CS 3311
Nov. 30, 2012
Friday (1)

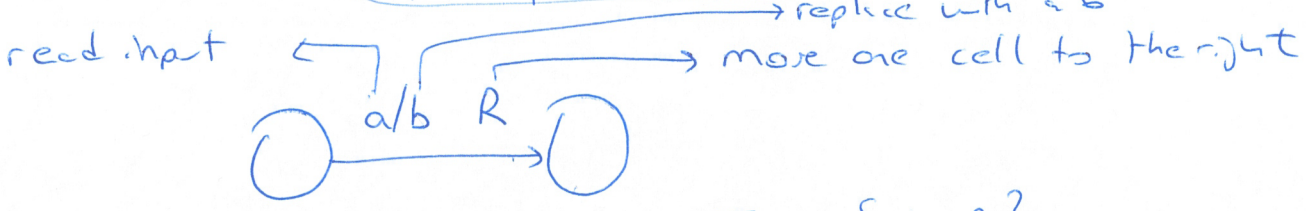
last day of November, time flies!

Last time: Turing machines

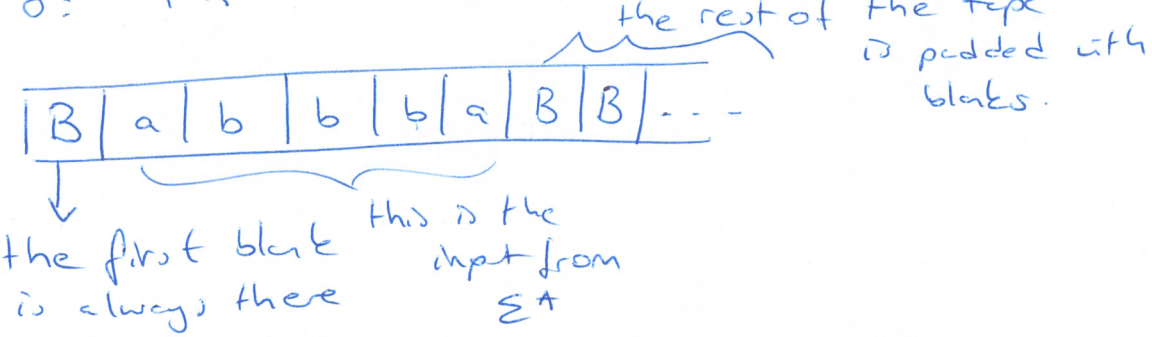
A Turing machine (TM) is a sextuple

$M = (Q, \Sigma, \Gamma, \delta, q_0, F)$

- F: accepting states
- q_0: initial state
- δ: transition function
- Q: set of states
- Σ: input alphabet ($B \notin \Sigma$)
- Γ: tape alphabet



$\delta: Q \times \Gamma \rightarrow Q \times \Gamma \times \{L, R\}$



Note that there no defined "dead state"

The machine just stops when a transition is undefined.

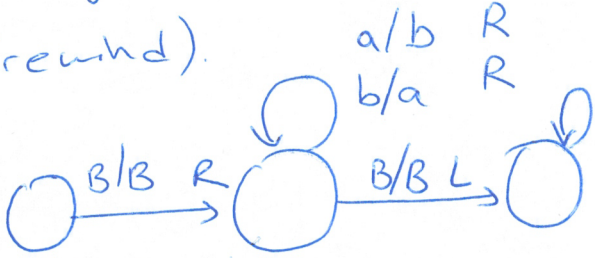
↑

This called a "normal" stop.

if it is at an accepting state ⇒ accepts

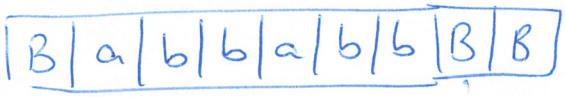
otherwise ⇒ rejects

Example 8.1.1 Interchange "a"s and "b"s and go to the beginning of the tape (rewind).

