

## Week1 monday

We will use vocabulary that should be familiar from your discrete math and introduction to proofs classes. Some of the notation conventions may be a bit different: we will use the notation from this class' textbook<sup>1</sup>.

Write out in words the meaning of the symbols below:

$$\{a, b, c\}$$

$$|\{a, b, a\}| = 2$$

$$|aba| = 3$$

$$(a, 3, 2, b, b)$$

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<sup>1</sup>Page references are to the 3rd edition (International) of Sipser's Introduction to the Theory of Computation, available through various sources for under \$30. You may be able to opt in to purchase a digital copy through Canvas. Copies of the book are also available for those who can't access the book to borrow from the course instructor, while supplies last (minnes@eng.ucsd.edu)

| Term                                 | Typical symbol   | Meaning   |
|--------------------------------------|------------------|---|
| Alphabet                             | $\Sigma, \Gamma$ | A non-empty finite set  |
| Symbol over $\Sigma$                 | $\sigma, b, x$   | An element of the alphabet $\Sigma$   |
| String over $\Sigma$                 | $u, v, w$        | A finite list of symbols from $\Sigma$  |
| The set of all strings over $\Sigma$ | $\Sigma^*$       | The collection of all possible strings formed from symbols from $\Sigma$          |
| (Some) language over $\Sigma$        | $L$              | (Some) set of strings over $\Sigma$   |
| Empty string                         | $\varepsilon$    | The string of length 0  |
| Empty set                            | $\emptyset$      | The empty language  |
| The power set of a set $X$           | $\mathcal{P}(X)$ | The set of all subsets of $X$   |
| Natural numbers                      | $\mathcal{N}$    | The set of positive integers  |
| Finite set                           |                  | The empty set or a set whose distinct elements can be counted by a natural number |
| Infinite set                         |                  | A set that is not finite.   |
| <i>Pages 3, 4, 6, 13, 14, 53</i>     |                  |   |

| Term  | Notation          | Meaning  |
|---|-------------------|--|
| Reverse of a string $w$   | $w^{\mathcal{R}}$ | write $w$ in the opposite order, if $w = w_1 \cdots w_n$ then $w^{\mathcal{R}} = w_n \cdots w_1$ . Note: $\varepsilon^{\mathcal{R}} = \varepsilon$ |
| Concatenating strings $x$ and $y$                                 | $xy$              | take $x = x_1 \cdots x_m$ , $y = y_1 \cdots y_n$ and form $xy = x_1 \cdots x_m y_1 \cdots y_n$   |
| String $z$ is a substring of string $w$                           |                   | there are strings $u, v$ such that $w = uzv$   |
| String $x$ is a prefix of string $y$                              |                   | there is a string $z$ such that $y = xz$   |
| String $x$ is a proper prefix of string $y$                       |                   | $x$ is a prefix of $y$ and $x \neq y$  |
| Shortlex order, also known as string order over alphabet $\Sigma$ |                   | Order strings over $\Sigma$ first by length and then according to the dictionary order, assuming symbols in $\Sigma$ have an ordering.             |

Pages 13, 14

Circle the correct choice:

A **string** over an alphabet  $\Sigma$  is an element of  $\Sigma^*$  OR a subset of  $\Sigma^*$ .

A **language** over an alphabet  $\Sigma$  is an element of  $\Sigma^*$  OR a subset of  $\Sigma^*$ .

Extra examples for practice:

With  $\Sigma_1 = \{0, 1\}$  and  $\Sigma_2 = \{a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z\}$  and  $\Gamma = \{0, 1, x, y, z\}$

An example of a string of length 3 over  $\Sigma_1$  is \_\_\_\_\_

An example of a string of length 1 over  $\Sigma_2$  is \_\_\_\_\_

The number of distinct strings of length 2 over  $\Gamma$  is \_\_\_\_\_

An example of a language over  $\Sigma_1$  of size 1 is \_\_\_\_\_

An example of an infinite language over  $\Sigma_1$  is \_\_\_\_\_

An example of a finite language over  $\Gamma$  is \_\_\_\_\_

**True or False:**  $\varepsilon \in \Sigma_1$

**True or False:**  $\varepsilon$  is a string over  $\Sigma_1$

**True or False:**  $\varepsilon$  is a language over  $\Sigma_1$

**True or False:**  $\varepsilon$  is a prefix of some string over  $\Sigma_1$

**True or False:** There is a string over  $\Sigma_1$  that is a proper prefix of  $\varepsilon$

The first five strings over  $\Sigma_1$  in string order, using the ordering  $0 < 1$ :

The first five strings over  $\Sigma_2$  in string order, using the usual alphabetical ordering for single letters: