## Mathematics of shuffling

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## YouTube Live Streaming June 23th - 2 pm

https://www.youtube.com/watch?v=S7KTCA\_1ntk



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## Abstract

The crux of a card trick performed with a deck of cards usually depends on understanding how shuffles of the deck change the order of the cards. By understanding which permutations are possible, one knows if a given card may be brought into a certain position. The mathematics of shuffling a deck of 2n cards with two "perfect shuffles" was studied thoroughly by Diaconis, Graham and Kantor in 1983. I will report on our efforts to understand a generalisation of this problem, with a so-called "many handed dealer" shuffling kn cards by cutting into k piles with n cards in each pile and using k! possible shuffles.

Cheryl Praeger is Emeritus Professor of Mathematics at the University of Western Australia. In 2007 she won an Australian Research Council Federation Fellowship and in 2010-14 she served as inaugural Director of the Centre for the Mathematics of Symmetry and Computation at UWA. Her mathematical research work has transformed our understanding of how groups act on large complex systems, through new theories, constructions, algorithms and designs, which exploit the classification of the finite simple groups.

Professor Praeger received BSc and MSc degrees from the University of Queensland, a DPhil degree from the University of Oxford in 1973, and has received honorary doctorates from Universities in six countries on

three continents. She has served on the Executive of the International Mathematical Union and on the Council and Executive of the Australian academy of Science. She is a former Vice President of the International Commission for Mathematical Instruction, and former Foreign Secretary of the Australian Academy of Science. She is Fellow of the American Mathematical Society, an Honorary member of the London Mathematical Society, and she was the first woman to be President of the Australian Mathematical Society of which she is now an Honorary Life Member. In 2019 she was awarded the Prime Minister's Prize for Science in recognition of her incredible contribution to mathematics research and education in Australia and around the world. Professor Praeger has published more than 400 journal articles and five research monographs, many of them with her students (30 PhD students, 10 research masters students, 21 postdoctoral research associates) and research colleagues. She has played an active role supporting and mentoring young scientists, especially women.

A conjecture of Medvedoff and Morrison suggests that all possible permutations of the deck of cards are achieved, as long as k is not 4 and n is not a power of k. We confirm this conjecture for three doubly infinite families of integers, but the conjecture remains open. We initiate a more general study of shuffle groups, which admit an arbitrary subgroup of shuffles. This is joint work with Carmen Amarra and Luke Morgan.





