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Schreier–Sims algorithm

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The **Schreier–Sims algorithm** is an [algorithm](#) in [computational group theory](#) named after mathematicians [Otto Schreier](#) and [Charles Sims](#). Once performed, it allows a linear time computation of the [order](#) of a finite group, group membership test (is a given permutation contained in a group?), and many other tasks. The algorithm was introduced by Sims in 1970, based on [Schreier's subgroup lemma](#). The timing was subsequently improved by [Donald Knuth](#) in 1991. Later, an even faster [randomized](#) version of the algorithm was developed.

Background and timing [\[edit\]](#)

The algorithm is an efficient method of computing a [base](#) and [strong generating set](#) (BSGS) of a [permutation group](#). In particular, an SGS determines the order of a group and makes it easy to test membership in the group. Since the SGS is critical for many algorithms in computational group theory, [computer algebra systems](#) typically rely on the Schreier–Sims algorithm for efficient calculations in groups.

The running time of Schreier–Sims varies on the implementation. Let $G \leq S_n$ be given by t [generators](#). For the [deterministic](#) version of the algorithm, possible running times are:

- $O(n^2 \log^3 |G| + tn \log |G|)$ requiring memory $O(n^2 \log |G| + tn)$
- $O(n^3 \log^3 |G| + tn^2 \log |G|)$ requiring memory $O(n \log^2 |G| + tn)$

The use of [Schreier vectors](#) can have a significant influence on the performance of implementations of the Schreier–Sims algorithm.

For [Monte Carlo](#) variations of the Schreier–Sims algorithm, we have the following estimated complexity:

$$O(n \log n \log^4 |G| + tn \log |G|) \text{ requiring memory } O(n \log |G| + tn)$$

In modern computer algebra systems, such as [GAP](#) and [Magma](#), an optimized [Monte Carlo algorithm](#) is typically used.

References [\[edit\]](#)

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Categories: [Computational group theory](#) | [Permutation groups](#)

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