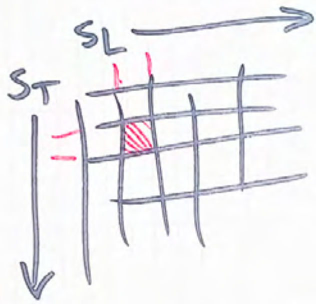
$p(pos \mid sensors)$?

$\frac{1}{42.8}$

★ $p(pos)$?

★ $p(sensors)$

$\frac{1}{1024 \times 1024}$



value of sensors

given pos.

★ $p(sensors \mid pos)$

Noise?
Experiments?

★ $p(pos \mid sensors)$