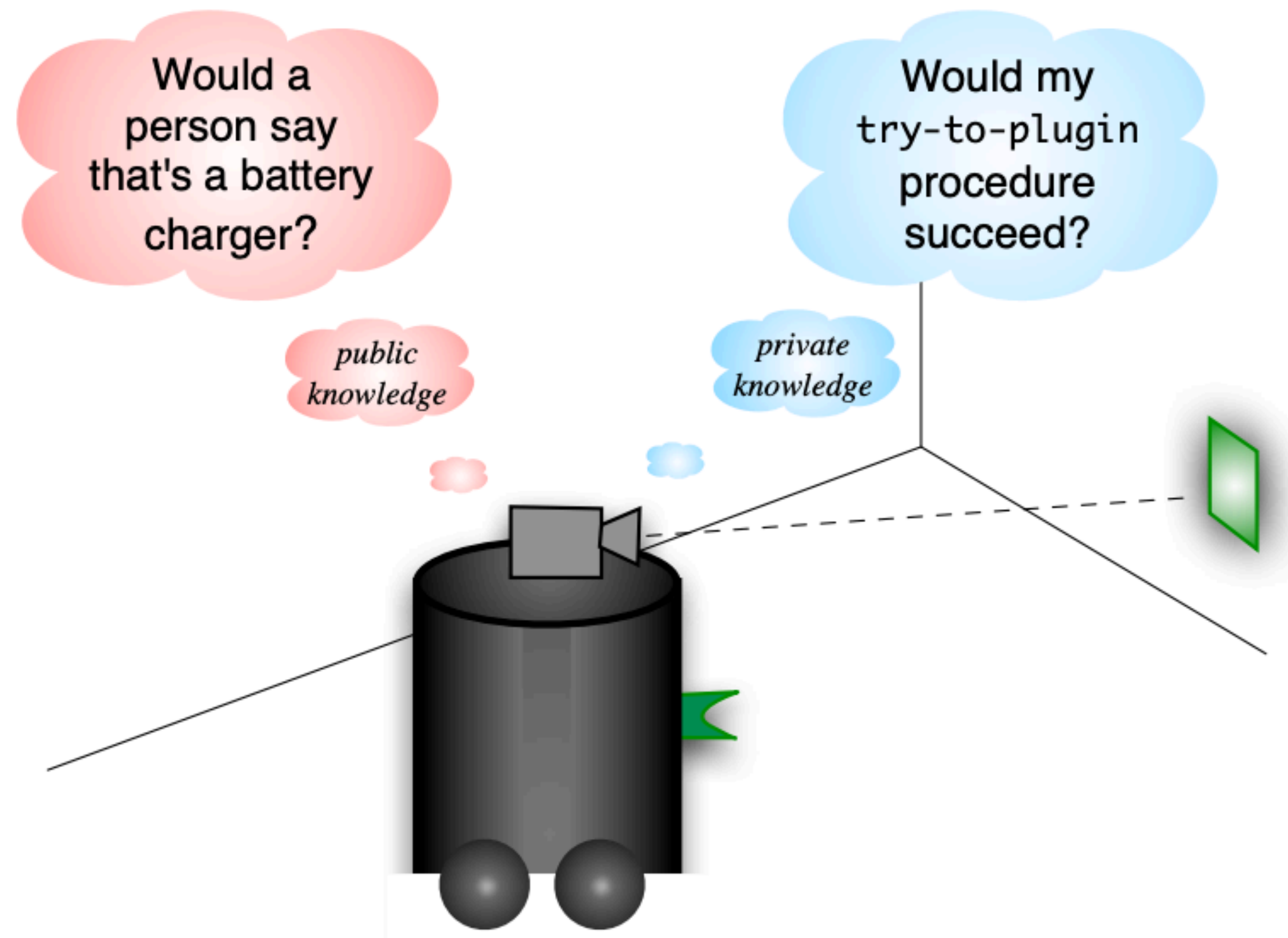


# How should we represent the agent's knowledge of the world?



# Everything the agent knows should be a statement about the data-stream

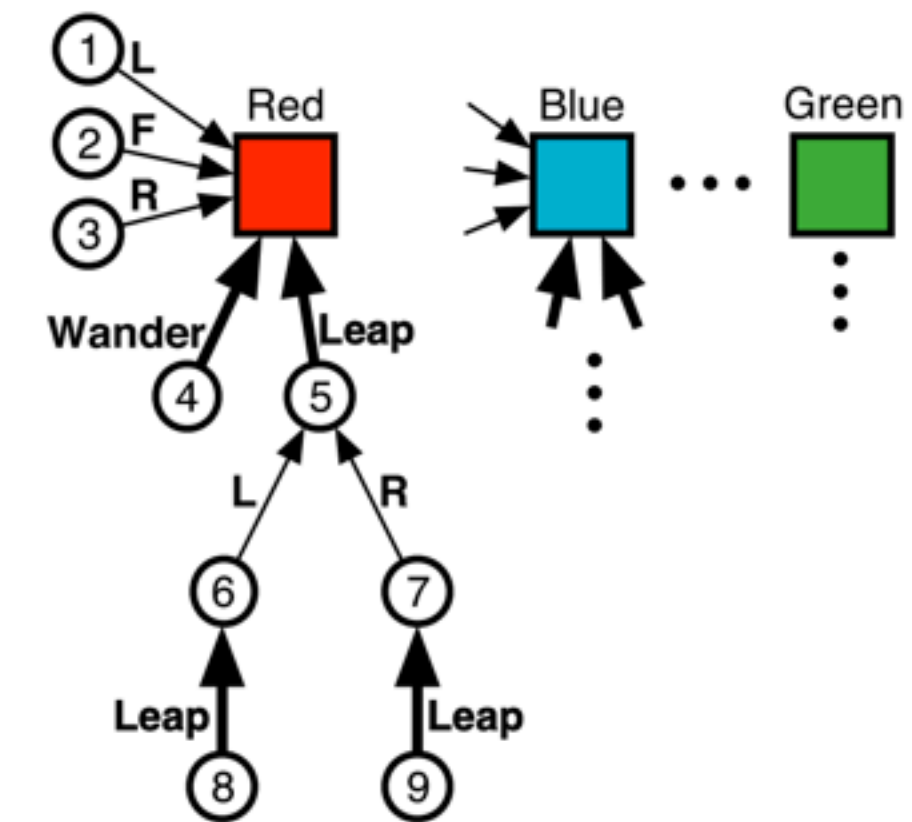
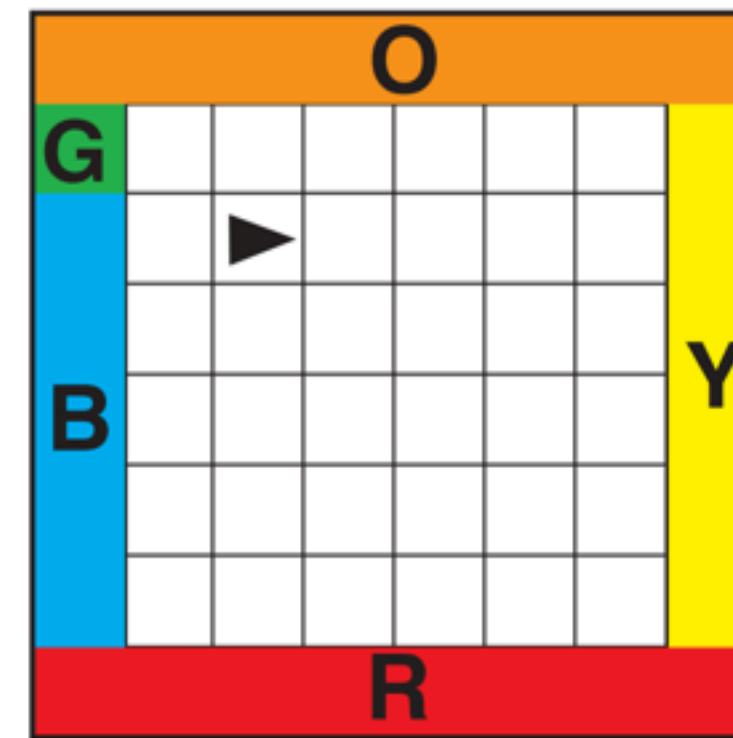
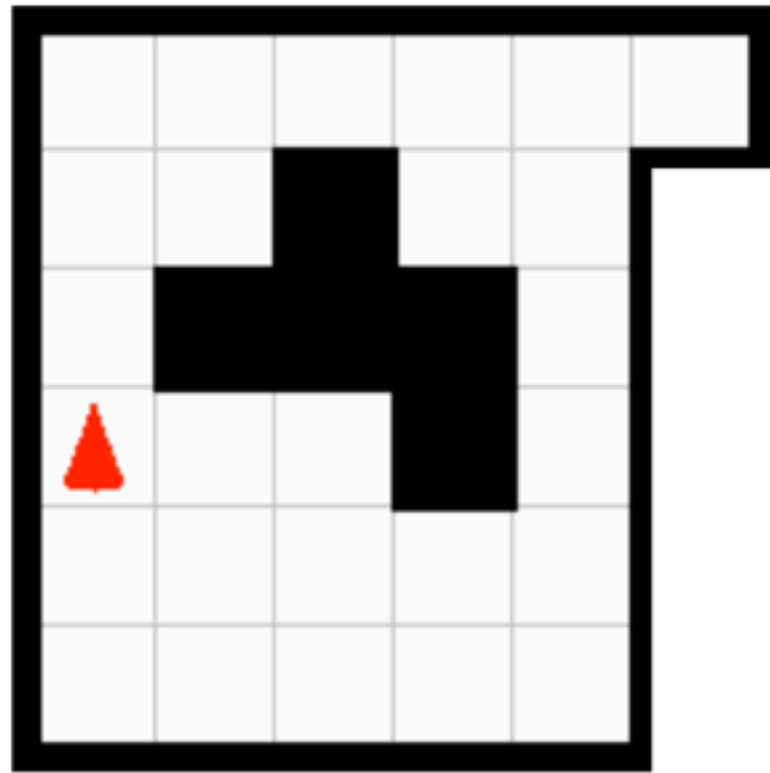


