Announcements:

- Today: exam review
- Review session: Tues 12/12 5:00 - close, 156 Henry Admin. Bldg.
- Final exam: Thurs 12/14, 8:00 - 11:00 am, 132 Bevier Hall

  TWO reference sheets (2x front and back) allowed

  Cumulative: everything from the course is fair game

  See Monday's email for full policies

Basic def'ns (e.g. vertex, edge, simple graph, etc.)

Basic examples (e.g. K_n, C_n, P_n, $K_{r,s}$, small examples)

Classes (e.g. trees, bipartite graphs, weighted graphs, digraphs)

Paths/cycles/walks/trails/circuits

Ch. 1 Theorems:

Eulerian circuits/trails for graphs/digraphs

Mantel's Theorem (max. edges in $\triangle$-free graph)

Konig's Theorem (bipartite $\leftrightarrow$ no odd cycles)

Havel-Hakimi Theorem

Trees:

- Equiv. defns
- Prüfer code & Cayley's formula
- Spanning subgraphs & spanning trees
- Matrix tree thm.
- Kirchoff's Laws and Kirchoff's Thm.

Algorithms:

- Kruskal (min. wt. spanning tree)
- Dijkstra (distances)
- Gale-Shapley (stable matching)
- Algorithmic thinking

Matchings:

- Perfect vs. maximum vs. maximal (general concept)
- M-alt. paths & M-aug. paths
- Theorems: Berge, Hall, Tutte, Berge-Tutte, Petersen x2
- Relationships btwn. matchings, vertex/edge covers, and indep. sets
- k-factors

Vertex/edge connectivity:

- Def'ns
- Whitney's Thm.
- Different characterizations of 2-connectivity and 2-edge-connectivity
- Digraph vertex/edge connectivity
- Menger's Theorem (4 versions)

Max-flow, min-cut theorem

- Def'ns
- Theorem itself
- Ford-Fulkerson algorithm

Connections between: flows, cuts, (edge)-disjoint paths, matchings, indep. sets, vertex/edge covers, etc.

Vertex coloring

- Def'ns (e.g. Chromatic number, k-criticality)
- "Easy bounds", and more difficult ones (e.g. Brooks' Thm.)
- Greedy coloring: Algorithm & Consequences

- Mycielski's construction and theorem
- Chromatic polynomial
  - Values / how to compute for small graphs
  - Deletion-contraction recurrence

Planar graphs

- Planar graph vs. plane graph vs. planar embedding
- Dual graph & vertices/edges/faces (degree sum x2)
- Euler's formula & consequences
  - Polyhedra
  - $e(G) \leq 3n(G) - 6$
  - Nonplanarity of K_5 & $K_{3,3}$
- Triangulations (equiv. defns)
- Kuratowski's thm. and proof of easy direction
- k-color theorems and proof technique

Examples:

1) Let G be a graph w/ ≤ 11 vertices.

Without using the 4-color theorem, prove that G is 4-colorable.

2) Use network flows to prove that for any two nonadjacent vertices $x, y \in V(G)$,

$$K(x,y) = \lambda(x,y).$$