

Error Recovery in Soar Agents



Jennifer Kiessel

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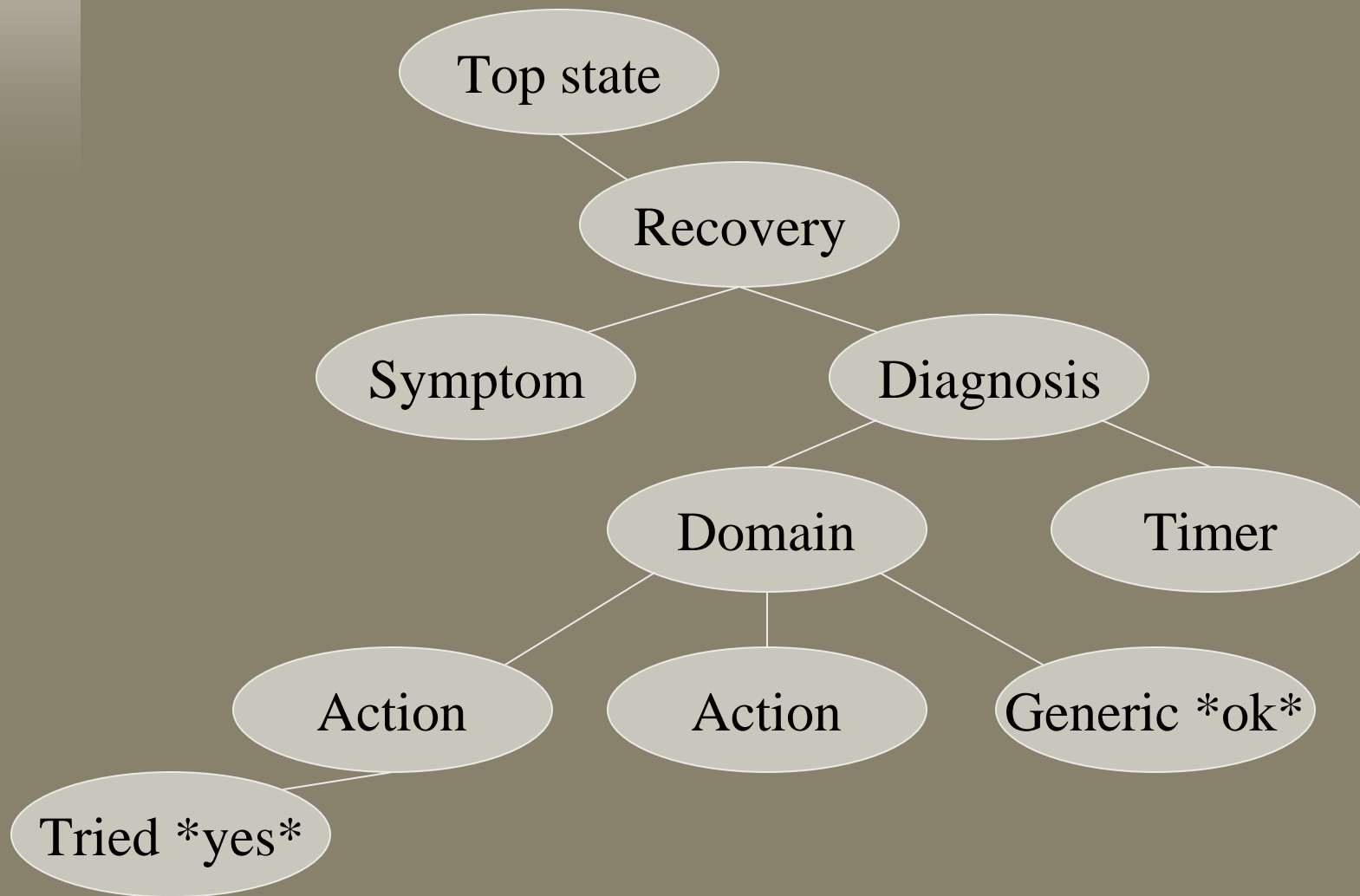
Outline

- Implementation Overview
- Methodologies for Recovery Actions
- Recovery Action Implementation
 - Known solutions
 - Generic solutions
- Future Work
 - Causal Models
 - Learning

Implementation Overview

- Symptoms
 - If (problem) → create symptom structures
- Diagnoses
 - If (symptoms) → create domain, timer, actions, and generic *ok* flag
- Corrective action
 - If (action) → execute it and set “tried” flag
 - If no untried actions && generic *ok* → generic actions

