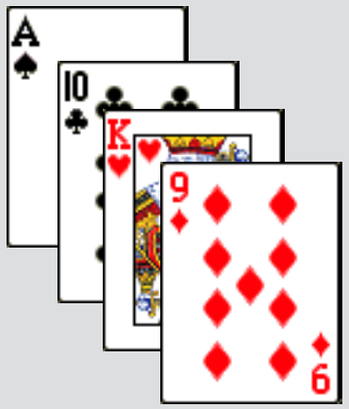
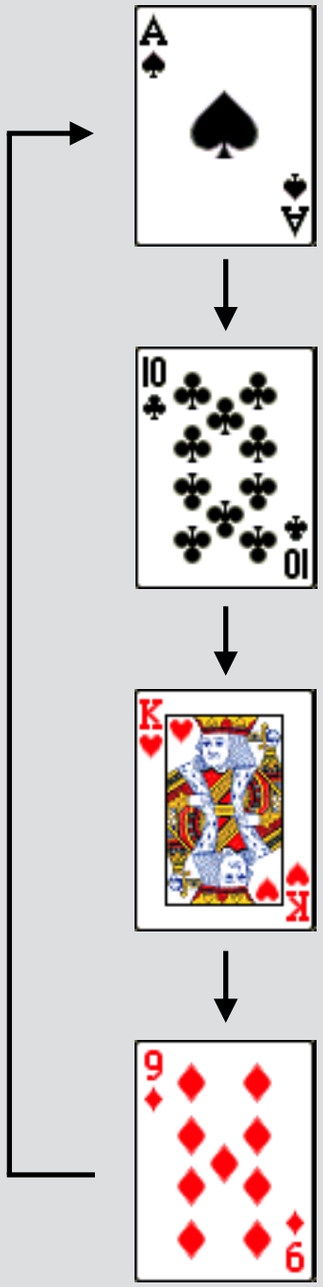
Magical Mathematics!

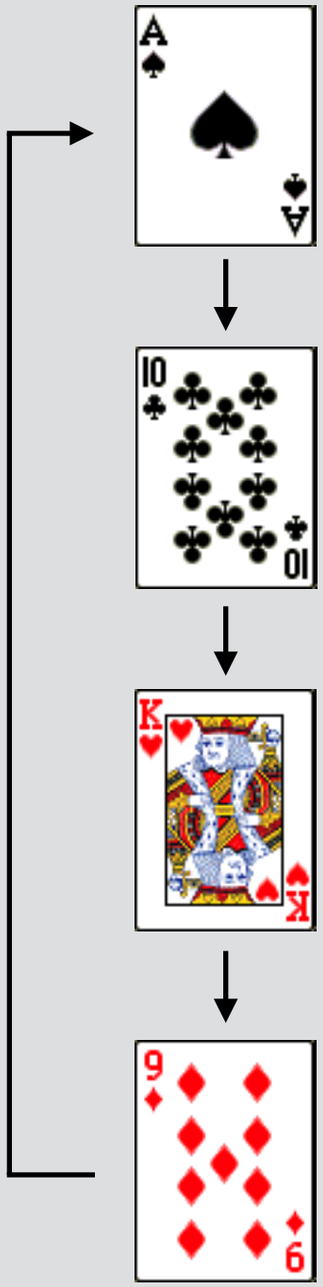
Cutting the deck keeps the order

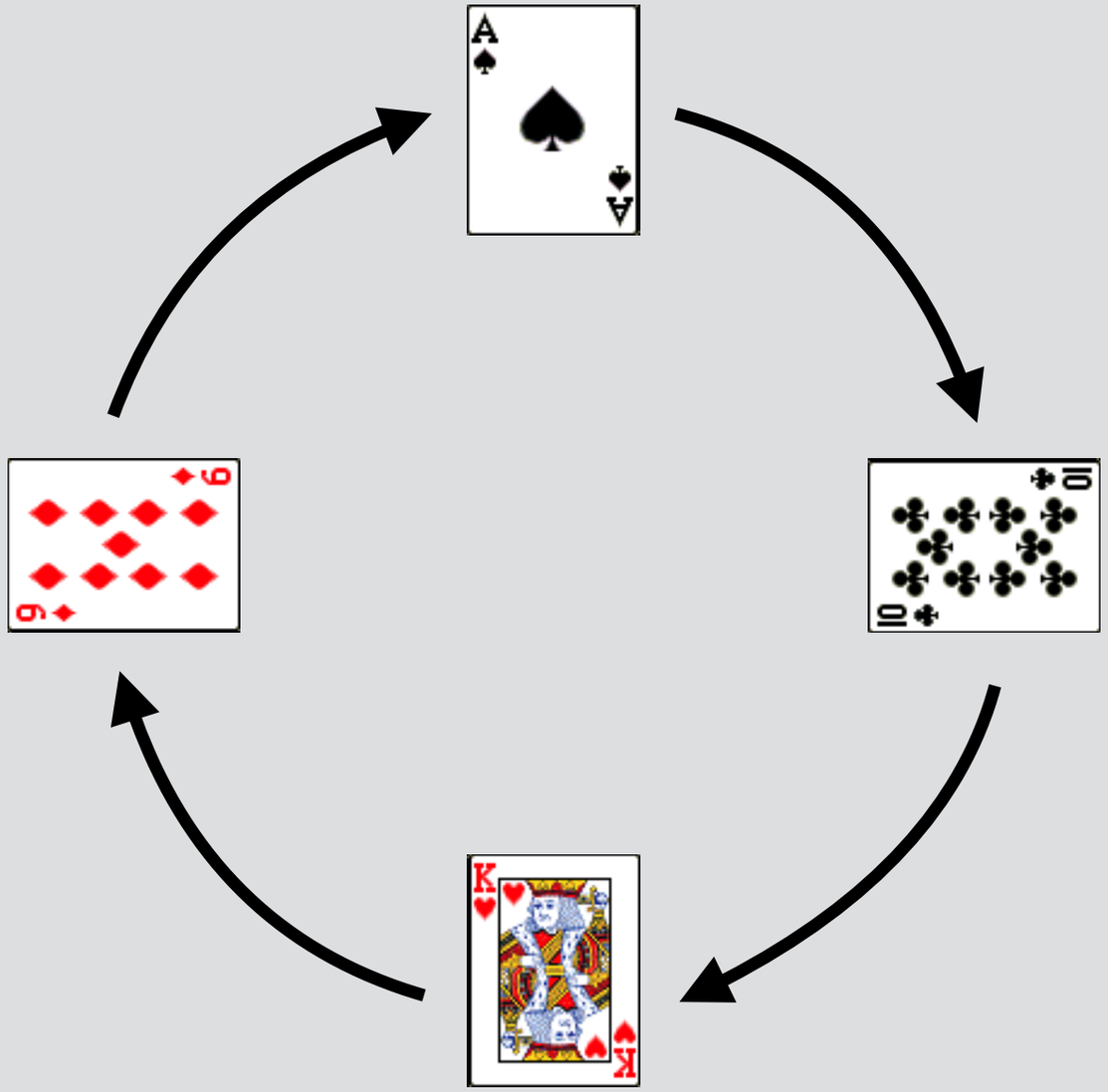


Cutting the deck keeps the order

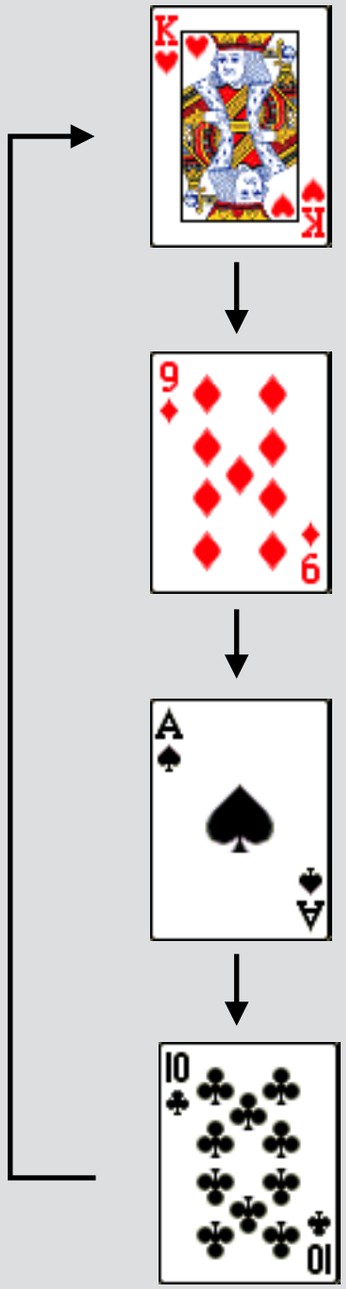


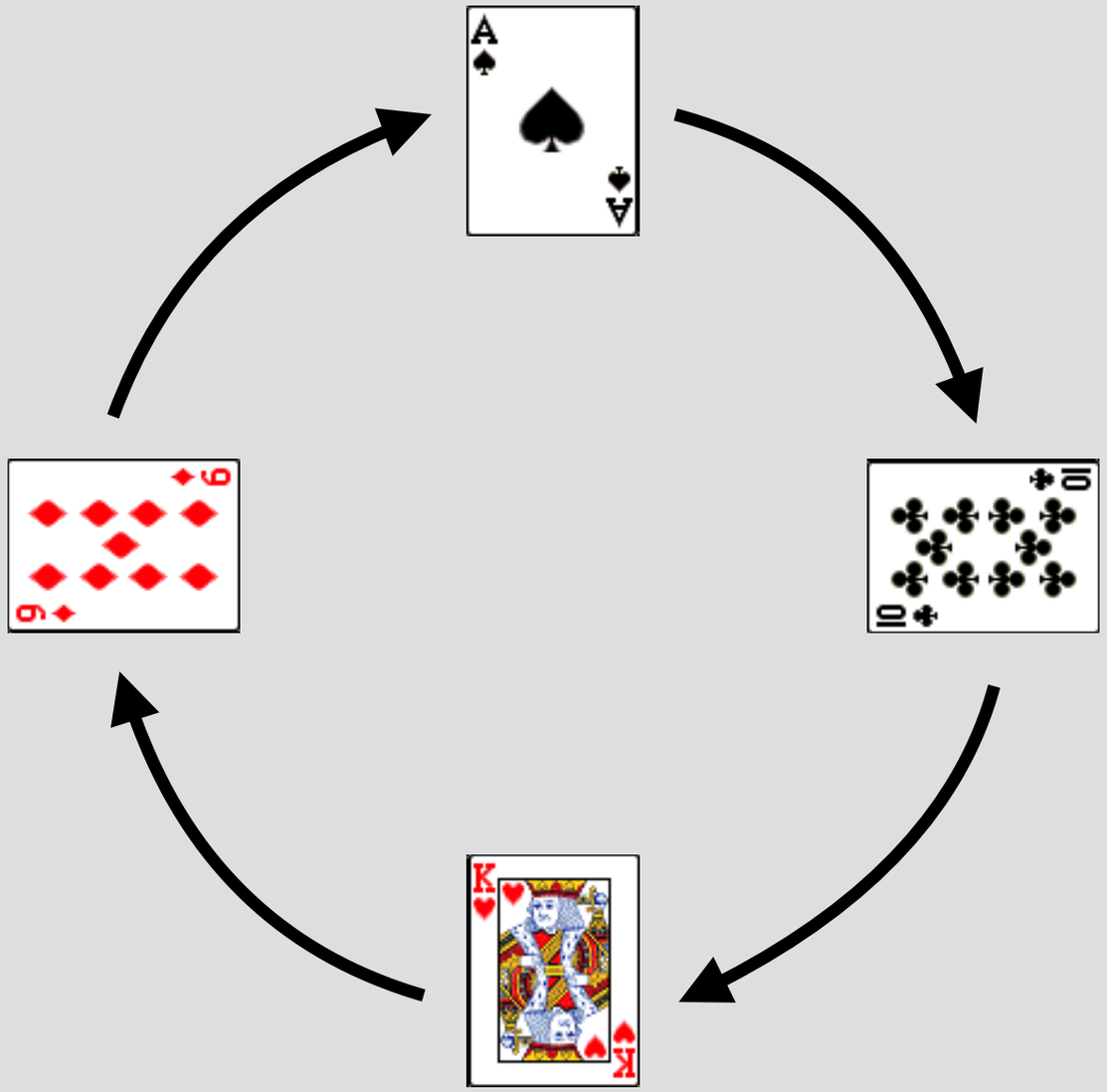
Cutting the deck keeps the order





Cutting the deck keeps the order





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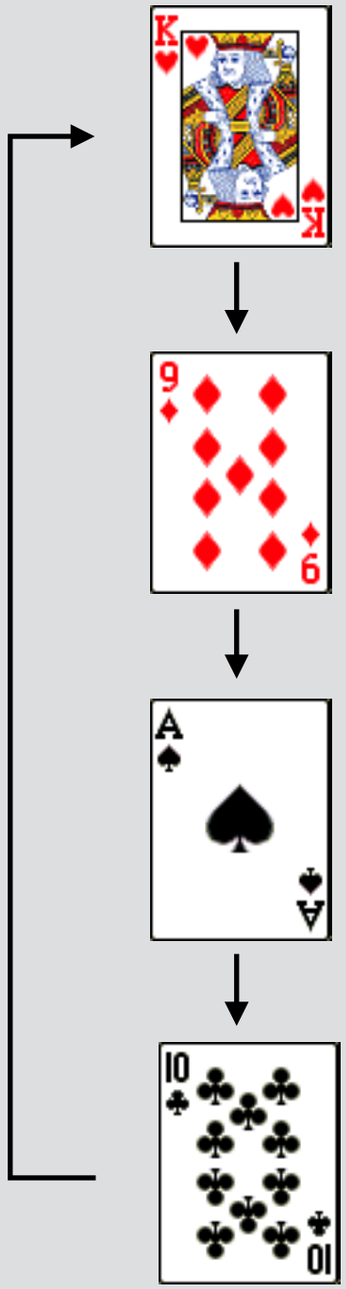
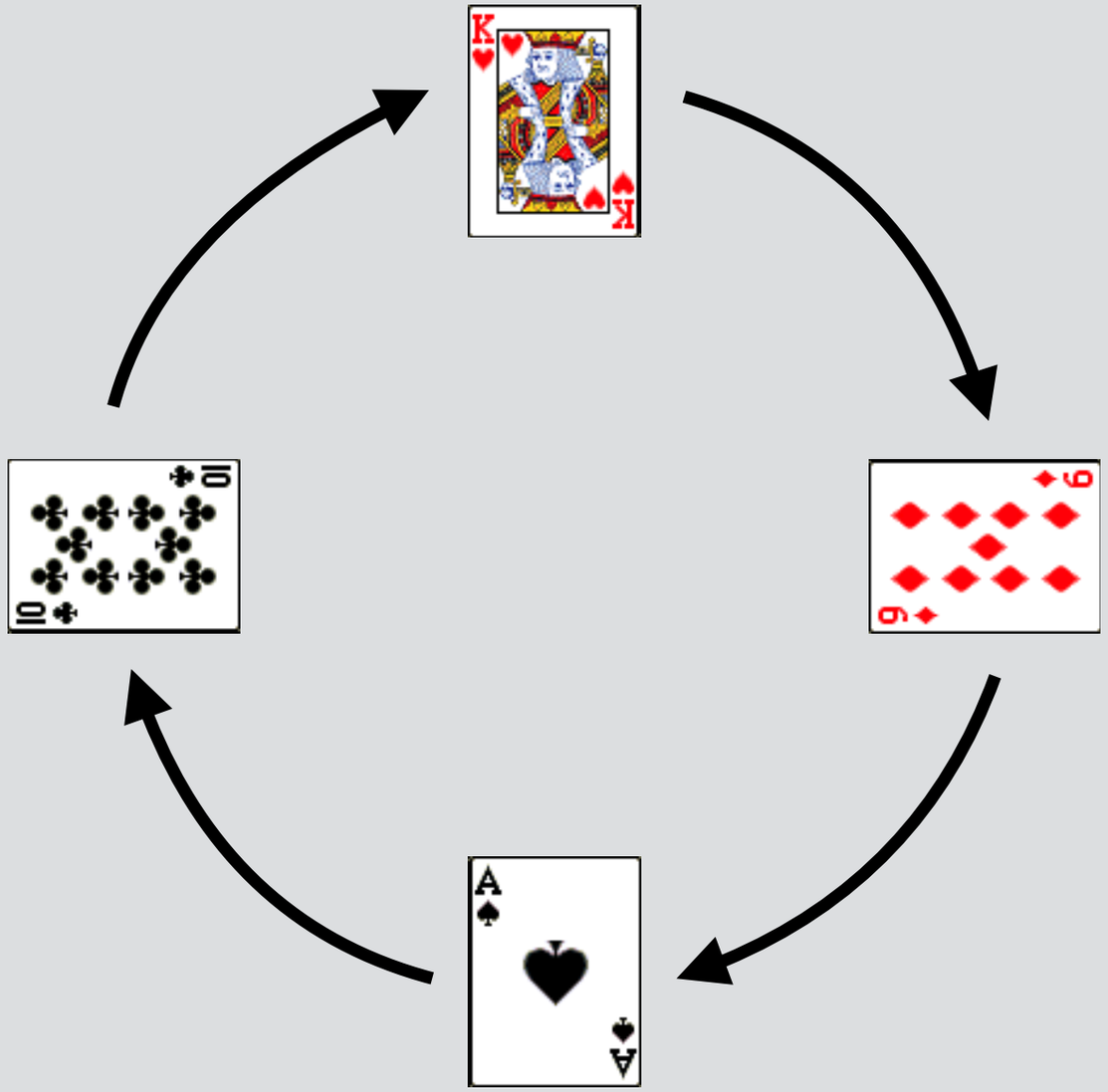
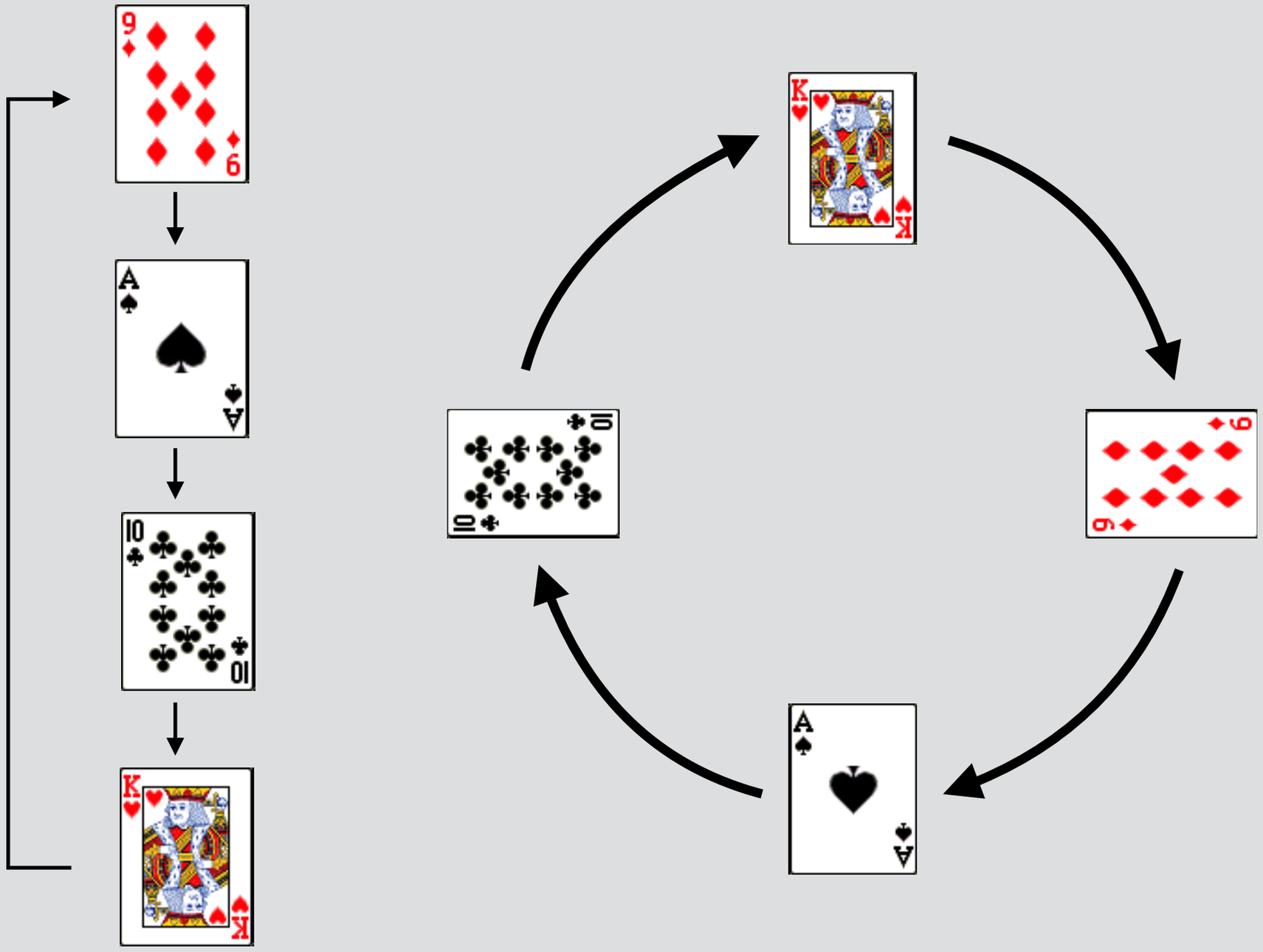
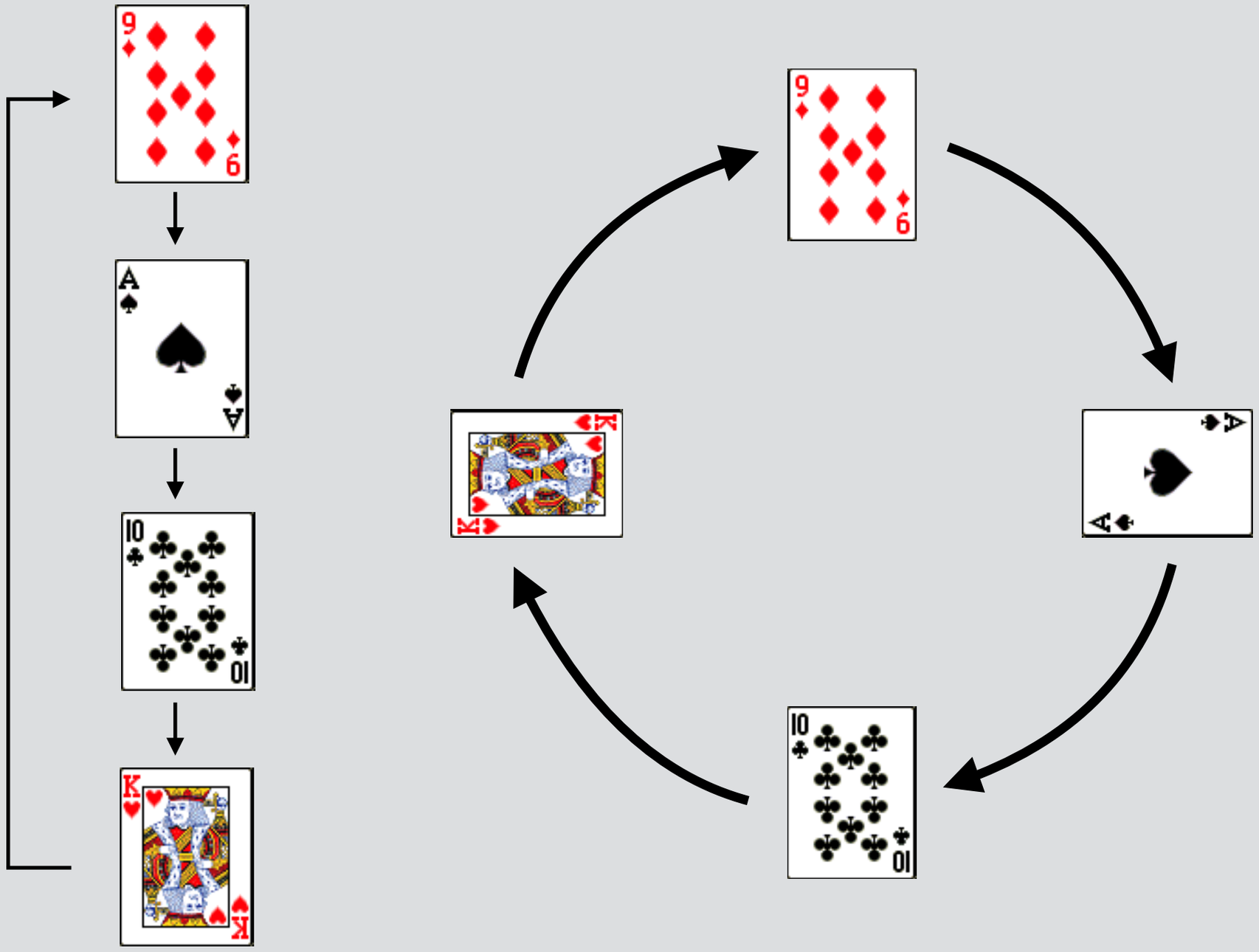


