Micro-Survey - 1

Why do we want the DAG we can build from $G^{SCC}$?

• Many algorithms only work on DAGs, so now you can use them on the graph

• Lots of algorithms are very “expensive” so we can use the SCC version of the graph to cut down on the work we have to do.

• Big example is model checking: uses a state machine and explores all possible paths looking for counterexamples to some property (usually temporal). State explosion occurs. So we want the minimal number of states we can get away with.

• Looking for relationships among groups (people in social networks, pages in a website, ....)

• Finding cycles – if you find an SCC with >1 node, then there is a cycle. State machine checking, program static analysis, ...
Why use $G^T$? How do you related the 2 DFS results?

Let’s go back to the archaeology example. If we start at K, it will have $u.\pi = \emptyset$. When M or N get to it, it will already be black, so $u.\pi$ won’t change. Thus, it will look like a root, as do M and N.

BUT M and N will both have finish times AFTER K, so in the $v_{ord}$ list they will come before K when we run DFS on $G^T$. By running DFS on $G^T$ we’ll pick up the fact that either M or N is reachable from K, and one of them will be the root of that SCC, and K and all of its descendants in G will be identified as being part of that SCC.
Why doesn’t a sink node in G change the SCC in $G^T$?

- Because of the order in which we visit nodes when doing the DFS on $G^T$.

![Graph G](image1)

$v_{ord} = b, e, a, c, d, g, h, f$

![Graph $G^T$](image2)
How does topological sort fit into DFS?

• Topo sort runs a DFS on a DAG to figure out a valid precedence order of nodes

Why does running DFS on $G^T$ come up with the same SCCs?

• Because the edges in $G$ create a path between each pair of nodes in the SCC, and since we changed the direction for all of the edges in the path, we can traverse the same path, just in the opposite direction.

• The exception is if we didn’t get all of the nodes in the SCC of $G$ (see example on 2$^{nd}$ slide), so we’ll get the rest of the SCC when running DFS on $G^T$. 