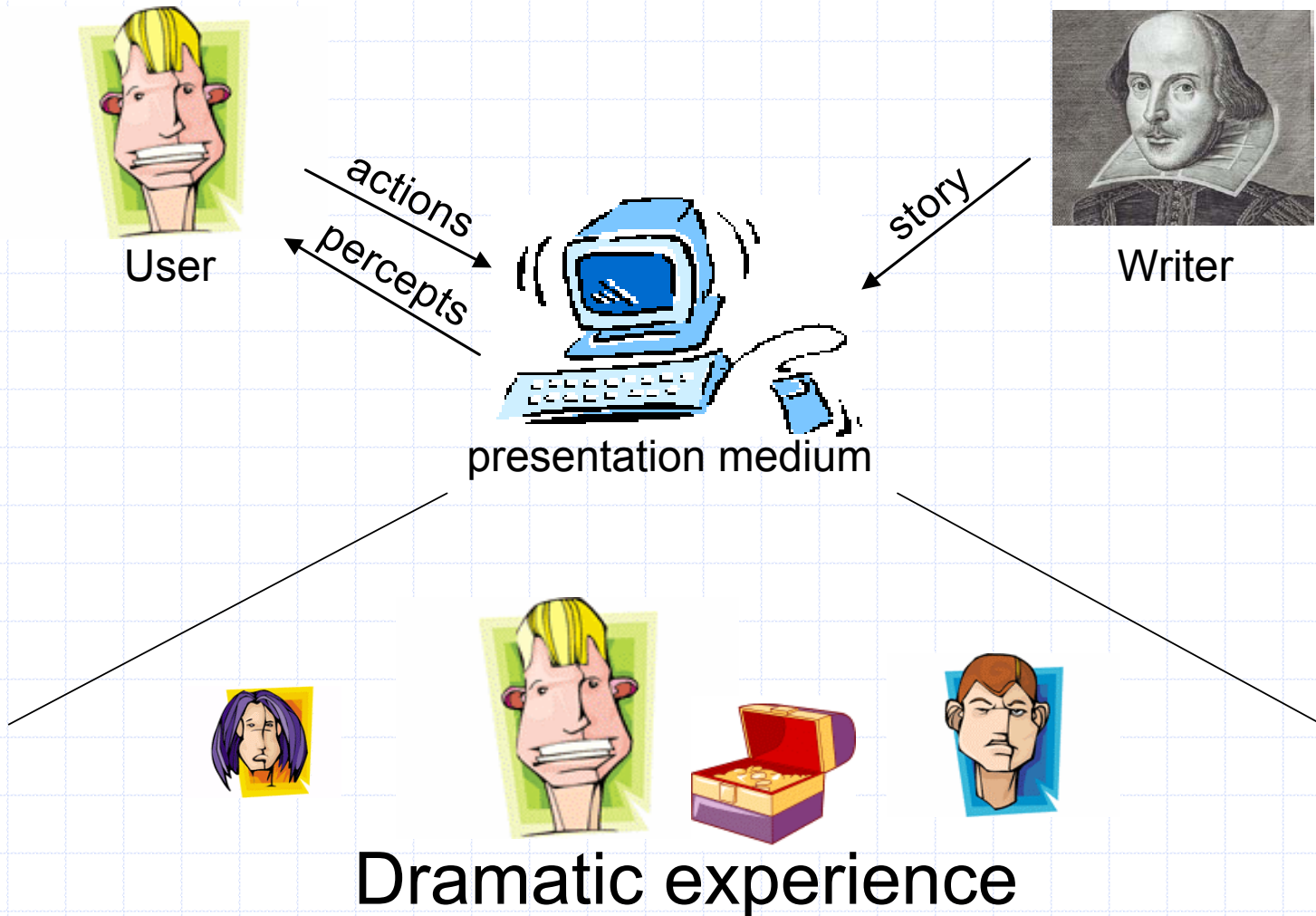# Incorporating User Modeling into Interactive Drama

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Soar Games group

www.soargames.org

Generic Interactive Drama

User

actions

percepts

story

Writer

presentation medium

Dramatic experience

Example Narrative

- You are a ghost in the story, trapped in an unfamiliar mansion.
- First part of story involves you meeting and befriending the Hitchhiker character
- You see him, but decide to scare him repeatedly until he runs away screaming
- How can the story continue?

Problem Statement

- Author communicates a particular artistic vision
  - Specific temporal structure
  - Humans are great storytellers
  - "I want control from beginning to end."
- The User is a character in the story
  - Behavior may be positive or negative to the story
  - "I want to act how I want in the story."
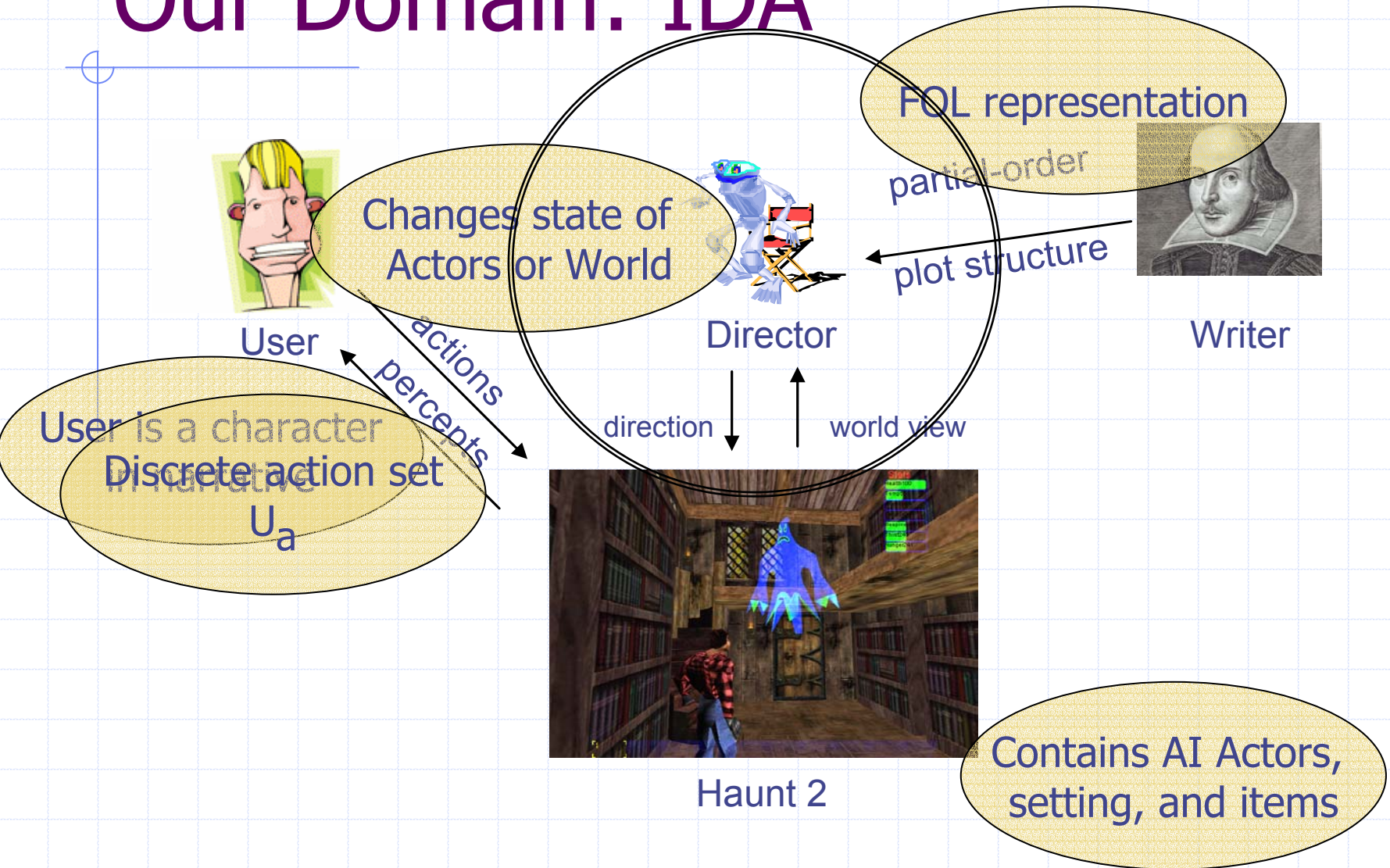- How do we balance the tension between author and User desires?

