Evaluation Scheme

Autumn End Semester Examination-2018

FLAT (CS-3003)

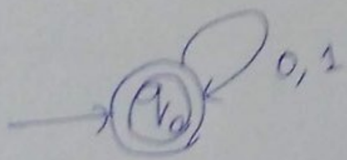
Q1)

(a) Max^m no. of states $= 2^k$ and

Min^m no. of states $= 1$

Making use of subset construction the above no. of states are possible.

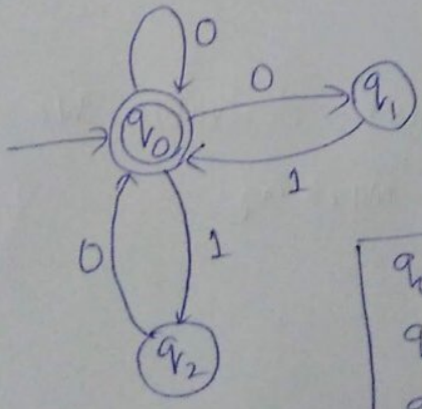
(b)



(c) $L1 = \{a^n b^m c^m : n, m \geq 1\}$ &

$L2 = \{a^n b^n c^m : n, m \geq 1\}$

(d)



$q_0 : S$
$q_1 : A$
$q_2 : B$

Regular Grammar

$S \rightarrow 0S \mid 0A \mid 1B \mid \lambda$

$A \rightarrow 1S$

$B \rightarrow 0S$

(e) $h(L) = \{ h(10111010\,11),\ h(101011) \}$

$= \{ bbababababbab,\ ababbab \}$

(f) $L = \{a^n : n \geq 0\}$

(g) $A \to aC \mid bDDC \mid bDC$

$B \to a \mid bD \mid bDD$

$C \to bD \mid b$

$D \to K$

(h) Refer the previous Solution Scheme.

(i) $L = \{ 0^m 1^n : m, n \geq 1 \}$

(j) The given string is not derivable. We can look for step marking.

Q2)

(a) A pair (p,q) of states are said to be indistinguisable iff

$$\delta^*(p,w) \in F \Rightarrow \delta^*(q,w) \in F$$

and

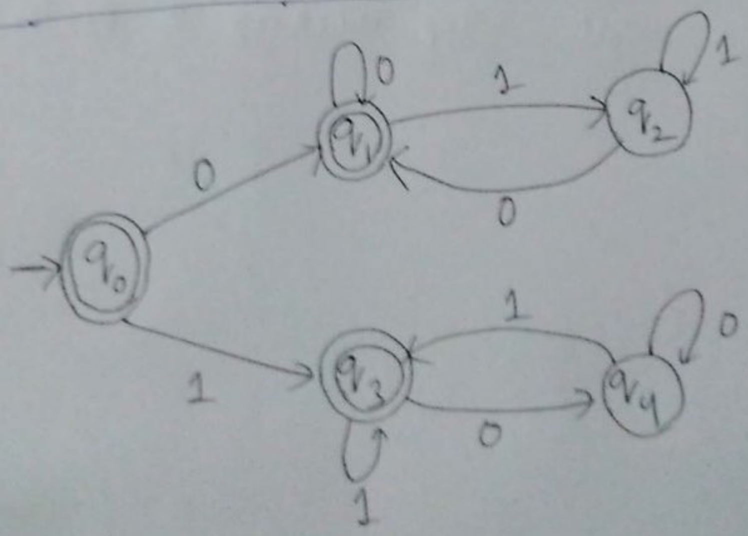
$$\delta^*(p,w) \notin F \Rightarrow \delta^*(q,w) \notin F$$

Proof:

