جامعة دمياط
Damietta University

امتحان نهائي
يناير ٢٠٢٣

الفرقة: مستوى ثالث
الشعبة: علوم حاسب وفيزياء وحاسب
المـــادة: نظريـــة التعقيـــد complexity theory
الكود: (٣٠٣ س)

جامعة دمياط
كلية العلوم
قسم الرياضيات

التاريخ: ٥ / ١ / ٢٠٢٣ الزمن: ساعتان الدرجة الكلية: 90 درجة

Answer the following questions

Question 1(18 Marks 6 each)

(a) Give the transition functions δ of a deterministic finite automaton DFA, a nondeterministic finite automaton NDFA, deterministic Turing machine and nondeterministic Turing machine.

(b) Find the complexity of the recurrence:

$$T(n) = \begin{cases} 2T(n-1) - 1, & if \ n > 0 \\ 1, & otherwise \end{cases}$$

(c) What is the order of complexity of the following code, Explain your result.:

```
int i, j, k = 0;
for (i = n / 2; i <= n; i++) {
   for (j = 2; j <= n; j = j * 2) {
      k = k + n / 2;
   }
}
```

Question 2 (18 Marks 6 each)

(1) If P_1 is NP-complete and there is a polynomial time reduction of P_1 to P_2, then P_2 is in NP-complete.

(2) Show that there are five truth assignments for (P, Q, R) satisfying $P \vee (\neg P \wedge \neg Q \wedge R)$

(3) Show that the function $f_2(x, y) = x * y$ is primitive recursive function.

Question 3 (18 Marks 6 each)

1. Define (i) NP-Hard class (ii) Co-NP class (iii) Computability
2. What's the difference between recursively language and recursively enumerable language?
3. Design a TM which accept the even **balindromes** over the alphabet $\Sigma = \{a, c\}$.

Question 4 (18 Marks 6 each)

1) Prove that if some *NP-complete* problem is in *P* then *P=NP*.
2) What is the difference between recursive function and partial recursive function?
3) Only state The Cook-Levin theorem.

Question 5 (18 Marks 6 each)

1) Define (i) Deterministic space DSPACE (ii) Non-deterministic Space DSPACE (iii) Diagonalization.
2) State and prove **Cantor's** theorem.
3) The Ackermann's function is defined by: $A(0, y) = y + 1$, $A(x + 1, 0) = A(x, 1)$
$$A(x + 1, y + 1) = A(x, A(x + 1, y))$$
   (i) Is the Ackermann's function is primitive recursive or not?.
   (ii) Compute $A(1, y)$, $A(2, y)$ in terms of y.

With Best Wishes Prof. Dr. Ahmed. M.K. Tarabia

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