

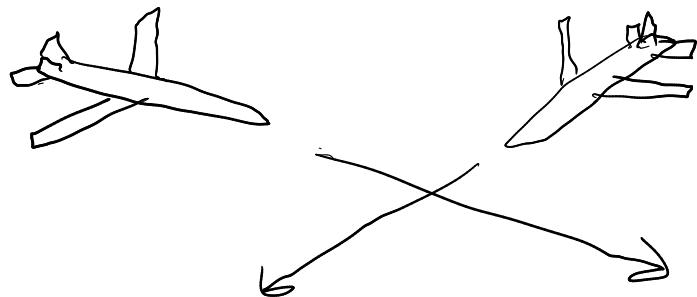
ASEN/csci 5264

Decision Making under Uncertainty

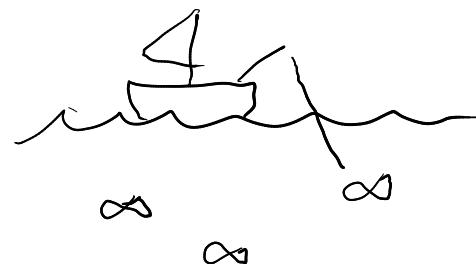


3 Example Problems

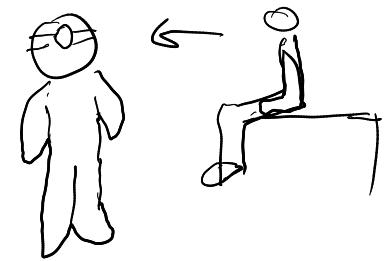
A/C Collision Avoidance



Fishery Management



Treatment Medical Testing



Uncertainty

Positional

Behavior

Environment
-Wind

Dynamics

Predation

Reproduction

Competition

Interpreting Communication

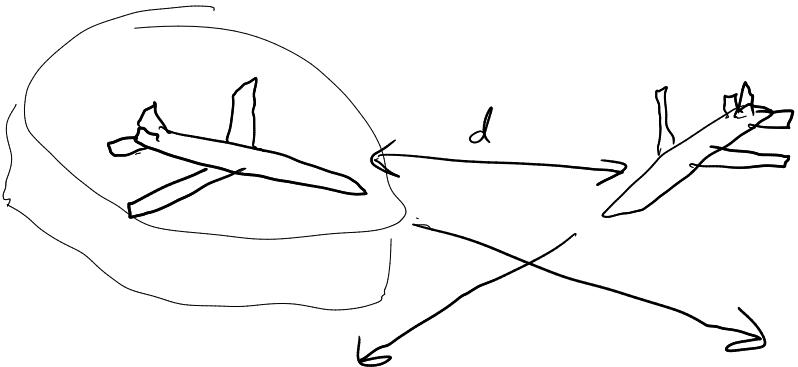
False positives

False negatives

→ Reaction to treatments

→ Unclear evidence
about treatment outcomes

A/C Collision Avoidance



$$R(s, a) \rightarrow R$$

$$R(s, a) \begin{cases} -1000 & \text{collision} \\ -1 & \text{maneuver} \end{cases}$$

