Simulated environment as described in previous talks.

User

Controls

Avatar

Director

Synthetic Characters

Simulated Environment

Directable Synthetic Characters

Talk Overview

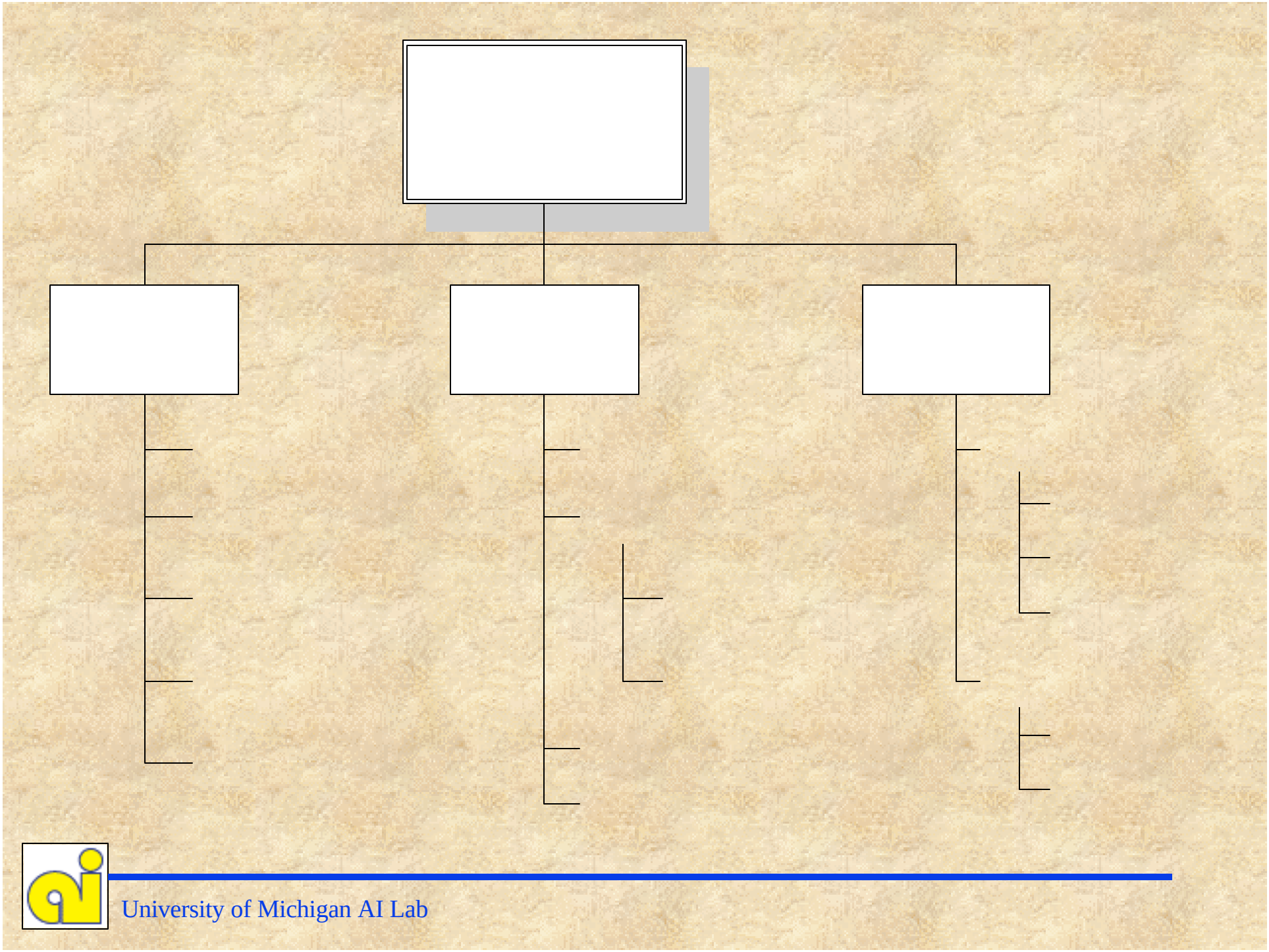
- Design goals: what do we want these characters to do
- Explore a challenge that they all face, *behavior coherency*
- Describe our approach and current progress

A Taxonomy of Design Goals for Directable Synthetic Characters

Why formalize a taxonomy of design goals?

