Thu Nov 10 11:33:49 PST 2011

T/F/O: Known to be true, Known to be false, or Open.

1. _____ Every subset of a regular language is regular.
2. _____ Let L be the language over $\Sigma = \{a, b\}$ consisting of all strings of the form $a^m b^n$, where $m \geq n$. Then L is a regular language.
3. _____ The complement of every regular language is regular.
4. _____ If a language has an context-free grammar, then it is is accepted by some push-down automaton.
5. _____ If a language has an ambiguous context-free grammar, then it is is not accepted by any deterministic push-down automaton.
6. _____ There is a PDA that accepts all valid C++ programs.
7. _____ The intersection of any two regular languages is regular.
8. _____ The language consisting of all base 3 numerals for positive integers n such that $n \% 7 = 3$ is regular.
9. _____ The language consisting of all base 5 numerals for prime positive integers.
10. _____ The intersection of any two context-free languages is context-free.
11. _____ The Kleene closure of every context-free language is context-free.
12. _____ If a language has an unambiguous context-free grammar, then it is is accepted by some deterministic push-down automaton.
13. _____ There is a PDA that accepts all valid C++ programs.
14. _____ $\mathcal{P}$-TIME = $\mathcal{NP}$-TIME.
15. _____ If a languages is not in the class $\mathcal{P}$-TIME, then it must be undecidable.
16. _____ The set of all mathematical statements which are provably true is decidable.
17. _____ The set of all mathematical statements which are provably true is recursively enumerable.
18. _____ If a language L is accepted by some NTM, then there is a TM which accepts L.
19. _____ The problem of whether a given grammar generates the empty language is decidable.
20. _____ The problem of whether a given grammar generates all strings over an alphabet Σ is decidable.
21. _____ Every language that can be parsed by an LALR parser can be accepted by some DPDA.
22. _____ Every language generated by an unambiguous context-free grammar is accepted by some DPDA.
23. _____ If a real number x is the solution to a polynomial equation with integral coefficients, then there must be a TM that runs forever, writing the decimal digits of x.

24. _____ There exists a polynomial time algorithm which finds the factors of any positive integer, if the input integer is written in unary ("caveman") notation.

25. _____ The Boolean circuit problem is undecidable.

26. _____ The complement of every recursive language is recursive.

27. _____ The complement of every recursively enumerable language is recursively enumerable.

28. _____ Every language which is generated by an unrestricted grammar is recursively enumerable.

29. _____ The question of whether two context-free grammars generate the same language is undecidable.

30. _____ There exists some proposition which is true but which has no proof.

31. _____ The set of all binary numerals for prime numbers is in the class $\mathcal{P}$.

32. _____ If L_1 reduces to L_2 in polynomial time, and if L_1 is $\mathcal{NP}$, and if L_2 is $\mathcal{NP}$-complete, then L_1 must be $\mathcal{NP}$-complete.

33. _____ Given any context-free grammar G and any string $w \in L(G)$, there is always a unique leftmost derivation of w using G.

34. _____ For any deterministic finite automaton, there is always a unique minimal non-deterministic finite automaton equivalent to it.

35. _____ Using multi-processors and other advanced technology, it is possible to design a machine which decides the halting problem.

36. _____ The question of whether two regular expressions are equivalent is decidable.

37. _____ Let $L = \{\langle M \rangle \mid M \text{ halts with no input}\}$. Then L is recursively enumerable.

38. _____ The complement of every context-free language is context-free.

39. _____ The complement of every $\mathcal{NP}$ language is $\mathcal{NP}$.

40. _____ The class of context-free languages is a subclass of $\mathcal{P}$.

41. _____ No language which has an ambiguous context-free grammar can be accepted by a DPDA.

42. _____ The question of whether a given Turing Machine halts with empty input is decidable.

43. _____ The class of languages accepted by non-deterministic finite automata is the same as the class of languages accepted by deterministic finite automata.

