

Computing Decisions

Nate Derbinsky

Teaching Professor

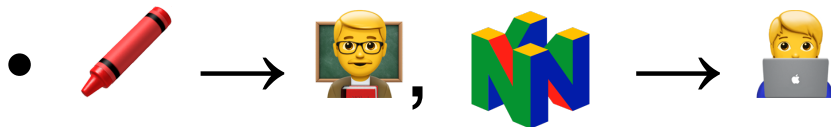
Associate Dean of Teaching Faculty

Khoury College of Computer Sciences



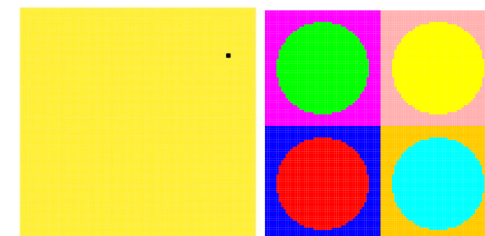
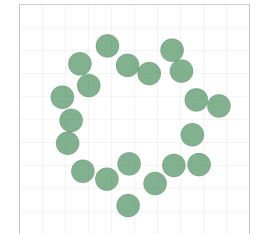
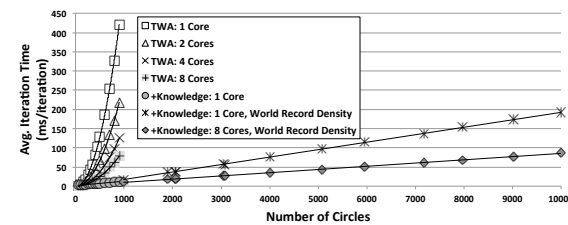
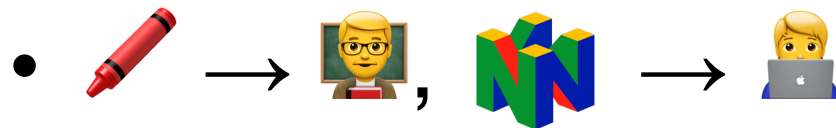
Who am I?

- 1st Gen 🇺🇸

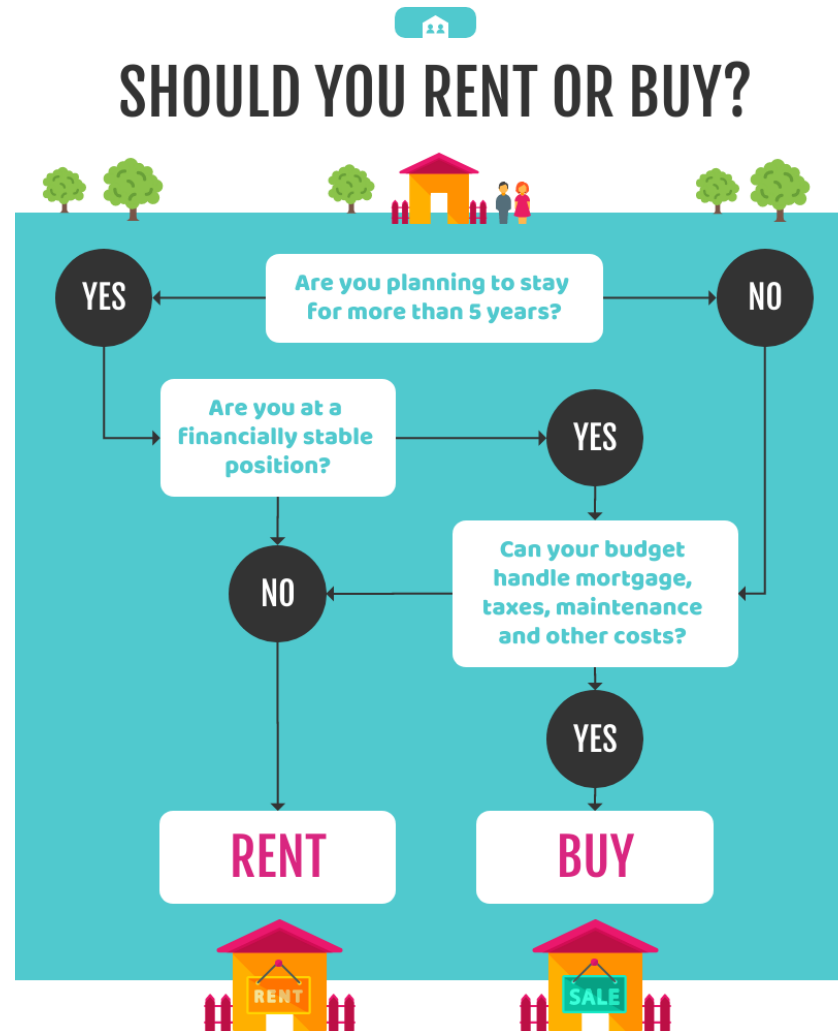


Who am I?

