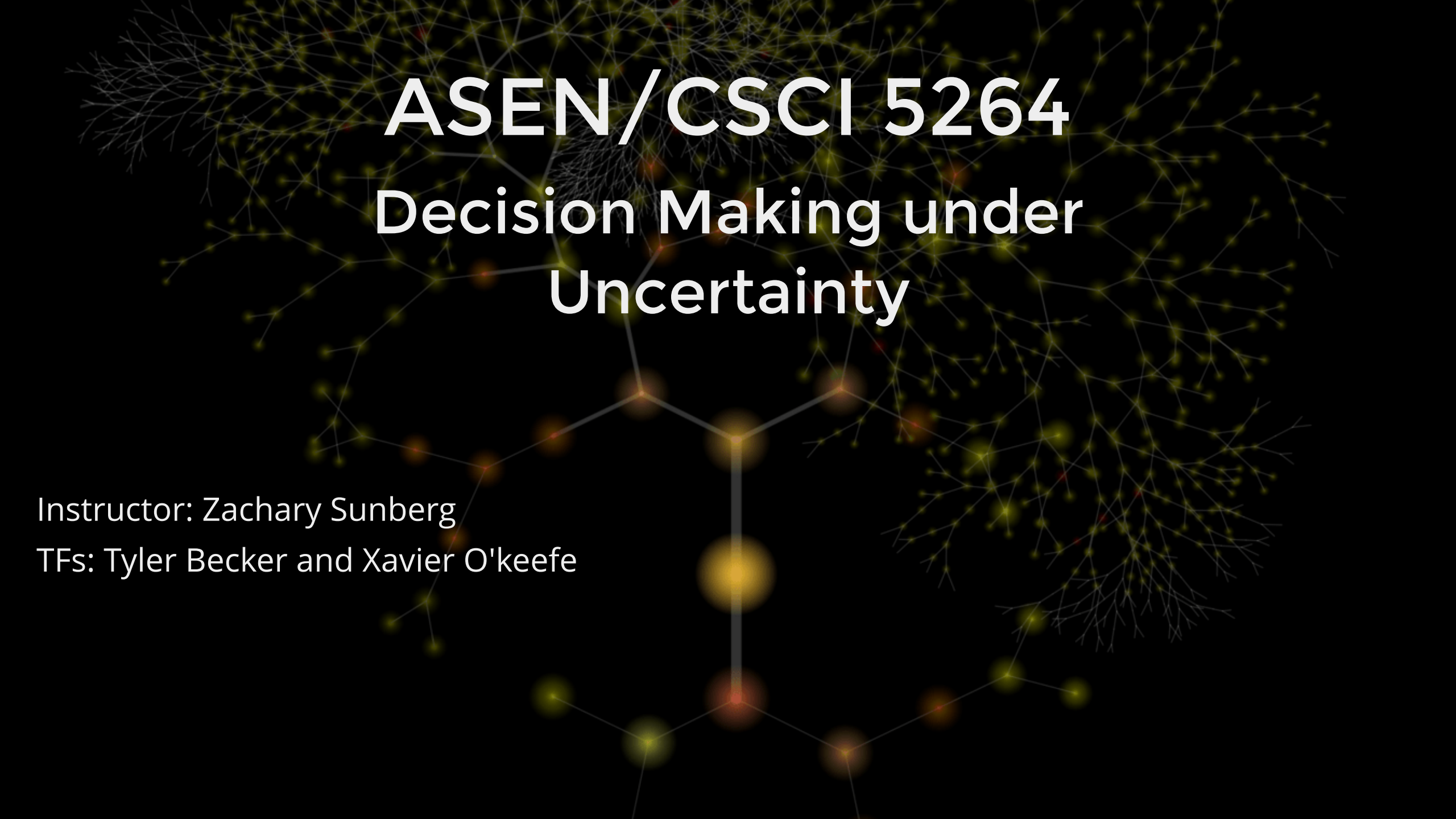


ASEN/CSCI 5264

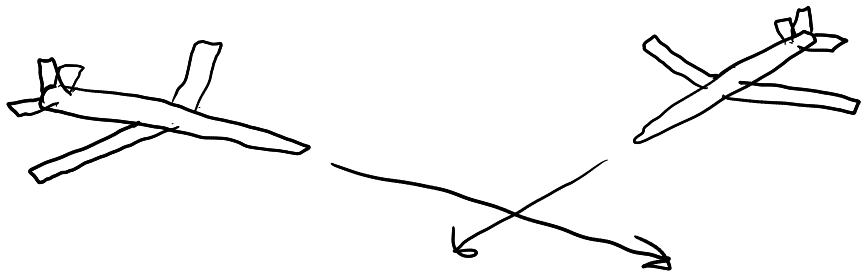
Decision Making under Uncertainty

Instructor: Zachary Sunberg

TFs: Tyler Becker and Xavier O'keefe

3 Example Problems

A/C Collision Avoidance



Uncertainty

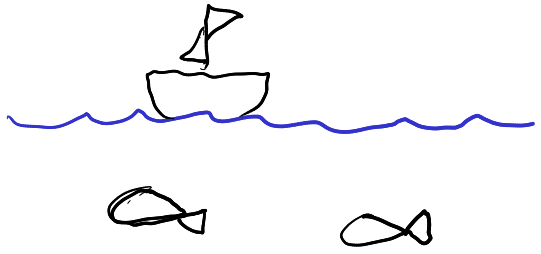
Position, Velocity

Environment
Wind, etc.

Behavior
of other aircraft

Dynamics model

Fishery Management



What the other Fishermen do

How many fish?

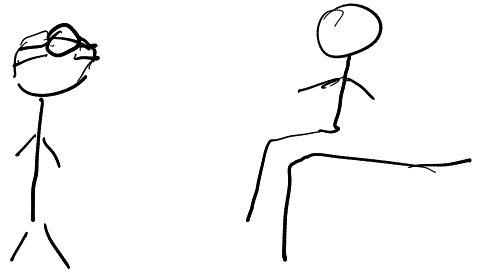
Spawning / Predation

Migration, etc.

Demand

Ability to go out

Medical Treatment



Internal state

Symptoms/test

False positives/False Negatives

Choosing test

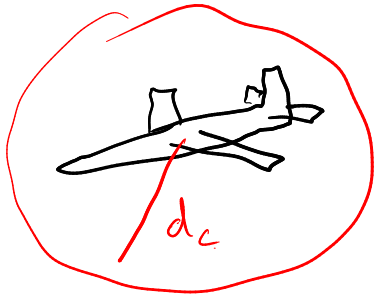
Making Diagnosis

A/C Collision Avoidance

State space
- set of all possible configurations of env.