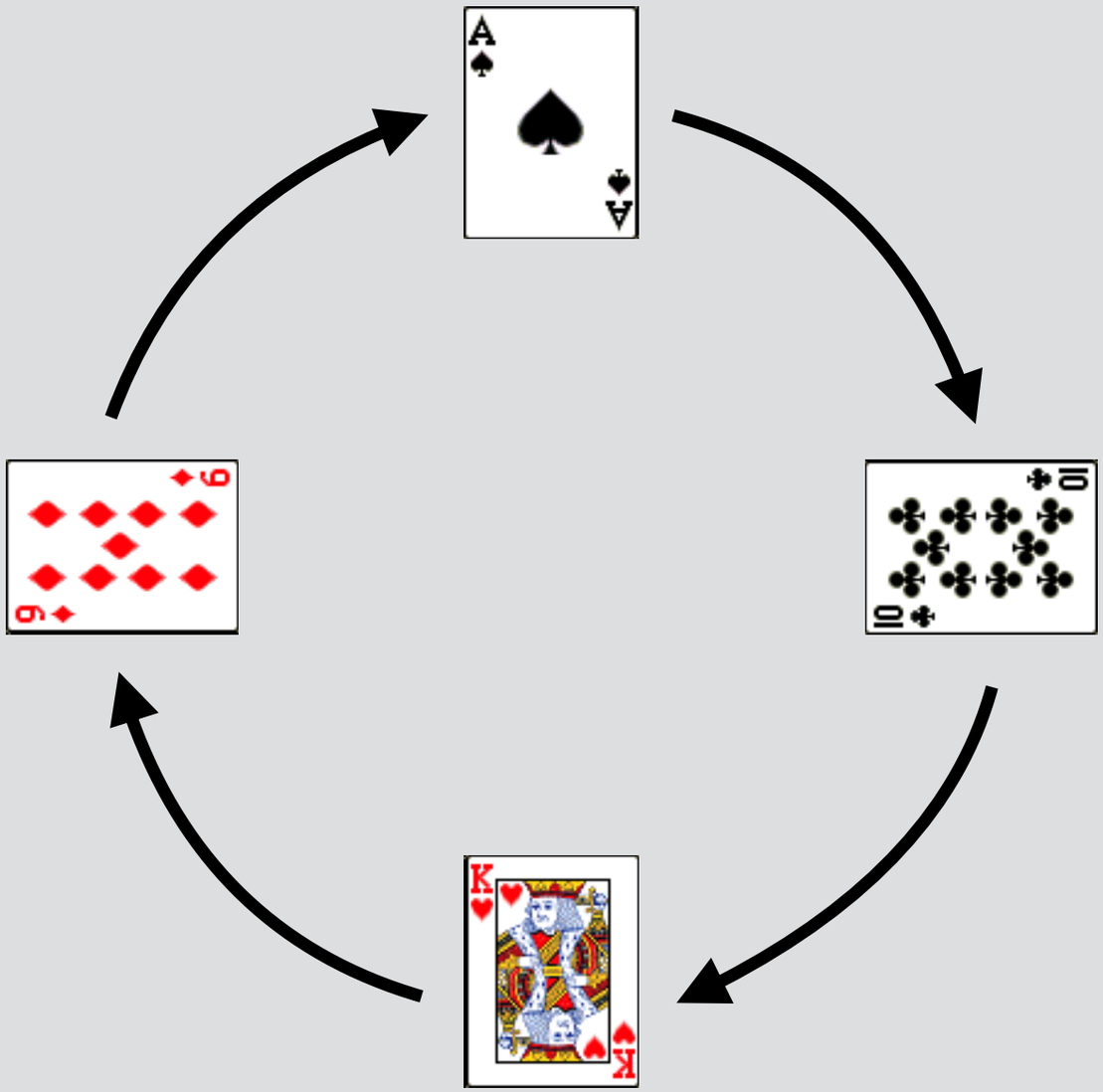


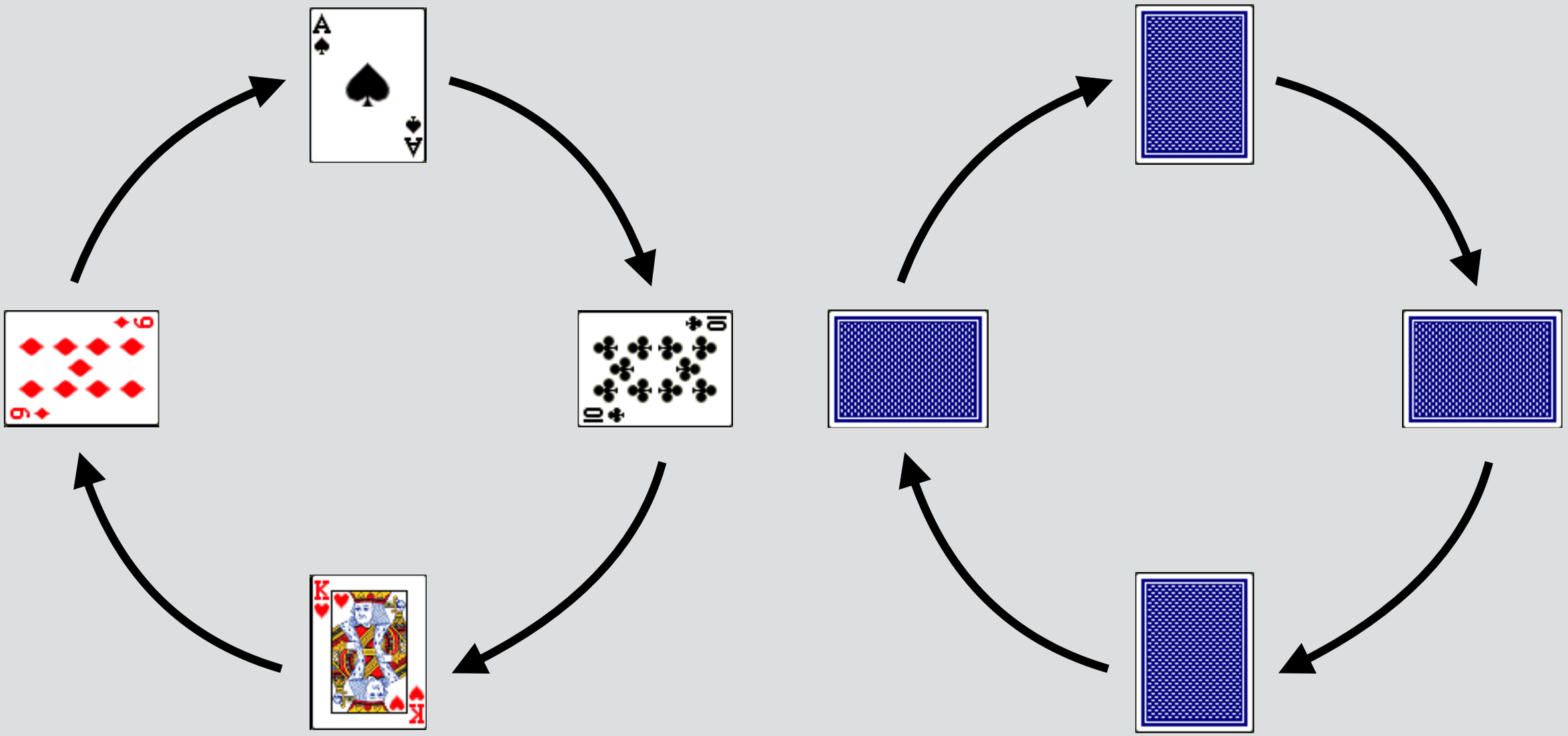
Cutting the deck keeps the order



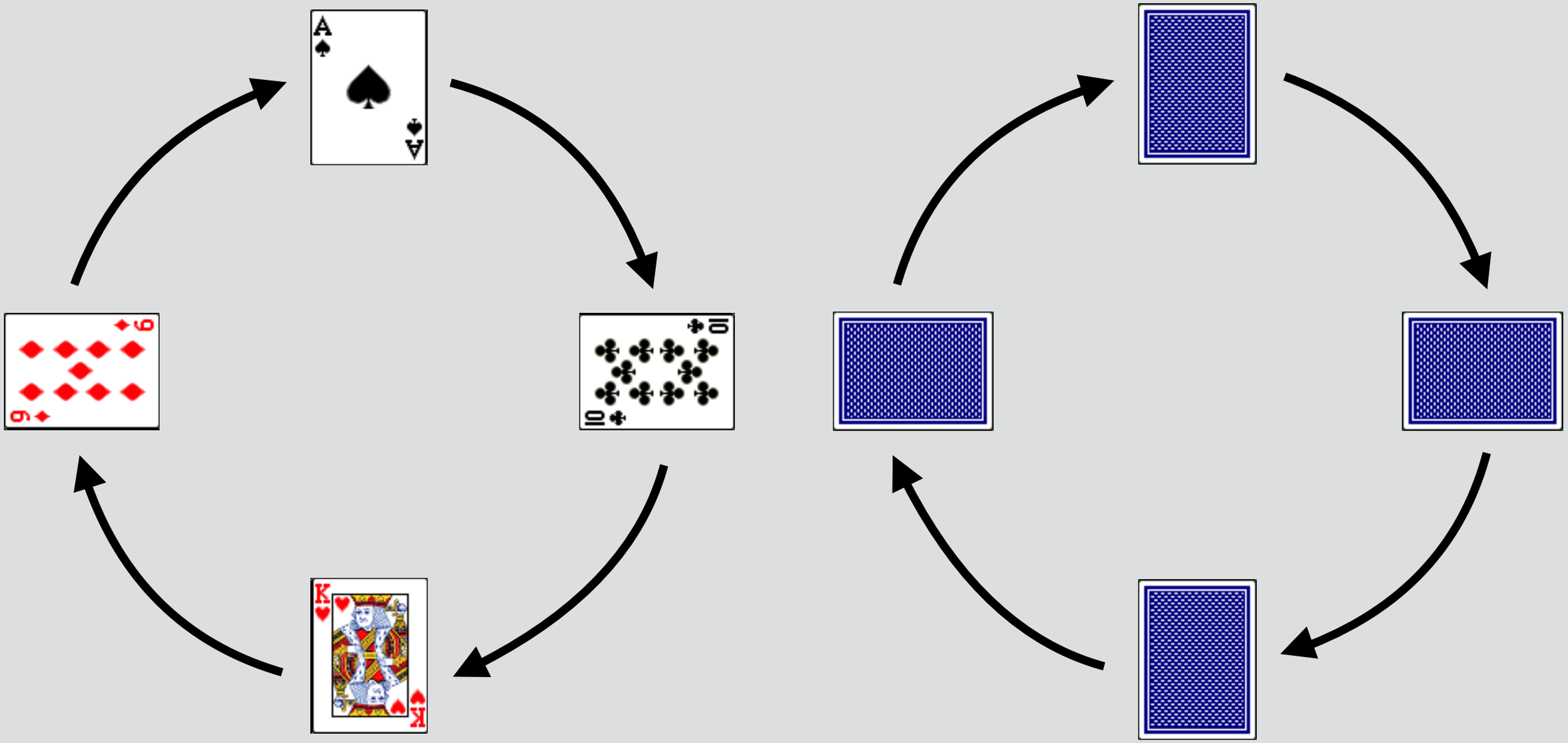
Cutting the deck keeps the order



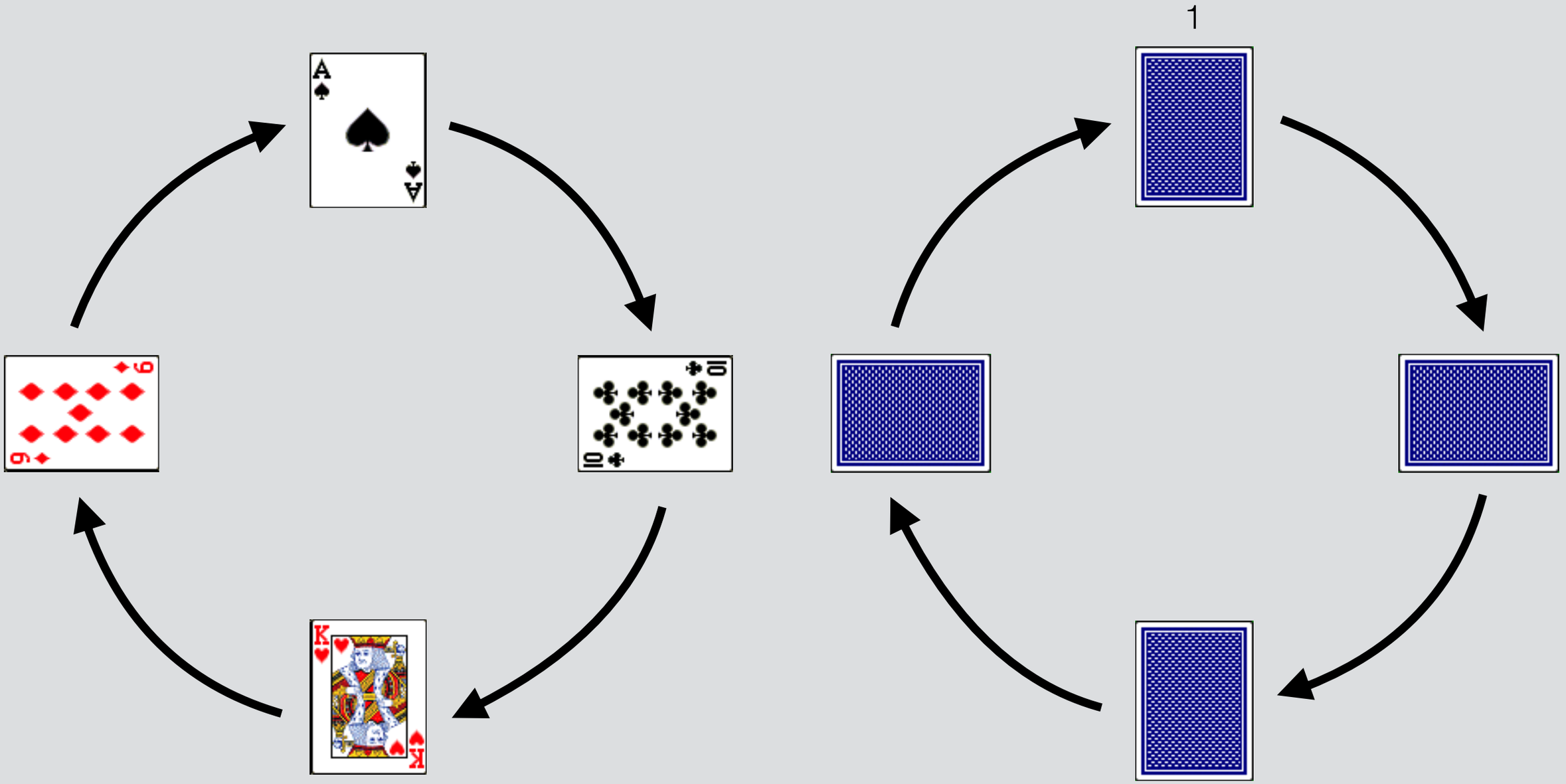




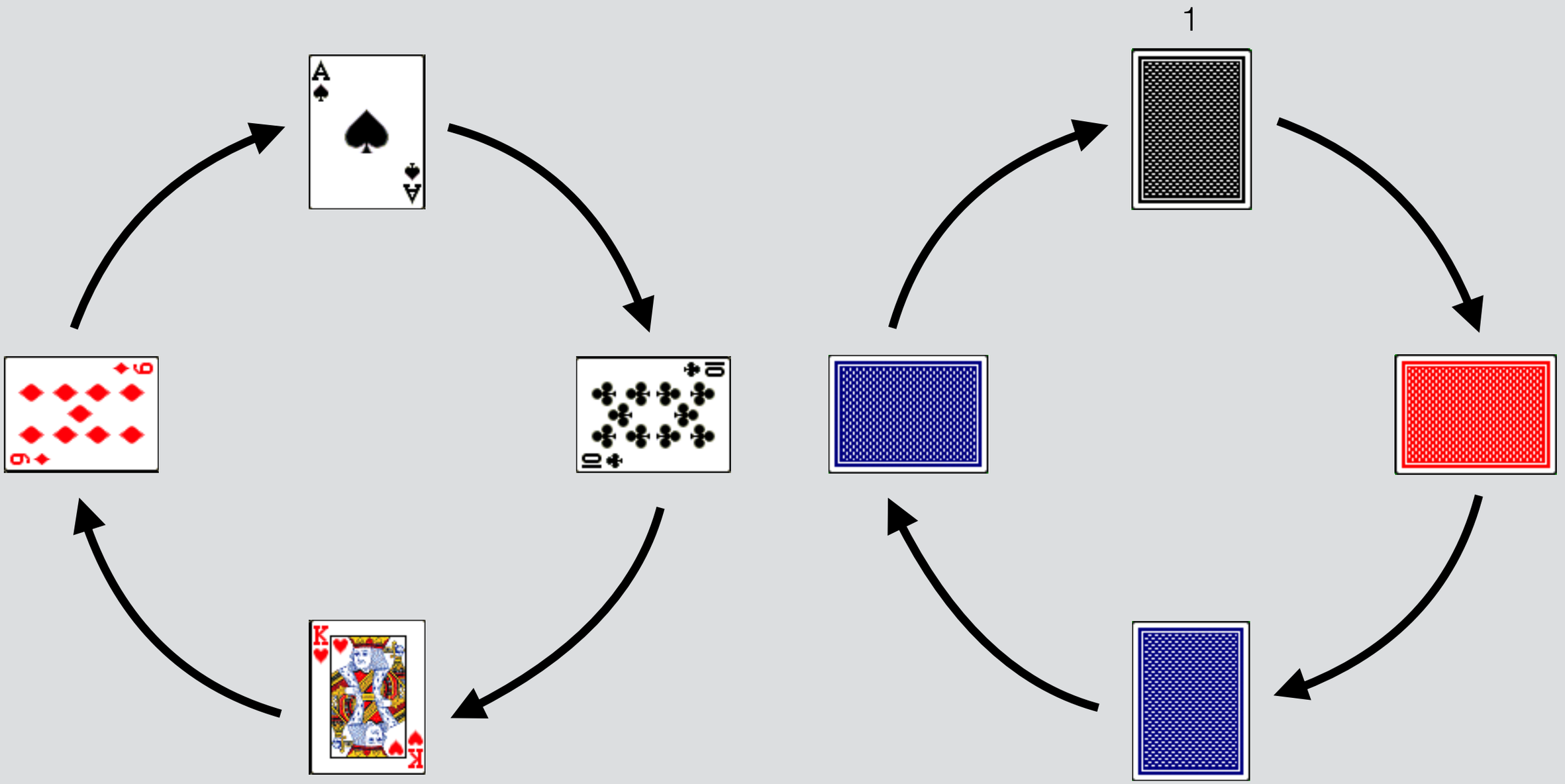
Cut the deck



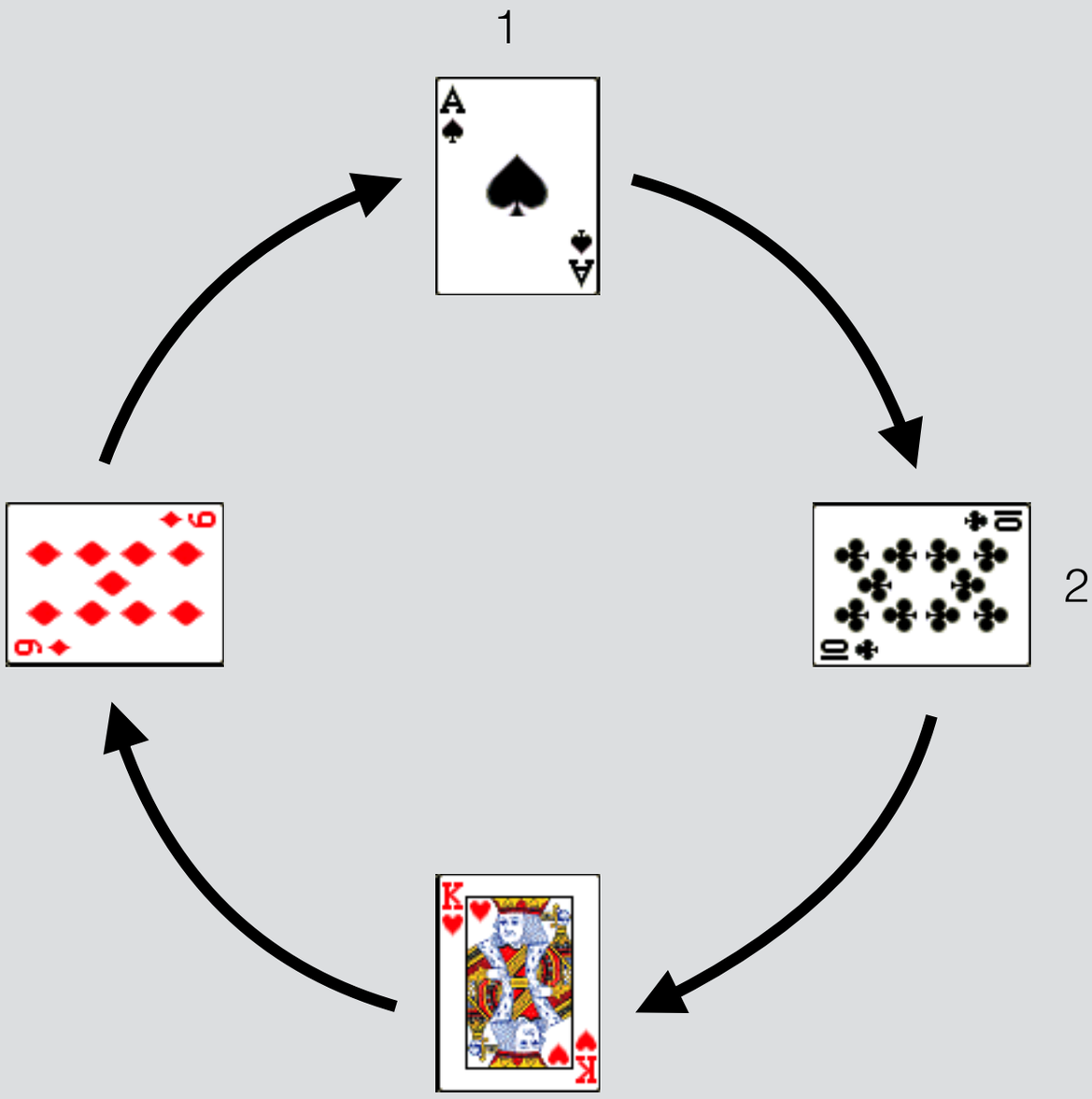
Draw two cards

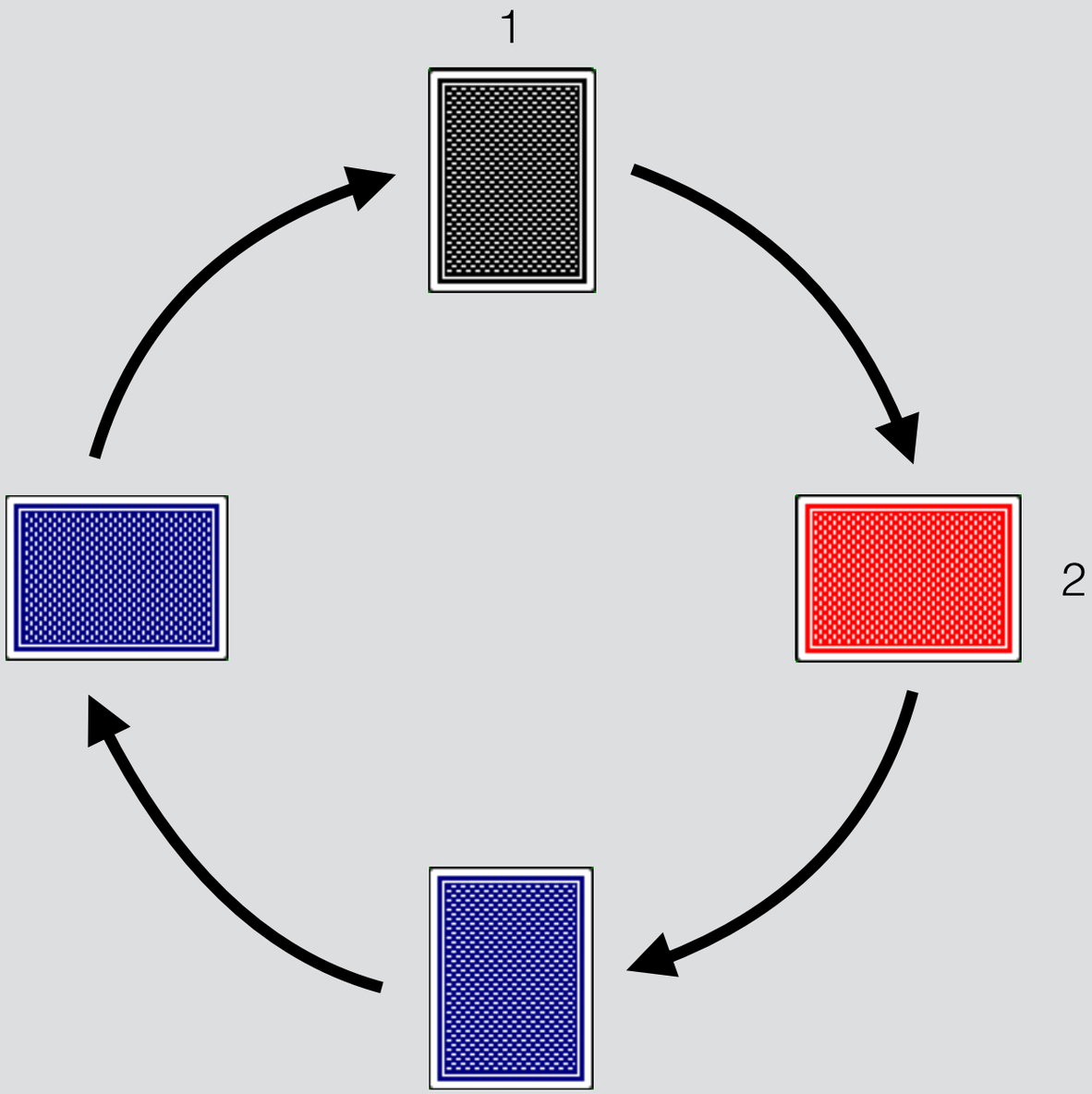