Novel approach to Interactive Drama,
using existing AI techniques

How is This Problem Unique?

- ◆ Why not just counter-plan against User actions?
  - ■ Disallowing errant behavior breaks believability
  - ■ Connection between User and character harmed
- ◆ Given that errant behavior *is* allowed, we can:
  - ■ Attempt to elegantly avoid it
    - ◆ Recognize errant behavior in present and future
    - ◆ Predict behavior that is likely to happen
  - ■ Attempt to incorporate the behavior into the plot

"Can a predictive model be incorporated into an ID to help find a balance between User and Writer desires?"
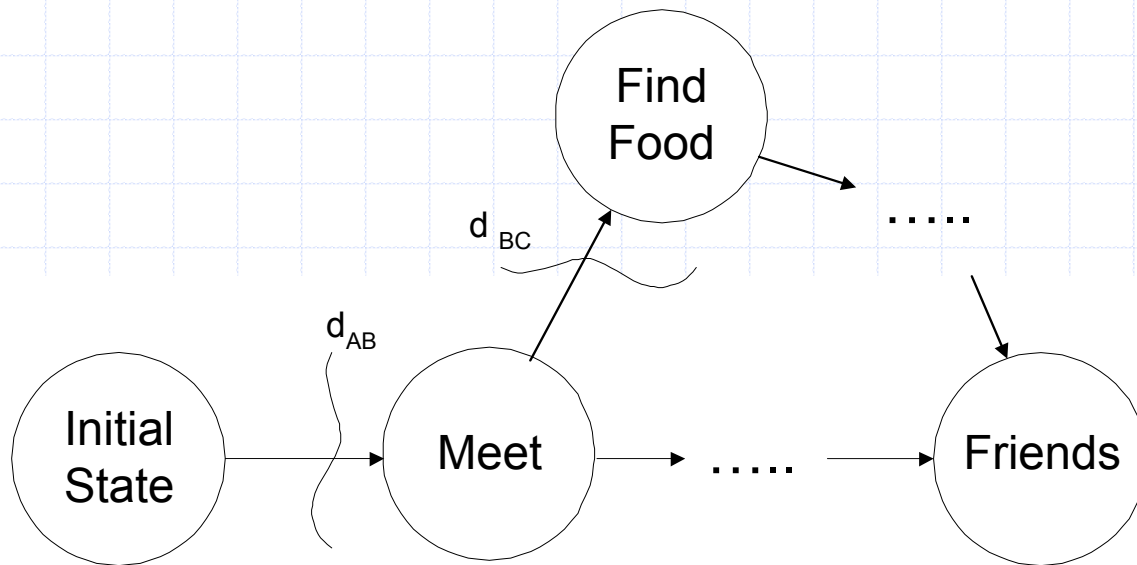
Our Domain: IDA

FOL representation

Changes state of Actors or World

partial-order

plot structure

User

Director

Writer

actions

percents

User is a character in narrative

Discrete action set U_a

direction

world view

Haunt 2

Contains AI Actors, setting, and items

What does the Director **do**?

- ◆ **Monitor temporal constraints**
  - ■ Is the story flowing?

Plot: A Single Scene

- Scene represents the set of desired behaviors
- Partial ordering of states
- Temporal constraints between state transitions
- Short in length, inspired by screenwriting theory
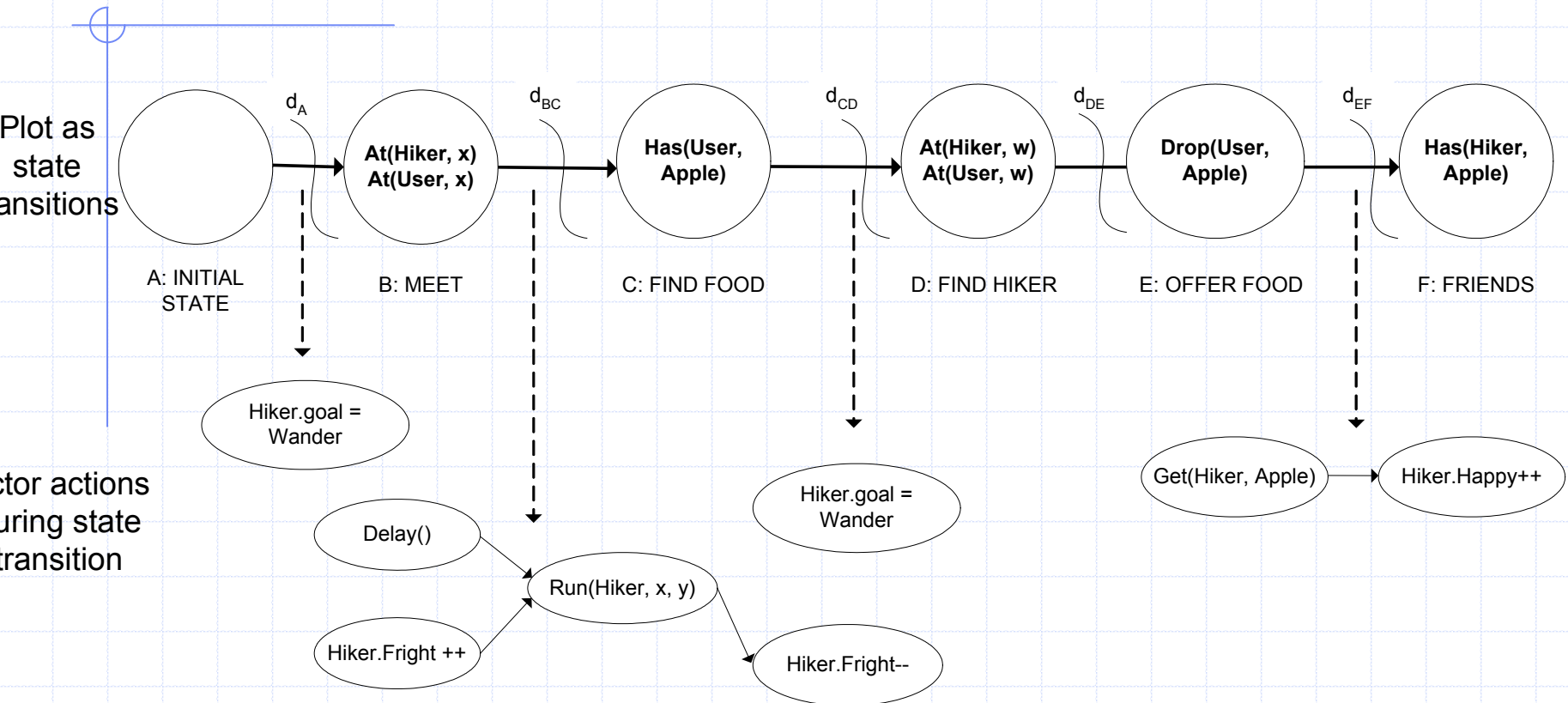
What does the Director **do**?

