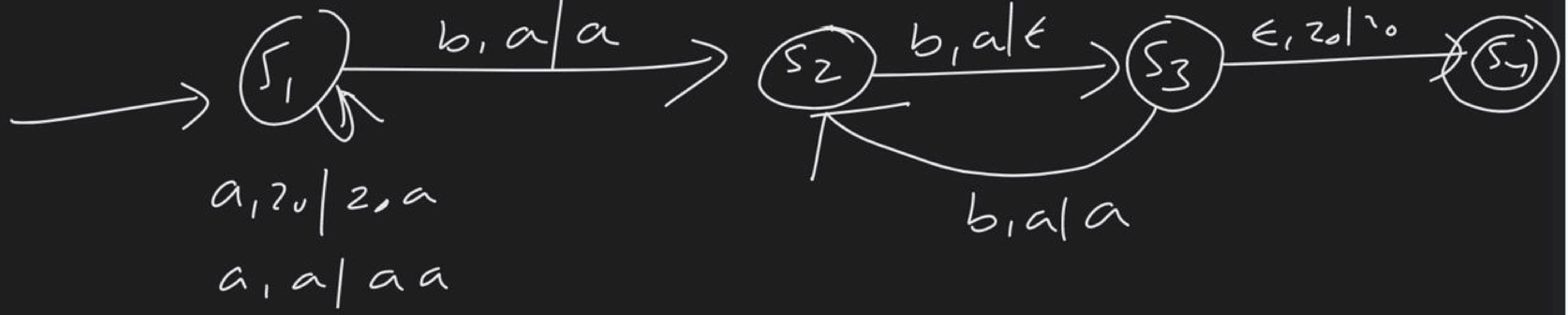
Undecidability - III

Complete Course on Theory of Computation

Subbarao Lingamgunta • Lesson 43 • Apr 6, 2022



S1
S2
S3
S4
b, a|a
b, a|ε
ε, z0|z0
b, a|a
a, z0|z0 a
a, a|aa

Closure Properties

Union

S_1

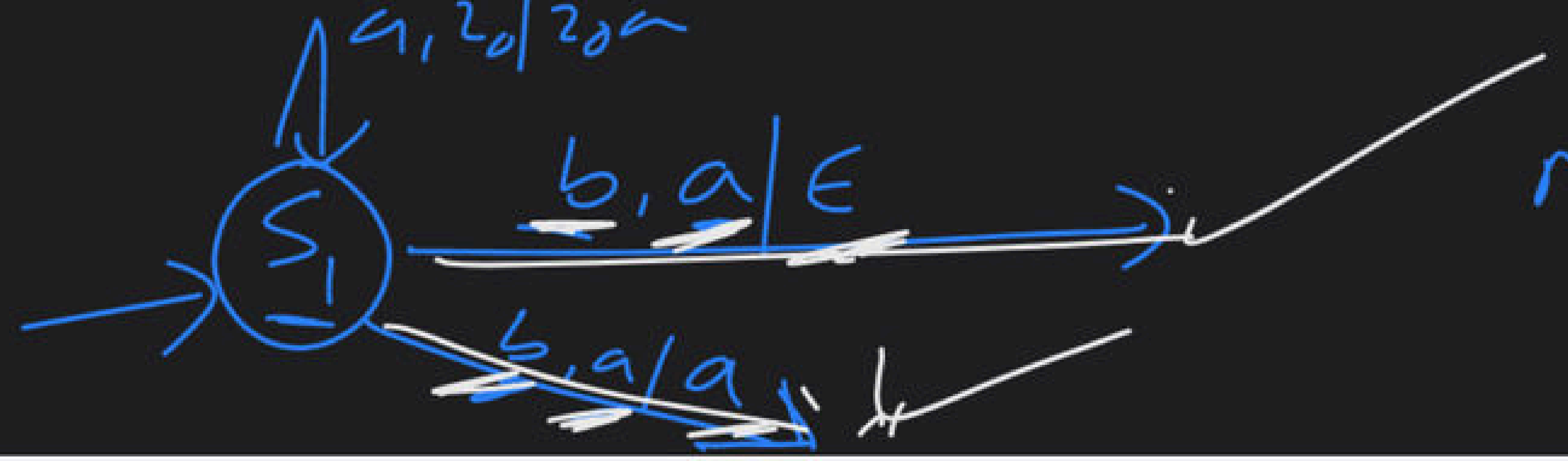
$L_1 : a^n b^n \mid n \ge 1 \Longrightarrow$ DCFL $\Longrightarrow$ CFL

