

# Report Submission

CON101- Introduction to Computer Science and Engineering

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## 1 Introduction

There is a Professor and an Assistant. The Assistant goes into the audience with a deck of 52 cards while the Professor does not look there.

Five audience members each select one card from the deck. The Assistant then gathers up the five cards and holds up four of them so the Professor can see them. The Professor correctly names the secret, fifth card!

Such magic tricks are flooded and most of them have some mathematics as the underlying principle.

## 2 Mathematics behind the trick

1. As discussed by Dr. Naveen Garg, we can construct a bipartite graph as all possible set of 5 cards on left to sequence of 4 distinct cards on right. There is an edge between a set of 5 cards and a sequence of 4 if every card in the sequence is also in the set.
2. The Professor and the Assistant can decide it beforehand which sequence of 4 numbers to choose corresponding to the sequence of 5 vertices.
3. But the question arises, what should they decide upon beforehand so that they don't have to remember all the graph edges and cover all the possibilities at the same time. By pigeonhole principle we know that from a sequence of 5 cards, there will be at least 2 edges with same suit and.
4. Also, they can decide on the ordering like cyclic ordering and now the rank of the secret card is between 1 and 6 hops clockwise from the rank of the first card revealed.
5. So, the problem reduces to communicate a number between 1 and 6 which is achieved by assigning different ordering like this: LMH – 1 , LHM – 2 , MLH – 3 , MHL – 4 , HLM – 5 , HML – 6 (L: less, M: Medium, H: High)

### 3 Case of 4 cards

1. The main achievement in 5 cards was to reduce the whole of information on graph to communicating 6 numbers. Now with 4 cards from pigeon-hole principle, there will be 3 possibilities for each sequence. However, if somehow the Assistant conveys that which one is it, then it becomes possible.
2. There might be another way by deciding beforehand on the sequence by applying more constraints. Like so far, it was the normal ordering on cards, after that it can be color or something.
3. Basically we need one or two more parameters to reduce these 3 possibilities.

### 4 References

Mathematics for Computer Science by Eric Lehman