Ask what color they are

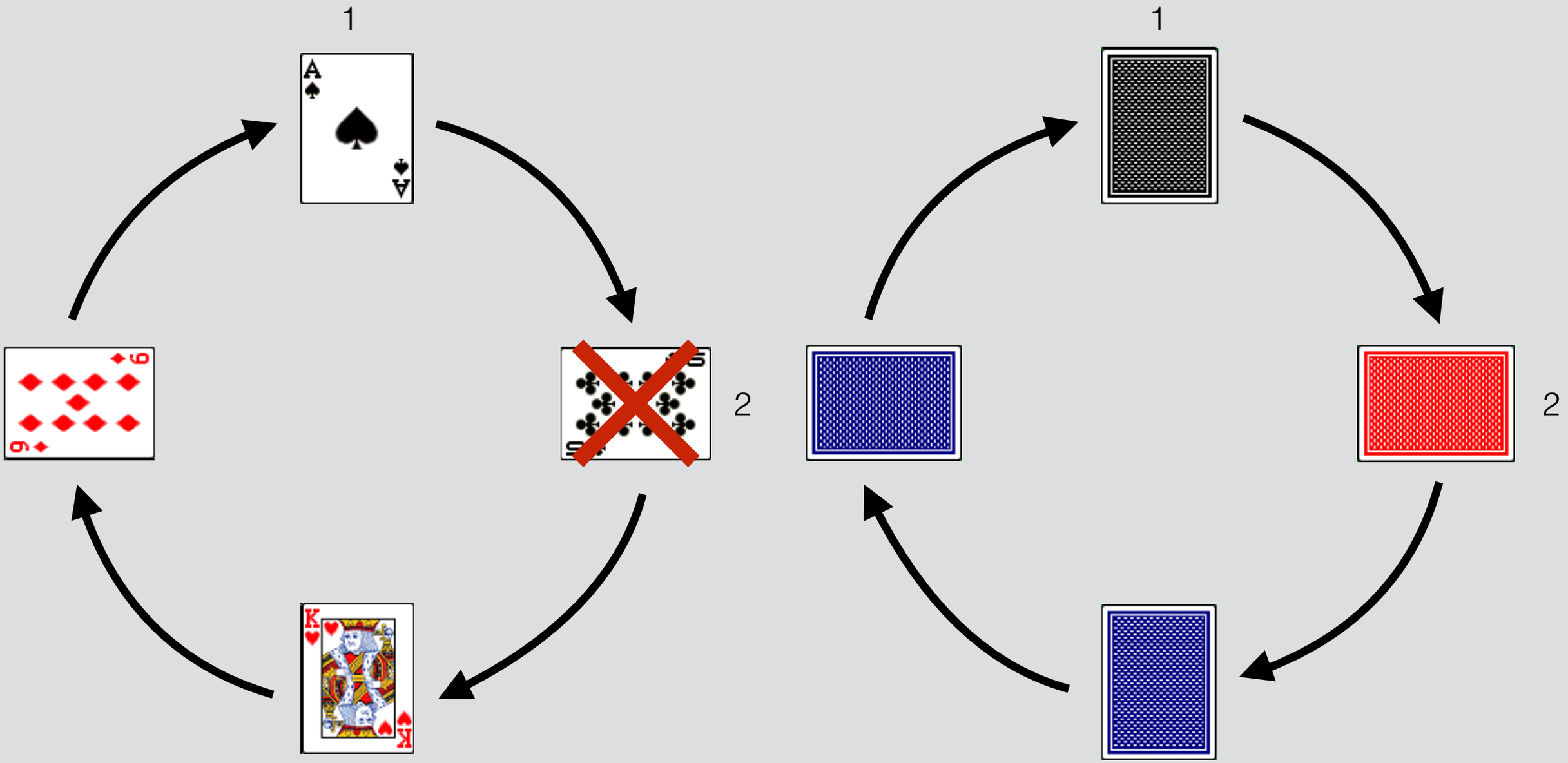


Match the colors

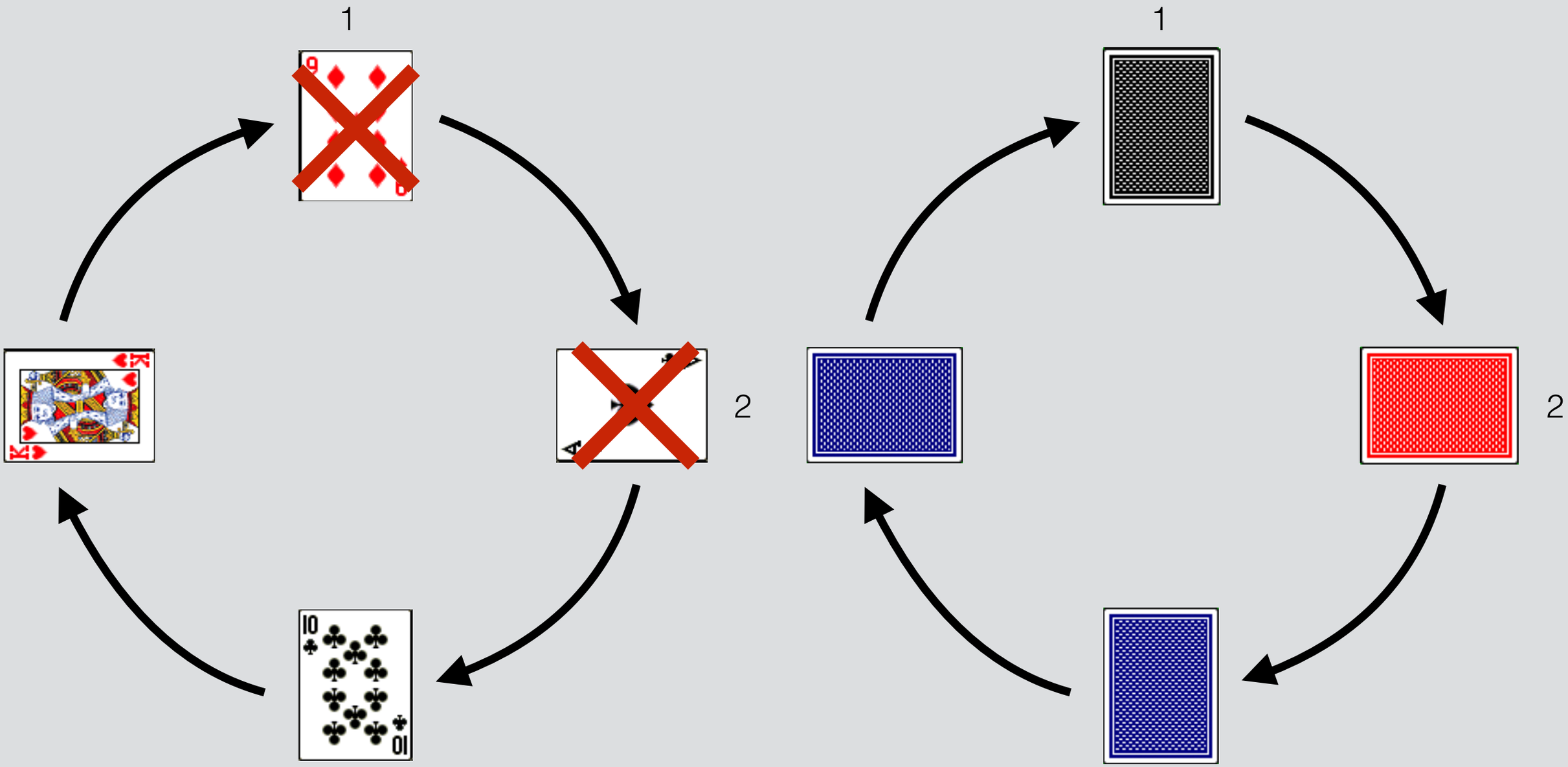




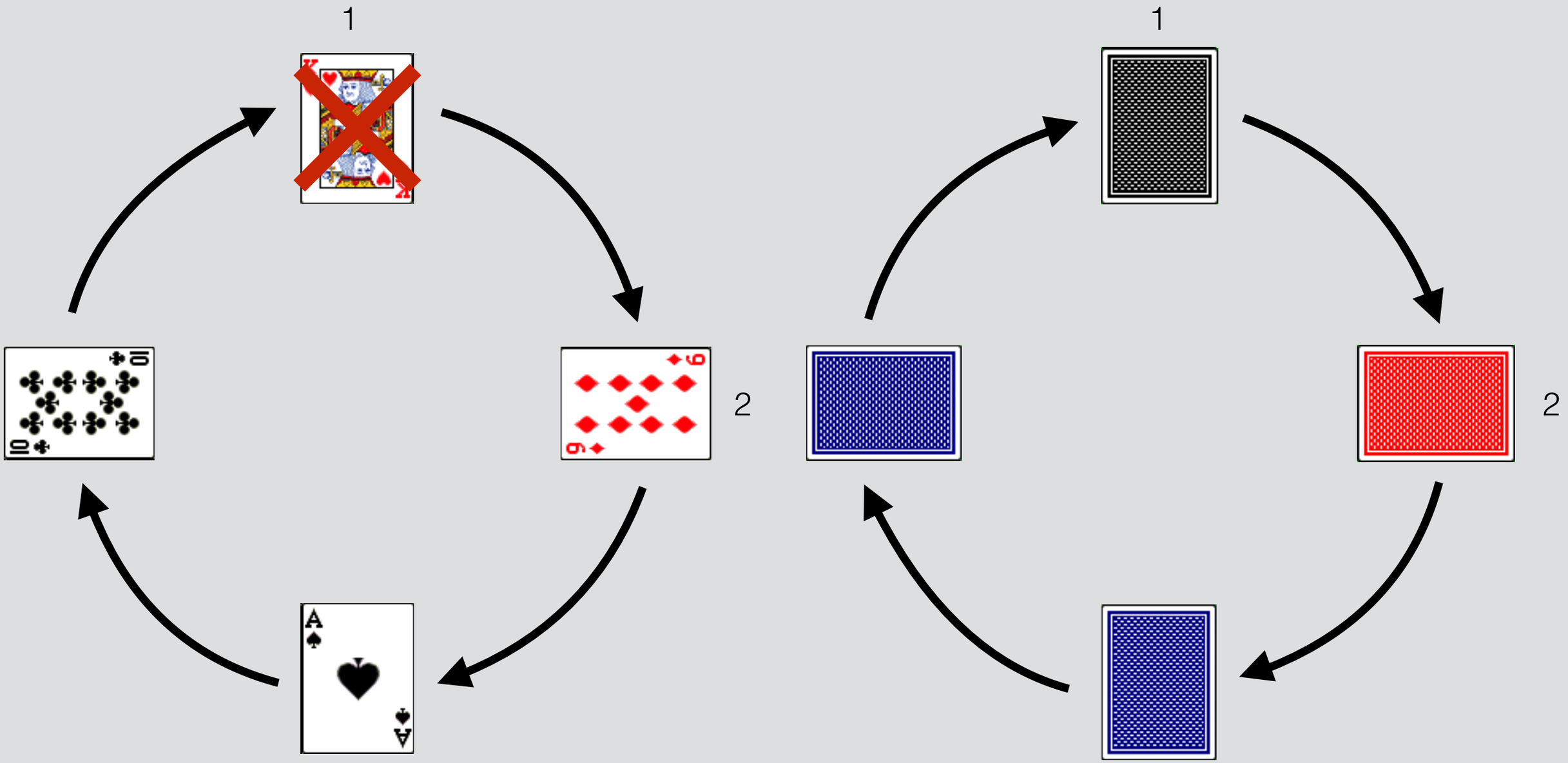
Match the colors



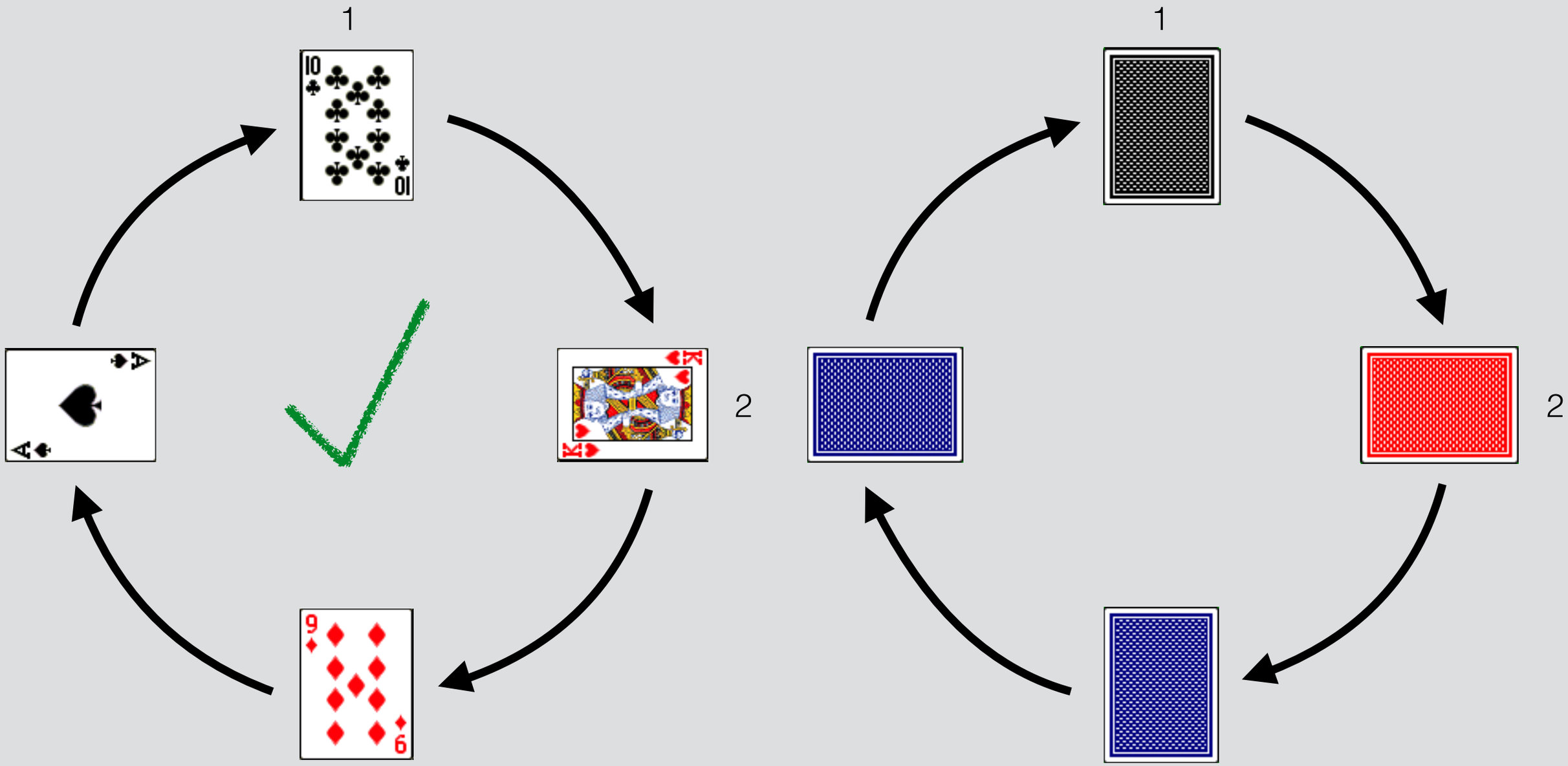
Match the colors



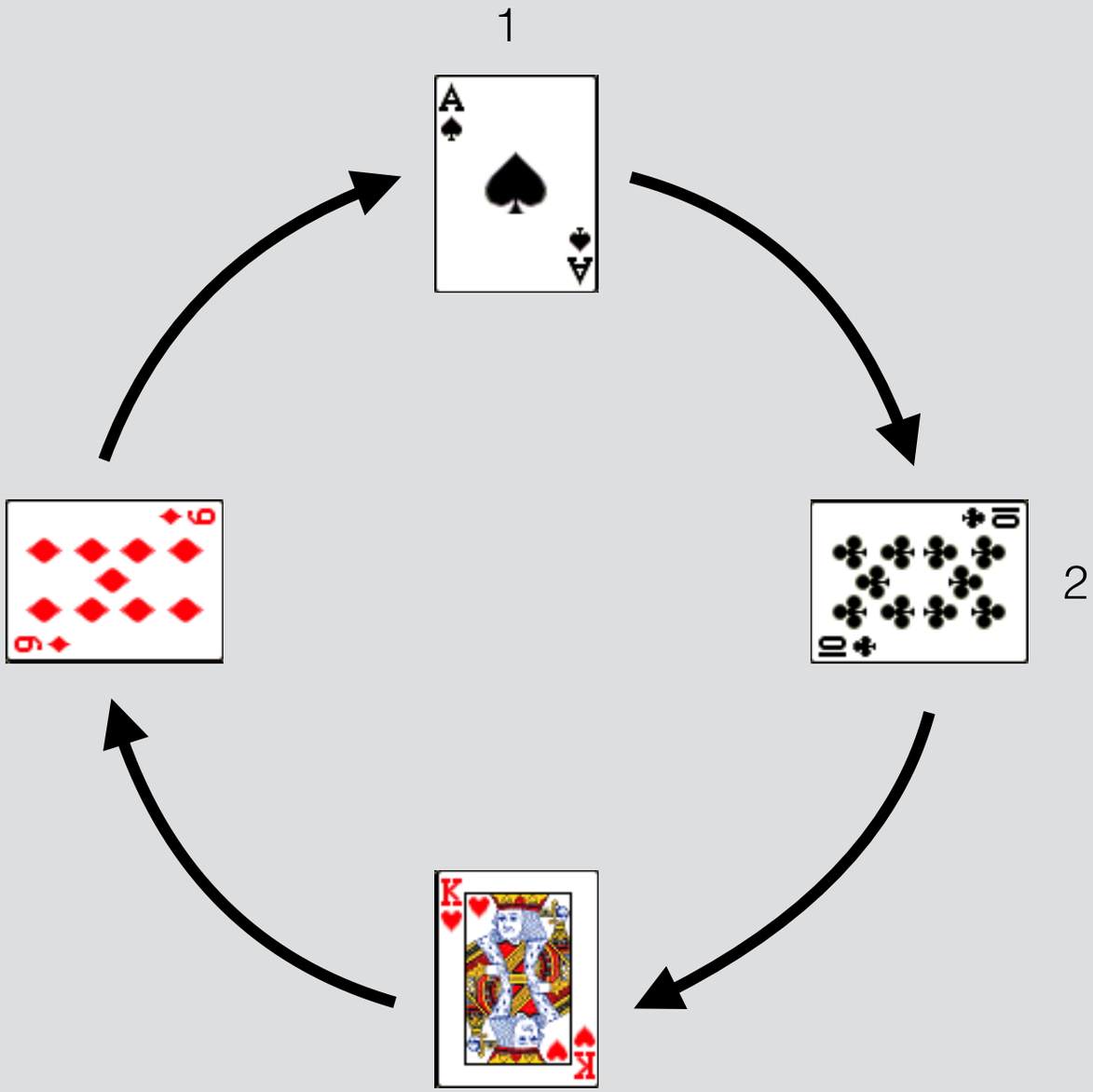
Match the colors



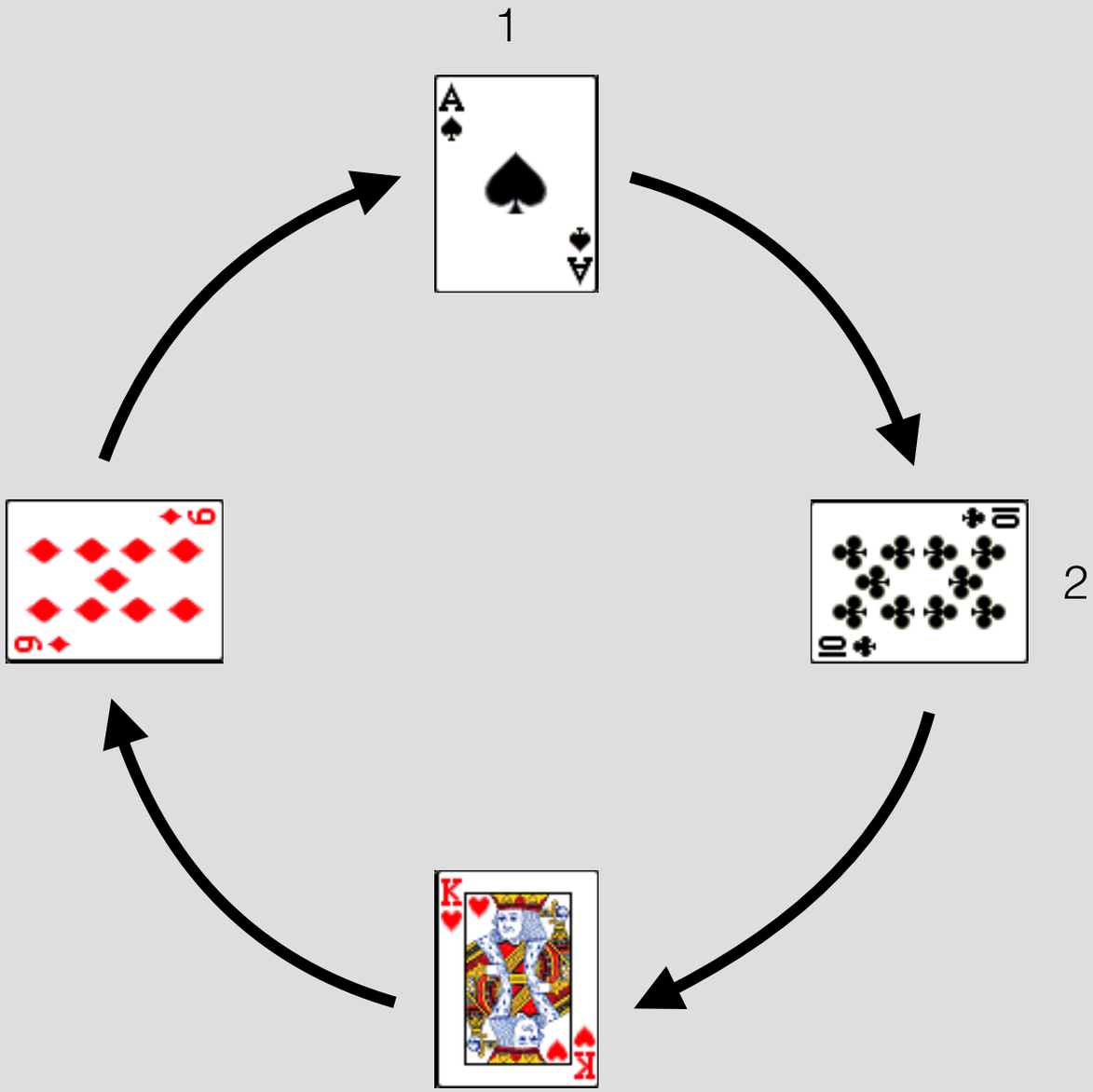