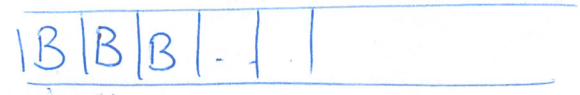


skip over the initial blank

no transition on B, so the machine will stop.



b a a b a a



a tape with all B's represents the null input (2).

Example 8.2.2

$L = \{ a^i b^i c^i \mid i \geq 0 \}$

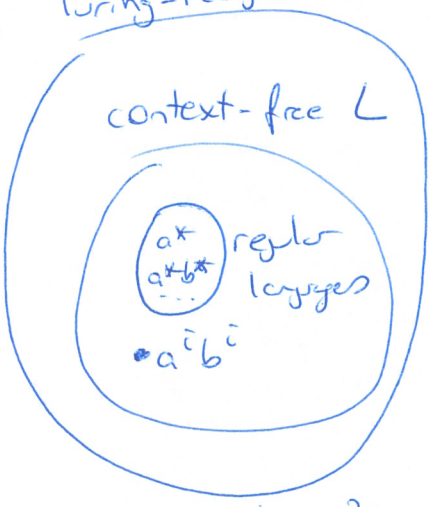
Algorithm

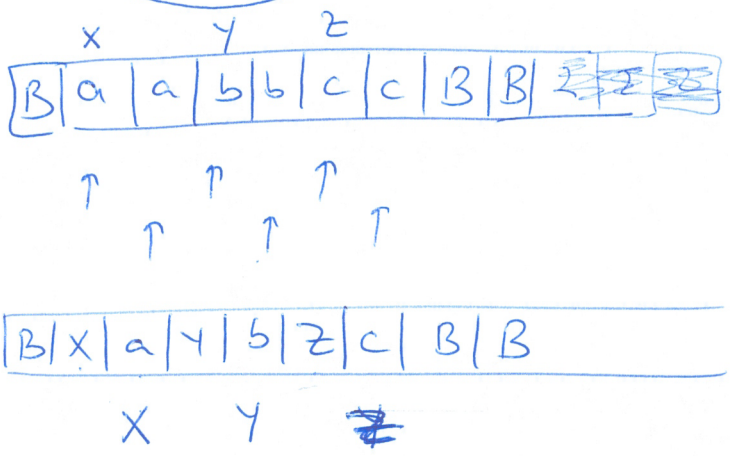
$a^i b^i$ cannot be expressed as a regular expression

