

Class Project: PEAS Assessment

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Assignment: PEAS Assessment of Problems

Complete a PEAS assessment and implement a model for the environment you have selected for your project. The assessment should also identify the intended search strategy.

PEAS Assessment

Spider Solitaire is a card game that requires strategic planning and decision-making to organize two shuffled decks of four suits of thirteen cards (Ace to King) each into complete sequences. The primary objective is building eight foundation piles, one for each suit, from King to Ace in descending order (King to Ace).

A useful AI agent would analyze the current layout of cards, determine the best moves to make, and optimize the game-play strategy to complete the game efficiently. The optimal result would be to maximize the number of completed sequences while minimizing the number of moves and time taken, all while adhering to the game's rules and constraints regarding card movement.

The Performance Measure:

The performance measure for the Spider Solitaire agent will be calculated based on the following criteria, with the sum of these factors yielding a positive score for a good agent. The best agent will have the highest performance measure. The components of the performance measure are as follows:

- **10 * (number of face-down cards turned face up):** For each initial face-down card that gets turned over, the agent is awarded 10 points.
- **15 * (number of piles that contain zero face-down cards):**
- **2 * (number of cards placed atop the next higher card of the same suit)**
- **50 * (number of completed suits)**
- **2 * (number of completed suits after the first three):** If the game ends with 4 or more completed suits still in the tableau, add 2 points for each suit after the first three.

(Scoring system from Sun Microsystems implementation of Spider Solitaire in 1989) The highest possible score using the Sun Microsystems implementation is 1000 points.

The following penalties are added to the performance measure to focus on more efficient agents.

- **-1 * (number of moves taken)**

I will also consider an additional performance measure multiplier that rewards more points based on the number of unused bank piles. This might incentivize the agents to make drawing from the bank a less desirable action without giving a penalty to the agent.

A move is defined as:

- Placing a card or group of cards
- Drawing from the bank

The Environment is:

- **Observability: Partially observable.** The agent can see the cards currently in play and how many cards are in each pile. It can see the number of banks it has left and the number of suits it has been able to complete. It cannot see the value and suits of cards that are face down in both the bank and the piles.
- **Uncertainty: Semi-Deterministic.** Once the agent makes a move with turned-over cards, the outcome is predictable, but when the agent turns over a card by revealing a card in a pile or pulling from the bank only a probability can be calculated for what that card might be.
- **Duration: Sequential.** Each move affects the state of the game, however, the agent only needs to reassess the best strategy when a new card is revealed.
- **Stability: Static.** The layout of cards remains unchanged until the agent acts, but the agent must adapt its strategy based on the current state of the game and the sequence of available moves.
- **Granularity: Discrete.** The game operates in discrete actions where each move, card draw, and card placement are counted as a separate event. The agent will consider each action distinctly.
- **Participants: Single-agent.** The agent plays independently without other participants. Its decisions are based solely on the current game state and its internal strategies.
- **Knowledge: Known.** The rules of Spider Solitaire are well-defined and the mechanics of card movement, win conditions, and available strategies are understood. The agent will leverage this knowledge to inform its decision-making process, and further details regarding optimal strategies will be documented.

The Actions (Actuators):

- **Pick Up Card (or card group):** The agent can pickup a card or an entire group of cards from a card pile if the cards are in the same suit and are in descending order. Only one card or card group can be held by the agent at a time. If the agent picks up a card group, the group must remain in the same order it was picked up.
- **Place Card (or card group):** The agent can place a card or card group onto a card pile if the bottom-most card in the group is one value less than the topmost card on the selected card pile. If the agent is placing a card group, the entire group must be placed at once in the same order it was picked up.

- **Play Bank Cards:** The agent can deal one card on top of each pile (including empty piles) from the bank. All banks must get one new card in this action due to the rules of Spider Solitaire.

The Percepts (Sensors):

- The current layout of the card piles:
 - This includes the values and suits of all visible cards in each pile and,
 - The turned over (hidden) cards.
- Order and number of cards in the agent's hand.
- Number of completed runs.
- Number of cards left in the bank.
- The move count of the agent.
- The game score (see the performance measure).