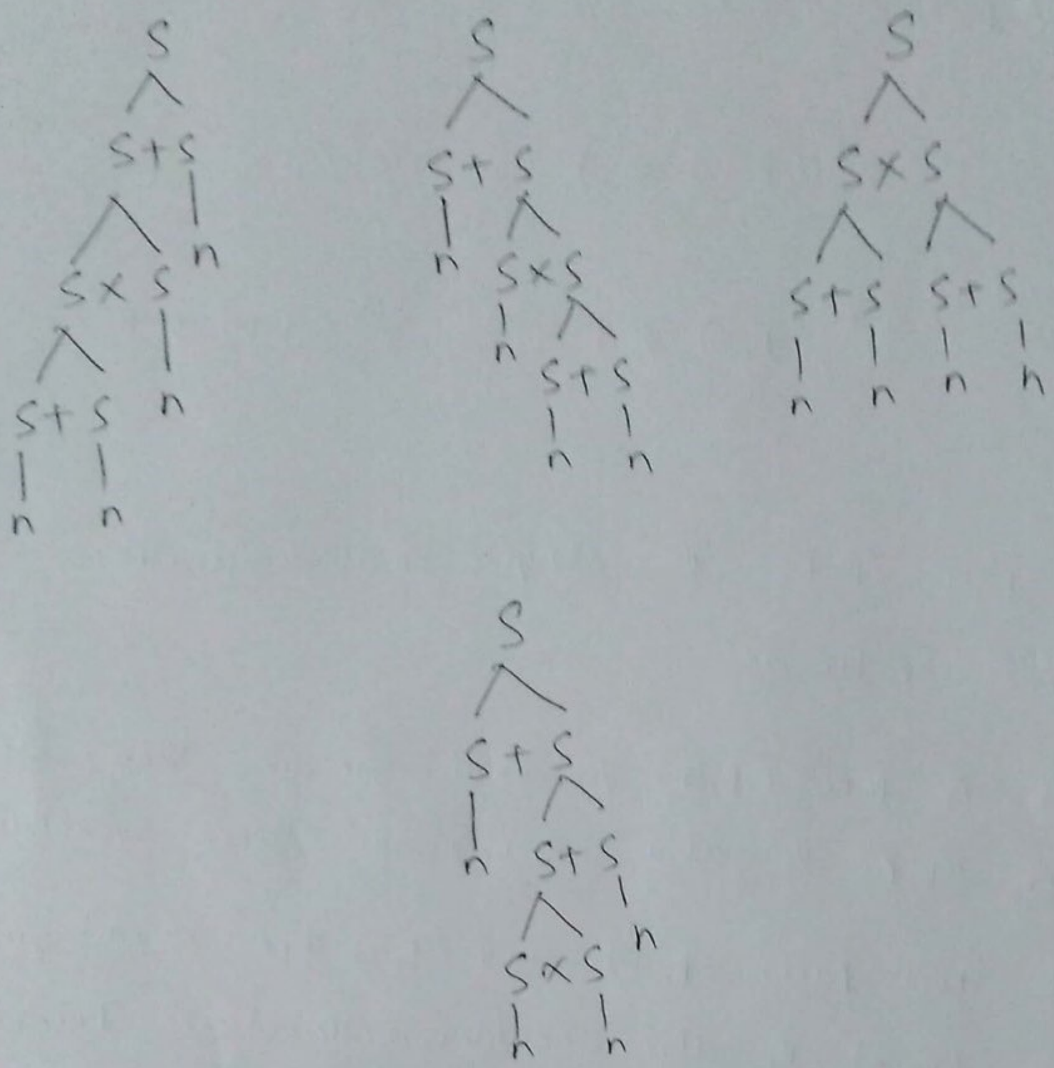
- A pair (p,p) is always indistinguisable hence reflexive
- If A pair (p,q) is indistinguisable then, the pair (q,p) is also indistinguisable. Hence Symmetric
- If two pairs (p,q) and (q,r) are indistinguisable then (p,r) is also indistinguisable. Hence Transitive.

So, Indistinguishability is an equivalence relation

(b)



3)
(a)



(b) Refer the previous ~~man~~ end sem manual for the soln. Step marking is preferalle.

Q.4.a) Pumping Lemma for Regular Language

↳ The pumping Lemma says that for any Regular Language L, there exist a constant P, such that any word w in L with length atleast p can be split into three substrings $|w| = xyz$, where $|xy| \leq |w|$ & $|y| \geq 1$, such that $xy^iz \in L \; \forall \; i > 0$.

↳ If there exist atleast one value of i such that $xy^iz \notin L$, then L is not Regular.

<u>proof</u>: $L = \{a^n : n \text{ is a perfect square}\}$ is Not Regular.

Considere the string $w = a^{P^2} \in L$. Since $|w| = P^2 > P$, we can split w into three parts x, y, z, that is, we can write $w = xyz$ such that

1. $|xy| \leq P$
2. $|y| \neq 0$, i.e $y \neq \epsilon$
3. $xy^iz \in L$ for any $i \geq 0$.

