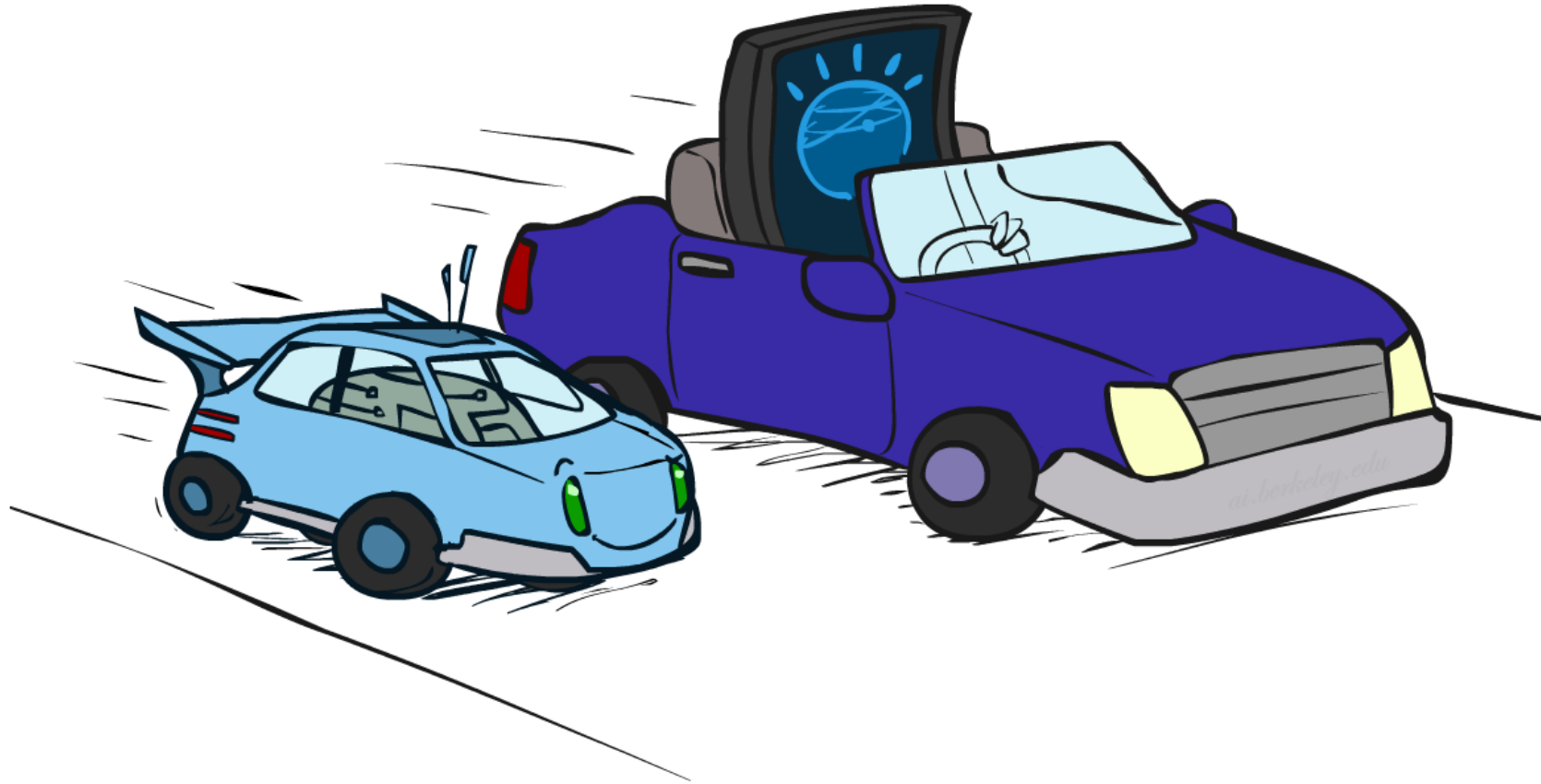
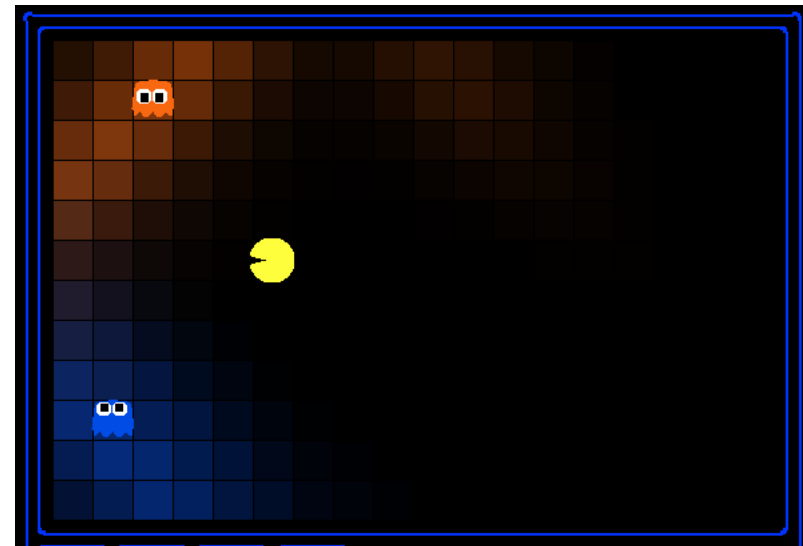
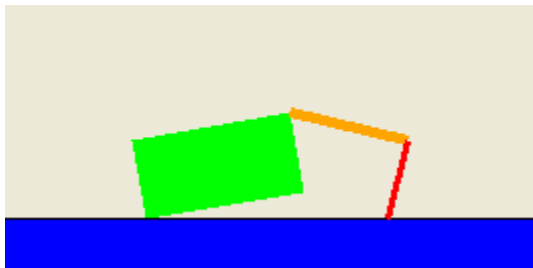
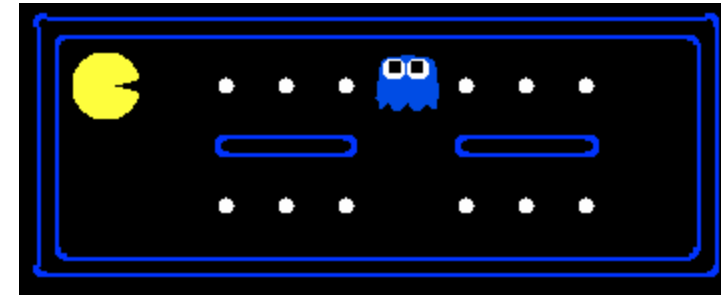
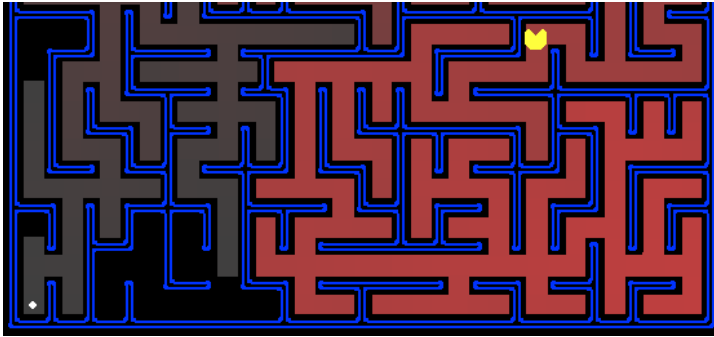


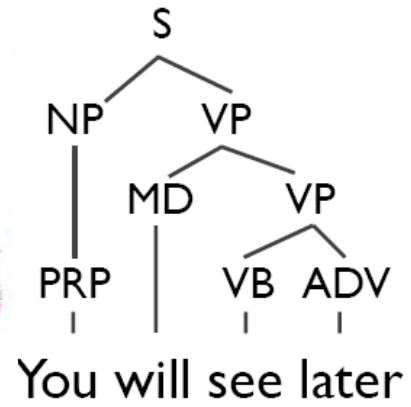
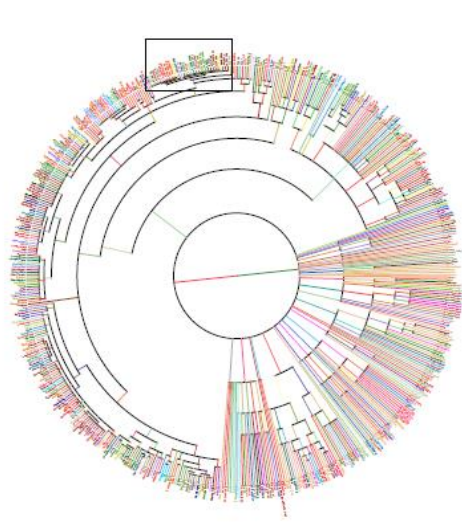
NLP, Games, and Robotic Cars



So Far: Foundational Methods



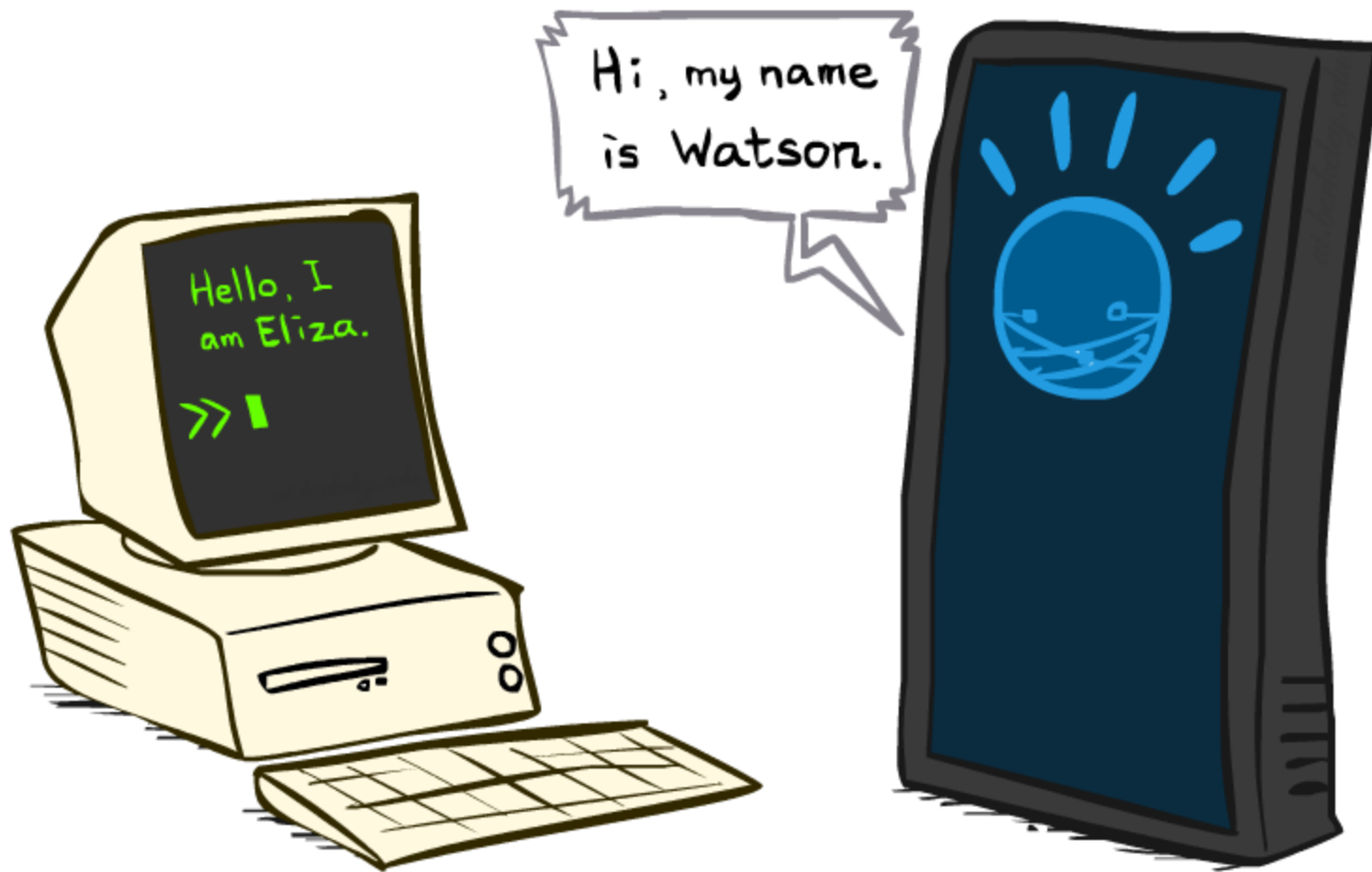
Now: Advanced Applications



Después lo verás



Natural Language Processing



What is NLP?