◆ Monitor temporal constraints
  ■ Is the story flowing?
◆ **Actor direction**
  ■ Giving new goals / information to agents

Plot: Linearization of a Scene

Plot as state transitions

ctor actions during state transition

| | d_A | | d_{BC} | | d_{CD} | | d_{DE} | | d_{EF} | |

A: INITIAL STATE

At(Hiker, x)
At(User, x)

B: MEET

Has(User, Apple)

C: FIND FOOD

At(Hiker, w)
At(User, w)

D: FIND HIKER

Drop(User, Apple)

E: OFFER FOOD

Has(Hiker, Apple)

F: FRIENDS

Hiker.goal = Wander

Hiker.goal = Wander

Get(Hiker, Apple) → Hiker.Happy++

Delay()

Run(Hiker, x, y)

Hiker.Fright ++

Hiker.Fright--

•Each "state" represents a set of possible states

•Preconditions / effects

What does the Director **do**?

- Monitor temporal constraints
  - Is the story flowing?
- Actor direction
  - Giving new goals / information to agents

- **Monitoring User behavior (Recognition)**
  - Is meeting the scene goals possible?
  - Is meeting the scene goals likely?
- **Modifying the world (Action)**
  - Incorporate User behavior
 - Help User reach the end of the scene

Approaches to Prediction

"Can a user model be incorporated into an ID to help find a balance between User and Writer desires?"

◆ Soar QuakeBot
  - Internal modeling of opponent
  - Anticipates opponent's next moves to determine best strategy
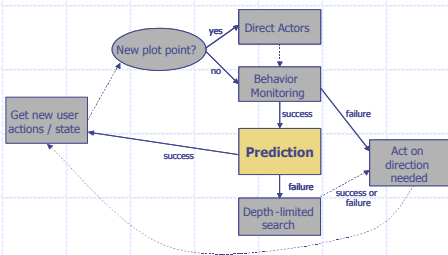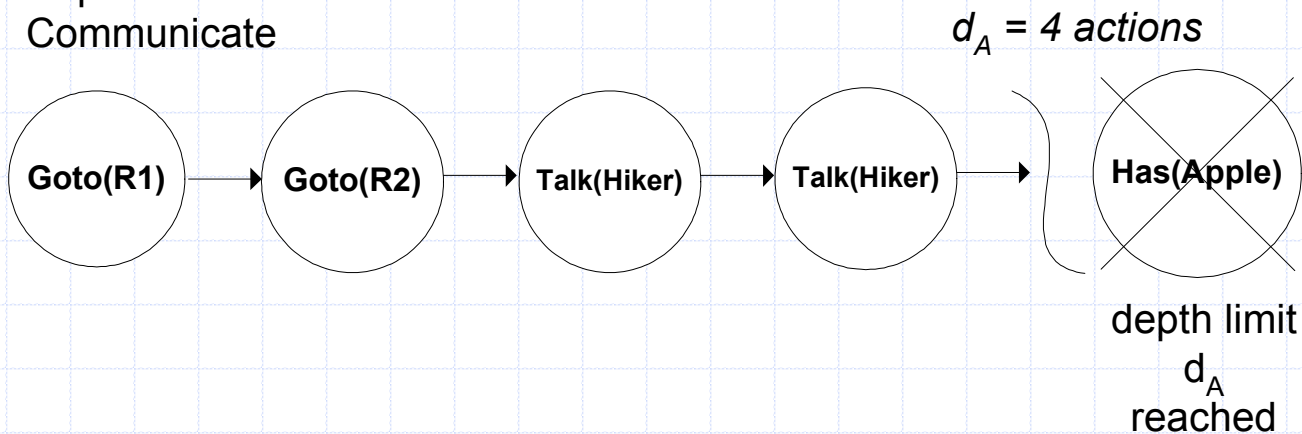
◆ Bayesian Prediction
  - Record user on a MUD (action/state pairs)
  - Build CPT's for predicting which quest the user is working on
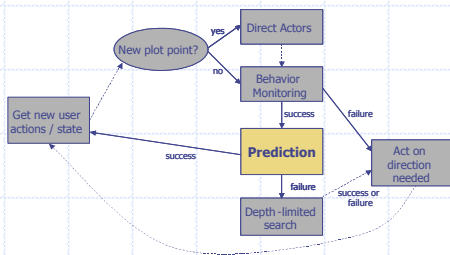
Prediction

◆ Is the User *likely* to reach the next state?

User's predicted Goal:
    Communicate

d_A = 4 actions

(Goto(R1)) → (Goto(R2)) → (Talk(Hiker)) → (Talk(Hiker)) → (Has(Apple)) ✕

depth limit
d_A
reached

Steps in Modeling

◆ Hand-built model
  ▪ Rule-based model of user behavior
  ▪ If this works, a *good* model will
◆ What if it doesn't work?
  ▪ Classify User & select from multiple models
  ▪ Incorporate individualized learning / adaptation
◆ If this *does* work, this project has succeeded

*A "working model" is defined by our evaluation criteria, discussed at the end*

Search

- Depth limited by temporal constraints
- Takes advantage of small scene size
- Searches through possible User actions
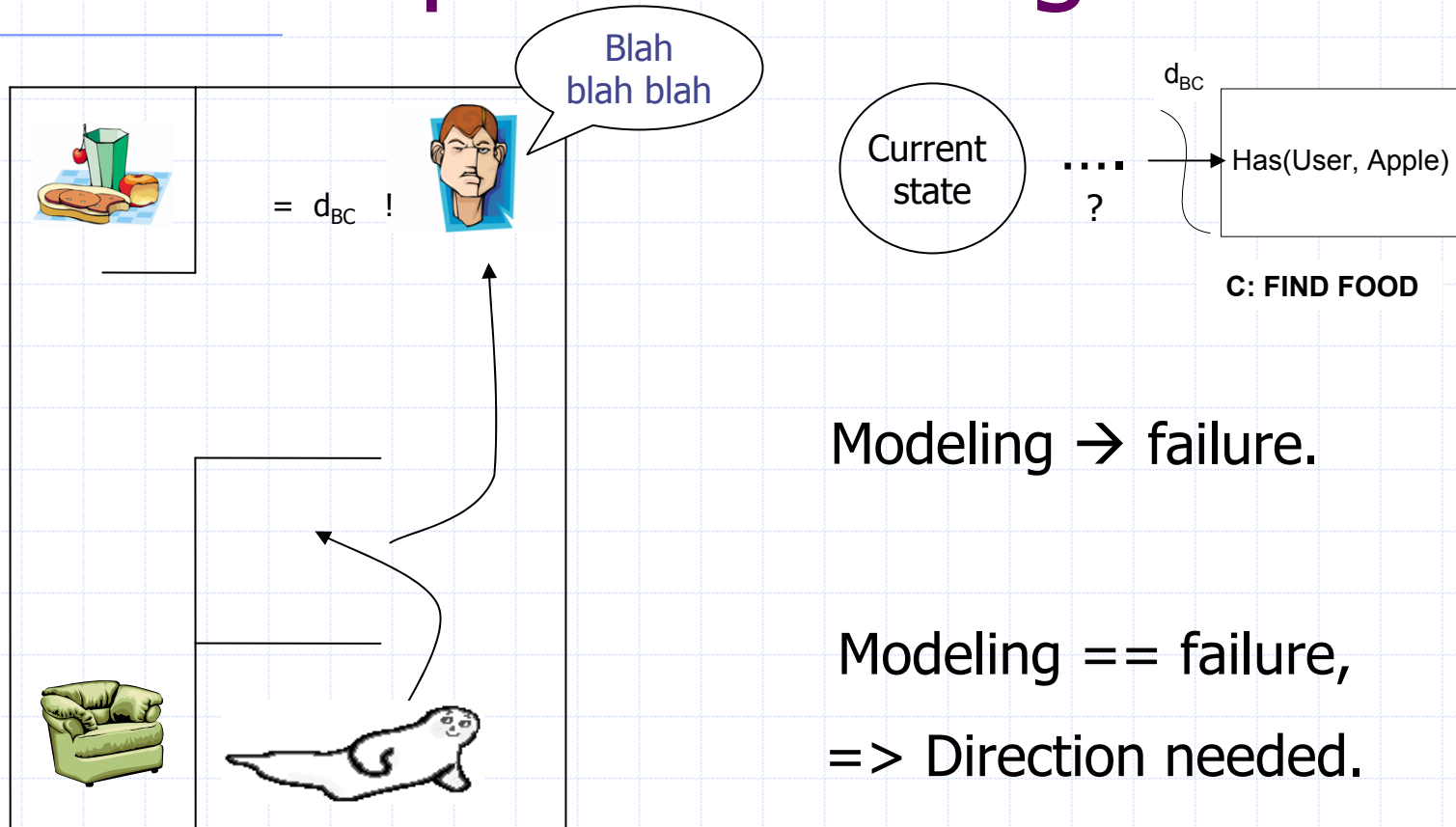- Open question how to include Actor actions
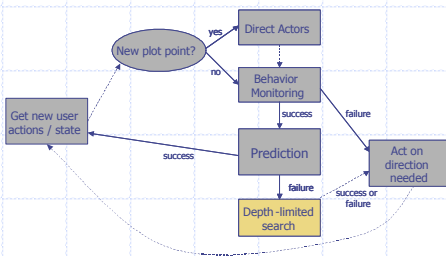
Example of Simple Direction