but it can be expressed as a CFG or as a PDA

$a^i b^i c^i$ is not context-free

TM Turing-recognizable L





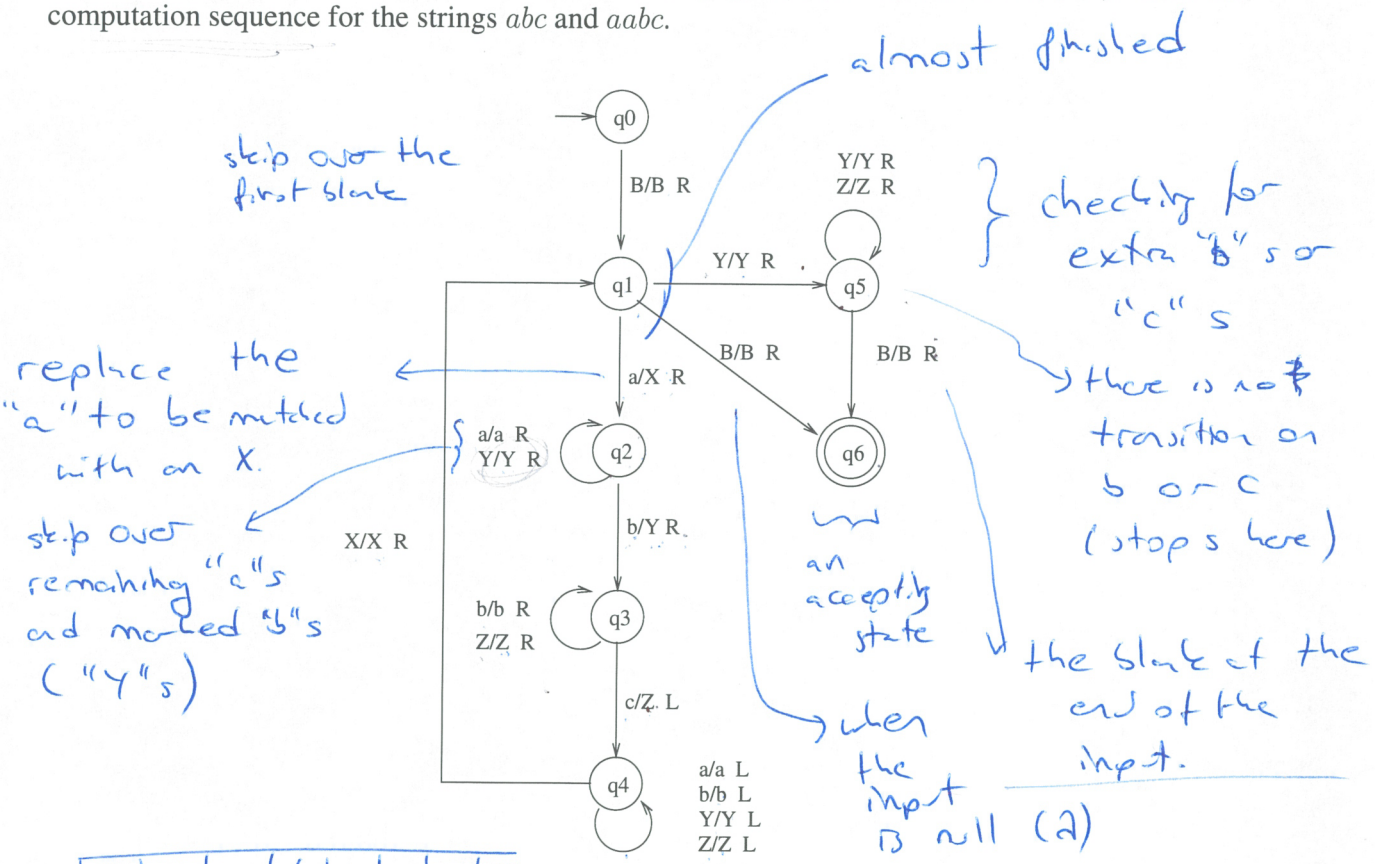
3. *(10 points)* Let M be the PDA in Example 7.1.3 on page 226 (the one for even length palindromes). Show the computation trees for the strings $baab$ and bab.

4. *(30 points)* Construct PDAs that accept each of the following languages. Explain how you construct the PDA.

a. $\{a^i b^j \mid 0 \leq i \leq j\}$

b. $\{a^i b^j c^k \mid i + k = j\}$

5. *(20 points)* Let M be the TM in Example 8.2.2 on page 261 (the machine for $a^i b^i c^i$). Show the computation sequence for the strings abc and $aabc$.



B	a	a	b	b	c	c	B

X Y Z

X Y Z

B	X	X	Y	Y	Z	Z	B

aaabbcc

caught at q_2

X X a Y Y Z Z

X

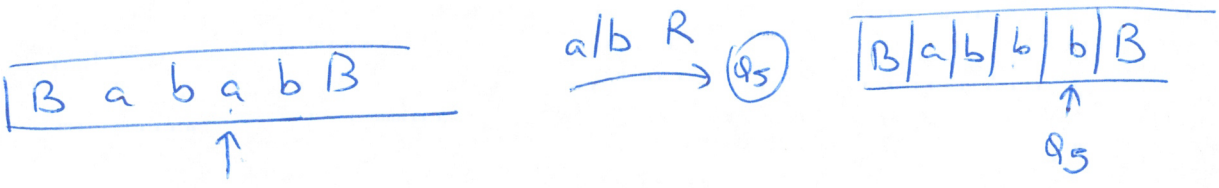
aabbbcc

caught at q_5

X X Y Y b Z Z

The configuration of a TM:

- state
- the tape contents
- the tape position



q_4

B a b q_4 a b B

put the state before the character that the machine is pointing to.

B a b b q_5 b B