Greedy Algorithm

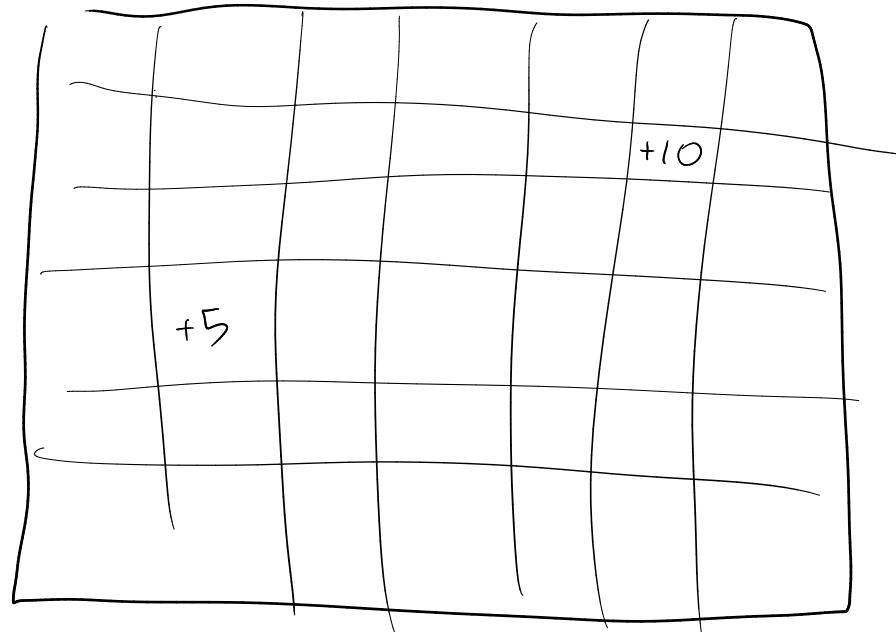
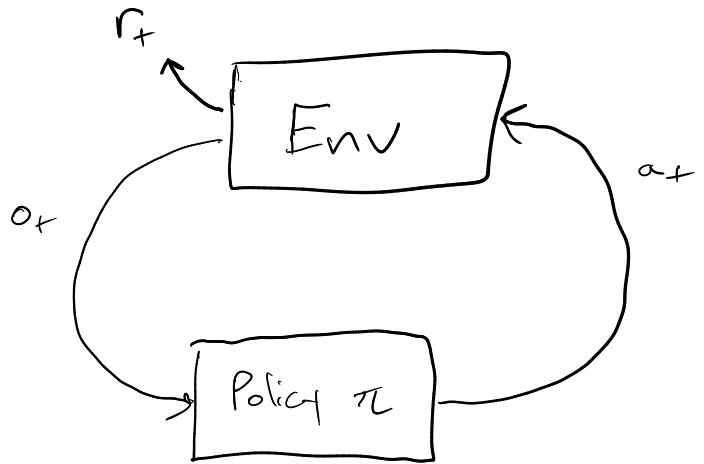
$$\pi(s) \equiv \underset{a \in A}{\operatorname{argmax}} R(s, a)$$

Markov Decision Process



Sense-Plan-Act Loop

$$\pi^* = \operatorname{argmax} E\left[\sum_{t=0}^{\infty} r_t\right]$$



Four Big Challenges in DMU

1. Immediate + Future Rewards
2. Unknown (or hard-to-represent) Models
3. Imperfect Observations
4. Other Agents

MDP
Reinforcement Learning
POMDP
Game MG
POMG

From an ML perspective
"Reinforcement Learning"

Four Types of Uncertainty in DMU

1. Outcome Uncertainty
 2. Model Uncertainty
 3. State Uncertainty
 4. Interaction
- Probabilistic } Allelactic
Epistemic (Static)
Epistemic (Dynamic)

Break

Break

- Engineering is a team sport!

Break

Grocery Trip
Self-Driving Cars
Course Selection
Investing

- Engineering is a team sport!
- Groups of 2-4:
 - Name
 - Department
 - Sequential decision making problem

Course Materials/Logistics

Course Materials/Logistics

- Edstem

Course Materials/Logistics

- Edstem
- Syllabus

Course Materials/Logistics

- Edstem
- Syllabus
- Github

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- Edstem
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- Homework