Match the colors



Order is important!

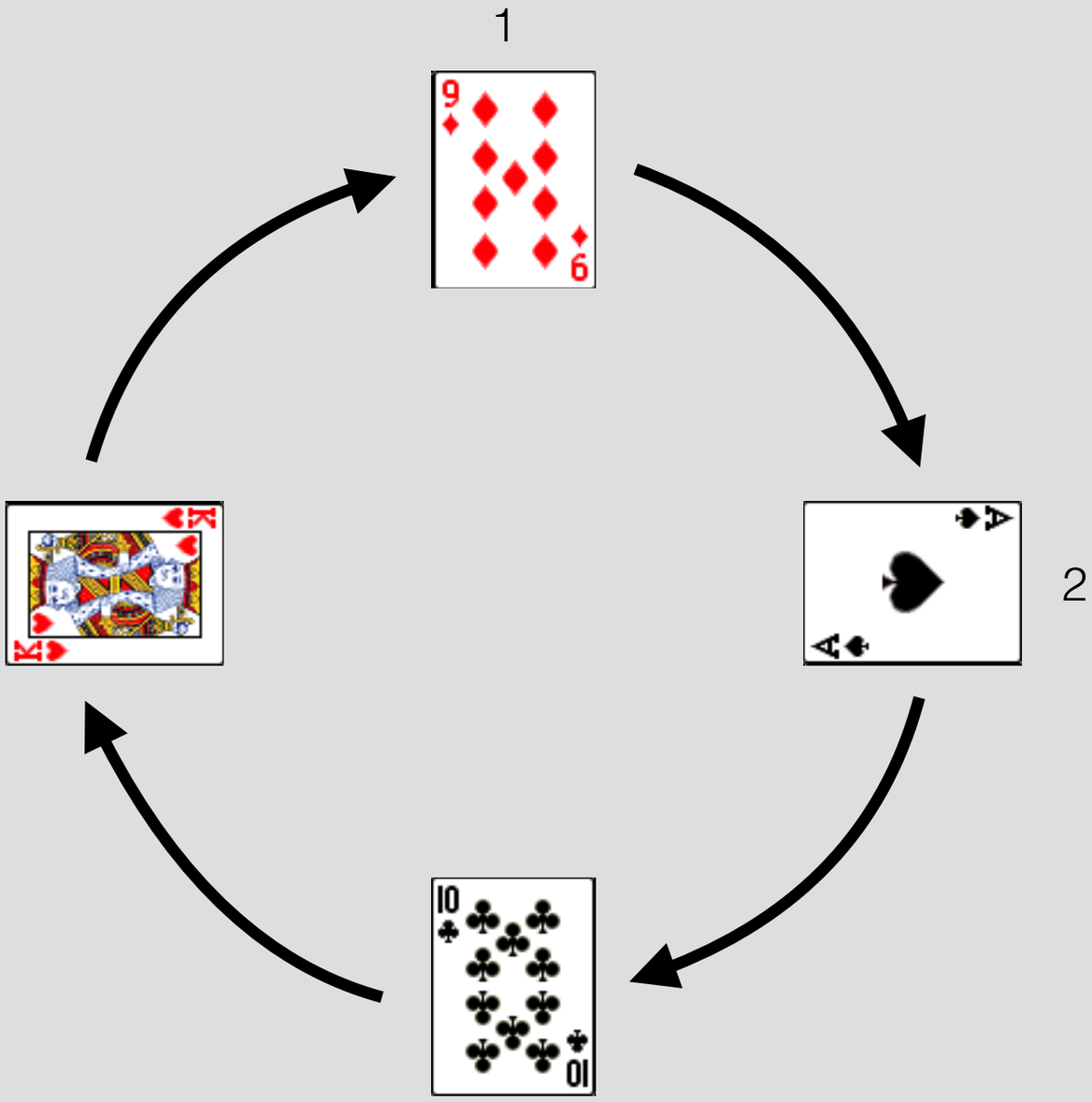


Order is important!



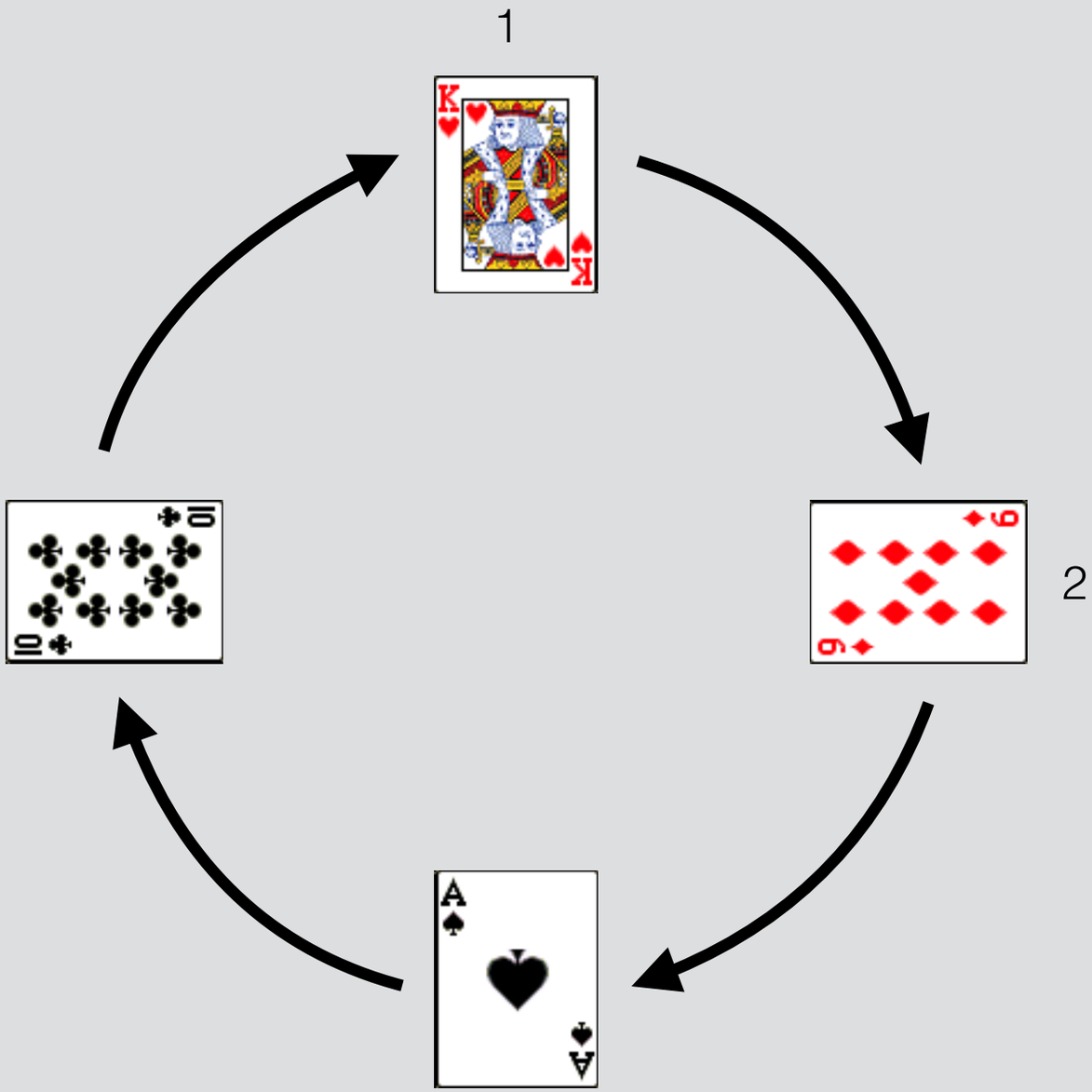
1. Black Black

Order is important!



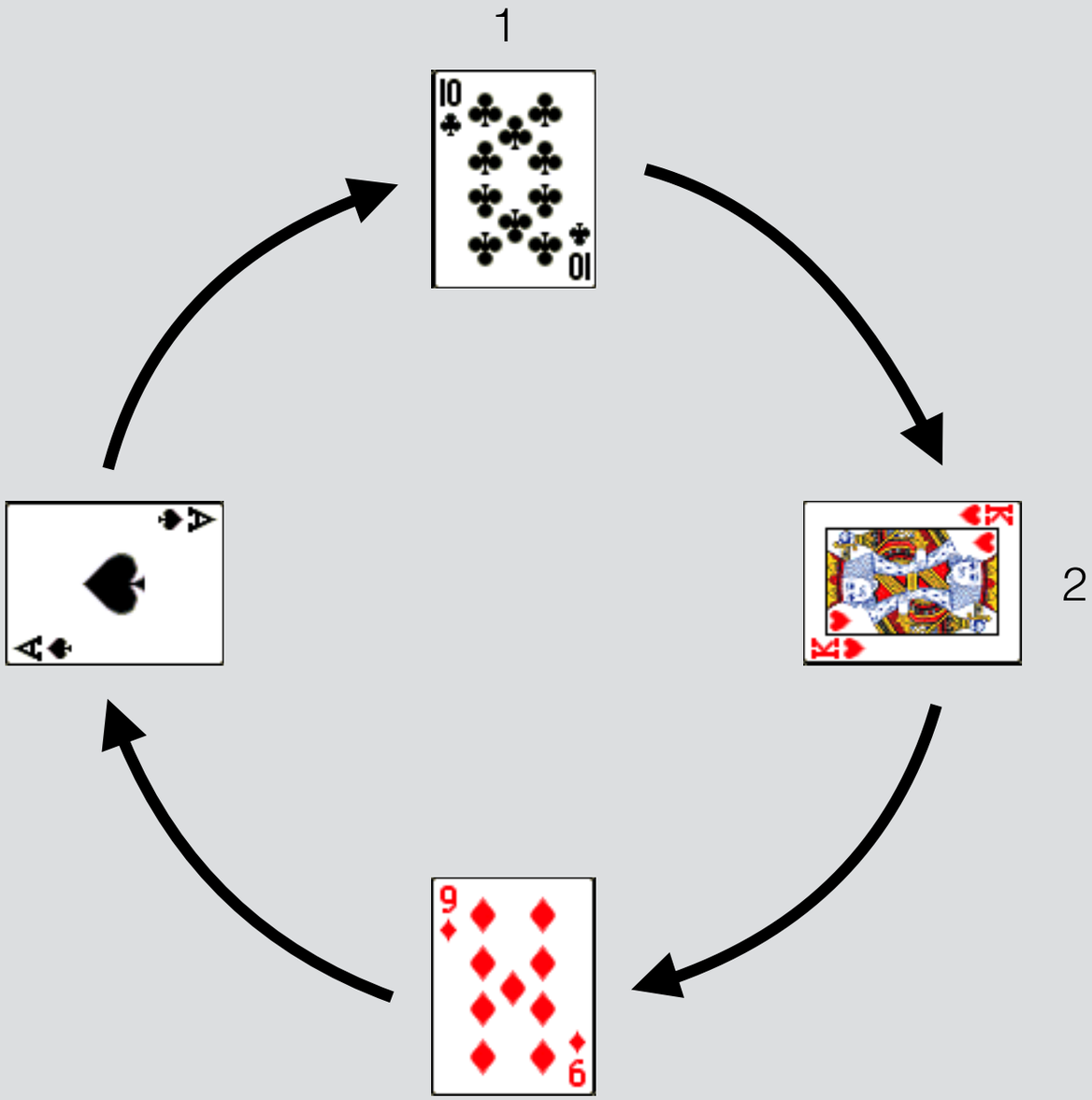
1. Black Black
2. Red Black

Order is important!



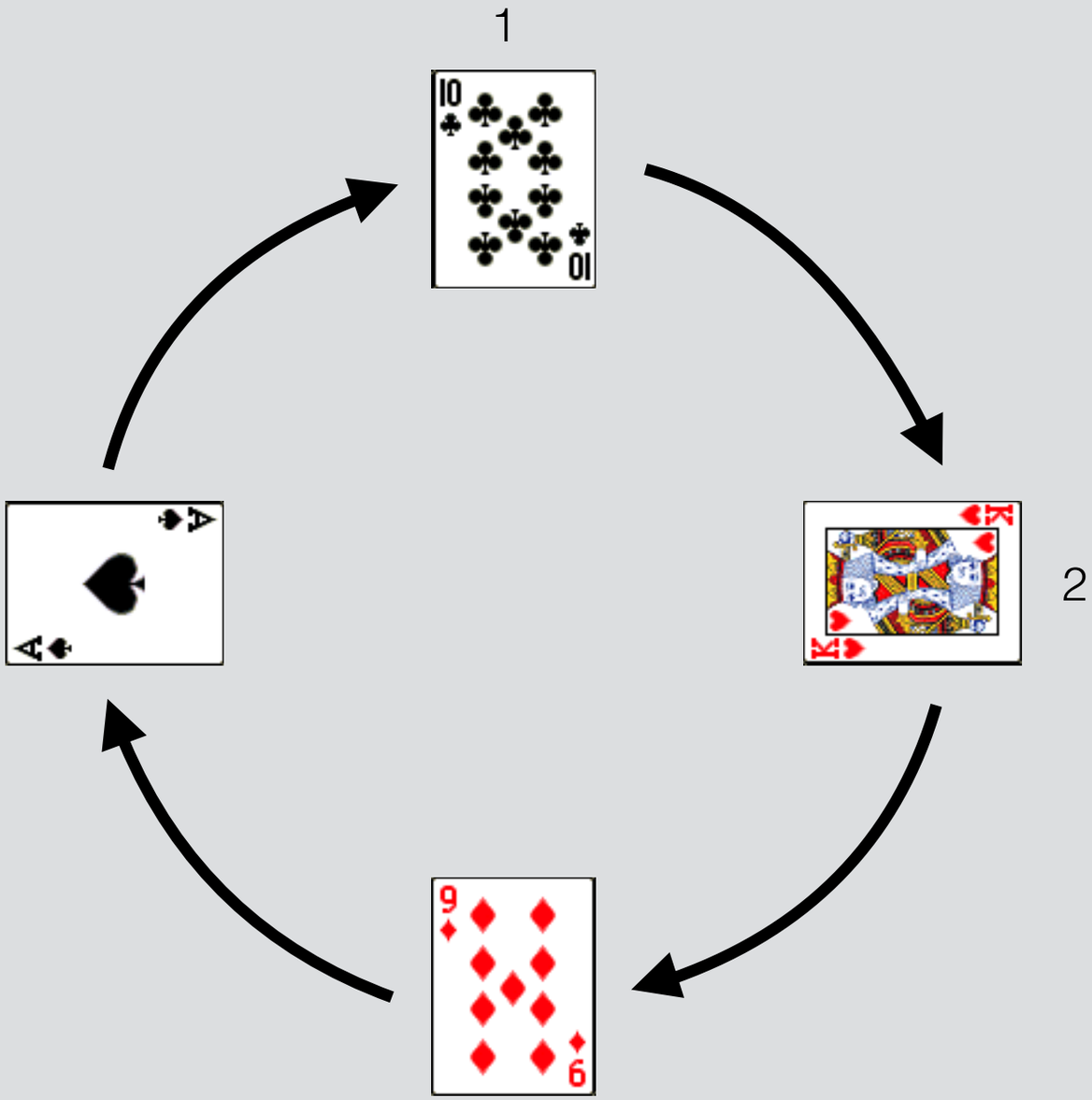
1. Black Black
2. Red Black
3. Red Red

Order is important!