Symptoms to Recovery



Methodologies for Recovery Actions

- Awareness of Context
- Awareness of Time
- Managing Multiple Actions

Awareness of Context

- Corrective actions should be contextually appropriate
 - Diagnoses can use their awareness of particular symptoms to suggest appropriate recovery actions
 - Even without detailed suggestions of specific actions, sufficient information provided by the model suggests a generic domain of possible actions
 - EXAMPLE:
 - If there is a threat ahead of you and it is a surface-to-air missile (SAM) site → turn away
 - If there is a threat ahead of you and it is an enemy fighter plane → do NOT turn your back

Awareness of Time

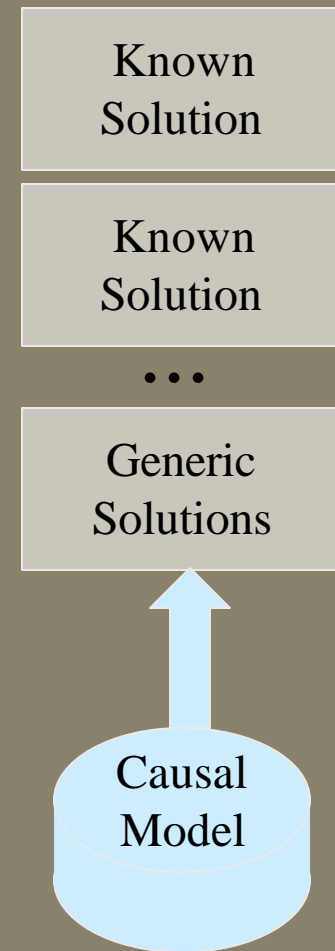
- Eventually give up if action is not working
- Monitor results
 - Apply alternative strategy if not making progress toward goal
- Each recovery action has a time element associated with it: how long should the agent try the action before giving up?
 - After time has elapsed, agent will try new action

Managing Multiple Actions

- Partial order of priorities
 - Using Soar operator preferences on recovery actions
 - All actions suggested by diagnostics will be proposed and best choice will be selected
- Progression from known to generic solutions
 - Try solutions based on prior knowledge before exploring new possibilities

Recovery Action Implementation

- When a diagnosis is formed:
 - it may provide recovery actions
 - it always provides a domain for the problem
- Try known solutions (suggested actions) first, if there are any
- If no known solutions or known solutions don't alleviate symptoms, generic solutions within the suggested domain are tried



Known Solutions

- Recovery actions suggested by diagnostics
- Simple responses to qualitative model's symptoms
 - EXAMPLE: Goal is to shoot target and agent is facing away from target
- Programmed by developer

Generic Solutions Rationale

- When Soar agents are at a loss for what to do, they get stuck
- When humans are at a loss for what to do, they will try new solutions to the problem
- **EXAMPLE:** Invisible barrier
- Try changing heading, altitude, or speed in the Flight domain



Generic Solutions

- General recovery actions for a particular domain
- As a developer, how to choose generic actions?
 - Constrained to the effectors of the system
 - TacAir Soar: twiddling speed, radar parameters, etc.
- If all else fails
 - Return to base
 - Land the plane

Examples of Generic Solutions

- COMMUNICATIONS
 - Mark message as read; request message resend
- FLIGHT
 - Change heading, altitude, or speed
- RADAR
 - Change radar mode, elevation, or azimuth
- WEAPONS
 - Mark weapons as having been fired

