EE 382V: Parallel Algorithms **Summer 2017**

Lecture 1: June 9

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1.1 Introduction

Students in EE 382V are required to scribe lecture notes for one lecture. These lecture notes will be done using the document processing system called Latex. We have posted the file *scribe.tex* on the Canvas system. You can run `pdflatex` on that file to generate *scribe.pdf*. The remaining document shows usage of some of the commands in Latex.

1.2 All Pairs Shortest Paths

The naive and obvious solution to All Pairs Shortest Path(APSP) problem is to run a Single Source Shortest Path algorithm from each starting vertex v. If the graph has arbitrary edge weights, it takes the Bellman-Ford algorithm $O(|E||V|^2)$ time to solve APSP. But there are better approaches.

1.2.1 Floyd-Warshall Algorithm: Dynamic Programming

Label the vertices $1, 2, \ldots, n$. Define $d^{(k)}(i, j)$ to be the length of a shortest path from i to j, using intermediate vertices from $\{1, 2, \ldots, k\}$ only. Obviously, $d^{(n)}(i, j)$ is the full problem.

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1.3 Transitive Closure

Our goal is to achieve running time $O(M(n) \log n)$ for APSP where $M(n)$ is the time for $n \times n$ matrix multiplication. Let's see if we can achieve this for a simpler but related problem, namely *Transitive Closure*:

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References

[AGM97] N. Alon, Z. Galil and O. Margalit, On the Exponent of the All Pairs Shortest Path Problem, *Journal of Computer and System Sciences* **54** (1997), pp. 255–262.

[F76] M. L. Fredman, New Bounds on the Complexity of the Shortest Path Problem, *SIAM Journal on Computing* **5** (1976), pp. 83-89.