

## **Finite automata**

Reduction of one problem to another

Diagonalization

Nondeterminism

Interweaving

Finite automata

Nondeterministic finite automata

Conversion nfa to fa

Sets accepted by finite automata are called regular sets

Not all sets are regular

Class of regular sets closed under complement.

Epsilon moves, multiple start states, restricting to one final state.

Regular expressions

The class of sets denoted by regular expressions is the class of set defined by finite automata.

Closure properties of class of regular sets

Machine constructions

Homomorphisms and inverse homomorphisms

Operations like shuffle

Minimizing states in fa.

Pumping lemma for regular sets

Decision procedures

Interesting fa

## **Context-free languages**

cfl's properly contains regular sets

cfl's defined by error in string

pda's

acceptance by final state and by empty store define same class of languages

reduction of many state to one state

one state equivalent to cfl's

machine construction for intersection with regular sets

normal forms: eliminate useless variables, epsilon productions, singleton productions

Chomsky normal form

Pumping lemma for cfl

Closure properties

Decision properties

Dynamic programming applied to membership problem

## **Turing machines and computability**

Turing machine

Instantaneous description

Valid computation 2-counter machine construction

Recursive and r.e. sets

10 properties of recursive and r.e. sets

Rado's Sigma function

Halting problem undecidable

Rice's theorem

undecidable problems for cfls

## **P and NP**

3-CNF

Other NP-complete problems: clique, 3-colorable, Hamilton circuit

PSPACE and NPSPACE

PSPACE=NPSPACE

QBF and Generalized Geography complete for PSPACE

Oracles

Hierarchy of undecidable problems