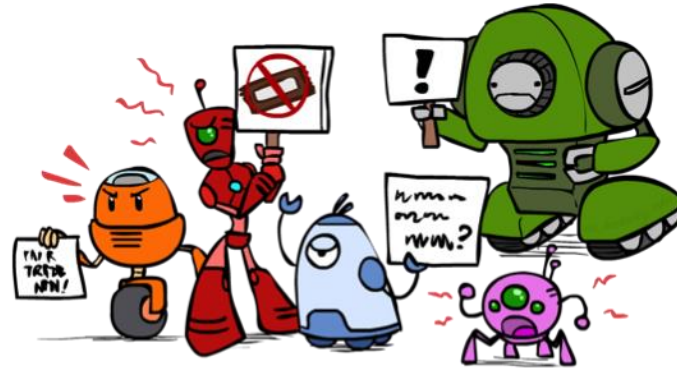
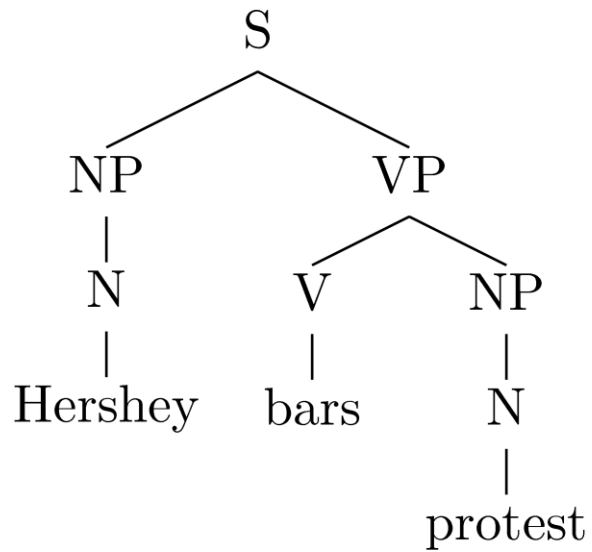
- Fundamental goal: analyze and process human language, broadly, robustly, accurately...
- End systems that we want to build:
 - Ambitious: speech recognition, machine translation, information extraction, dialog interfaces, question answering...
 - Modest: spelling correction, text categorization...

Problem: Ambiguities

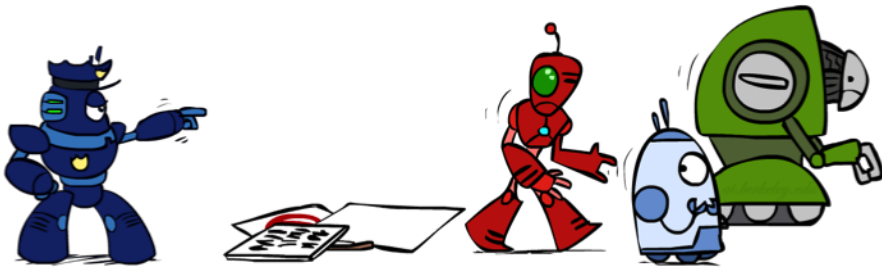
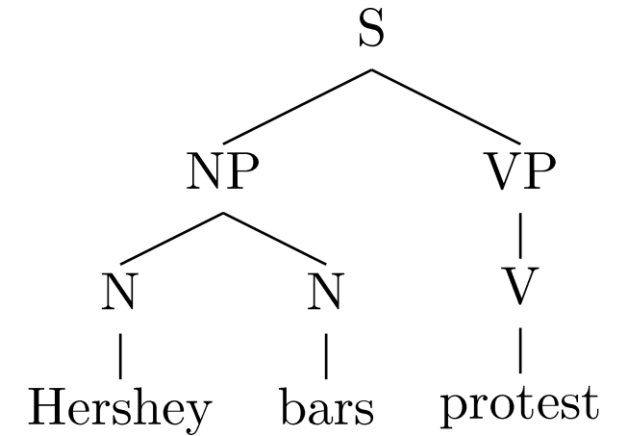
- Headlines:
 - Enraged Cow Injures Farmer With Ax
 - Hospitals Are Sued by 7 Foot Doctors
 - Ban on Nude Dancing on Governor's Desk
 - Iraqi Head Seeks Arms
 - Local HS Dropouts Cut in Half
 - Juvenile Court to Try Shooting Defendant
 - Stolen Painting Found by Tree
 - Kids Make Nutritious Snacks
- Why are these funny?



Parsing as Search

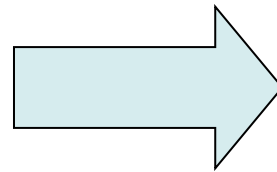
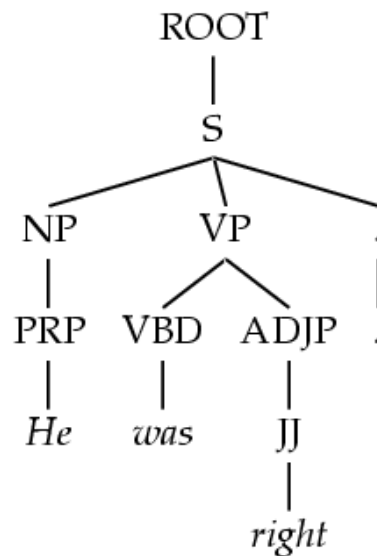


Hershey bars protest



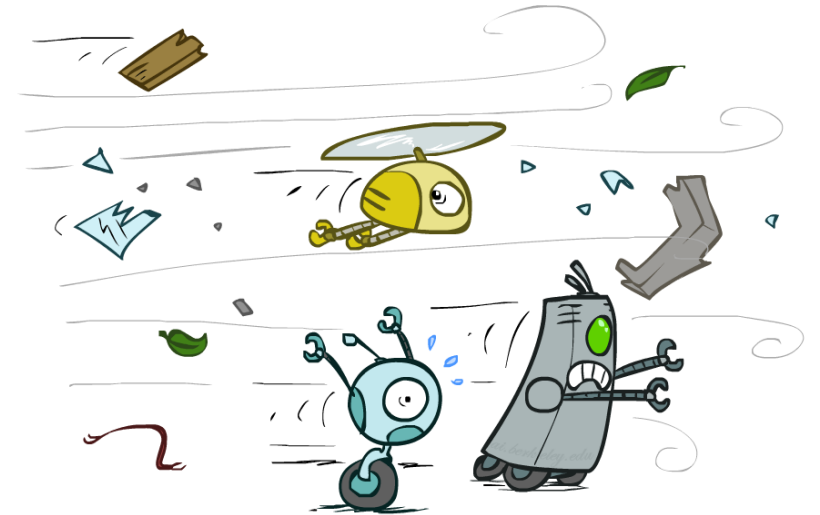
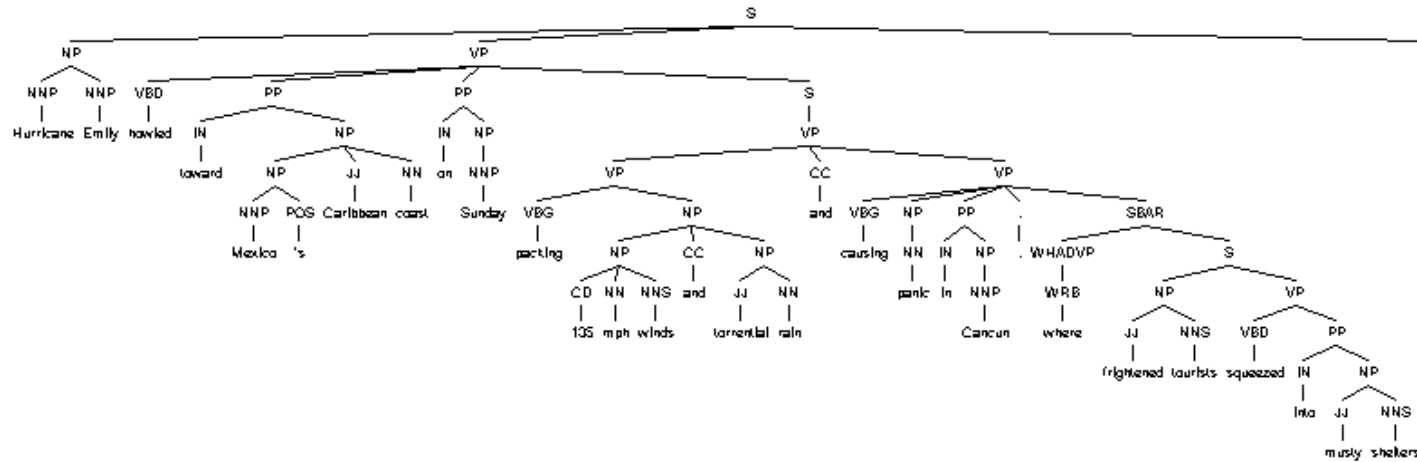
Grammar: PCFGs

- Natural language grammars are very ambiguous!
- PCFGs are a formal probabilistic model of trees
 - Each “rule” has a conditional probability (like an HMM)
 - Tree’s probability is the product of all rules used
- Parsing: Given a sentence, find the best tree – search!



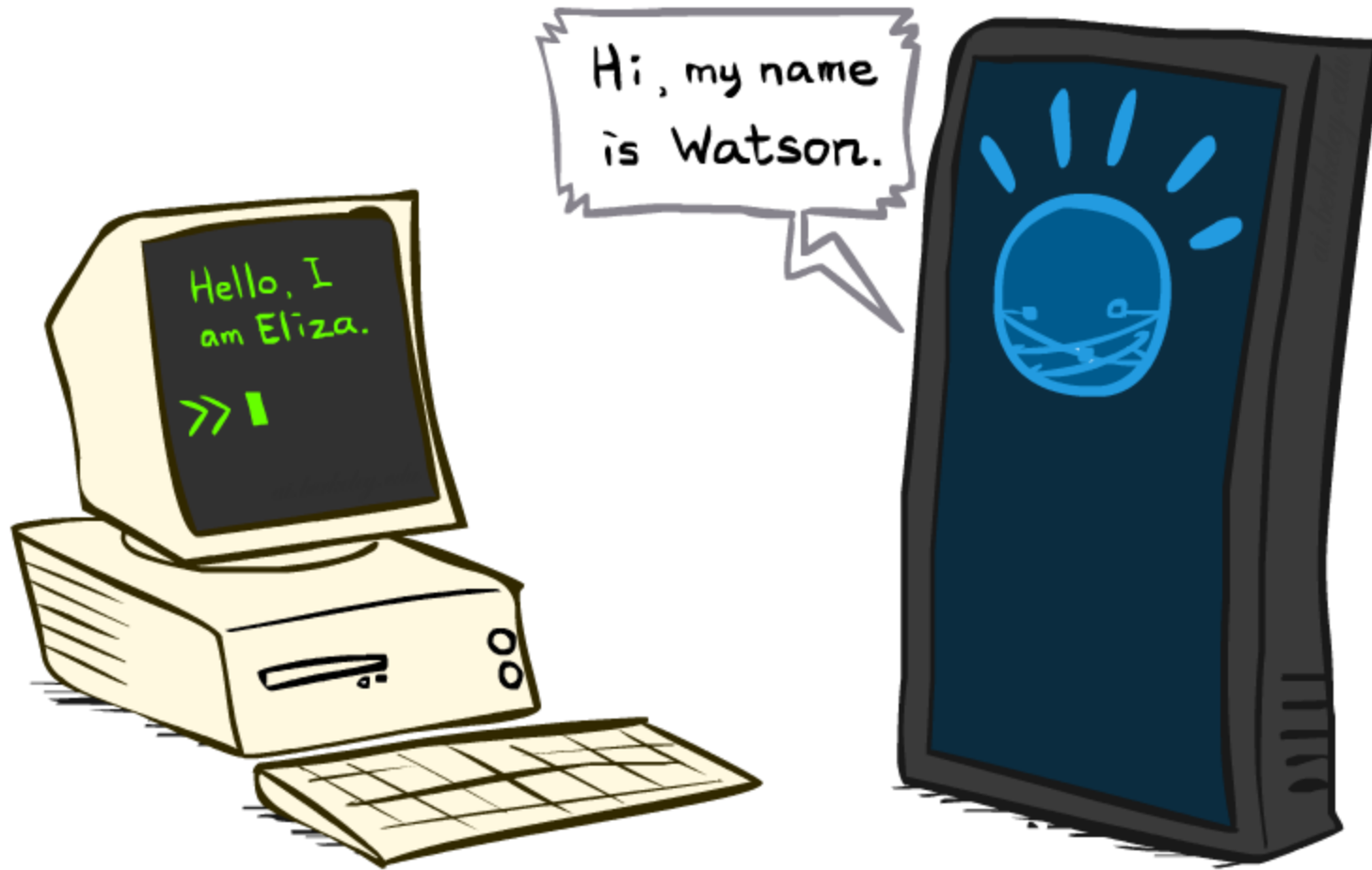
ROOT → S	375/420
S → NP VP .	320/392
NP → PRP	127/539
VP → VBD ADJP	32/401
.....	