- User *may* get the food, but it's unlikely
- State C: *Has(User, Apple)* is annotated with Direction action(s)
- Examples:
  - Hiker.speak("I am hungry.")
  - Kitchen.noise(crash)
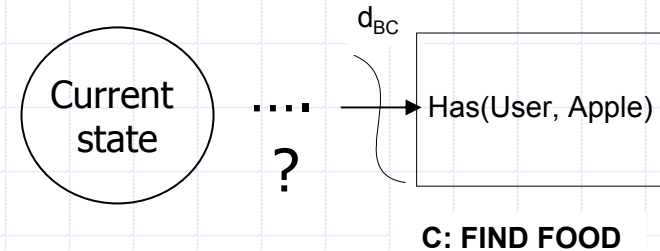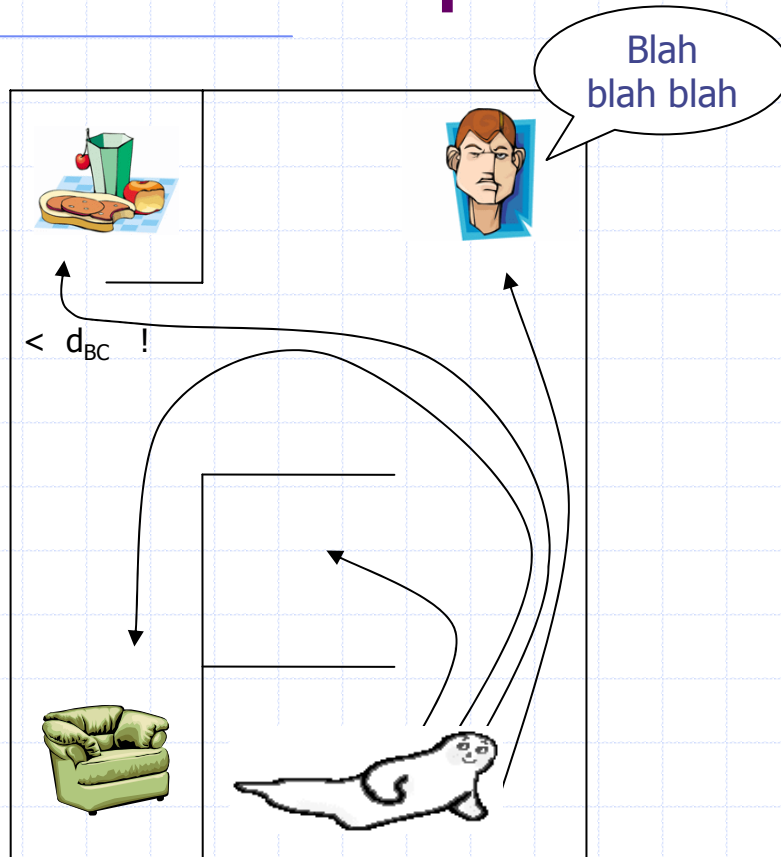 - Kitchen.light(off)
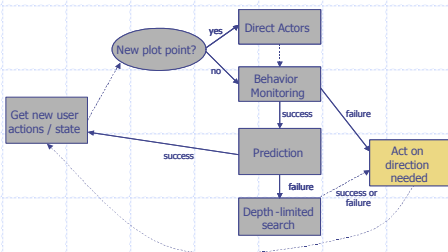
An Example: Modeling

Modeling → failure.

Modeling == failure,

=> Direction needed.

Conduct search,
then direct.

An Example: Search
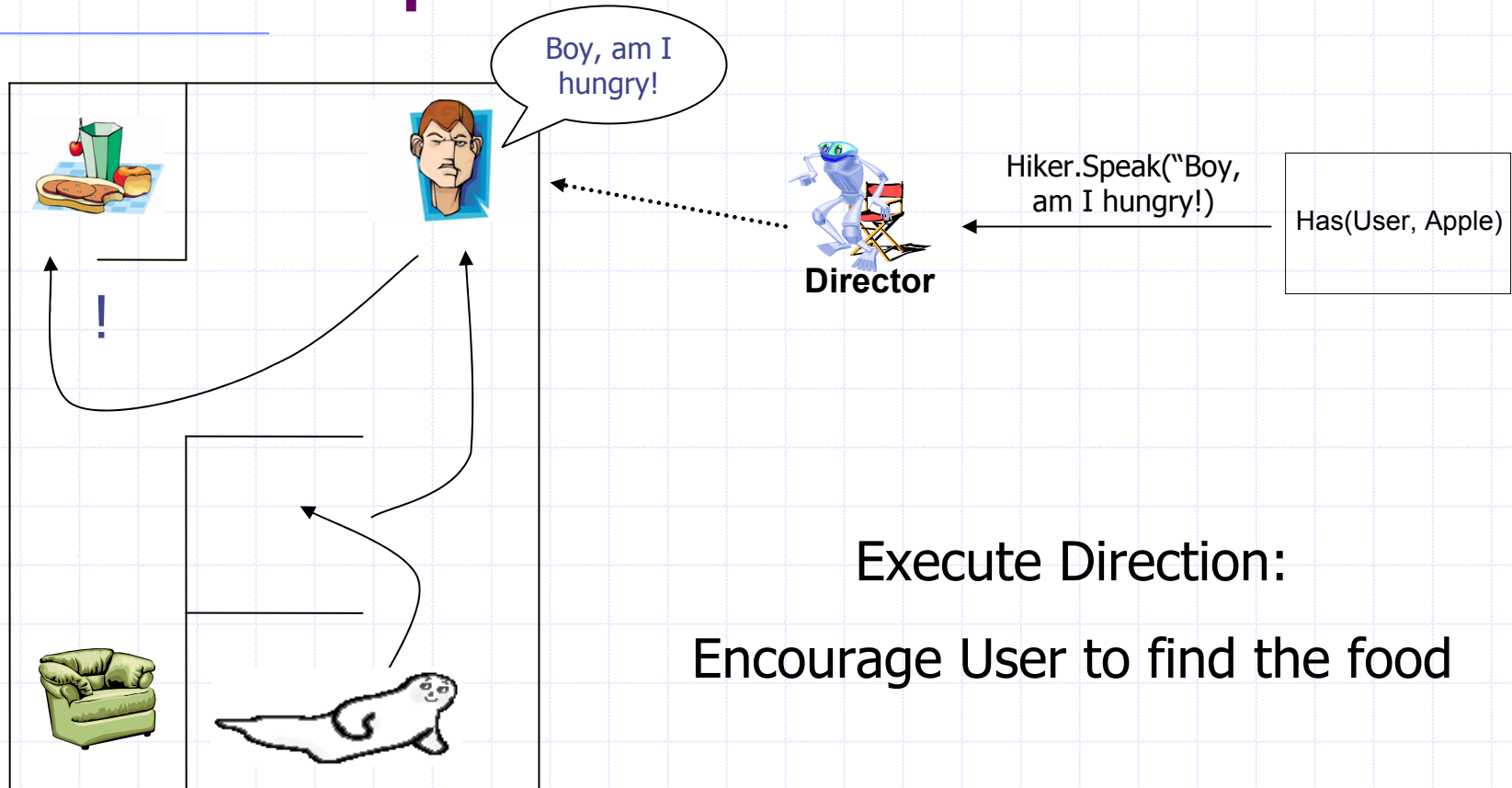

Search → success

Search == success,

Model == failure =>

Execute Direction

An Example: Direction

Evaluation

- Experimentally compare system with / without search & prediction
  - How often are temporal constraints violated in each group?
  - Compare number of errors Users *commit* in each group
  - Compare user experiences via questionnaire?
- Examine model robustness
  - Begin with user model as the User
  - Make systematic changes to Soar agent playing game
  - Very useful in iterative design of system and model
- When am I done?
  - Successful integration and evaluation of user model in an interactive drama

Evaluation

◆ Examine model robustness
- Begin with user model as the User
- Make systematic changes to Soar agent playing game
- Each iteration, ask "How is model accuracy affected?"
- Very useful in iterative design of system and model

◆ How difficult is building / incorporating an effective model?
- Man hours & lines of code

◆ When am I done?
- Successful integration and evaluation of user model in an interactive drama

Nuggets

- Laid out means for evaluation of an ID
- Clear path to our goal
- A new interactive drama
  - Meets our requirements
- User modeling in interactive drama
  - A novel application
- Plot modification
  - Accommodates User actions into plot
- Overlapping work with research at ICT

Coal

- A lot of work ahead
  - Creative
  - Technical
- Search algorithm is not complete
- Representation doesn't consider modern views of narrative

Classification of User Behavior

- **Ideal**: following along with the scenario
- **Acceptable**: not negatively affecting the scenario
- **Unacceptable**: irrevocably harming the scenario (clobbering) as it has been written and instantiated (i.e. breaking the vase)

Motivations for Interactive Drama

- Why is interactivity good?
  - Direct connection between user desire and the experience
  - More immersive
- Why interactivity + drama?
  - The User IS the character
  - Attempt to combine best of games & literature
  - Open question as to whether or not is entertaining

Motivation for My Approach

- *More interaction* desired
  - *Choose Your Own Adventure* is not very flexible nor interesting
  - A strong step towards a higher degree of interactivity
- *More plot control* for Writer desired
  - Avoid dynamic generation of plot content
  - Explicit ordering of plot content desired
  - Use different narratives with same environment

Allowing More Interactivity

◆ Recognition

- How to recognize errant behavior?
- How to possibly predict errant behavior?

◆ Action

- How do we reconcile this error with the plot?
- How does the plot keep moving?

Allowing More Interactivity

◆ Recognition

- How to recognize errant behavior?
- How to possibly avoid errant behavior?

◆ Action

- How do we reconcile this error with the plot?
- How does the plot keep moving?

Relevant System Requirements

- Expressivity
  - 5 W's (and an H thrown in for good luck)
- Flexibility
  - Don't constrain the User unnecessarily
  - Categorization of different possible behaviors
    - Distinguish between plot relevant / irrelevant / harmful behavior
- Variability
  - Different behaviors elicit different results
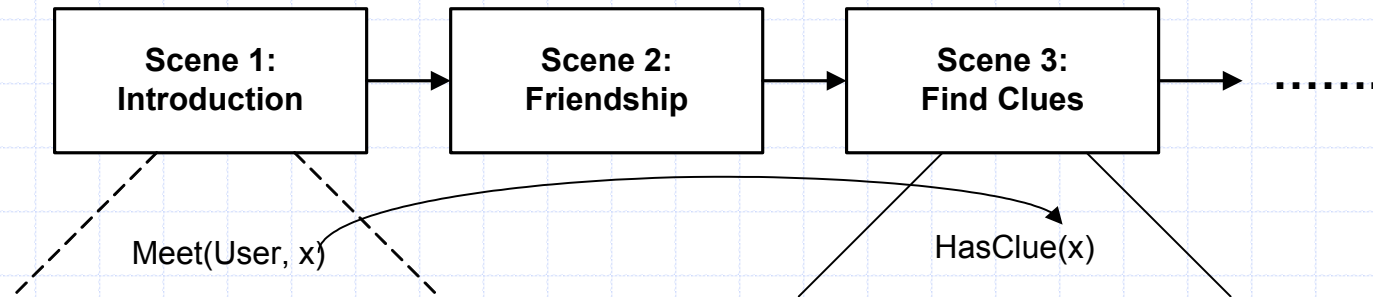- Variety in Degree of Autonomy
  - Strong vs. Weak autonomy

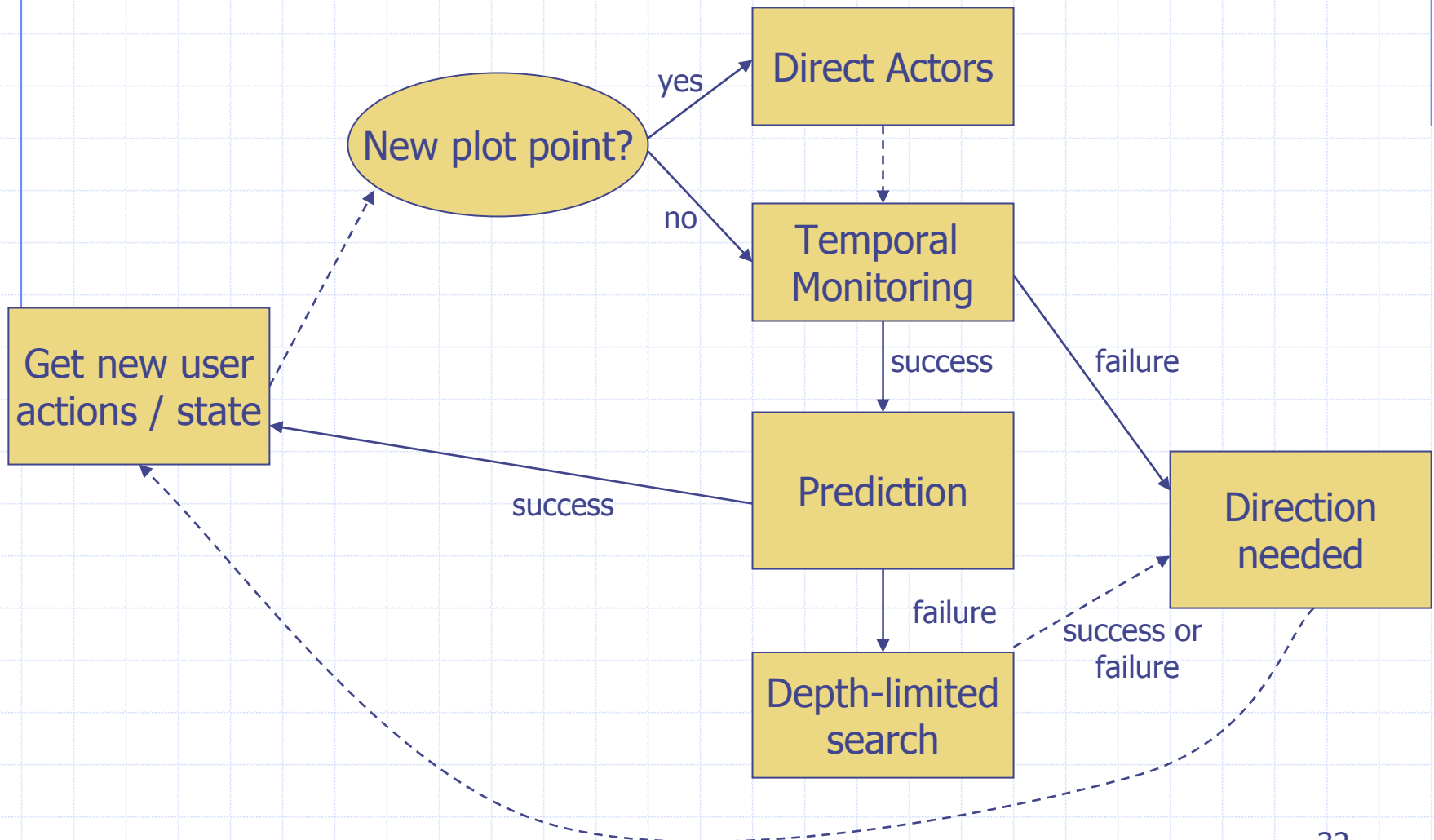# What does the Director **do**?

