

Course Code: CS301	Course Name: Theory of Automata
Instructor Name:	M. Shahzad, Shaharbano, Zeshan Khan
Student Roll No:	Section No:

Instructions :Solution Paper

- Return the question paper.
- Read each question completely before answering it. There are **4 questions and 2 pages**.
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- Start each question in a new sheet.

Time: 60 minutes.

Max Marks : 60 points

Question 1:

[15 Points]

Build the regular expression for the language of URL consisting of Alphabets (a-z, A-Z), Digits (0-9) and Characters ( -, . , : , // ). All the strings from this language should satisfy following scenario:

Scenario:

- Must start with http or https or ftp followed by ://
- Must match a valid domain name (all valid domain name rules)
- Could contain a port specification (http://www.example.com:80)
- Could contain digit, letter, dots, hyphens, forward slashes

Example Strings:

URL = {http://www.abc.com:8080, https://www.abc12.com:80, ftp://www.abc-12.com:808,..}

Solution

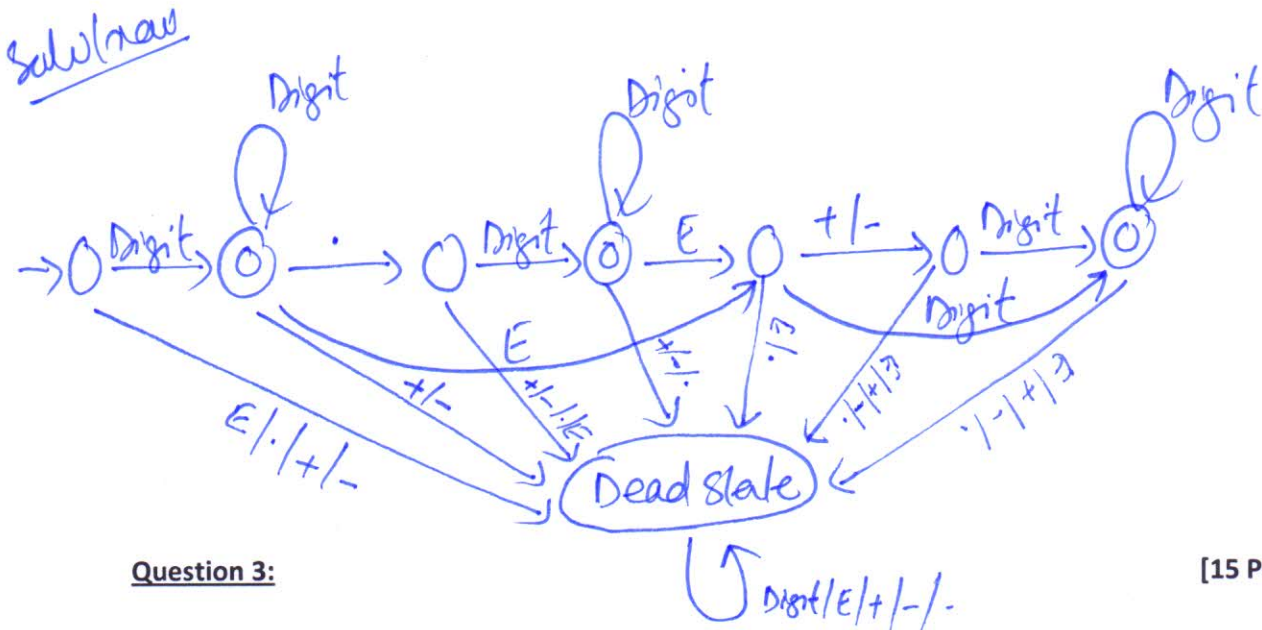
$$\begin{aligned}
 & (http+https+ftp)(://)(www)(\cdot) \left[ (a-zA-Z)^+(0-9)^* + (a-zA-Z)^+(-)(a-zA-Z0-9)^+ \right] \\
 & \left[ (://)(0-9)^+ \wedge \right] \\
 & \left[ (!:)(00+8)^+ \wedge \right] \\
 & \left[ (!:)(00+8)\{2,4\} \right]
 \end{aligned}$$

**Question 2:****[15 Points]**

Construct a deterministic finite automaton that accepts the strings of the language  $L$  of unsigned numbers defined over  $\Sigma = \{0-9, E, .\}$ . Following are the few words from the Language  $L$ :

$L = \{0, 10, 120.33, 54E17, 24.5E3, 4.5E-21, 7.2E+3, \dots\}$

Note: E in the above words denote the exponent. Moreover you can use the term **Digit** to express any single numeric digit from 0 to 9 instead of using numeric values.

**Question 3:****[15 Points]**

Compare and contrast DFA vs. NFA in term of time and space complexity for the worst case scenario. Your discussion must have logical and understandable reasoning with example.

Solution

Time:

- \* Running time of DFA is  $O(n)$  where  $n$  is the length of input string
- \* NFA takes  $O(m^2n)$  /  $O(mn)$  because of backtracking

Space:

- \* DFA requires more space because of incorporating all the transition
- \* NFA requires less space

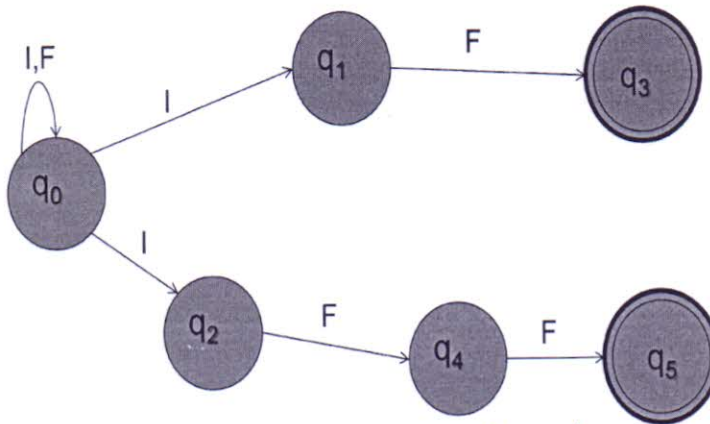
Example

Language  $L$  accepts all the strings that ends on either web or ebay defined over  $\Sigma = \{a-zA-Z\}$

**Question 4:**

[15 Points]

Find the DFA of the given NFA, where  $\Sigma = \{I, F, G\}$ ,  $Q = \{q_0, q_1, q_2, q_3, q_4, q_5\}$ ,  $A = \{q_3, q_5\}$ ,  $q_0 = \{q_0\}$



Solution:

State	Input		
	I	F	G
$\alpha = \{q_0\}$	$\{q_0, q_1, q_2\}$	$\{q_0\}$	$\emptyset$
$\beta = \{q_0, q_1, q_2\}$	$\{q_0, q_1, q_2\}$	$\{q_0, q_3, q_4\}$	$\emptyset$
$\gamma = \{q_0, q_3, q_4\}$	$\{q_0, q_1, q_2\}$	$\{q_0, q_5\}$	$\emptyset$
$\delta = \{q_0, q_5\}$	$\{q_0, q_1, q_2\}$	$\{q_0\}$	$\emptyset$
$\lambda =$	$\emptyset$	$\emptyset$	$\emptyset$

.....End of Paper.....

