Computer Science

Theory of Computation

Undecidability

Lecture No.- 1

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Recap of Previous Lecture

Topic Turing Machine

Topics to be Covered

- Topic — Decidable (Recursive)
- Topic — SDUD (RE but not recursive)
- Topic — RE
- Topic — Not RE
- Topic — Undecidable [either SDUD or Not RE]

} SD (RE)

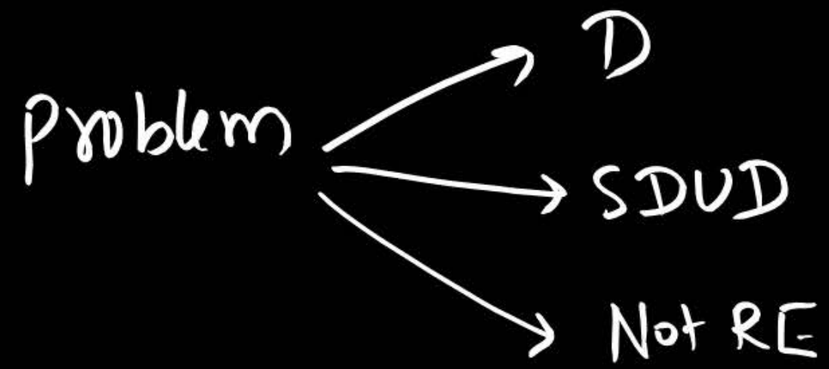
Decision Properties

Table :

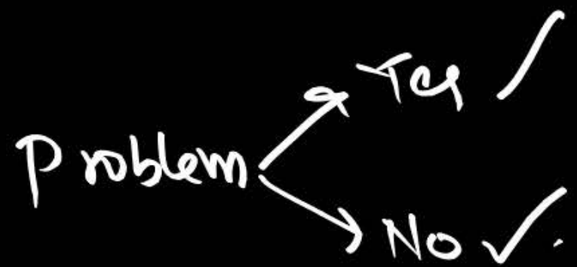
	Problem	FA	DPDA	PDA	LBA ≡ HTM	TM
1)	Halting	✓	✓	✓	✓	X
2)	Membership	✓	✓	✓	✓	X
3)	Emptiness	✓	✓	✓	X	X
4)	Finiteness	✓	✓	✓	X	X
5)	Totality	✓	✓	X	X	X
6)	Equivalence	✓	✓	X	X	X
7)	Disjoint	✓	X	X	X	X
8)	Set containment	✓	X	X	X	X

✓ : Decidable

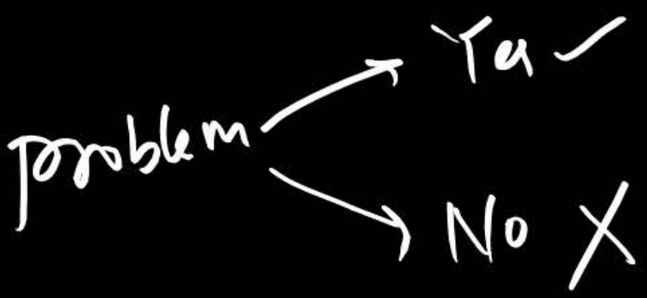
X : Undecidable


Problem
D
SDUD
Not RE

D :


Problem
Yes
No

SDUD :


problem
Yes
No

Not RE


problem
Yes

Decision Properties

Halting problem :

Is FA halts on w ?

Is DPDA halts on w ?

Is PDA halts on w ?

Is TM halts on w ?

Is TM halts on w ?

Yes : Halts at final

No : Halts or never halts

Decidable

SDUD

Decision Properties

Membership problem (IS M accepts w ?)
IS $w \in L$?
IS $w \in L(G)$?

FA
DPDA
PDA
HTM
} CYK Algo $O(n^3)$ n length input ⇒ Valid : Halts ✓
Invalid : Halts ✓ } D

TM : Valid ⇒ Halts ✓
Invalid ⇒ ? : X
} SDUD

Emptiness Problem:

Is M accepts nothing ?

Is $L = \phi$?

Is $L(G) = \phi$?

Finiteness :

Is M accepts finite language?

Is $L(M)$ = finite?

Is $L(G)$ = finite?

Totality :

Is $L = \Sigma^*$?

Is M accepts everything ?

Equivalence :

Is $M_1 \cong M_2$?

Is $L(M_1) = L(M_2)$?

Disjoint : (Intersection empty)

Is $L_1 \cap L_2 = \Phi$?

Is $L(M_1) \cap L(M_2) = \Phi$?

Set Containment [subset check]:

Is $L_1 \subseteq L_2$?

Is $L(M_1) \subseteq L(M_2)$?

2 mins Summary

Topic

→ Decision properties

THANK - YOU