## Day1

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.

<sup>&</sup>lt;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 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	arepsilon, arepsilon, arepsilon	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	Ø	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 $xy =$
String $z$ is a substring of string $w$		$x_1 \cdots x_m y_1 \cdots y_n$ there are strings $u, v$ such that $w = uzv$
String $x$ is a substring of string $y$		there are strings $a, b$ such that $w = azb$ 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 <u>an element of  $\Sigma^*$  OR a subset of  $\Sigma^*$ .</u>

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: