Name: _____ Date: _____

Note: The purpose of the following questions is:

• *Enhance learning*	• *Summarized points*	• *Analyze abstract ideas*

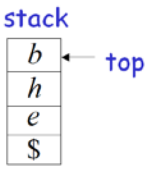
Class 10: Pushdown Automata.

1. Why the description of context-free languages by means of context-free grammars is convenient?
2. Why finite automata cannot recognize all context-free languages? Explain
3. Is there is a class of automata that can be associated with context-free languages?
4. Considering finite memory issue, what happened when scanning string from the language $L = \{a^n b^n : n \geq 0\}$
5. Considering finite memory and storage issues, what happened when scanning string from the language $L = \{ww^R\}$
6. Can you suggest a class of machines that handle the languages $L = \{a^n b^n : n \geq 0\}$ and $L = \{ww^R\}$.

In this class, we explore the connection between pushdown automata and context-free languages. We first show that if we allow pushdown automata to act nondeterministically, we get a class of automata that accepts exactly the family of context-free languages. But we will also see that here there is no longer an equivalence between the deterministic and nondeterministic versions. The class of deterministic pushdown automata defines a new family of languages, the deterministic context-free languages, forming a proper subset of the context-free languages.

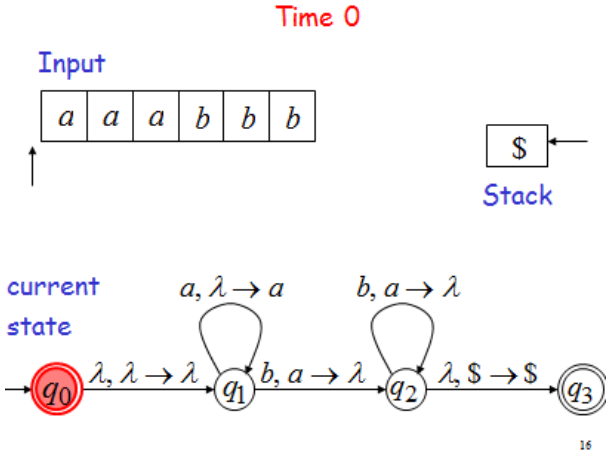
7. Give a schematic representation of a pushdown automaton and explain how it works.
8. Give a precise definition of a pushdown automaton.
9. What we mean by an ***npda*** accepting language?
10. Show the following effect of the following *individual* transitions on the following stack

a, b → c
a, λ → c
a, b → λ
a, λ → λ

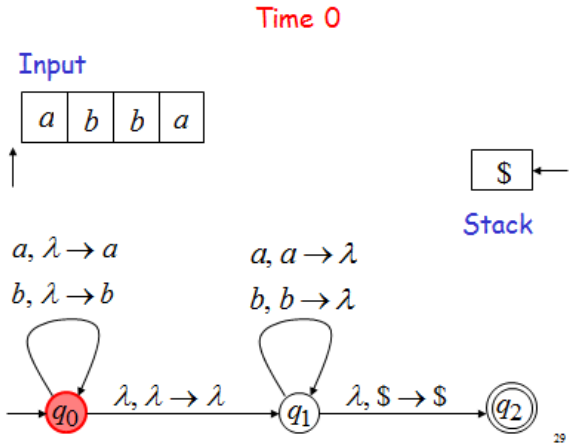


11. Show effect of the transition ***a,$ → λ*** on the stack, where **$** is the top of the stack.
12. Show the effect of the transition ***a, b → c*** on *empty stack*.
13. Show the effect of the transition ***a, λ → c*** on *empty stack*.
14. Show effect of the transition ***a,$ → b*** on the stack, where **$** is the top of the stack.
15. Give a precise definition of ***NPDA*** and give examples of allowed transitions.

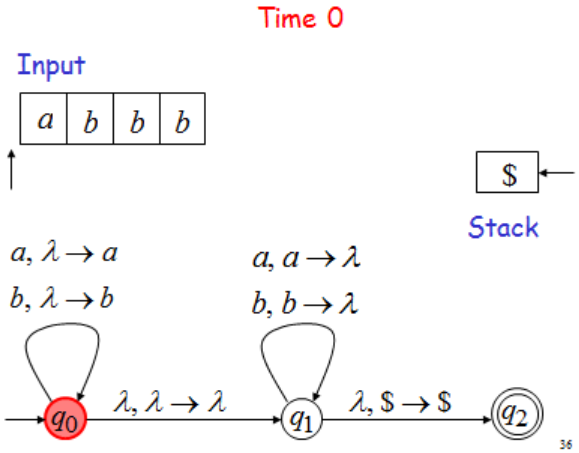
16. For the following NPDA example, show the *actions* of the automaton and the *language* accepted by this NPDA.



17. What we mean by NPDA *accepting* string?
18. For the following NPDA example, show the *actions* of the automaton and the *language* accepted by this NPDA.

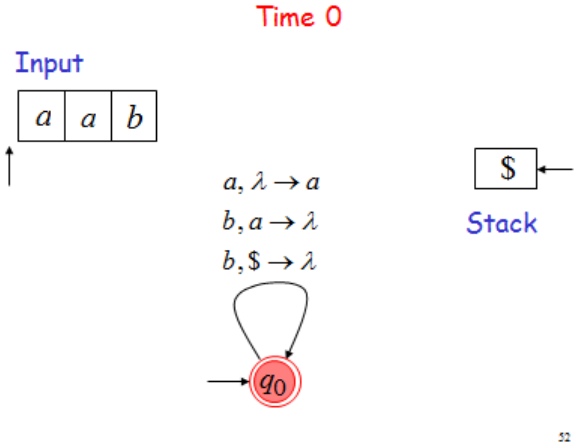


19. For the following NPDA example, show the *actions* of the automaton

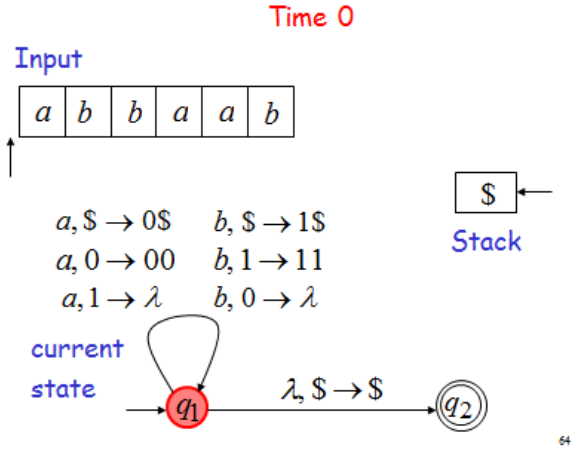


20. For the previous example show another computation on same string.
21. What we mean by NPDA *rejecting* string?

22. For the following NPDA example, show the *actions* of the automaton.



23. For the previous example show the actions for the input ***abbb***.
24. For the following NPDA example, show the *actions* of the automaton.



25. What is the formal definition of NPDA?

Instantaneous Description: While transition graphs are convenient for describing npda's, they are less useful for making arguments. The fact that we have to keep track, not only of the internal states, but also of the stack contents, limits the usefulness of transition graphs for formal reasoning. Instead we introduce a succinct notation for describing the successive configuration of an npda during the processing of a string. The relevant factors at any time are the current state of the control unit, the unread part of the input string, and the current contents of the stack. Together these completely determine all the possible ways in which npda can proceed.

26. Construct npda that accpts the language $L = \{a^n b^n : n \geq 0\}$ and Show the *instantaneous descriptions* for accepting the string *aaabbb*.