Serious Games for K-12 Education

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Intelligent Game-Based Learning

- Narrative-centered learning
  - Actively participate in “story-centric” problem-solving activities
  - Immersed in captivating, highly tailored narratives

- Revolve around
  - Believable characters
  - Compelling virtual worlds
  - Rich stories
Research

- Computational models of game-based learning: *Mixed-initiative* systems facilitating human problem-solving and learning by providing context-sensitive assistance tailored to individual users.

- **Intelligent User Interfaces:** Synthetic agents, user modeling, and affective reasoning

- **Natural Language Processing:** Natural language dialogue, explanation generation, narrative prose generation, natural language understanding
Applications

- Methodology: Design, implement, and empirically evaluate cognitively-grounded educational software and natural language systems
- Stress-testing technologies in different families of applications:
  - Education
  - Training
  - Entertainment
- Lab’s history:
  - Founded 1994
  - Built many intelligent tutoring systems, empirically studied in lab and classroom
  - Built several natural language systems, including a narrative prose generator
Narrative Learning Environment

Captivating intelligent story-centric learning!

Narrative Learning Environment =
Film-quality Story +
Video-game-quality Interaction +
One-on-one-human-tutor-quality Learning

- Unfolding narratives highly tailored to individual learners in inquiry-based problem-solving episodes
- Subject matter tightly integrated with engaging story world
Crystal Island
Crystal Island

- Rich, 3D environment implemented in Valve Software’s Source™ Engine (HalfLife2)
- 8th grade microbiology curriculum
- Science mystery with the student playing the role of detective
Crystal Island Storyworld

1. **Beach / Dock**: Entrance to island and Al’s working area
2. **Field**: Agatha’s working area
3. **Women’s Quarters**: Living Quarters for Agatha, Audrey, Elise, Jin, and Teresa
4. **Men’s Quarters**: Living Quarters for Al, Ford, Quentin, and Robert
5. **Laboratory**: Research lab facilities
6. **Dining Hall**: Camp’s dining facilities – location for Quentin
7. **Restrooms**: Camp’s lavatory facilities
8. **Infirmary**: Camp’s medical facilities – location for Jin
9. **Bryce’s House**: Living quarters for Bryce
Crystal Island Storyworld

Al Schmidt
(Foreman)

Audrey Newsome
(Field Scientist)

Sebastian Patterson
(Financier)

Bryce Reid
(Lead Scientist)

Elise Johnson
(Lab Technician)

Jin Lee
(Nurse)

Quentin Nash
(Cook / Maintenance)

Robert Campbell
(Lab Scientist)

Sebastian Patterson
(Research Scientist)

Teresa Moore
(Lead Scientist)
Narrative-Centered Creativity

- Narrative an ideal laboratory for studying creativity
- Centrality of multiple representations
- Multiple representations in creativity for narrative generation:
  - Uni-modal: Linguistic
  - Multi-modal: Animated stories, spoken character dialogue, narration
Narrative Theatre Creativity Cycle

Narrative Model
- Setting
- Character
- Plot

Narrative Generation
- Camera Planning
- Dialogue Generation
- Action Interpreter
- Character Controller

Narrative Interpretation
- Plot Elements
- Character Behaviors
- World Events
- Narrative Constraints

Narrative Understanding
- Discourse Analysis
- Sentential Analysis

Student

3D Narrative

Written Narrative

Written Narrative
Conclusion

- Intelligent game-based learning can support a broad range of pedagogical activities.

- Fusing game technologies, adaptive reasoning, human language technologies, and rich media interfaces that dynamically adapt to their users provides a solid foundation for next-generation learning.
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