



**UTM**  
UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF ENGINEERING

SCHOOL OF COMPUTING

SESSION 2020/2021 SEMESTER 2

**SCSJ3203 THEORY OF COMPUTER SCIENCE**  
**SECTION 04**

**TUTORIAL 2**  
**LANGUAGES**

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## TCS Tutorial 2: Languages.

1. Let  $X = \{00\}$ , and  $Y = \{w \in \Sigma^*, |w| = 2\}$  are languages over  $\Sigma = \{0, 1\}$

a) List the members of set  $Y$

$$Y = \{00, 01, 10, 11\}$$

b) How many strings of length 4 are there in  $X^*$ ?

$$= \{0, 00, 0000, 00000, \dots\}$$

$$4 = 10001$$

= There is only 1 string of length 4

c)  $YX$

$$= \{00, 01, 10, 11\} \times \{00\}$$

$$= \{000, 0100, 1000, 1100\}$$

2. Let  $\Sigma = \{a, b\}$ ,  $L_1 = \{x \in \Sigma^* : |x| < 3\}$  and  $L_2 = \{aa, aaa\}$ .  
List the elements in each of the following languages  $L$ :

a)  $L_3 = L_1 \cup L_2$

$$L_1 = \{\epsilon, a, b, aa, ab, ba, bb\}$$

$$L_2 = \{aa, aaa\}$$

$$L_3 = \{\epsilon, a, b, aa, ab, ba, bb, aaa\}$$

b)  $L_4 = L_1 \cap L_2$

$$L_4 = \{aa\}$$

c)  $L_5 = L_1 L_4$

$$L_5 = \{\epsilon, a, b, aa, ab, ba, bb\} \{aa\}$$

$$= \{\epsilon aa, aaa, baa, aaaa, abaa, baaa, bbaa\}$$

d)  $L_6 = L_1 - L_2$

$$L_6 = \{\epsilon, a, b, aa, ab, ba, bb\} - \{aa, aaa\}$$

$$= \{\epsilon, a, b, ab, ba, bb\}$$

3. Let  $W = abbaaababb$

| Substring  | Prefix     | Suffix     | Palindrome | None |
|------------|------------|------------|------------|------|
| aab        | abbaa      | abb        | bab        | baba |
| abab       | abb        | babb       |            | bbb  |
| abbaa      | abbaaababb | abbaaababb |            |      |
| bba        |            |            |            |      |
| babb       |            |            |            |      |
| bab        |            |            |            |      |
| abb        |            |            |            |      |
| abbaaababb |            |            |            |      |

4.  $S^*$ , where  $S = \{a, ab, bb\}$

| IN the language                                                                   | NOT IN the language                 |
|-----------------------------------------------------------------------------------|-------------------------------------|
| a, bb, abb, aaaa, aab,<br>aaba, aabb, abaa, abab,<br>abba, abbb, bbaa, bbab, bbbb | b, baaa, baab, baba,<br>babb, bbb a |

5. Write 3 valid/invalid strings. Value = m, n, p, q.

|    | Three VALID Strings   |                            |                              | Three INVALID Strings |                      |                        |
|----|-----------------------|----------------------------|------------------------------|-----------------------|----------------------|------------------------|
| b) | $a^1b^1c^1d^1 = abcd$ | $a^2b^1c^1d^1 = aab c d d$ | $a^3b^1c^1d^1 = a a c d$     | $a^1b^1c^1d^0 = abc$  | $a^1b^1c^0d^1 = abd$ | $a^1b^0c^1d^1 = a c d$ |
| c) | $a^1b^0c^0d^1 = ad$   | $a^2b^1c^1d^0 = a a b c$   | $a^3b^2c^0d^1 = a a a b b d$ | $a^1b^1c^1d^0 = abc$  | $a^1b^1c^0d^1 = abd$ | $a^1b^0c^1d^1 = a c d$ |

6. Write the value of m and n.

|    | m=1, n=1                            | m=1, n=0                        | m=0, n=1                        | m=1, n=2                            | m=2, n=1                            |
|----|-------------------------------------|---------------------------------|---------------------------------|-------------------------------------|-------------------------------------|
| b) | $a^1b^1c^1d^1 = abcd$               | $a^1b^0c^0d^1 = ad$             | $a^0b^1c^1d^0 = bc$             | $a^1b^2c^2d^1 = a b b c c d$        | $a^2b^1c^1d^2 = a a b c d d$        |
| c) | $a^{1+1}b^{1+2}c^{1+1} = a a b c c$ | $a^{1+1}b^{1+2}c^{1+0} = a a b$ | $a^{0+1}b^{0+2}c^{1+1} = a c c$ | $a^{1+1}b^{1+1}c^{1+1} = a a b c c$ | $a^{1+1}b^{1+2}c^{1+1} = a a b c c$ |
| d) | $a^1a^1b^1c^1 = a a b c$            | $a^1a^0b^0c^1 = ac$             | $a^0a^1b^1c^0 = ab$             | $a^1a^2b^2c^1 = a a a b b c$        | $a^2a^1b^1c^2 = a a a b c c$        |