Figure 2: The compass world (left) and a portion of the



# Admin

- Should finish marking the midterms this week
- From now on every lecture will contain project standups:
  - <https://docs.google.com/presentation/d/1EoKmJ-N2aN8hYBWg6zQozaHM5-hKy03jBYm568tSyA>
  - Your group can do so every lecture!
- You have started working on projects right?
  - Have you run your first experiment?

# Project draft marking guide

- Use latex! No MS Word, Pages, Google docs etc
- Use a conference style file: Neurips, ICML, ICLR

# Project draft marking guide

- Required content:
  - title, abstract, introduction, background, descriptions of the experiments you have run & results description and initial conclusions
- A complete draft:
  - No formatting issues, polished, no spelling mistakes / grammar problems
  - An early polished version of the project (a subset of the final project, but well done)

# Project draft marking guide

- You must have at least one empirical result
- Including ...
  - A complete write-up for the goals of the experiments
  - Its ok to have preliminary results, or empty stand in plots
  - specify the hypotheses and questions you seek to answer
  - specify environments and the experiments you plan to run (algorithms, baselines, evaluation scheme)

# Project draft marking guide

- You must follow good empirical practices
  - enough runs
  - measured statements
  - statistical measures of uncertainty or confidence
  - good treatment of hypers
  - Well done plots
  - etc
- Not sure about something: ask in class, **do a standup**



# Draft marking

- Like reviewing and generally evaluating anything marking is subjective
- I will follow these principles:
  - Did you follow the practices and methodologies we have discussed in class?
  - With a couple months more work, could this be part of a NeurIPS paper?
  - Does this look and read like an academic paper?
  - Was there effort and pride put into the work?

- Writing is a critical part of the draft
- Poor, unclear writing is not good
- That's what we will talk about in today's lecture

# Writing is a key part of science



# Writing is hard, assume the reader is barely following at all times

- **The reader cannot ask you questions as they read: this is your one shot to convey your ideas and messages**
- You are too close to the work
- So you forget to say the simple and obvious things to you: try to figure those things out and say them
- Never underestimate how people can misunderstand another's writing
- Never underestimate how two people can think one paragraph can mean totally different things

# General advice

- **Writing is about structure**
- Write a topic sentence
- Make sure each paragraph has one idea
- Say important things first
- Be direct and say things as plainly as possible

# Be sincere

- Be sincere about what you are trying to do in the paper
  - You have to care about what you are doing, and your writing will reveal when you don't!
- Think about: what do I really want to communicate here?
- If its not clear in your mind what you want to say, then what you write down will not be clear
- Writing is also for you: it makes you question your work which makes the work better

# Scoping your work

- Clearly identify the problem setting: exactly what problem are you addressing and for what specific setting?
- This also helps narrow the scope, to constrain related work
- Example:
  - Too vague: We care about policy evaluation algorithms
  - More specific: We care about online off-policy policy evaluation algorithms that are sample efficient

# Placing your work

- Tell us how it fits into the body of prior work
- Don't just list things that seem related
- Talk about the history of the problem or idea
  - Where previous efforts ended and what are the natural next steps and open questions
- This can always be done in a positive and constructive fashion



# Writing an introduction

- State your problem. As early as possible: *what this paper is about*
- Explain what has been done
  - It is usually better to include your literature survey here, instead of in a separate Related Work section
- Identify a specific open question, and how/why it hasn't been done
  - ...also why its hard, interesting and not already done
- Explain what you do and key contributions