S_2

$L_2 : a^n b^{2n} \mid n \ge 1 \Longrightarrow$ DCFL $\Longrightarrow$ CFL

$L = L_1 \cup L_2 \Longrightarrow a^i b^j \mid i == j$ (or) $j = 2 * i$

$S \to S_1 \mid S_2$



NPDA $\Rightarrow$ ~~DCFL~~ CFL

DCFL's are not closed under union

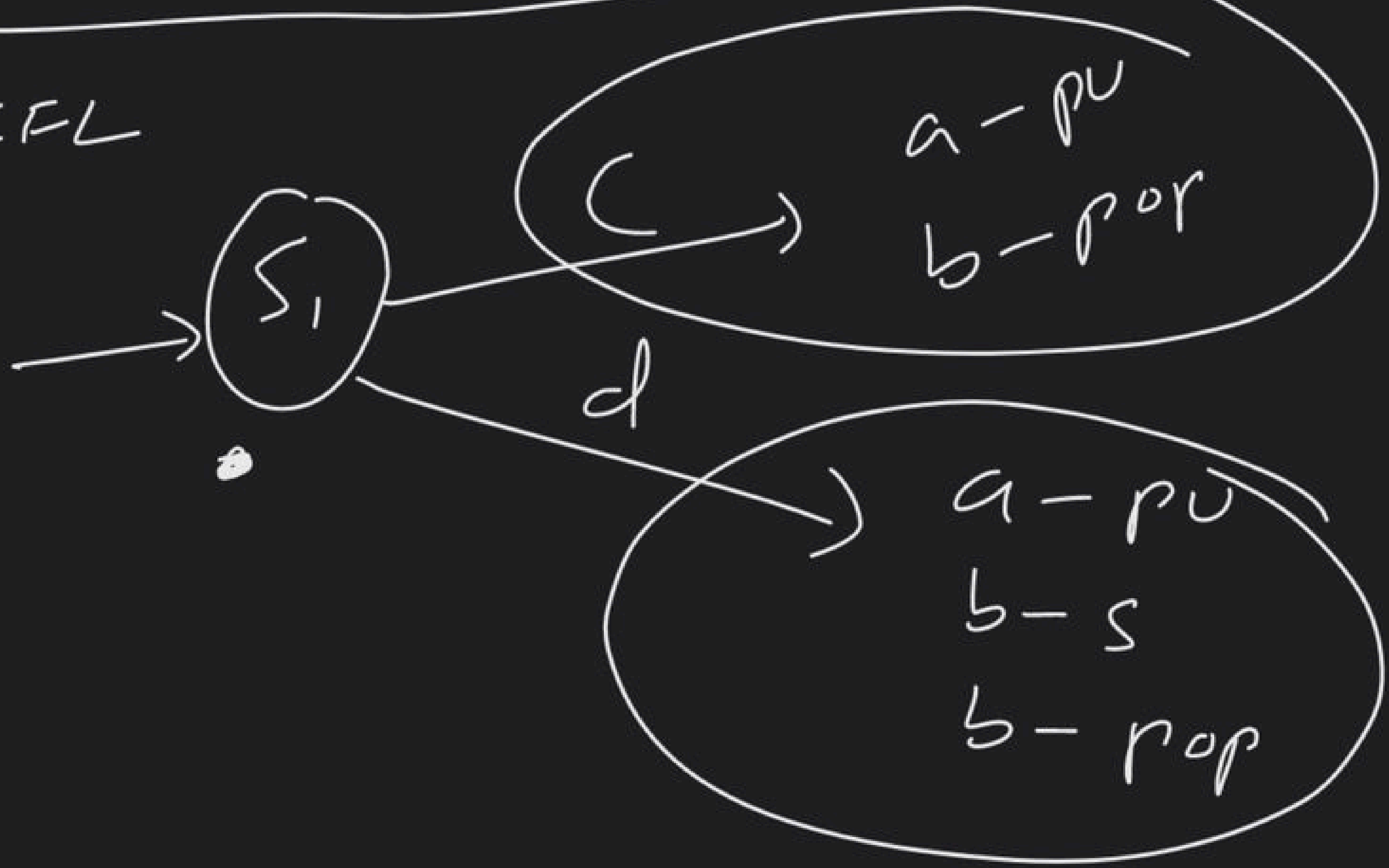
But CFL's are closed under union

$ca^nb^n \cup da^nb^{2n}$

DCFL DCFL

DCFL

DCFL



DCFL

DCFL

a^nb^n

a^nb^{2n}

Intersection

aabbbccc

DCFL $\Downarrow$ not closed

CFL's $\Downarrow$ not closed

aaabbbcc

aabbcc

aabbcc, aabbbccc ✓

ex

$L_1 : a^m b^n c^n \mid m, n \geq 1 \implies$ DCFL, CFL

aaabbbccc ✓

aabbcc

$L_2 : a^m b^m c^n \mid m, n \geq 1 \implies$ DCFL, CFL

aabbcc

$L_1 \cap L_2 : a^i b^i c^i \mid i \geq 1 \implies$ ~~DCFL~~ ~~CFL~~ CSL

complementation

$a^n b^n \mid n \geq 1 \Longrightarrow$ DCFL

$a^m b^n \mid m != n \Longrightarrow$ DCFL

DCFL closed under complementation

$a^i b^j c^k \mid i \neq j$ (or) $j \neq k$

$\boxed{d a^n b^{2n}}$

$\bar{L}: ww =$ ~~CFL~~ CSL

$L: \overline{ww} =$ CFL

$L: \overline{a^n b^n c^n} =$ CFL

$\bar{L}: a^n b^n c^n =$ ~~CFL~~ CSL

CFL's are not closed complementation

d dda bbbbb b

$L = \{ a^p \mid p \text{ is prime} \} \Longrightarrow$ non regular

$\bar{L}$ = non-regular

5

