From Human Writers to AI Experience Managers
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..."
**Framework**

- 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
2007 - present: Emotion and Culture Modeling

- 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 with play style
- PaSSAGE
  - shown to increase the player’s fun
Congratulations, students.
2011 - present: + Al Planning

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

\[ S_t \]
(person red)
(alive red)
(wolf wolf)
(alive wolf)
(hungry wolf)
(knows wolf red)
(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

player

PACE

socializing with friends

confronting a rival

narrative progression
iGiselle

- end of ballet class
- confronting a rival
- socializing with friends

narrative progression
player's hope
iGiselle

University of Alberta created video game focuses on Romantic ballet Giselle
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**
Past Work

- Flow in a Reinforcement Learning framework (Bulitko & Brown 2012)
  - simple value iteration
  - additional reward signal: the “flow reward”
    - $\text{flow} = \frac{1}{|\text{ability} - \text{complexity}|}$
  - 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 s_0, control policy π, meta-control policy \( \tilde{\pi} \)

output: trajectory \((s_0, s_2, \ldots, s_T), s_T \in \{s^\dagger\} \cup L_n\)

1. \( t \leftarrow 0 \)
2. while \( s_t \notin \{s^\dagger\} \cup L_n \) do
3. \( s' \leftarrow \tilde{\pi}(s_t), p \leftarrow s_t \)
4. \( s_{t+1} \leftarrow \pi(s'), p \leftarrow s' \)
5. \( t \leftarrow t + 1 \)
```

Vadim Bulitko
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

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

You see a Rock lizard (unhurt), 0 N, 3 E.
Dwarf
Rookie
Warrior

LEVEL 1
NXT 11
AU 84

| ~(
STR: 18/40
INT: 5
WIS: 18
DEX: 18
CON: 14
CHR: 6
Cur AC 10
HP 20/29

Target level
Average lifetime return

- regular
- flow (bi-directional)
- random eps=0.5

Vadim Bulitko
Flow-maximizing Experience Management

end of ballet class

player

manager

go to a party

socializing with friends

confronting a rival

narrative progression
Flow-maximizing Experience Management

player's flow vs. narrative progression

- end of ballet class
- confronting a rival
- socializing with friends
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
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
Sabbatical: July 2015 - June 2016

- A lot of expertise in AI-managed storytelling at NCSU

Collaborations:

- interactive storytelling as flow optimization in the player/trainee
- defining cognitive skills and complexity in humans
- validation via biometrics, etc.

- Is keeping the audience in maximum flow for as long as possible all that matters for telling a good (interactive) story?
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

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