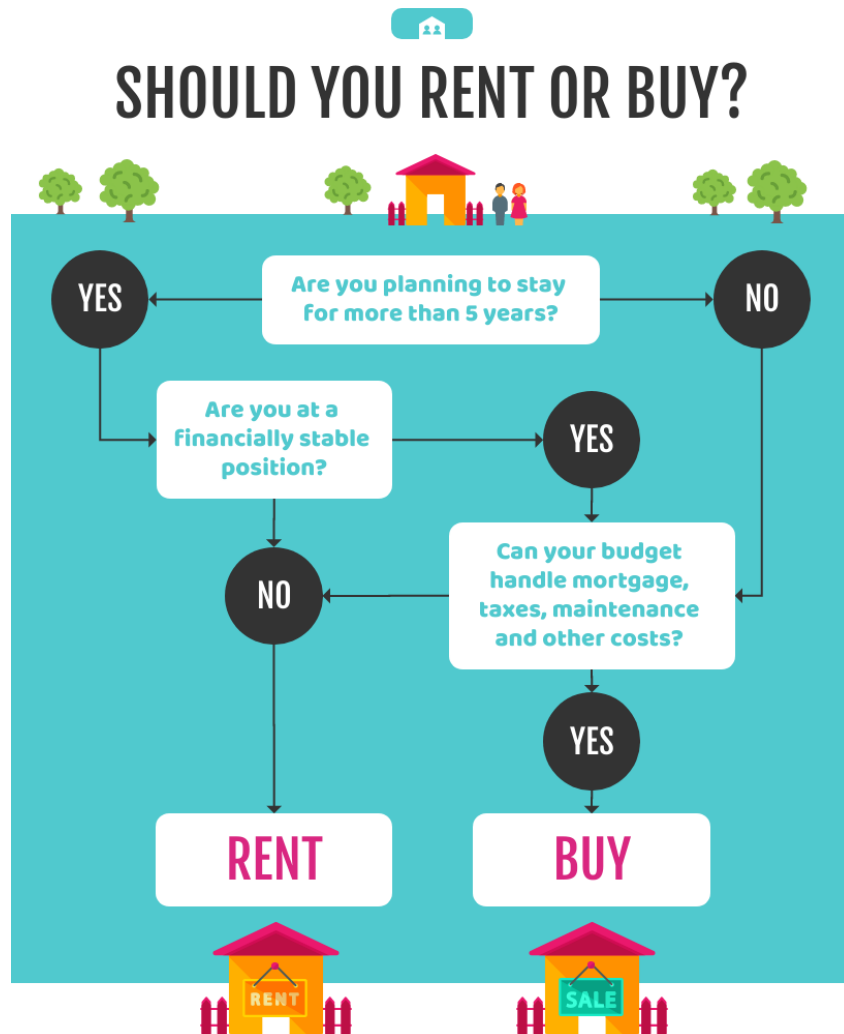
- 1st Gen 🇺🇸



What is this?

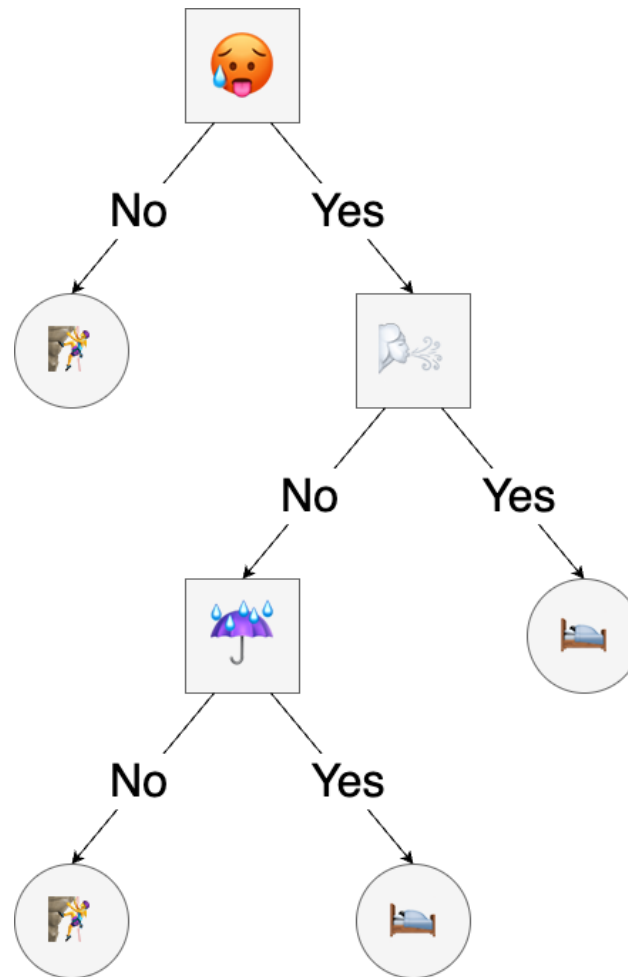


What is this?