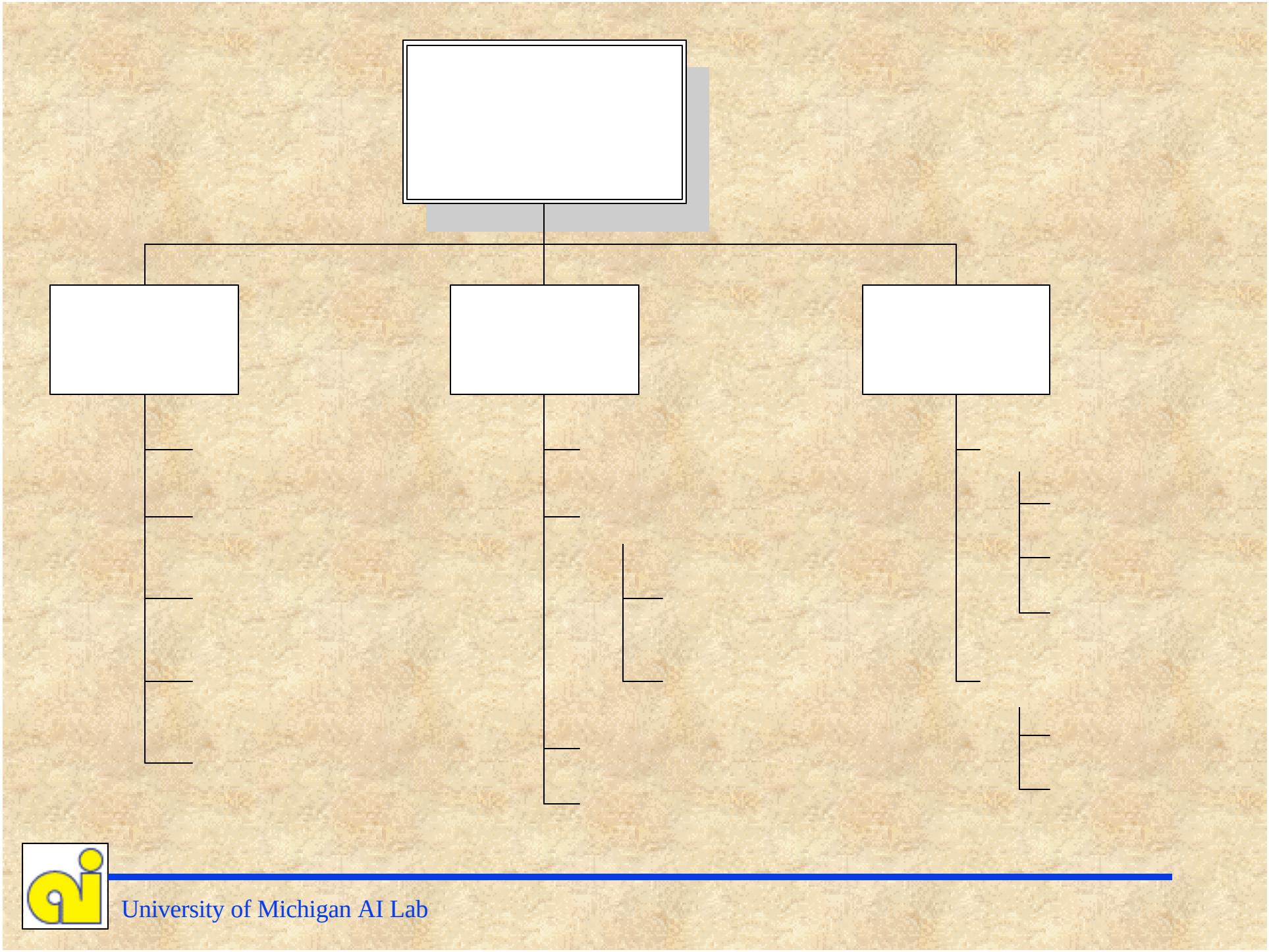
- To determine capabilities needed
- To determine which of these capabilities interact with issue of directability

