Integrating formal qualitative analysis techniques within a procedural narrative generation system

Ben Kybartas
Clark Verbrugge
McGill University
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gr@m - Games Research at McGill
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Goals

- Ensure that each narrative is *playable*
- Every modification should make the narrative *better*
- The game world should allow *better* narratives
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**Introduction**

**ReGEN**

**Game World**

- Alice
- Claire
- Loves
- Hates

**Game Narrative**
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**ReGEN**

**- Initial Rewrite Rules**

Make a narrative

**Game World**

- **Alice**
- **Bob**
  - **Loves** Claire
  - Claire **Hates** Alice

**Game Narrative**

1. **Talk to Claire**
2. **Kill Alice**
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**ReGEN- Secondary Rewrite Rules**

Add narrative “twists”

**Game World**

- Alice
- Bob
- Claire
- Loves
- Hates

**Game Narrative**

- Talk to Claire
- Kill Alice
- Ambushed by Bob
Goal 1

Ensure that each narrative is *playable*

- *Solution: Use formal narrative validation*
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Narrative Validation

Process

Validation

1. Generate \textit{Pre}, \textit{Post} and \textit{Lost Conditions}
2. Compute

\[ \text{out}(e) = \text{post}(e) \cup (\text{out}(\overleftarrow{e}) - \text{lost}(e)) \]

3. Assert

\[ \text{pre}(e) \subseteq \text{out}(\overleftarrow{e}) \]
Effect

- Monitored number of invalid rewrites for each narrative
- Reject any invalid rewrites
- Fluctuation between 0 to 15%
Goal 2

Every modification should make the narrative *better*

- *Solution: Always pick optimal narrative at each iteration*
Structural Narrative Metrics

Example:

- **Length** = 3.5
- **Branches** = 1

- **Length** = Average number of narrative events for all possible paths
- **Branches** = Average number of branching nodes for all possible paths
Evaluated narratives based on structural properties

1. User weights importance of each metric
2. At each rewrite stage, evaluate all possible narratives
3. Pick best narrative rewrite

**Scoring Function**

\[
score(n, m) = \frac{m(n)}{m(\hat{n})} \times w(m) \quad (1)
\]
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### Structural Narrative Metrics

#### Effects

<table>
<thead>
<tr>
<th>Metric</th>
<th>Weight</th>
<th>Normal</th>
<th>MER</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branches</td>
<td>5</td>
<td>0.61</td>
<td>0.78</td>
<td>22%</td>
</tr>
<tr>
<td>Length</td>
<td>4</td>
<td>5.02</td>
<td>5.09</td>
<td>1%</td>
</tr>
</tbody>
</table>

- Pro: MER creates overall measurably better narratives
- Con: Unpredictable, no direct correspondence to weights
Goal 3

The game world should allow better narratives

- Solution: Explore effects of game world construction on narrative quality
Process

- Create three different game worlds:
  - Hand Authored Sparse world
  - Hand Authored Dense World
  - Commercial sized game world from Skyrim
- Average metric results over generation
Inter-Narrative Metrics

- *Richness* - Narratives influenced by player actions
- *Weight of Choices (WoC)* - Effect of choices on final game world
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Construction of Game World

Effects

Effects

Metric Comparison for Different Game Worlds

Metric Values (Normalized to Dense)

- Sparse World
- Dense World
- Skyrim

Path Length
Branches
Richness
WoC
Conclusion

- Used formal methods to create better narratives
  1. Ensured valid narratives using condition analysis
  2. Developed customizable metric enhanced rewriting
  3. Explored effects of game worlds on narrative quality
Future Work

- Validation of narrative metrics
- Effects of rules on quality
- Optimize Richness and WoC for large game worlds
Questions?