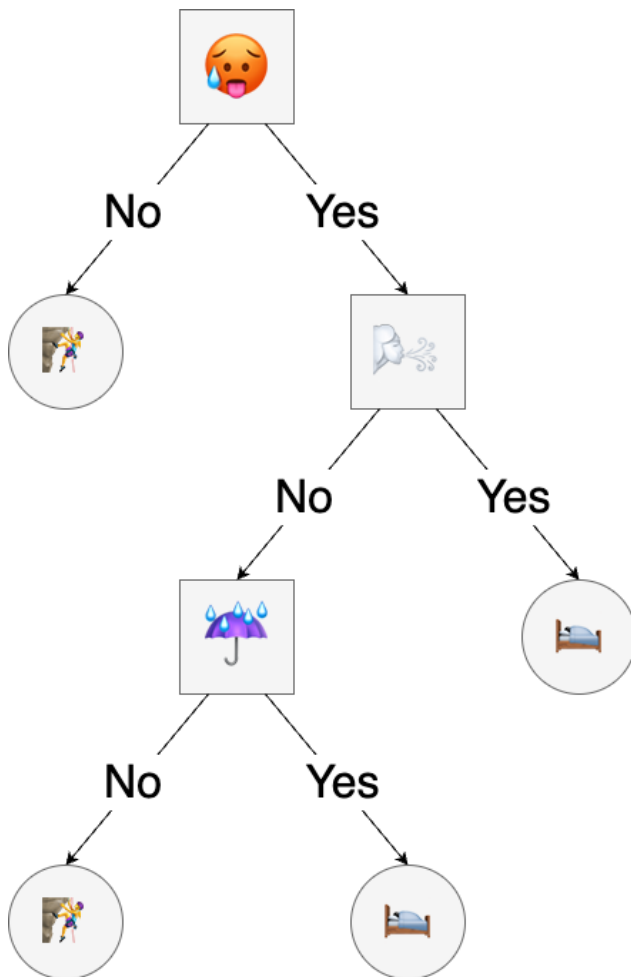


- **Data representation** that captures (useful) experience
- When properly **interpreted**, a process for making decisions (effectively)