Syntactic Analysis



Hurricane Emily howled toward Mexico 's Caribbean coast on Sunday packing 135 mph winds and torrential rain and causing panic in Cancun, where frightened tourists squeezed into musty shelters.

Dialog Systems



ELIZA



- A “psychotherapist” agent (Weizenbaum, ~1964)
- Led to a long line of chatterbots
- How does it work:
 - Trivial NLP: string match and substitution
 - Trivial knowledge: tiny script / response database
 - Example: matching “I remember ___” results in “Do you often think of ___”?
- Can fool some people some of the time?

Watson



"a camel is a horse designed by"

a multilingual free encyclopedia

Wiktionary
[ˈwɪkʃənəri] n., a wiki-based Open Content dictionary
Wikipedia [ˈwɪpɪˈkiːpiːdi]

Main Page
Community portal
Preferences
Requested entries
Recent changes
Random entry
Help
Donations
Contact us

Toolbox
What links here
Related changes
Upload file
Special pages
Printable version
Permanent link

In other languages
Français
Русский

Log in / create account

Entry Discussion Read Edit History Search

a camel is a horse designed by a committee

Contents [hide]
1 English
1.1 Alternative forms

The Phrase Finder

e > Discussion Forum

Google™ Custom Search Search

A camel is a horse designed by committee

Posted by Ruben P. Mendez on April 16, 2004

Does anyone know the origin of this maxim? I heard it way back at the United Nations, which is chockfull of committees. It may have originated there, but I'd like an authoritative explanation. Thanks

- [Re: A camel is a horse designed by committee](#) SR 16/April/04
 - [Re: A camel is a horse designed by committee](#) Henry 18/April/04

If a camel is a horse designed by committee then what's this contemporary Routemaster?

What's in Watson?

- A question-answering system (IBM, 2011)
- Designed for the game of Jeopardy
- How does it work:
 - Sophisticated NLP: deep analysis of questions, noisy matching of questions to potential answers
 - Lots of data: onboard storage contains a huge collection of documents (e.g. Wikipedia, etc.), exploits redundancy
 - Lots of computation: 90+ servers
- Can beat all of the people all of the time?



Machine Translation



Machine Translation

"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion tibétaine: Le China sur ses gardes



"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

Video Anniversary of the Tibetan rebellion: China on guard



- Translate text from one language to another
- Recombines fragments of example translations
- Challenges:
 - What fragments? [learning to translate]
 - How to make efficient? [fast translation search]

The Problem with Dictionary Lookups

顶部	/ top /roof/
顶端	/summit/peak/ top /apex/
顶头	/coming directly towards one/ top /end/
盖	/lid/ top /cover/canopy/build/Gai/
盖帽	/surpass/ top /
极	/extremely/pole/utmost/ top /collect/receive/
尖峰	/peak/ top /
面	/fade/side/surface/aspect/ top /face/flour/
摘心	/ top /topping/

Example from Douglas Hofstadter

MT: 60 Years in 60 Seconds



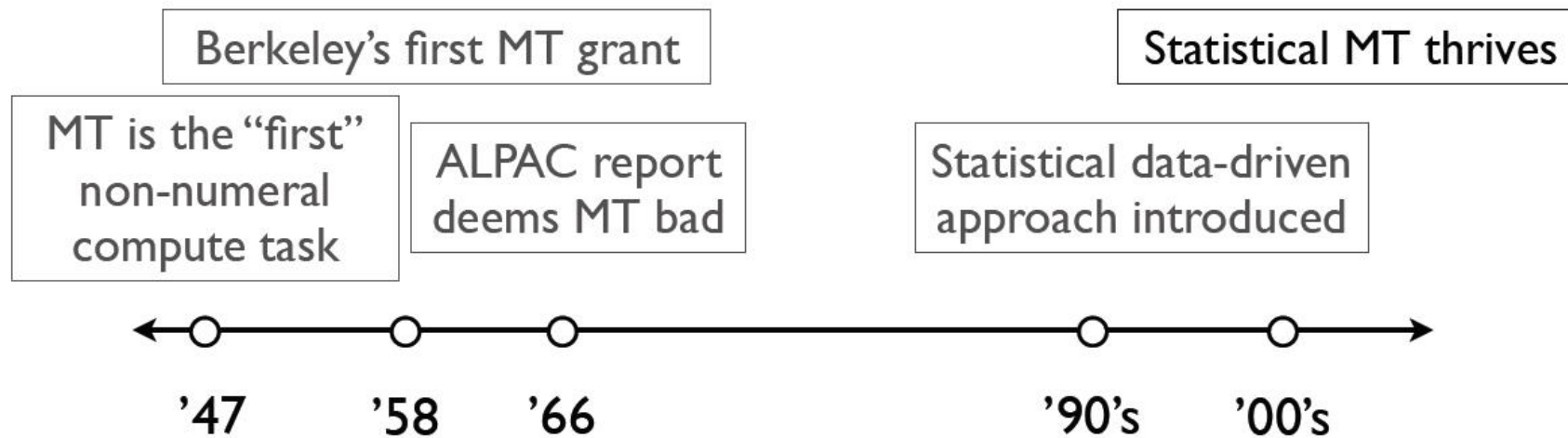
Warren Weaver

When I look at an article in Russian, I say: "This is really written in English, but it has been coded in some strange symbols. I will now proceed to decode."

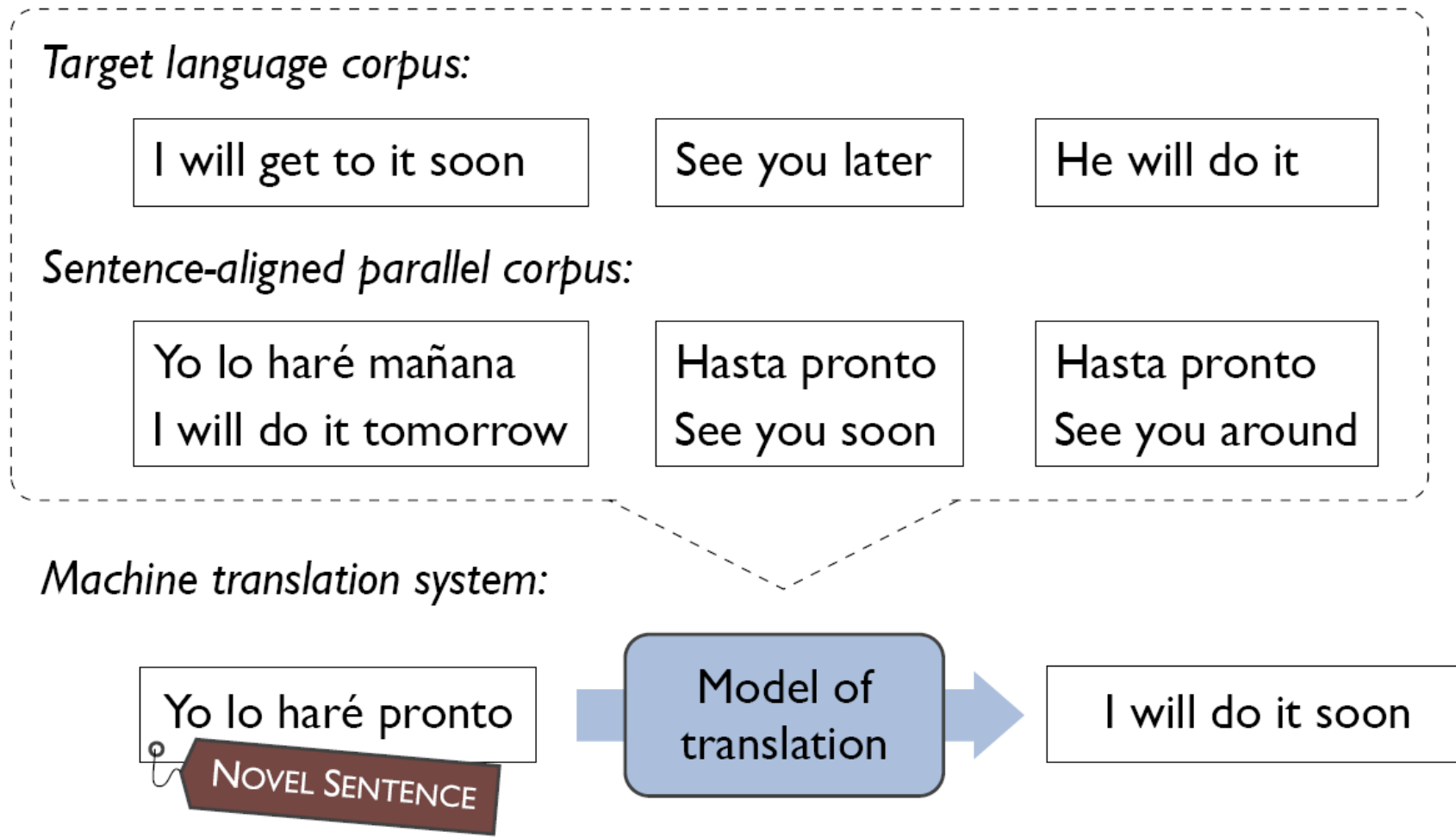


John Pierce

"Machine Translation" presumably means going by algorithm from machine-readable source text to useful target text... In this context, there has been no machine translation...



