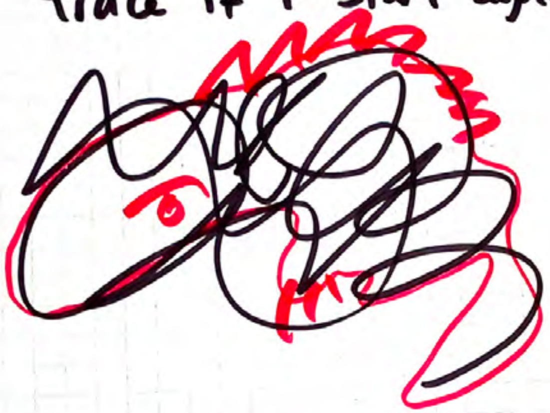
COGS 300 Detection 01 Oct 7/25

Warm up: Scribble until "something" emerges. Trace it + start again.

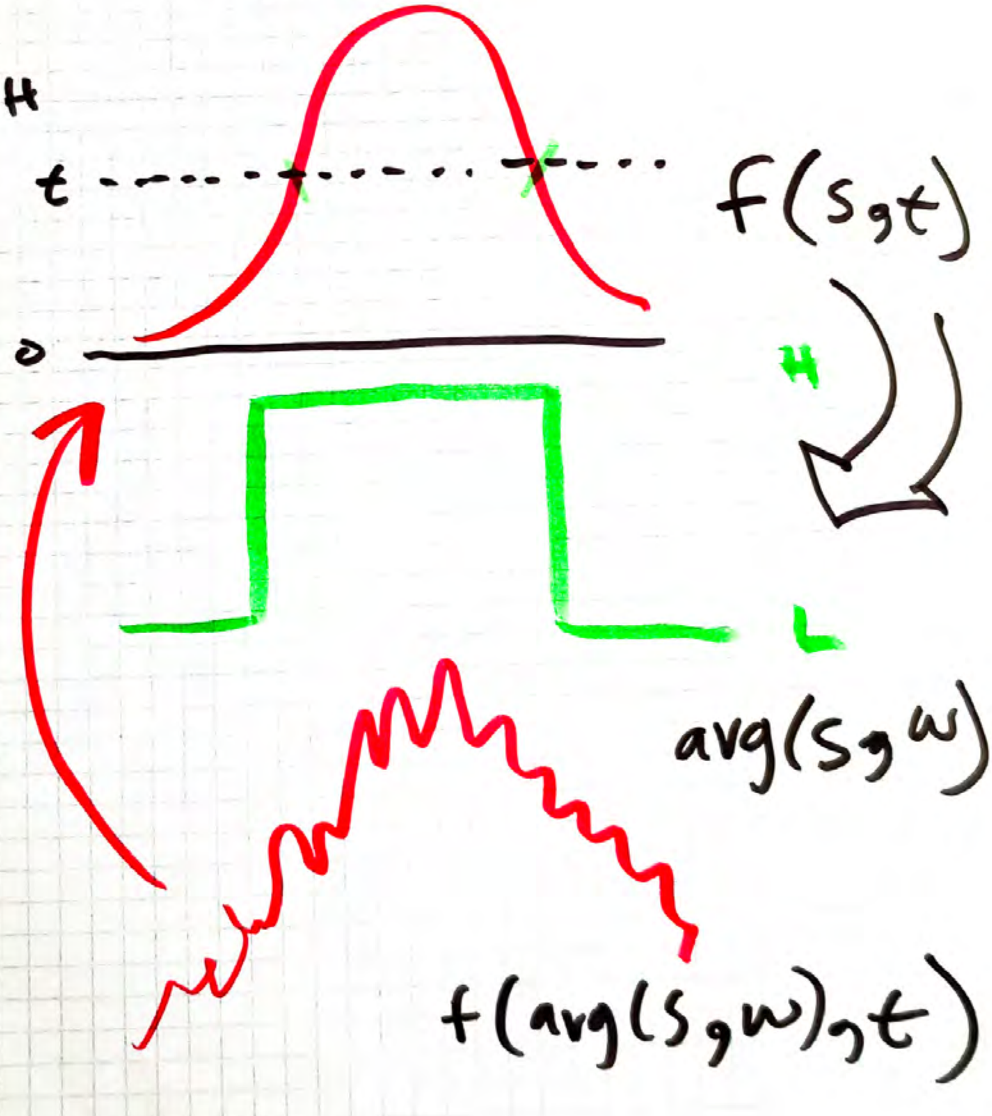


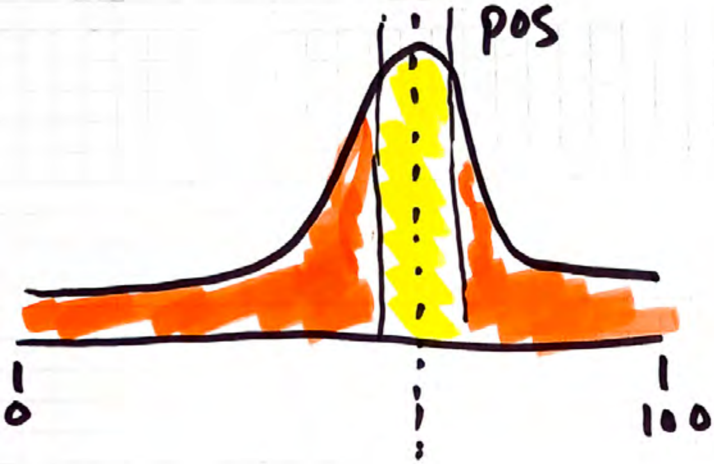
— CSS EVENTS —

Weekly Social TONIGHT! - 5PM
(MOVIE NIGHT!)

RESUME-BUILDING WORKSHOP - OCT 8
5PM
ANGU 237
(RSVP!)

simplest Detector threshold filter





