**Air Force Institute of Technology**

**Graduate School of Engineering and Management**

**Department of Electrical and Computer Engineering**

**CSCE 532 Automata and Formal Languages**

**Winter 2019**

# Day 5

# nonregular Languages

§1.3 Regular Expressions and Nonregular Languages (cont.)

### Example (Sipser Exercise 1.29a)

Use the pumping lemma to show that is not regular.

### Proof

Assume is regular. Then it has a pumping length such that for any string with there exist , , and such that and furthermore

1. For each , ,
2. , and
3. .

Let . Then because of condition 3, where (in particular, consists entirely of ’s). Next, because of condition 2, where , so . However, this contradicts condition 1. Therefore, our assumption that is regular must be false.

### Example (Sipser Exercise 1.46b)

Prove that is not regular. You may use the pumping lemma and the closure of the class of regular languages under union, intersection, and complement.

### Proof

Assume that is regular. Then by the closure of regular languages under complement and intersection, is also regular. However, consists of all strings of ’s followed by ’s such that the number of ’s is not different from the number of ’s, i.e. , which is not regular. Thus, our assumption must be false.

Note: Sipser offers two proofs. The first is essentially identical to mine, which the second is based on the pumping lemma.

### Practice (Sipser Exercise 1.29b)

Use the pumping lemma to show that is not regular.

### Solution