

## JUST A TEST

**Q1.** Regular Expression

- (a) All strings over  $\{a, b\}$  that start and end with the same symbol  
 $a(a|b)^*a \mid b(a|b)^*b \mid a \mid b$
- (b) All binary strings representing powers of 2  
 $(1—0)^*0$
- (c) All binary strings that do not contain two consecutive zeroes  
 $(1|01)^*(0|\epsilon)$
- (d) Lowercase alphabet strings that start and end with a vowel (a, e, i, o, u)  
 $(a|e|i|u|o)[a-z]^*(a|e|i|u|o)$
- (e) Alphanumeric passwords with at least one uppercase, one lowercase, or one digit  
 $[A-Za-z0-9]^+$

**Q2. DFA & NFA**

- (a) DFA for all binary strings representing odd numbers.

Basically, we want binary strings that end with 1

- (b) DFA for strings over  $\{a, b\}$  that contain the substring "aba"  
(c) DFA for binary strings divisible by 4  
(d) DFA for hexadecimal strings representing powers of 2

**Q3.** Write a Context-Free Grammar for polynomial expressions. Terms can be sorted in any order, for simplicity. Use the ^ character to denote superscript exponents.

First, we have the Terminals

- $\{+, -, *, /, ^\}$
- $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$  or  $[0-9]$

Then, we have the Non-terminals

$$\langle \text{polynomial} \rangle ::= \langle \text{expression} \rangle$$
$$\begin{aligned} \langle \text{expression} \rangle &::= \langle \text{expression} \rangle + \langle \text{term} \rangle \\ &| \langle \text{expression} \rangle - \langle \text{term} \rangle \\ &| \langle \text{term} \rangle \end{aligned}$$
$$\begin{aligned} \langle \text{term} \rangle &::= \langle \text{term} \rangle * \langle \text{factor} \rangle \\ &| \langle \text{term} \rangle / \langle \text{factor} \rangle \\ &| \langle \text{factor} \rangle \end{aligned}$$
$$\begin{aligned} \langle \text{factor} \rangle &::= \langle \text{number} \rangle ^ \langle \text{number} \rangle \\ &| \langle \text{number} \rangle \end{aligned}$$
$$\begin{aligned} \langle \text{number} \rangle &::= \langle \text{digit} \rangle \langle \text{number} \rangle \\ &| \langle \text{digit} \rangle \end{aligned}$$
$$\langle \text{digit} \rangle ::= [0 - 9]$$