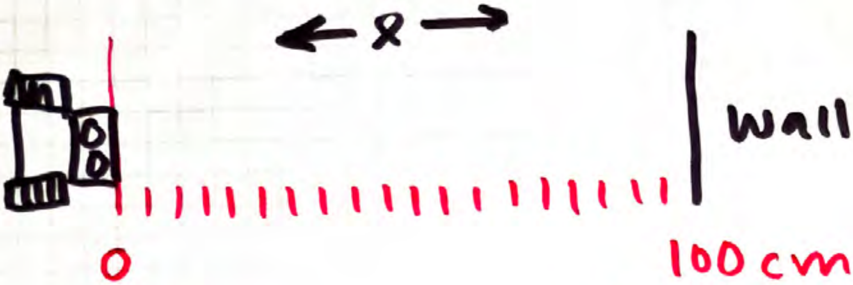

$= P(pos)$

$p(pos \mid sensor)$?

$P(sensor)$? $1/1024$

$P(S=5) = 1/1024$

$P(5 < S \leq 10) = 5/1024$

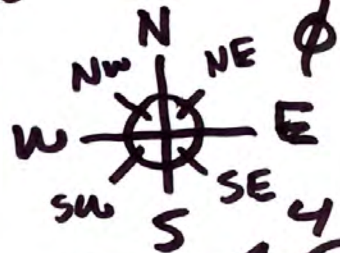


1cm blocks

discretize according to resolution

$p(pos = a) = 1/100$

$p(pos = (x, \phi))$?



100×4

100×8

100×360

4

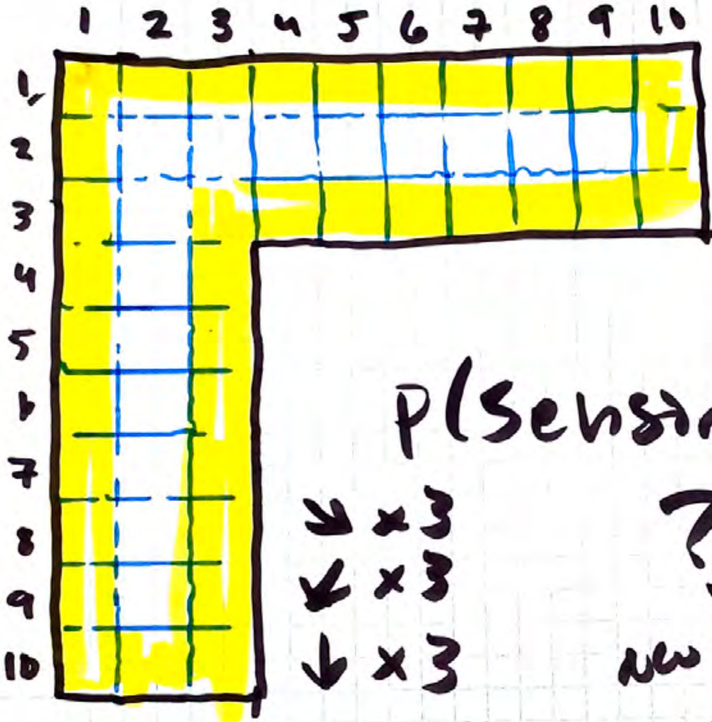
	N	S	W	E
0	0,N	0,S	0,W	0,E
1	1,N	1,S	1,W	1,E
2				
3				
⋮				

