**ECE374 Assignment 9**

Due 04/24/2023

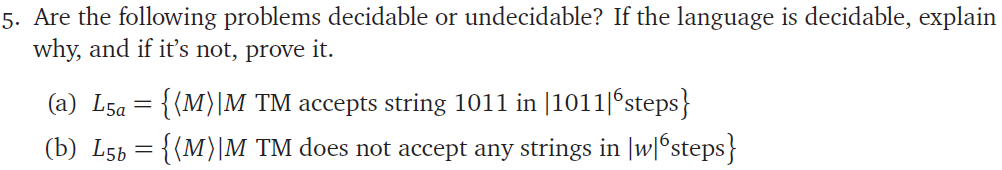
**Group & netid**

*Chen Si chensi3*

*Jie Wang jiew5*

*Shitian Yang sy39*

**Problem 5**



(a)

Solution:

This problem is decidable.

We could build the following decider (DECIDER\_5A):

**M’** (M):

Run M on 1011 for steps k=1 to |1011|6

if M accept on step k:

return True

return False

<M’>

<M>

Construct M’

<M>

True

False

Run M’

accept

reject

It takes in a Turing Machine M, constructs a Turing Machine that runs 1011 on M for at most |1011|6 steps. If M ends on an accepting state within |1011|6 steps, it returns True and if M doesn’t end on an accepting state|1011|6 steps, it returns False. When M’ return True, we accept the decider DECIDER\_5A and when M’ returns False, we reject the decider DECIDER\_5A.

As the length of |1011| is fixed and the running step are also finite, we are supposed to finish this decider within |1011|6 steps plus some constant time and it’s thus decidable.

(b)

Solution:

This problem is undecidable.

We could construct a reduction from Halting to L5b:

Halting: {<M, w> | M is a TM and M halts on w}

We could construct the following reduction graph of DECIDER\_HALT

<M’>

<M, w>

<M, w>

accept

reject

accept

reject

ORAC

L5b

Construct TM M’

(see details below)

We construct a Turing Machine M’ given <M, w>:

**M’** (M, w):

Run M on w for |w|6 steps

if M halts within |w|6 steps:

reject

else:

accept

Analysis:

(1) If M halts on w, M’ would halt on w within |w|6 steps, and M’ would reject.

In this case, M’ doesn’t accept any string within |w|6 steps, and ORAC\_L5b would return accept. Therefore, an Accepting case for Halting problem, where M halts on w, would be solved by calling ORAC\_L5b.

(2) If M doesn’t halt on w, M’ would not halt on w within |w|6 steps, and M’ would accept on any input string. In this case, ORAC\_L5b would return reject. Therefore, an Rejecting case for Halting problem, where M doesn’t halt on w, would also be solved by calling ORAC\_L5b.

Given that Halting is undecidable and we reduced Halting to L5b, we could prove that L5b is undecidable.