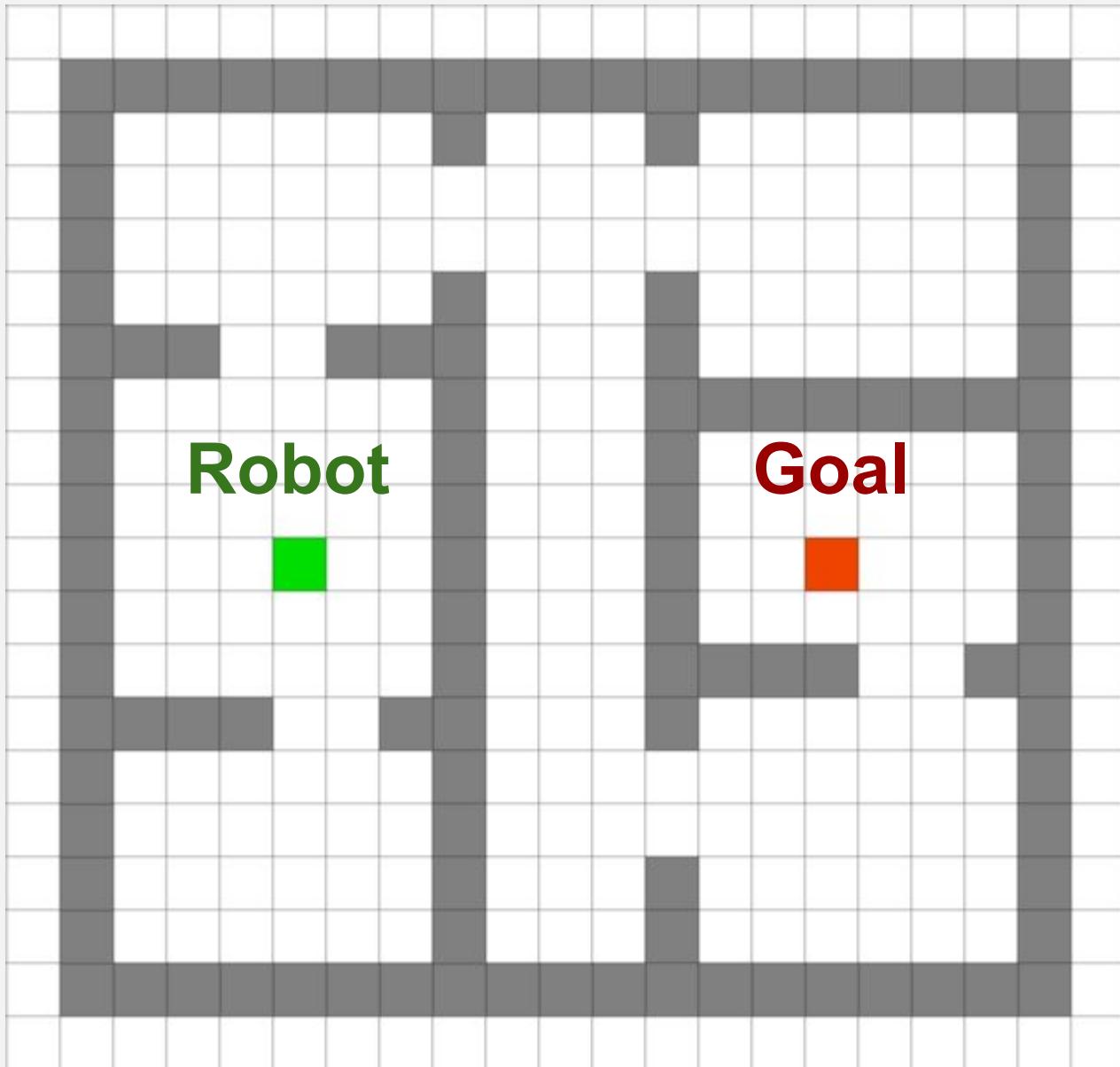
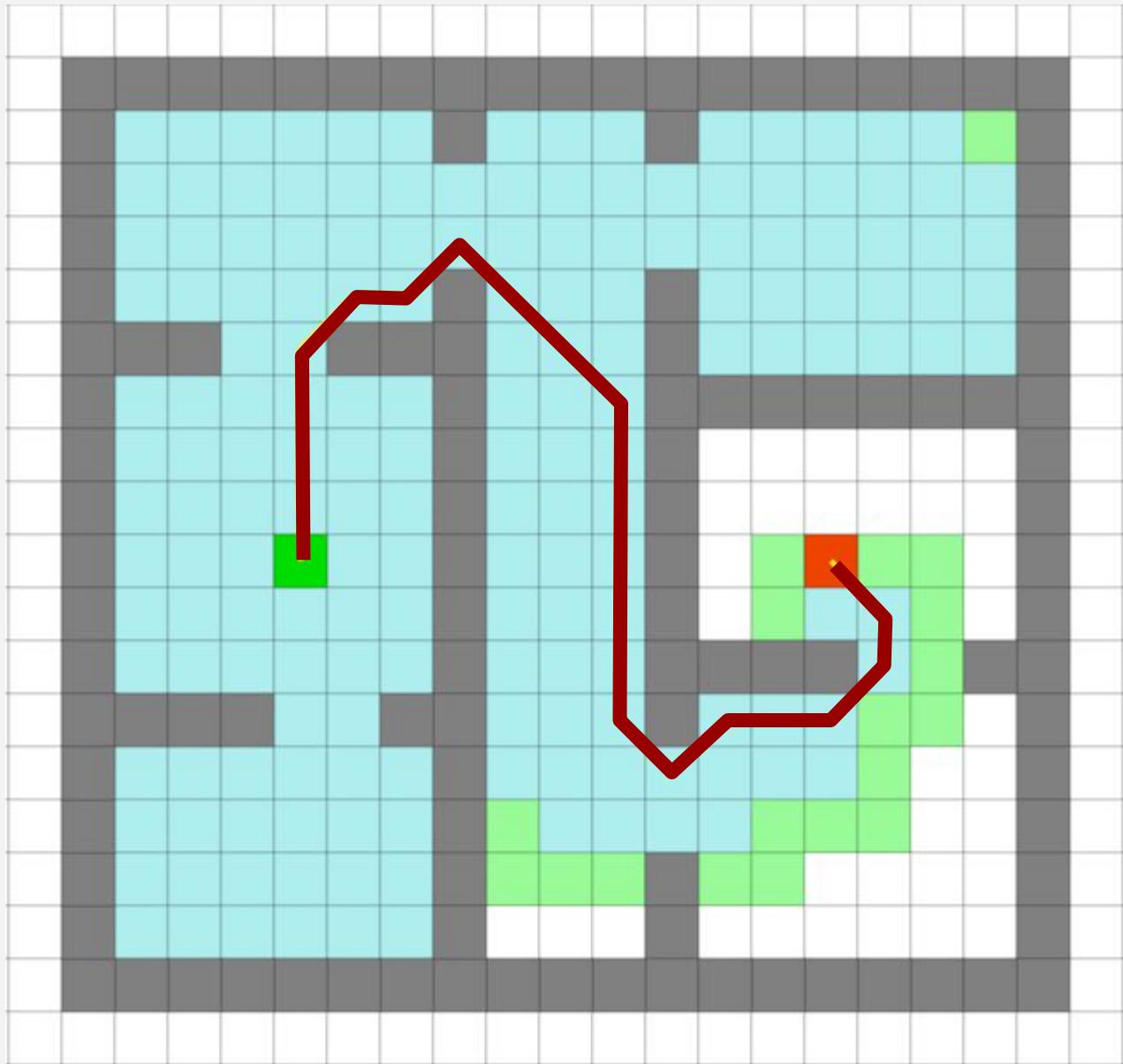


# Being Polite to Humans: A Robot's Perspective

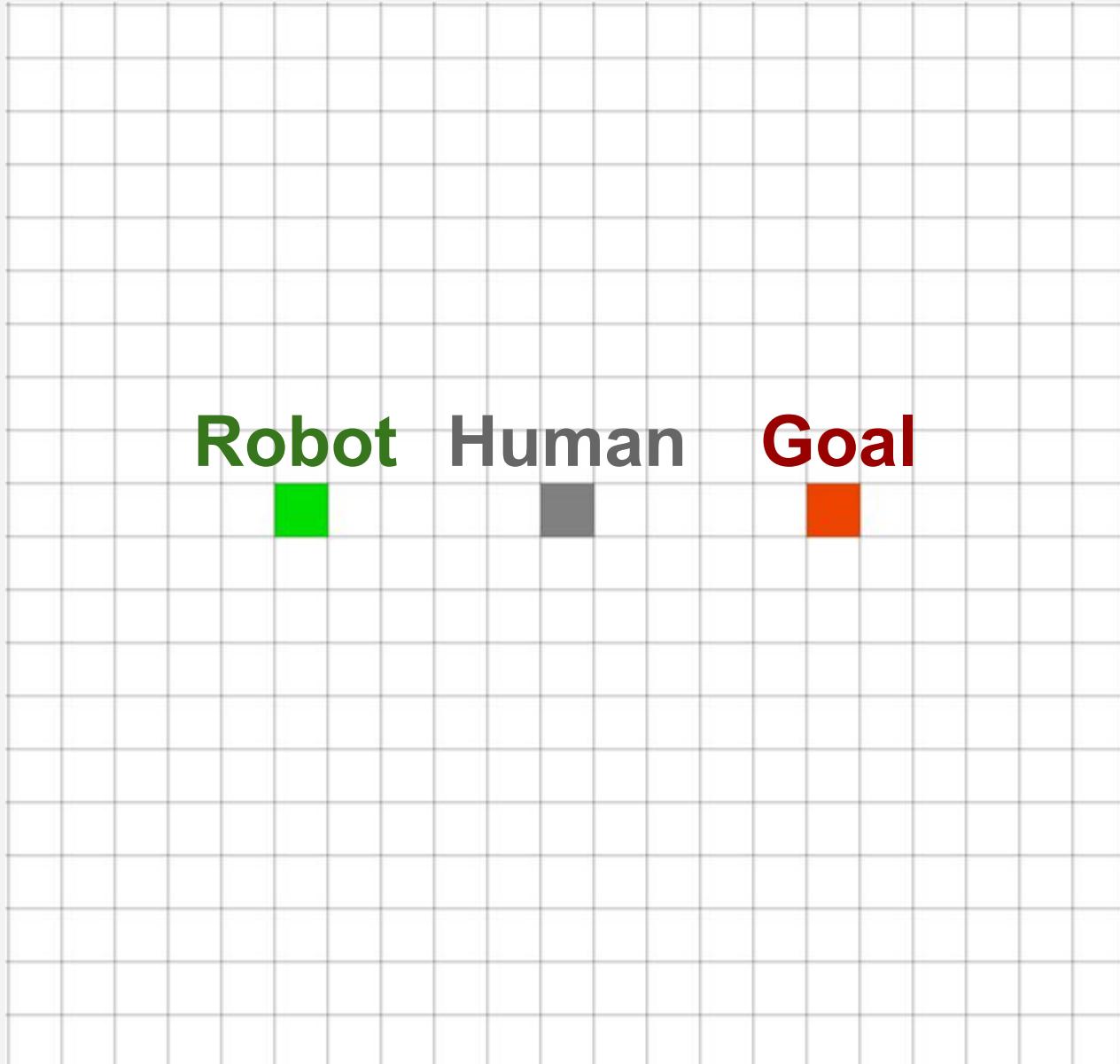
Robotic Navigation  
in Human Populated Environments