# Minimalist and Just-in-time

- Don't talk about things that are not relevant to your topic, to your contributions, to your insights, and to your reader
- Tell the reader what they need to know, only when they need to know it
- This means leaving out certain related works
- This means talking about certain ideas and related work later when you need it

# Are Related Work sections bad?

- This usually just turns into a list
- Example:
  - Here is all the methods that are used for exploration with FA
  - And now here are all the methods that are for this other problem
  - And this why they are all bad
- This often becomes negative, less connected ideas and problems
- **NEVER EVER: put related work at the end**

# Abstracts

- Mini version of the intro, which is a mini version of the paper!
  - Structure and repetition are important
- **To start:** take the topic sentence from each paragraph in the intro
- **Better:** Keep the same structure as the intro, but make it more succinct
- It is ok to make bold statements in the abstract, without substantiating it, as long as the paper substantiates it
- Very early in the abstract, ideally line one, tell us what the paper is about

# Technical sections

- Be precise. Make sure all variables are defined, and used consistently. Clearest evidence of amateur or sloppy work
- Adhere to your notation budget. Try to limit how much notation needs to be introduced.
- Correctness is king. Do not add math/theory unless its (a) stated precisely and (b) you're confident in it
- Background section should define the problem setting formally and any notation you will need later in the paper
- I should never come across a symbol later in the paper that was not defined

# Be consistent, be boring

- At least at first
- Don't use a different word or phrase for the same thing to spice things up
- Hunt for consistency issues in your document: e.g., interchanging “method”, “algorithm”, “agent”
- Don't use flowery, over the top language: called **purple prose**
- Don't use words like “very”, “extremely”, “interestingly” to make your prose more impactful. Improve the content instead

# Experiments

- Make sure you communicate to your self: do the results convince you? Be a sceptic of your own work
- Make clear design decisions, and justify them:
  - If you are embarrassed or not wanting to write down some of the details of your experiment that should be a warning sign!
  - Example: hmm this choice was a bit arbitrary, so I am going to make up a reason why I choose this parameter or this environment
- Tell us about we learned from the experiments
- We have talked about experiments a lot by now. Any additional questions?

# Edit, Edit, Edit

- You have to be willing to throw it all in the garbage
  - I often delete sentences, paragraphs and sections...multiple times
- Be your own reviewer
  - Question everything; anticipate questions the reader might have
  - Did this paragraph convey what I wanted? What was this paragraph or section even about?
  - Is this idea concisely explained? Remove extra words and phrases
  - Could I completely re-organize this to get it across better?



# Small things

- Watch out for backward sentences: say the most important thing first
- Don't define acronyms that you only use once
- Don't use lists too much
- Don't use meaningless or irrelevant words (“modern” RL algorithms, “popular” optimizer)
- Avoid meaningless motivations: we work on this because everyone else is
- Related work: talk about ideas and methods not people
- The reference should not be part of the sentence: “As in [Sutton et al, 2004] we ...” BAD

# Small things

- Read your sentences and ask yourself: “is this true?”, often times its not—sloppy prose
- Wrong subject for verb: “Reinforcement learning tries to solve”, RL is a formalism, it cannot be trying something. This is literally not true!
- Ask yourself: could the opposite of this sentence also be true?
- Avoid long sentences. The reader forgets halfway through
  - Short punchy declarative sentences are easy to read

# Small things

- Focus on what you **do**, not on what you **do not do**
  - “In this work we do not investigate planning, rather we focus on policy evaluation” << Backwards sentence also
- Avoid overclaiming, and only state factually true things
  - “Our method X is better than method Y” -> “Our method X performs statistically significantly better than method Y on this problem”
- Be precise!
- Don't use silly names. Research can be fun but papers should be serious and professional—no place for jokes or informality

# Small things

- Watch out for false parallelism in lists
  - “There are many possible approaches to exploration including (1) optimistic initial values, (2) upper confidence bound actions selection,...” all list items should be the same type
- Don’t use **bold** or **colours** to emphasize things
- Be consistent with British vs American spellings
- Avoid strong words like “must”, “requires”
  - Avoid strong statements...they are often false

# It takes time ...

- Find good writers and study how they craft intros and their general writing style
  - Learn from demonstration
- Practice, Practice, Practice
- Remember writing is hard for all of us, and many good writers don't enjoy it!

# Links to resources

- Strunk and White is the classic reference book
- Other stuff:
  - <http://approximatelycorrect.com/2018/01/29/heuristics-technical-scientific-writing-machine-learning-perspective/>
  - <https://icml.cc/Conferences/2002/craft.html>