國立政治大學九十 六 學年度研究所(博/碩)士班入學考試命題紙

考試科目	計算機概論	所別	A821 資訊科學系碩士在職專班	考試時間	3月17日 星期六 第四節

一、

(20%) 1. Give asymptotic upper and lower bounds for $T(n)$ in each of the following recurrences. Assume that $T(n)$ is constant for $n \le 2$. Make your bounds as tight as possible, and justify your answers.

(a) $T(n) = 16T(n/4) + n^2$.
(b) $T(n) = 7T(n/2) + n^2$.
(c) $T(n) = 2T(n/4) + \sqrt{n}$.
(d) $T(n) = T(\sqrt{n}) + 1$.

(10%) 2. Suppose we use a hash function h to hash n distinct keys into an array T of length m. Assuming simple uniform hashing, what is the expected number of collisions? More precisely, what is the expected cardinality of $\{\{k, l\} : k \neq l \text{ and } h(k) = h(l)\}$?

(10%) 3. Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O-bound tasks issue an I/O operation once for every millisecond of CPU computing and that each I/O operation takes 10 milliseconds to complete. Also assume that the context switching overhead is 0.1 millisecond and that all processes are long-running tasks. What is the CPU utilization for a round-robin scheduler when:

(a) The time quantum is 1 millisecond
(b) The time quantum is 10 milliseconds

(10%) 4. Assume we have a demand-paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds. Assume that the page to be replaced is modified 70 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds?

備考	試題隨卷繳交

命題委員：081 (簽章) 96 年 2 月 16 日

命題紙使用說明：1.試題將用原件印製，敬請使用黑色墨水正楷書寫或打字（紅色不能製版請勿使用）。
2.書寫時請勿超出格外，以免印製不清。
3.試題由郵寄遞者請以掛號寄出，以免遺失而示慎重。

考試科目	計算機概論	所別	AB21 資科系碩士在職專班	考試時間	3 月 17 日 星期 六 第 4 節

二、

1. **[Terminology]** What do the following abbreviations stand for? Give your answer in English to get full credits (e.g., ROM: Read Only Memory). (10%)
   (1) LAN
   (2) XML
   (3) MP3
   (4) DRAM
   (5) RAID

2. **[Recursion]** Given two positive integers, the GCD is the largest integer that divides them both. GCD(m, n) can be calculated as follows:
   - GCD(m, n) is n, if n is less than or equal to m and n divides m.
   - GCD(m, n) is GCD(n, m), if m is less than n.
   - GCD(m, n) is GCD(n, m%n), otherwise. (%: MOD)

   (1) Use the above definition to compute GCD(8,60). (4%)
   (2) Using pseudo-code or any high-level computer programming language of your choice to write a recursive function to compute the GCD of two positive integers. (6%)

3. **[Adder]** A half-adder takes two input bits A and B to produce sum (S) and carry (C_{out}) outputs.
   (1) Use basic logic gates to construct the circuits for a half adder. (6%)
   (2) Use exactly two half-adders and one OR gate to construct a full adder. (4%)

4. **[Turing]**
   (1) Write a Turing machine that takes a binary string as input, which we will think of in sign-magnitude notation, and changes the sign of the number. (6%)
   (2) Methods to prevent spam messages or automatic registration such as those shown below are sometimes referred to as the 'Reverse Turing Test.' Can you explain why? (4%)

5. **[High-level Language Programming]**
   (1) Illustrate the overall sequence of operations on a high-level language program using a diagram. [Hint: from source code to execution results.](6%)
   (2) List the four phases of the compilation process. (4%)