CSE596 Lecture Tue 1/29/19 Spr 2019

763476 [went thru syllabus and webpages for 35+ minutes]

Elements of Theory: Numbers and $\boxed{\text{Strings.}}$

- **Char**: A symbol that can be told apart from other symbols.
  'a', 'i', Spanish ch, rr, Chinese chars can even be composed of multiple other chars.

- **Alphabet** = a (finite) set of symbols. set<char>
  Binary alphabet {'0','1'} or {'a','b'}
  ASCII alphabet: {32 control codes, ^ " # .. A .. Z .. a .. z ...
  #0 '\0' (NUL)
  Mapped over {0,1}^8 i.e. 00000000 ... 11111111
  Codes #128 thru #255 are "upper ASCII."

- **String** = a (finite) list of char, repetitions allowed.
  string = list<char>

  Main operation: • for concatenation, eg 'ab' • 'ba' = abba
  empty string "" We will denote it by ε epsilon (alternative λ lambda)

  For any string x, $\varepsilon \cdot x = x \cdot \varepsilon = x$.

- **Language** = a set of strings. Often infinite!
  language = set<string>
  Added: often interchangeable with set<integer>.

  Example: $\emptyset$ is the empty set / language
  It is not the same as $\{\varepsilon\}$.

Languages have associated operations too:

- All set operations $\cup$, $\cap$, $\sim$ (complementation)
- Concatenation of languages

Convention: Lowercase x, y, z, w, v, u.. strings. Uppercase L, A, B, C, D.. for languages.

$A \cdot B$ = { all strings formed by concatenating a string x in A then a string y in B }

$= \{ x \cdot y : x \in A \wedge y \in B \}$

Alphabet is $\Sigma = \{0, 1\}$. The $\cdot$ is not a terminal char.

Example: $A = \{"01", "010"\}$
$B = \{"11", "011"\}$

$A \cdot B = \{ 01 \cdot 11, \underbrace{01 \cdot 011, 010 \cdot 11}, 010 \cdot 011 \}$
$= \{ 0111, \underset{\text{same string}}{01011}, 010011 \}$ only!

Different from Cartesian Product $A \times B$.

Added: $A \times B = \{ (x, y) : x \in A \ \& \ y \in B \}$.

In this case, $A \times B = \{ (01, 11), \underline{(01, 011), (010, 11)}, (010, 011) \}$

as ordered pairs, these remain different.

Always $|A \times B| = |A| \cdot |B|$ but as above, $|A \cdot B| < |A| \cdot |B|$ can happen

(when $|\ldots|$ might confuse with length of a string, we can write $\|A\|$ for cardinality instead.

Length of string: $|aba| = 3$, $|x \cdot y| = |x| + |y|$, $|\varepsilon| = 0$.)

End