"Using BDI to model player behavior in an interactive fiction game" by Jessica Rivera-Villicana, Fabio Zambetta, James Harland, and Marsha Berry discusses automatic generation of story scenarios to imitate the gameplay of a real person. It uses the Belief-Desire-Intention (BDI) model which is based on three key characteristics by which humans interact with the environment. We have decided to implement the Interactive Narrative BDI model that aims to capture human behaviour in general. To demonstrate this idea, we will be using a section of the game *Anchorhead*, which was used in two of the three research papers.

Our intelligent agent aims to predict and produce a model/sequence of actions that would resemble the player's sequence of actions. Important plots of the story, or *plot points*, are captured to develop a directed acyclic graph (DAG). As the player encounters these plot points, certain actions would be triggered that must be relevant to the previous plot points discovered by the player. For example, the model should not try to *open_safe* unless the *get_safe_combo* and *discover_safe* have already been encountered.

Another important aspect is that, during initial gameplay, any real player is unaware of the goal. Hence, exploration should be the primary aspect of the model during this phase. To ensure this, the graph should be developed in such a way that it includes paths open for exploration. Absence of this would make the story short and result in a few number of endings, forced on the model so as to find the optimal path. As the model encounters plot points, its aim should shift toward a specific goal expected by the author. During the exploration phase, if the model is present in state with no direct goal path, then it should explore the map to find objects that were not a priority during the preceding stages. The aim should be to discover plot points that would lead the model towards the goal.

We must ensure the model triggers certain immediate actions after a specific item's discovery. For example, if the model encounters a locked door in the story, it should return to the door as soon as it discovers a key during future sequences of the game. If the key is not present in the inventory and the model discovers the existence of the key, it should follow the path towards the key's location. The model should not follow any other path but the door after it finds the key as that is what a human player would do.

The model should be developed in a way that it picks up all the object it encounters as it may be required during the latter stages of the game. It should interact with the object naturally like a human. For ex: If the model discovers a torch, it should switch it on. The interaction with the torch should be to switch it on instead of unnatural interactions, such as smelling or destroy the torch. To ensure this behavior, acceptable actions on objects should be predefined. For example, [door-> open, close] [key-> lock, unlock] [gun-> fire, look for bullets, load the gun]

These are some behaviors that should be expected from the model to resemble human gameplay. To procedurally generate worlds, the results from the model will be used to develop a more interesting narrative or change certain plot points to include more endings. By predicting

the choices a player will make, we can adjust the plot to different scenarios based on what we believe will maximize the player's experience.

To better illustrate our approach, here are some examples of inputs and possible outputs.

Inputs	Outputs
The player does not interact with NPCs enough. However, they thoroughly explore the room. Executed: x bookcase x chair x rug Not executed: ask about x talk about x	For first time players, the model should encourage exploration. An item that is needed to proceed may be moved from the current room to another room that can only be accessed through talking to an NPC.
The player continuously finds items before understanding their intended function, which the author does not want. For example, they keep finding keys before finding a corresponding locked door.	The model may change key presence to only exist after the corresponding locked door is interacted with.
The user interacts more in certain rooms that denote their plot interest. In the context of *Anchorhead*, the user interacts more in the observatory.	The ending of seeing an evil god approaching through the telescope will be generated by the model instead of the ending about the family's buried secrets.

Collecting user data is both expensive and time-consuming. The sequence of actions provided by the intelligent agent would help the author understand different approaches a real player could take during the game. This could be used to develop a story/generate worlds for a game using Inform 7. The author could launch a beta version of the game that would be incomplete without a specific ending. The author can then analyze different approaches simulated by the system and work on the remainder of the story based on the results. This would help the author to understand multiple viewpoints rather than his/her own perception of the story. Once the game is completed, the author can review multiple results of the intelligent agent and analyze how often different endings are achieved. If the results are poor, the author can tweak some plot points to make the story more engaging in order to arrive to various endings expected by the author.