# COL 870 – Reinforcement Learning

## Assignment 1 – Achieve 31

### State Space

My state representation is of the form:

Where represents the set of possible states, represents number of total usable special cards, represents hard sum of player and represents set of possible dealer cards at start. represents the state in which player busts in the game as described in the problem statement. Now:

1. As the player can have at max 3 special cards each of black cards of 1, 2, 3:
2. We define hard sum as the sum of all cards of the player without considering any card as special. Hence, we add all black cards face values and subtract red cards face values to obtain the hard sum of the player. Now, for a no special cards the hard sum can vary from 0 to 31, otherwise the player would go bust if it exceeds 31 or goes below 0. For 1 special card, the hard sum can range from -10 to 31 as for {-10, … -1} the special card can be used as higher value and for {20, ... 31} can not be used as higher value. Similarly, for 2 and 3 cards the hard sum can vary from -20 to 31 and -30 to 31. Hence, hard sum has overall range:

Note that the states where hard sum is less than the value possible as per the number of special cards are considered as bust state

1. As the dealer can have cards 1 to 10 the dealer hand:

Among these states, the non-actionable states are those in which soft sum i.e. the maximum sum that can be formed by the cards (including the special ones) such that the sum is less than or equal to 31 is 31, or the player is in bust state. This is because when the soft sum is 31 it is obvious that the only reasonable option would be to stick and not hit. If the player sticks it can win or lead to a draw. If it sticks it will always go to bust state. The other case in which every possible combination of cards leads to sum of > 31 or < 0 is also non-actionable as player has lost (or draw match as per special case in the statement) in this state.