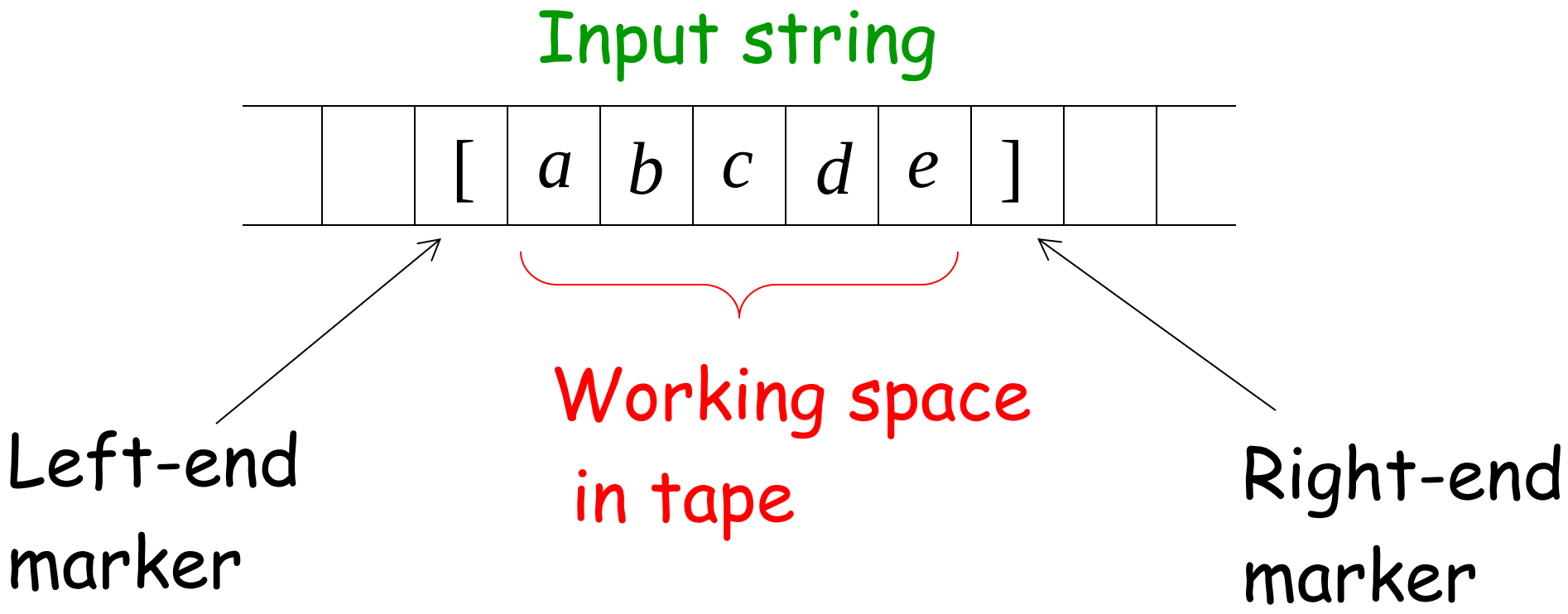
The Chomsky Hierarchy

Linear-Bounded Automata:

Same as Turing Machines with one difference:

the input string tape space
is the only tape space allowed to use

Linear Bounded Automaton (LBA)



All computation is done between end markers

We define LBA's as NonDeterministic

Open Problem:

NonDeterministic LBA's
have same power as
Deterministic LBA's ?

Example languages accepted by LBAs:

$$L = \{a^n b^n c^n\} \qquad L = \{a^{n!}\}$$

LBA's have more power than PDA's
(pushdown automata)

LBA's have less power than Turing Machines

Unrestricted Grammars:

Productions

$$u \rightarrow v$$

String of variables and terminals

String of variables and terminals

Example unrestricted grammar:

$$S \to aBc$$

$$aB \to cA$$

$$Ac \to d$$

Theorem:

A language L is Turing-Acceptable if and only if L is generated by an unrestricted grammar

Context-Sensitive Grammars:

Productions

$$u \rightarrow v$$

String of variables and terminals

String of variables and terminals

and: $|u| \leq |v|$

The language $\{a^n b^n c^n\}$

is context-sensitive:

$$S \rightarrow abc \mid aAbc$$

$$Ab \rightarrow bA$$

$$Ac \rightarrow Bbcc$$

$$bB \rightarrow Bb$$

$$aB \rightarrow aa \mid aaA$$

Theorem:

A language L is context sensistive

if and only if

it is accepted by a Linear-Bounded automaton

Observation:

There is a language which is context-sensitive

but not decidable

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