- **Instantiate plot structure**
  - Fills in missing content as response to User actions

Plot: Scene by Scene

Scene 1: Introduction	Scene 2: Friendship	Scene 3: Find Clues	…….

Meet(User, x)   HasClue(x)

- Linear ordering of scenes
- Global variables may be shared across scenes
- Variables may be instantiated at runtime

Monitoring User Behavior

Conclusion

"*Can a user model be incorporated into an ID to help find a balance between User and Writer desires?*"

◆ Can errant behavior be elegantly avoided via search and user modeling?

◆ Can writer's vision be communicated while the User is still "his own character?"

◆ Can we evaluate the success of this technique?

Influences on Interactive Drama

- Automated Storytelling
  - BRUTUS, TALE-SPIN, UNIVERSE
- Commercial Computer Games
  - Quake, Deus Ex, Bladerunner, The Sims
- Role-playing Games
  - Advanced Dungeons & Dragons
- Intelligent Tutoring Systems
  - Model tracing: monitor progress within problem
  - Knowledge tracing: monitor learning across problems

Previous Research

- **DEFACTO** (Sgorous)
  - Emergent plot
  - Definitions of dramatic concepts
- **MOE** (Oz group)
  - Centralized Director agent
  - Heuristic evaluation of plot development
- **Mimesis** (Liquid Narrative group)
  - Represent story as a plan
  - Counter-plan against possible undesired User actions

Previous Research

- **Façade** (Mateas & Stern)
  - General dramatic story arc
  - "Beat" chosen based on current location in arc and user's interactions
- **"Friends"** (Cavazza, et. al)
  - Characters defined by hierarchical task networks
  - Story emerges as characters try to fulfill personal goals
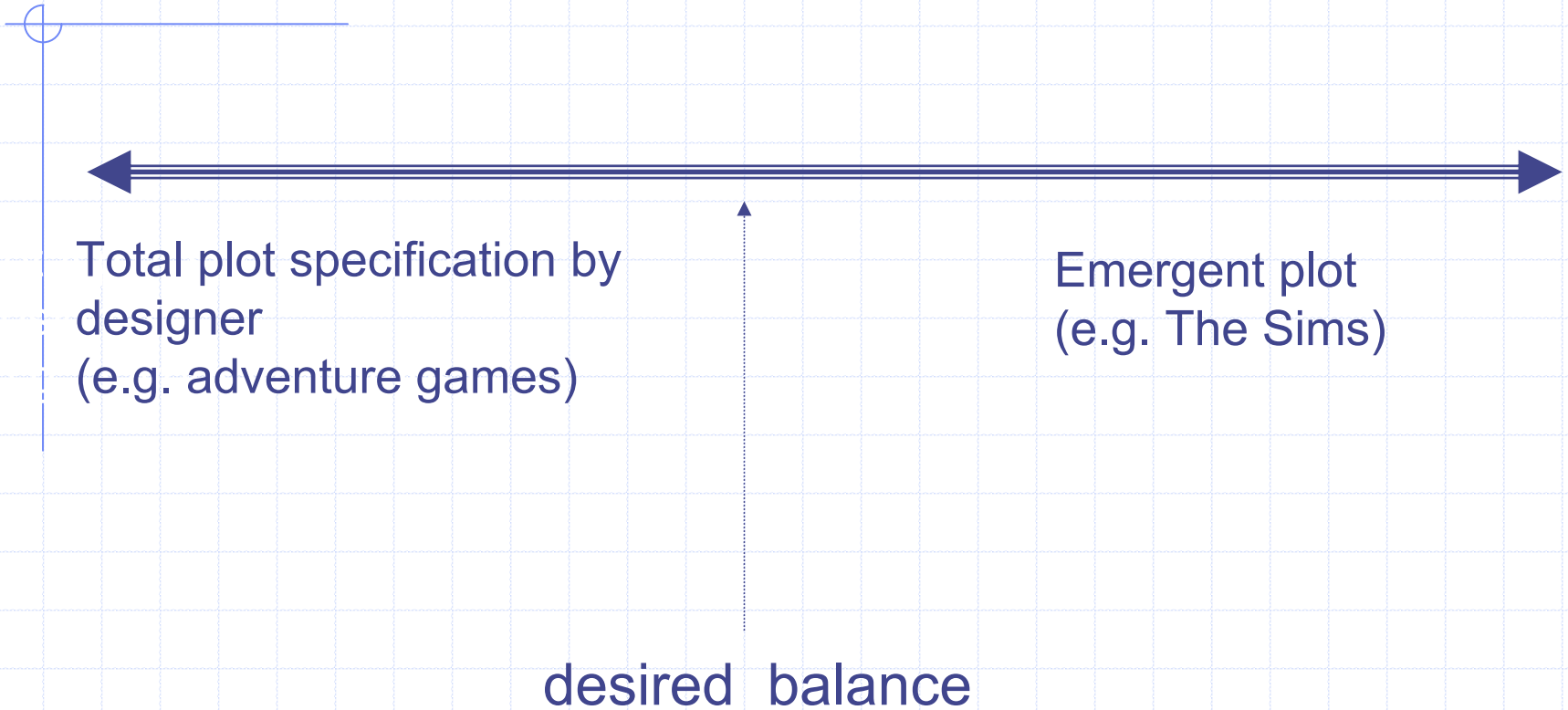 - User can 'meddle' with the world, forcing characters to replan

Interactive drama = oxymoron?

- The User is a *variable character* (the protagonist)
- How can writer control the pace, plot, etc.?
- How can the user feel in control but be "led" through a story?

Systems and Our Requirements

	expressivity	flexibility	variability	varying autonomy	categorize behavior
Façade	➤	➤	➤		
Mimesis	➤			➤	➤
DEFACTO	➤	➤	➤		
MOE	➤		➤ *(temporal)*		
Friends			➤	➤	
IDA	➤	➤	➤	➤	➤

