Puzzle 6: Cut To Perfection

Included with your puzzle materials is a brand new deck of cards. Your challenge is to order the 52 cards in the deck (remove the Jokers) in a most advantageous way.

Traditionally, before cards are dealt from a deck, they are "cut" by a non-dealing player. This is done by dividing the deck into two sub-decks and placing what was the bottom portion atop what was the top portion. There are 52 possible ways to do this, depending on how many cards are lifted from the top of the original deck (it is allowable to lift 0 cards, meaning that the "cut" leaves the deck as-is).

Imagine that you are the Dealer of a round in a 2-player game of Texas Hold 'em Poker. You have an opportunity to "stack the deck" by ordering the cards however you wish. The other player will be allowed to cut the deck, however, so you want to order the cards in such a way as to maximize your chances of dealing yourself a the winning hand. In other words, stack the deck in a way so that you, as Dealer, will have the winning hand (ties don't count) as many times as possible when each of the 52 possible cut decks is considered. A "perfect" solution to this challenge would give the Dealer a winning hand for each of the 52 possible cut decks (and yes, this is possible to arrange).

When you have your stacked deck ready for scoring, take it to Eric. He will enter your deck arrangement into his laptop and see how many wins the Dealer gets. Your score for this puzzle will be 40 Points for each win (2080 maximum Points if you have stacked the cards such that the Dealer will ALWAYS win regardless of how the deck is cut).

Notes:

Summary of how a 2-player Texas Hold 'em hand is dealt. After the deck is cut, the cards are dealt out. For a 2-player game, the Other player (non-Dealer) will get the first card, the Dealer gets the second card, the Other player the third, and then the Dealer gets the fourth. Each will then have two cards in his hand (these cards are called the players' "pockets"). After that, the next (fifth card) is discarded ("burnt") and then the next three cards (sixth, seventh, eighth) are laid out on the table, the ninth card is burnt, the tenth card is added to the table, the eleventh card is burnt, and the twelfth (final) card is added to the table. So, each player holds his pocket of two cards, and five cards lie face-up on the table. Each player then forms the best possible five-card poker hand using any of his pocket cards and any of the cards on the table (obviously he may not use any of the cards from his opponent's pocket). The player who can form the best possible five-card poker hand wins the round.

Types of Poker Hands. Here is a summary of possible poker hands listed from strongest to weakest (continues to next page):

- **Straight flush:** five cards in sequence in the same suit (Ace may be high or low). Between two straight flushes, the one headed by the highest-ranking card wins.
- **Four of a kind:** any four cards of the same rank. If multiple players have the same four-of-a-kind (all cards coming from the table), then the fifth card may act as a tie-breaker.
- **Full house:** three of a kind and a pair. Between two full houses, the one with the highest ranking triplet set wins.
- **Flush:** any hand of five cards all of the same suit. Between two flushes, the one containing the highest-ranking card wins. If these two cards tie, the next-highest-ranking card decides, and so forth.
- **Straight:** any five cards in sequence but not all of the same suit (if all are the same suit, you have a Straight Flush). Between two straights, the one headed by the highest ranking card wins.
- **Three of a kind:** such as three 6's, with two unmatched cards. Between two hands of three-of-

a-kind, the higher ranking triplet set wins. If there is a tie (because of the table cards), then the unmatched cards are compared.

- **Two pairs:** two cards of any one rank and two cards of any other rank, with an unmatched fifth card in hand. Between two such hands, the one with the higher pair wins. If both hands contain the same high pair, the lower pair is compared. If still tied, the unmatched cards are compared.
- **One pair:** any two cards of the same rank. Between two such hands, the higher pair wins. If tied, then highest extra cards are compared.
- **High card:** five unmatched cards. Compare highest cards (or second highest, etc) for winner.

Note that ties might result when hands are compared, but ties *do not* count as a win for the Dealer in this puzzle. Also, in poker no suit is considered stronger than any other suit, so the suits of cards are never used as tie-breakers.

If any of the details or mechanics of this puzzle are unclear, do not hesitate to ask Eric for more information or examples (I don't want a team to possibly lose points because they don't fully understand how Texas Hold 'em Poker is dealt or played).

This puzzle was inspired by research first done by Ben Joffe in 2009.