Project 3: Ghost Buster Game

All team members worked together on the project:

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Code on GitHub & TOC: https://github.com/NiemaAM/Ghost-Buster-Game
YouTube video: https://www.youtube.com/watch?v=zjdRetC5ajk&ab_channel=NAM
Online demo: https://ghost-buster-game.vercel.app/

Conditional probability distributions:

Task 1: Define and use conditional probability distributions P(Color/Distance from Ghost) that reflects the sensor's sensibility for each distance.

Conditional Probabilities $P(Color \mid Distance)$

- $P(Red \mid 0) = 0.65$
- $P(Orange \mid 1) = 0.10, P(Orange \mid 2) = 0.10$
- $P(Yellow \mid 3) = 0.05,\ P(Yellow \mid 4) = 0.05$
- $P(Green \mid 5) = 0.05$

Marginal Probabilities $P(Distance)$

Assuming uniform distribution over distances:

- $P(Distance = 0) = 0.20$
- $P(Distance = 1) = 0.20$
- $P(Distance = 2) = 0.20$
- $P(Distance = 3) = 0.20$
- $P(Distance = 4) = 0.20$
- $P(Distance = 5) = 0.20$

Joint Probability Formula:

$$P(Color, Distance) = P(Color \mid Distance) \cdot P(Distance)$$

- Conditional Probabilities $P(Color \mid Distance)$:

Color	Distance	P(Color/Distance)
Red	0	0.6500
Orange	<= 2	0.20
Yellow	>=3 <= 4	0.10
Green	>= 5	0.050

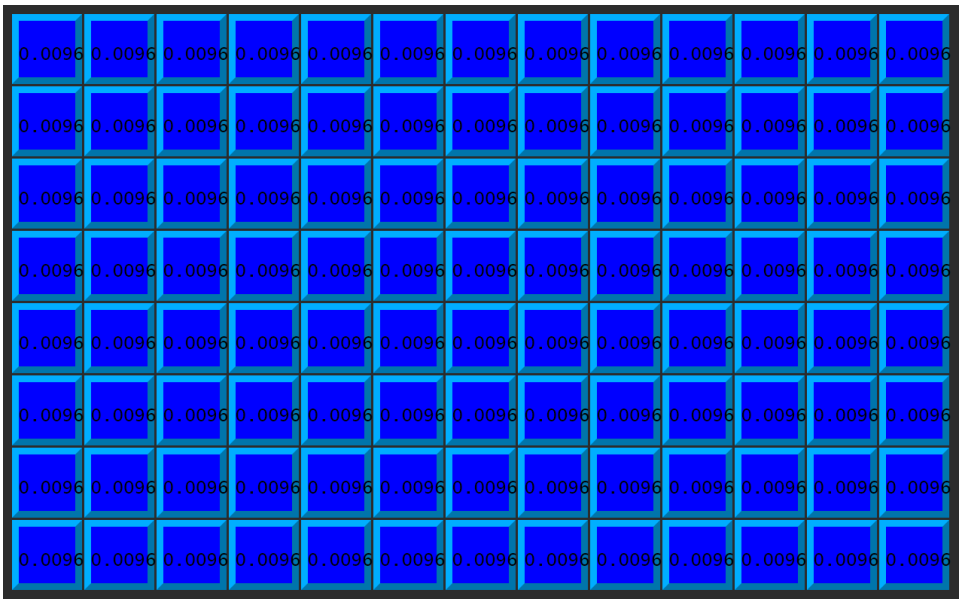
- First selected cell $P\ (Ghost \mid Selected\ Cell\ Color)$:

Selected Cell Color	P (Ghost/Selected Cell Color) for the other cells	Reasoning
No Selected Cell	0.0096	Uniform distribution across all cells if no specific cell is selected.
Red	0.0	If Red is selected, the ghost must be in the clicked cell.
Orange	0.08	If Orange is selected, nearby cells (1-2 away) are more likely.
Yellow	0.04	If Yellow is selected, cells 3-4 away are more probable.
Green	0.02	If Green is selected, cells far away are more probable.

