Group Project on Blackjack

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Blackjack Rules and General Setup:

- Player bets $B_k(S_{k-1})$ before round k begins;
- Host gives 2 cards to the player and 2 to himself but only shows the 2nd one.
- Player choose to:
  1. Hit (add 1 more card to hand)
  2. Stand (keep current hand).
- Losing Conditions:

  Either: 1. Bust = player's total hand (PTH) succeeds 21

  Or: 2. PTH after choosing stand < Host's total hand ≤ 21 (HTH)
- Draw Condition:

  PTH after choosing stand = HTH.

I. States:

$$S_{kt} = \vec{\delta} \qquad \text{with } \vec{\delta} = \begin{pmatrix} \delta_1 \\ \delta_2 \\ \cdots \\ \delta_{10} \\ \\ \delta_n \end{pmatrix}$$

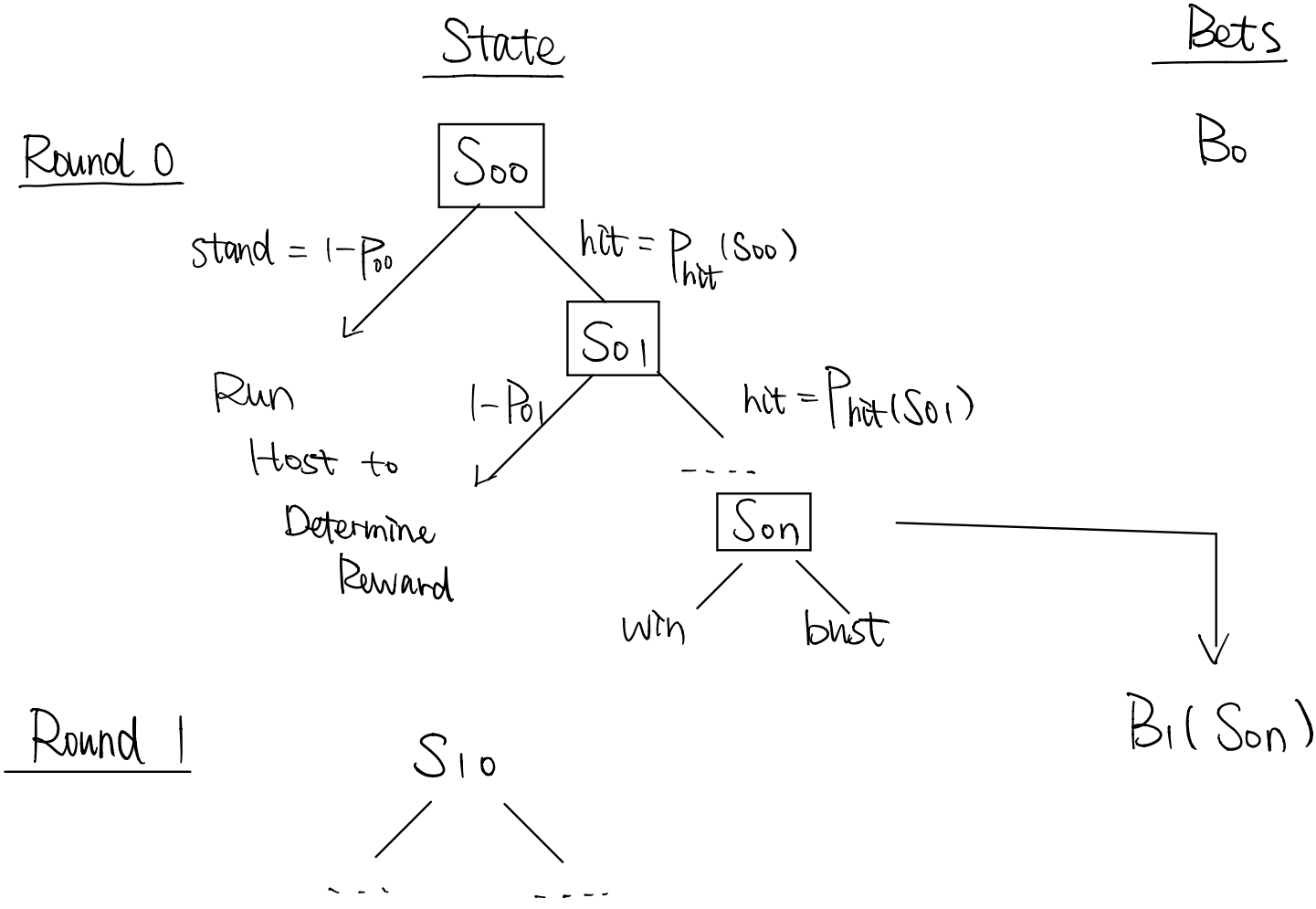
(k: round k, t: step t)

where δ_i is the counting number of player having cards with value i in this k-th round at step t. So,

If player has $\{2, 2, J\}$, then $\begin{bmatrix} \delta_1 \\ \delta_2 \\ \cdots \\ \delta_{10} \end{bmatrix} = 2e_2 + e_{10}$.

And δ_n is the value of host's showing card.

When K's round is over, we bet $B_{k+1} = F(S_{kt\_final})$ and then reset $S_{k+1\,t}$ to count cards in hand in this $k+1$-th round at step t.



II. Policy (Action):

Probability of hitting given state S_{kt} expressed in NN:

$$P_{hit}(S_{kt}) = a(W_t \delta + b_t)$$

III. Reward / Value Function:

With bet = B_k at k-th round, define value function of $S_{kt} = \delta$ to be:

$$V(S_{kt}) = \frac{\sum_{i=1}^{10} S_i}{21} \cdot B_k$$