

CPT411 Automata Theory & Formal Languages

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Tutorial I

- Examine the following formal description of sets so that you understand which member they contain. Write a short informal English description of each set.
 - Set containing all positive odd numbers.
 - Set containing all even integers.
 - Set containing all positive even numbers/multiples of 2.
 - Set containing numbers of multiples of 2 and 3/all multiples of 6.
 - Set containing all binary palindromes.
 - Set is empty. No number can be equal to itself plus one.
- Write formal descriptions of the following sets:
 - $\{1, 10, 100\}$
 - $\{n \mid n \in \mathbb{Z}, n > 5\}$
 - $\{n \mid n \in \mathbb{N}, n < 5\}$
 - $\{\text{"aba"}\}$
 - $\{\varepsilon\}$
 - $\{\emptyset\}$
- Let A be the set $\{x, y, z\}$ and B be the set $\{x, y\}$.
 - No. A contains z , which is not in B .
 - Yes. Every element in B is also in A .
 - $\{x, y, z\}$
 - $\{x, y\}$
 - $\{(x, x), (x, y), (y, x), (y, y), (z, x), (z, y)\}$
 - $P(B) = \{\emptyset, \{x\}, \{y\}, \{x, y\}\}$
- If A has a elements and B has b elements, how many elements are there in $A \times B$?
If $|A| = a$ elements and $|B| = b$ elements,
 $\therefore |A \times B| = a \times b$
- If C is a set with c elements, how many elements are there in the power set of C ?
 $|P(C)| = 2^c$
- Let X be the set $\{1, 2, 3, 4, 5\}$ and Y be the set $\{6, 7, 8, 9, 10\}$. The unary function $f : X \rightarrow Y$ and the binary function $g : X \times Y \rightarrow Y$ are described in the following tables.
 - $f(2) = 7$
 - $\forall x \in X : x \in D_f, R_f[6, 7]$
 - $g(2, 10) = 6$
 - $\forall (x, y) \in X \times Y : (x, y) \in D_g, R_g[6, 10]$
 - $g(4, 7) = 8$
- Consider the domain and range values in following table. State whether it is a function or a relation.
R at 0 has multiple possible outputs.
 \therefore It is a relation.
- Give an example of a relation that you have encountered in:
 - Daily life:** “is a fan of football club of”
 - School of Computer Sciences:** “instructs modules of”
- Which method is better to describe a person and his/her age? Function or relation?
Each person has exactly one age at a given time.
 \therefore Function is better for the description.
- Give examples to show that:
 - Let $A = \{2n \mid n \in \mathbb{N}\}$ and $B = \{3n \mid n \in \mathbb{N}\}$, $A \cap B = \{6k \mid k \in \mathbb{N}\}$ and only 0 is divisible by 2 and 3 \therefore finite.
 - Let $A = \mathbb{N}$ and $B = \{n \mid n \geq 5\}$, $A \cap B = \{5, 6, 7, 8, \dots\}$ \therefore countably infinite.
 - Let $A = \mathbb{R}$ and $B = \mathbb{Q}$, $A \cap B =$ Some isolated points \therefore finite.