Touring Machine - III

Complete Course on Theory of Computation

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1

TM Languages

Recursive Language

$\Downarrow$

$\forall w \in L \Rightarrow$ TM - Halt - Final

$\forall w \notin L \Rightarrow$ TM - Halt - Non-Final

$\Downarrow$

Halting - TM

$\Downarrow$

Algo

Recursive Enumerable Language.

$\Downarrow$

$\forall w \in L \Rightarrow$ TM - Halt - Final

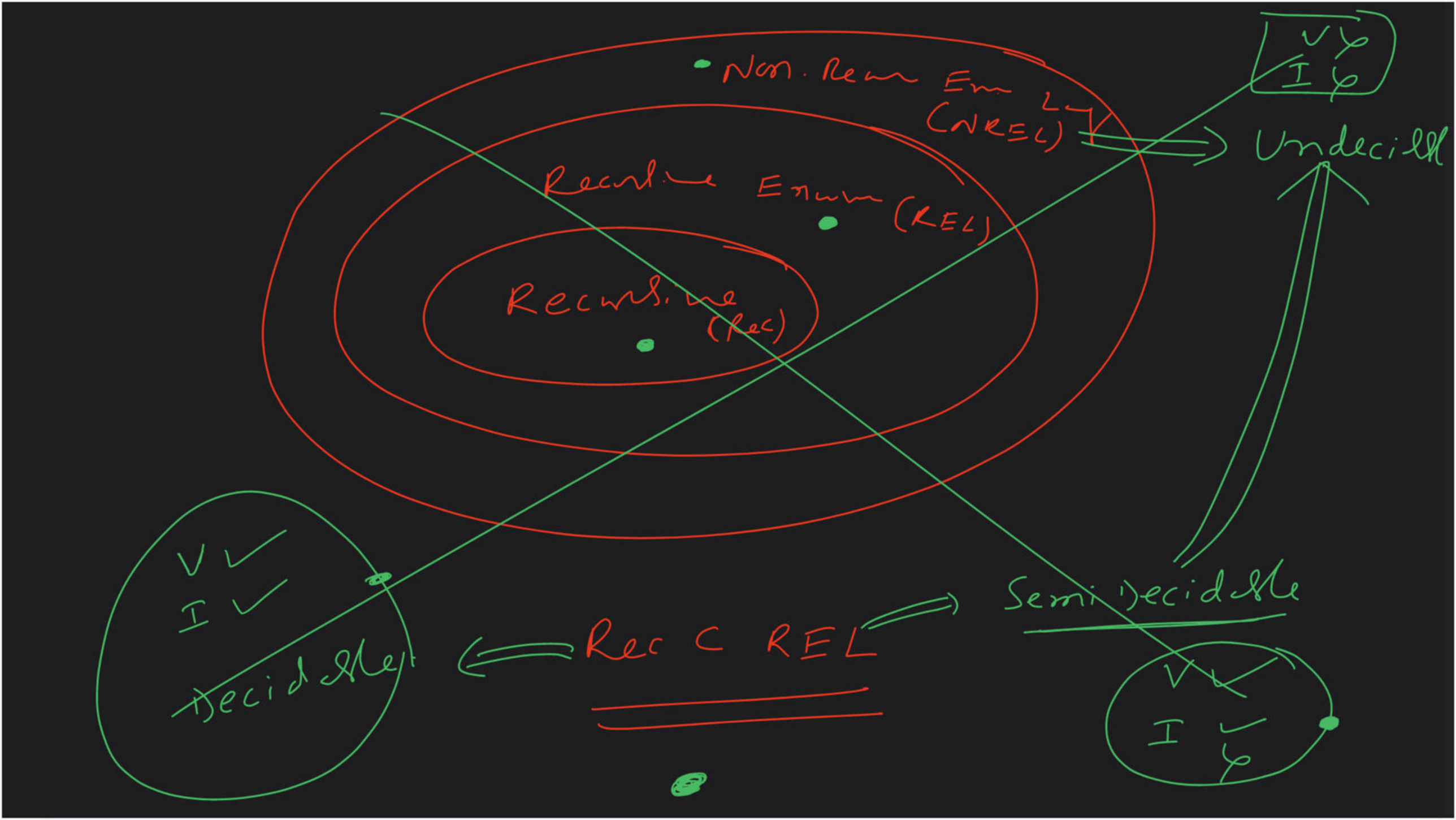
$\forall w \notin L \Rightarrow$ TM - Halt - Non Final