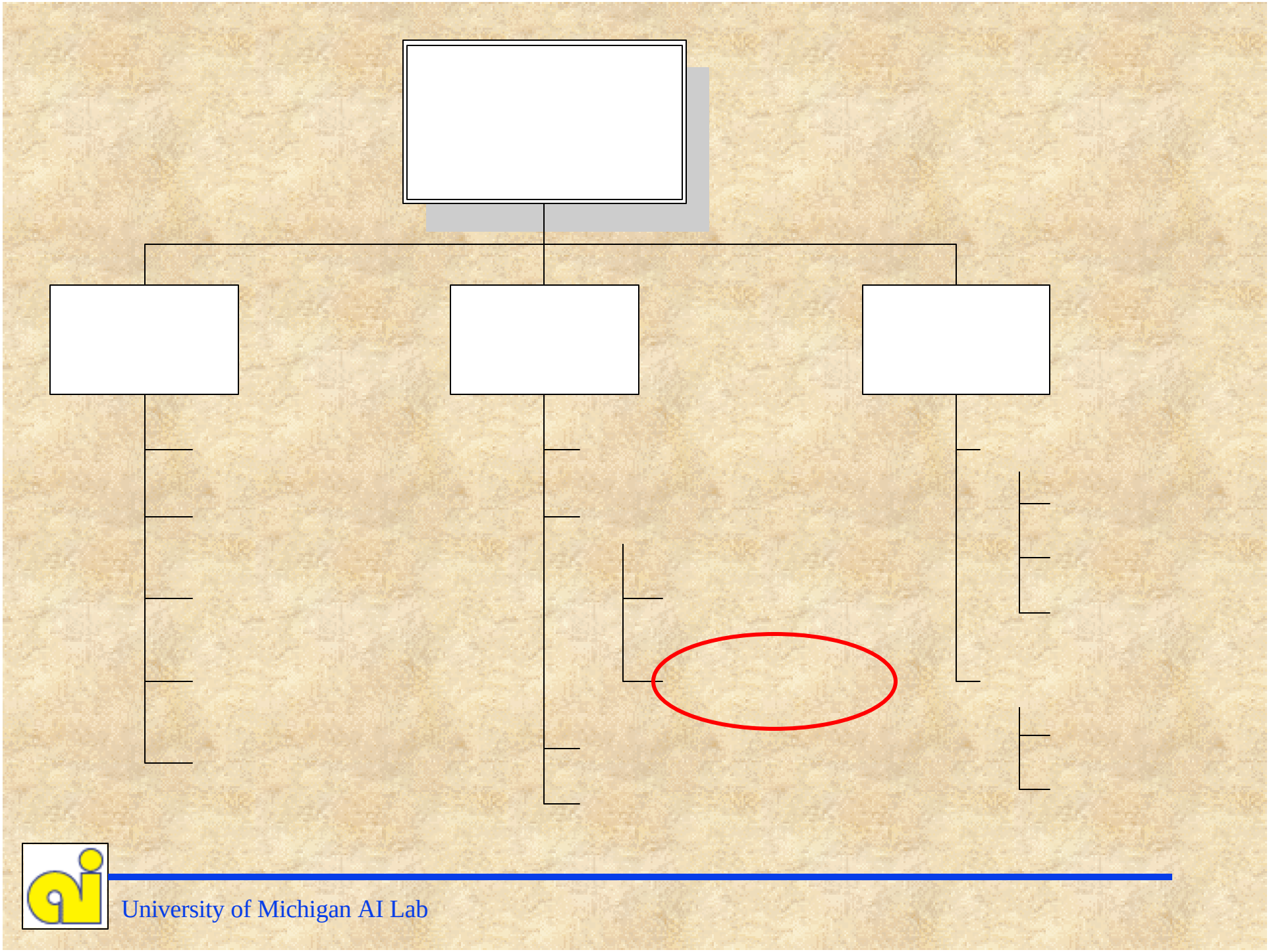
- Note:
  - This taxonomy is for an *ideal* directable character
    - Our goal is not necessarily to build one of these broad agents
  - Synthesis of previous work