Now, choose $i = 2$. Then we must have $w' = xy^2z = xyyz \in L$. Let $|y| = q$. Since $w = a^{P^2} = xyz$, it follows that $s = a^{P^2+q}$.

↳ By cond^n(2), $q \neq \epsilon$, so $P^2 < P^2+q$, which can be as follows $P^2 < P^2+q < P^2+2P+1 = (P+1)^2$.

Hence $|S| = P^2+q$ is not a perfect square since it lies strictly between two consecutive perfect squares.

Therefore $a^{P^2+q} = S \notin L$. This gives desired contradiction

So, $L = \{a^n : n \text{ is a perfectsquare}\}$ is Not Regular.

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Q. 4.(b)

(a) $L = \{a^m b^n a^n b^m : m > 0 \; \& \; n \geq 0\}$

CFG : $S \rightarrow aSb \mid aAb$

$A \rightarrow bAa \mid ba \mid \lambda$.

(b) $L = \{ a^m : m = 2*i + 5*j \text{ for } i, j \geq 0\}$

$L = \{ a^{2*i + 5*j} \text{ for } i, j \geq 0\}$

$= \{ \underbrace{a^{2*i}}_{A} \cdot \underbrace{a^{5*j}}_{B} \text{ for } i, j \geq 0\}$

$S \rightarrow AB$

$A \rightarrow aaA \mid \lambda$

$B \rightarrow aaaaaB \mid \lambda$.

5(a)

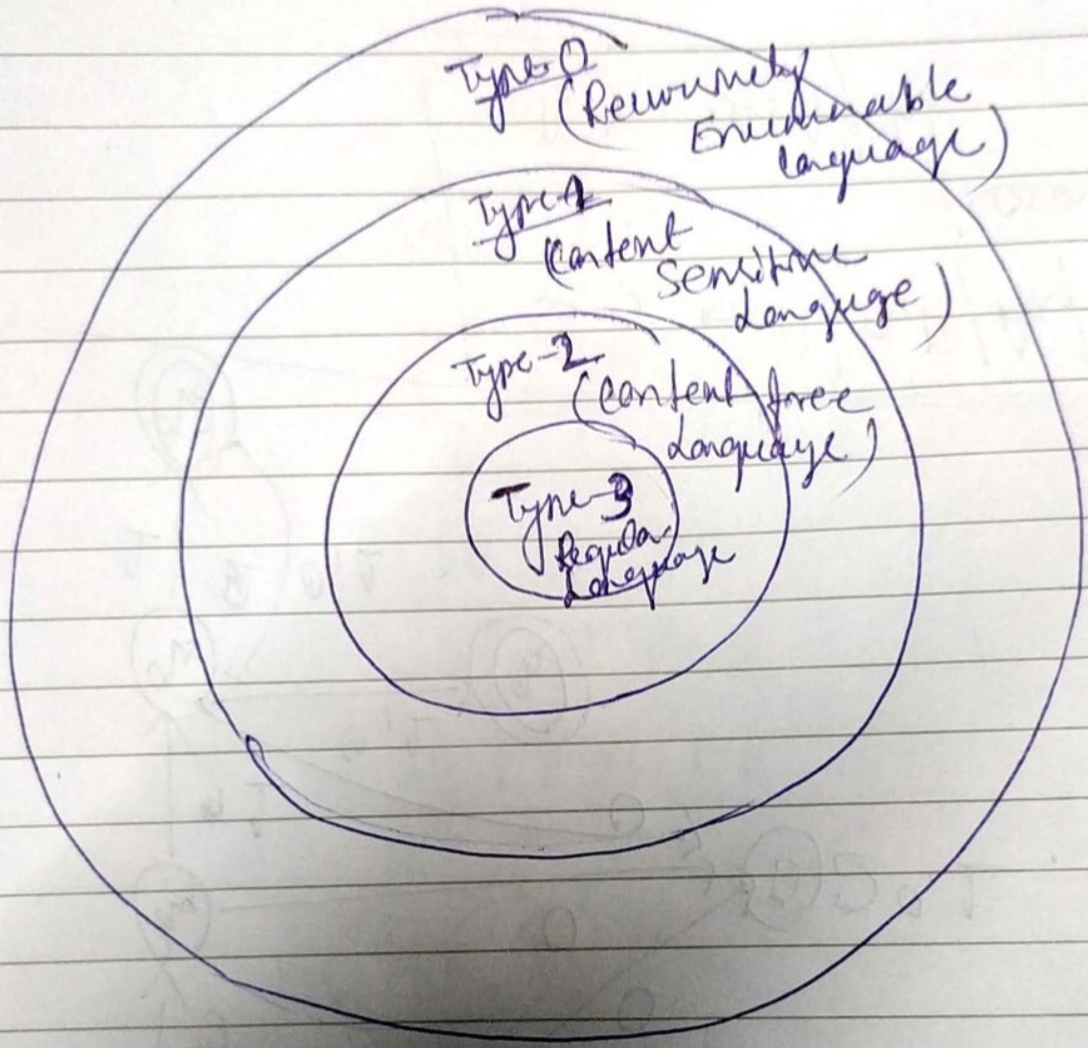
Recursively Enumerable Language (Type-0 (RE) language)