Action space

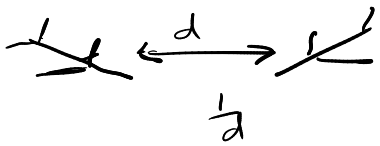
What a colision is



Reward

~~Cost~~ function

determines which states are good/bad



Reward = -1000 collision
1 in destination

$R(s,a)$ { -1000 if s is in collision
-1 if deviate from path

Dynamics

Transition Distribution

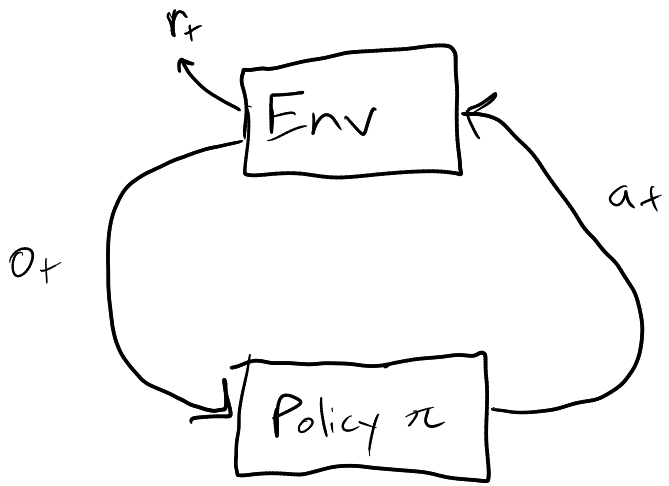
0,7

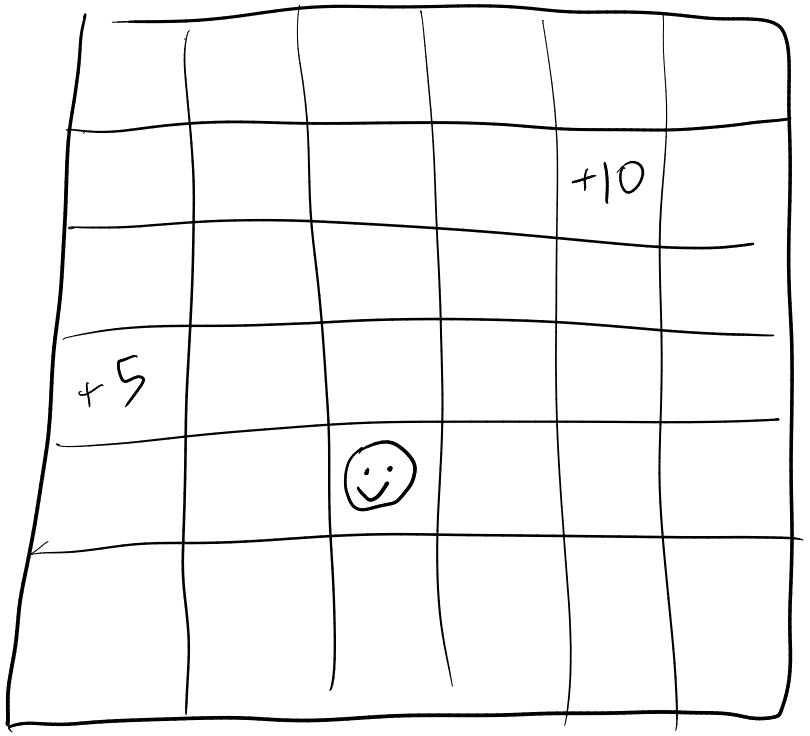
(S, A, R, T)

MDP

$$\arg\max_{\pi} E\left[\sum_{t=0}^{\infty} \gamma^t R(s_t, a_t)\right]$$

Sense-Plan-Act Loop





Four Big Challenges in DMU

1. Future Rewards that depend uncertain outcomes — MDP
2. Unkown (or hard-to-represent) Model — Reinforcement Learning
3. Imperfect Observations — POMDP
4. Other Agents — Game < MG, POMG

Four Types of Uncertainty in DMU

1. Outcome Uncertainty — Aleatoric
2. Model Uncertainty — Epistemic (Static)
3. State Uncertainty — Epistemic (Dynamic)
4. Strategic Uncertainty

Known Unknowns

Unknown Unknowns

Not in this class

Break

Break

- Engineering is a team sport!

Break

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

Problems in DMU

Limited	**Powerful**
Finite, discrete spaces	Continuous spaces
Specific parameterized distribution classes (e.g. Gaussian)	Arbitrary distributions
Approximate algorithms	Fast, globally optimal algorithms

Problems in DMU

Limited	**Powerful**
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Usually, you only get to pick two in this column!

Course Materials/Logistics

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- Syllabus

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- Syllabus
- Github

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- Syllabus
- Github
- Book

Course Materials/Logistics

- Syllabus
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- Edstem

Course Materials/Logistics

- Syllabus
- Github
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- Edstem
- Homework

Course Materials/Logistics

- Syllabus
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- Julia

A bit about me

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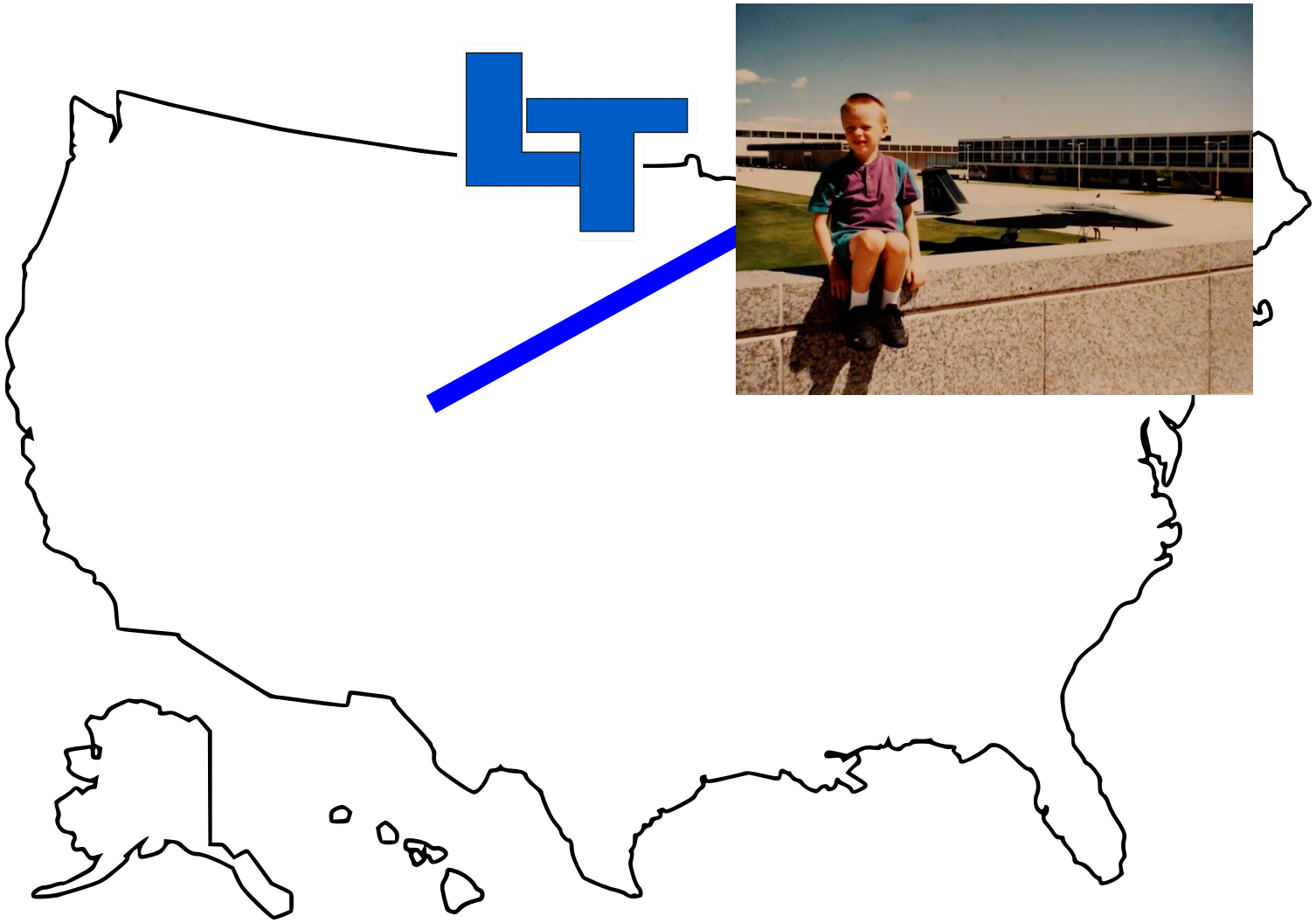
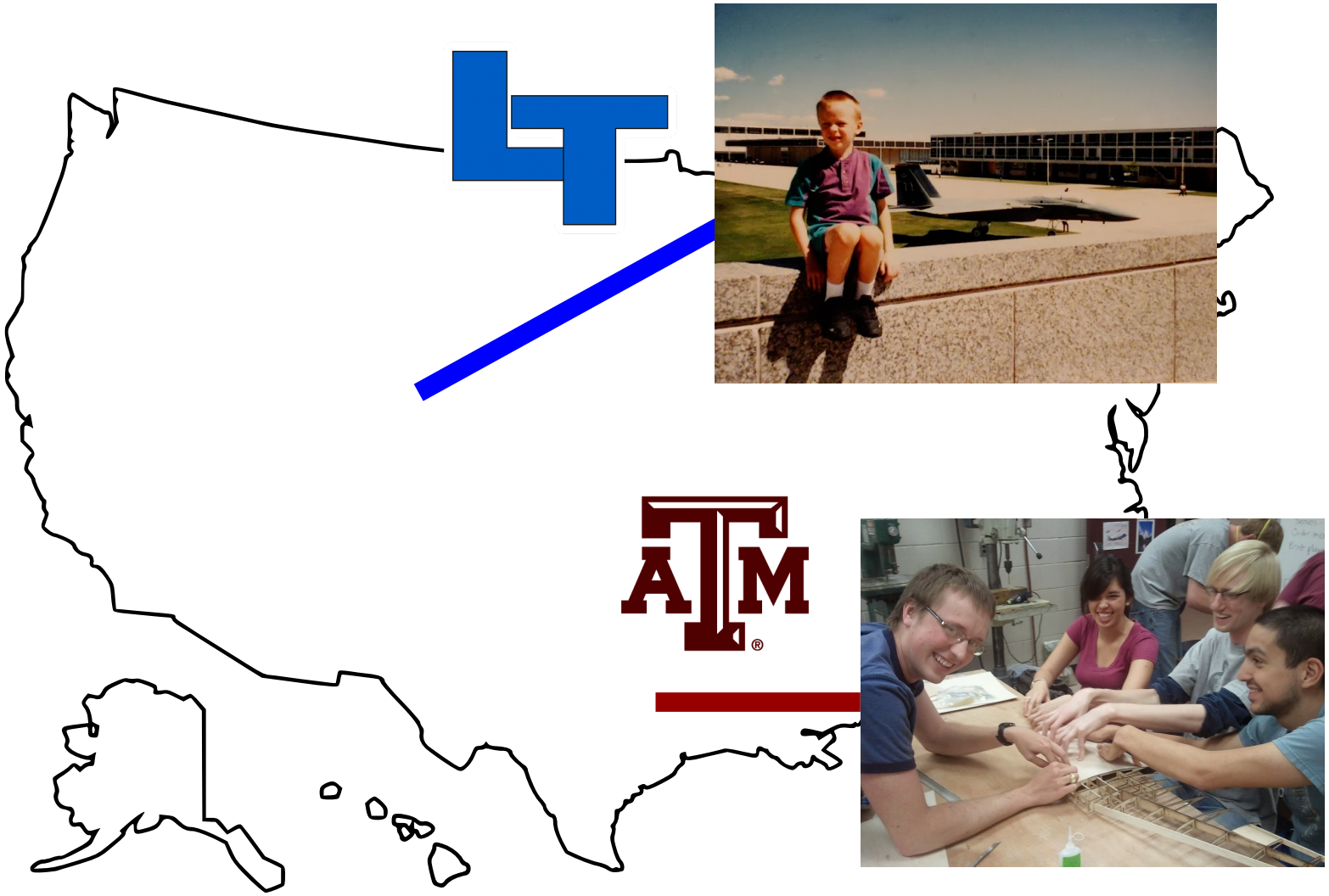


A bit about me



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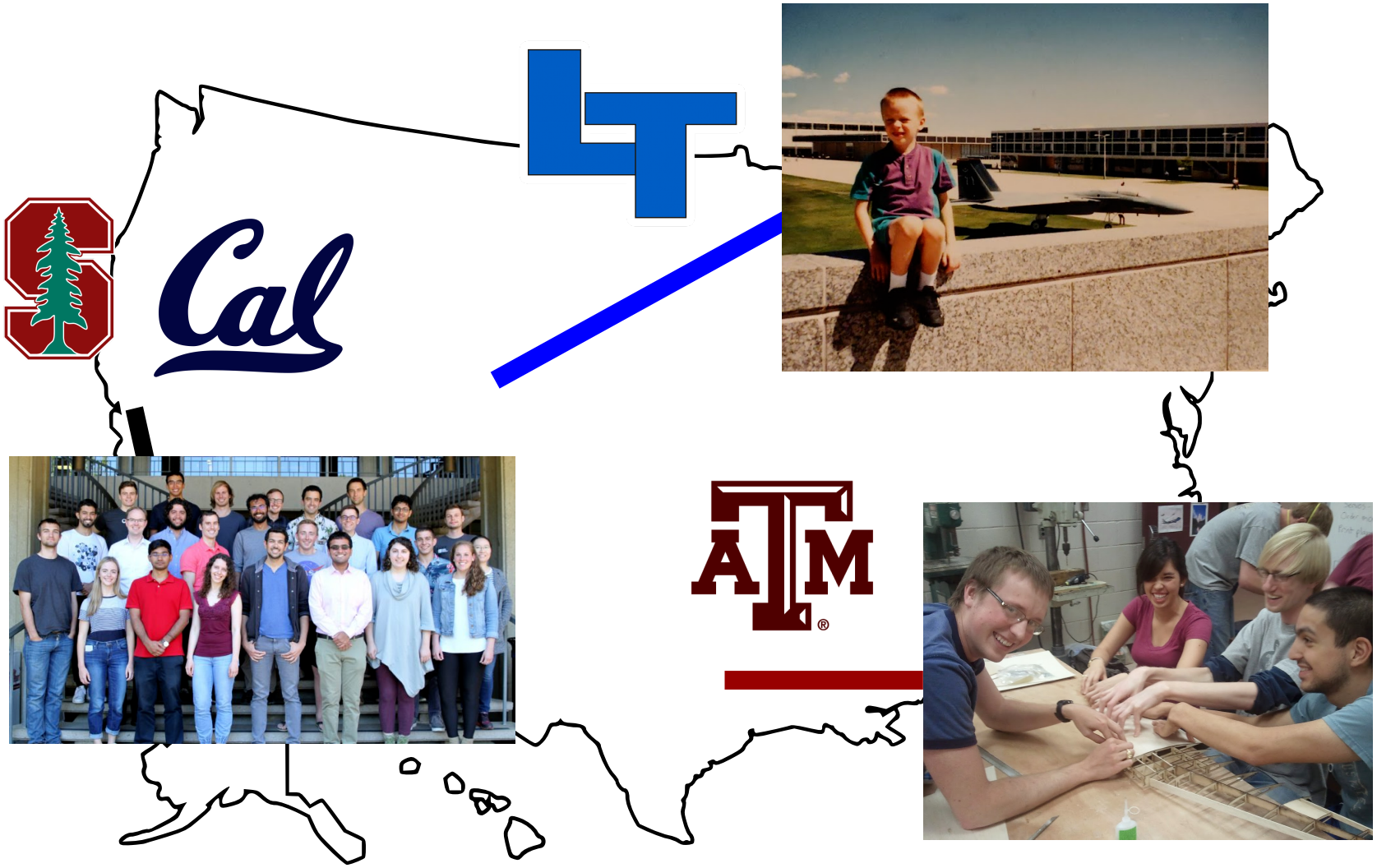

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