Summary

- Analyzing the design goals helps us isolate some of the challenges of directability
- This research focuses on coherent agent behavior





Summary

- Analyzing the design goals helps us isolate some of the challenges of directability
- This research focuses on coherent agent behavior

Summary

- Analyzing the design goals helps us isolate some of the challenges of directability
- This research focuses on coherent agent behavior
  - An important issue that will impact any directable agent, but especially:
    - Highly autonomous characters
    - Breadth of available actions
    - Aberrant behavior observable but difficult or expensive to model computationally
- We define inter-goal coherency as “goals that have a clear and logical structure between them.”

Inter-goal Coherency

- *Def'n:* Goals that have a clear and logical structure between them
  - Just a definition. Author or context of situation may intentionally violate.
  - Rational goal switches
    - More important new goal? OK to abandon old goal?
  - Transitions should be "natural"
    - Unnecessarily abrupt or radical
    - User should be able to explain switch

Inter-goal Coherency

- Evaluating is difficult
  - Inherently fuzzy requirement (e.g. “natural”)
- Critical to directability
- There has been previous work on this
  - Most applicable is Phoebe Senger’s thesis on schizophrenic agents

Approach

How will we deal with this?

2 main components:

- Develop several heuristics to measure relative coherency
- Design algorithm to utilize these heuristics to *improvise* direction in real-time

Action-selection Algorithm

- Many techniques could potentially work
- Planning
  - Plan Generation
  - Plan-merging
  - Reactive “Planning”
- Hand-coded Expert Rule Based Systems (HERBs)

Action-selection Algorithm

- Conflicting design criteria for an ideal agent
- The types of environments we are interested in imply three main areas of evaluation
  - Performance Criteria
  - Real-time response and behavior modification.
  - Support for *author-friendly* individualization

Extending HERB Systems

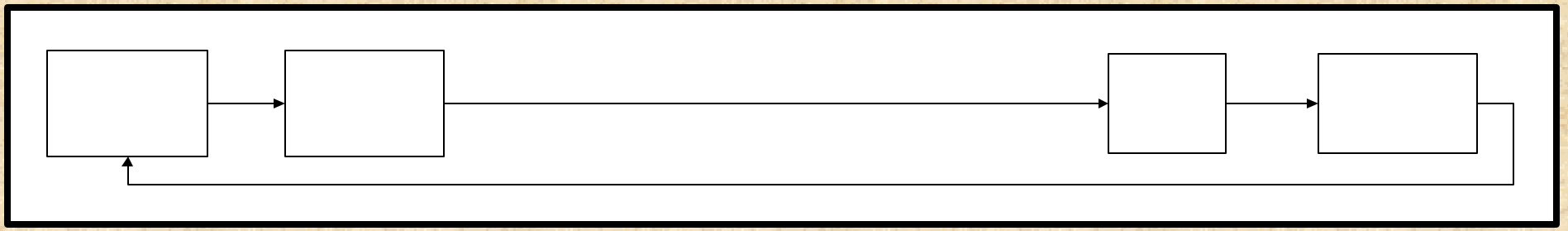
- *Two main modifications*
  - Goal Selection
    - Larger set of goals to choose from
  - Coherency Heuristics
    - To choose more natural transitions from this larger set of goals

