Pedagogical agents

Special purpose interactive virtual agents

What is a pedagogical agent

- Lifelike animated character (virtual agent) aimed at facilitating the learning process.
- Also called: *tutor agent*
- *Characteristics (IAIAA):*
  - *Interactive*
  - *Animated*
  - *Intelligent*
  - *Affective*
  - *Autonomous*

What is it supposed to do?

- Enhance the learning process
  - Experience
    - More pleasant learning experience
  - Outcome
    - Better knowledge transfer

Interlude: *virtual agents*

What is a virtual agent?

- "a simulated embodied agent"
  - Simulated: not directly interacting with the real world (it's sensors and actuators are connected to a simulated world)
  - Embodied: has a body used for interaction with the environment
    - Here, the weak sense: *has a bodily representation*
  - Agent: an autonomous entity responsible for it's own behavior
    - (classically: having goals, intentions etc…)
- "an autonomous entity responsible for its own behavior with a body used for interaction with a simulated environment"

Types of virtual agents?

- Flavors include:
  - Conversational agents (online help)
  - NPCs (gaming)
  - *Pedagogical (tutor) agents (e-learning systems)*
  - Social Agents (interfacing)
  - Avatars (simulation and training)

Why do we study virtual agents?

- Human Computer Interaction (HCI/CHI)
  - Facilitate human-system interaction
  - Natural mode of interaction
- Realism (believability / immersion / presence)
  - Gaming
  - Training
  - Therapy
- Research
  - Simulated robot prototypes
  - Testing psychological models
  - Study human-machine interaction principles

Why do we study virtual agents?

- Typical questions:
  - Does a body/face/etc… help acceptance of online advice?
  - Do facial expressions enhance the effectiveness of a tutor agent?
  - Do social mechanisms add to the level of realism and as a result more skill transfer in simulation training?
  - Do more realistically rendered NPC add to the level of immersion / feeling of presence?
  - Do humans attribute agency to virtual agents?

How are they build?

- From the inside out:
  - Wire frame → rendered bodies /faces etc..
  - Animations (e.g., short pre-rendered movies)
  - Body dynamics (joints, etc…)
  - Voice (text-to-speech, pre-recorded)
- From the outside in:
  - Event-based (mostly global)
    - Blackboard architecture, event-stack, etc…
  - Sensor based (robot-oriented approaches)
    - Translation and interpretation of situated stimuli

How are they build?

- The inside:
  - Scripting
    - Set of event-triggered scripts for simple reactive behavior
  - Belief Desire Intention
    - Goal-oriented reasoning to generate complex behavior
  - Affective Computing
    - Artificial emotions and emotion recognition for interaction
  - Cognitive Modeling
    - Models based on cognitive psychology to cope with complexity

Back to *pedagogical agents*

Issues in their design

- Roles
  - Expert, motivator, coach
- Believability
  - Character + story
- Pedagogical interaction
  - Explanation & theory, example, experience, feedback, guidance
- Physical form
  - Human, animal, head, complete agent, mobile, etc..
- Adaptation and interaction
  - Detect user (student) cognitive-affective state and adapt learning experience

Roles

	Expert	Motivator	Mentor
Image			
Animation	Limited gestures	Highly expressive	Highly expressive
Voice	Limited intonations	Enthusiastic, higher speed	Calm, engaging
Script	Information	Encouragement	Information & Encouragement
Affect	Low	High	High

Table 1: Agent Roles, by Characteristics

(Baylor & Kim, 2003)

Believability

- Story/Script + interactive & compelling

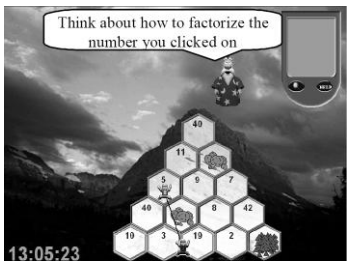
- Character
  - Personality, emotions, self-motivation, change, social relationships, *illusion of life*
- Presentation
  - Appealing, not too distracting
- *Believability is NOT the same as realism*
- A believable character is:
  - one that seems lifelike, whose actions make sense, who allows you to suspend disbelief.

Pedagogical style

- Theory
  - Explain the principles, then let loose
- Example
  - Show it, then repeat
- Feedback
  - Try out, give reward/punishment/explanation
- Guidance
  - Point attention to significant sub-problem
- Cooperation
  - Solve a problem together
- Experience
  - Live through the problem

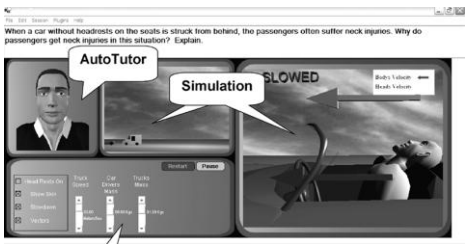
Examples and physical form (1)

- Prime climb, for kids (Conati & Zhao, 2004)



Examples and physical form (2)

- AutoTutor, generic architecture (Graesser et al, 2005)
  - Here: conceptual physics



Mission Rehearsal Exercise (*Gratch & Marsella*)

- *Realism*: study the influence of artificial emotions on
  - **planning** mechanism of virtual characters,
  - **training effect** on **trainees** (emotion might enhance effect)

STEVE and Cosmo (Lester)

- *STEVE* (Rickel & Johnson, 2997) Pedagogical agent to train procedural tasks in a virtual environment.
- Cosmo: explanation of how the internet works (Lester)

Virtual Agent health care training

- Virtual patient training (Kenny et al)

Adaptation and interaction

- Content
  - Difficulty level
  - Knowledge gaps
  - Conceptual errors
- Process
  - Motivation
  - Affective state
  - Flow

Controversies

- What is the additional beneficial effect of an agent?
- How should agents look like (context dependent)?
- How to adapt to the student?
- What is the trade-off between learn-play?
- How to detect appropriate pedagogical style?
- How to detect flow (Csikszentmihalyi)?