$L = wcw^R \mid w \in (a+b)^* \Longrightarrow$ DCFL

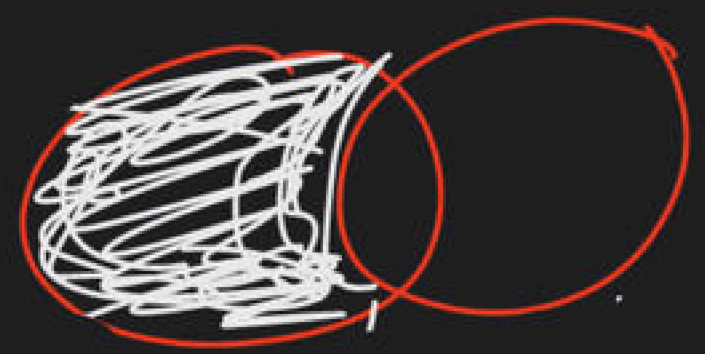
$\bar{L} = \overline{wcw^R}$ = DCFL (Becz DCFL's are closed under complement)

$L = \underline{ww^R} \mid w \in (a+b)^* \Longrightarrow$ CFL

$\bar{L} = \overline{ww^R} \Longrightarrow$ CFL (Becz CFL's are not closed (complement) [illegible]

Difference

$\Downarrow$

$L_1 - L_2 = L_1 \cap L_2^c =$ 

DCFL $\cap$ $(\text{DCFL})^c$

DCFL $\cap$ DCFL

✓ DCFL   × DCFL

$L_1 \cap L_2'$

CFL $\cap$ $(\text{CFL})^c$

CFL $\cap$?

?

DCFL's && CFL's not closed Difference.

If $L_1 \Rightarrow CFL$, $L_2 \Rightarrow$ regular

$L_1 - L_2$

$\Downarrow$

$CFL \cap (\text{Regular})^c$

$CFL \cap \text{Regular}$

$\Downarrow$

$\underline{\underline{CFL}}$

$CFL \cap Reg = CFL$

$CFL \cup Reg = CFL$

If $L_1 \Rightarrow DCFL$ & $L_2 \Rightarrow reg$

$DCFL \cap (Reg)^c$

$DCFL \cap Reg$

$\Longrightarrow \underline{\underline{DCFL}}$

concatenation

DCFL's not closed concatenation

$$L = \{ \underbrace{a^n b^n}_{DCFL} \cdot \underbrace{a^k b^{2k}}_{DCFL} \mid n, k \geq 0 \}$$

~~DCFL~~ CFL ✓

CFL's closed under concatenation

Thanks All

Dedicate

SPM $\Longrightarrow$ P&EDS

$a^n b^n \cup \phi = CFL$ ✓

$a^n b^n \cup (a+b)^* = (a+b)^* \Rightarrow Ry \Rightarrow CFL$ ✓