

reduce to APSP with nonnegative edge weights.

1.  $O(nm)$  using SSSP [2].
2. randomized  $\frac{n^3}{2^{\Omega(\sqrt{\log n})}}$  [3], and deterministic  $\frac{n^3}{2^{\Omega(\sqrt{\log n})}}$  [1].

## References

- [1] Timothy M. Chan and Ryan Williams. Deterministic apsp, orthogonal vectors, and more: Quickly derandomizing razborov-smolensky. In *Proceedings of the twenty-seventh annual ACM-SIAM symposium on Discrete algorithms*, pages 1246–1255. Society for Industrial and Applied Mathematics, 2016.
- [2] Mikkell Thorup. Undirected single-source shortest paths with positive integer weights in linear time. *Journal of the ACM (JACM)*, 46(3):362–394, 1999.
- [3] Ryan Williams. Faster all-pairs shortest paths via circuit complexity. In *Proceedings of the forty-sixth annual ACM symposium on Theory of computing*, pages 664–673, 2014.