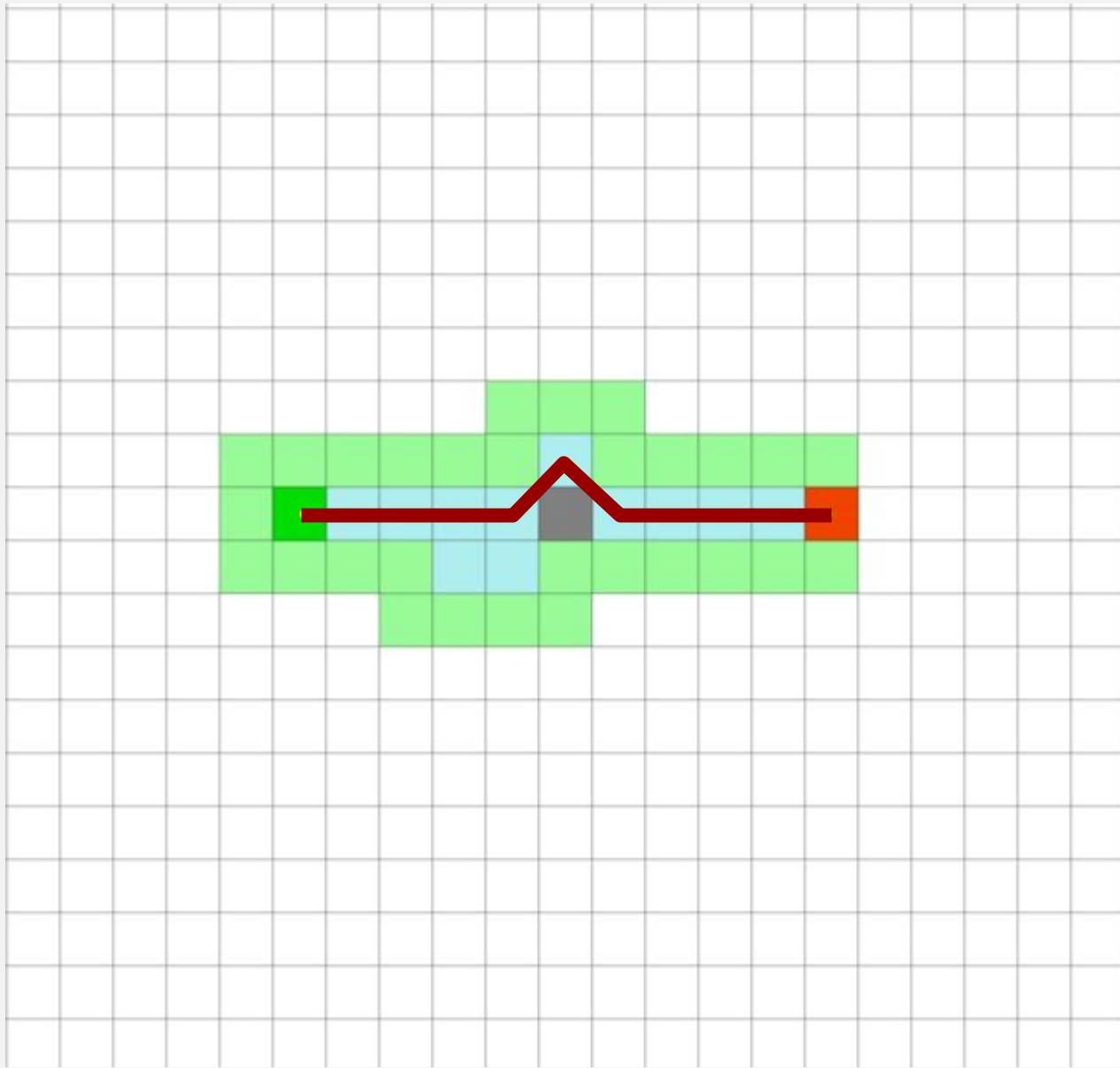
# Robotic Navigation



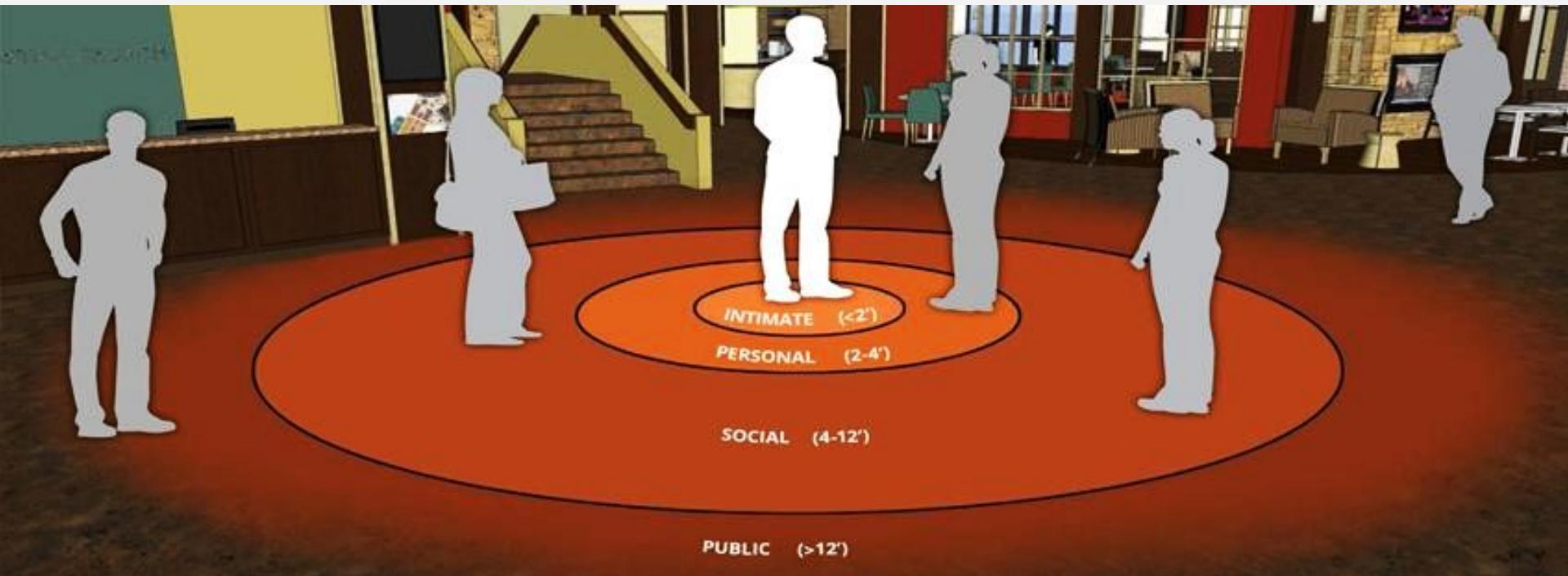


How about humans?