Course Materials/Logistics

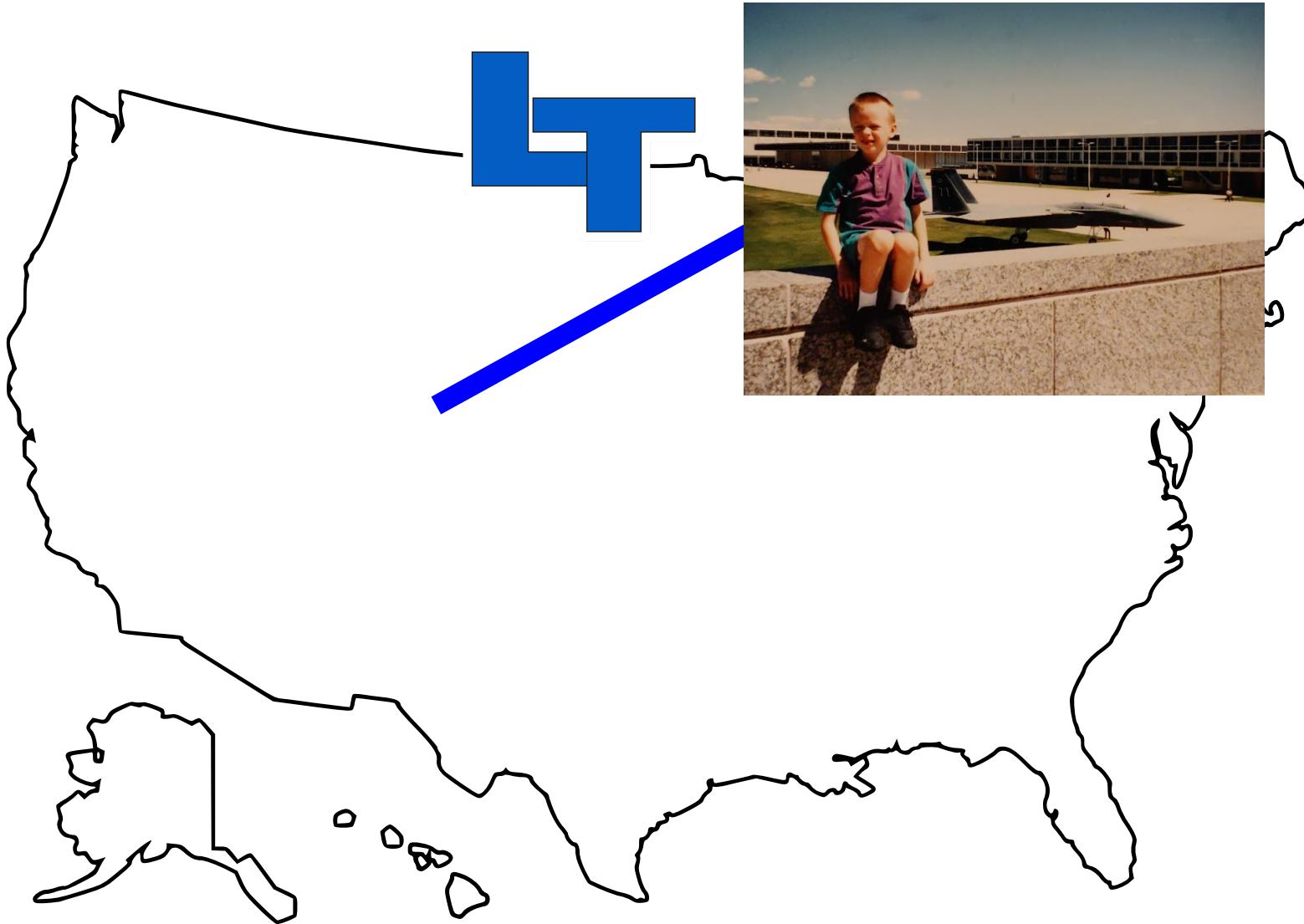
- Edstem
- Syllabus
- Github
- Book
- Homework
- Julia

