

## 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: