UNIVERSITY COMPUTER SCIENCE • EXERCISE SHEET

11.1 Automata and regular languages

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

KEY WORDS deterministic finite automaton • pumping lemma

Objective

Trace DFAs exactly and use the pumping lemma as a ceiling.

1 Key knowledge and worked examples

■ The machine

States plus a transition table; acceptance only at end of input ✓. The ends-in-ab DFA: `aabab` accepts, `aba` rejects ✓.

■ Worked example: the ceiling

Pumping: any long accepted string has a pumpable y; $a^n b^n$ breaks when pumped – not regular ✓.

2 Practice

2.1 In the ends-in-ab DFA, which state accepts? [3]

2.2 Why is `aba` rejected? [3]

2.3 One line: what does the pumping lemma forbid a regular language from doing? [3]

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3 Exam-style questions

3.1 The ends-in-ab DFA over the alphabet a, b has these transitions: q0 on a goes to q1; q1 on a stays q1; q1 on b goes to q2; q2 on a goes to q1; q0 on b stays q0; q2 on b goes to q0. The accepting state is q2.

Give the full state trace of `babbab` and the verdict. Give the trace of `babba`. State which two positions of the input could be swapped to flip the verdict, and why. Draw (or describe) the missing 8th transition a complete table needs if any input letter were added. [8]

3.2 Use the pumping lemma to argue $L = \{a^n b^n\}$ is not regular with p as the pumping length.

Choose the string and state its constraint on n. Split it xyz and state what y must contain. Pump once and derive the contradiction. State what this ceiling means for a lexer that must match nested brackets. [7]

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