This talk surveys how $KAK$ decompositions of the unitary group have been applied to quantum computing. Such decompositions view $U(2^n)$ as the space of quantum computations of arbitrary complexity and (often) choose $K \subseteq U(2^n)$ to be the symmetry subgroup of the (real) quadratic form which carries $(x,y) \in (\mathbb{C}^{2^n})^2$ to the component of $x$ on the spin-flip of $y$. In two qubits, $K = SU(2) \otimes SU(2)$ which is conjugate to $SO(4)$, and $U(4) = SU(2) \otimes^2 A SU(2) \otimes^2$ has been exploited in quantum control theory (Khaneja,Brockett,Glaser, Physical Review A 63 032308) and CNOT-optimized two qubit logic circuits (Vidal, Dawson PRA 69 010301) (Shende, Bullock, Markov, PRA 70 012310). In the general case, $K$ is symplectic or orthogonal as $n$ is odd or even, and in the latter case the $KAK$ decomposition has implications for an entanglement monotone (Bullock,Brennen,O’Leary, Journal of Mathematical Physics 46 062104). Certain constructions generalize to involutions other than spin flips (D’Alessandro,Albertini preprint). (Received September 12, 2007)