100

$3\nearrow$ $3\searrow$ $\rightarrow 3$ $\nwarrow 10$

$\nearrow 10$

$\uparrow 10$



$\downarrow 7$

$\swarrow 7$

$\searrow 7$

$p(\text{Sensor} < 1)$

$\searrow \times 3$

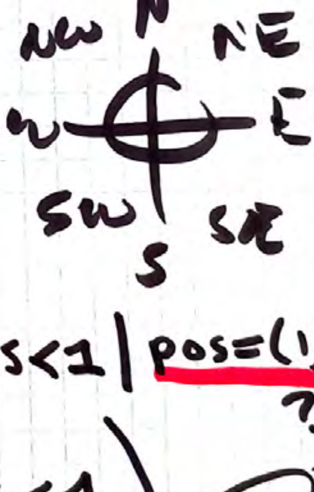
$\swarrow \times 3$

$\downarrow \times 3$

?

$p(s<1 \mid pos=(1,1))$

?



$10 \leftarrow$ $\rightarrow \times 7$

$10 \swarrow$ $\searrow \times 7$

$10 \nwarrow$ $\nearrow \times 7$

$p(s<1 \mid pos=(1,1,N$

?

$P(pos=(1,1,N) \mid s<1)$

?

5

$$p(pos = (1,1) \mid s < 1)\ ?$$

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

$$P(pos = (1,1)) = 1/51$$

$$P(s < 1 \mid pos = (1,1)) = 5/8$$

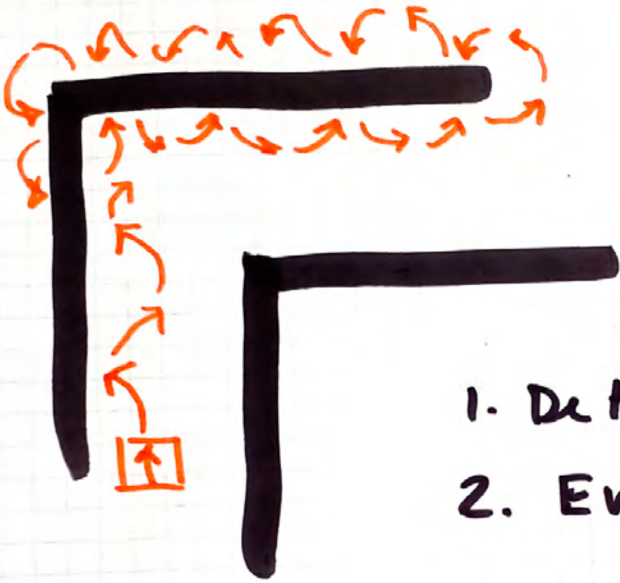
$$P(s < 1) = 51 \times 8 = \frac{103}{408}$$

$$p(pos = (1,1) \mid s < 1) = \frac{\frac{1}{51} \cdot \frac{5}{8}}{\frac{103}{408}} =$$

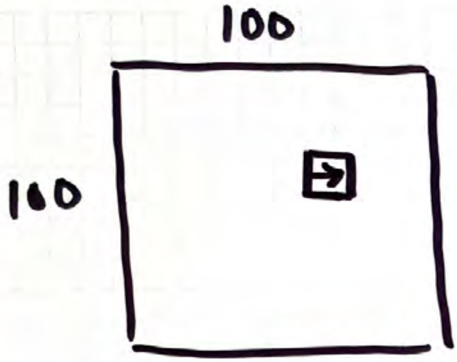
$0.0485\ldots$

~ 0.05

$\sim 1/20$



1. Detection
2. Emergent



pos = (60, 40, E)

p(pos = ↑)

100 × 100 × 8 = 80000

	N				S			
	1	2	3	4	1	2	3	4
1	1,1,N	1,2,N	. . .		1,1,S	. . .		
2								
3								
4								

P(sensor < 1)

?