-) These are generated by Type-0 grammar
-) These languages are recognized by Turing Machine. That means it will enter into final state for the strings of language and may or may not enter into rejected state for the strings which are not the part of the language.
-) These are called Turing Recognizable language

Recursive Language (REC)

-) A recursive language (Subset of RE) can be decided by TM that means it will enter into final state for the strings of languages and rejecting states for the strings which are not part of the language.
-) These are called Turing decidable language.

Chomsky hierarchy :-



(b) $S \to aABc \mid aAd$

$A \to aBB \mid b$

$B \to bBd \mid A$

Step-1 convert the CFG to GNF.

$S \to aABc$

$S \to aAd$

$B \to bBd$

$B \to A$ $\to$ eliminate Unit prodn

$\Downarrow$

$\boxed{B \to aBB \mid b}$

$S \to aABC$, $\because C \to c$

$S \to aAD$, $\because D \to d$.

$B \to bBD$, $\because D \to d$.

So, the GNF :

$$\boxed{\begin{array}{l} S \to aABC \mid aAD \\ A \to aBB \mid b \\ B \to bBD \mid aBB \mid b \\ C \to c \\ D \to d \end{array}}$$

Step-2
push-down automata

(i) $\delta(q_0, \lambda, Z_0) = (q_1, SZ_0)$

productn.	Transition
$S \to aABC$	$\delta(q_1, a, S) = (q_1, ABC)$
$S \to aAD$	$\delta(q_1, a, S) = (q_1, AD)$
$A \to aBB$	$\delta(q_1, a, A) = (q_1, BB)$
$A \to b$	$\delta(q_1, b, A) = (q_1, \lambda)$
$B \to bBD$	$\delta(q_1, b, B) = (q_1, BD)$
$B \to aBB$	$\delta(q_1, a, B) = (q_1, BB)$
$B \to b$	$\delta(q_1, b, B) = (q_1, \lambda)$
$C \to c$	$\delta(q_1, c, C) = (q_1, \lambda)$

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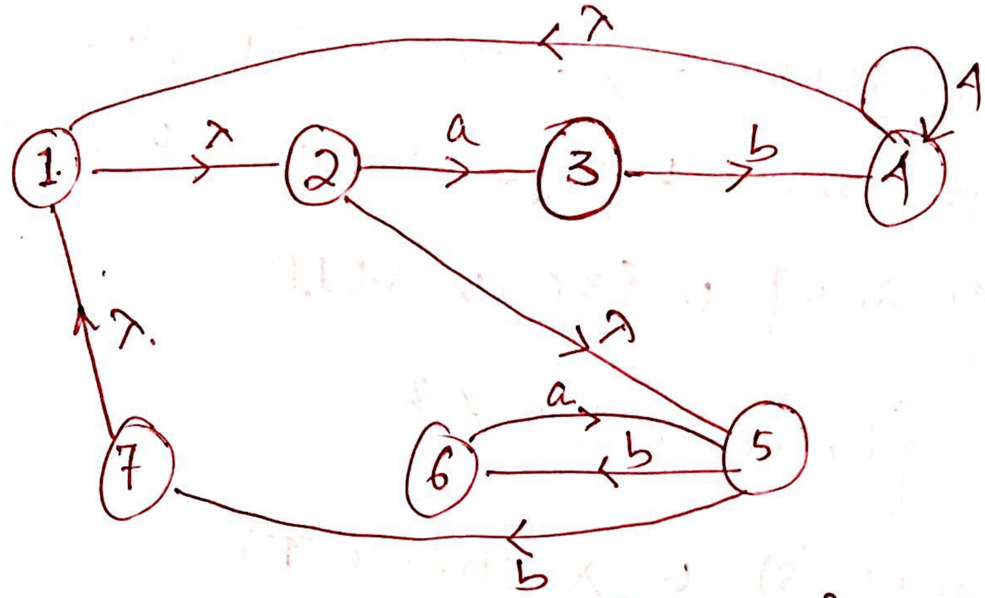
Q.6.(b)