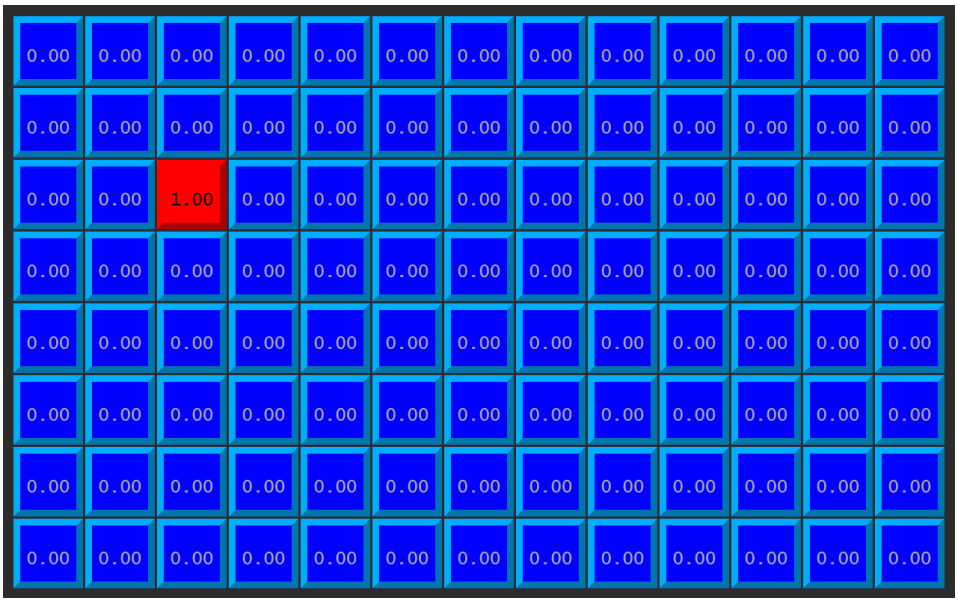
- Joint distribution $P(Color, Distance)$:

Color	Distance = 0	Distance = 1	Distance = 2	Distance = 3	Distance = 4	Distance = 5	Total
Red	$0.65 \cdot 0.20 = 0.13$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	0.13
Orange	$0 \cdot 0.20 = 0.00$	$0.10 \cdot 0.20 = 0.02$	$0.10 \cdot 0.20 = 0.02$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	0.04
Yellow	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0.05 \cdot 0.20 = 0.01$	$0.05 \cdot 0.20 = 0.01$	$0 \cdot 0.20 = 0.00$	0.02
Green	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0 \cdot 0.20 = 0.00$	$0.05 \cdot 0.20 = 0.01$	0.01
Total	0.13	0.02	0.02	0.01	0.01	0.01	0.20