# Proxemics or the “human obstacle”



PUBLIC SPACE

SOCIAL SPACE

PERSONAL SPACE

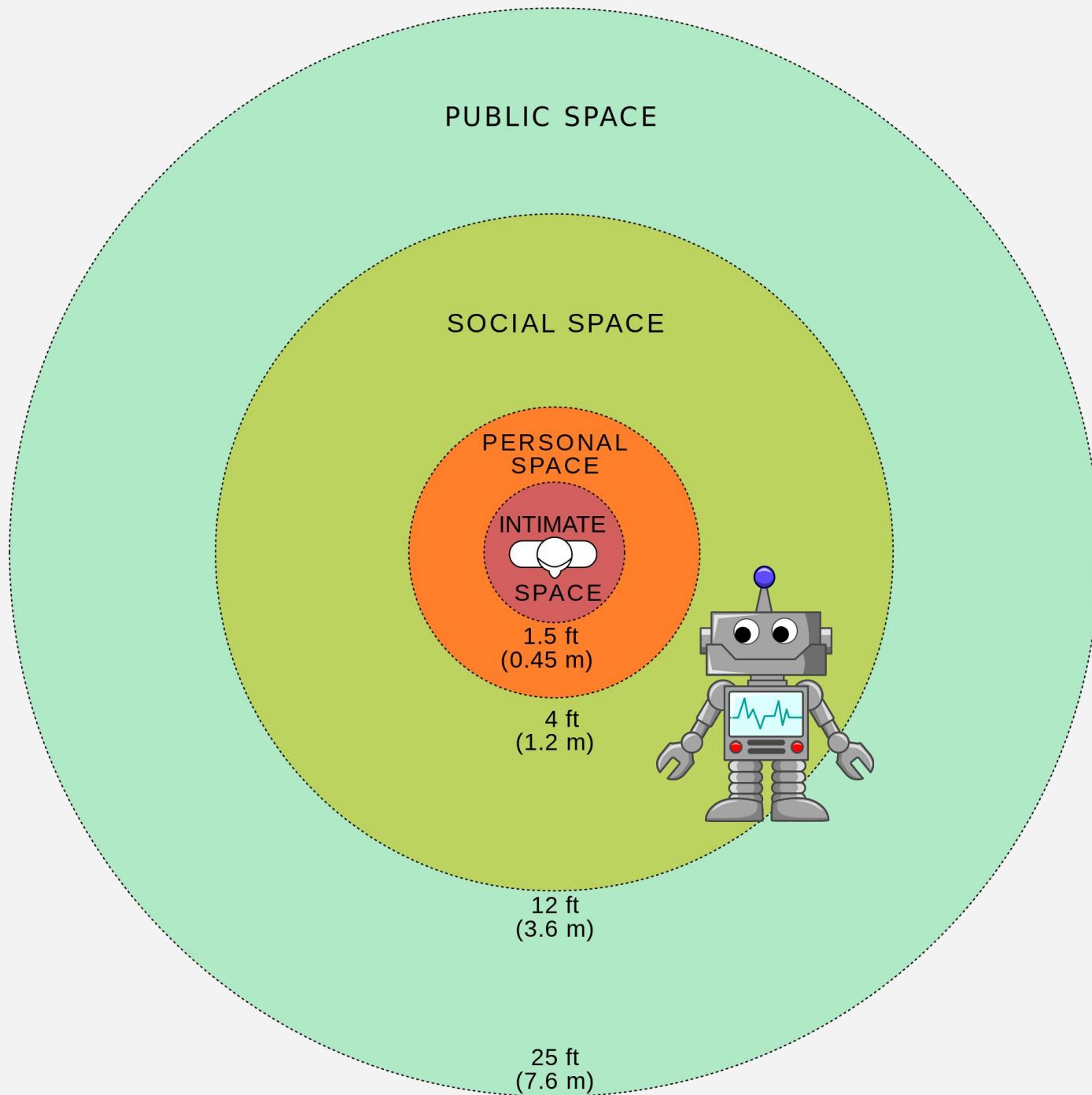
INTIMATE  
SPACE

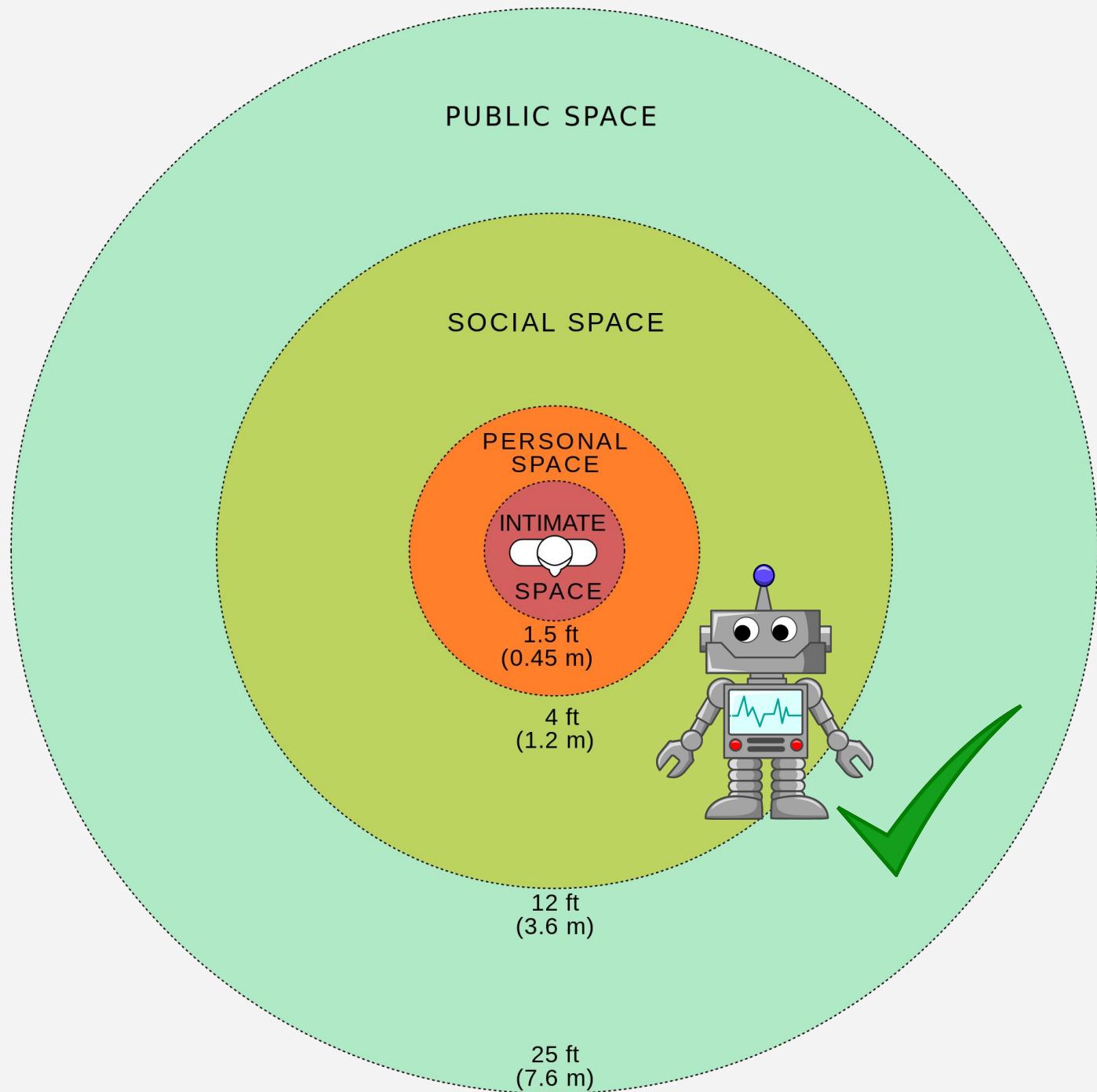
1.5 ft  
(0.45 m)

4 ft  
(1.2 m)

12 ft  
(3.6 m)

25 ft  
(7.6 m)





# Human-Aware Navigation







# Static models

Carl Friederich Gauß

1777 - 1855

# Carl Friederich Gauß

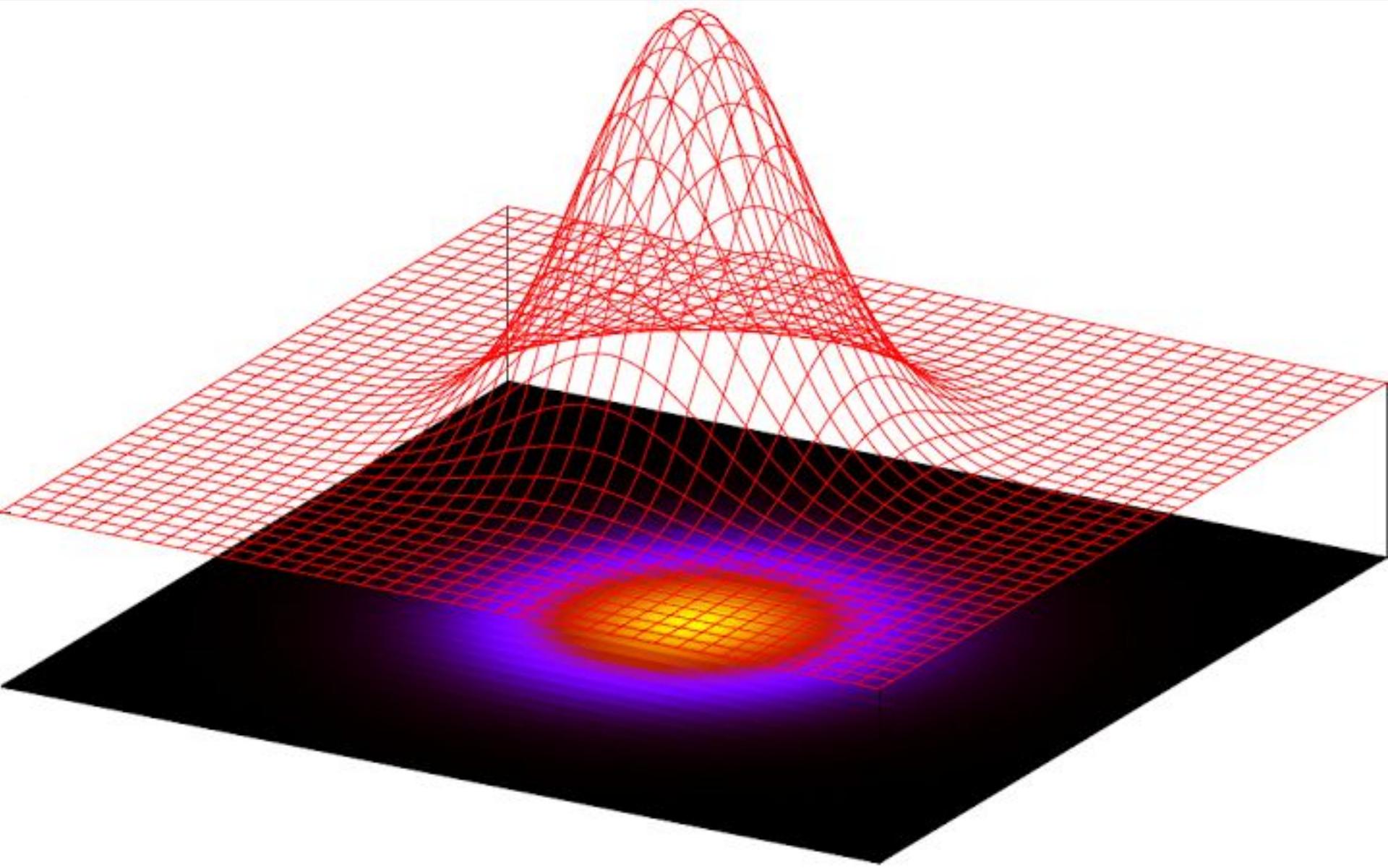
## 1777 - 1855

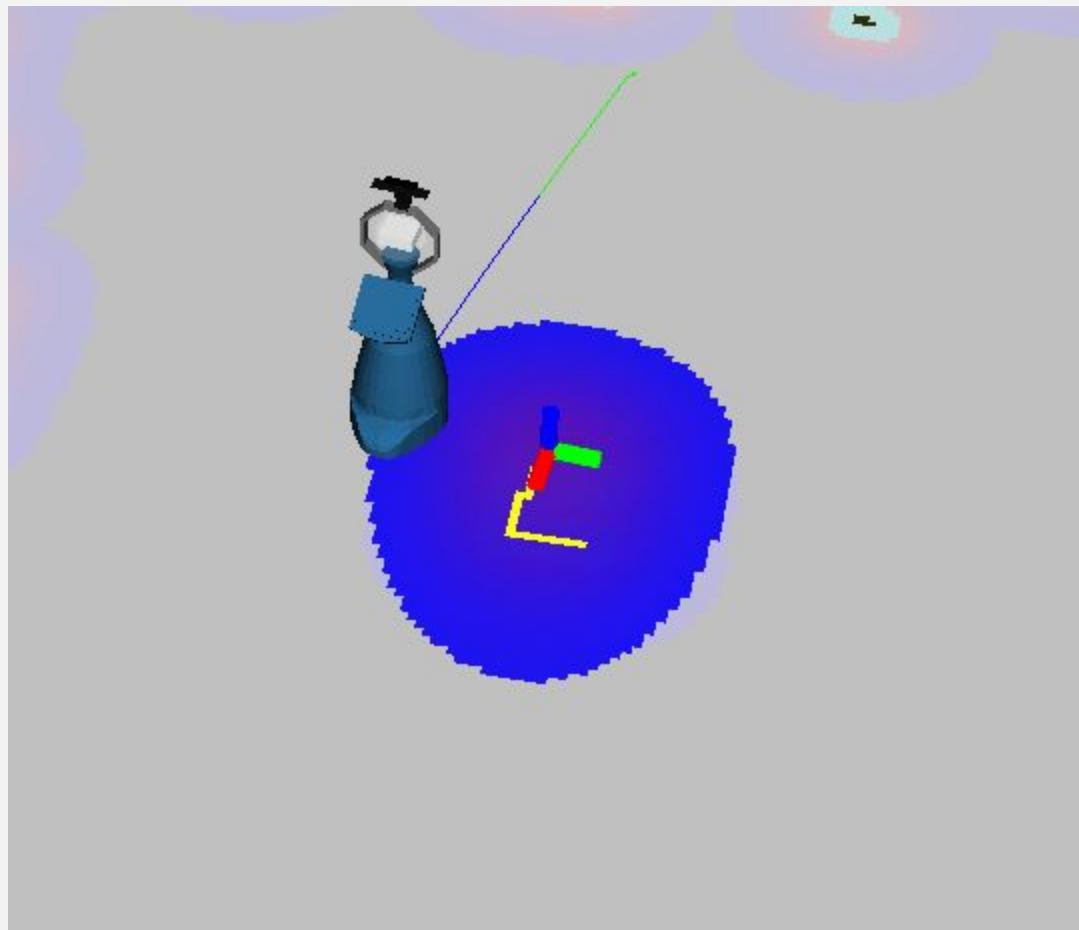
GL0011661A1



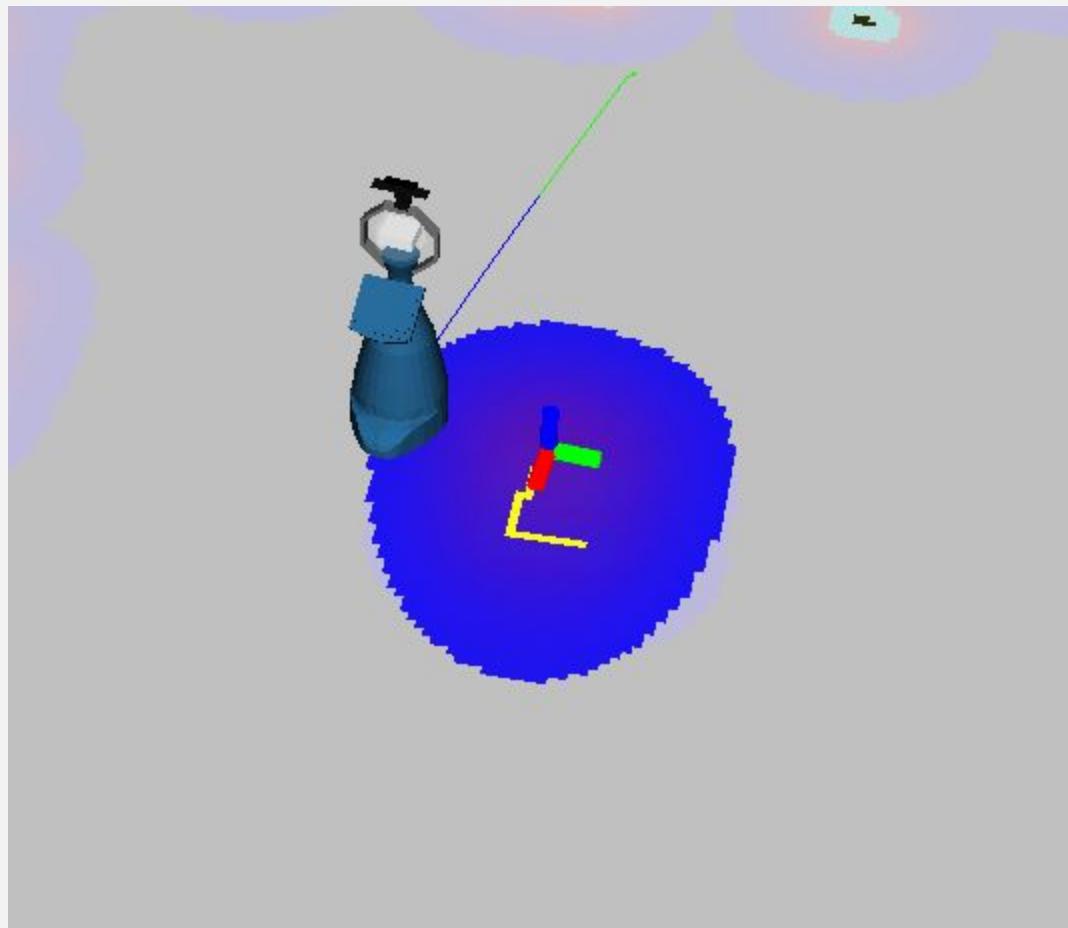
ZEHN DEUTSCHE MARK

# Gaussian cost models





Exact same model for every person ...



... and every situation

# Learning from experience

Shop All Departments

Search All Departments



Basket

Wish List

Books

Advanced Search

Browse Genres

New &amp; Future Releases

Bestsellers

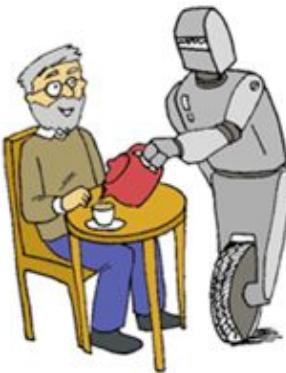
Paperbacks

Audio Books

Bargain Books

Special Offers

Sell Your Books



### Your Service Robot

No customer reviews yet. [Be the first.](#)

RRP: £2500.00

Price: **£2340.00** & this item **Delivered FREE In the UK** with Super Saver Delivery. [See details and conditions](#)

#### Temporarily out of stock.

Order now and we'll deliver when available. We'll e-mail you with an estimated delivery date as soon as we have more information. Your account will only be charged when we ship the item.  
Dispatched from and sold by **Amazon.co.uk**. Gift-wrap available.