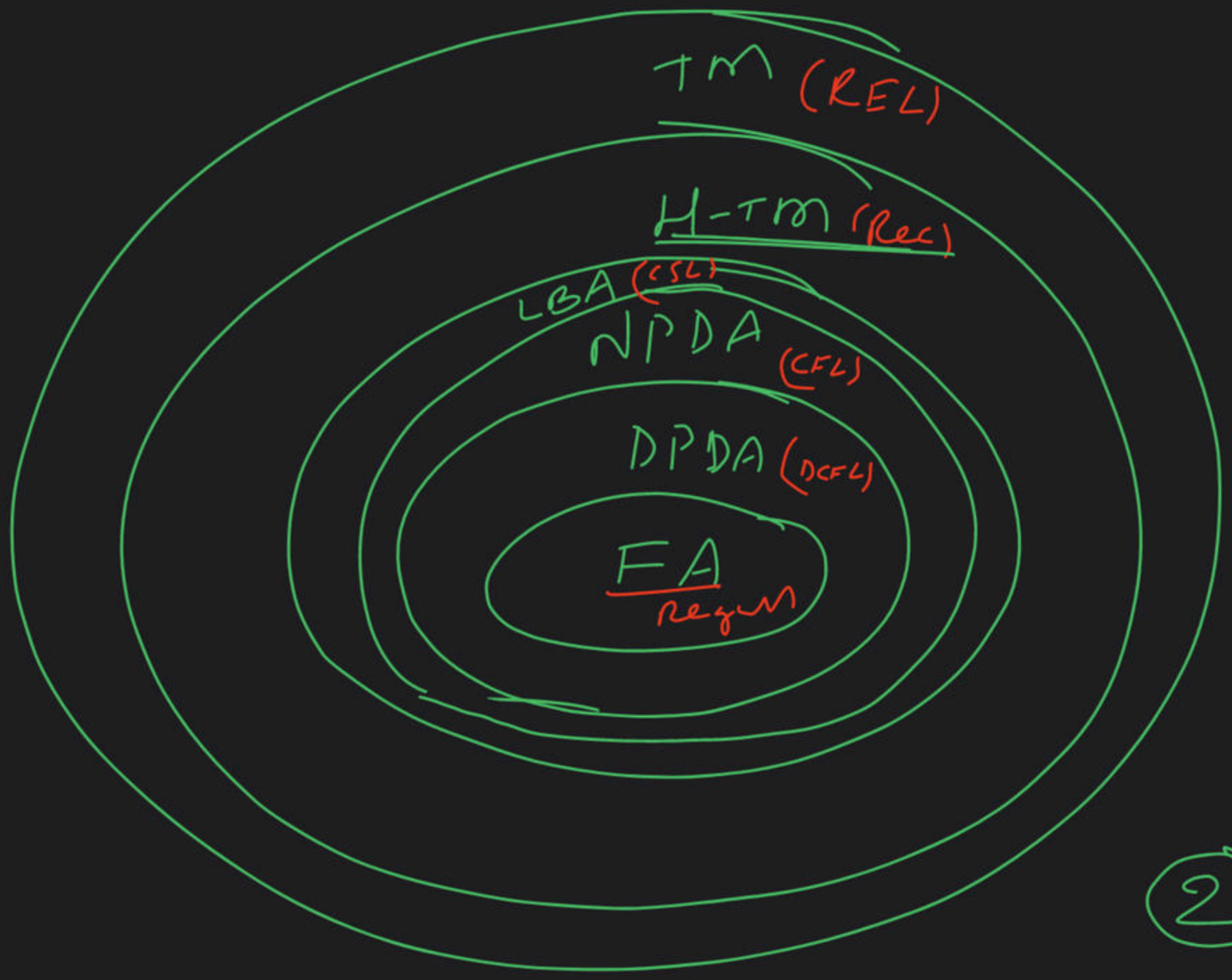
(or)

TM - may goto infinite loop.

$\Downarrow$

program.


Non. Recur Enu L
(NREL)
Recursive Enum (REL)
Recursive (Rec)
Undecidable
Decidable
Rec ⊂ REL
Semi Decidable


TM (REL)
H-TM (Rec)
LBA (CSL)
NPDA (CFL)
DPDA (DCFL)
FA
Regular

closure properties

Rec

⇓

Rec ∪ Rec = Rec ✓

Rec ∩ Rec = Rec ✓

Regular ⇒ CFL ✓

CFL ⇏ Regular

(3)

REL

⇓

REL ∪ REL = REL ✓

REL ∩ REL = REL ✓

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(1) REC ∩ REL

⇓

REL ∩ REL = REL

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(2) Rec ∪ REL

⇓

REL ∪ REL = REL

Conclusion ✓

REL ✓

Rec ✓

Rec

(4)

$\overline{Rec} = Rec$ ✓

Complementation ✓

REL

$\overline{REL}$ = need not be REL

Complementation

L is Decidable

⇓

(1) $\forall w \in L$ TM – Halt: Final

$\forall w \notin L$ TM – Halt: Non-Final

(2) $L \Downarrow$ H–TM possible

(3) $L \Downarrow$ Algo possible.