1. Black Black
2. Red Black
3. Red Red
4. Black Red

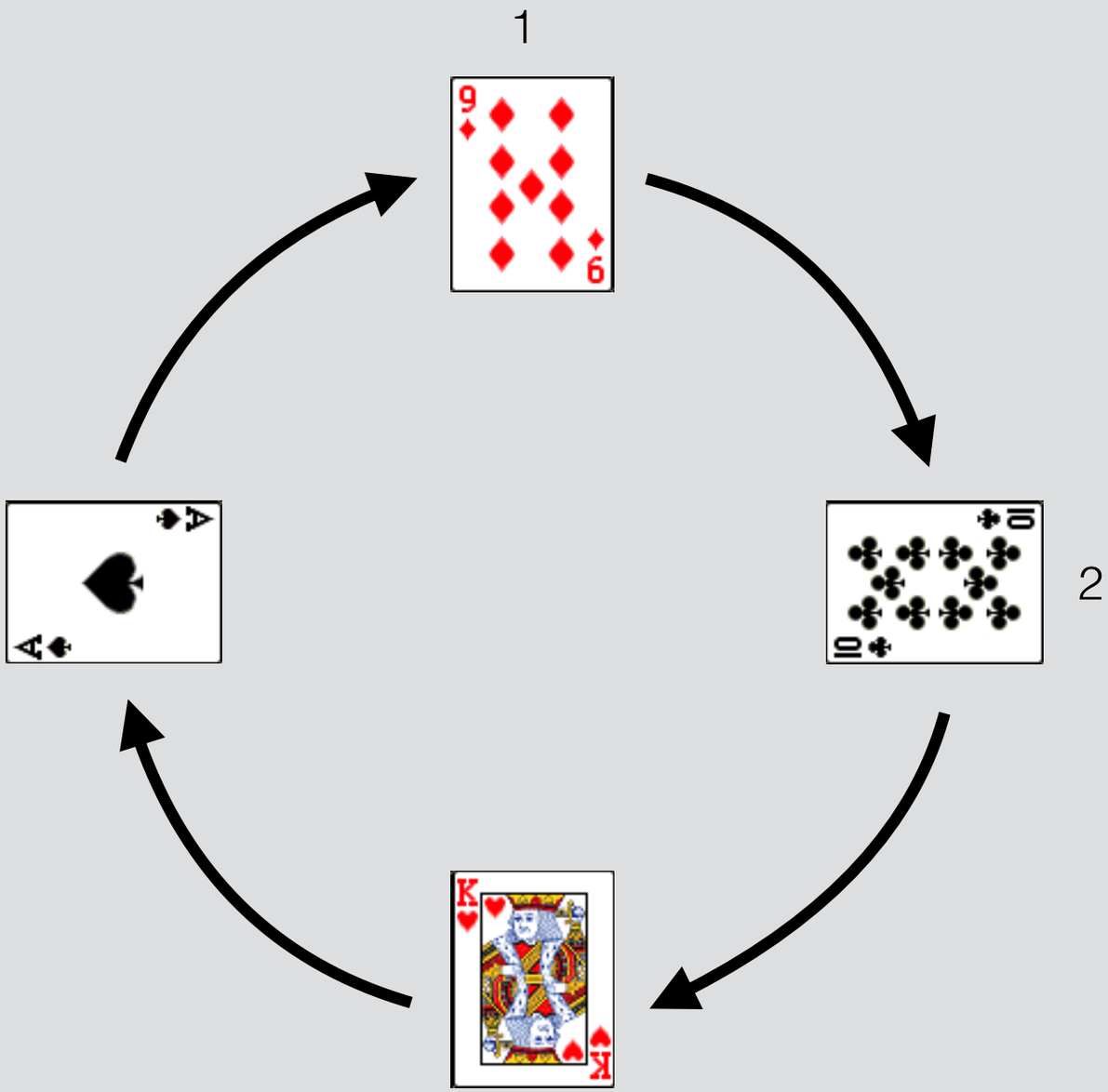
Order is important!



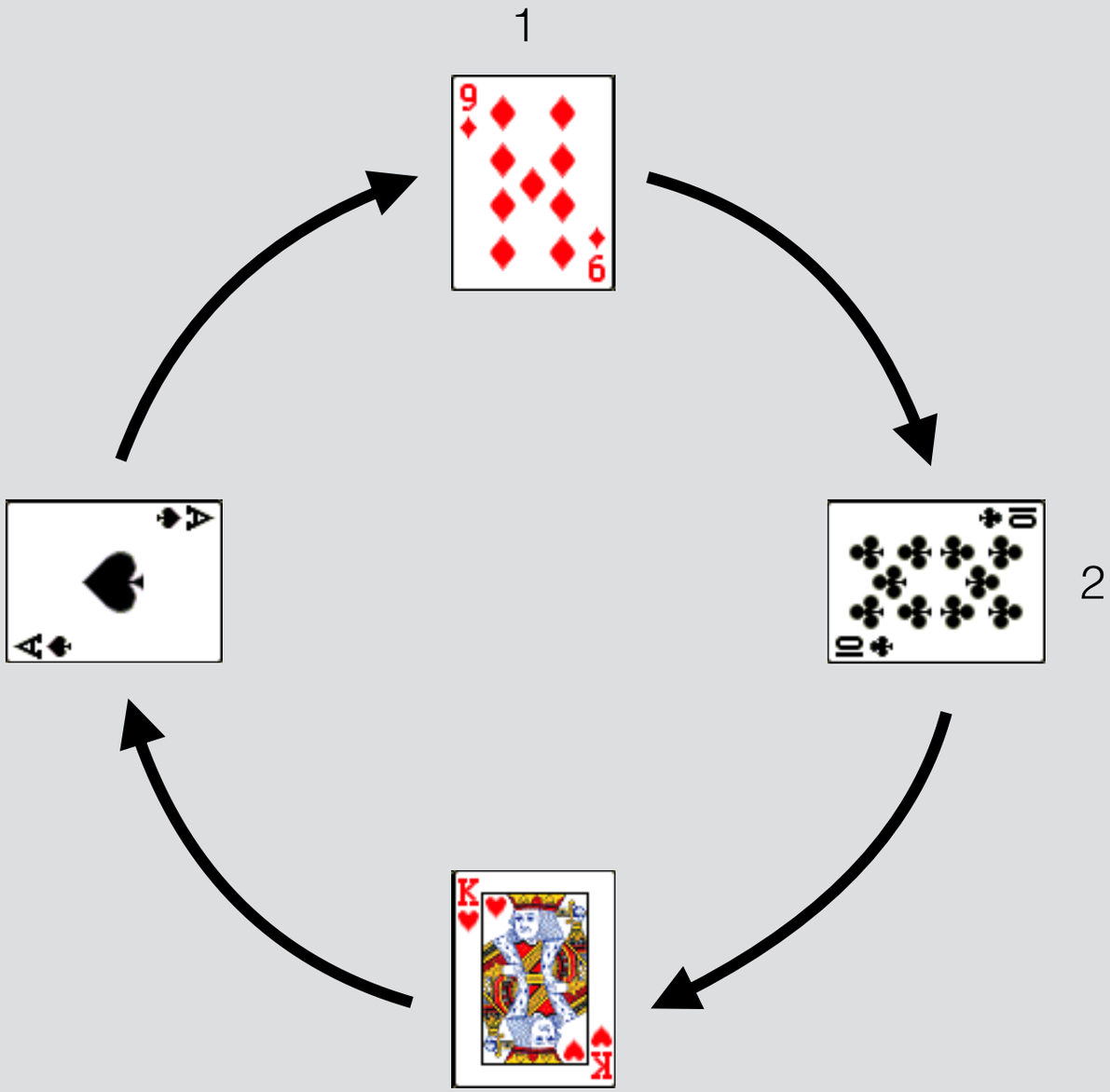
1. Black Black
2. Red Black
3. Red Red
4. Black Red

Every combination only happens once!

Order is important!

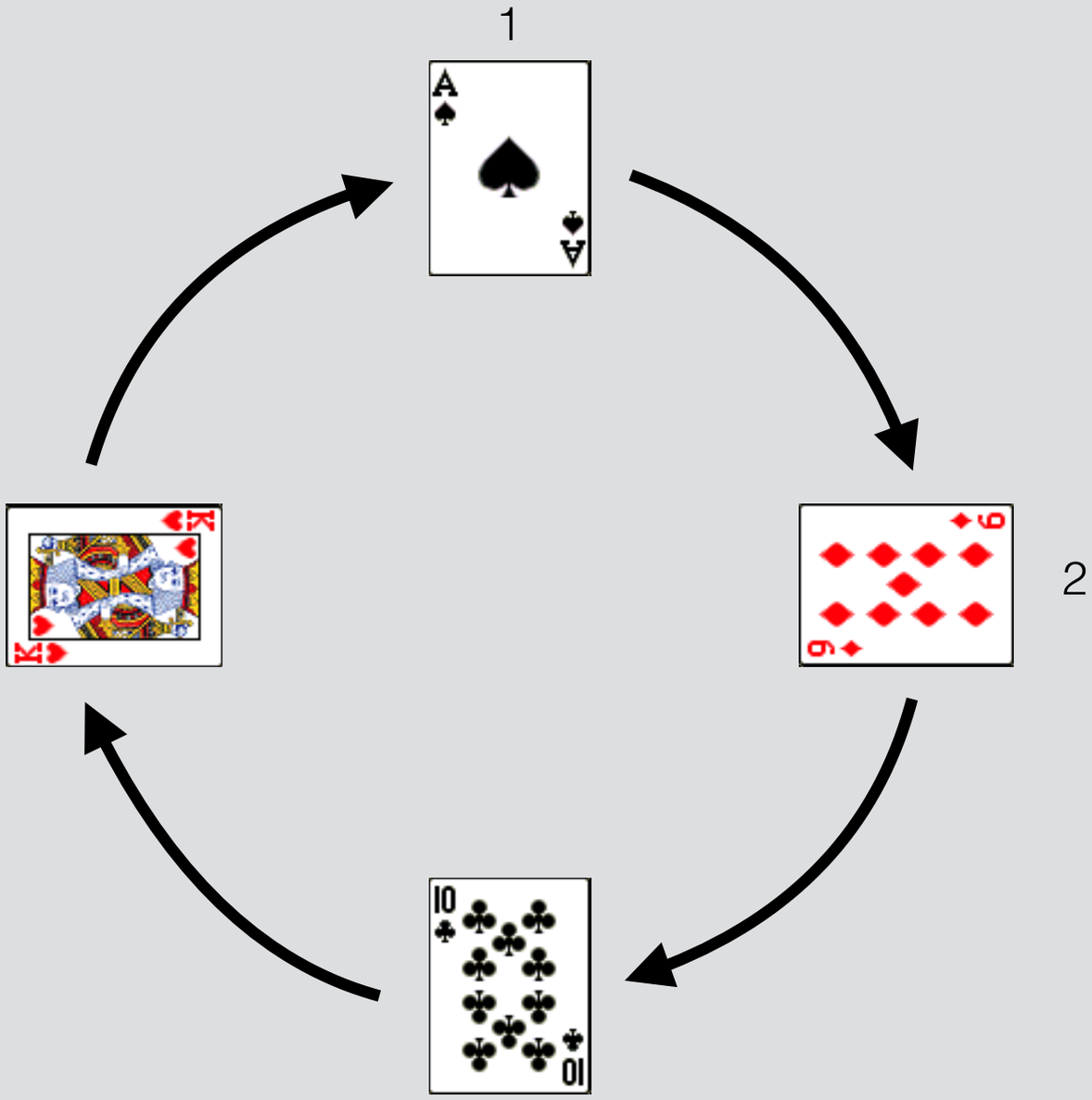


Order is important!



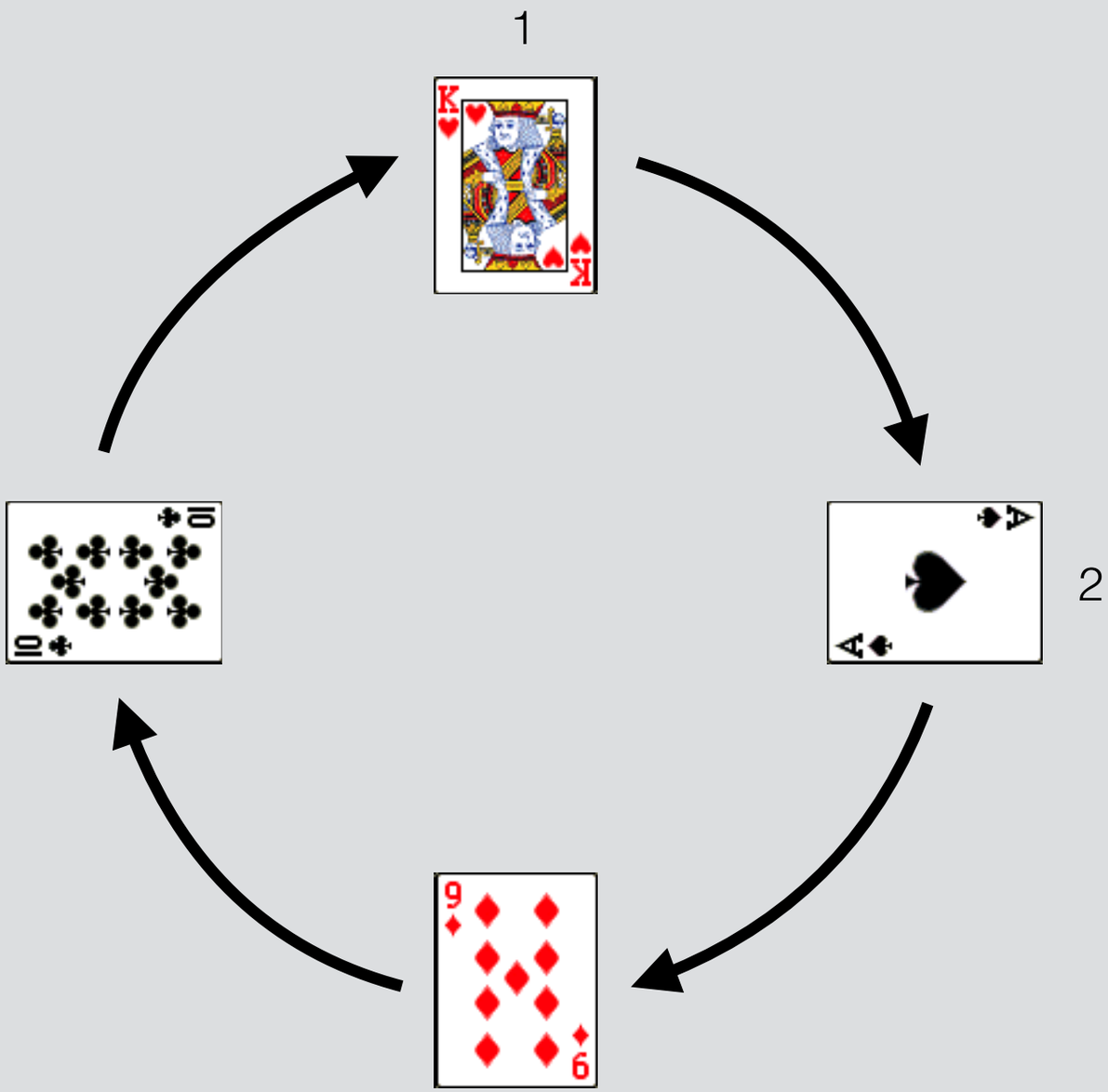
1. Red Black

Order is important!



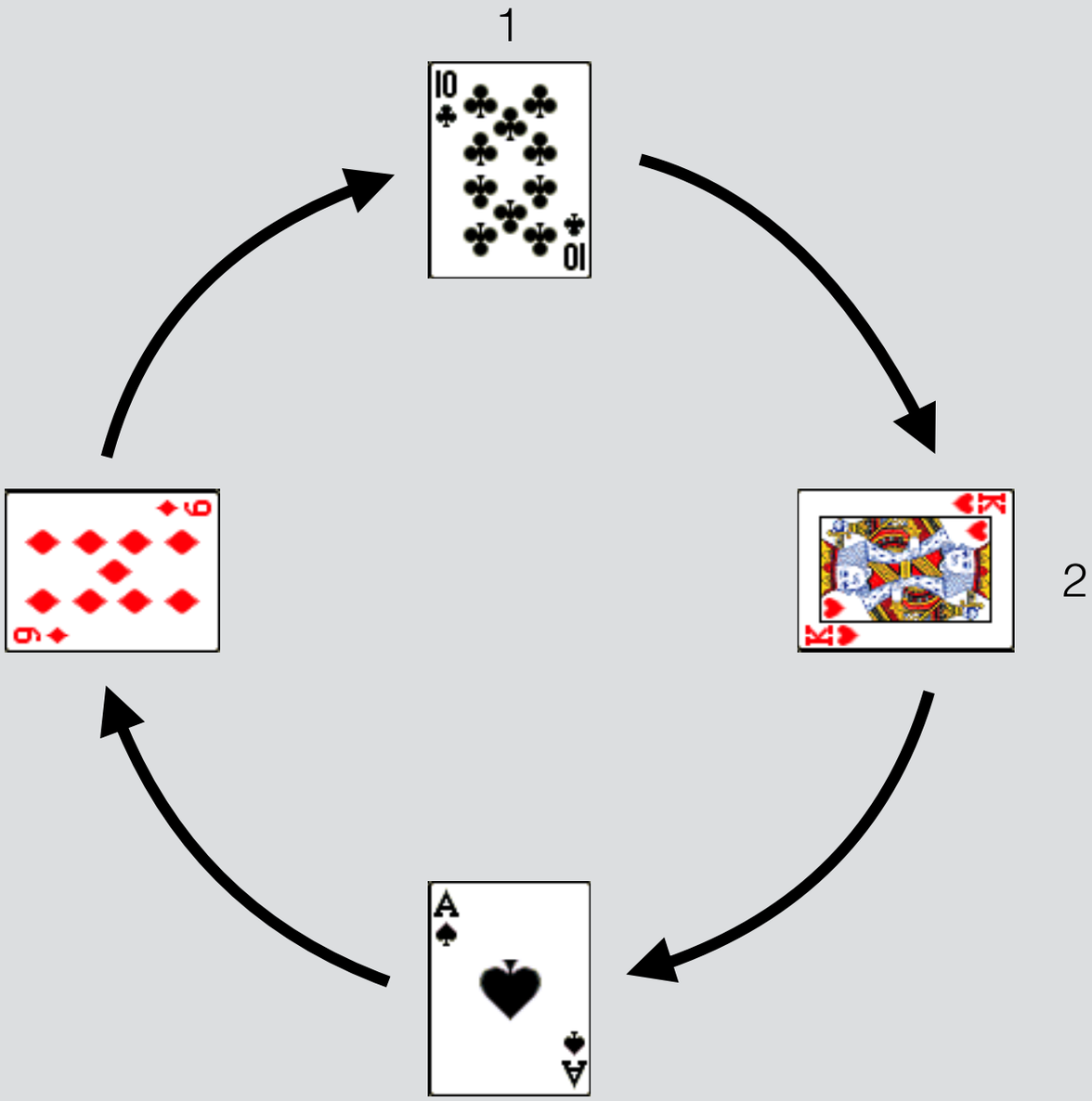
1. Red Black
2. Black Red

Order is important!



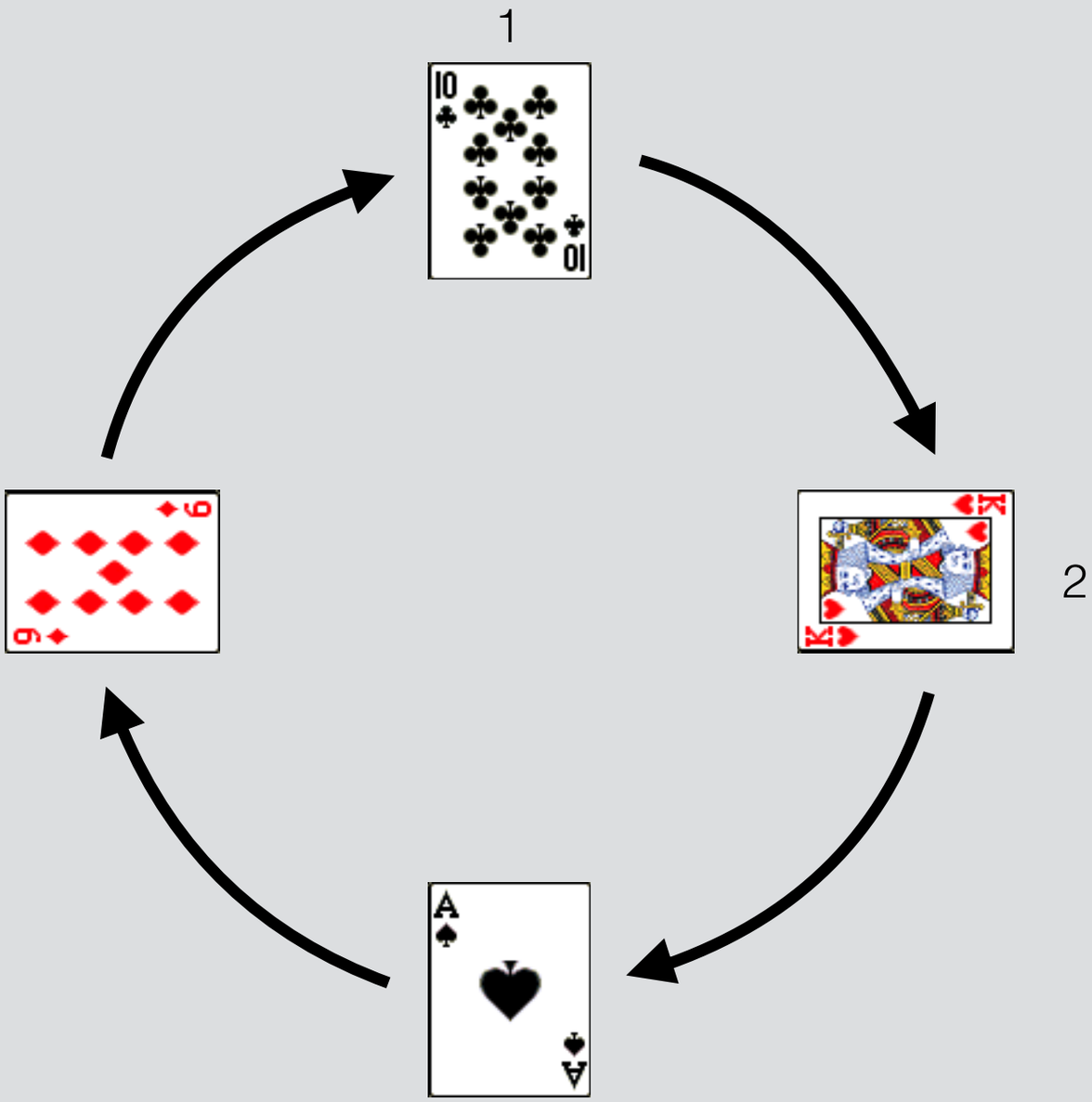
1. **Red** Black
2. Black **Red**
3. **Red** Black

Order is important!



1. **Red** Black
2. Black **Red**
3. **Red** Black
4. Black **Red**

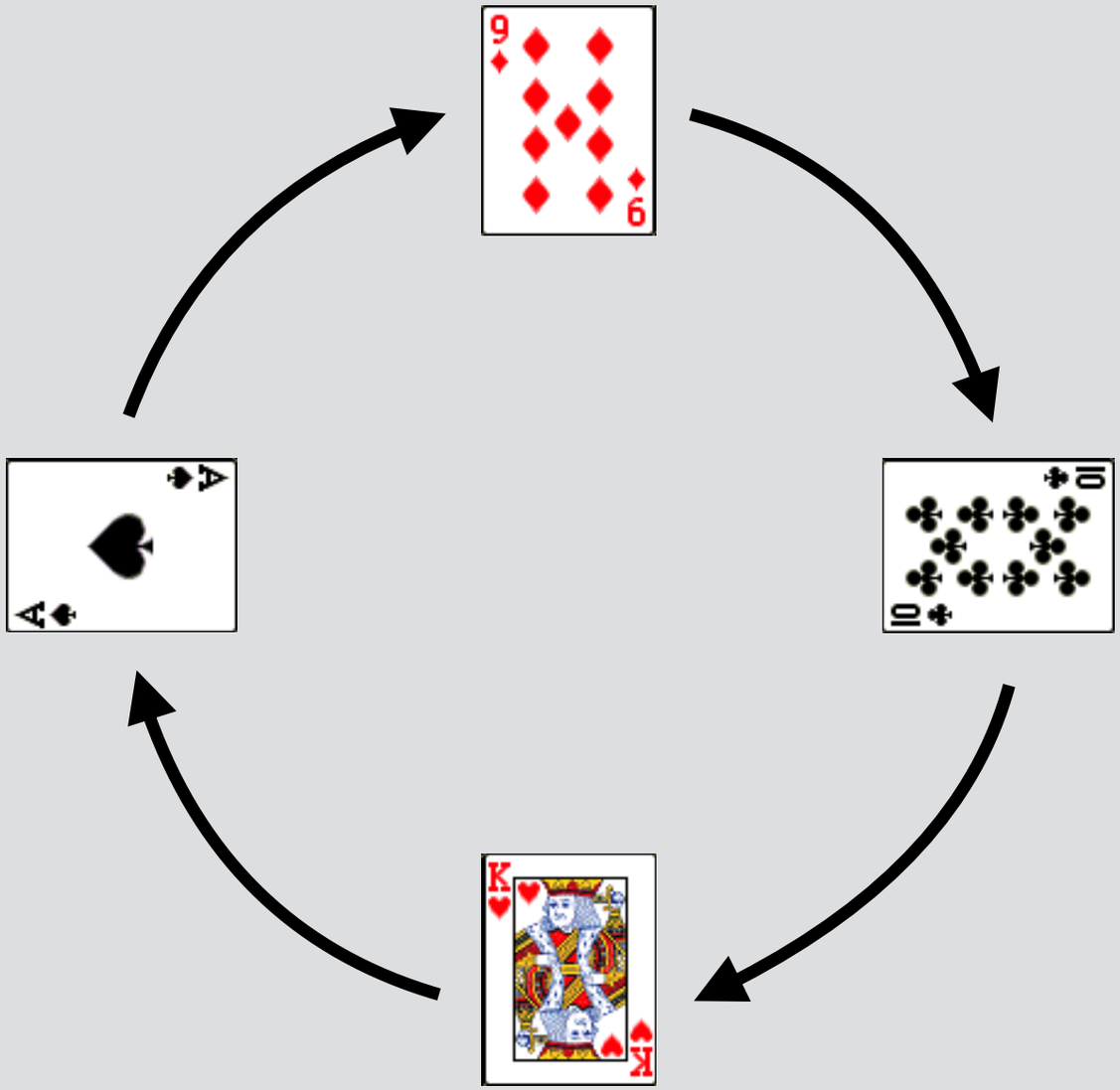
Order is important!



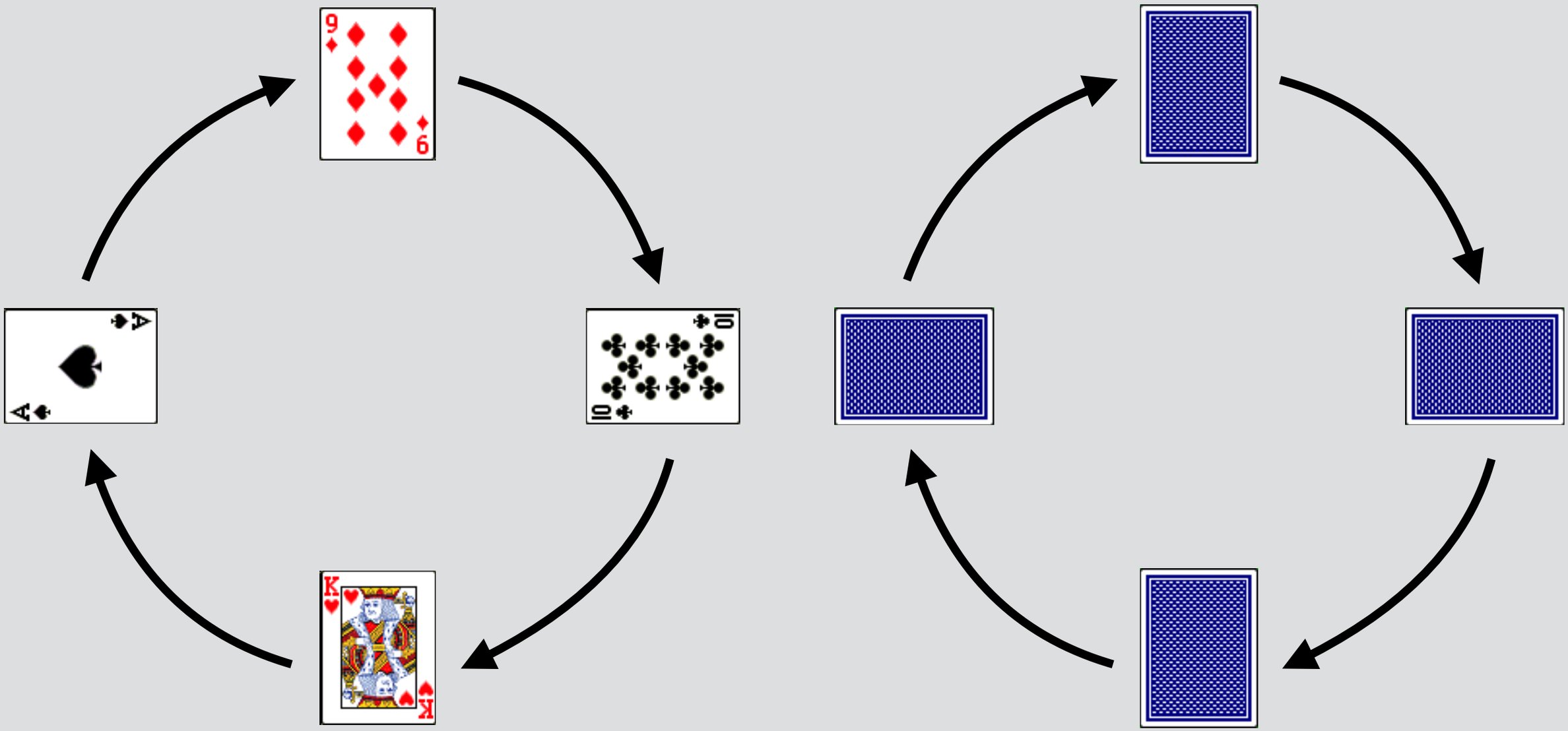
1. **Red** Black
2. Black **Red**
3. **Red** Black
4. Black **Red**

Combinations repeat!

Order is important!



Order is important!



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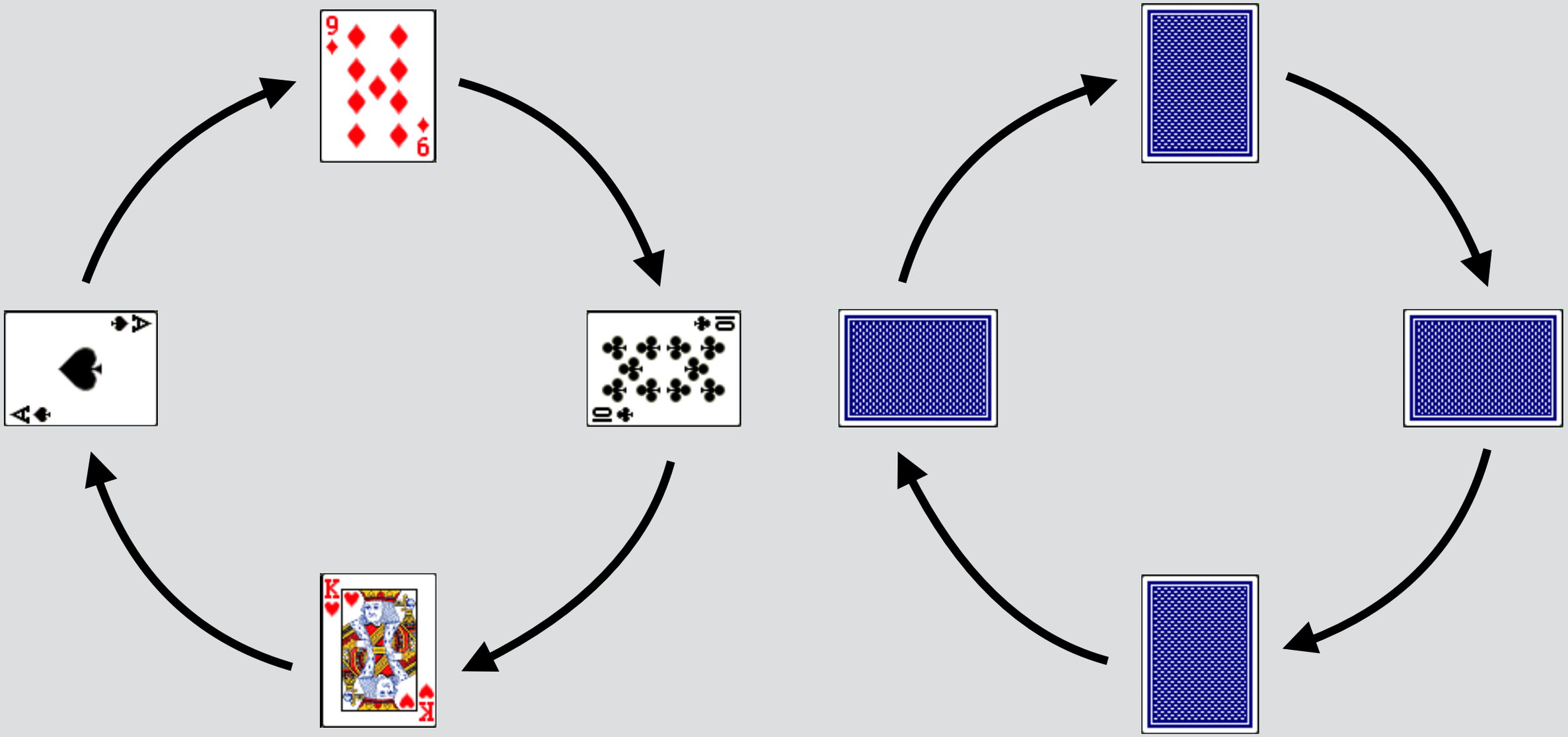
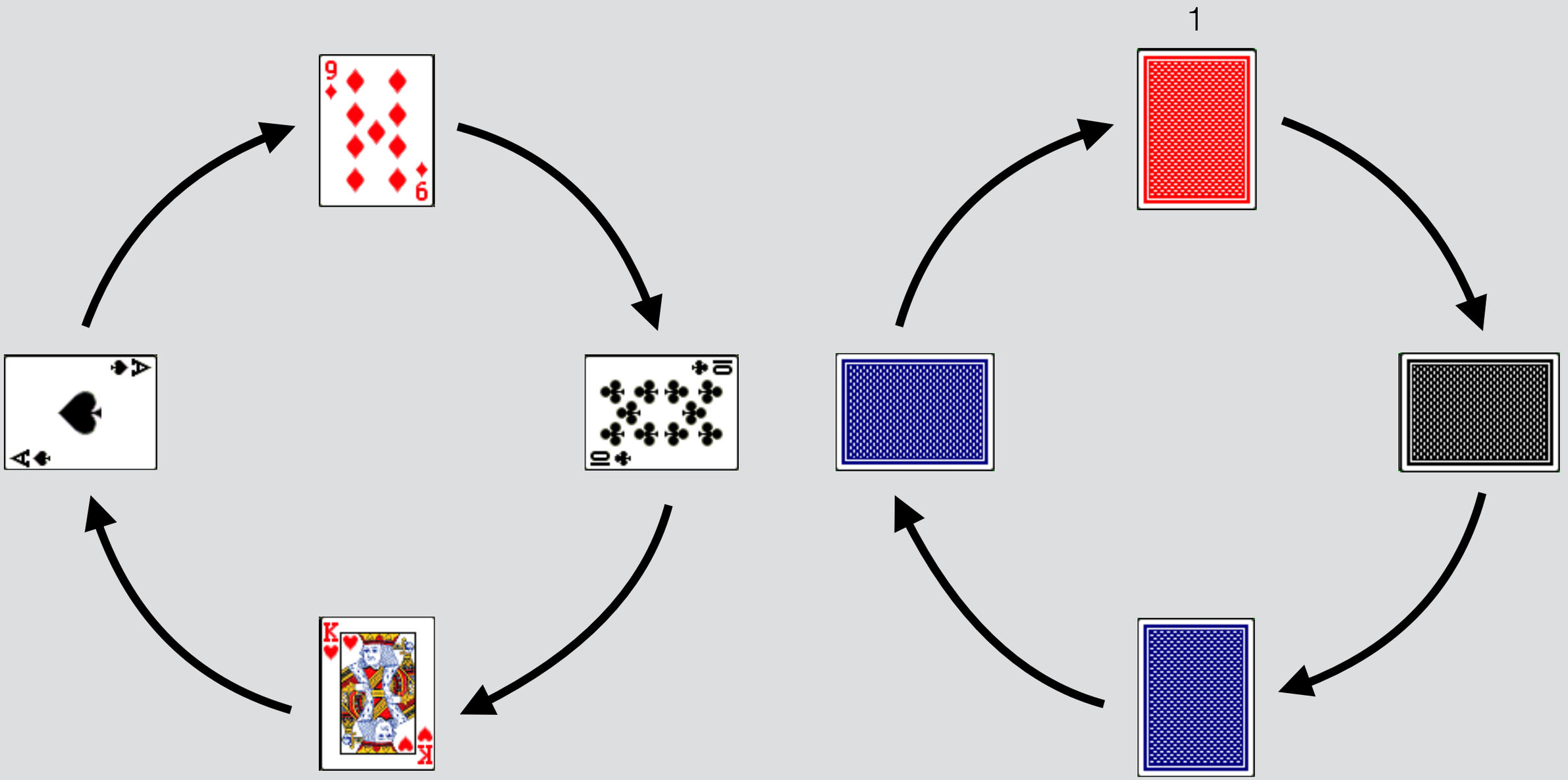
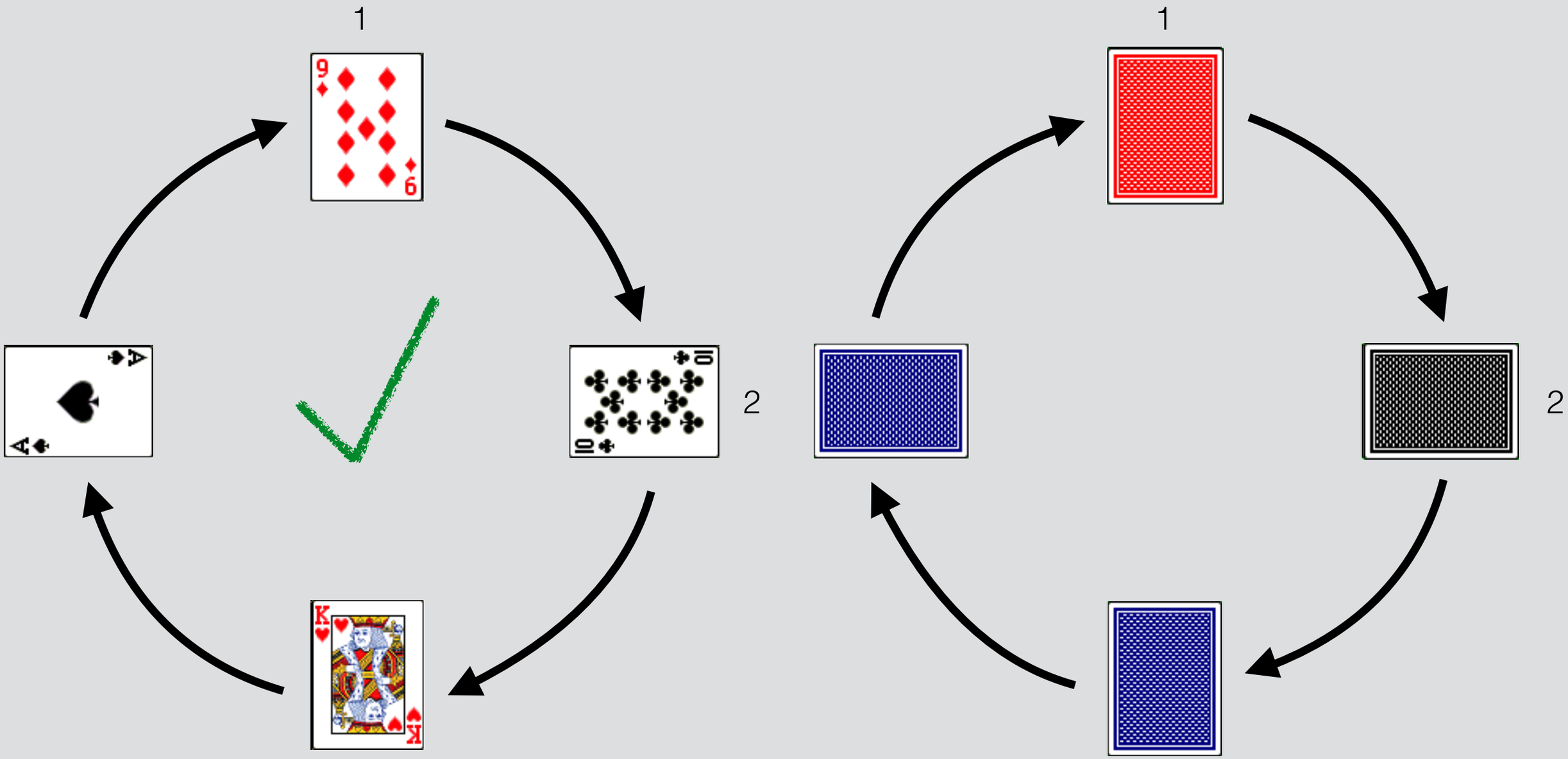


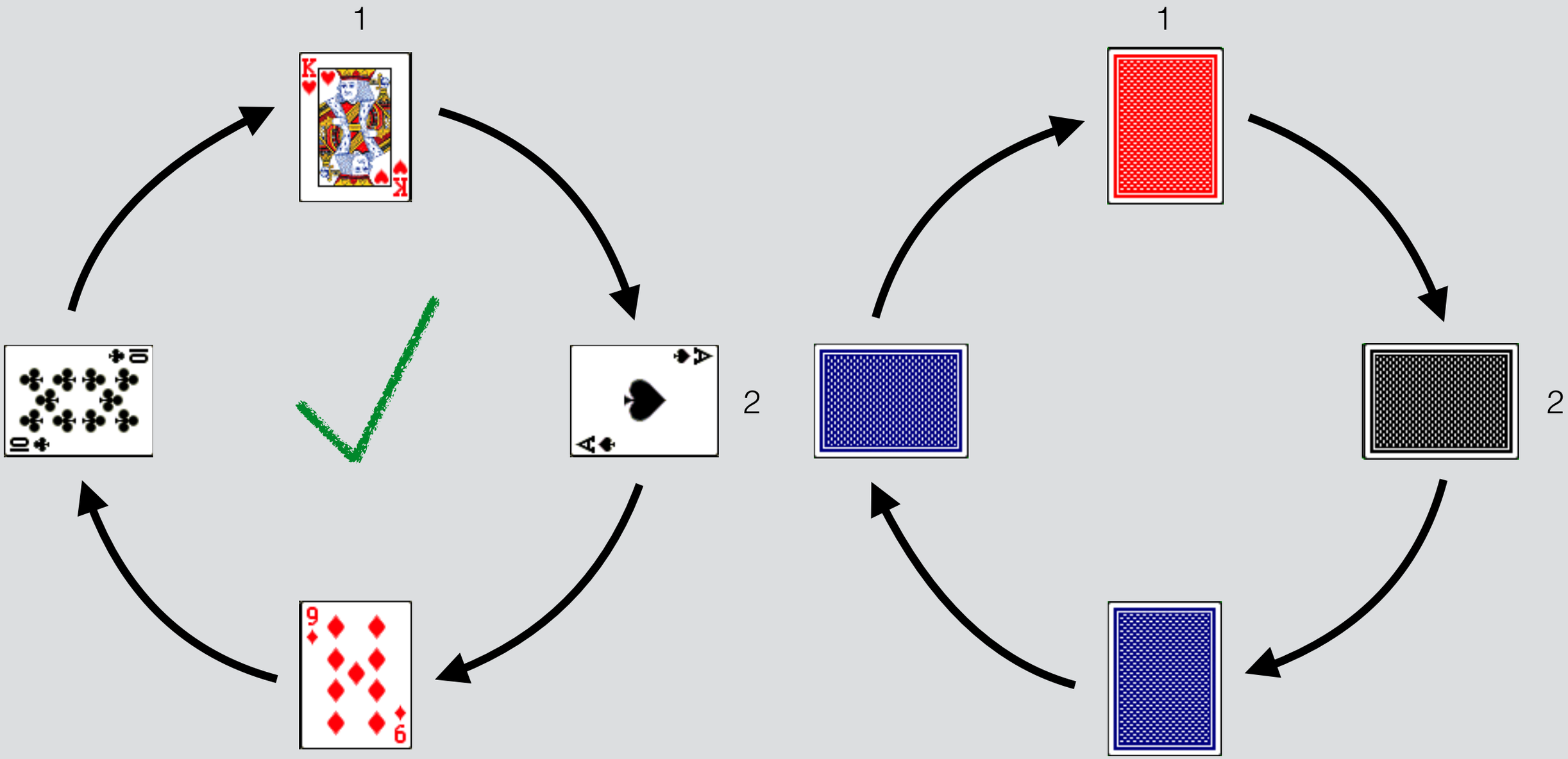
Order is important!



