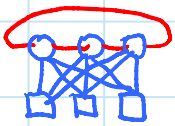
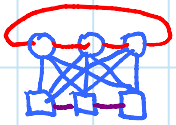
6.892	Class 4	Feb. 27, 2019

Recall: [L7]



- monotone 3SAT remains NP-hard when variable-clause bipartite graph + cycle through all variables is planar, even with pos./neg. edges on opposite sides of the variable cycle ← e.g. x axis

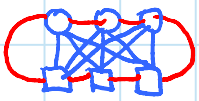


- 3SAT is polynomial when variable-clause bipartite graph + cycle through all variables + path through all clauses is planar
  ↳ forced on one side of var. cycle

what if path? hard!

Linked Planar 3SAT: [Pilz 2018] "Mario SAT"

not monotone



- 3SAT-3 remains NP/#P/ASP-hard when variable-clause bipartite graph + cycle that visits all variables & then visits all clauses is planar, even with pos./neg. edges on opposite sides of the cycle
- without side constraint, same holds for
  - monotone 3SAT-3
  - E3SAT (except ASP)
  - positive 1-in-3SAT
- Careful: planar ⇒ E4SAT & monotone E3SAT & sided linked monotone 3SAT are $\in$ P!

Proof: reduction from Planar 3SAT
- cool trick to view Hamiltonian cycle as alternating sequence of vertical lines
- crossing removal gadget
- quadratic blowup
- sided & -3: use bigger chains
- monotone 3SAT: alternate $x, \bar{x}$ copies
- E3SAT uses a trick by [Mansfield 1973]
  - c-monious but not parsimonious

Corollary: the following reductions no longer need a crossover gadget
- Super Mario Bros. (with adjustment)
- Super Mario World (with adjustment)
- Legend of Zelda hookshot (with adjustment)
- Metroid (with adjustment)

- but: need clause to take unlock signals from both sides of check path

Research timeline: the typical workflow

focus so far

1. pose open problem → staff's job, but you can too!
2. brainstorm solution → during/between classes
3. write paper → time consuming!
   - call for authors (everyone chooses whether they contributed "enough" e.g. via ideas, solutions, counterexamples, asking questions, discussion, writing) (we can help judge if you're unsure)
   - write formal proofs in LaTeX via Github or Overleaf
     - often find bugs/oversights!
   - write motivation/context (Introduction)
4. submit paper to conference and/or journal
   - choose venue
   - work toward deadline
5. revise paper based on referee comments

→ all optional for 6.892, but good for career & community

Relation to final projects: PROPOSALS DUE APRIL 2

- writing up (3) collaborative work from class is highly encouraged!
- should discuss (e.g. via Coauthor) who's doing what on paper/project writing
- working on multiple projects is OK — just make sure $\sum_i$(contributions) sufficient