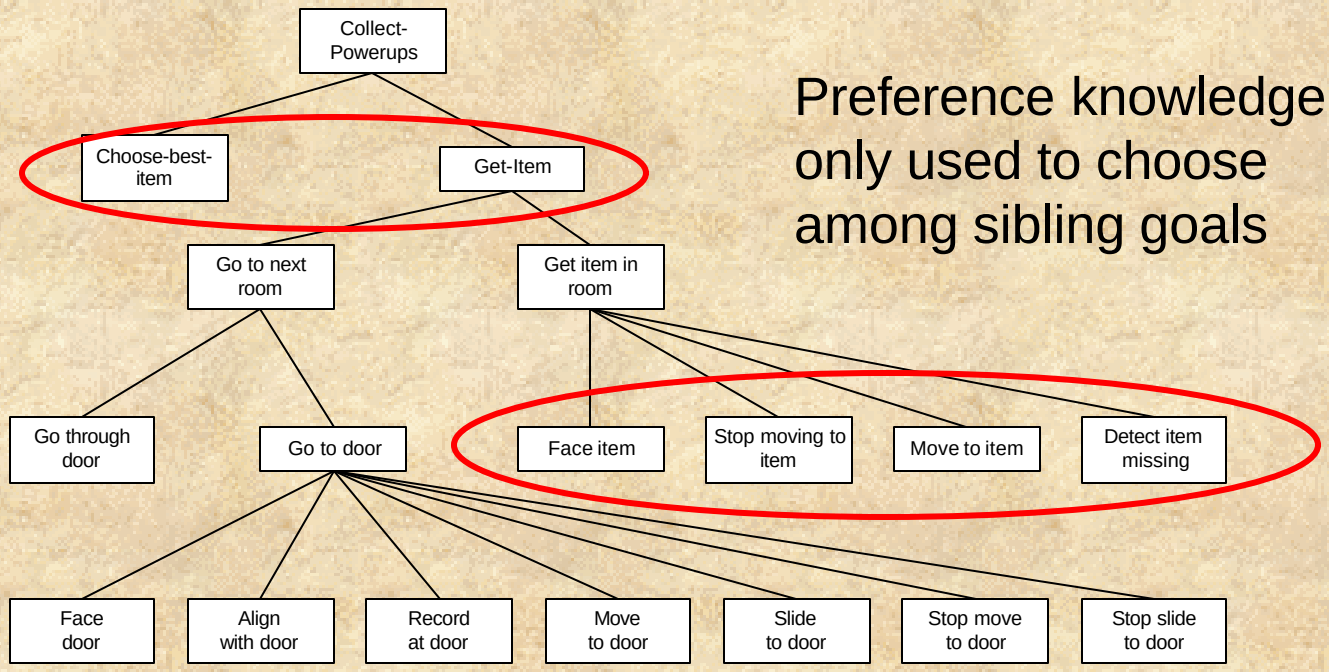
Coherency Heuristics

- What agent would normally do without out direction is natural behavior
- “Similar” goals will have more natural, coherent transitions