The Balance of Plot Control

Total plot specification by
designer
(e.g. adventure games)
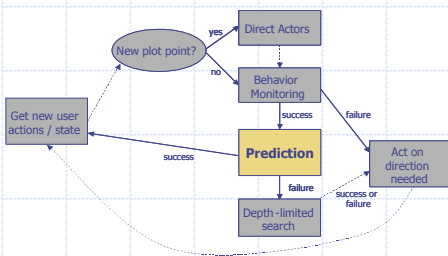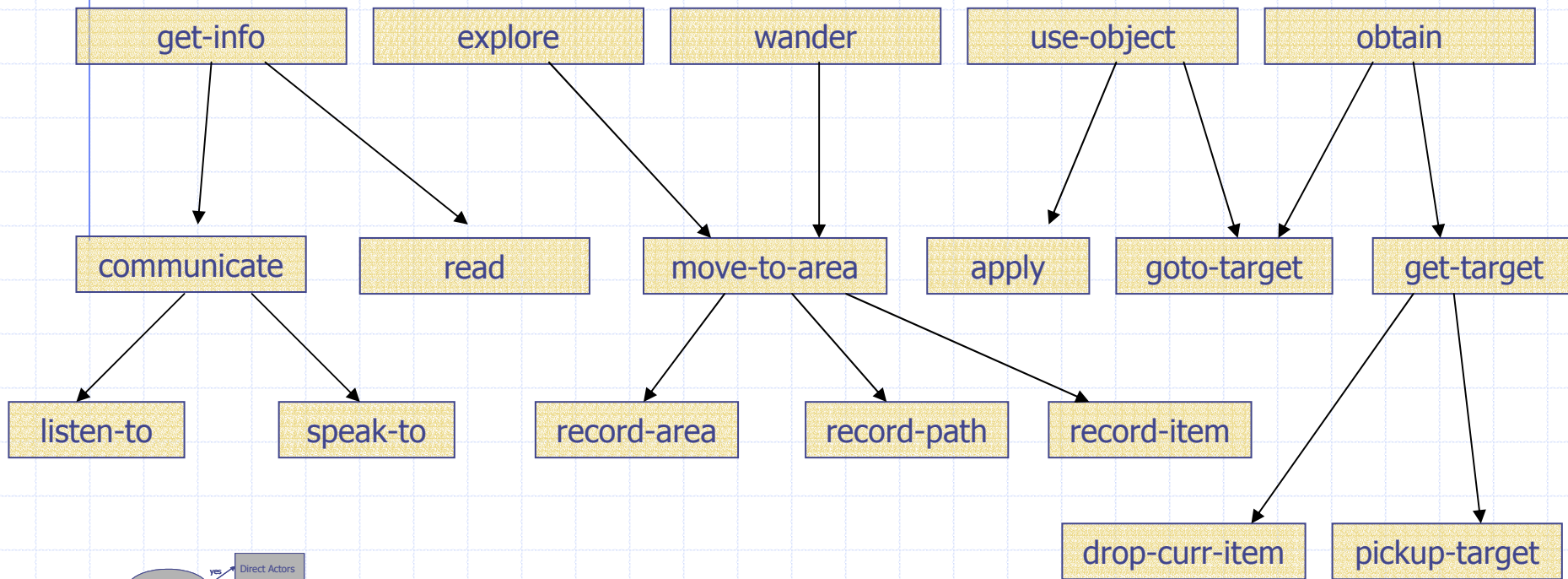
Emergent plot
(e.g. The Sims)

desired balance

World

- Built in UnrealTournament
- 1st person point of view for User
- Socket communication with Soar agents
- "Haunted house" setting
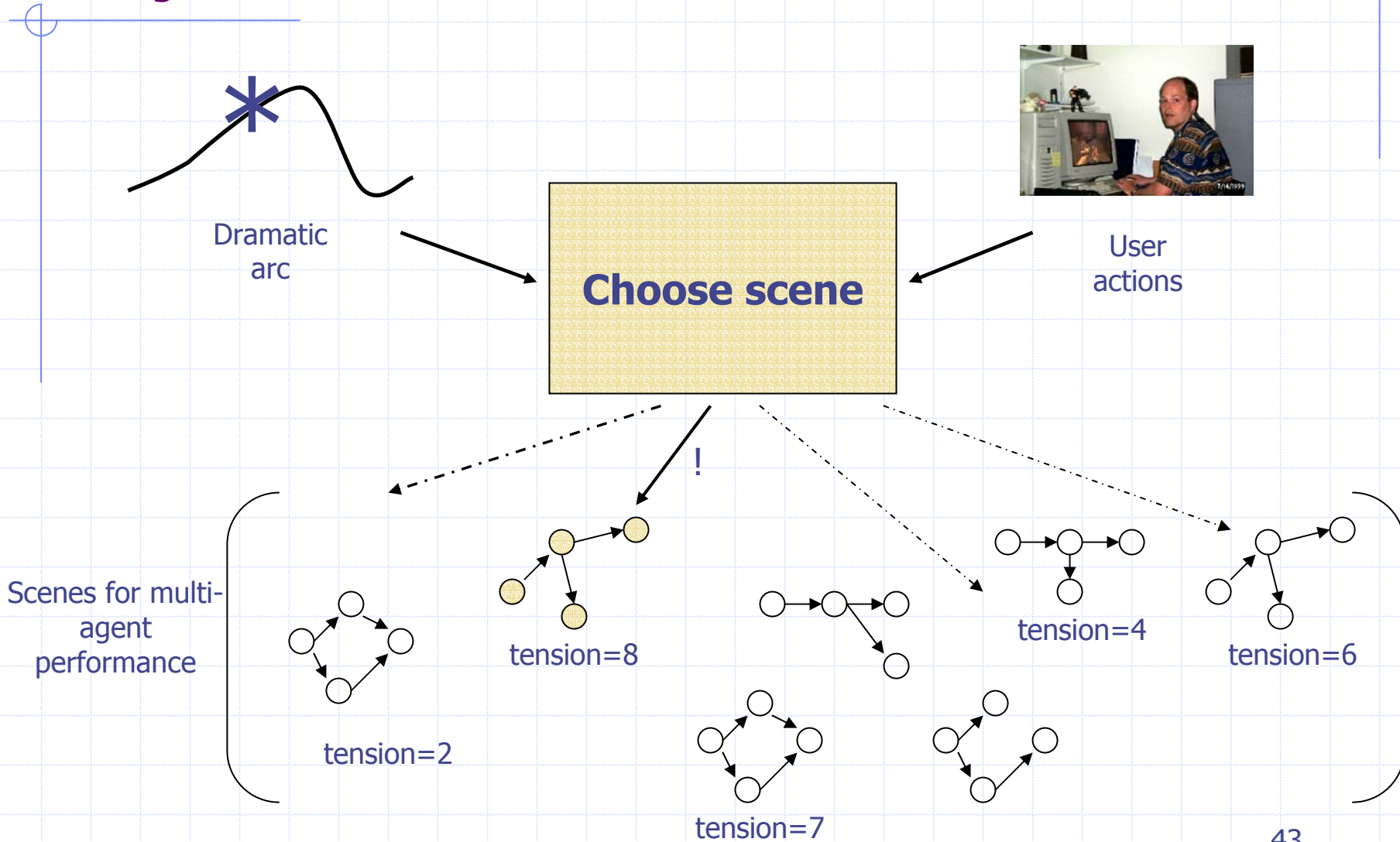- Populated with usable objects and AI actors