Data-Driven Machine Translation

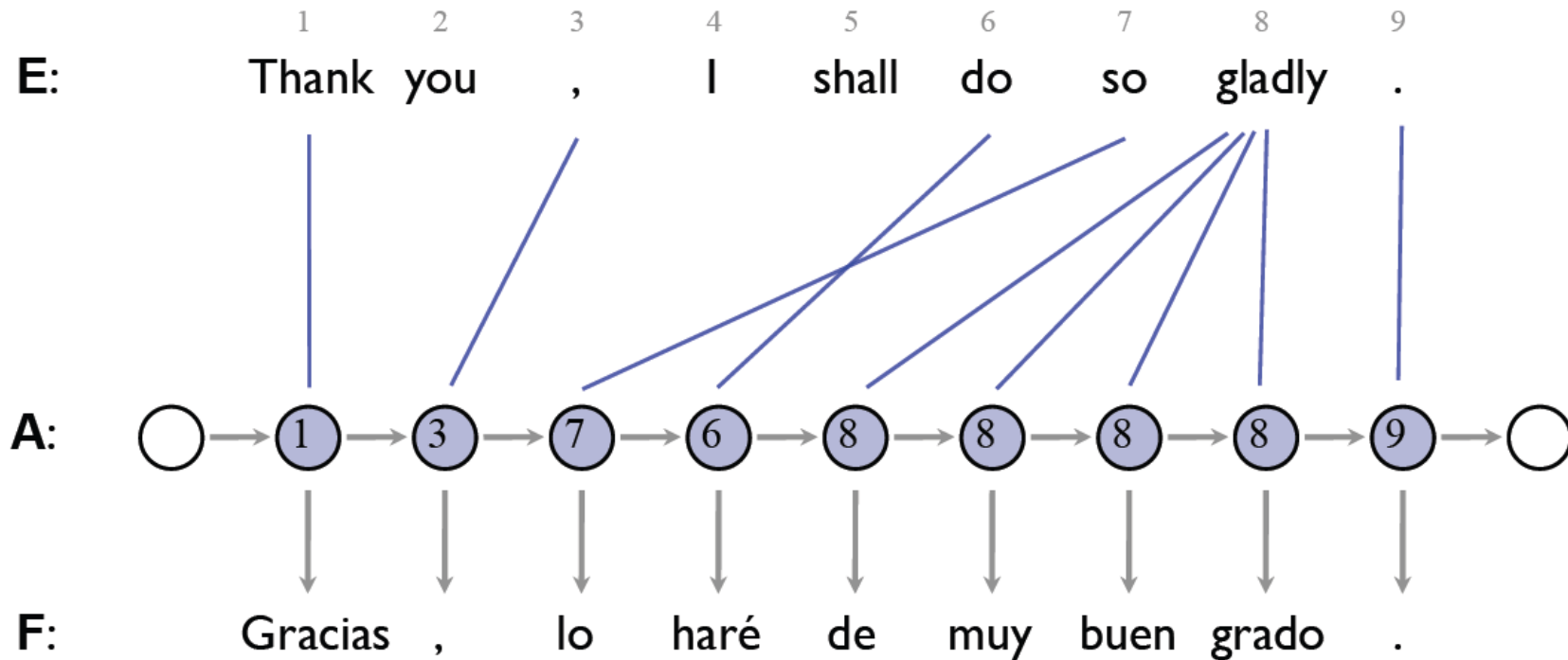


Learning to Translate

		CLASSIC SOUPS		Sm.	Lg.			
清	燉	雞	湯	57.	House Chicken Soup (Chicken, Celery, Potato, Onion, Carrot)	1.50	2.75	
雞	飯	湯	58.	Chicken Rice Soup	1.85	3.25		
雞	麵	湯	59.	Chicken Noodle Soup	1.85	3.25		
廣	東	雲吞	60.	Cantonese Wonton Soup.....	1.50	2.75		
蕃	茄	蛋	湯	61.	Tomato Clear Egg Drop Soup	1.65	2.95	
雲吞	湯	62.	Regular Wonton Soup	1.10	2.10			
酸	辣	湯	63.	Hot & Sour Soup	1.10	2.10		
蛋	花	湯	64.	Egg Drop Soup.....	1.10	2.10		
雲吞	湯	65.	Egg Drop Wonton Mix.....	1.10	2.10			
豆	腐	菜	湯	66.	Tofu Vegetable Soup	NA	3.50	
雞	玉	米	湯	67.	Chicken Corn Cream Soup	NA	3.50	
蟹	肉	玉	米	湯	68.	Crab Meat Corn Cream Soup.....	NA	3.50
海	鮮	湯	69.	Seafood Soup.....	NA	3.50		

Example from Adam Lopez

An HMM Translation Model

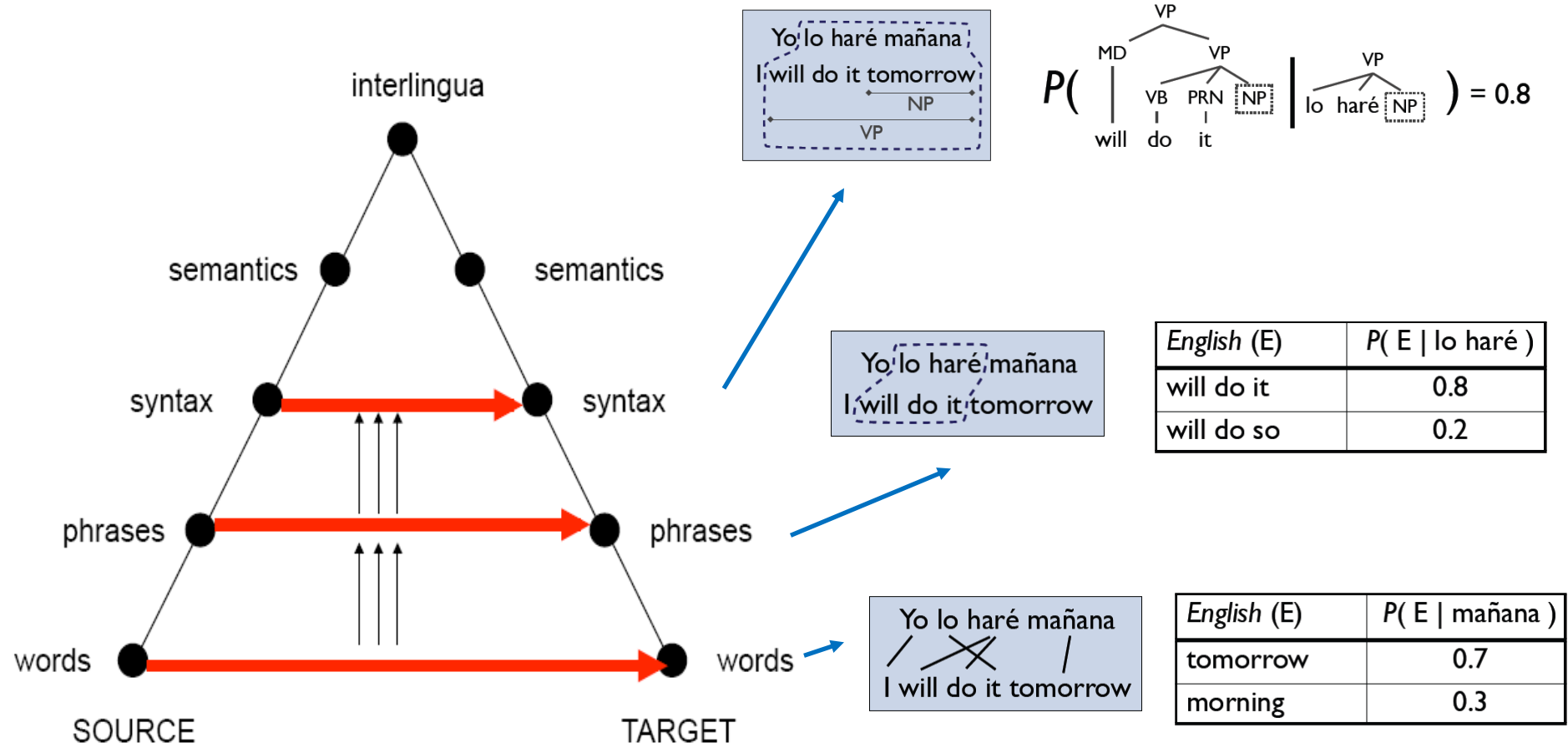


Model Parameters

Emissions: $P(F_1 = \text{Gracias} \mid E_{A_1} = \text{Thank})$

Transitions: $P(A_2 = 3 \mid A_1 = 1)$

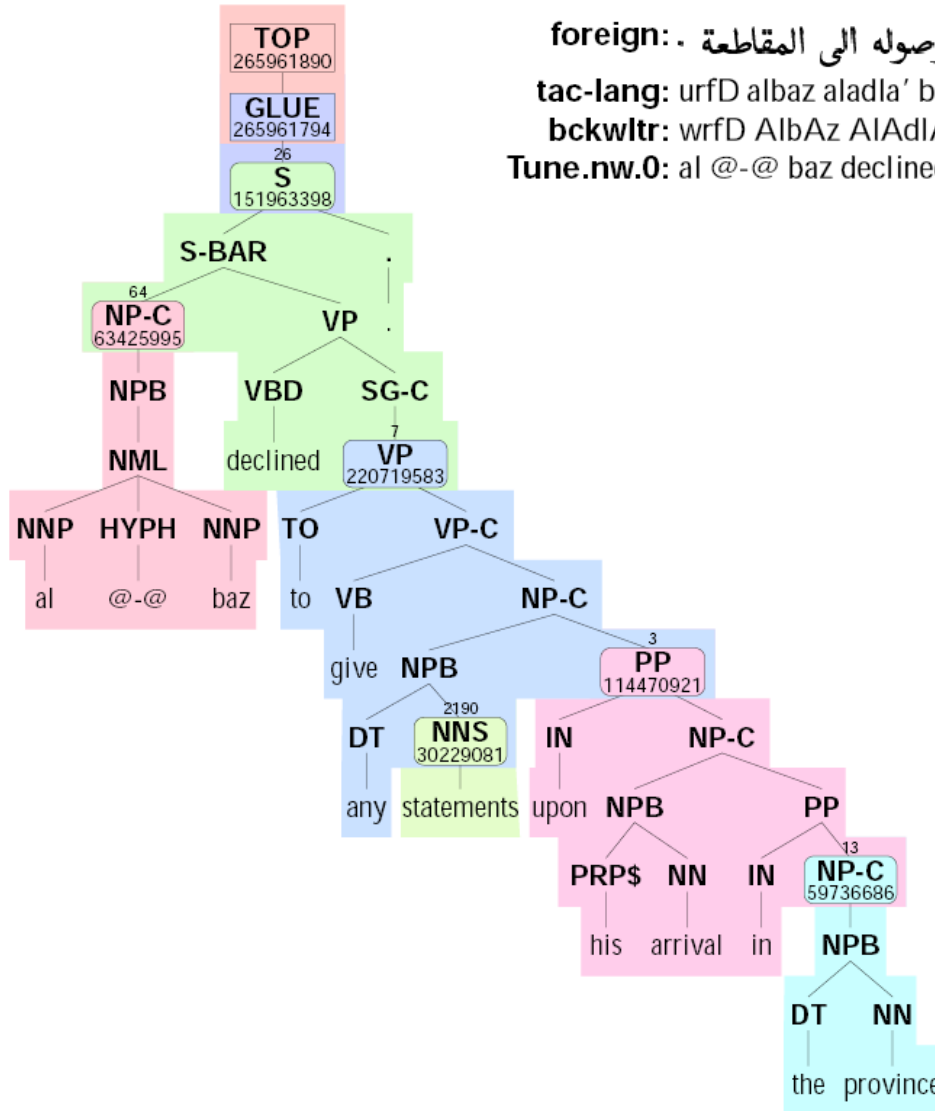
Levels of Transfer



English (E)	$P(E \mid \text{lo haré})$
will do it	0.8
will do so	0.2

English (E)	$P(E \mid \text{mañana})$
tomorrow	0.7
morning	0.3

Example: Syntactic MT Output



foreign: . ورفض الهاز الادلء باى تصرلحات فور وصوله الى المقاطعة .

tac-lang: urfD albaz aladla' baá tSryHat fur uSulh alá almqaT'e .

bckwltr: wrfD AlbAz AlAdIA' bAY tSryHAt fwr wSwlh AIY AlmqaTEp .

Tune.nw.0: al @-@ baz declined to make any statements upon his arrival in the province .

