Managing Interactive Experience with Artificial Intelligence

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Outline

- Problem Formulation
- Our work
- Applications
Problem Formulation

Problem
- to develop deeply interactive video games / multimedia training systems

Hypothesis
- if you know something about the **specific** player/trainee
- then you can improve their gaming/training experience

Cannot enclose game master with every game/MOOC
- need **AI**
- for **player-specific** gaming/training
Open-world gaming is the current trend. Yet an emotionally engaging story and character development is desired. Dragon Age: Inquisition. Traditional methods may not work very well due to player's control over the story.

Character foil which involves PC [Yap 2014]

"This is where the inquisition is a great device for us to use," he said. "When you're in the more open-world parts of the game, you're increasing the renown of the inquisition. You're gathering agents. You're encountering small quests that are more traditional to what we do, but your freedom's really high. When you're reaching the point where your inquisition is strong enough to unlock—essentially what you're doing is then the inquisition itself is able to bring you towards the next part of the critical path. The reason why I think this is so powerful is it allows us to have a strong narrative spine in the core of the game. You can explore, you can gather materials and do crafting, and explore the regions and find this lore, but when
Player/trainee in an immersive multimedia environment

his/her experience is managed dynamically/on-line

by an AI manager

models the player/trainee

uses the model to select the next bit of content

to follow authorial constraints

AI-based experience management
1996 - 2000: Intelligent Training Systems

- Training for damage control aboard naval vessels
  - simultaneous crises, uncertainty, stress, teamwork
- Real-life training: rare, expensive and dangerous
- Need immersive multimedia training
- AI for:
  - providing instructional feedback to the trainee
Emotions need to be modelled procedurally
- mapping from actions to emotion states
- appraisal model of emotions
- resource model of emotions

EMA + CAB = CEMA
Now combining CEMA + COR-E
2007 - present: Play-style Modeling

- Model the player’s inclinations
- RPG style
- Select content which is most aligned to with play style
- PaSSAGE
  - shown to increase the player’s fun
Congratulations, students.
Tactician
Fighter
Power Gamer
Method Actor
Storyteller
2011 - present: + AI Planning

- Too expensive to manually specify all narrative branches
- AI planning:
  - domain theory + goals = plans
  - use the play-style model to select the best plan
- PAST results:
  - shown to increase perceived agency

\[ S_t \]
\[ (\text{person red}) \]
\[ (\text{alive red}) \]
\[ (\text{wolf wolf}) \]
\[ (\text{alive wolf}) \]
\[ (\text{hungry wolf}) \]
\[ (\text{knows wolf red}) \]
\[ (\text{knows red wolf}) \]
2012 - present: + Emotion Modeling

- Several accommodations of player’s actions may be generated by the planner
- select the one to keep the player on an emotion trajectory
- PACE
- iGiselle
iGiselle

end of ballet class → go to a party

socializing with friends

confronting a rival

player → PACE

narrative progression
iGiselle

- End of ballet class
- Confronting a rival
- Socializing with friends

Player's hope vs. narrative progression
iGiselle

University of Alberta created video game focuses on Romantic ballet Giselle

The University of Alberta protostars are now on piano in creating one of the first video games around ballet.

Using different physical movements to guide the character and no game controller, Giselle will allow gamers to control the ending of the Romantic ballet Giselle.

The original ballet performance features the death of the main character, but "enemies" in the video game want to change that by allowing users to alter the story ending in the original version.
Several accommodations of player’s actions may be generated by the planner. Select the one to keep the player in **flow**.

- Clearly defined goals
- Immediate feedback
- **Skills match challenges**

**Primary source of enjoyment/happiness**
Past Work

- Flow in a Reinforcement Learning framework (Bulitko & Brown 2012)
  - simple value iteration
  - additional reward signal: the “flow reward”
    - flow = 1 / | ability - complexity |
  - complexity of the subtask is given to the agent
  - positive results
    - appropriate ring selected
  - limited to RL
Current Work

- Flow as an objective function for meta control
- State space partitioned into levels
- Flow-maximizing meta policy selects the right level
- Ground-level policy controls the agent within its current level

\[ S = \bigcup_{i=0}^{n} L_i \]

**Algorithm 1: Agent Operation**

```plaintext
input : MDP (S, A, p), start state s₀, control policy π, meta-control policy \( \tilde{\pi} \)
output: trajectory \((s₀, s₂, \ldots, sₜ), sₜ \in \{s^\dagger\} \cup L_n\)
1  \( t \leftarrow 0 \)
2  while \( s_t \notin \{s^\dagger\} \cup L_n \) do
3    \( s' \leftarrow \pi(s_t), p \)
4    \( s_{t+1} \leftarrow \pi(s'), p \)
5    \( t \leftarrow t + 1 \)
```
Illustration of the Task

- **Angband**
  - a text-based dungeon crawler
  - dungeons (levels) become progressively tougher
  - watch to reach the max dungeon
    - as quickly as possible

- An AI policy exists
  - can be de-coupled from dungeon advance

- **Dexterity**
- **Hit points**
- **Armor class**
Maximizing Flow: Angband

You see a Rock lizard (unhurt), 0 N, 3 E.
Dwarf
Rookie
Warrior
LEVEL 1
NXT 11
AU 84
| ~(STR: 18/49
INT: 5
WIS: 18
DEX: 18
CON: 14
CHR: 6
Cur AC 10
HP 29/29

Target level
Average lifetime return
Flow-maximizing Experience Management

- End of ballet class
- Go to a party
- Socializing with friends
- Confronting a rival
- Player
- Manager

Narrative progression
Flow-maximizing Experience Management

narrative progression

player's flow

end of ballet class

socializing with friends

confronting a rival
Application #1: Video Games

- **On-line**: dynamic storytelling to keep the player on an emotion curve
- **Off-line**: aiding the story designer in exploring the story space
- **Procedurally emotional NPCs**
NPC Emotions in Video Games
Application #2: Intelligent Training

- Build the training scenario on-the-fly
- to keep the trainee on a certain emotion/stress curve

- Emergency room training
- Neonatal intensive care program
  - Vazhkudai “Kumar” Kumaran

Application #3: Online Education

- Massive Open Online Courses (MOOCs)
  - use AI to select the content intelligently, per student
    - model the student’s emotional state (e.g., frustration)
- University of Alberta
  - Jonathan Schaeffer
  - Sean Gouglas
- Stanford University
  - Michael Genesereth
Possible Collaborations

- Emotion modeling
  - based on conservation of resources validation
- Flow modeling
  - validation
  - biometrics
- Use of our interactive storytelling game engines for experiments
Summary

- Improving gaming/training via:
  - AI-based experience management on the fly
  - Player/trainee modelling
    - Play style
    - Emotional state
  - Automated planning

- Applications
  - Video games
  - Medical training
  - MOOCs