
CSE 322

Exam Reviews

Basic Concepts

- Formal Languages

- Alphabet (Σ)
- String (Σ^*)
- Length ($|x|$)
- Empty String (ϵ)
- Empty Language (\emptyset)

- Language/String Operations

- “Regular” Operations:
 - Union (\cup)
 - Concatenation (\bullet)
 - (Kleene) Star ($*$)
- Other:
 - Intersection
 - Complement
 - Reversal
 - Shuffle
 - ...

Finite Defns of Infinite Languages

- English, mathematical
- DFAs
 - States
 - Start states
 - Accept states
 - Transitions (δ function)
 - M accepts $w \in \Sigma^*$
 - M recognizes $L \subseteq \Sigma^*$

- **Nondeterminism**
- NFAs
 - Transitions (δ relation)
 - Missing out-edges
 - Multiple out-edges
 - ϵ -moves
 - N accepts $w \in \Sigma^*$
 - N recognizes $L \subseteq \Sigma^*$
- Regular Expressions
 - $\emptyset, \epsilon, a \in \Sigma, \cup, \cdot, *, ()$
- GNFA

Key Results, Constructions, Methods

- L is regular iff it is:
 - Recognized by a DFA
 - Recognized by a NFA
 - Recognized by a GNFA
 - Defined by a Regular Expr

Proofs:

GNFA \rightarrow Reg Expr
(Kleene/Floyd/Warshall: $R_{ik} R_{kk}^* R_{kj}$)

Reg Expr \rightarrow NFA
(join NFAs w/ ϵ -moves)

NFA \rightarrow DFA
(subset construction)

DFA \rightarrow GNFA
(special case)

- The class of regular languages is closed under:
 - Regular ops: union, concatenation, star
 - Also: intersection, complementation, (& reversal, prefix, no-prefix, ...)
- NOT closed under \subseteq, \supseteq
- Also: Cross-product construction (union, ...)

Applications

- “globbing”
 - `lpr *.txt`
- pattern-match searching:
 - `grep “Ruzzo.*terrific” *.txt`

- Compilers:
 - `Id ::= letter (letter|digit)*`
 - `Int ::= digit digit*`
 - `Float ::=`
`d d* . d* (ϵ | E d d*)`
 - (but not, e.g. expressions with nested, balanced parens, or variable names matched to declarations)
- Finite state models of circuits, control systems, network protocols, API’s, etc., etc.