Quantity: 1

Add to Basket

or

[Sign in to turn on 1-Click ordering.](#)

Add to Wish List

#### More Buying Choices

Have one to sell? [Sell yours here](#)

Share

[Share your own customer images](#)

[Search inside this book](#)

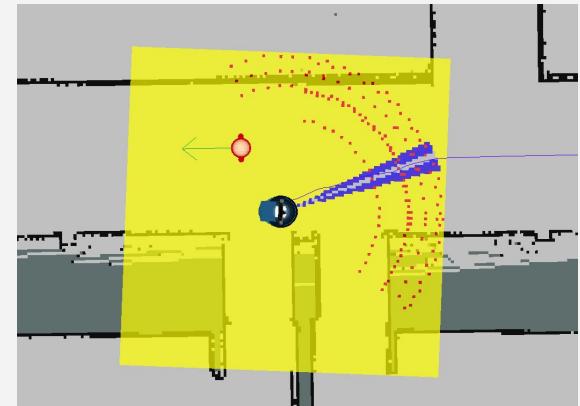
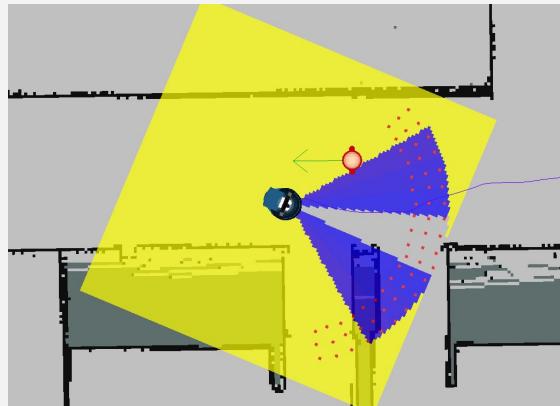
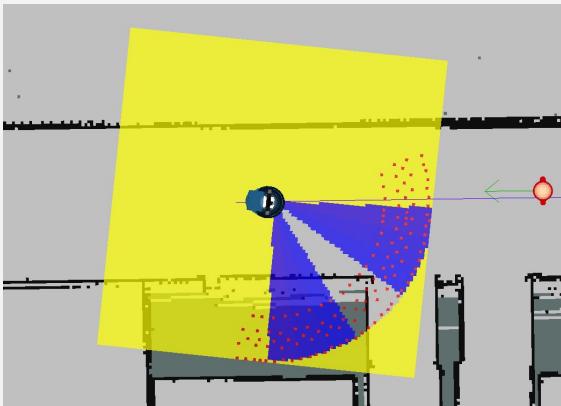
### Product details

# Shaping

# Behaviour shaping

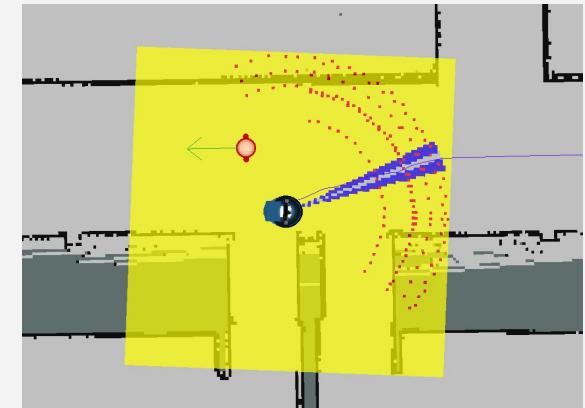
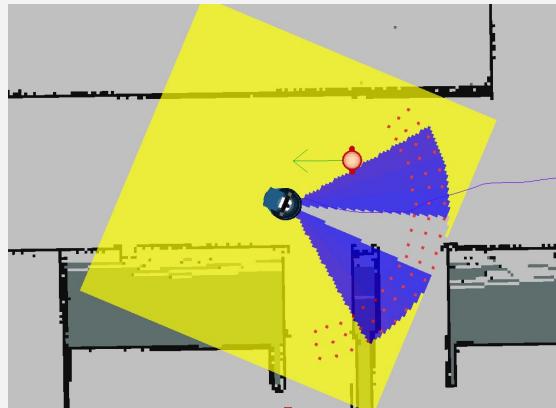
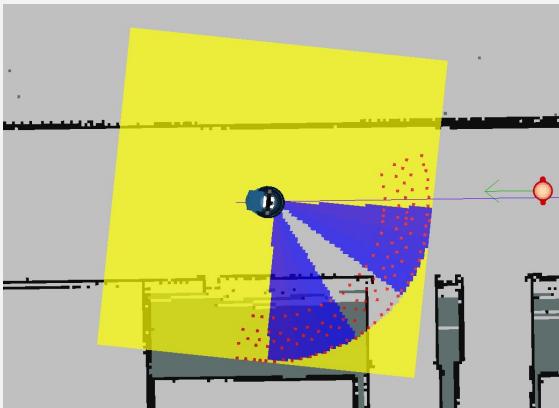


# Simple example

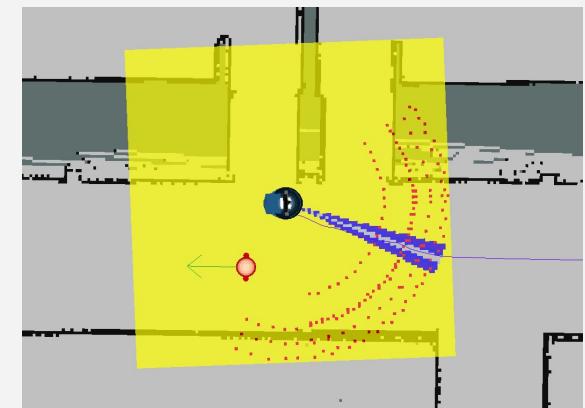
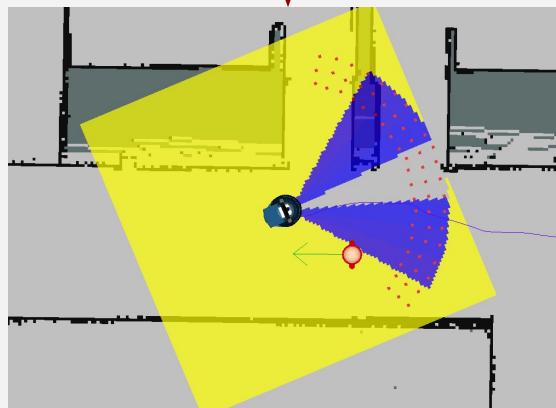
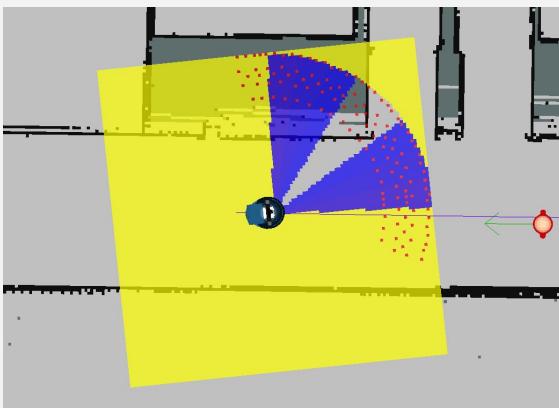