(4) L – H–TM

L^c – H–TM

(5)

L is semi-decidable (L is REL)

⇓

(1) L has TM but L^c has no-TM

⇓

(2) L is REL but L^c is non-REL

(3) $\forall w \in L$ has logic

$\forall w \notin L$ no-logic

(6)

(4) L has program (TM ✓)

~~TM ✗~~

L is non-REL

⇓

(1) L has no-TM

(2) $\forall w \in L$ no-logic

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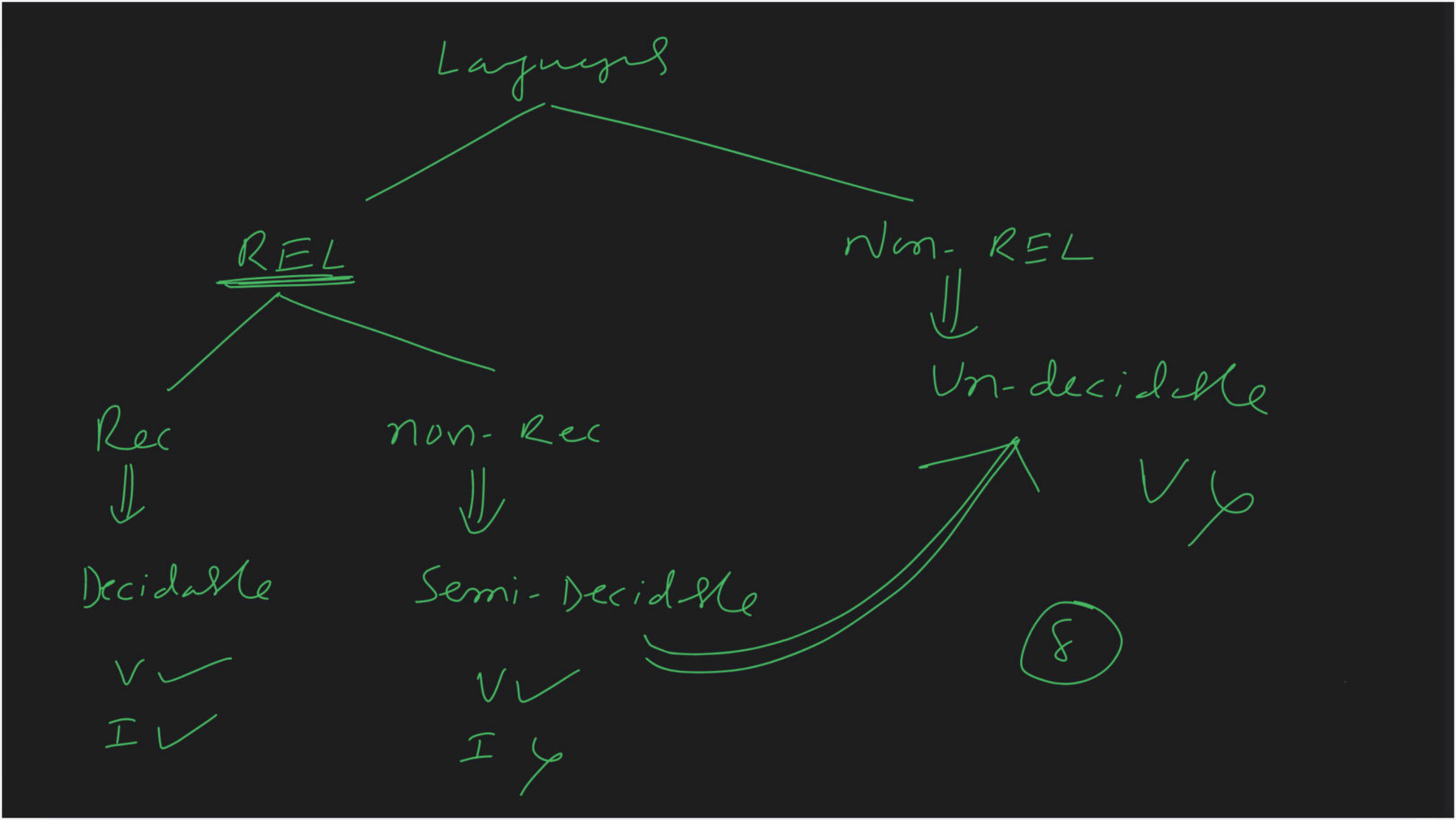

Languages
REL
Non-REL
Rec
non-Rec
Un-decidable
Decidable
Semi-Decidable
V
I
V
I
V
I
8

b b R

1. If L is Rec then L^c also Rec.

2. If L is REL & L^c also REL
then L should be Rec.

3. If L is REL & L^c is non-REL then
L is not Rec.

- L is non-rec but REL

$\Downarrow$

$L^c \Longrightarrow$ non-REL

L is Rel

iff

L^c is also Rel

Then

L is Rec.

