CpSc 3500 — Goddard

Warmup 5: Recursive, R.e., Decidable and Undecidable

1. Which of the following is generated by a context-sensitive grammar but not by any unrestricted grammar?

   (a) $\mathtt{0}^n\mathtt{1}^n$
   (b) A_{tm}
   (c) S_{tm}
   (d) None of the above

   D. Does not exist.

2. Which of the following does NOT change the power of a TM?

   (a) Adding multiple tapes
   (b) Adding multiple heads
   (c) Replacing the tape by 3 stacks
   (d) All of the above

   D

3. True/False: Every finite language is recursive.

   True

4. In which of the following is it essential that we use parallelism?

   (a) The proof that recursive languages are closed under star
   (b) The proof that recursive languages are closed under intersection
   (c) The proof that r.e. languages are closed under star
   (d) The proof that r.e. languages are closed under intersection

   C

5. Which of the following problems is decidable for a regular language?

   (a) Is it infinite?
   (b) Does it contain the string TIGER?
   (c) Is it equal to its complement?
   (d) All of the above

   D

6. Which of the following problems is decidable for context-free grammars?

   (a) Does the grammar generate the string ORANGE?
   (b) Does the grammar generate everything?
   (c) Do two grammars generate the same language?
   (d) All of the above

A

7. Which of the following is true about the language A_{tm}?

   (a) It is recursive
   (b) It is r.e.
   (c) It is finite
   (d) It consists of the encodings $\langle M \rangle$ such that M accepts $\langle M \rangle$

B

8. True/False: The complement of A_{tm} is also r.e.

False

9. True/False: S_{tm} is defined as the set of representations of TMs that do not halt on their own representation.

False

10. Which of the following statements is true about the proof that S_{tm} is not r.e.

    (a) It relies on the fact that a TM cannot recognize its own representation
    (b) It relies on the fact that a TM can simulate another TM
    (c) It relies on the fact that the sky is green
    (d) All the above

B

11. Which of the following decision problems is decidable?

    (a) The halting problem for TMs
    (b) The halting problem for nondeterministic TMs
    (c) The halting problem for DFAs
    (d) The halting problem for 2-PDAs

C

12. Diagonalization was invented by

    (a) Cantor
    (b) Deacon
    (c) Priestley
    (d) Pope

A

13. When one performs diagonalization on the following grid, what is the result?

P	O	N	Y
U	T	A	H
A	C	H	E
N	A	V	Y

(a) TEST
(b) ROFL
(c) QUIZ
(d) GAGA

C

14. Assume that language A reduces to language B and language B reduces to language C. Assume that A is recursive and C is r.e. What can we say about language B?

(a) It is recursive
(b) It is r.e. but not recursive
(c) It is r.e. and might or might not be recursive
(d) The given situation is impossible

C. The language B might actually be A or C

15. Which of the following sets is NOT countable?

(a) Binary strings
(b) CFGs
(c) Languages
(d) REs

C