國立臺灣大學95學年度碩士班招生考試試題

1. (18 points) Please answer the following questions.
   (a) (3 points) Compare digital transmission against analog transmission.
   (b) (3 points) Compare circuit switching against packet switching, where for packet switching, consider datagram particularly.
   (c) (3 points) Compare FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access) technologies.
   (d) (3 points) Compare WiFi (Wireless Fidelity) against WiMAX (World Interoperability for Microwave Access).
   (e) (3 points) Compare symmetric-key against asymmetric-key (public-key) cryptosystems.
   (f) (3 points) Compare unicasting, multicasting and broadcasting mechanisms.

2. (8 points) Please answer the following questions.
   (a) (3 points) Compare error detecting code against error correcting code.
   (b) (5 points) For an error control scheme, if the set of legal code-words is {1010101010, 1111111111, 0000000000, 0101010101, 1111100000, 0000011111}, then (i) what is the Hamming distance of this code system and (ii) up to how many bits in error can this code system surely detect and correct, respectively?

3. (12 points) Please answer the following questions.
   (a) (6 points) Please derive the maximum achievable throughput for a slotted ALOHA system, where (i) the total number of stations approaches infinity, (ii) each frame is of the same length (one slot time), and (iii) for the shared channel the new frame arrival process and the composite frame arrival process (including new frames and retransmitted frames) are assumed to be Poisson.
   (b) (2 points) Please compare relative advantages and disadvantages associated with slotted and pure ALOHA systems.
   (c) (2 points) Please explain how the system throughput may be improved from ALOHA to CSMA (Carrier Sense Multiple Access) and then to CSMA/CD (Carrier Sense Multiple Access with Collision Detection).
   (d) (2 points) Is the CSMA/CD protocol suitable for a WAN (Wide Area Network) environment and why?

4. (12 points) Consider a noiseless bidirectional channel using a geo-stationary satellite, which is 36,000 Km (kilometers) over the earth surface. Assume that signal travels at the speed of 300,000 Km/sec, and that the channel capacity is 1 Mbps (mega bits per second) on either direction. Assume also that each frame is of 10,000 bits (header overhead is ignored), and that 6 bits of frame sequence numbers are used. Each correctly received data frame is immediately acknowledged, where all the frame processing time and the acknowledgement frame transmission time are ignored. Please calculate the maximum achievable throughput for a sender and a receiver (both are located right beneath the satellite) using this channel, where the timeout interval is set to 1 second and the following three sliding-window protocols, i.e., (i) stop-and-wait, (ii) go-back-*N* and (iii) selective-repeat, are adopted, respectively.

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5. (15 points) Given a relation R(A, B, C, D, E, F, G) with FD's A→BCD, B→EF, C→D, EF→G, G→F,
   (a) normalize R into 3NF.
   (b) normalize R into BCNF.
   (c) find the primary keys for each decomposed relation in (a) and (b).

6. (20 points) Consider the following relations for a database that keep track of the business trips of employees in a company.

   Employee(Employee_ID, Name, Start_year, Dept_No, Phone)
   Trip(Trip_ID, Employee_ID, From_city, To_city, Departure_date, Return_date, Expense)
   Department(Dept_No, DName, Manager_ID)

   where the underlined attributes are the primary keys of the relations.
   (a) Write an SQL query to list all employees who took business trips to New York City.
   (b) Write an SQL query to find all employees who took more than two trips in year 2005.
   (c) Write an SQL query to list the total trip expenses for each department in year 2005.
   (d) Write an SQL query to retrieve the most commonly visited city for each department.

7. (15 points) Consider the following (incomplete) schedule S:

   $w_1(x), r_2(x), w_1(y), w_2(y), w_3(x), r_3(y), w_2(x)$.

   For each of the following questions, modify S to create a complete schedule that satisfies the stated condition. If a modification is not possible, explain briefly. If it is possible, use the smallest possible number of actions (read, write, commit, or abort). You are free to add new actions anywhere in the schedule S, including in the middle.
   (a) Resulting schedule is recoverable but not cascadeless.
   (b) Resulting schedule is cascadeless.
   (c) Resulting schedule is conflict serializable.