CS701 – MidTerm Questions (All in One)

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Questions from MidTerm Spring 2015 Papers

Q1. { [1/0],[101/0],[0/001]} in PCP problem. Find is there any match? If yes prove it. (05)

Q2. In numbers 64 , 32965. Show that these numbers relatively prime (05)

Q3. Consider the pair of numbers 1274 and 10505. show that they are relatively prime or not.

Question 2 Answer:
10505=1274*8+313
1274=313*4+22
313=22*14+5
22=5*4+2
5=2*2+1
2=1*2+0

Q4. A={<R>|R is a regular expression describing a language containing at least one string w that has 111 as substring(i.e.w=x111y for some x,y } show A is decideable. (10) (Exercise 4.15)
Q5. Let NOTSUB= {<A,B>} where A , B are descriptions of TMs and there is some string w which is accepted by A but not accepted by B, Language accepted by A is not a subset of language accepted by B. is NOTSUB decidable? Prove in either case. (10)
Q6. Let LALL = {<M>|M is a TM with input alphabet Σ and L(M)=Σ*} prove that LALL is not Turing recognizable. (10)

Q7. Let x be the set {1,2,3,4,5} and y be the set {6,7,8,9,10}we describe the functions f:x y and g:x y in the following table

n	F(n)		n	G(n)
1	6		1	10
2	7		2	9
3	6		3	8
4	7		4	7
5	6		5	6

Q8. Let Path = {<G, s, t>|G is a digraph ha has directed path from s to t} show path belongs to P class. (15)

Q9. Prove that Turing recognizable languages are closed under concatenation or union

Q10. Show that Atm is not mappig reduable to Etm, Prove by contradiction.

Q11. If L is a turing recognizable language than can we say that it is also decidable . Why or why not.

Q12. Show that A<= T B and B<= T C then A <= T C. (Exercise 6.3)

Q13. Show that the set of all odd integers has one-to-one correspondence with the set of all even integers.

Q14. Can we say every problem is Turing decidable? If yes how? If no give counter example. (05)

Q15. In the silly Post Correspondence Problem, SPCP, in each pair the top string has the same length as the bottom string. Show that the SPCP is decidable. 10 Marks (PROBLEM 5.15 of Sipser book)

Q16. All DFA = { <A>| A is DFA and L(A)= ∑*} show that is AllDFA decidable (Exercise 4.3)

Answer: Consider the following Turing machine
M = " on input <A>, where A is a DFA

1. Create a DFA B such that L(B) = Σ*
2. Submit <A,B> to the decider for EQ_{DFA}
3. If it accepts, **accept**
4. If it reject, **reject.**"

M is clearly a decider since steps 1, 3, and 4 will not create an infinite loop and step 2 calls a decider. Furthermore, M will accept those DFA's whose language is the same as B's language – i.e. DFA's whose language is Σ* -- and will reject all other languages. Therefore, M is a decider for ALL_{DFA} so ALL_{DFA} is decidable.

Q17. Let {<M>} | M is a TM and if we start M with blank input tape, then it will finally write some non-blank symbols on its tape. Is it decidable, proof in either case.

Answer: Let L = f< M > jM is a single tape turing machine that writes a blank
symbol over a non-blank symbol during the course of it's computatation over some

input string g.
Let L be decidable and N be the decider for L. We reduce ETM to L by constructing
a TM S that decides ETM as follows:
S = On input < M >:
Step 1: Use M to build M0 as follows:
M0 has a special symbol (say #) in it's tape alphabet which is not present in the tape alphabet of Ma. Whenever M writes a blank symbol, M0 writes a #.
b. Whenver M0 reads a #, it behaves as M would on reading a blank symbol.
c. Before accepting, M0 writes a # on the tape and overwrites it with a blank symbol.
Step 2: Run N on input < M0 > and accept if N rejects, reject otherwise.
It is easy to see that < M >2 ETM i_ < M0 >=2 L and hence S decides ETM, contradicting the fact that ETM is undecidable.

Q18. There exist x and there exist y such that R1(x, y)^ R1(y, x) prove that sentence is true and justify your answer (Example 6.10)

Q19. The collection of provable statements in Th(N,+,x) is Turing-recognizable. 10 Marks (Theorem 6.15 of Sipser book)

Q20. Time complexity of k-tape turing machine, prove, t(n)=o(t^2(n)), 10 marks

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Questions from Last Year Papers

Q21. Prove DFA equal to RE

Q22. T={(I,j,k)|I, j , k belong to N} show T is counable

Q23. Is PCP decideable over uniary alphabet?

Q24. A Turing machine with stay put instead of left is similar to an ordinary Turing machine, but at each Point the machine can move its head right or let it stay in the same position. Show that this Turing machine variant is not equivalent to the usual version. What class of languages do these machines recognize? 15 Marks (PROBLEM 3.13 of Sipser book)

Q25. One question was to describe string (0,1)* using diagnolization is countable or not

Q26. Let MORE= {<A,B>} the language of A is larger than B. Prove that A or B is decideable. Consider either case. 10

Q27. A useless state in a turing machine is one that is never entered on any input string consider the problem of determining whether a turing machine

has any useless states and formulate this problem as a language and show that it is undecidable?

Q28. Consider the sentence ∀y ∃x[R1(X,X,Y)]. Lets assign PLUS to R1 where PLUS(a,b,c) is TRUE. Whenever a+b=c. if universe is R(real number) is this statement TRUE? Justify your answer.

Q29. Show that if A is turing reducible to be ,b is turing reducible to c, c is turing reducible to A.

Q30. Prove that $A_{TM} \leq_m E_{TM}$?

Q31. Let t(n) be a function, where $t(n) \geq n$. Then every t(n) time nondeterministic single tape TM has an equivalent $2^{O(t(n))}$ time deterministic single tape TM.

Q32. Consider the sentence, $\forall y \exists x[R_1(x, x, y)]$

Let assign "PLUS" TO R, where "PLUS" (a,b,c) is True whenever a+b=c, If "Universe" is R(Real Number). Is this sentence True ? Justify your answer?

MCQs:

Q.1 EMPTINESS problem for LBA is decidable ?

1. TRUE
2. **FALSE**

Q.2 A property that holds for almost all strings also hold incompressible strings ?

1. TRUE
2. **FALSE**

Q3. For a TM M and string w ={x|x is an acceptable computation History M on w}. Then is decidable ?

1. TRUE
2. **FALSE**

Q.4 A string x is b-compressible if K(x)>|x|- b ?

1. **TRUE**

2. FALSE

Q5. If L is decidable Language will also be decidable ? Note(demotes reverse of Language)

1. **TRUE**

2. FALSE

Q.6 A correspondence or one-to-one correspondence is a function that both one-to-one and onto ?

1. **TRUE**

2. FALSE

Q.7 Time contains Time (n log n tha ya n)

1. TRUE

2. **FALSE**

Q.8 If A reduces to B, It is not necessary that compliment of A reduces to compliment of B ?

Q.9 yields ?

1. = Correct Option rest of three are not in mind.

Q.10 Let Which String belongs to L?

1. aabb

2. **aabbcccc**

3. aaabbccc

4. aabbbccc