

## Week0 friday

The CSE 105 vocabulary and notation build on discrete math and introduction to proofs classes. Some of the conventions may be a bit different from what you saw before so we'll draw your attention to them.

For consistency, we will use the notation from this class' textbook<sup>1</sup>.

These definitions are on pages 3, 4, 6, 13, 14, 53.

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<sup>1</sup>Page references are to the 3rd edition of Sipser's Introduction to the Theory of Computation, available through various sources for approximately \$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@ucsd.edu)

| Term  | Typical symbol<br>or Notation | 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) empty string  | $\varepsilon$                 | The (only) string of length 0  |
| 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 $\Sigma$  |
| (The) empty language  | $\emptyset$                   | The empty set, i.e. the set that has no strings (and no other elements either)   |
| The power set of a set $X$  | $\mathcal{P}(X)$              | The set of all subsets of $X$  |
| (The set of) natural numbers                                      | $\mathcal{N}$                 | The set of positive integers   |
| (Some) finite set   |                               | The empty set or a set whose distinct elements can be counted by a natural number  |
| (Some) infinite set   |                               | A set that is not finite.  |
| 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              |

Write out in words the meaning of the symbols below:

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

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

$$|aba| = 3$$

*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  $\Sigma^*$ .

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  $\Gamma = \{0, 1, x, y, z\}$

**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: