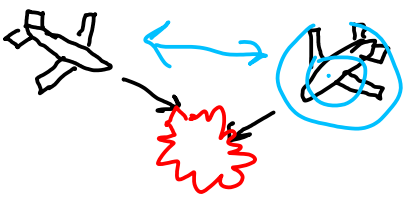
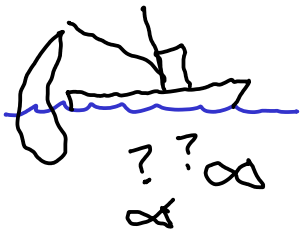
3 Example Problems

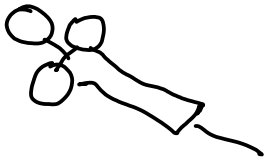
A/C Collision Avoidance



Fisheries Mgmt.



Cancer Screening



POMDPs

Sequential Decisions → Uncertainty ←

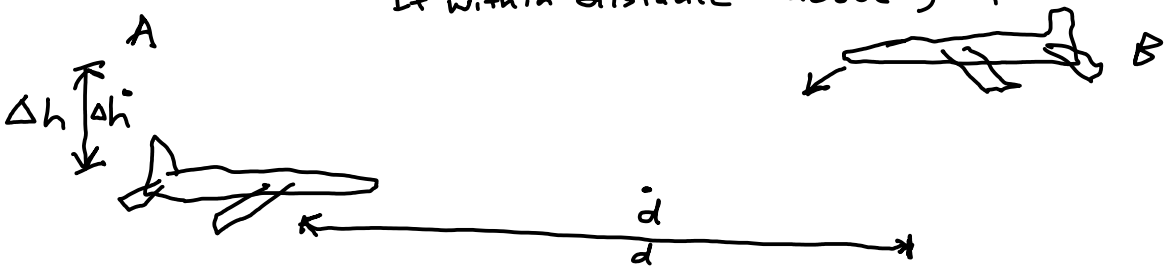
FAA: Prevent Collisions How?

TCAS

What should TCAS tell pilot?

Rules:

If within distance + above ↓ go up!



1. I.D. variables that describe env: state

$$s_t = [d_t, \dot{d}_t, \Delta h_t, \Delta \dot{h}_t]$$

2. I.D. how states change over time: dynamics ← unc.
3. I.D. what actions we can take: $\{up, down\}^2$

$\{up^A, up^B; up^A, down^B \ldots$

4. ID what states are better than others $R(s,a)$

$$R(s,a) = \begin{cases} -1000 & \text{if } \Delta h < \overline{\Delta h} \quad d < \bar{d} \\ -1 & \text{maneuvering} \end{cases}$$

$$a = \pi(s)$$

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

$f(x) = -x^2 + 1$

$\max f(x) = 1$

$\operatorname{argmax} f(x) = 0$

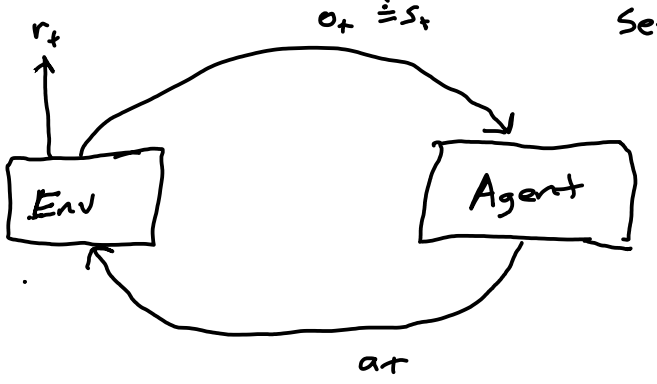
4 Big challenges in DMU

1. Immediate + Future Rewards	MDP
2. Unknown models	RL
3. State Uncertainty	POMDP
4. Other Agents	Game Theory

Types of Uncertainty

Probabilistic

1. Outcome	Action/Aleatory	coinflip
2. Model	Epistemic Static	Loaded die
3. State	Epistenic Dynamic	Blackjack
4. Interaction		Rock Paper Scizzor



Sense - Act Loops

1. Name, Major
2. A decision in your life
+ approach