Let's Practice Interpreting Data



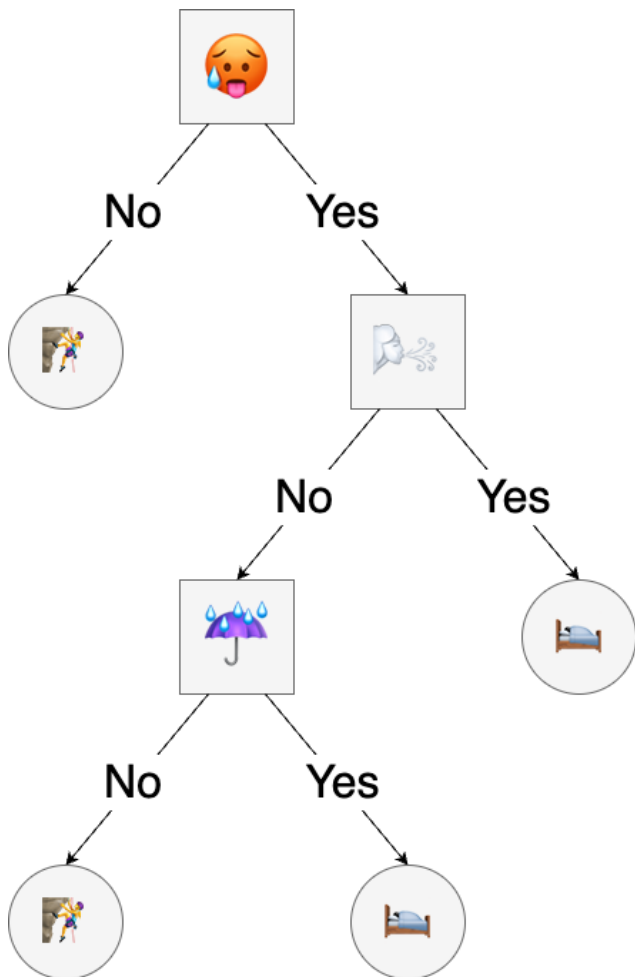
Data + Computing -> Decision



				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	

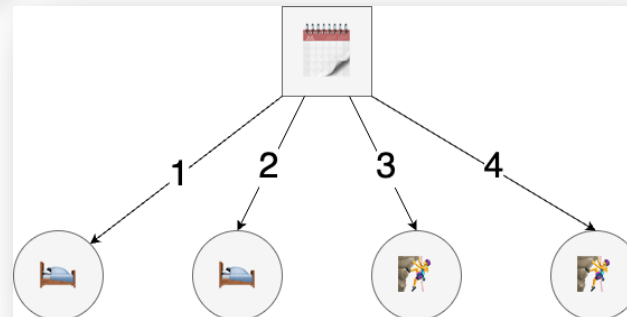
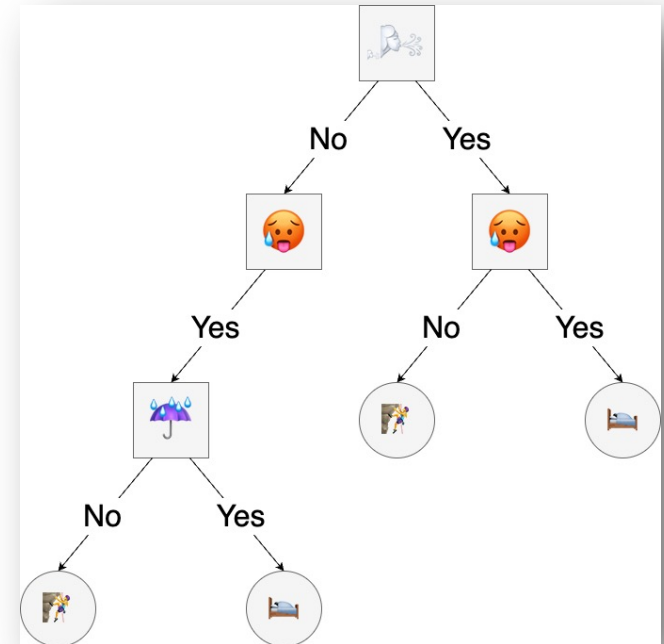
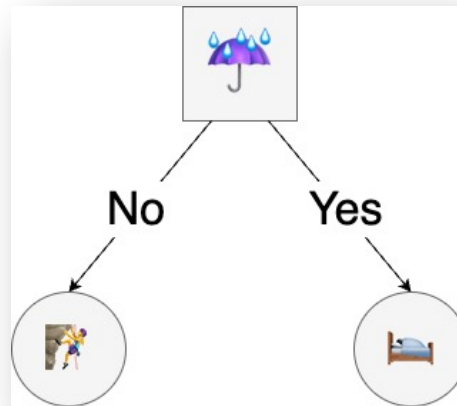
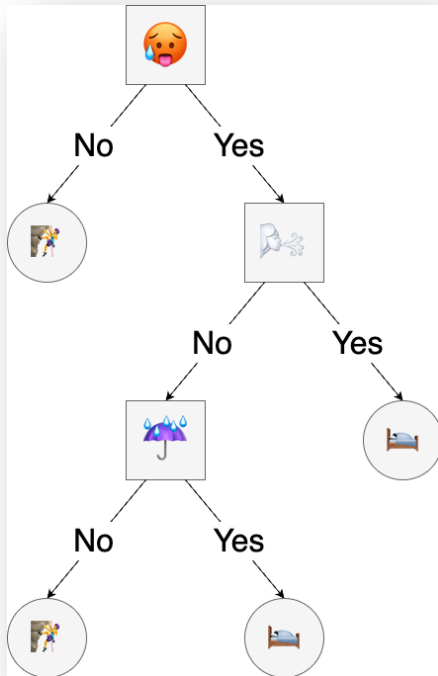


Data + Computing -> Decision



				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	

Tradeoffs in Data Representation



How to **Generate** a Representation?

- If we have some data, what steps (**algorithm**) would produce the “best” representation of how to compute the decision based upon the data?
- Such a **machine learning** approach might be useful for other problems 🤔

				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	



One Idea: ID3

- The **Iterative Dichotomiser 3** algorithm (Ross Quinlan, 1986) decides based upon the column (**feature**) that provides the greatest immediate gain in certainty
 - This approach is considered “greedy”
- If there is remaining uncertainty, these are then handled one-by-one (iteratively) with the same methodology as above
 - A **recursive** “divide-and-conquer” approach








Let's Practice Greedily

				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	













Let's Practice Greedily

				
1				
2				
3				
4				



Let's Practice Greedily

				
1				
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Let's Practice Greedily