[ISI MT system output]

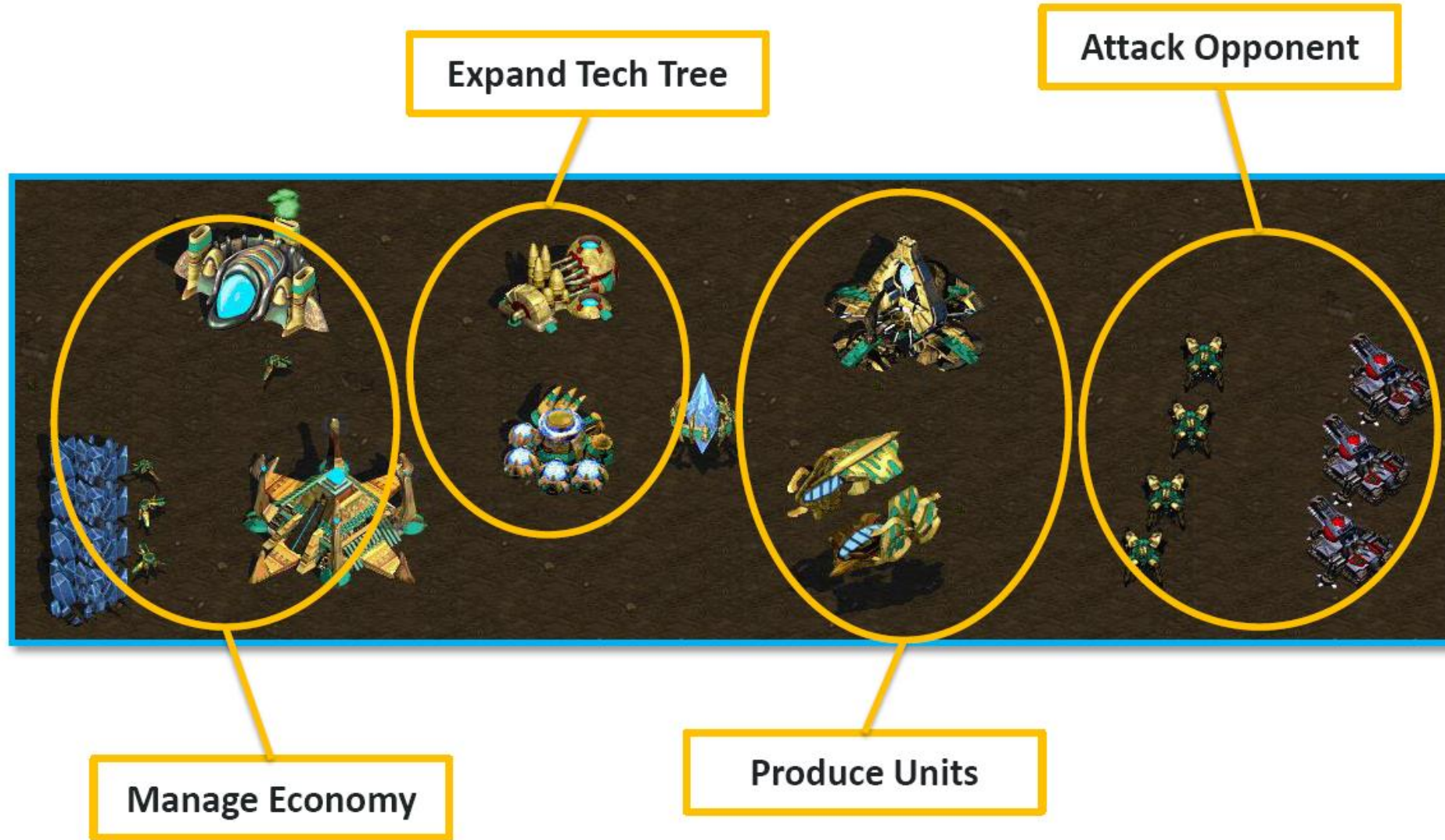
Starcraft



Starcraft



What is Starcraft?

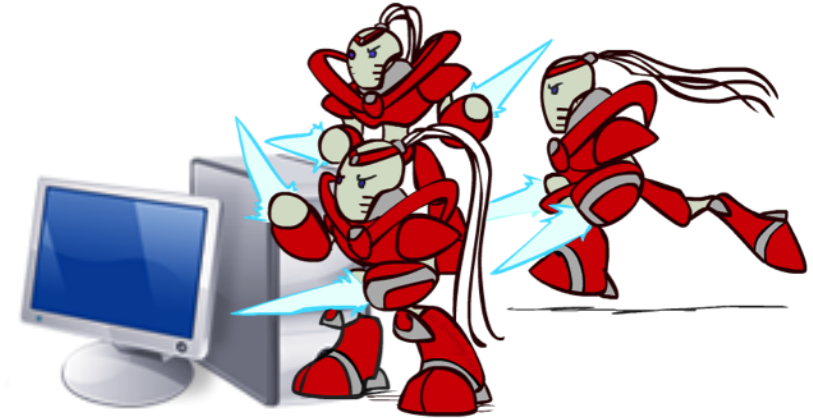


Why is Starcraft Hard?

- The game of Starcraft is:
 - Adversarial
 - Long Horizon
 - Partially Observable
 - Real-time
 - Huge branching factor
 - Concurrent
 - Resource-rich
 - ...
- No single algorithm (e.g. minimax) will solve it off-the-shelf!



Starcraft AIs: AIIDE 2010

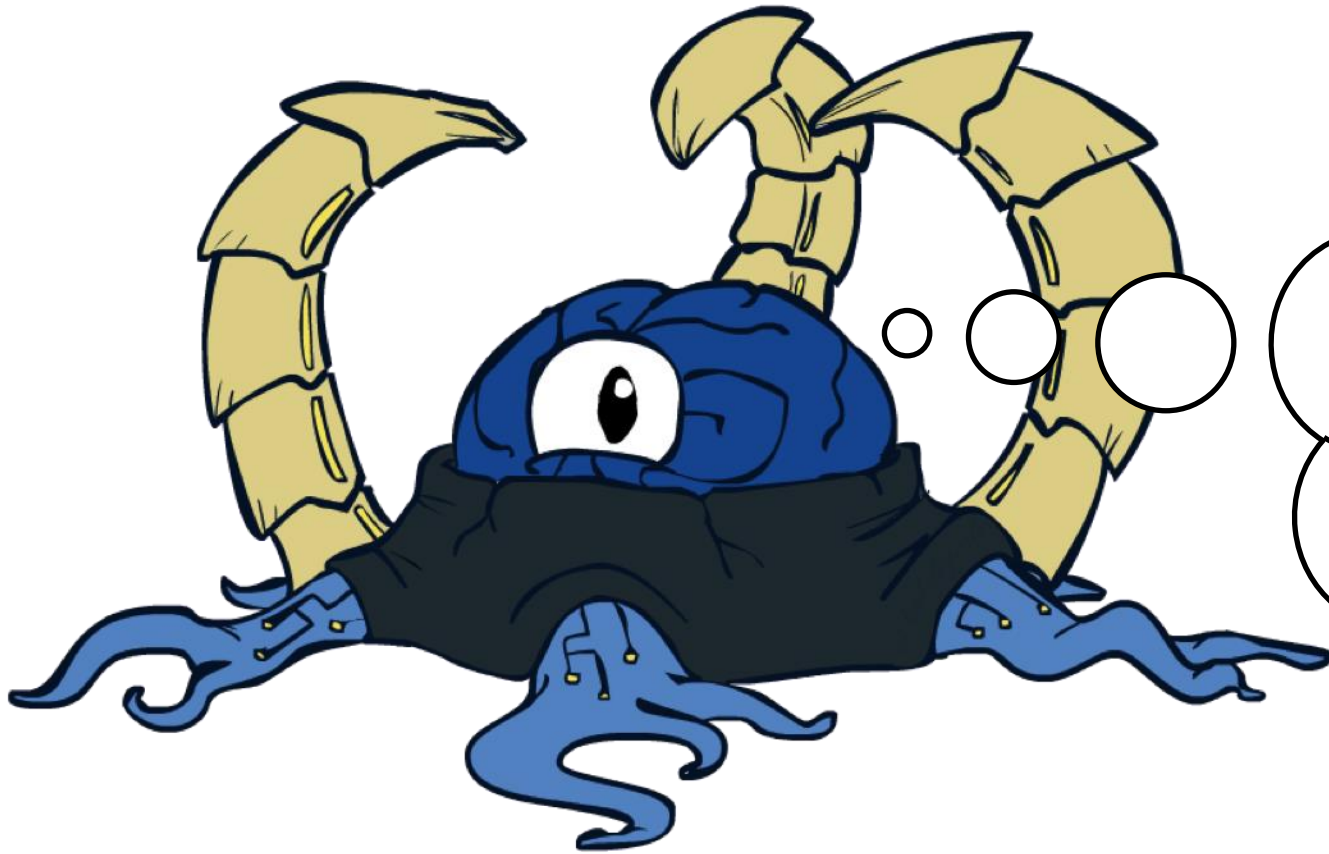


```
onFrame() {  
  units = Broodwar->getAllUnits();  
  unit->attackUnit(enemyUnit);  
}
```

```
onFrame() {  
  units = Broodwar->getAllUnits();  
  unit->attackUnit(enemyUnit);  
}
```

- 28 Teams: international entrants, universities, research labs...

The Berkeley Overmind



Search: path planning

CSPs: base layout

Minimax: targeting

Learning: micro control

Inference: tracking units

Scheduling: resources

Hierarchical control

Search for Pathing



Minimax for Targeting



Machine Learning for Micro Control



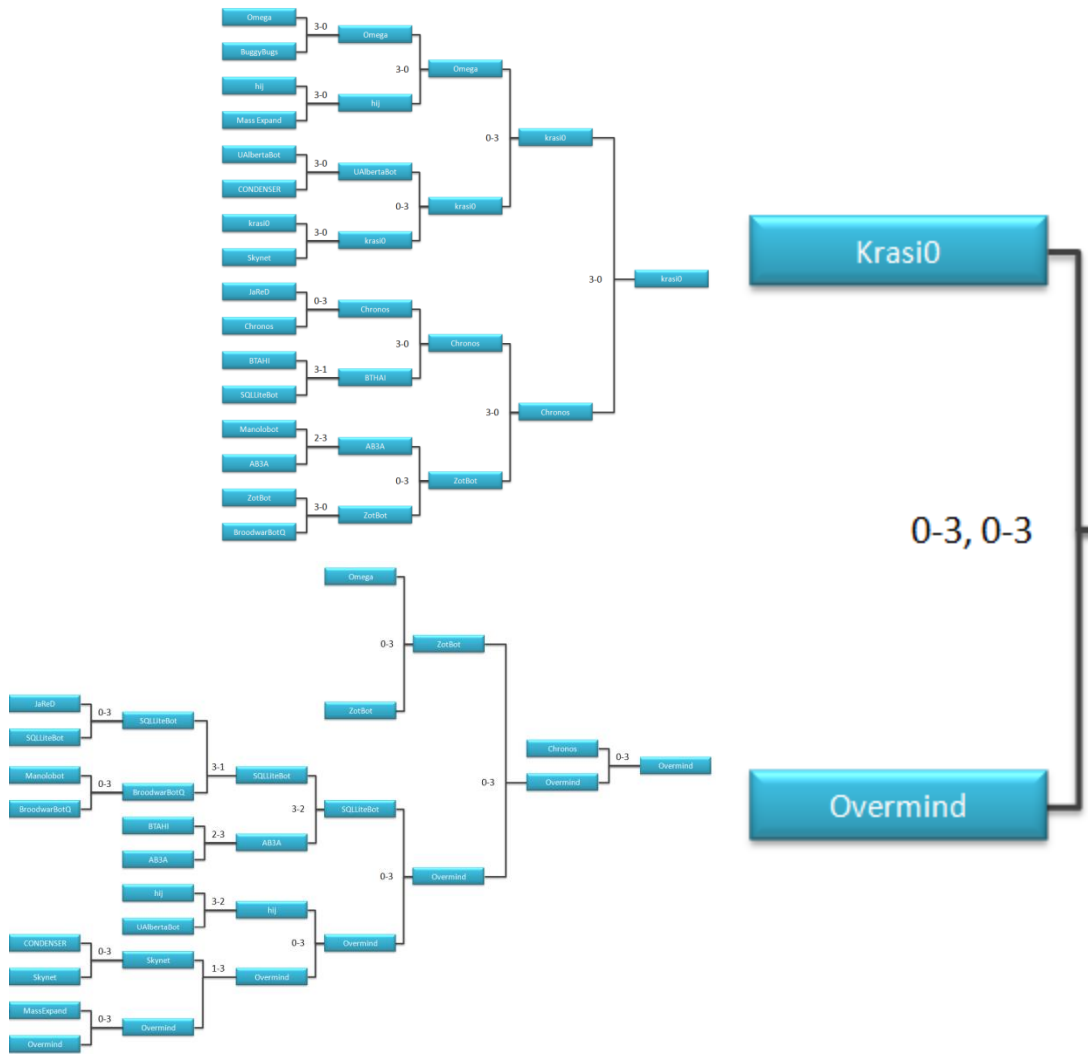
[RL, Potential Fields]