Details

Standard HERB Goal Selection Mechanism

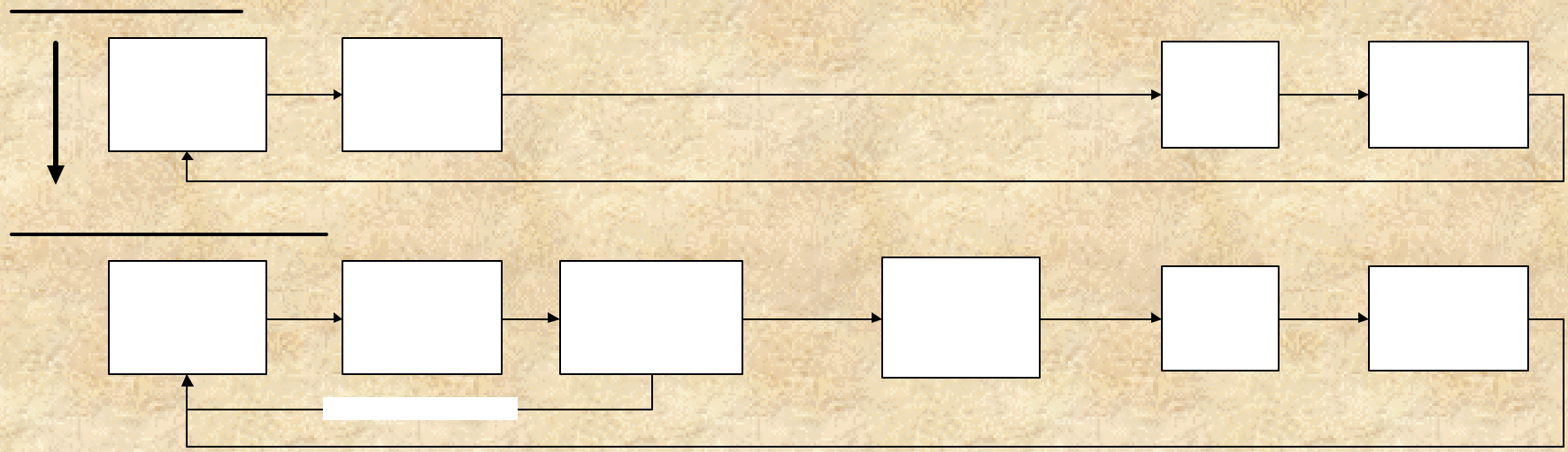




Preference knowledge only used to choose among sibling goals

Improvisational Goal Selection

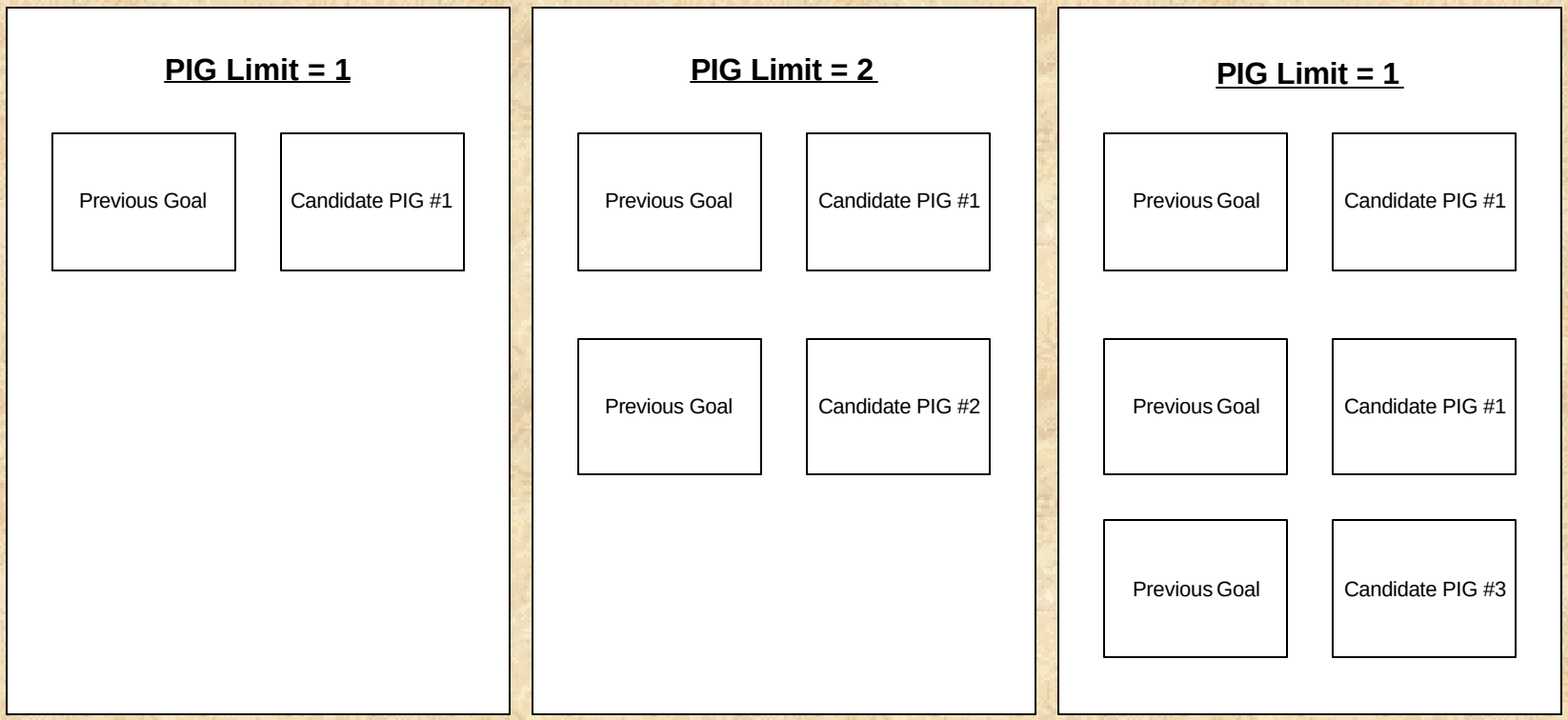
- Generate an ***improvisation set*** of goals