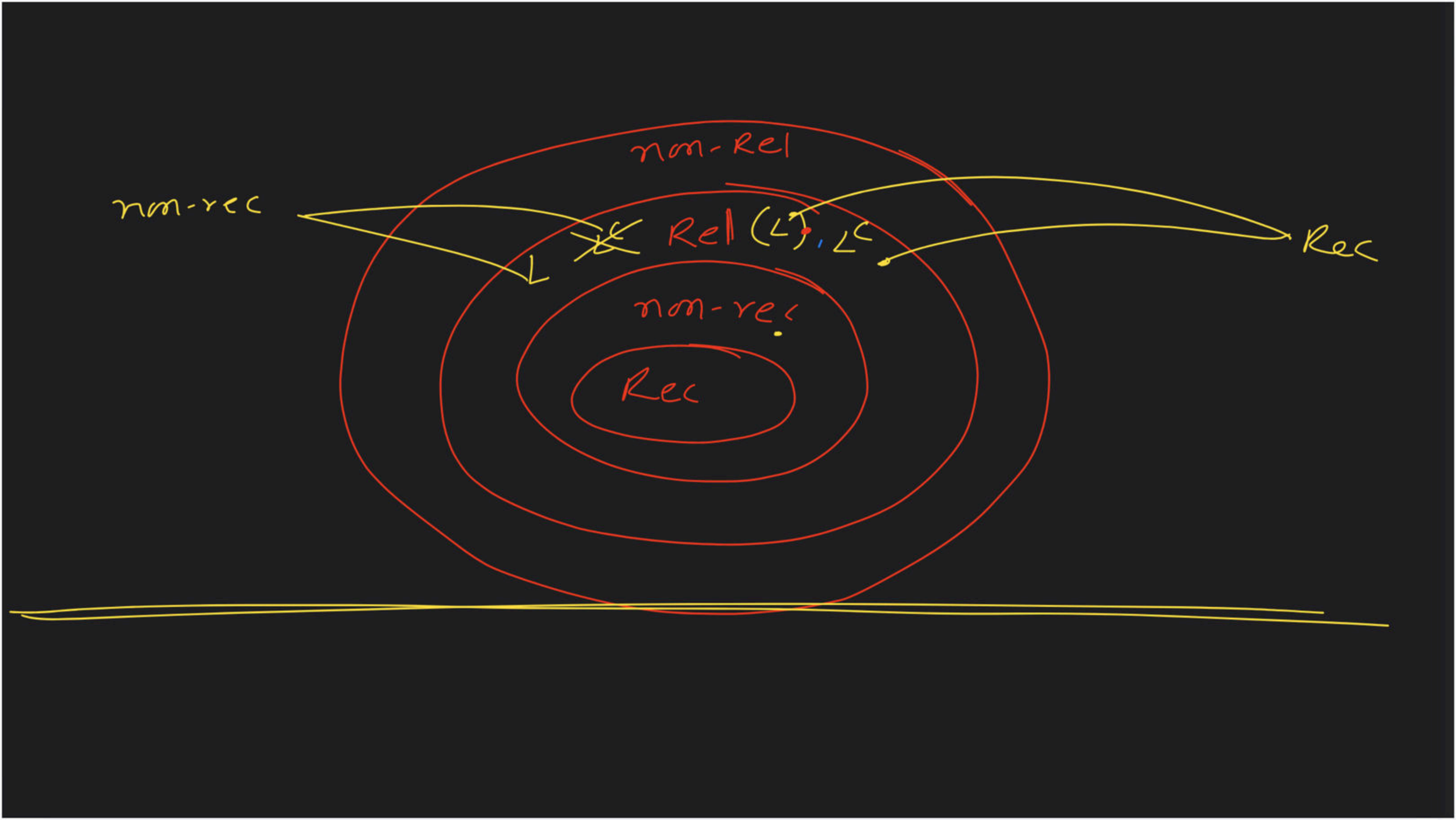
① If L is rec then L^c also rec

② If L is Rel then L^c

Rel $\Longrightarrow$ Rec

non-Rel $\Longrightarrow$ non-rec

③ If L is Rel but not rec then L^c is non-rel


non-Rel
non-rec
Rel (L), L^c
non-rec
Rec
L
Rec