$S = \{1, 2, 3\}$ $\quad T = \{1, 3, 4\}$

(a) $\lambda\text{-closure}(\lambda\text{-closure}(S)) = \lambda\text{-closure}(\lambda\text{-closure}\{1,2,$

$= \lambda\text{-closure}\{\lambda\text{-closure}(1) \cup \lambda\text{-closure}(2) \cup \lambda\text{-closure}($

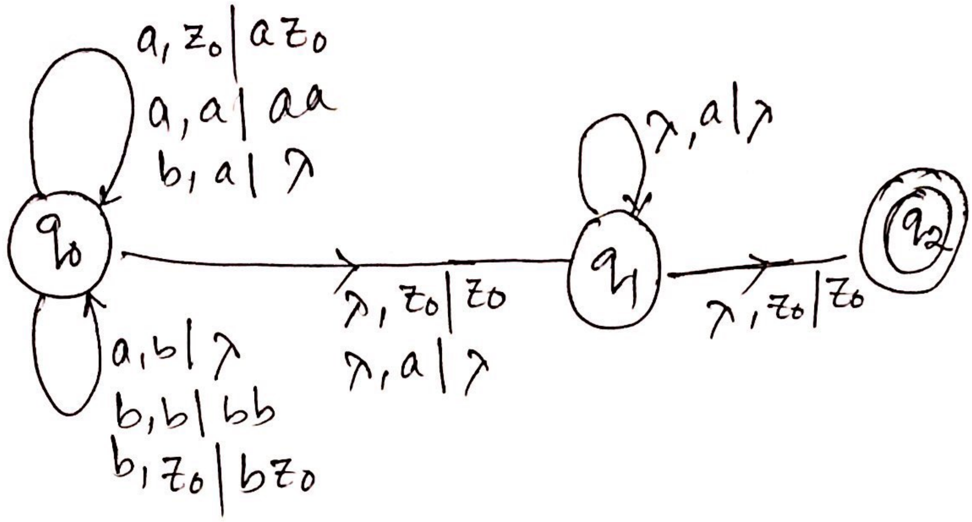
$= \lambda\text{-closure}\{\{1, 2, 5, \cancel{7}\} \cup \{2, 5\} \cup \{3\}\}$