Inference / VPI / Scouting

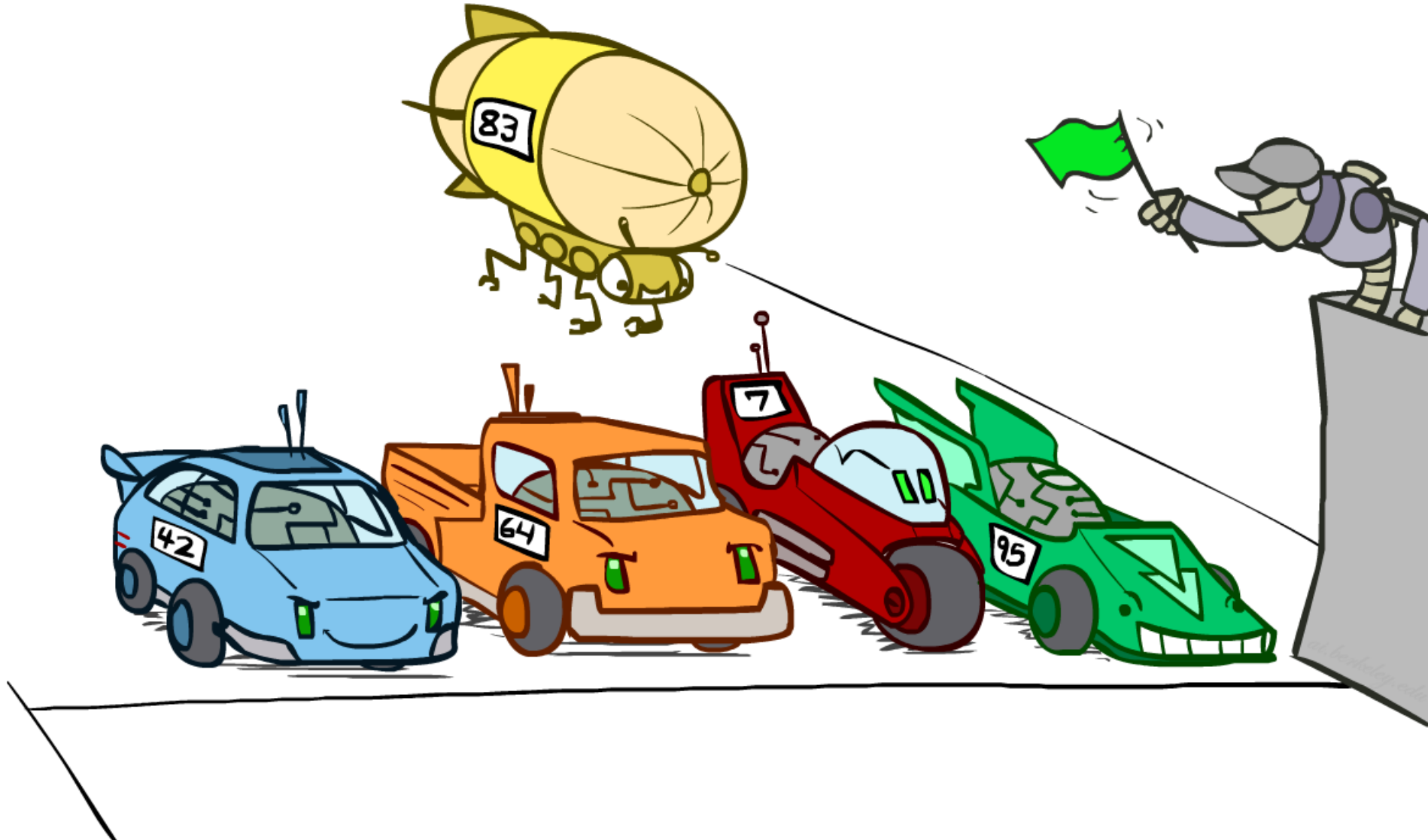


[Scouting]

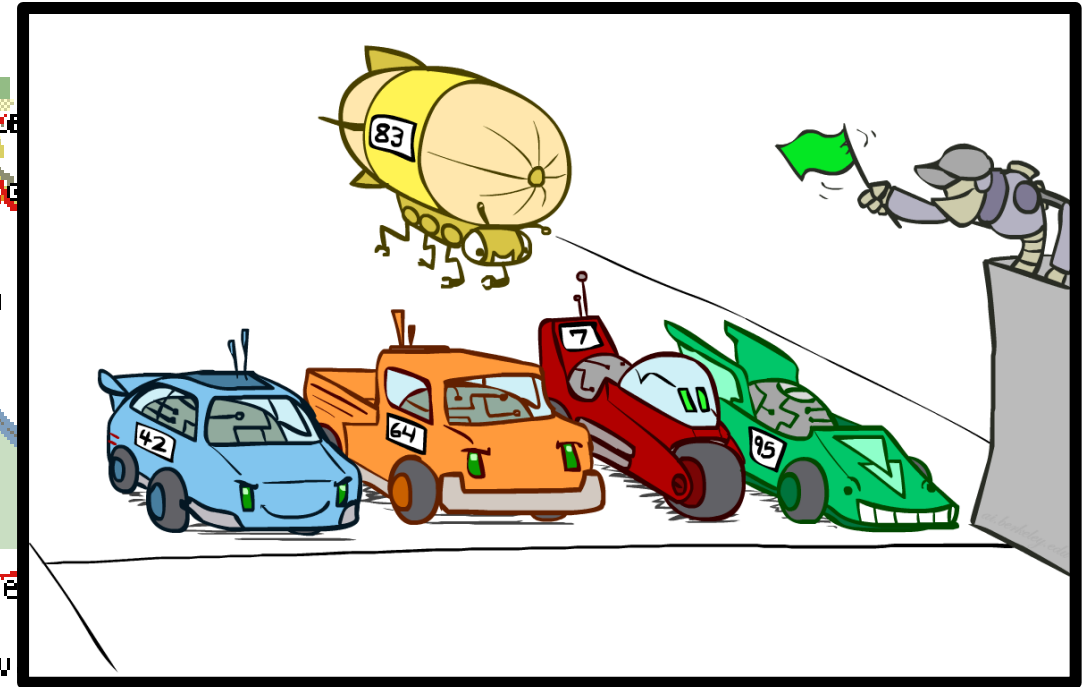
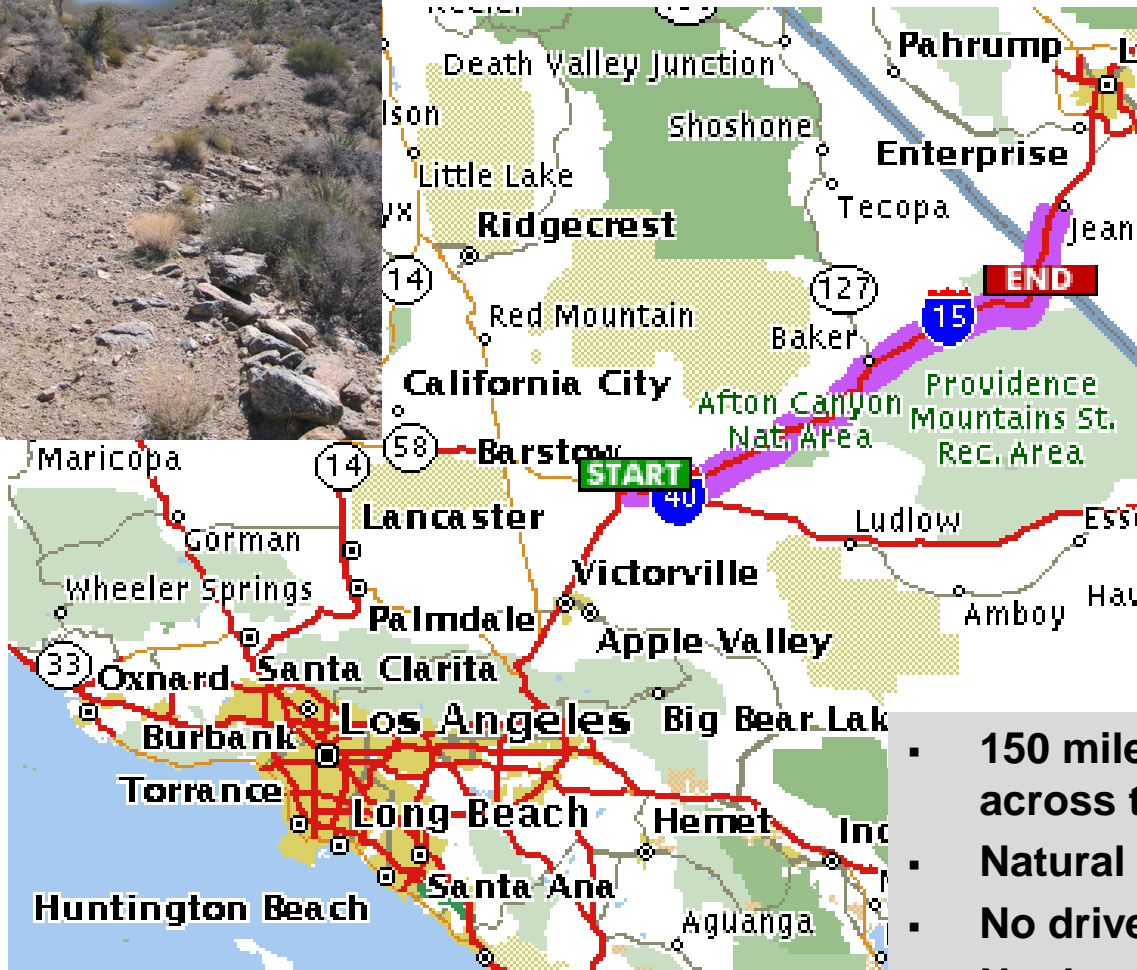
AIIDE 2010 Competition



