

國立臺灣科技大學
八十八學年度碩士班招生考試試題

系所別：資訊管理系碩士班

組別：甲組

科目：離散數學

1. (5%) Let f and g be functions such that both f and $f \circ g$ are onto. Can we conclude that g is onto? If yes, prove it; otherwise give an counterexample.
2. (5%) Can we determine a unique binary tree from a preorder traversal and a postorder traversal? If true, give an example, if false, give a counterexample.
3. (5%) State whether this is true or false?
If $f(n)$ is $O(n^2)$, then n^2 is $O(f(n))$.
If true, give an example, if false, give a counterexample.
4. (8%) Consider graph $G(V, E)$ where $V = \{a, b, c, d\}$ and
degree(a) = 2, degree(b) = 3, degree(c) = 2, degree(d) = 2.
(a) Does such a graph G exist? If not, why not?
(b) Does such a multi-graph G exist? If not, why not?
5. (12%) Each of the following defines a relation on the set N of positive integers.
R: x is greater than y , S: $x + y = 10$, T: $x + 4y = 10$
(a) Determine which of the relations (R, S, T) are reflexive?
(b) Determine which of the relations (R, S, T) are symmetric?
(c) Determine which of the relations (R, S, T) are transitive?
(d) Determine which of the relations (R, S, T) are anti-symmetric?
6. (15%) Let $P(x)$ be the statement "*student x knows logic*". Let $Q(y)$ by the statement "*class y contains a student who knows logic*". Express the following as quantifications of $P(x)$ and $Q(y)$:
(a) Some students know logic
(b) Not every student knows logic
(c) Every class has a student who knows logic
(d) Every student in every class knows logic
(e) There is at least one class with no students who know logic
7. (13%) Shwo that 3-satisfiability problem is NP-complete.
8. (13%) Write a Turing program to recognize the set $\{0^n 1^n \mid n \geq 1\}$ and simulate your program using a small example.
9. (12%) Using the inclusion-exclusion technique, determine how many solutions does $x_1 + x_2 + x_3 = 11$ have, where $0 \leq x_1 \leq 3$, $0 \leq x_2 \leq 4$, $0 \leq x_3 \leq 6$?

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10. (12%) What is the next largest permutation in lexicographic order after 372541?
Design a linear-time program to find it.