				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	



Let's Practice Greedily

	😓			
	Yes			🛏
	Yes			🛏
	No			🧗
	Yes			🧗



Let's Practice Greedily

	😓			
	Yes			🛏️
	Yes			🛏️
	No			🧗
	Yes			🧗

😓	
Yes	🛏️ 🛏️ 🧗
No	🧗








Let's Practice Greedily

				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	










Let's Practice Greedily

				
1	Yes	Yes	Yes	
2	Yes	Yes	No	
3	No	No	Yes	
4	Yes	No	No	

	
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Yes	  
No	

	
Yes	 
No	 

	
Yes	 
No	 











Let's Practice Recursively




			
Yes	Yes	↔	
Yes	Yes	↕	
Yes	No	↔	X
No	Yes	↕	X
No	Yes	↔	X






Let's Practice Recursively

			
Yes	Yes	↔	
Yes	Yes	↕	
Yes	No	↔	X
No	Yes	↕	X
No	Yes	↔	X

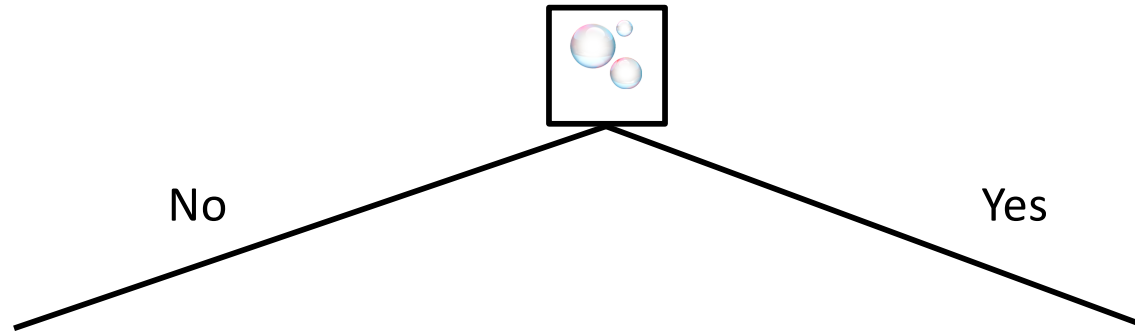
	
Yes	  X
No	X X






	
Yes	  X X
No	X

	
↔	 X X
↕	 X



Let's Practice Recursively

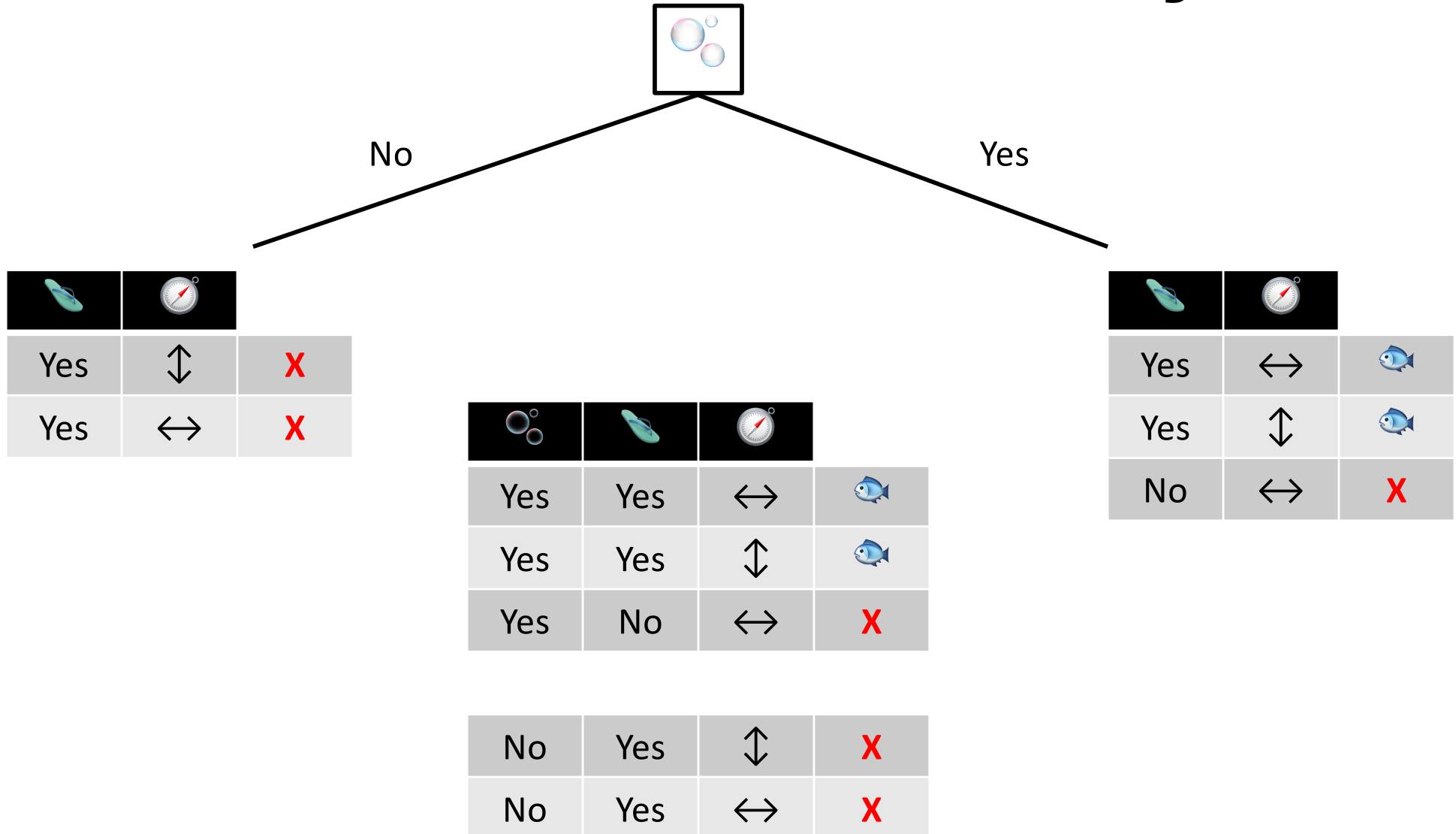


			
Yes	Yes	↔	
Yes	Yes	↕	
Yes	No	↔	X

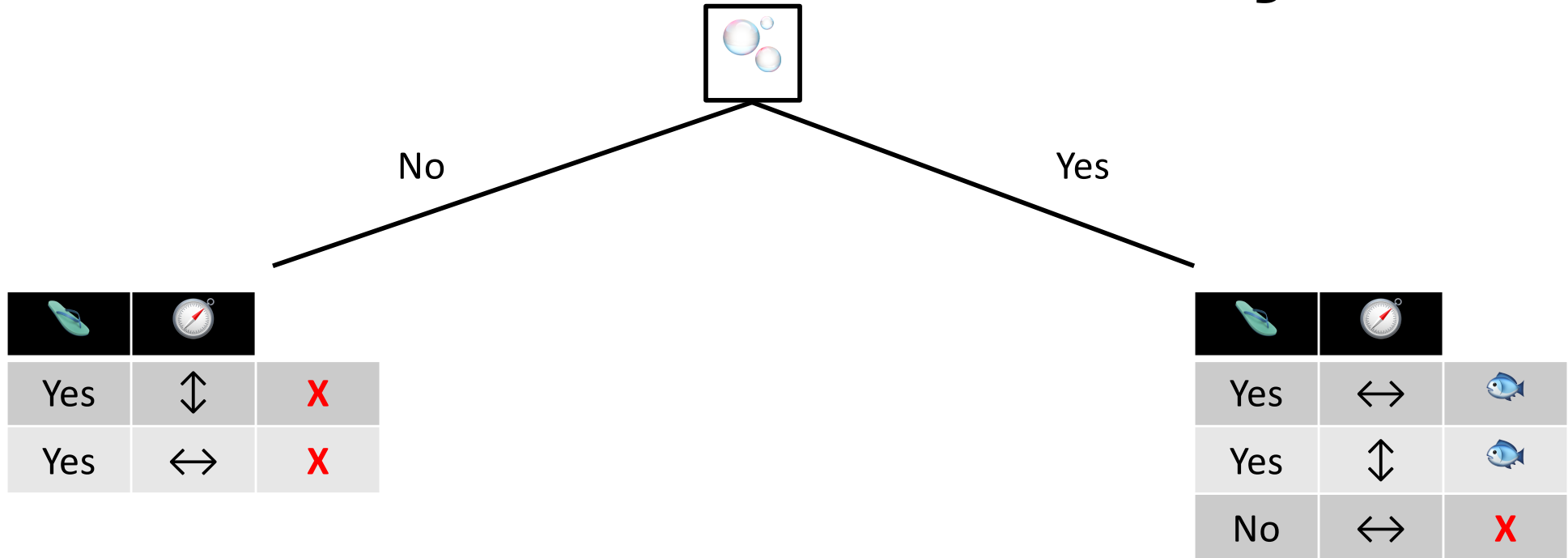
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No	Yes	↔	X