Autonomous Driving



Grand Challenge 2005: Barstow, CA, to Primm, NV



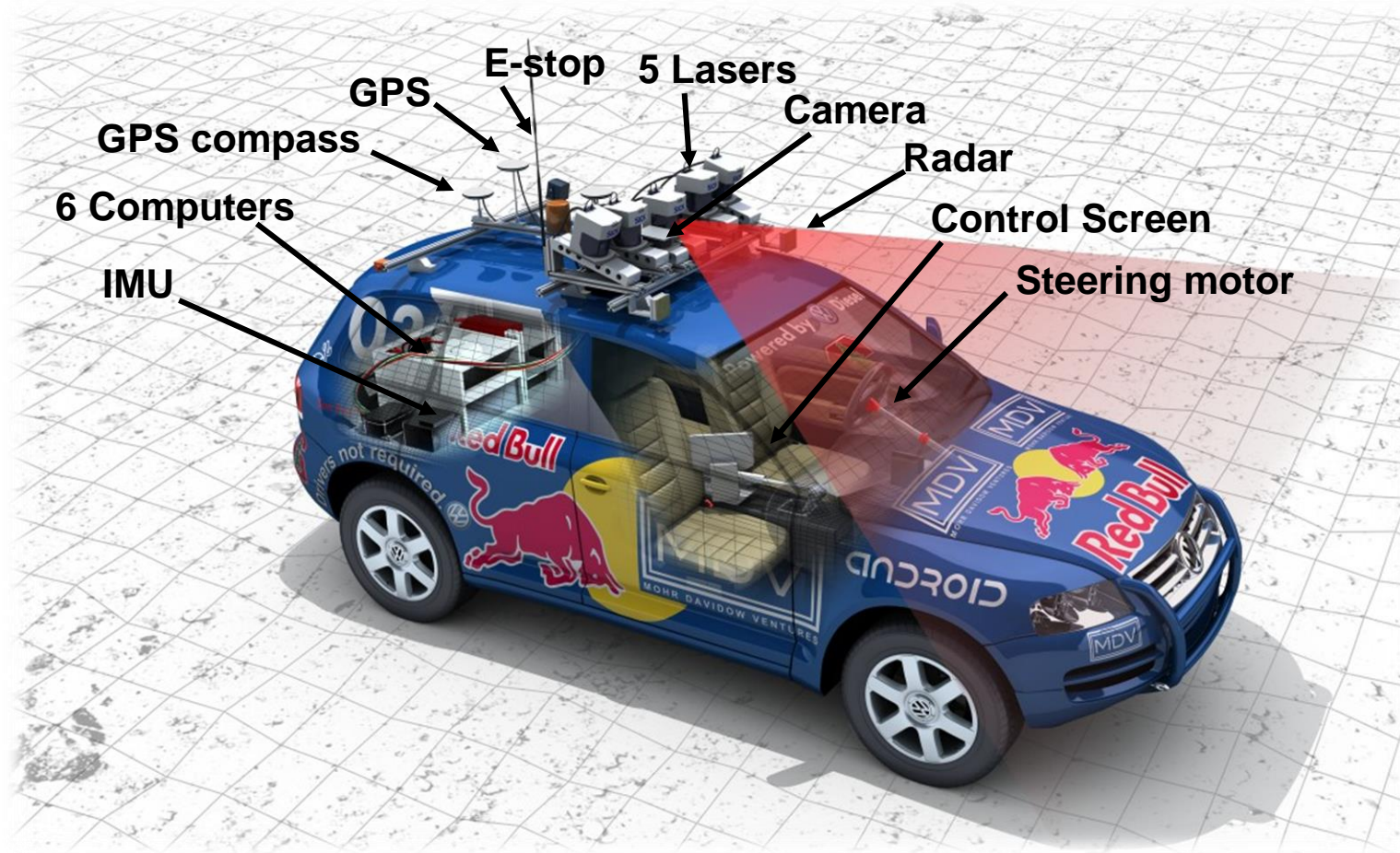
- 150 mile off-road robot race across the Mojave desert
- Natural and manmade hazards
- No driver, no remote control
- No dynamic passing

Autonomous Vehicles

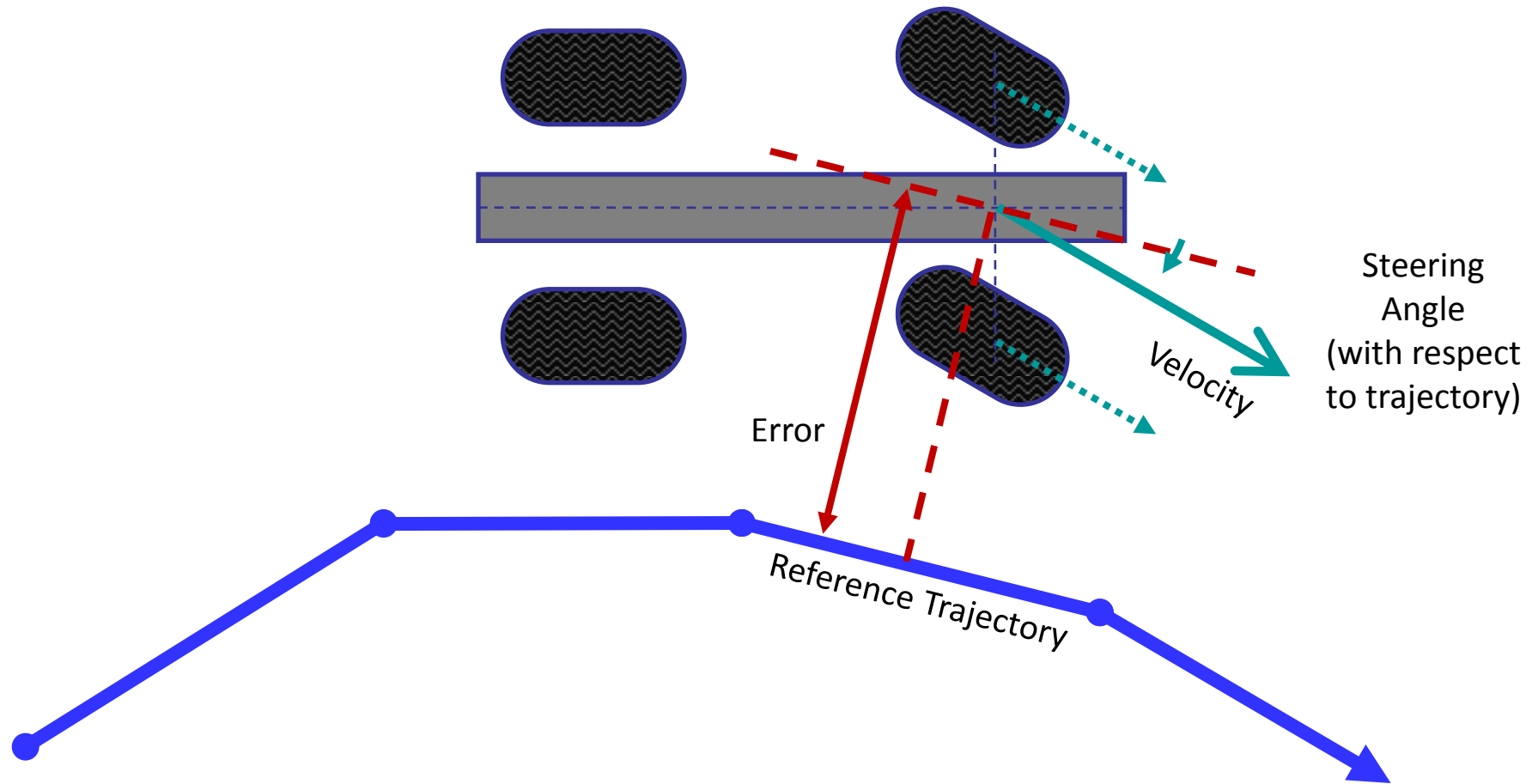


[VIDEO: GC Bad]