Passing on the right

# Simple example



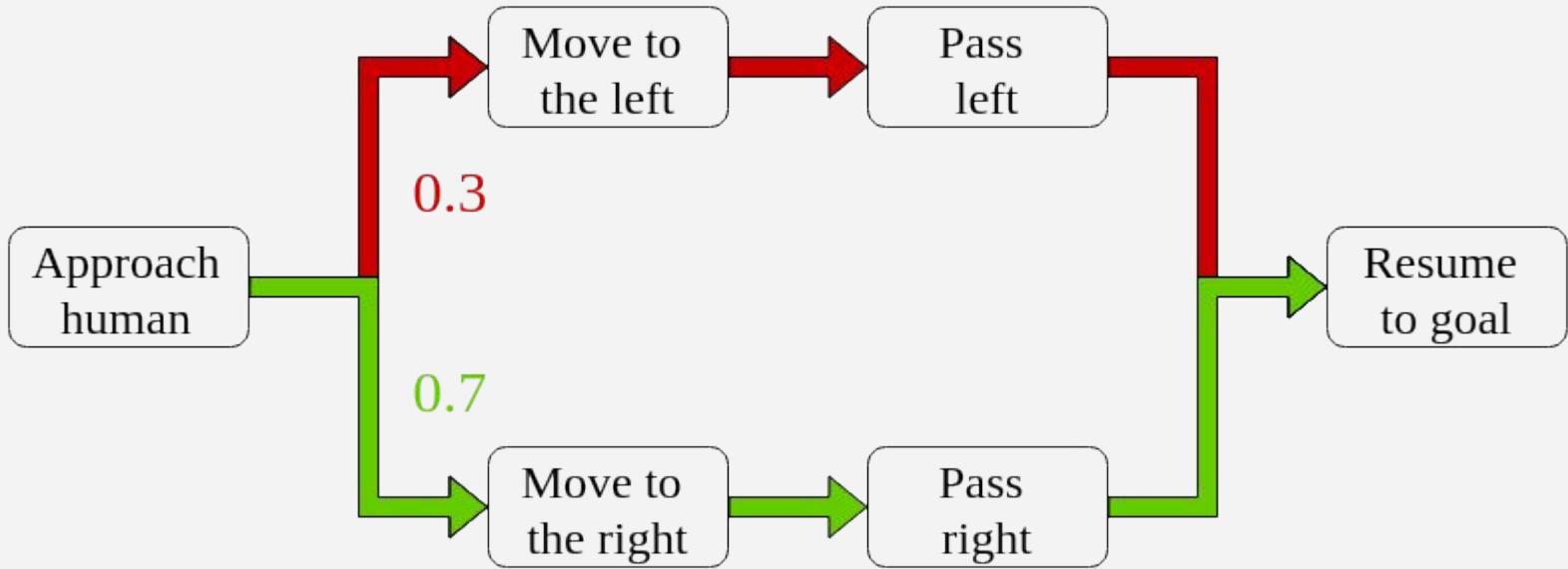
Punishment



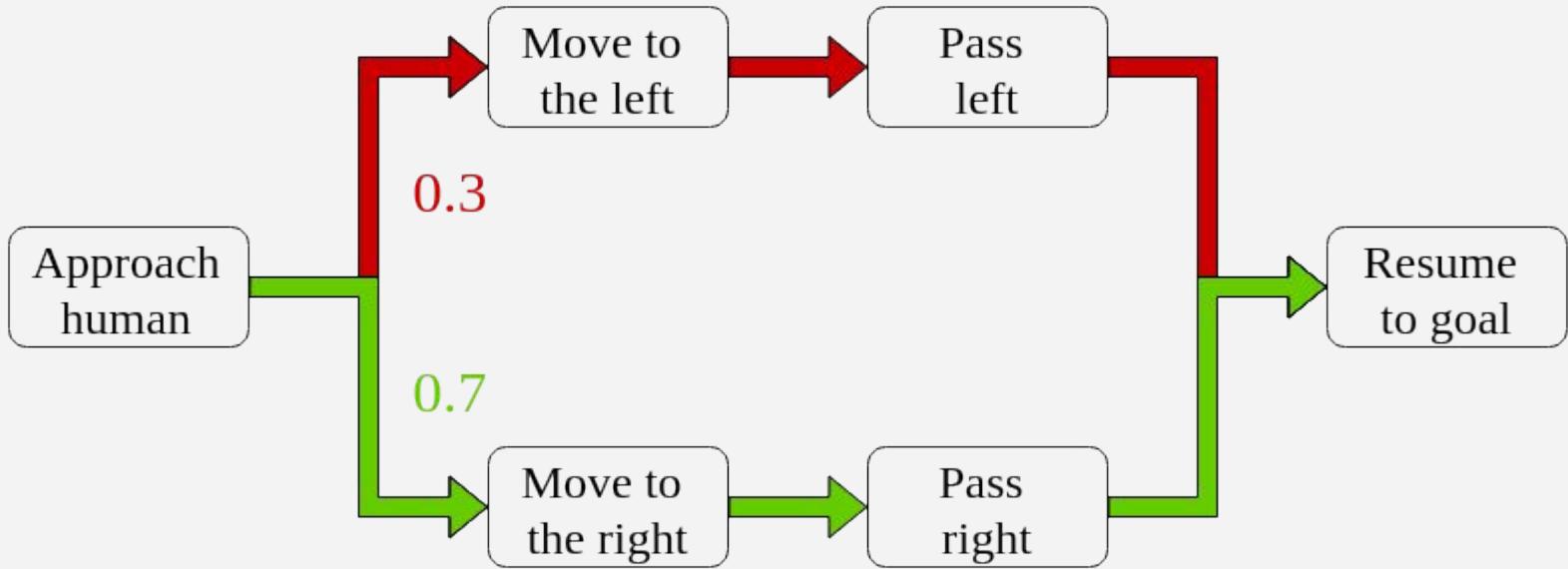
Passing on the left

Using probabilistic models  
and qualitative states

# Passing on the right most likely

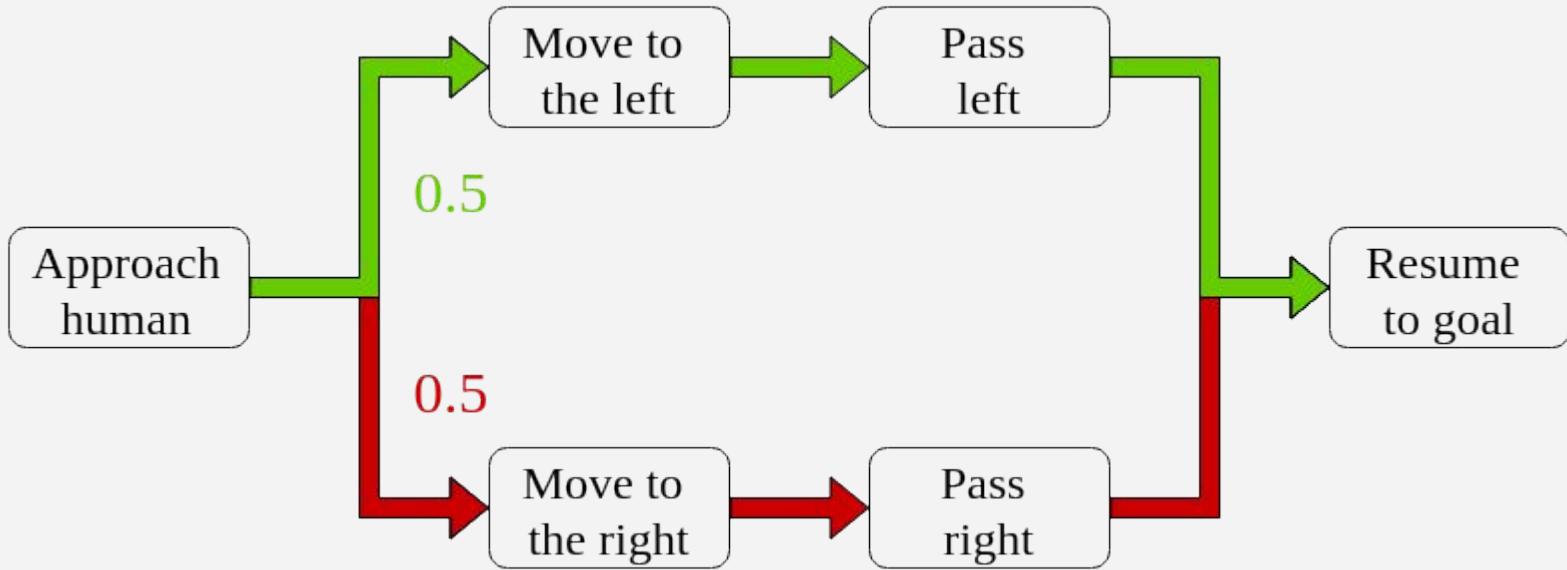


