12s: NP Complete Problems Friday, April 30, 2021 11:20 AM **Goals:** Understand meaning of NP-Hard, NP-Complete • Start describing reduction of 3SAT to HamPath **Announcements:** • Go/middhacks2022 • Great exit tickets on Friday- see pinned discussion for my responses • Don't forget about quiz, midterm revisions! Don't leave for the last minute! 35AT Halting Problem 3 SAT Ep Ham Path Hard HamPath Sp 35AT · NP-pute. 1 Ham Path In fact, if find a fast NP alg for 3SAT or HamPath, you could use it to solve every other problem in NP. Closest Points MW15 on a live solver (M, Vu_2) ... 35AT Ham Path - f(x)-Solver 15 X a YCS
Instance of polynomial
SSXT polynomial NP-Hard: QENP-Hard if YRENP, REPQ For all RENP R Solver poly time def: NP-Complete: If QENP-Hard Then QENP-Complete / How? Show 3-SAT =pQ Theorem: of 3SATEPQ then QENP-Hard: Mis function exists 3SAT Solver $3 \longrightarrow y' \rightarrow [] \longrightarrow Q(y') \longrightarrow 3SAT(y)$ +3SAT >Q Solver paynomial Fact: 3SAT is NP-Hard (See 301). So & RENP K Golver 3SAT tR=335AT Mon for any RENP, REPQ, because. K Solver $\begin{array}{c|c}
f_{2\rightarrow3SAT} & f_{3SAT\rightarrow0} \\
\Rightarrow & & \\
\end{array}$ $\begin{array}{c|c}
 & & \\
\end{array}$ Solver polytime polytime So Q is NP-Hard. 1. Fill in box to finish proof. 2. Brainstorm ideas for 35AT = HamPath Meorem: Hamitonian Path is NP-Complete Pf. HamPath & NP / HamPath & NP-Hard L> 3SATEP HamPath 3SAT X -> G(X) -> Ham Path (G(X)) -> 3SAT(X) A Need to prove this reduction exists 1. Describe f3SA+ > HamPath 2. Analyze runtime of f3SA+>HamPath 3. Prove conversion is correct a) If HamPath (G(X)) = Yes >> 3SAT(X) = Yes b) If 3SAT(x)=Yes -> HamPath(G(x))=Yes 1. Describe + 35AT > HamPath $\left(u_1 \sqrt{7} u_2 \sqrt{u_6}\right) \Lambda \left(\cdots\right)$ Idea: Use Graph Gadget (a little graph that implements some functionality) How many Hamiltonian Paths are there from s to t? 2 paths LRL How many Hamiltonian Paths are there from s to t? 1 path Reverse direction of edges