44. _____ If L_1 reduces to L_2 in polynomial time, and if L_2 is $\mathcal{NP}$, then L_1 must be $\mathcal{NP}$.

45. _____ Let $F(0) = 1$, and let $F(n) = 2^{F(n-1)}$ for $n > 0$. Then F is Turing-computable.

46. _____ Every language which is accepted by some non-deterministic machine is accepted by some deterministic machine.

47. _____ The language of all regular expressions over the binary alphabet is a regular language.

48. _____ Let π be the ratio of the circumference of a circle to its diameter. (That's the usual meaning of π you learned in second grade.) The problem of whether the n^{th} digit of π, for a given n, is equal to a given digit is decidable.

49. _____ There cannot exist any computer program that can decide whether any two C++ programs are equivalent.

50. _____ An undecidable language is necessarily $\mathcal{NP}$-complete.

51. _____ Every context-free language is in the class $\mathcal{P}$-TIME.

52. _____ Every function that can be mathematically defined is Turing computable.

53. _____ The language of all binary strings which are the binary numerals for prime numbers is context-free.

54. _____ Every bounded function from integers to integers is Turing-computable. (We say that f is *bounded* if there is some B such that $|f(n)| \leq B$ for all n.)

55. _____ The language of all palindromes over $\{0, 1\}$ is inherently ambiguous.

56. _____ Every context-free grammar can be parsed by some deterministic top-down parser.

57. _____ Every context-free grammar can be parsed by some non-deterministic top-down parser.

58. _____ Every context-free grammar can be parsed by some deterministic bottom-up parser.

59. _____ Every context-free grammar can be parsed by some non-deterministic bottom-up parser.

60. _____ Commercially available parsers cannot use the LALR technique, since most modern programming languages are not context-free.

61. _____ The boolean satisfiability problem is undecidable.

62. _____ There is a parallel processor machine which can solve the boolean circuit problem in polylogarithmic time.

63. _____ The set of all binary numerals for prime numbers is in the class $\mathcal{P}$-TIME.

64. _____ If $\mathcal{P} = \mathcal{NP}$, then RSA coding is insecure.

65. _____ The Boolean satisfiability problem is $\mathcal{NP}$-complete.

Fill in the blanks.

1. Name two classes of machines that accept the class of regular languages. _____

   and _____.

2. Name one class of machines that accepts the class of context-free languages. _____.

3. If a machine M is _____, there is at most one legal move M can make from any give configuration.

4. Name two classes of machines that accept the class of regular languages. _____

   and _____.

5. Name one class of machines that accepts the class of context-free languages. _____

6. If a machine M is _____, there is at most one legal move M can make from any give configuration.

7. An LALR parser outputs a derivation of its input string which corresponds to the _____ visitation of the internal nodes of its parse tree.

8. If every string generated by a grammar G has a unique leftmost derivation using G, then we say that G is _____.

9. We are able to prove that every language accepted by an NTM is accepted by a TM. In this proof, we construct a TM that emulates the NTM using a bitstring which we call a _____ string.

Other

1. [30 points] Consider the NFA whose transition diagram is drawn below, where the input alphabet is $\{a, b, c\}$. Draw the transition diagram of an equivalent minimal DFA. Show your steps.

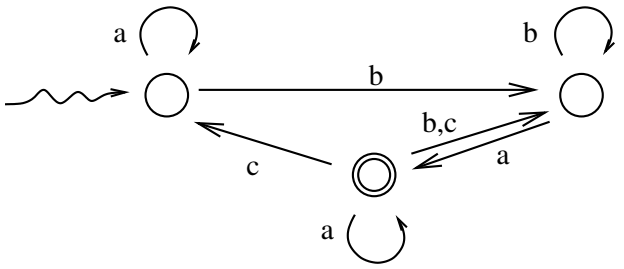

Figure 1: Find a minimal DFA equivalent to this NFA