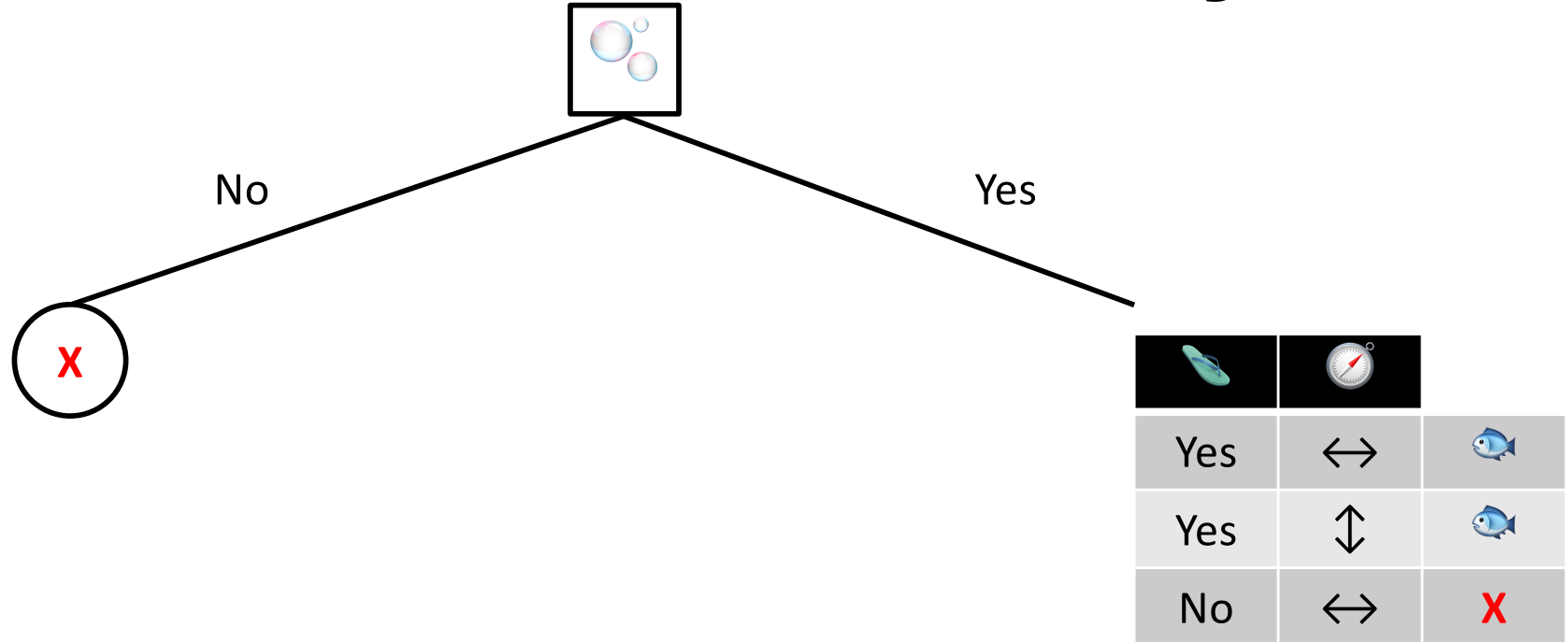
Let's Practice Recursively



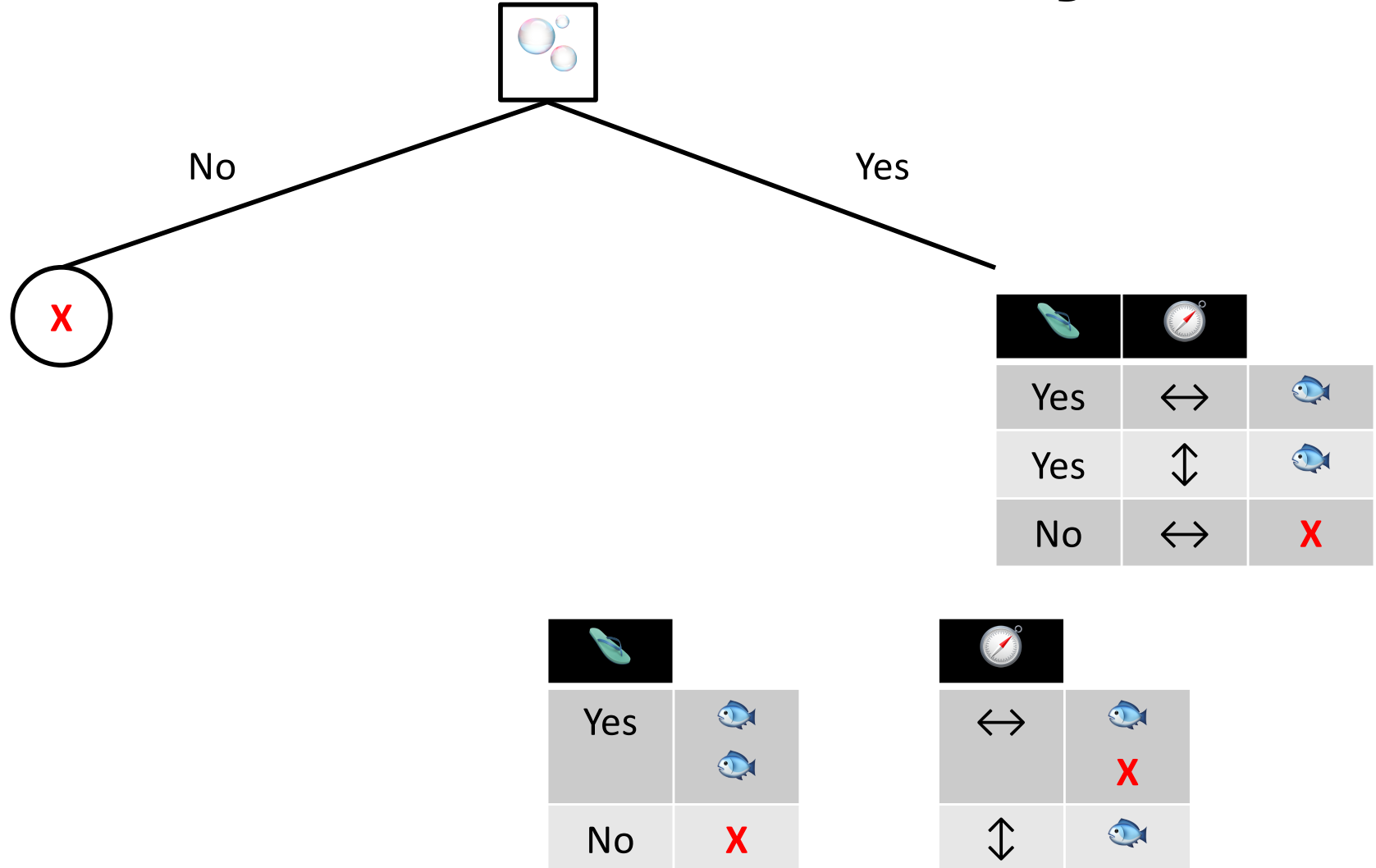
Let's Practice Recursively



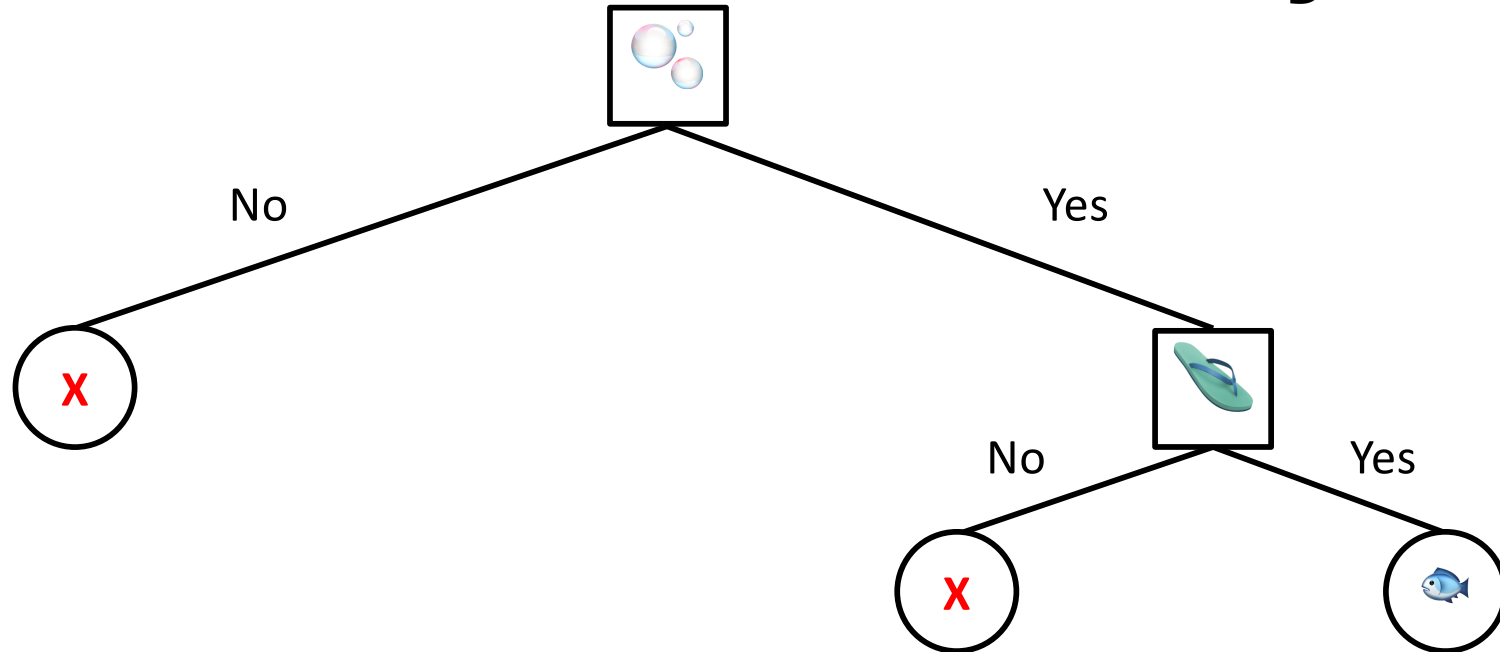
Let's Practice Recursively



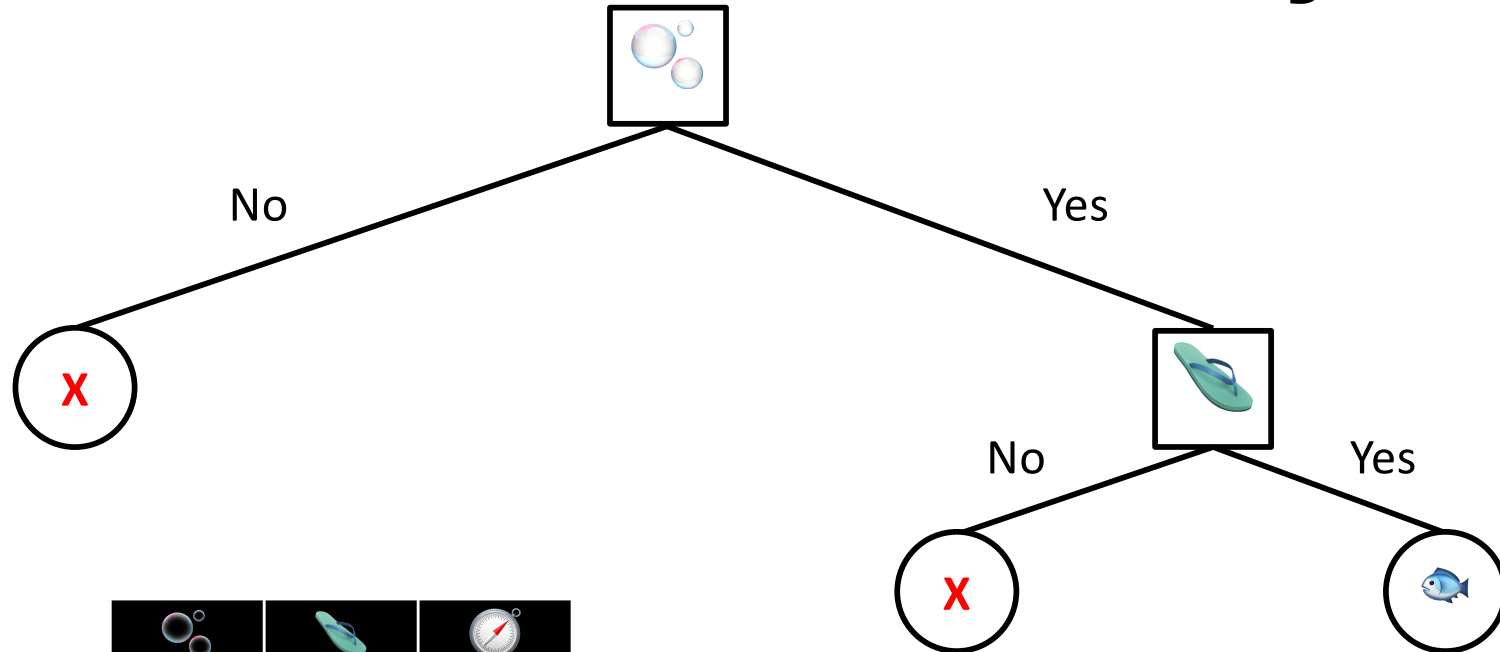
Let's Practice Recursively








Let's Practice Recursively



Let's Practice Recursively



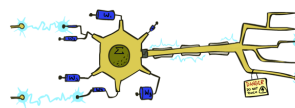
			
Yes	Yes	↔	
Yes	Yes	↕	
Yes	No	↔	X
No	Yes	↕	X
No	Yes	↔	X



Additional Paths for Exploration

How to...

- **program** a computer to do this automatically (including how to **calculate** certainty & handle numeric data)?
- **analyze** this approach (including the **efficacy** & **efficiency**)?
- apply alternate learning algorithms (including those that produce *other* representations)?



... 🧐



Thank You!!

Questions?

Nate Derbinsky

Teaching Professor

Associate Dean of Teaching Faculty

n.derbinsky@northeastern.edu