  - ***Partially Instantiated Goals (PIGs)*****:** Goals are annotated with information that may facilitate coherency comparisons

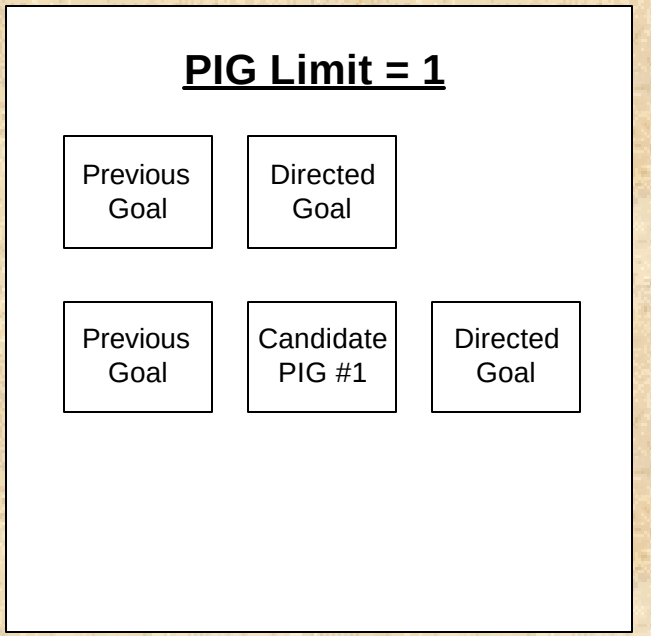
- Choose goal whose transition is most coherent

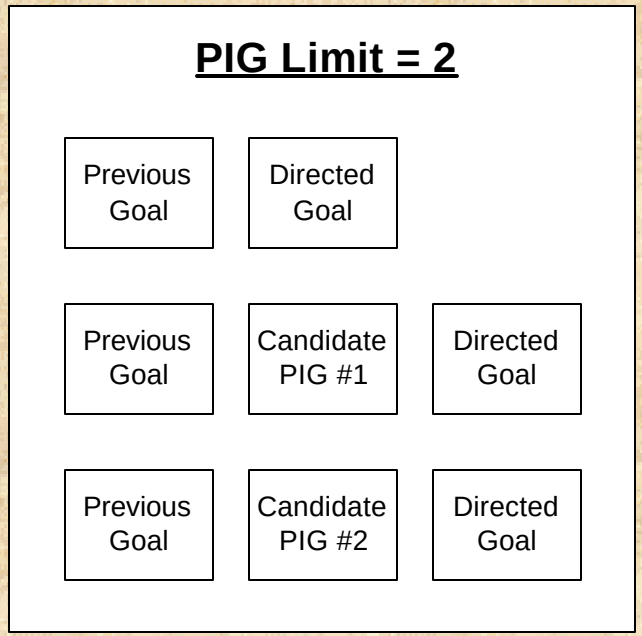
Goal Comparisons



- PIG limit of 1 is roughly equivalent to standard HERB goal selection

Accepting Directed Goals





- Compare only 2nd transition for now
- Can repeat until direction is smoothest transition

Coherency Heuristics

- Operator proposal order
- Goal hierarchy distance
- Effector summary information
- Engineered knowledge
  - Relation to emotion, personality or social model
  - Task classification
  - Character's personal valuation of goal
  - Amount of work performed/remaining

