Regular Languages

Generalized Nondeterministic Finite Automaton (GNFA)

**Theorem.** A language is regular if and only if some regular expression describes it.

**Proof.** ($\Rightarrow$)

**GNFA Ground Rules**

- Transition out to every other state, but no transitions in.
- Transition arrows have regular expressions as labels.
- Exactly one arrow from and to every other state other than start or accept.
- Transition in from every state, but no transitions out.

**Converting DFA into GNFA**

- Add new start state with $\epsilon$ arrow to old start state.
- Add new accept state with $\epsilon$ arrows from old accept states. Remove old accept states.
- Multiple labels on arrow are replaced by union of labels.
- Add arrows labeled $\emptyset$ between states that had no arrows.
Ripping Out States

Before

After

A Regular Expression for An Old Friend