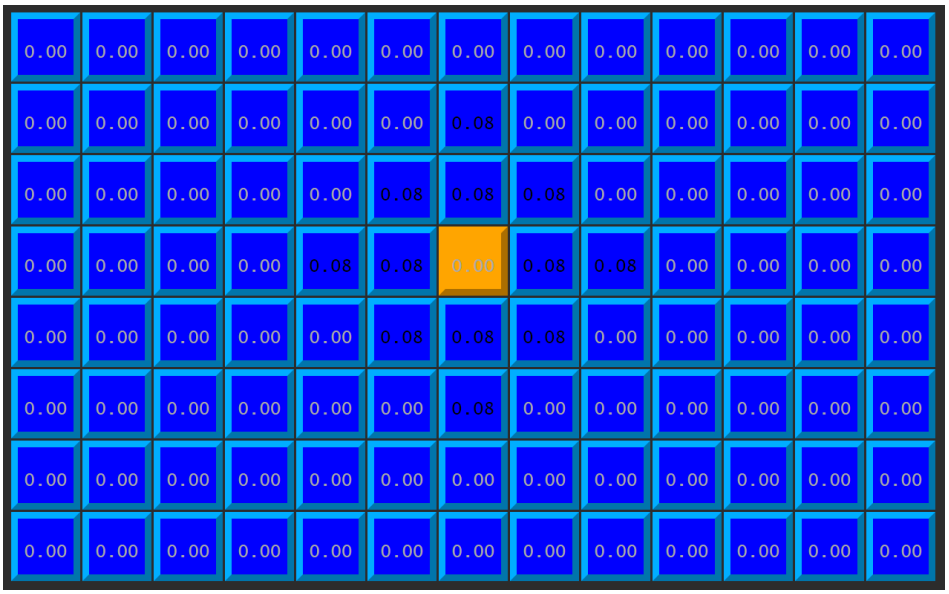
- *No selected cell:*



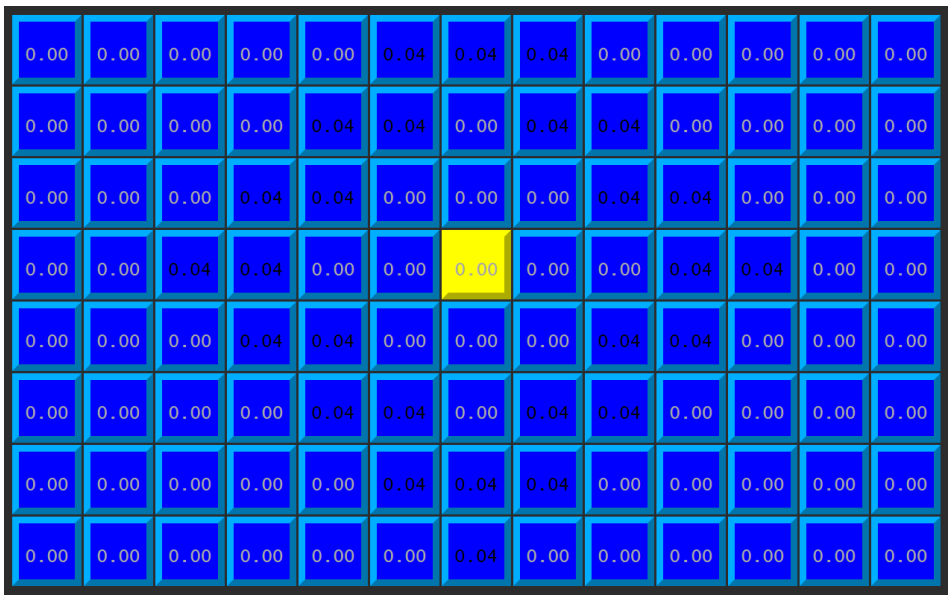
- *On the ghost:* `red`



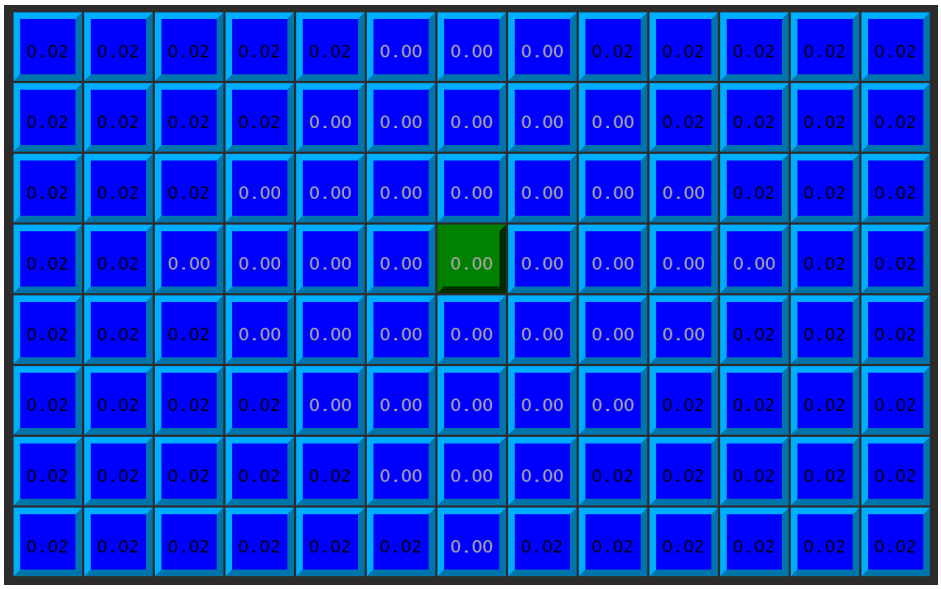
- *1 or 2 cells away:* `orange`



- *3 or 4 cells away:* `yellow`



- *5+ cells away:* `green`



Task2: Give the conditional distributions for the direction sensor.

- Marginal Probabilities $P(Direction)$:

Direction	Symbole	P
N	↑	0.125
NE	↗	0.125
E	→	0.125
SE	↘	0.125
S	↓	0.125
SW	↙	0.125
W	←	0.125
NW	↖	0.125

- Joint distribution $P(Direction, Color)$:

Direction	Symbol	Color	Distance	Joint Probability P(Direction, Color)
N	↑	Red	0	0.125 × 0.6500 = 0.08125
N	↑	Orange	≤ 2	0.125 × 0.20 = 0.025
N	↑	Yellow	3 ≤ d ≤ 4	0.125 × 0.10 = 0.0125
N	↑	Green	≥ 5	0.125 × 0.050 = 0.00625
NE	↗	Red	0	0.125 × 0.6500 = 0.08125
NE	↗	Orange	≤ 2	0.125 × 0.20 = 0.025
NE	↗	Yellow	3 ≤ d ≤ 4	0.125 × 0.10 = 0.0125
NE	↗	Green	≥ 5	0.125 × 0.050 = 0.00625
E	→	Red	0	0.125 × 0.6500 = 0.08125
E	→	Orange	≤ 2	0.125 × 0.20 = 0.025