Order is important!



Order is important!



Uh oh :(

What’s special about the order?

What’s special about the order?

Every color combination only happens once!

What's special about the order?

Every color combination only happens once!

Can we do this trick with more cards?

What's special about the order?

Every color combination only happens once!

Can we do this trick with more cards?

Yes, but we need longer combinations!

The Magic of de Bruijn Sequences

Deck of 4 cards: 2 card combinations

BBRR

The Magic of de Bruijn Sequences

Deck of 4 cards: 2 card combinations

BBRR

Deck of 8 cards: 3 card combinations

The Magic of de Bruijn Sequences

Deck of 4 cards: 2 card combinations

BBRR

Deck of 8 cards: 3 card combinations

BBBRRRBR

The Magic of de Bruijn Sequences

Deck of 4 cards: 2 card combinations

BBRR

Deck of 8 cards: 3 card combinations

BBBRRRBR

Deck of 16 cards: 4 card combinations

The Magic of de Bruijn Sequences

Deck of 4 cards: 2 card combinations

BBRR

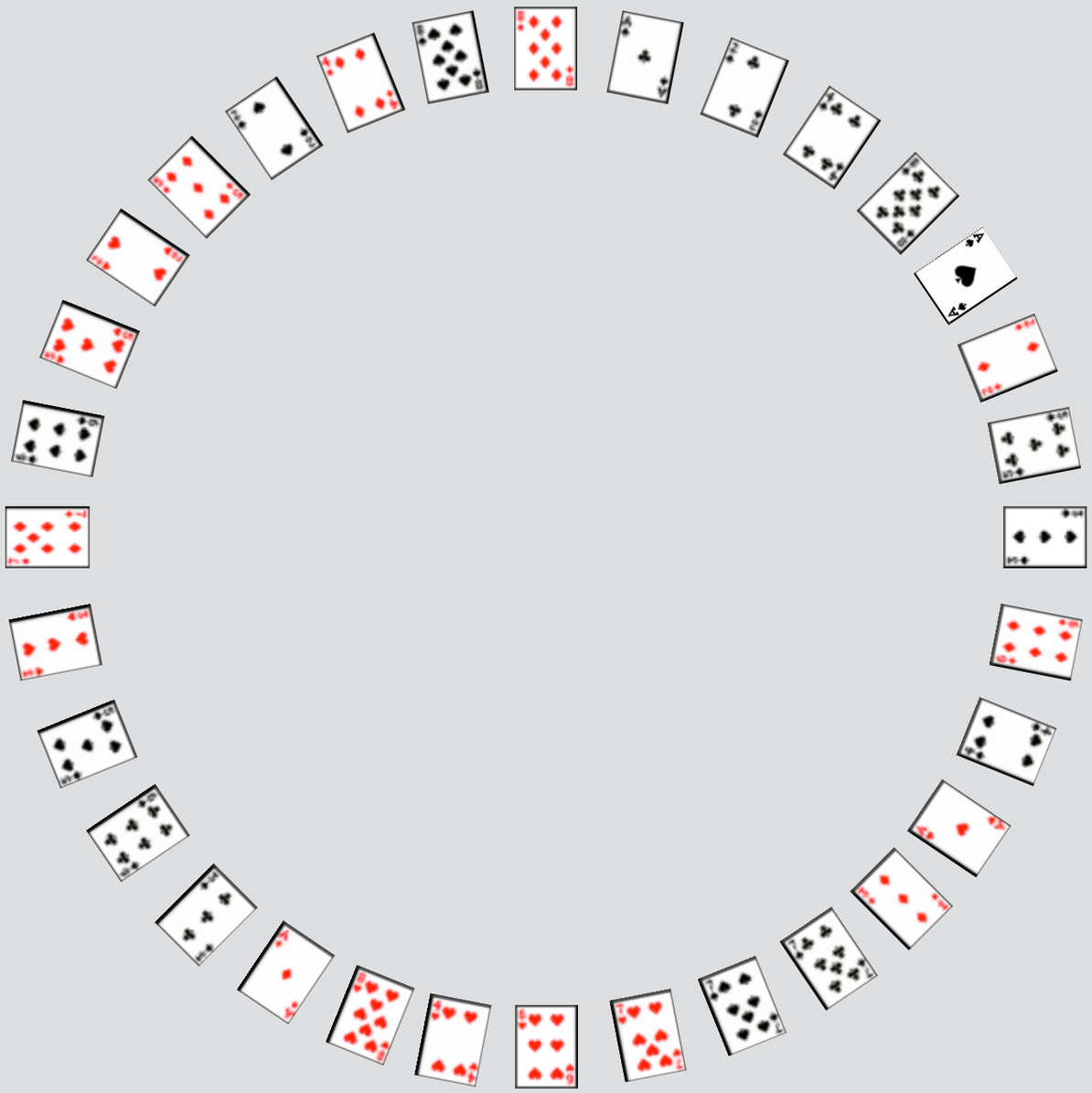