A bit about me

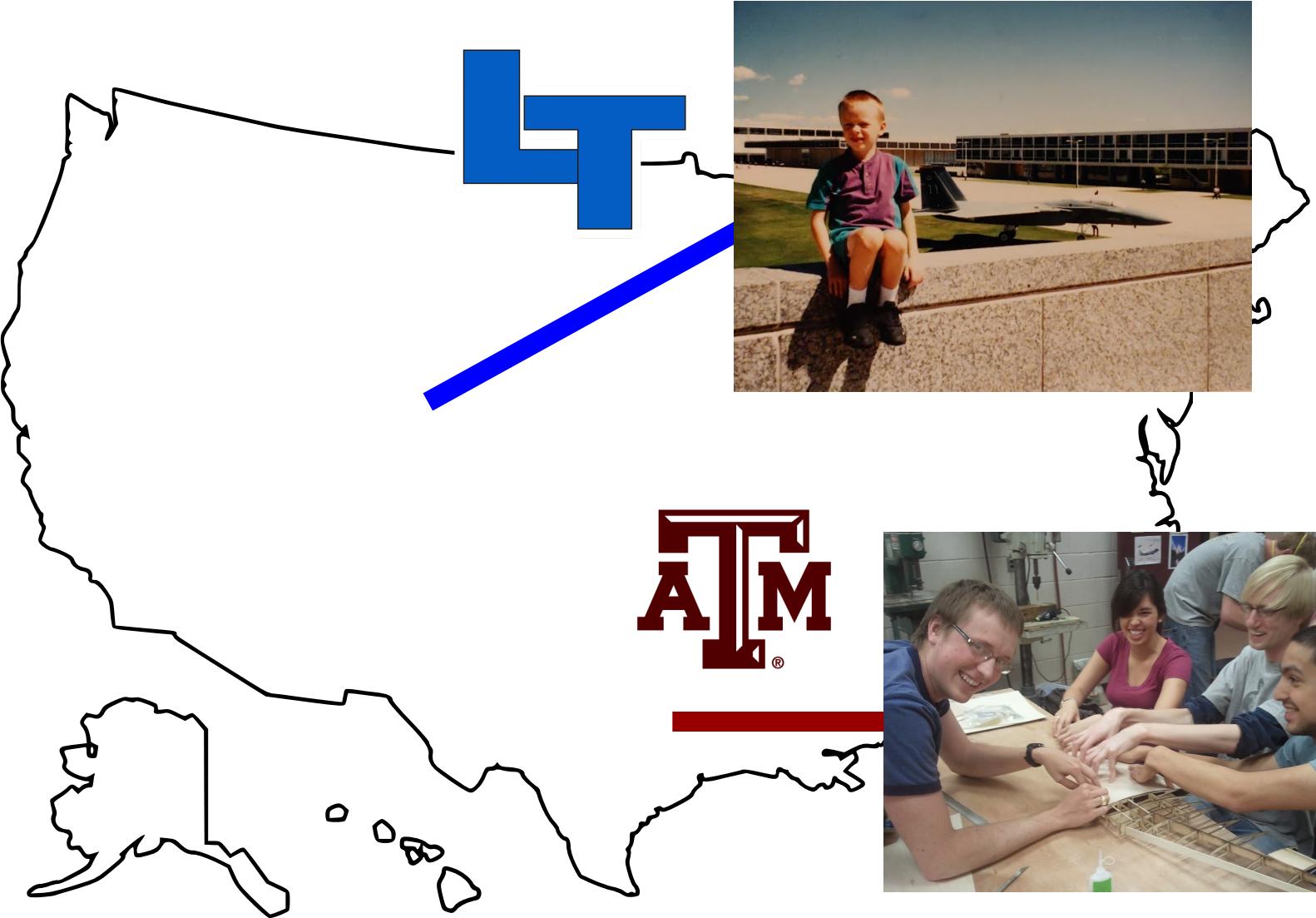
A bit about me



A bit about me



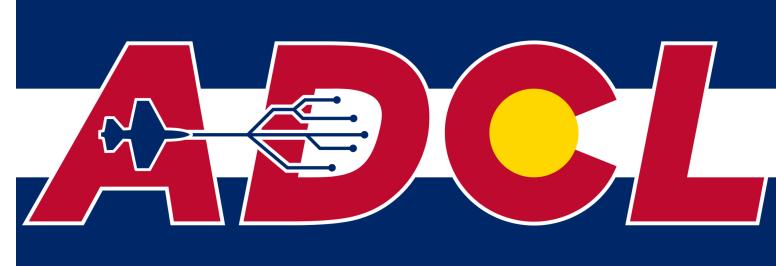
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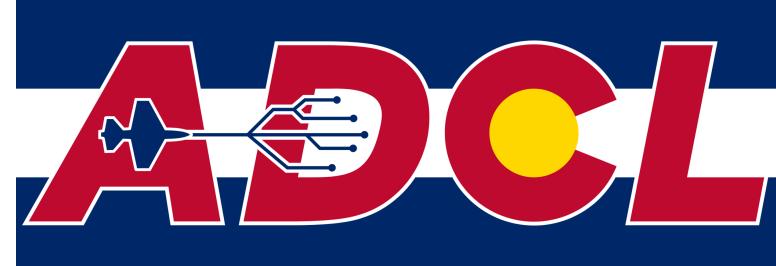
A bit about me



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