# Passing on the right most likely

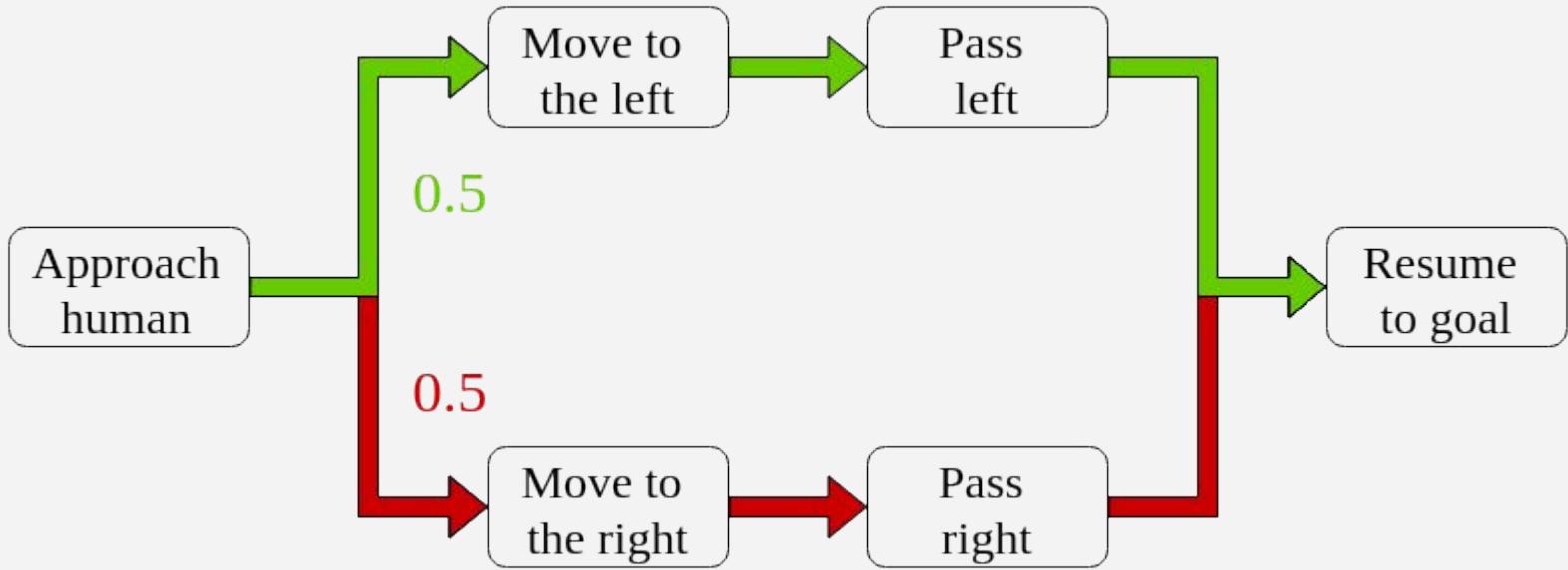


**Punish!**

# Passing on the left and right equally likely

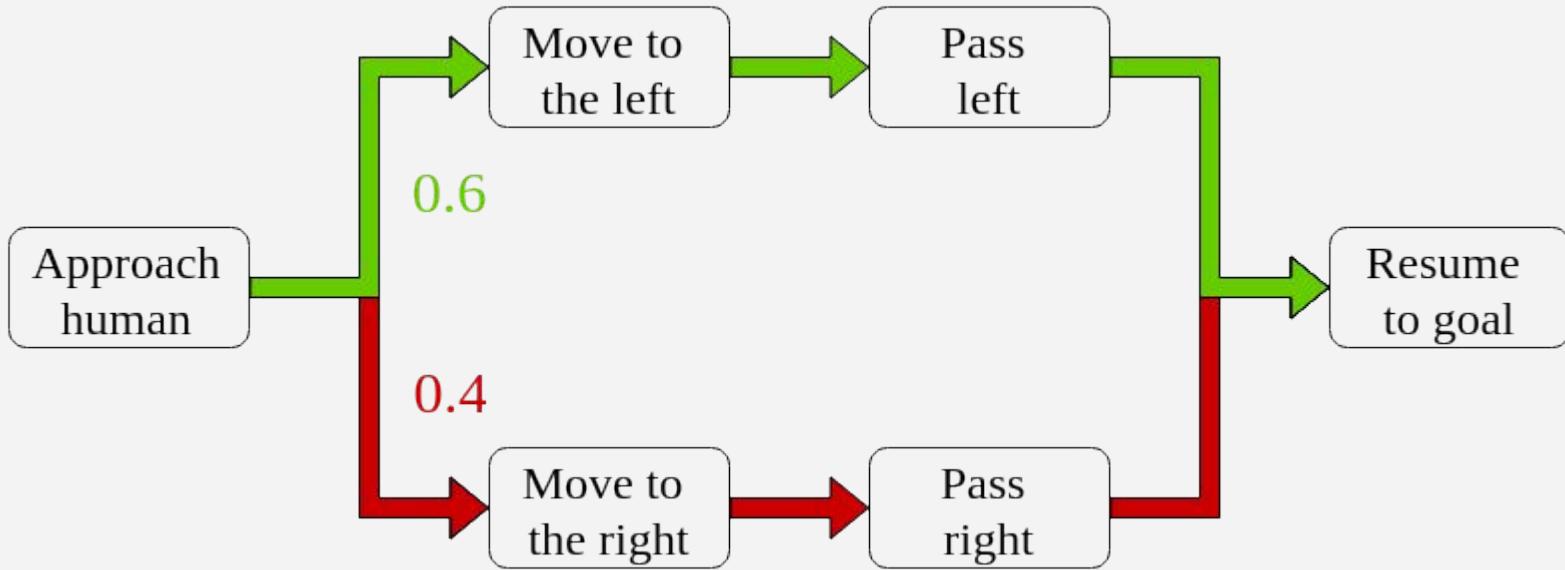


# Passing on the left and right equally likely

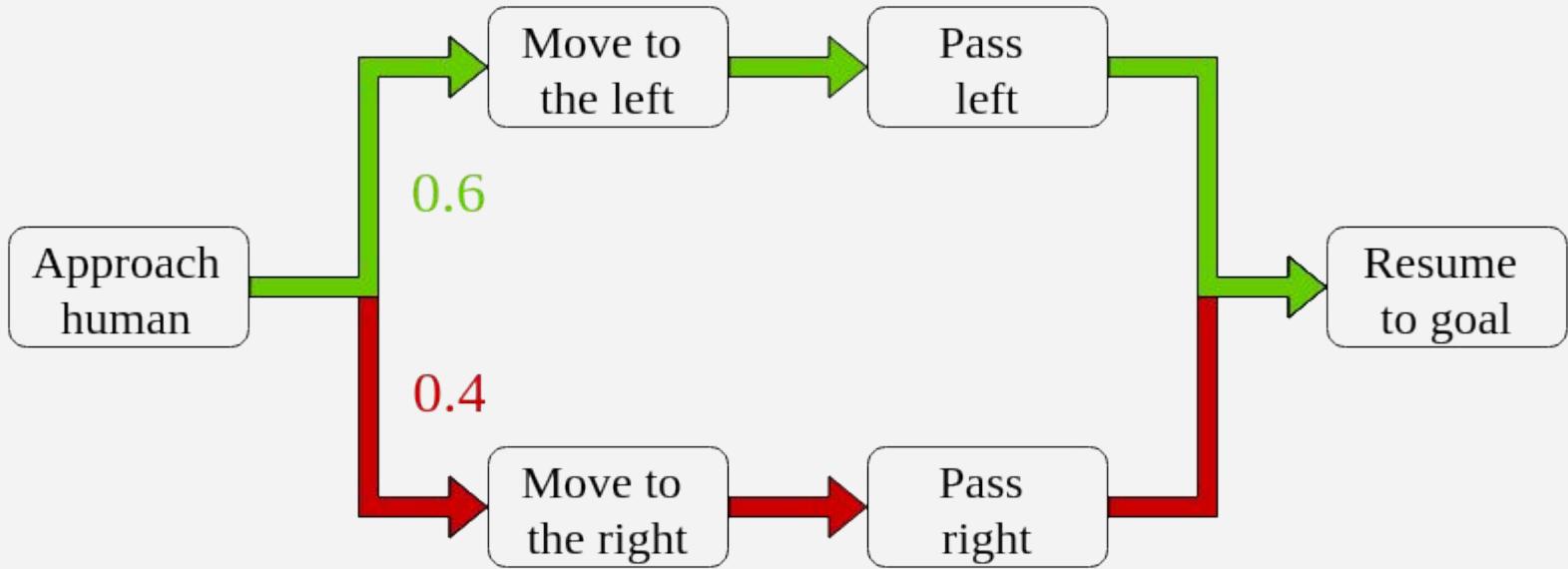


Reward!