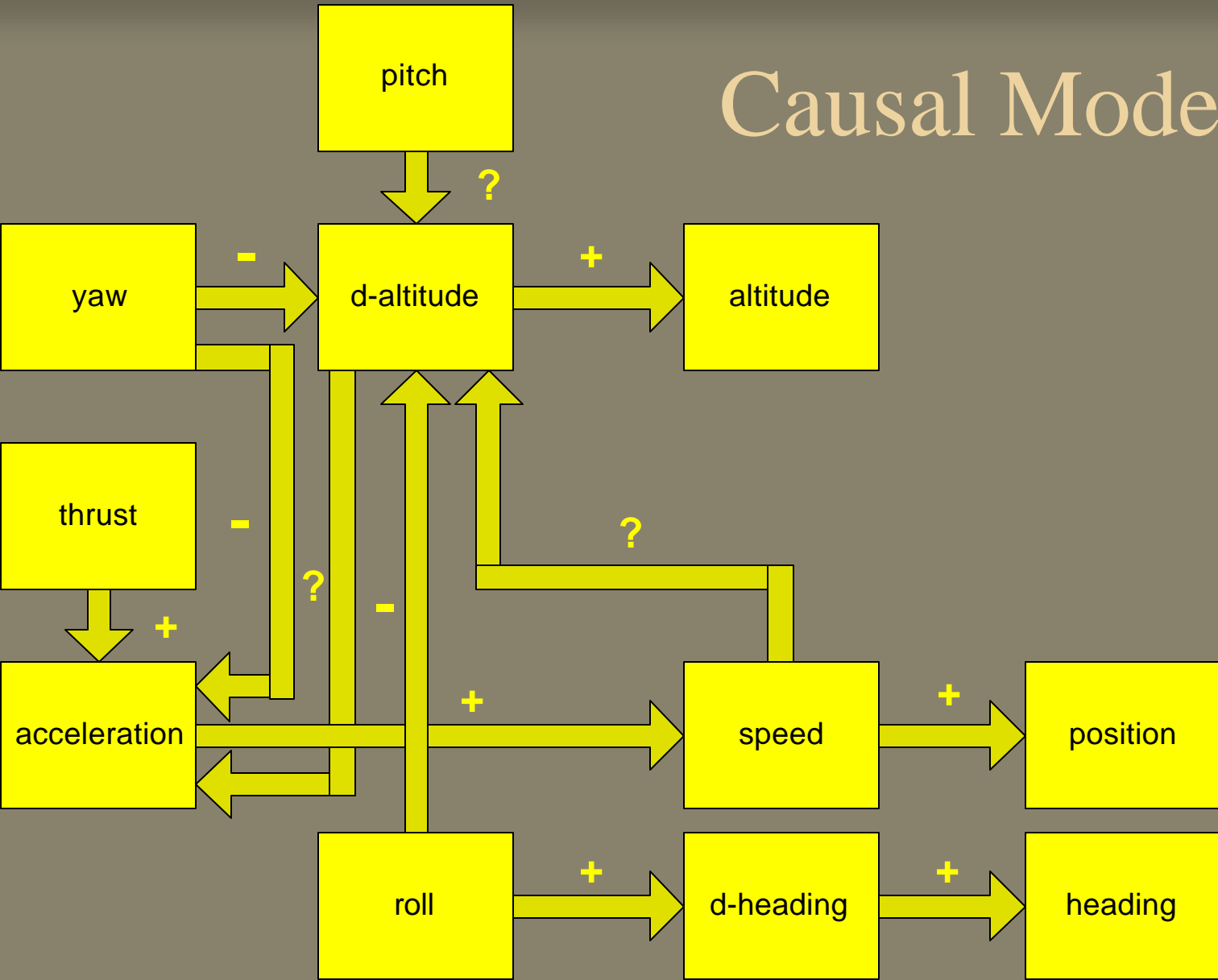
Future Work

- Causal models
 - Flight domain is designed but not implemented
 - Other domains need design and implementation
- Learning
 - Generic solutions should be learnable and tried as known solutions the next time
- Analogy

Causal Model Rationale

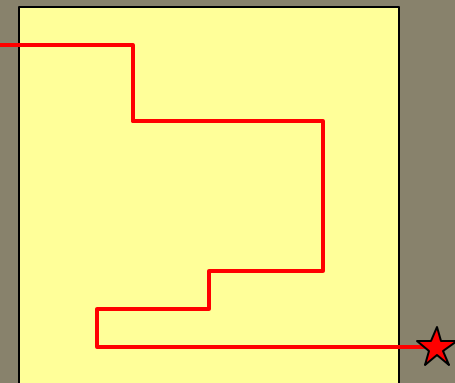
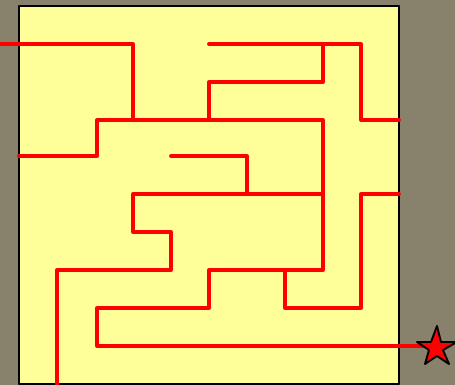
- Model of spatial relationships for Flight domain
- Extensible to any agent with concept of movement in three dimensions
- Credit/blame assignment
 - Can use causal model to determine possible error occurrence and take corrective action

Causal Model



Learning

- Objective: Learn successful behaviors
- When a generic solution is found that alleviates symptoms
 - Store as a known approach to the problem
- If the problem occurs again
 - Immediately try the discovered solution
- If learned solution is inadequate
 - The system is able to employ more detailed knowledge and possibly learn further
- Possibly use “chunky problem spaces” to turn on learning in TacAir Soar’s recovery problem space only



Nuggets and Coal

- System is implemented and being tested with good results
- Trying to make system extensible so recovery can be hooked into other Soar apps
- Scripts for generating symptoms, diagnosis, and recovery actions
- Causal model not implemented yet
- Learning not implemented yet
- Not enough time or money to devote to this project