Parameterized Algorithms for $k$-Internal Out-Branching

Solve many NP-hard problems by confining the combinatorial explosion to a parameter $k$.

- $O(3^k n^3)$
- $O(k! n^3 \log n)$
- $O(2^k n)$

Contribution?

The current fastest randomized algorithms for $k$-Internal Out-Branching:

- General graphs: An $O^*(4^k)$ time algorithm.
- Bounded degree graphs: A better algorithm.

How?

- A reduction to the $(k,l)$-Tree problem.
- Multilinear detection (an algebraic technique).
- A proper coloring of the input graph.

$k$-Internal Out-Branching?

Find an out-branching with at least $k$ internal nodes.

(spanning tree with exactly one node of in-degree 0)

Input: $k = 10$

Incorrect:

Correct:

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