# Passing on the left most likely

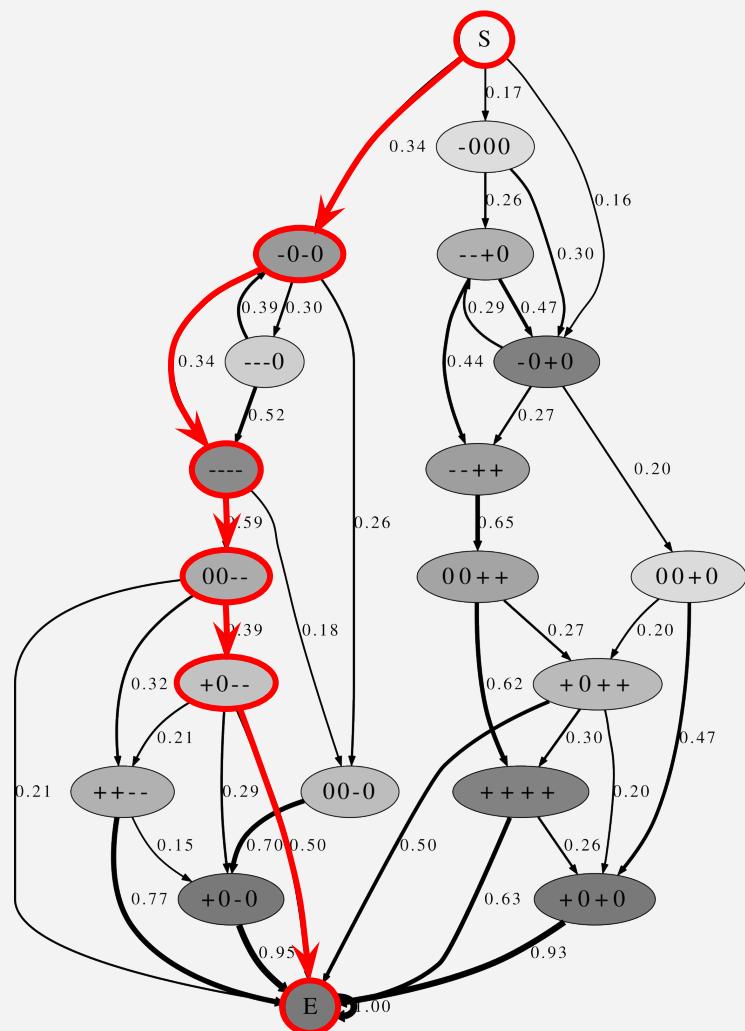


# Passing on the left most likely



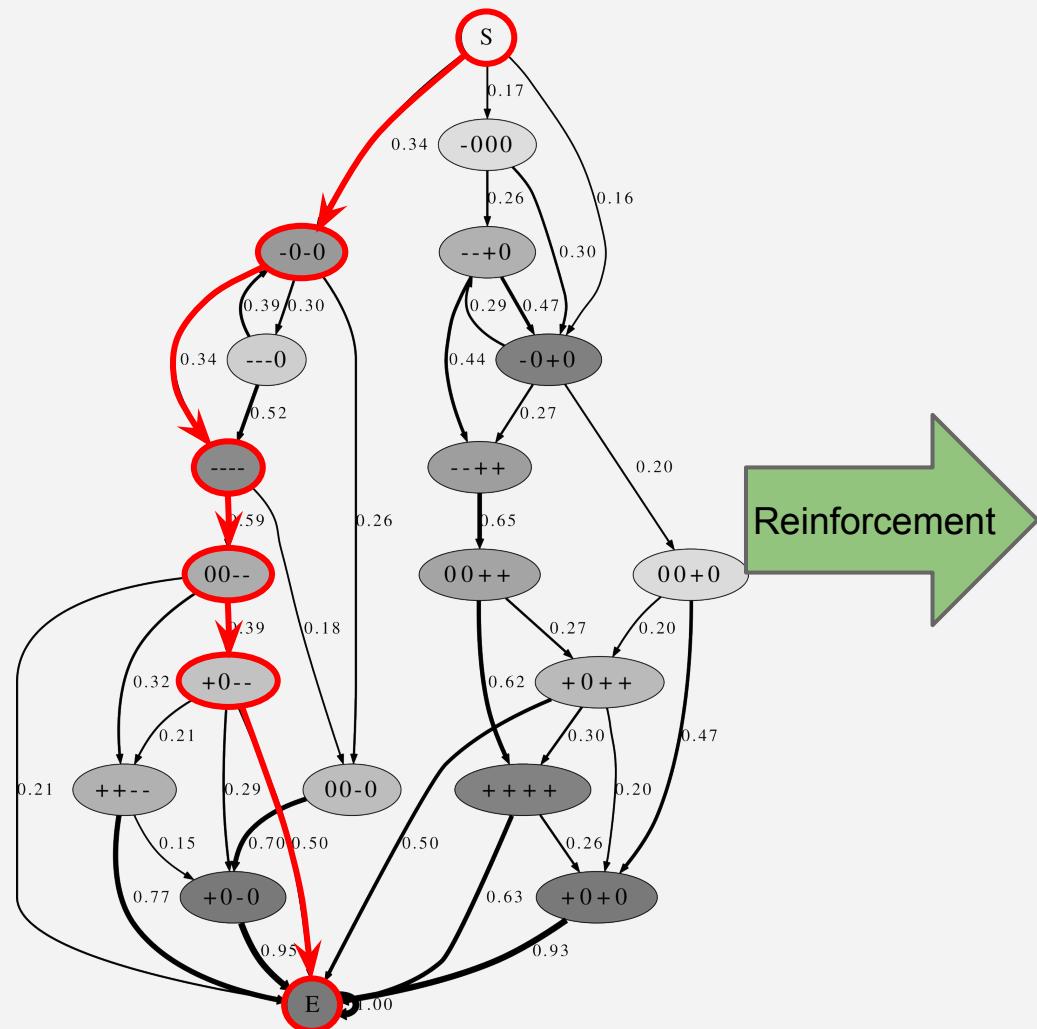
***Slightly simplified***

# Real model



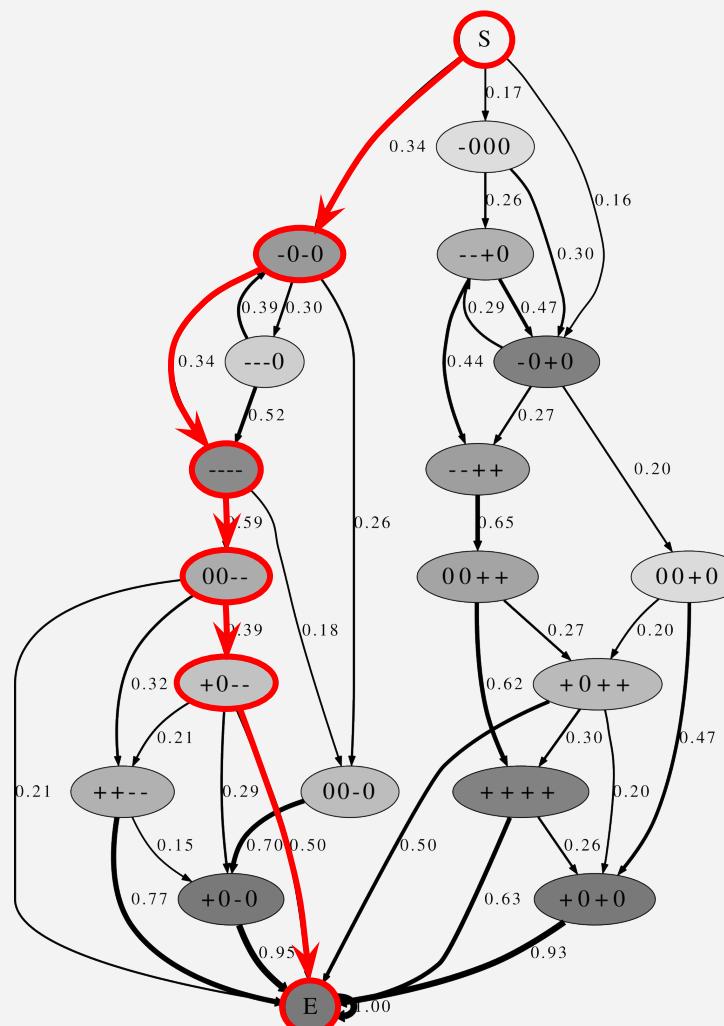
# Passing on the left

# Real model

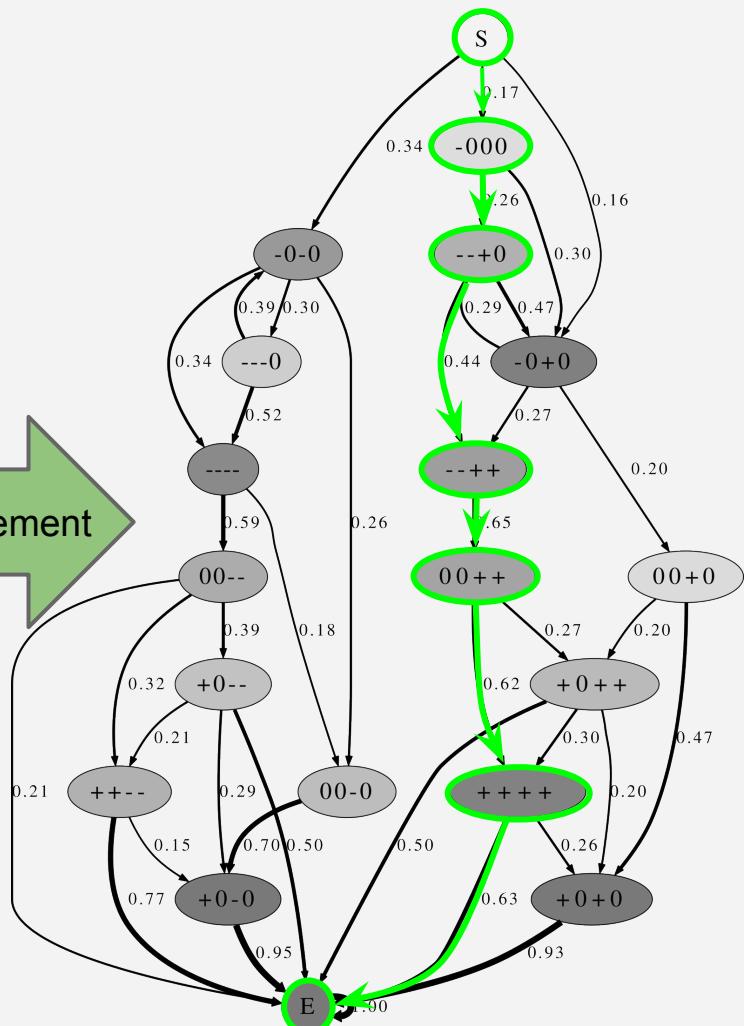


Passing on the left

# Real model



# Passing on the left



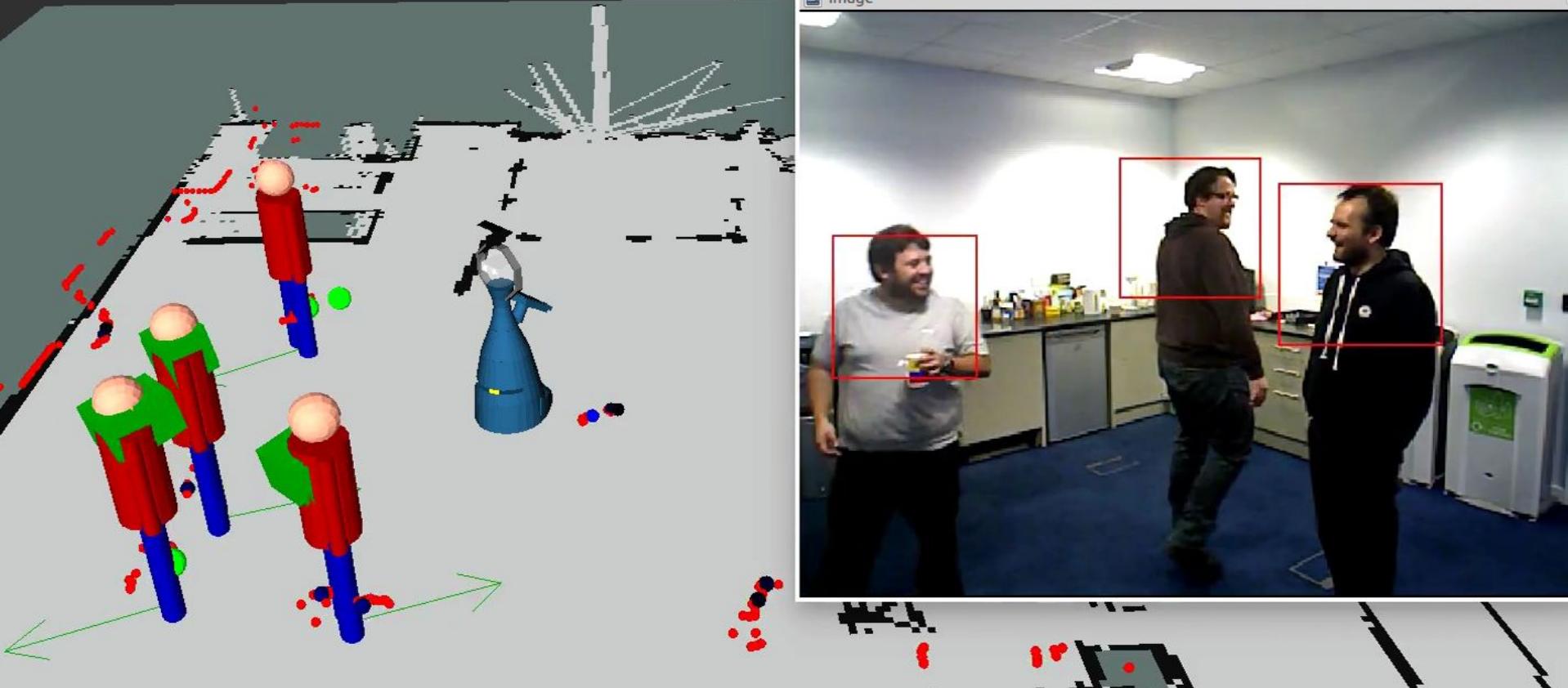
# Passing on the right

The biggest problem  
when interacting with humans:  
*Detecting them...*

# Computer vision on robots is hard!



# Detecting people is even harder!



**Because they move and are soft and squishy**

Would you like to know more?

See me at our stand!

# Thank you!

