考試科目 計算機數學所網路　組別 資訊科學 814　考試時間 3月18日 星期六 第 3 節

I. 離散 60%

(10%) 1. Let the language L consist of all strings of the form $a^k b^k$, where k is a positive integer. Symbolically, L is the language over the alphabet $\Sigma = \{a, b\}$ defined by

$$L = \{s \in \Sigma^* \mid s = a^k b^k, \text{ where } k \text{ is a positive integer}\}.$$

Is there a finite-state automaton that accepts L?

(10%) 2. Find the number of bit strings of length 10 that do not contain the pattern 11.

(10%) 3. Define a sequence $a_1, a_2, a_3, \ldots$ recursively as follows:

$a_1 = 1$,

$a_k = 2 \cdot a_{\lfloor k/2 \rfloor}$　　　for all integers $k \geq 2$.

Use iteration to guess an explicit formula for this sequence.

(10%) 4. Design a *mod* 3 counter i.e., an FSM (Finite State Machine) whose output at a given time equals the total number of 1s (*mod* 3) in the input stream, up to that time. As an example, here is one possible input sequence and the corresponding outputs:

(Inputs) x_n	0	1	1	0	1	1	1	1	0	1	1	0	0	1	...
(Outputs) y_n	0	1	2	2	0	1	2	0	0	1	2	2	2	0	...

(10%) 5. For each of the following four regular expressions, construct an NFA (Nondeterministic Finite Automaton) that accepts the corresponding regular language.

(a)　$a^*(b+\varepsilon)$

(b)　$a^*b^* + c^*$.

(10%) 6. Consider the set of all one-to-one and onto functions from the set $S = \{1, 2, \ldots n\}$ to itself. If f is one of these functions, a fixed point of f is an element $x \in S$ such that $f(x) = x$. If one of these functions is chosen at random, what is the probability that it has no fixed points?

備	考	試 題 隨 卷 繳 交

命題委員：　　　　　　　　69　　　（簽章） 95 年 3 月 4 日

Ⅱ、「計算機數學與網路」科之「計算機網路概論」部份，共佔 40%

[8%] 1. If the data link layer provides error checking, and the transport layer provides error checking, isn't this redundant? Explain.

[8%] 2. What is the principle difference between connectionless communication and connection-oriented communication?

[8%] 3. Give two reasons why networks might use an error-correcting code instead of error detection and retransmission.

[8%] 4. A datagram subnet allows routers to drop packets whenever they need to. The probability of a router discarding a packet is p. Consider the case of a source host connected to the source router, which is connected to the destination router, and then to the destination host. If either of the routers discards a packet, the source host eventually times out and tries again. If both host-router and router-router lines are connected as hops, what is the mean number of
(a) hops a packet makes per transmission?
(b) transmissions a packet makes?
(c) hops required per received packet?

[4%] 5. Both UDP and TCP use port numbers to identify the destination entity when delivering a message. Give two reasons for why these protocols invented a new abstract ID (port numbers), instead of using process IDs, which already existed when these protocols were designed.

[4%] 6. Can a firewall filter out requests to a particular IP address, a port address, or both? What is the difference?

備考　試題隨卷繳交

命題委員：　　　70　　　（簽章）