8
dir.

4.1?

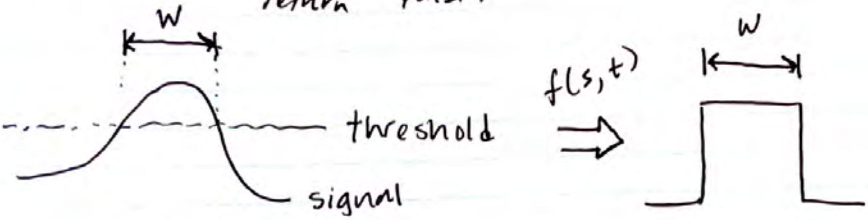
3x10 + 7x3 = 51

51 x 8 = 408

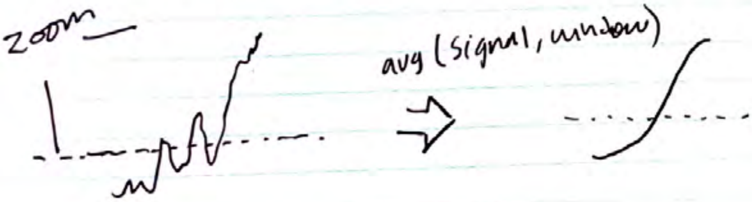
COGS 300 ✱ emergent Scribble. **Detection 01** Oct 7/25

The simplest "detector" is the threshold filter, which we've talked about:

```
f (signal, threshold):
    if signal > threshold:
            return true
    else:
        return false.
```



what if we have a messy signal?

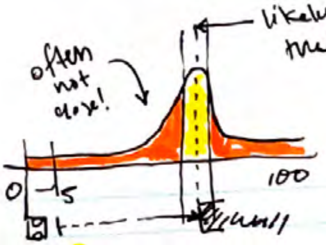


But now we question our "senses"...

To "detect", we need to model the robot's state.

We need a measure of confidence.

↳ Daniel



realistic distribution for sensor

$P(A) = \frac{A}{A+B}$ ... but B is big!

If just a threshold, false negative.
or false positive.

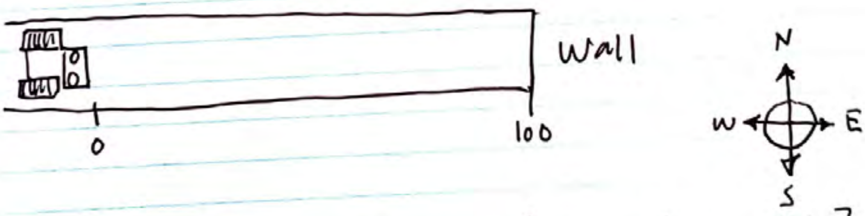
P(pos | sensor) ? Bayes.

P(sensor) ? Talked about it last time.

$P(s=5) = 1/1024$ ← assume for today.

$P(5 < s \leq 10) = 5/1024$

P(pos) ? Let's do a 1D model.



☆ what if the robot can face N, W, E, S?

↳ N, NE, SE, S, SW, NW, E, W?

$x \in \{0-100\}$ $\phi \in \{N, S, E, W\}$

State $= (x, \phi)$

0, N	1, N	. . .	100, N
0, S	⋮		⋮
0, E			
0, W			100, W

add dimension

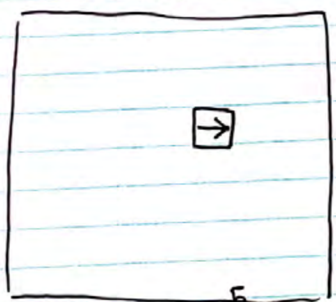
$y \in \{0-100\}$

state $= (x, y, \phi)$

0, 0, N	0, 1, N		0, 100, N
0, 0, S	0, 1, S	. . .	0, 100, S
0, 0, E	0, 1, E		0, 100, E
0, 0, W	0, 1, W		0, 100, W

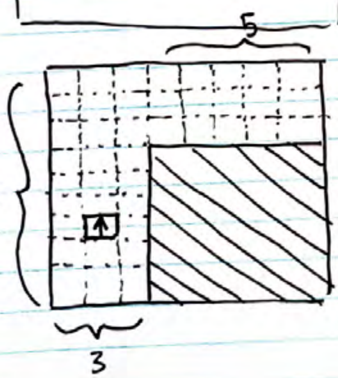
100

100



$P(65, 45, E)$?