Deck of 8 cards: 3 card combinations

BBBRRRBR

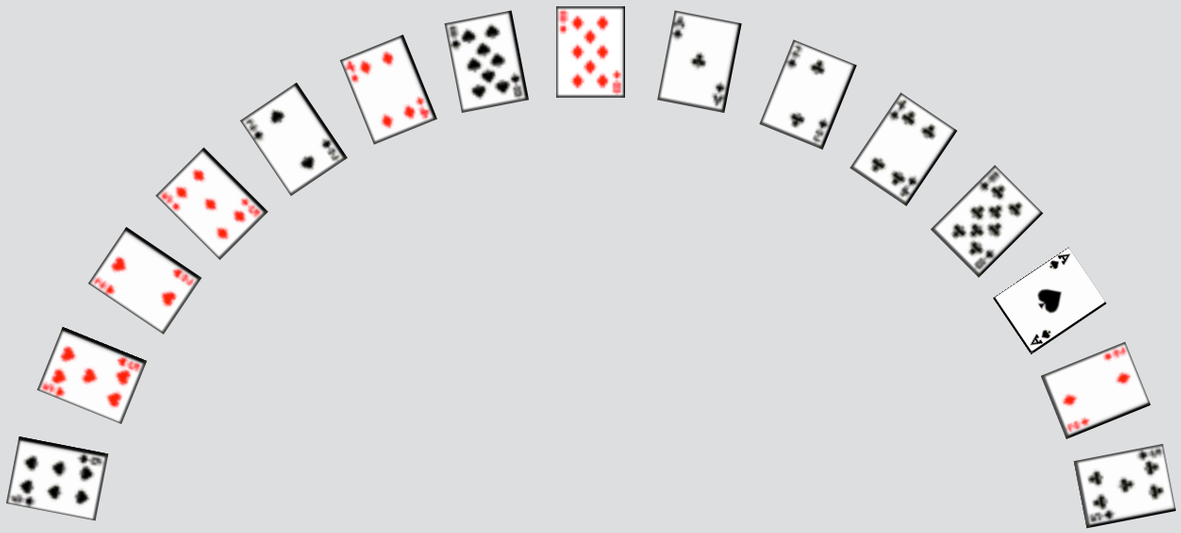
Deck of 16 cards: 4 card combinations

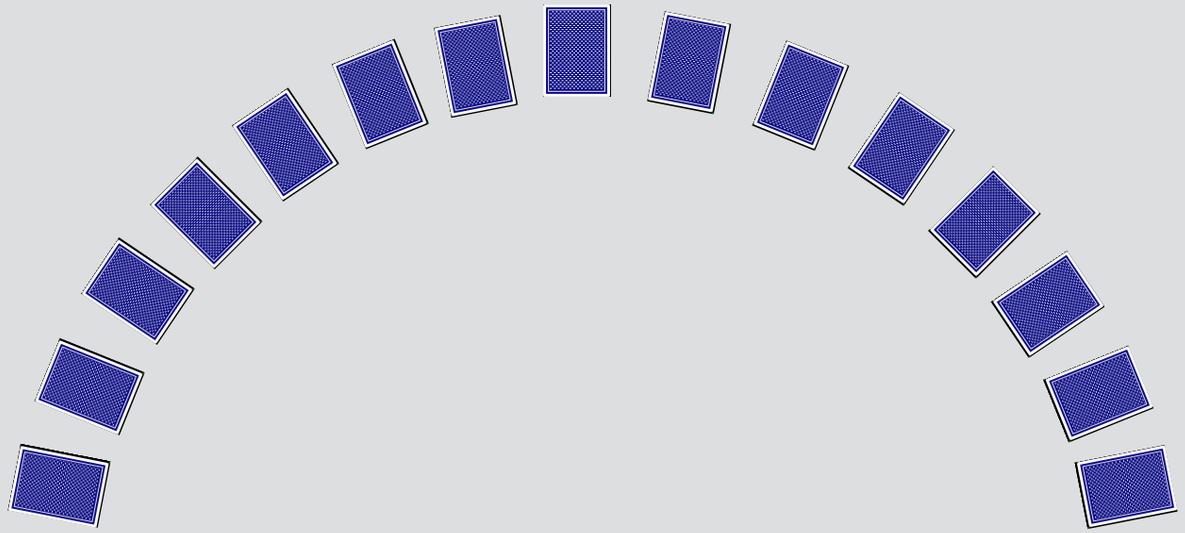
BBBBRBRRRRBBRRBR

Deck of 32 cards: 5 card combinations

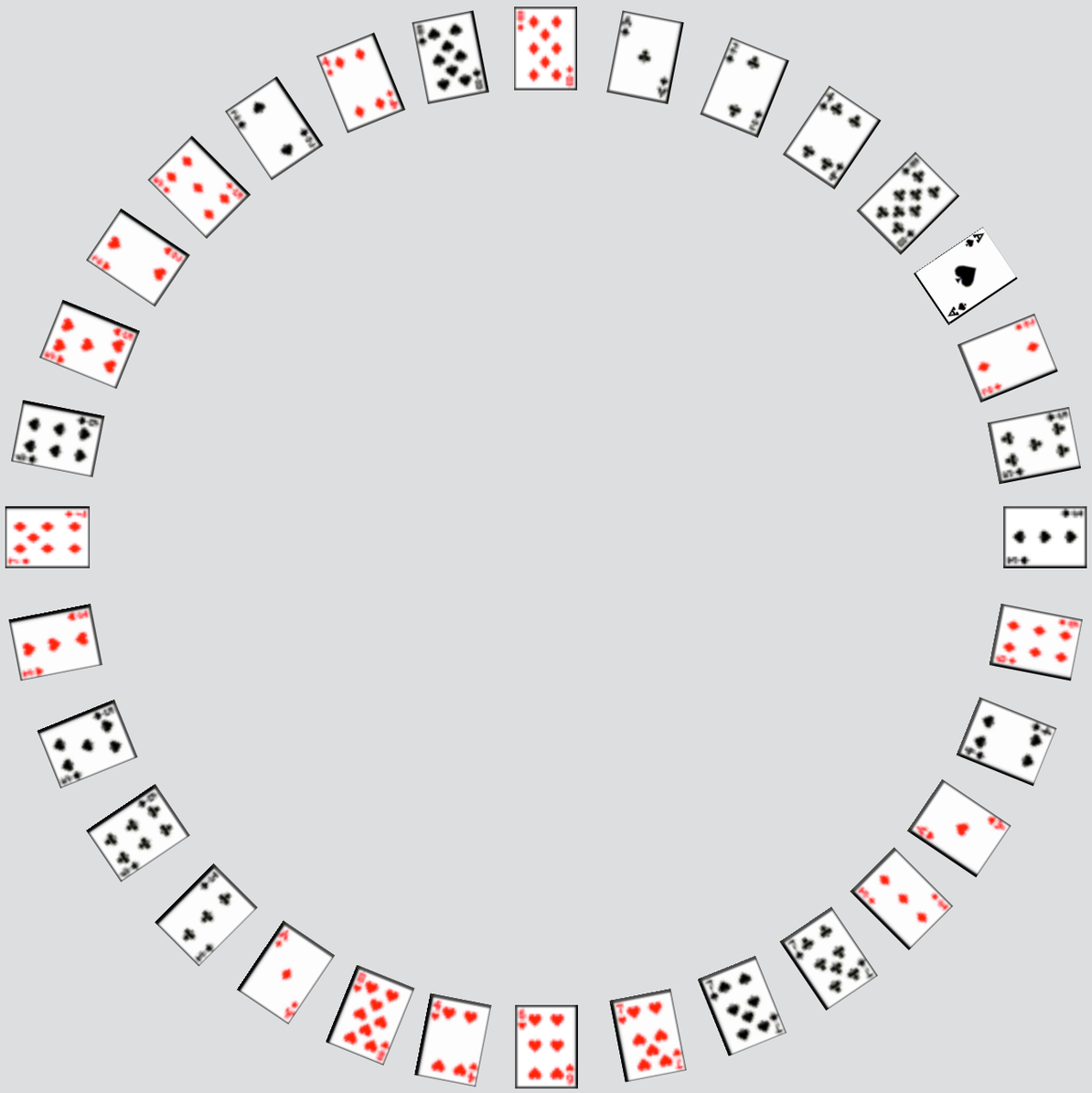


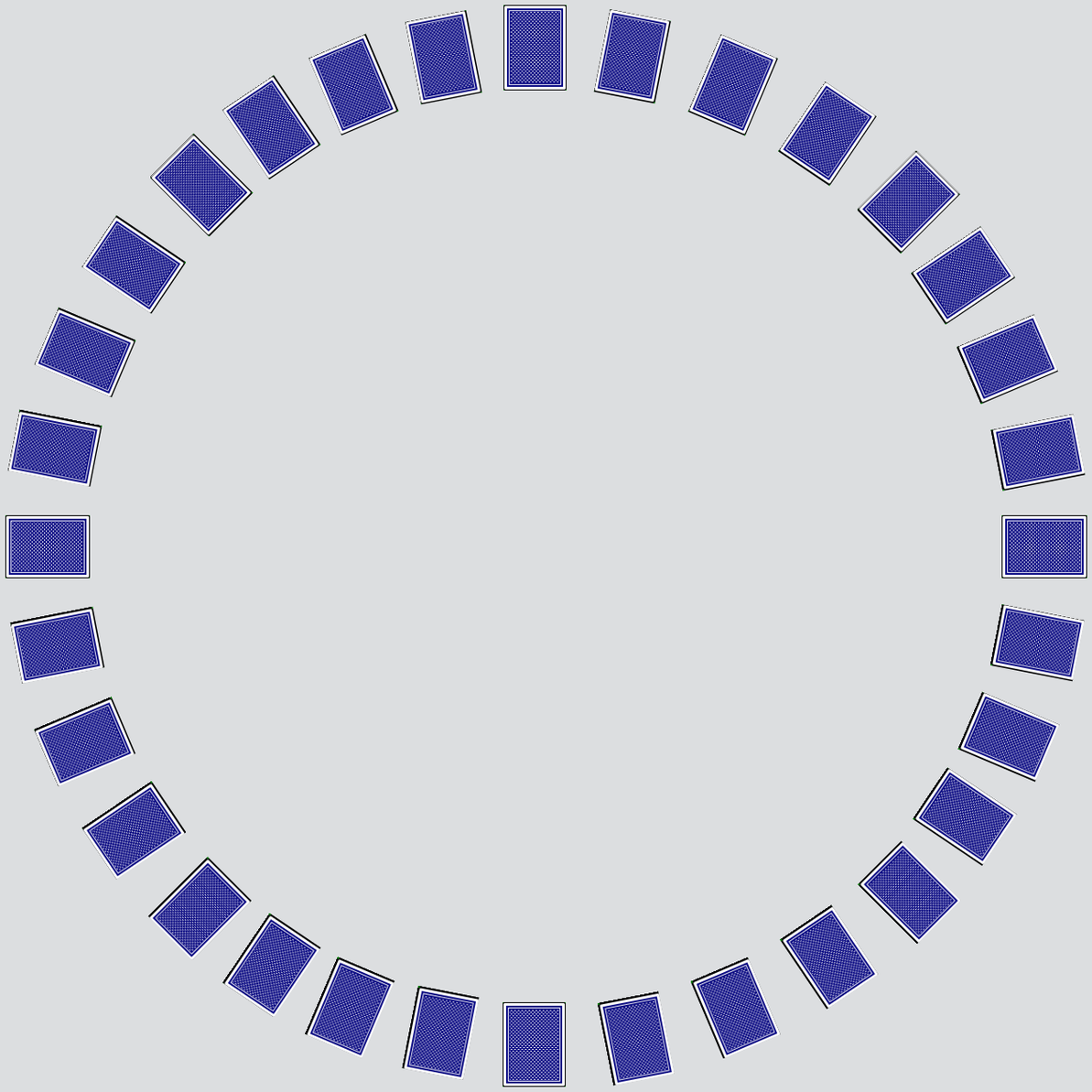
Deck of 32 cards: 5 card combinations



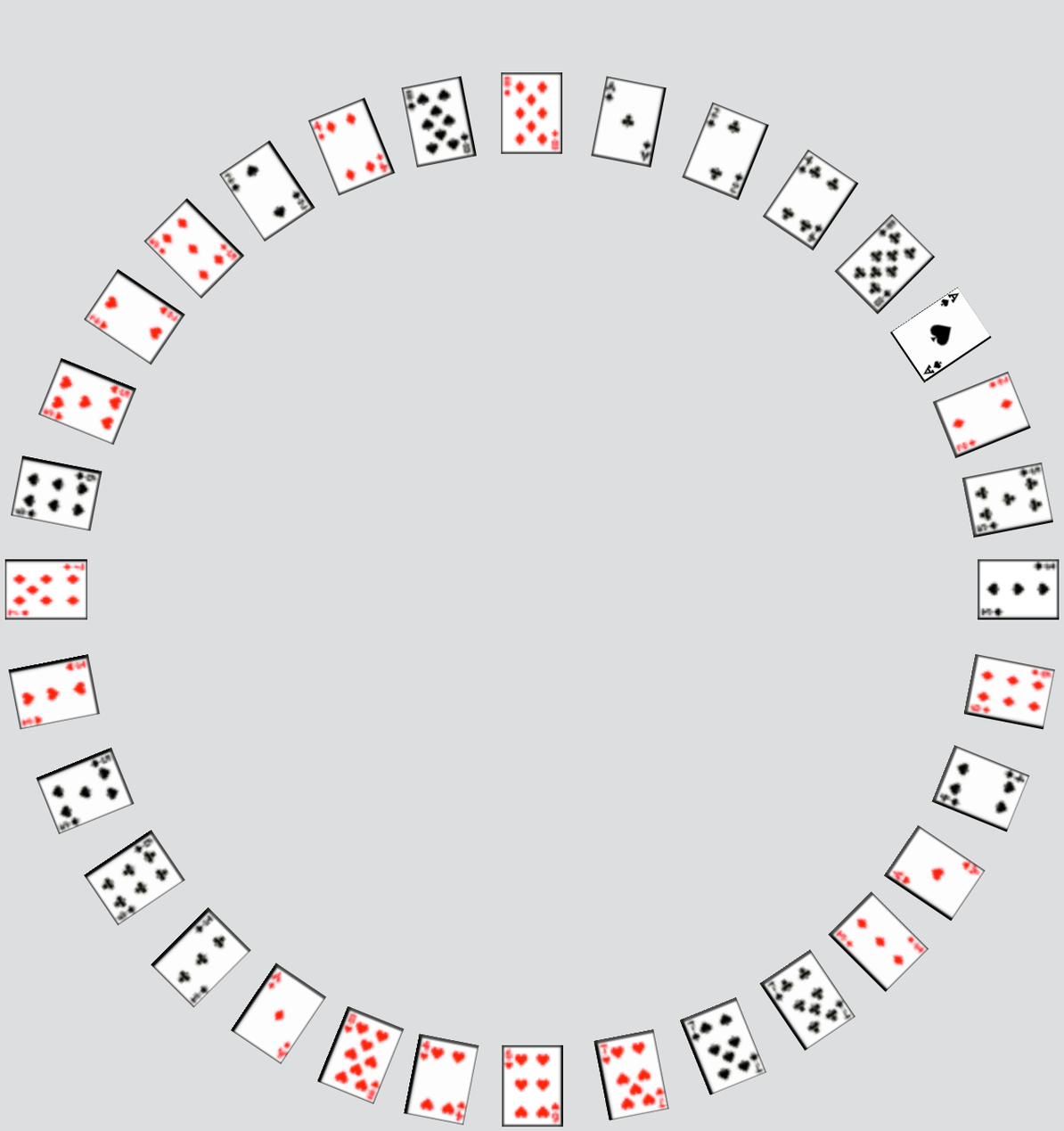


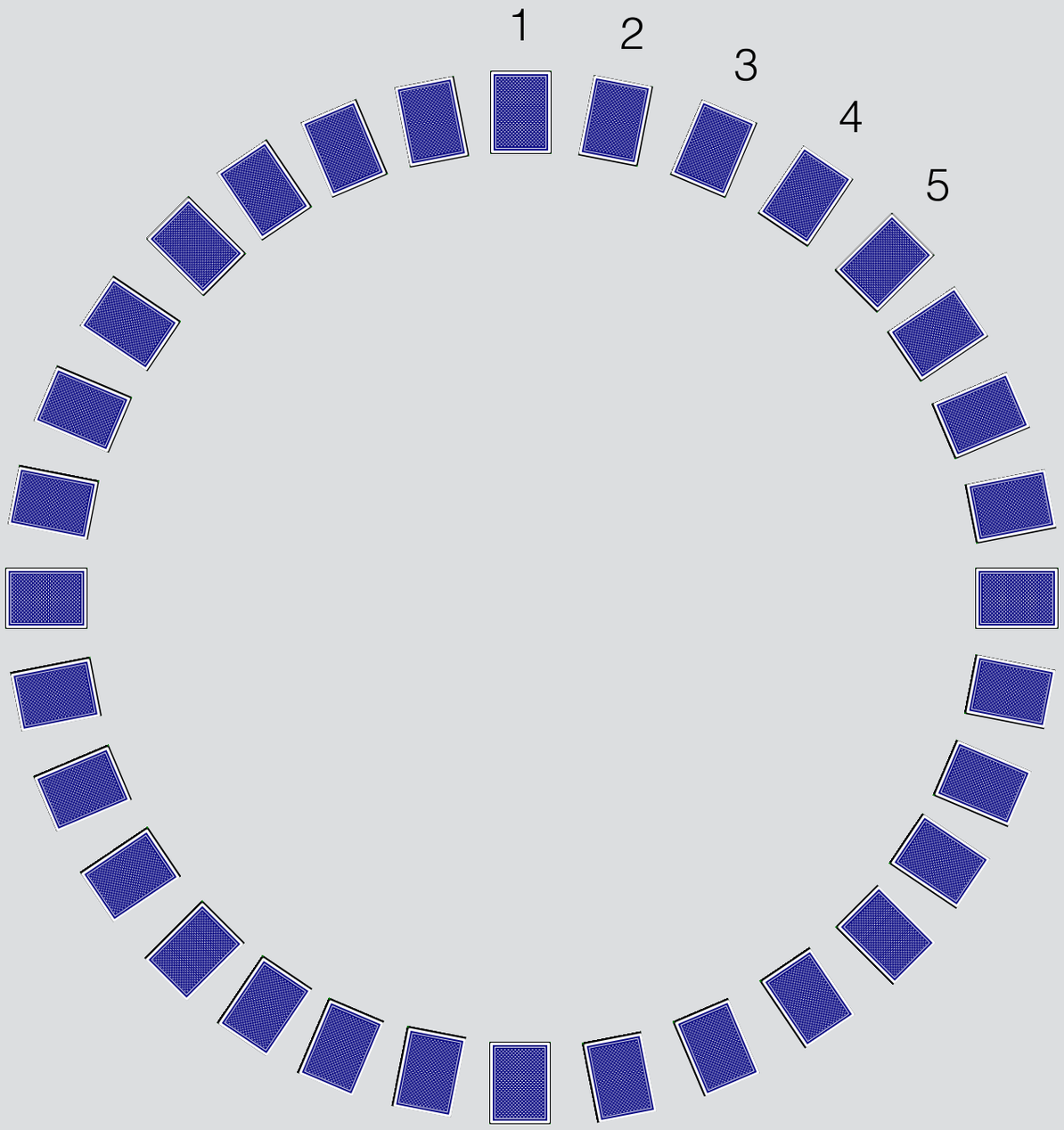
Deck of 32 cards: 5 card combinations



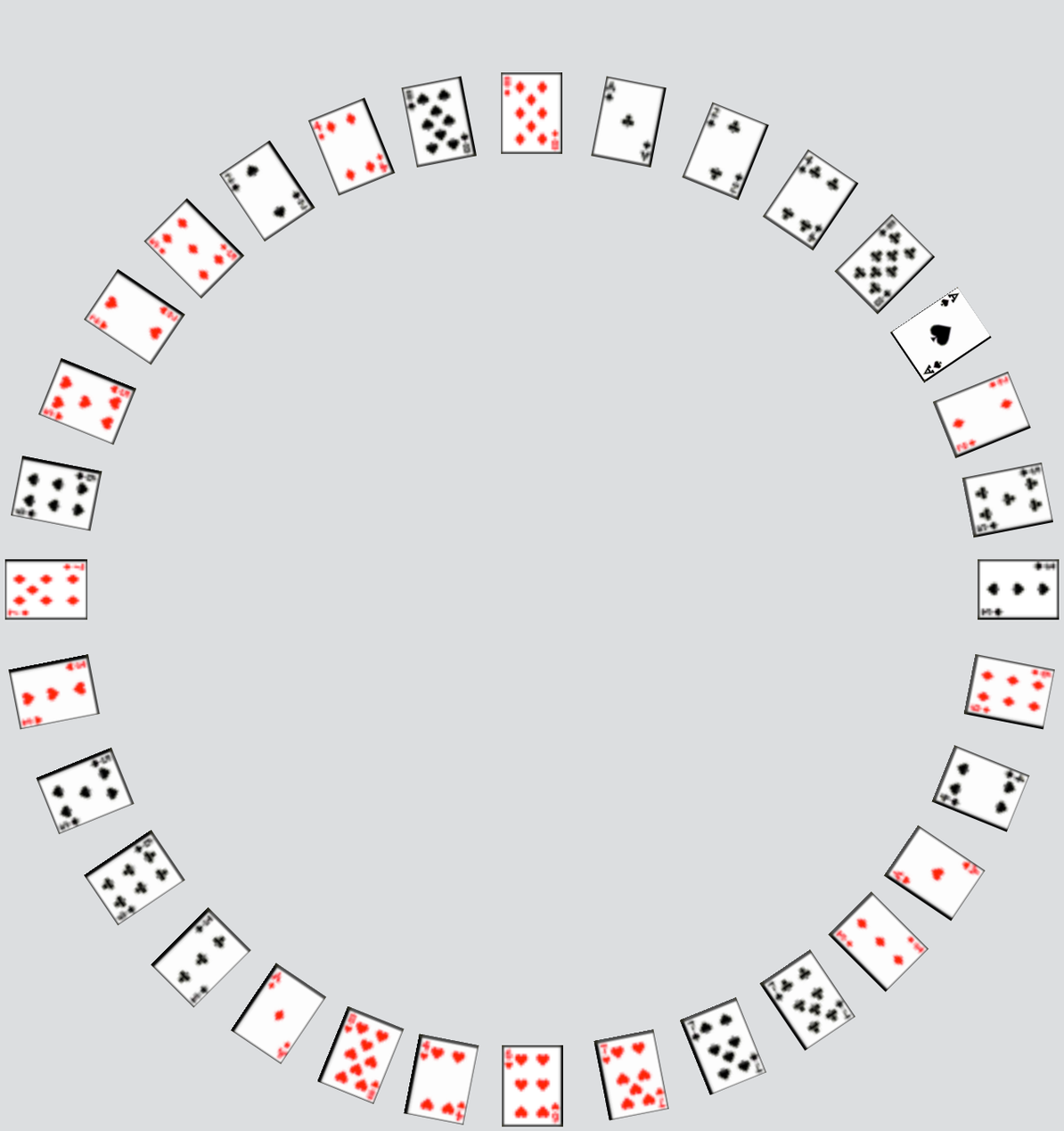


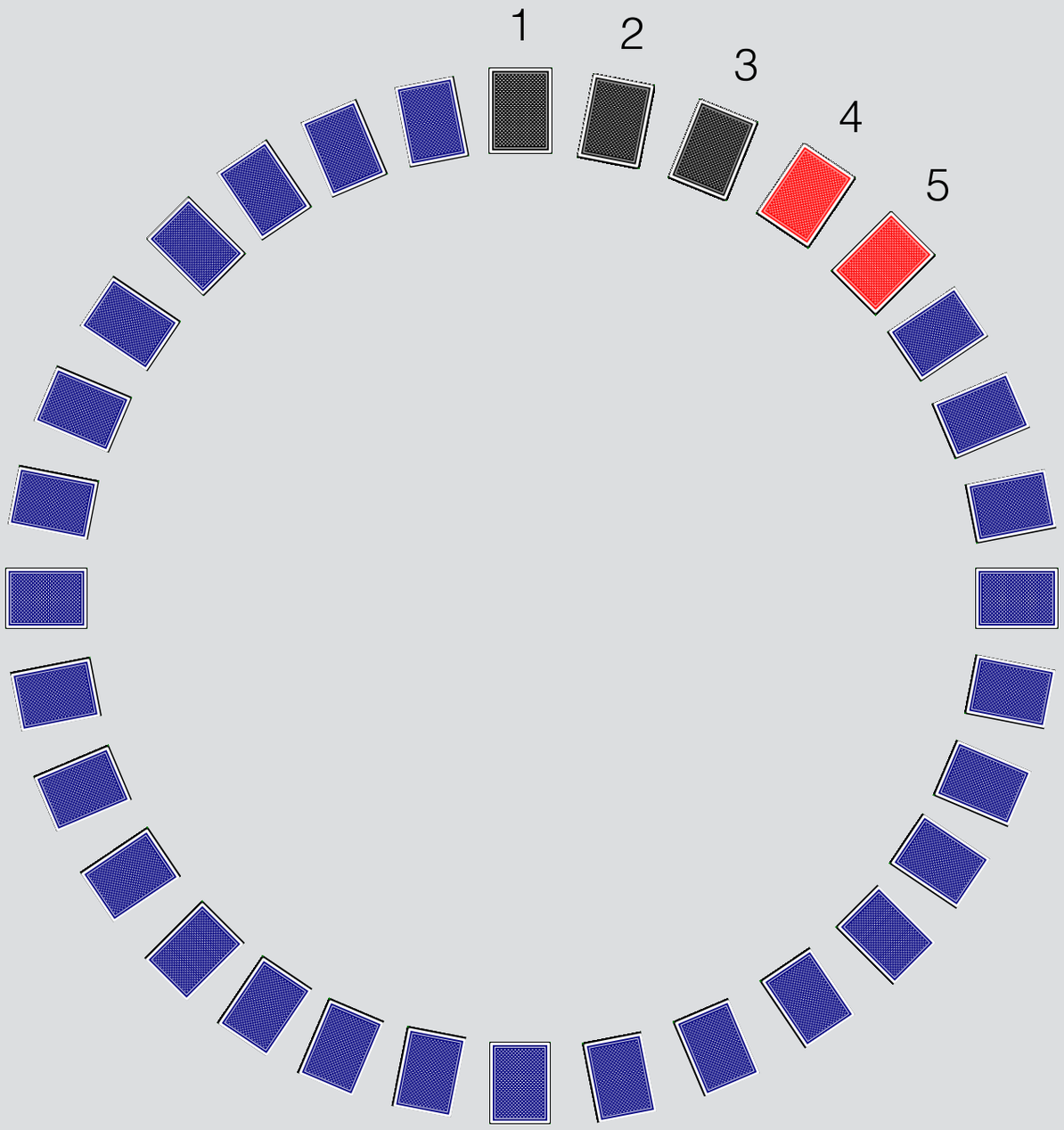
Deck of 32 cards: 5 card combinations



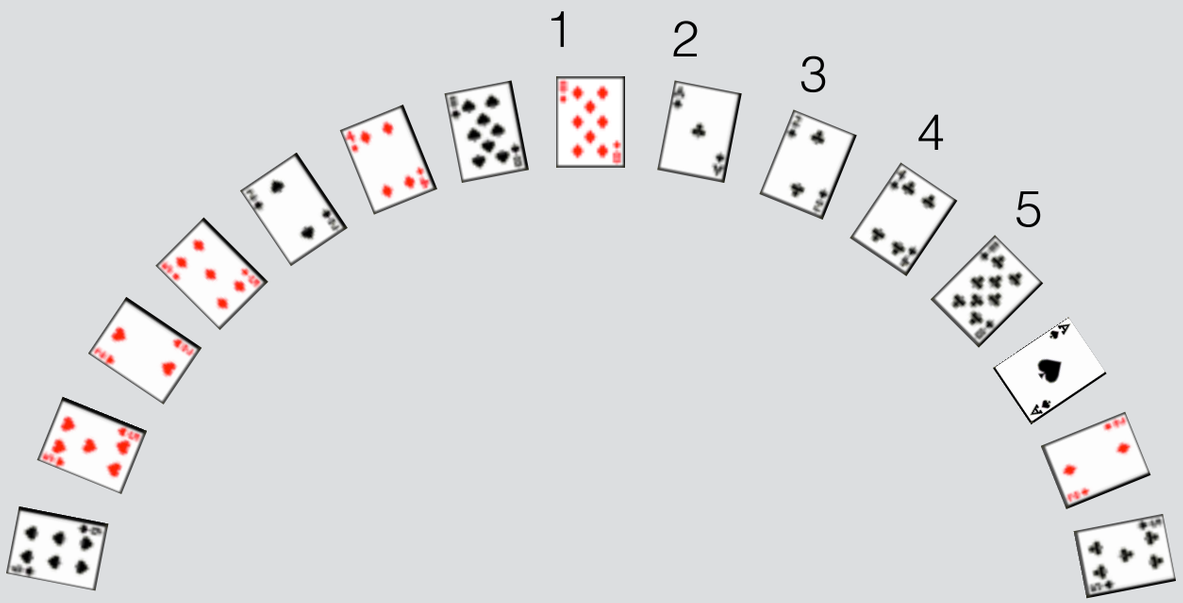


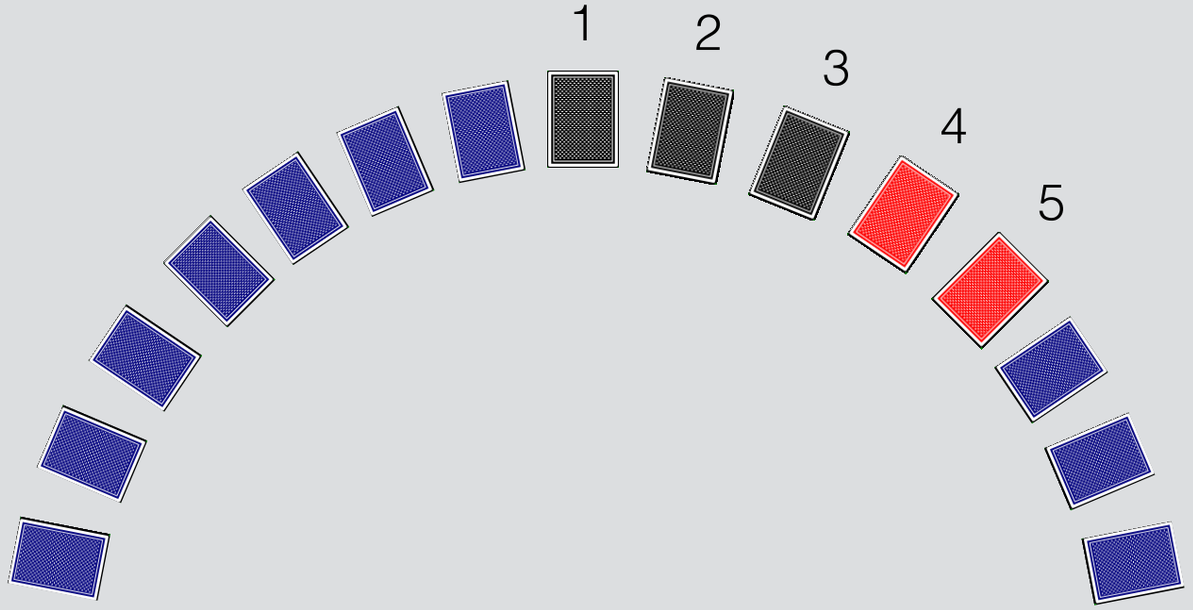
Deck of 32 cards: 5 card combinations



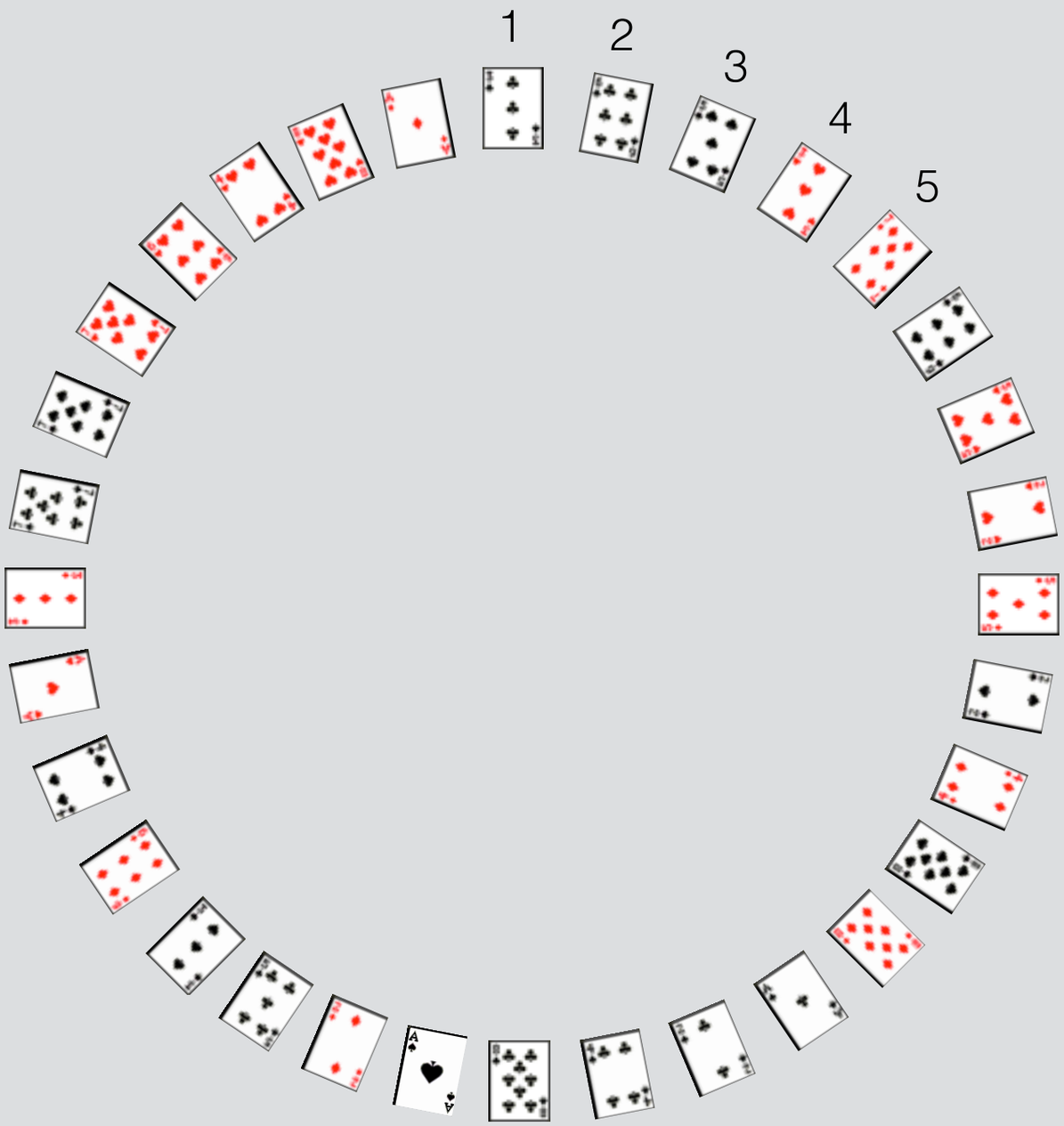


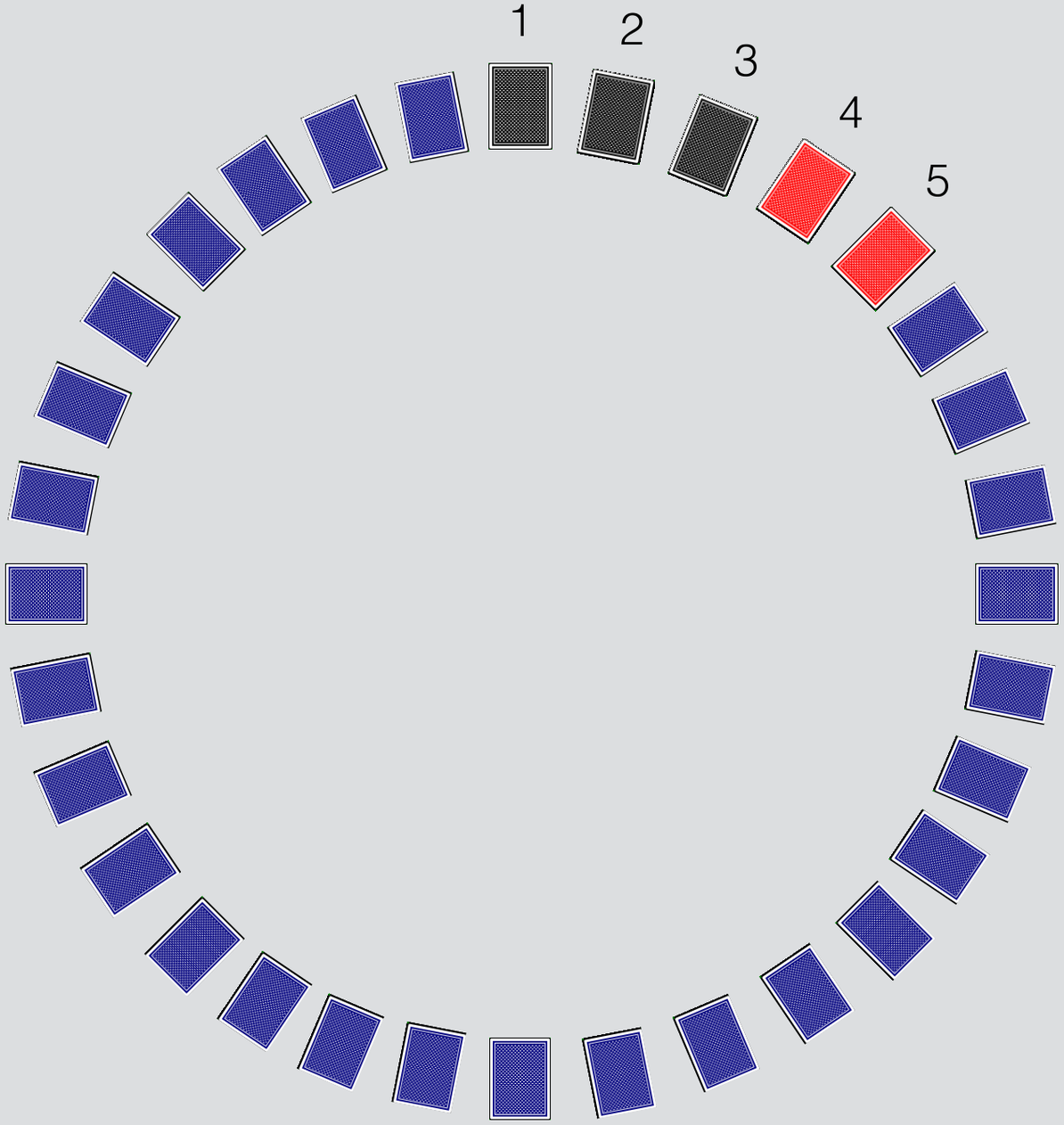
Deck of 32 cards: 5 card combinations





Deck of 32 cards: 5 card combinations





The Magic of de Bruijn Sequences

Reading DNA

Secret codes

Robot vision

Magical Mathematics!

Persi Diaconis

Ron Graham