CS 133 Exam 4

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1. _

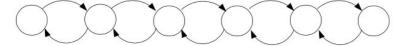
- 2. ALL_{TM} is undecidable.
 - a. Assume it is decidable and obtain a contradiction.
 - b. Suppose that R is a decider for ALL_TM .

We construct TM S to decide ${\cal E}_{TM}$ as follows:

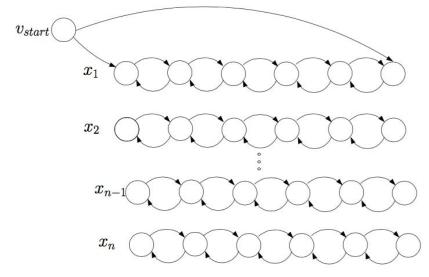
S = "On input < M > where M is a TM:

- Run R on input < M >.
- If R accepts, reject.
- If R rejects, accept.
- c. If R decides ALL_TM then S decides E_TM .
- d. But E_{TM} is undecidable. Hence, $\mathit{ALL}_{\mathit{TM}}$ must be undecidable.
- 3. Given $\rho = c1 \land c2 \land ... \land c_m$ where $c_m = (x_{i,1} \lor x_{i,2} \lor x_{i,3})$, the following steps convert this 3SAT problem to the Hamiltonian path problem:
 - a. For each x_i , we create a chain of vertices.

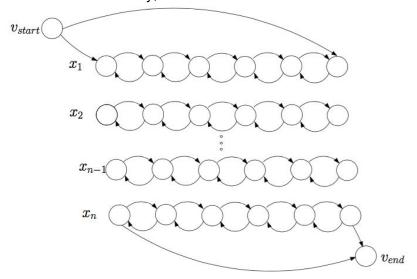
 x_i



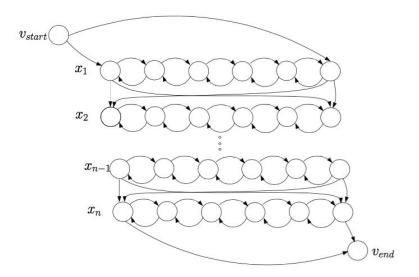
b. We then add a start vertex as follows.



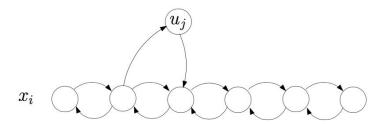
c. Similarly, we add an end vertex.



d. We interconnect the chains by adding 2 edges from the first and last vertices of each chain (except the last), to the first and last vertices of the next chain.



e. Then for each clause c_j , we add a vertex u_j as follows:



If the clause c_j contains a negated x_i , we reverse the directions of the edges. source: http://sma.epfl.ch/~moustafa/Other/Complexityslides/lec7.pdf

4. (a) No, since the 8 clauses represent all possible combinations of the values of x, y, and z. Hence, one of them is where all are false so that one of the clauses is false and so the whole statement is false.

(b-c)

	x	у	z	C1	C2	СЗ	C4	C5	C6	C7	C8	s
tx	1	0	0	1	1	1	1	0	0	0	0	10,011,110,000
fx	1	0	0	0	0	0	0	1	1	1	1	10,000,001,111
ty		1	0	1	1	0	0	1	1	0	0	1,011,001,100
fy		1	0	0	0	1	1	0	0	1	1	1,000,110,011
tz			1	1	0	1	0	1	0	1	0	110,101,010
fz			1	0	1	0	1	0	1	0	1	101,010,101
g1				1	0	0	0	0	0	0	0	10,000,000
h1				1	0	0	0	0	0	0	0	10,000,000
g2					1	0	0	0	0	0	0	1,000,000
h2					1	0	0	0	0	0	0	1,000,000
g3						1	0	0	0	0	0	100,000
h3						1	0	0	0	0	0	100,000
g4							1	0	0	0	0	10,000
h4							1	0	0	0	0	10,000
g5								1	0	0	0	1,000
h5								1	0	0	0	1,000
g6									1	0	0	100
h6									1	0	0	100
g7										1	0	10
h7										1	0	10
g8											1	1
h8											1	1
t	1	1	1	3	3	3	3	3	3	3	3	t = 11,133,333,333