How the Agent's Knowledge Must be Changed

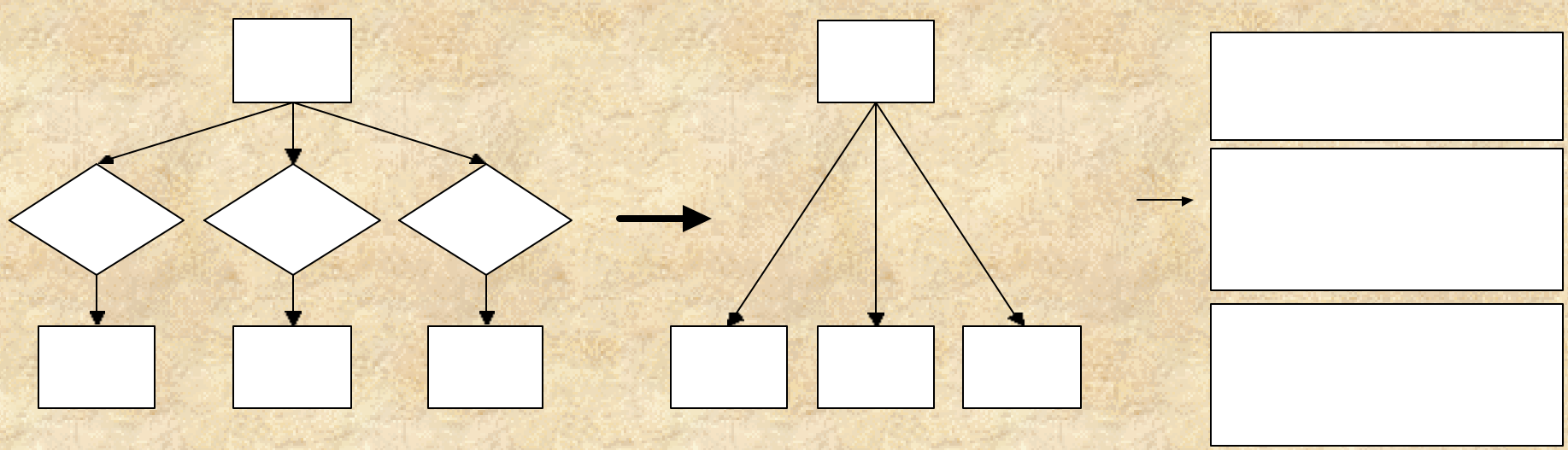
Two Main Areas

- Knowledge needed for coherency heuristics
- Restructured proposal and preference knowledge to facilitate improvisation

Restructuring Knowledge

- ***Whether an agent can*** propose a goal is often conflated with ***when an agent should*** propose a goal
- Move more conditions to preference knowledge
  - Increases number of potentially applicable operators

Restructuring Knowledge



Current Progress

Target Contributions of Experiments

- Create benchmark for coherency in directed behavior
- Specific experimental variations
  - Tests improvisational decision mechanism
  - Tests utility of heuristics
- Will allow us to generalize results since
  - Heuristics can be used in other approaches (planning)
  - Agent design does not make commitments to other components (emotion/personality models, etc.)

Experiments

- Build character-driven testbed and testing scenerio
- Build a suite of agents that implement variations of algorithms and heuristics
- Run agents within testbed scenario using human subjects hooked up to painful electrodes
- Evaluate results of simulations using both subjective and objective criteria

Agent Variations

- Standard HERB agent vs. neutered improvisational agent (different behavior with restructured knowledge? overhead costs)
- Suite of different algorithm variations
  - Coherency heuristics (ordering, selective use,combining)
  - PIG limits, i.e. size of improvisation set
    - Relation to quality of improvised behavior, computational load
    - Limit number of intermediate goals

Evaluation Criteria

- **Subjective**
  - Many facets hard to capture computationally (abstract, aesthetic, commonsense)
  - Comparative human surveys of agent behavior
    - Statistically significant trends (El-Nasr, Ioerger and Yen 1999)
  - "Cut!": interactive agent explanation of why goals chosen
- **Objective**
  - Number of imposed goal switches
  - Amount of time spent in portion of hierarchy (distance between goal transitions)

Testbed

- Unreal Tournament Character-Driven Environment
  - Articulated characters capable of:
    - Independently attending to objects
    - Facial movements (blinking, moving mouths)
    - Speech generation (multiple simultaneous voices, distance-based volume)
  - Limited user modeling
    - User's characters has attention that can be drawn to interesting events such as character activity (speech, expressions)

Testbed

- Synthetic character communication
  - Can communicate to other agents via transfer of working memory structures to other agents or to user via Microsoft speech generation SDK
  - Previously developed NLP system to translate natural language utterances directly to soar working memory elements
    - Grammar-driven natural language input to agents