$= \lambda\text{-closure}\{1, 2, 3, 5\}$

$= \{1, 2, 5, \cancel{7}\} \cup \{2, 5\} \cup \{3\}, \{5\}$

$= \{1, 2, 5, 3\} = \{1, 2, 3, 5\}$

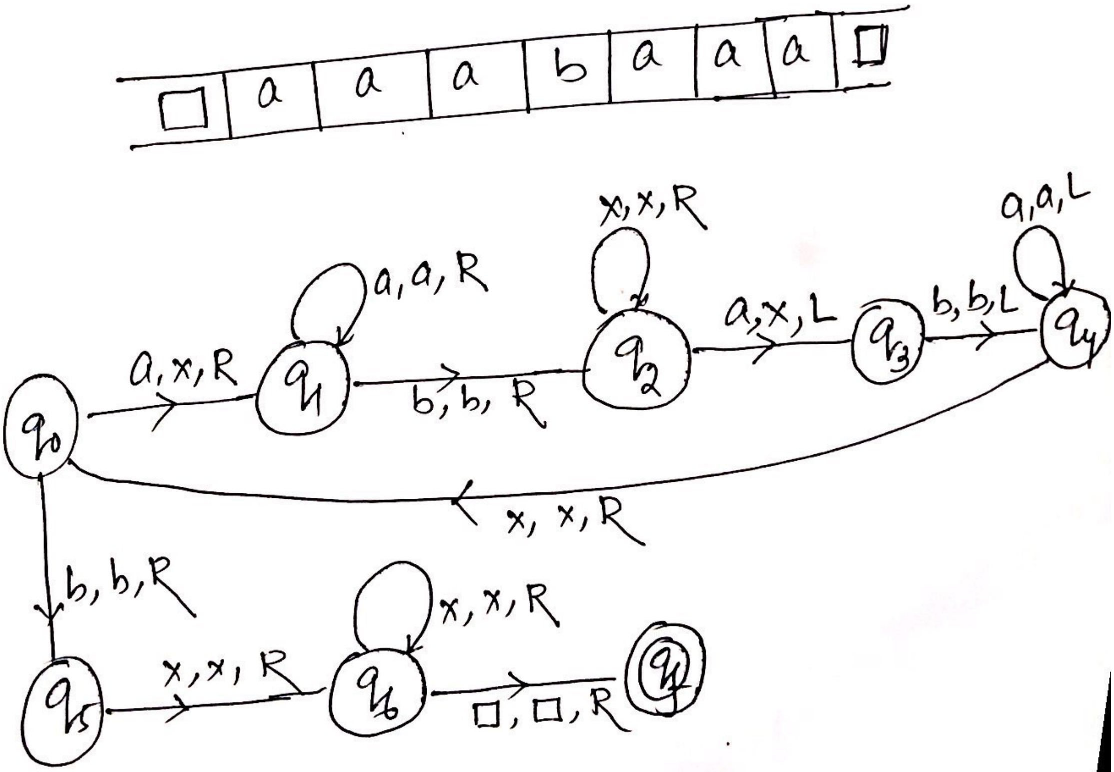
7(a)



(b)

$$
\begin{aligned}
(q_0, baaba) &\vdash (q_0, aaba, bZ_0)\\
&\vdash (q_0, aba, Z_0)\\
&\vdash (q_0, ba, aZ_0)\\
&\vdash (q_0, a, Z_0)\\
&\vdash (q_0, \lambda, aZ_0)\\
&\vdash (q_1, \lambda, Z_0)\\
&\vdash (q_2, \lambda, Z_0)
\end{aligned}
$$

8(a)



8 (b)

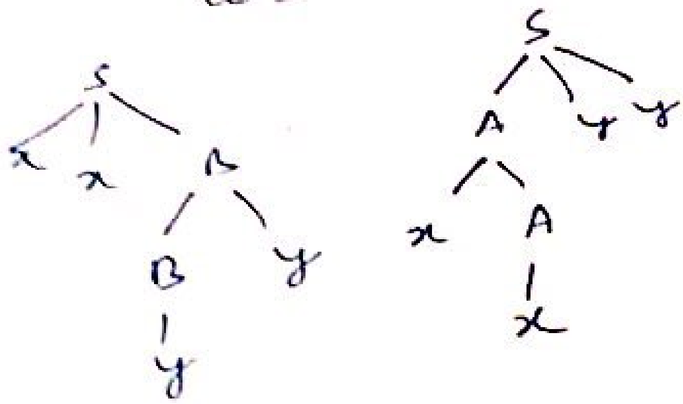
$S \rightarrow xxB \mid Ayy$

$A \rightarrow x \mid xA$

$B \rightarrow y \mid By$

$w = xxyy$

(a)



(b) The language of the grammar

$\{xxy^n : n \geq 1\} \cup \{x^m yy : m \geq 1\}$

the only common string which shows ambiguity is $xxyy$

Unambiguous grammar

$S \rightarrow xxB \mid Ayy \mid xyy$

$B \rightarrow y \mid yB$

$A \rightarrow xA \mid xxx$

6(b)

b. λ-closure(T) = λ-closure{1, 3, 4}

= λ-closure(1) $\cup$ λ-closure(3) $\cup$ λ-closure(4)

= {1, 2, 5} $\cup$ {3} $\cup$ {4, 1, 7}

= {1, 2, 3, 4, 5, 7}

λ-closure(S) $\cup$ λ-closure(T)

= {1, 2, 3, 5} $\cup$ {1, 2, 3, 4, 5, 7}

= {1, 2, 3, 4, 5, 7}

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