Lecture Tue 4/14: Compare Two Languages

Marked Double Word = \{ w \# w : w \in \{a,b\}^* \}

Even Palindrome Marked = \{ w \# w^R : w \in \{a,b\}^* \}

Two-Tape TMs M_0, M_1 for these languages

Strategy in both cases:
1. Copy the a-b chars before \# to Tape 2
2. If no \#, or more than one \#, compare from Tape 2 to the rest of Tape 1 after \#
3. Reject on the fly
4. Accept \#?
5. Accept \#? no = no

To recognize MDW, we need to rewind the Tape 2 head

\[ a(b/a,R)(b/b,R) \]

\[ \vdash \]

\[ \} \]

Ready to match LHS to RHS

Suppose we define the languages with no \#?

M is a deterministic PDA (DPDA), so \( \text{EPM is a DCEL} \)

ababa \& Even Pal
ababa \& Even Pal
but has no marked
ababa \& Even Pal M
Marked W
ababa \& Even Pal M
Lecture 14 cont'd

**Comparing Two Languages**

- **EvenPal Marked** = \{ \* W\#WR: W \in \{a,b\}^+ \} also \[ OW = \{ \* W\#W: W \in \{a,b\}^+ \} \] (without the #)

**Strategy for a 2-tape TM** for either EvenPal or DW: Count.

- \[ u \rightarrow \frac{\lambda}{a/a,R} \frac{\lambda}{b/b,R} \frac{\lambda}{u/u,L} \]
- \[ \frac{\lambda}{a/a,L} \frac{\lambda}{b/b,R} \frac{\lambda}{u/u,L} \]
- \[ \frac{\lambda}{a/a,R} \frac{\lambda}{b/b,R} \frac{\lambda}{u/u,L} \]

A **Non-deterministic PDA (NPDAs)** coded on a 2-tape **NTM**, can guess the midpoint instead of counting.

**Fact:**

- **Even Pal is a CFL**
- but it is not a **DCFL**

And, any **CFL L** such that its complement \( \bar{L} \) is not a CFL, is not a DCFL either.

**Example:** \( L = \{ \lambda \mid n \in \{0,1\} \} \) is not a CFL. But the \( \bar{L} \) of which this is a complement is a CFL: it is the language on HW* unioned with \( \lambda \) and \( \{a,b,c\}^* \).

Incidentally, to build a one-tape TM such that \( L(M) = \bar{L} \), design a "master loop" that on each "pass" X-es out one 'a', one 'b', and one 'c'. If in any pass it cannot do it for each, it rejects; if the tape is all X-es at the end of no pass, it accepts. HW* is similar.