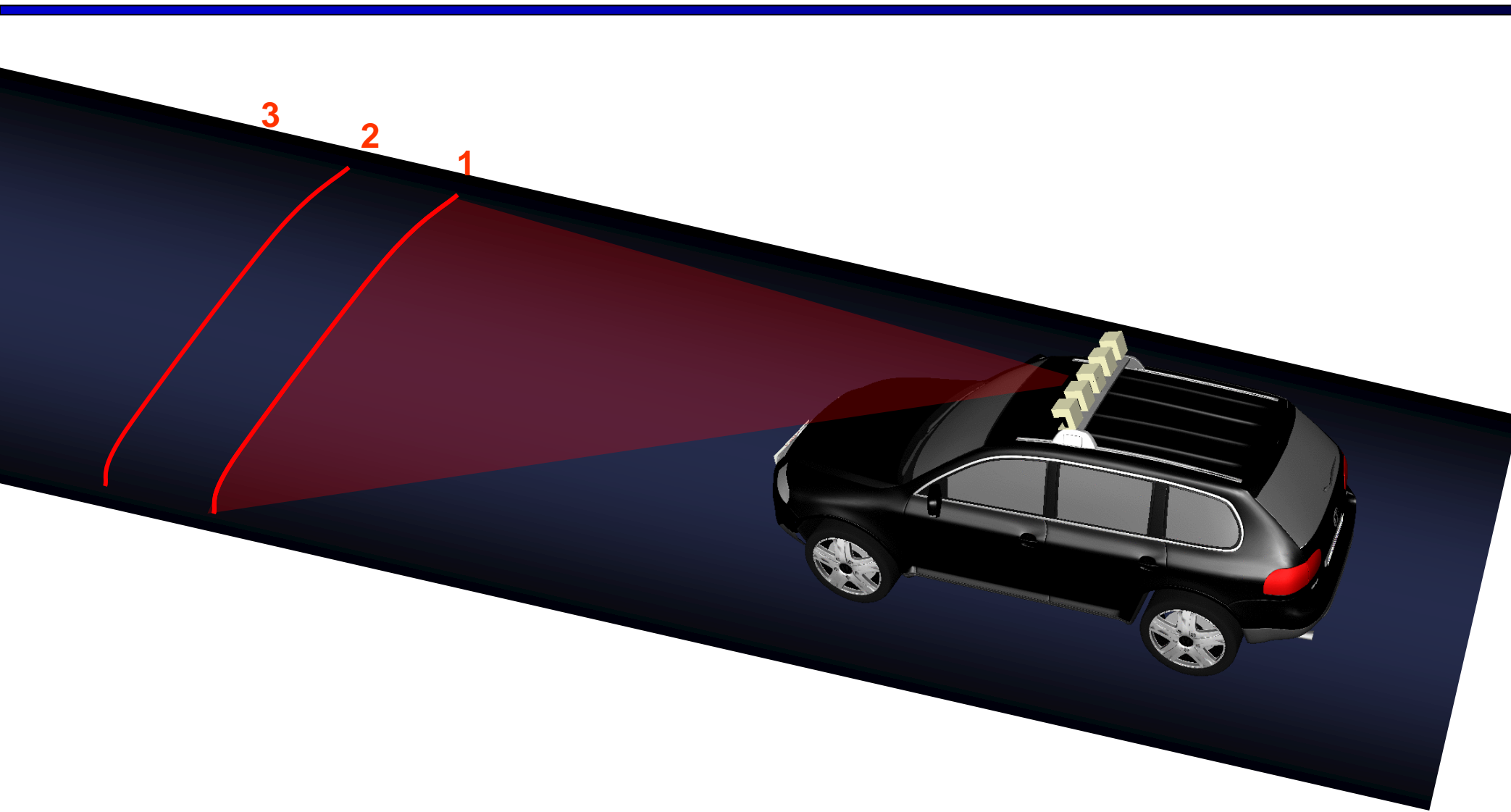
An Autonomous Car



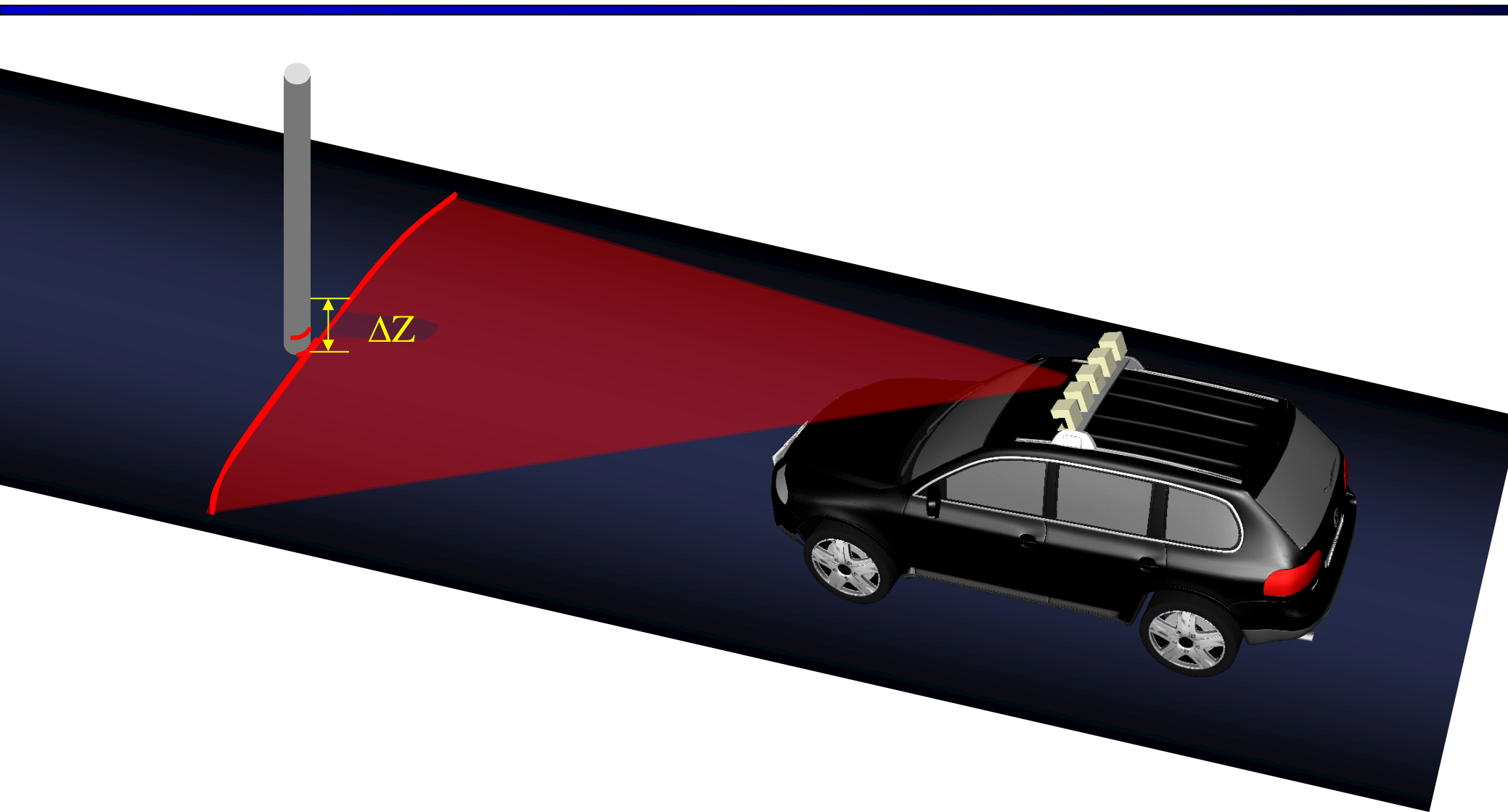
Actions: Steering Control



Laser Readings for Flat / Empty Road

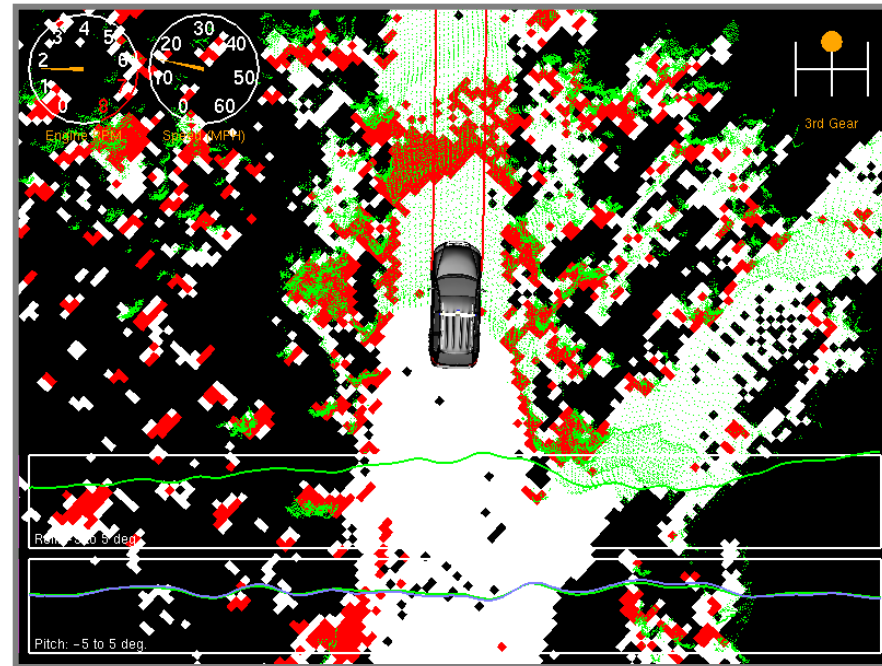


Laser Readings for Road with Obstacle



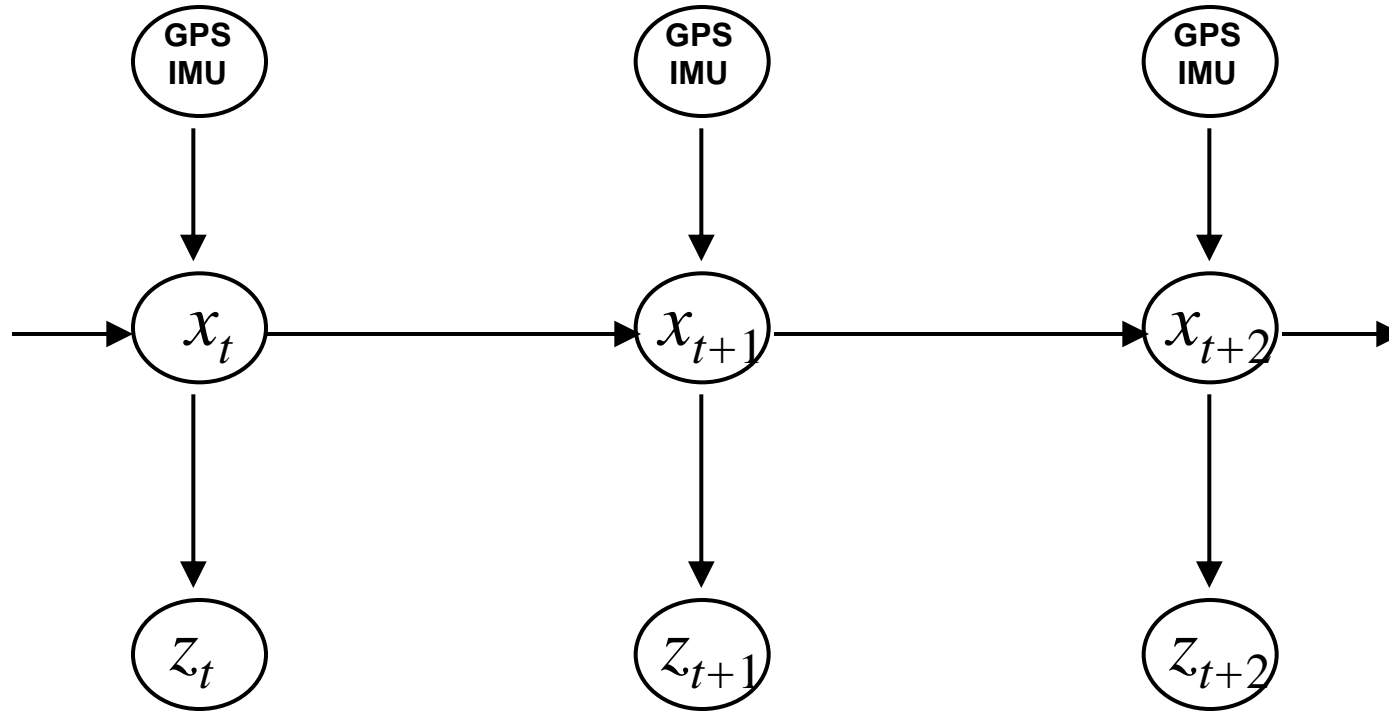
Obstacle Detection

Trigger if $|Z^i - Z^j| > 15\text{cm}$ for nearby z^i, z^j

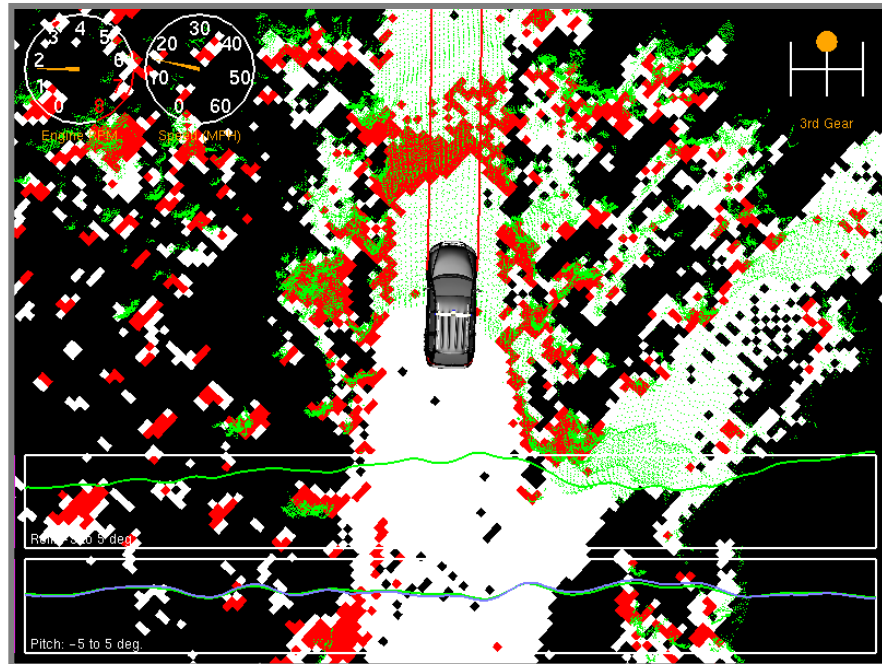


Raw Measurements: 12.6% false positives

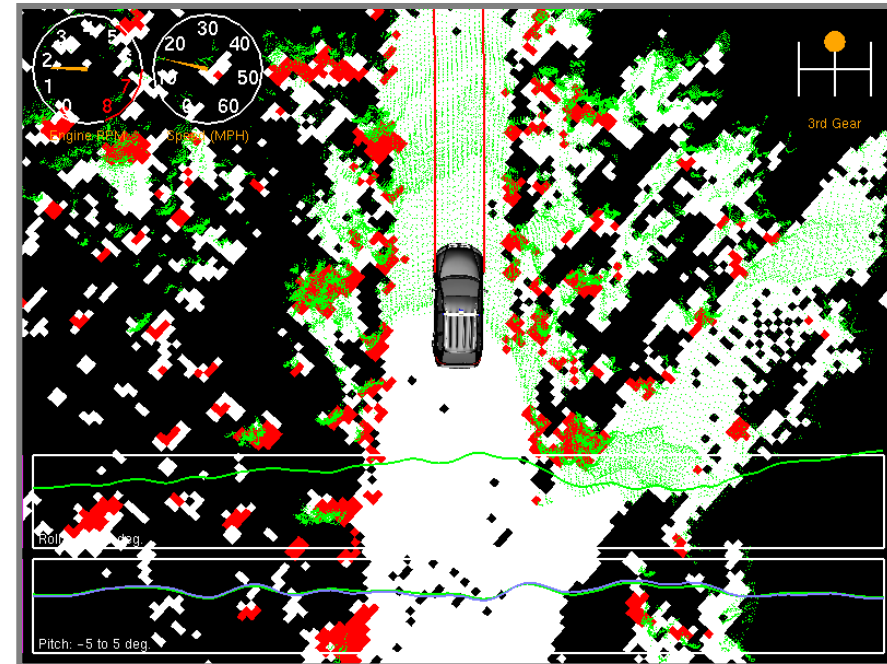
Probabilistic Error Model



HMMs for Detection



Raw Measurements: 12.6% false positives



HMM Inference: 0.02% false positives

Vision for a Car



Urban Environments