$101 \times 101 \times 4 = 40804$



discretize.

$4(3 \times 9 + 3 \times 5) = 4 \cdot 42$
$= 168$

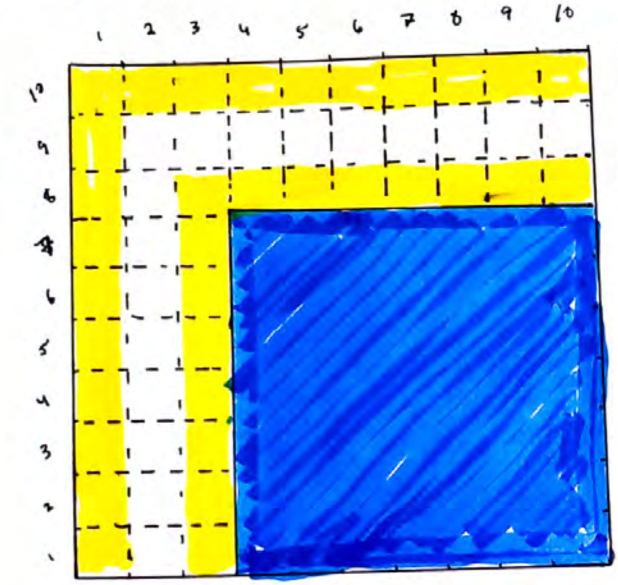
or

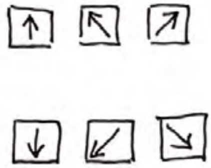
can't go here.

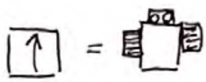
$8(3 \times 9 + 3 \times 5) = 336$

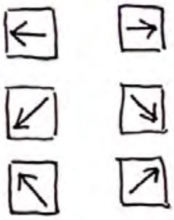
$P(\text{state} = (a, b, c)) = 1/336.$

model for robot in maze.









$P(\text{sensor} < 1) =$

$\{\leftarrow, \nwarrow, \uparrow\} \times 10 = 30$

$\{\uparrow, \nwarrow, \nearrow\} \times 10 = 30$

$\{\rightarrow, \searrow, \nearrow\} \times 7 = 21$

$\{\downarrow, \swarrow, \searrow\} \times 7 = 21$

$\{\searrow\} \times 1 = 1$

$$\frac{= 103}{(10 \times 10 - 7 \times 7) \times 8 = 408} = \frac{103}{408} \sim \frac{1}{4}$$

$$P(S < 1 \mid pos = (1, 10))? \quad \frac{\uparrow \nwarrow \nearrow \leftarrow \nwarrow \swarrow}{\uparrow \nwarrow \nearrow \leftarrow \nwarrow \swarrow + \downarrow \rightarrow} = \frac{6}{8}$$

$P(pos = (1,10) \mid s < 1)$?

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

$$P(pos = (1,10)) = 1/(10\times 10 - 7\times 7) = 1/51$$

$$P(s<1 \mid pos = (1,10)) = \frac{6}{8}$$

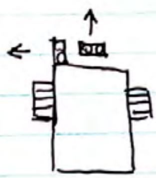
$$P(s<1) = \frac{103}{408}$$

$$P(pos = (1,10) \mid s<1) = \frac{\frac{1}{51} \cdot \frac{6}{8}}{\frac{103}{408}} = 0.05825\ldots \sim 1/20$$

you can "just" count!

if time.

☆ Add a sensor?

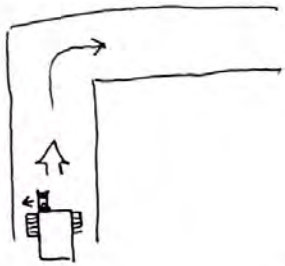


triangulate.

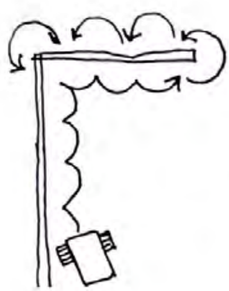
... but new errors also introduced.

Detection vs. *emergence*.

The best robots *may* not need to "detect" anything!



The robot doesn't "know" anything about wall-following. It "just works".



emergent algorithms are often very effective!

But then epistemic question:

does the robot "know"?

or does the system "know"?