Question 1

Build a DPDA to show that the language is deterministic context free.

defined by:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | **Current State** |  |  | | --- | |  | | |  | | --- | | **Input** | | |  | | --- | | **Stack Top** | | |  | | --- | | **Next State** | | **Stack Operation** |
|  |  |  |  | Push X |
|  |  |  |  | Push X |
|  |  |  |  | Pop X |
|  |  |  |  | Pop X |
|  |  |  |  | Pop X |
|  |  |  |  | Pop X |
|  |  |  |  | Pop X |
|  |  |  |  | - |

Transitions:

(q0, b, Z0) -> (q0, XZ0)

(q0, b, X) -> (q0, XX)

(q0, a, X) -> (q1, ε)

(q1, a, X) -> (q2, ε)

(q2, a, X) -> (q3, ε)

(q3, a, X) -> (q3, ε)

(q3, b, X) -> (q3, ε)

(q3, ε, Z0) -> (qf, Z0)

Question 2

Prove that the language

over the alphabet ∑ = {a, b} is non-context free.

Use the pumping lemma with length.

Pumping Lemma for context-free languages

[1] Assume that the language is context-free.

[2] For any context-free language

There exists a pumping length such that any string

with can be decomposed into five parts

satisfying the following conditions:

1. has at most ppp
2. is non-empty
3. For all , the string is also in

[3] Chose suitable word :

[4] Five ways in which can occur in the word:

1. Initial 'b' and some of the 'a's.

2. Some/all of the 'a's.

3. Some of the 'a's to 'b's and some of the 'b's.

4. Some or all of the 'b's.

5. The transition from 'b's to the final 'a's and some of the 'a's.

[5] show that pumping and results in a string that does not belong to L for each case

1. Suppose consists of an **Initial 'b' and some of the 'a's**

- and/or would have 'b's and 'a's.

- pumping and/or , change the number of 'a's before the sequence of 'b's disrupting the pattern of

- before 'b's must be .

2. Suppose consists of Some/all of the 'a's.

- and would have 'b's and 'a's.

- pumping and changes the number of 'a's disrupting the pattern of

- before 'b's must be .

3. Suppose consists of 'a's to 'b's and some of the 'b's.

- and would have 'a's and 'b's.

- pumping and/or would disrupt the count of 'a's

4. Suppose consists of Some or all of the 'b's

- and would have 'b's.

- pumping and changes the number of 'b's

- before 'b's must be .

5. Suppose consists of 'b's to the final 'a's and some of the 'a's.

- and would have 'b's and 'a's.

- pumping and/or would disrupt the count of 'b's disrupting the pattern of

- pumping and would disrupt the form of

- before 'b's must be .

Thus, is not a context-free language.

Question 3

Let be the grammar generating .

Let be the grammar generating .

First provide the grammars generating and respectively.

Then apply the applicable theorem of Chapter 17 to determine .

[1] Define grammar for

|  |  |
| --- | --- |
| **: Terminal(s)** |  |
| : **Non-terminal(s)** |  |
| **: Production Rule(s)** |  |

[2] Define grammar for

|  |  |
| --- | --- |
| **: Terminal(s)** |  |
| : **Non-terminal(s)** |  |
| **: Production Rule(s)** |  |

[3] Theorem on concatenation of context-free languages

|  |  |
| --- | --- |
| **: Terminal(s)** |  |
| : **Non-terminal(s)** |  |
| **: Production Rule(s)** |  |

Thus

|  |  |
| --- | --- |
| **: Terminal(s)** |  |
| : **Non-terminal(s)** |  |
| **: Production Rule(s)** |  |

Question 4

Decide whether the grammar given below generates any words

S → XY

X → SY

Y → SX

X → a

Y → b

[1] Derivation process

[2] Derivation process







[3] Derivation process



can be generated.

Therefore at least one word can be generated.

Thus, the grammar does generate words.