E	→	Yellow	3 ≤ d ≤ 4	0.125 × 0.10 = 0.0125
E	→	Green	≥ 5	0.125 × 0.050 = 0.00625
SE	↘	Red	0	0.125 × 0.6500 = 0.08125
SE	↘	Orange	≤ 2	0.125 × 0.20 = 0.025
SE	↘	Yellow	3 ≤ d ≤ 4	0.125 × 0.10 = 0.0125
SE	↘	Green	≥ 5	0.125 × 0.050 = 0.00625
S	↓	Red	0	0.125 × 0.6500 = 0.08125

S	↓	Orange	≤ 2	$0.125 \times 0.20 = 0.025$
S	↓	Yellow	$3 \leq d \leq 4$	$0.125 \times 0.10 = 0.0125$
S	↓	Green	≥ 5	$0.125 \times 0.050 = 0.00625$
SW	↙	Red	0	$0.125 \times 0.6500 = 0.08125$
SW	↙	Orange	≤ 2	$0.125 \times 0.20 = 0.025$
SW	↙	Yellow	$3 \leq d \leq 4$	$0.125 \times 0.10 = 0.0125$
SW	↙	Green	≥ 5	$0.125 \times 0.050 = 0.00625$
W	←	Red	0	$0.125 \times 0.6500 = 0.08125$
W	←	Orange	≤ 2	$0.125 \times 0.20 = 0.025$
W	←	Yellow	$3 \leq d \leq 4$	$0.125 \times 0.10 = 0.0125$
W	←	Green	≥ 5	$0.125 \times 0.050 = 0.00625$
NW	↖	Red	0	$0.125 \times 0.6500 = 0.08125$
NW	↖	Orange	≤ 2	$0.125 \times 0.20 = 0.025$
NW	↖	Yellow	$3 \leq d \leq 4$	$0.125 \times 0.10 = 0.0125$
NW	↖	Green	≥ 5	$0.125 \times 0.050 = 0.00625$