AI Actors

- Goal-based behavior
  - Soar agents
  - Basic world knowledge (navigation, item use, communication)
- Individualized personality
  - Emotion modeling
  - Physiology
- Directable
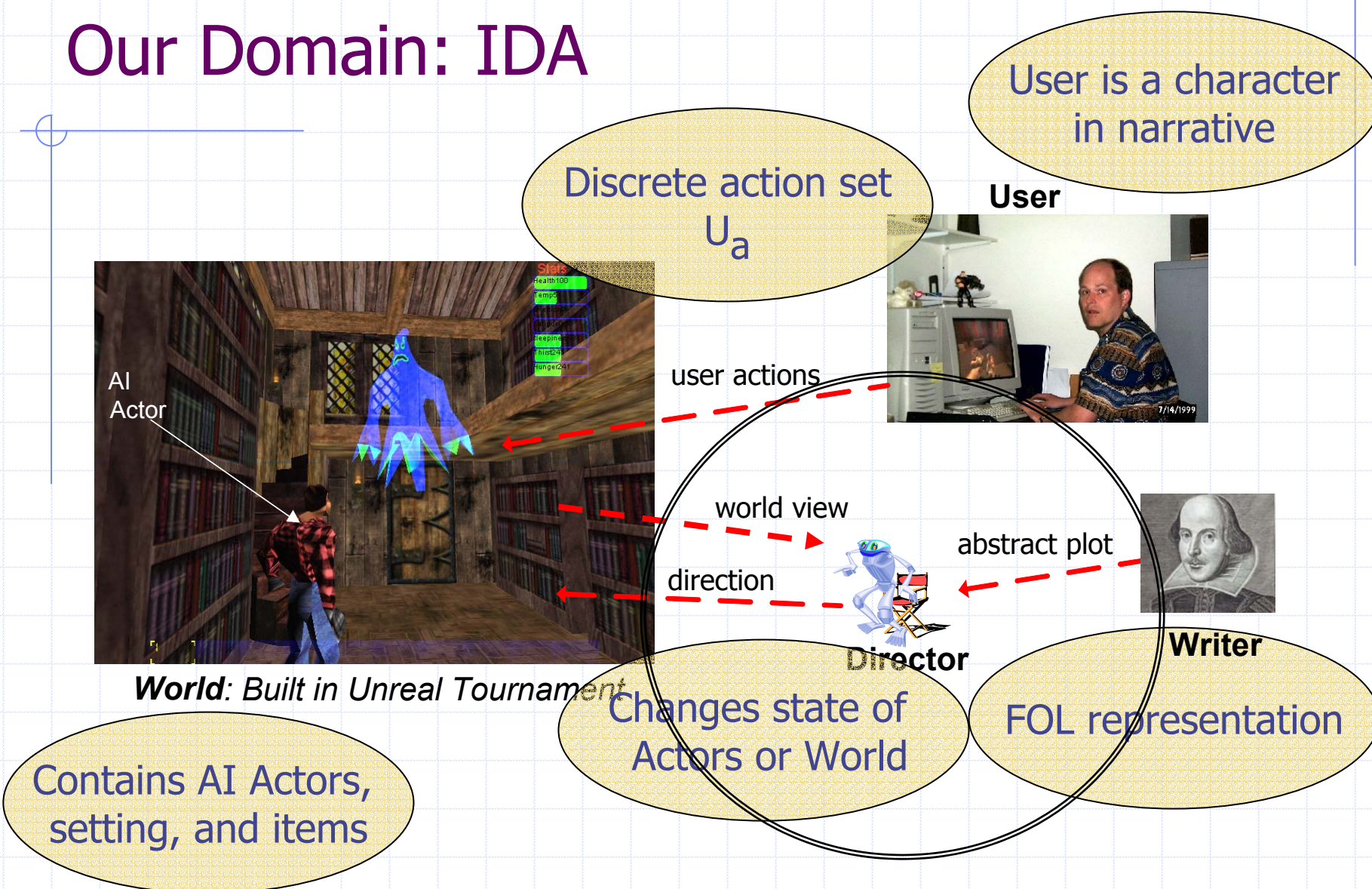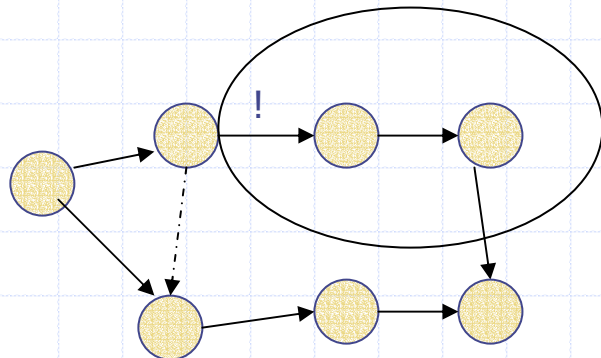
Example User Model in Haunt

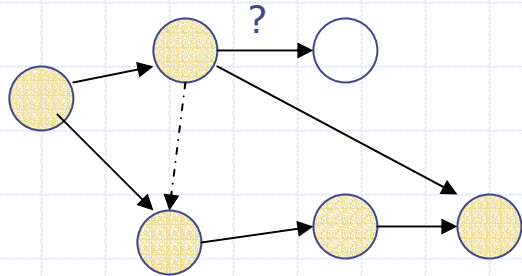get-info   explore   wander   use-object   obtain

communicate   read   move-to-area   apply   goto-target   get-target

listen-to   speak-to   record-area   record-path   record-item

drop-curr-item   pickup-target

Façade

Dramatic arc

Choose scene

User actions

!

Scenes for multi-agent performance

tension=8

tension=4

tension=6

tension=2

tension=7

43

Our Domain: IDA

Discrete action set U_a

User is a character in narrative

User

AI Actor

user actions

world view

abstract plot

direction

Director

Writer

World: Built in Unreal Tournament

Changes state of Actors or World

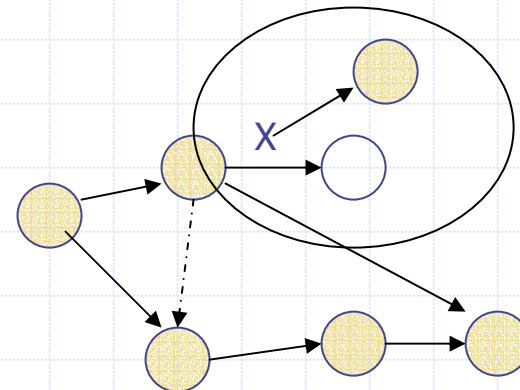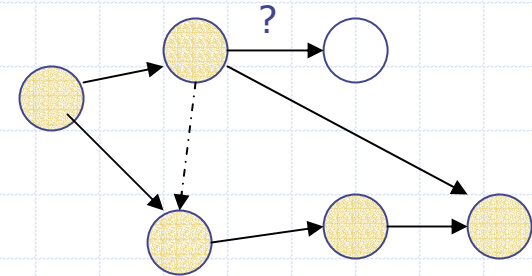FOL representation

Contains AI Actors, setting, and items

Mimesis

Accommodation: user action incorporated into plot structure

Intervention: user action forbidden

Primitive Examples

- *Choose Your Own Adventure*
  - Pre-written story
  - Character's actions determine what happens
  - Explicit, narrow choices for User
- Computer Adventure Games
  - Advent, Zork, Gabriel Knight 2, Bladerunner
  - User "figures out" what he should do next
  - Plot is embedded to the structure of game
- *You* are the character
- *Your actions* determine how the story evolves

Describing Story: Content & Structure

- Content
  - "What happens" in the story
  - Beats
    - Atomic dramatic element of action
    - e.g. "Luke, I am your father."
- Structure
  - "When things happen" in the story
  - Temporal ordering of content
  - Dramatic structure

Contributions

- A new interactive drama
  - Meets our requirements
- Means of evaluating an ID
- Director agent
  - Fulfills roles
- User modeling in interactive drama
  - A novel application
- Plot modification
  - Accommodates User actions into plot

Current work

- Finish Director prototype
  - *Summer 03*
  - Soar
  - UnrealTournament
- Build a more complete user model and experiment
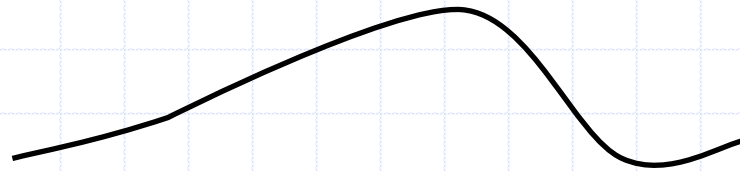 - *Fall 03 / Winter 04*
  - Experiment and evaluate

Future Work

- Continue to work on Haunt 2 with Soar Games group
  - *Summer / Fall 03*
  - characters, story, environment development
- Improve approach to search
  - *Fall 03*
- Evaluate model & system
  - *Fall 03 / Summer 04*

What is "Interactive Drama?"

◆ Drama
  ■ Traditional Aristotelian view:
    Setup → Confrontation → Resolution

Dramatic arc

◆ "Interactive" = ??

  ■ Human user's decisions influence the outcome of his experience through his actions

◆ *You* are the character

◆ *Your actions* determine how the story evolves