

九十五學年度第二學期

96 年 5 月 25 日

第二十九次博士資格考

(影印時請注意將每次考試科目排好)

5/2007 博士班資格考： 機率與統計 Show All Details.

1. Let x and y are two RVs. (20%)
 - a. Define the joint moment of x and y for m_{xy} .
 - b. Define the joint characteristic functions of x and y .
 - c. Please show how to use the result of (b) to find the result of (a).
2. Let $x_1, x_2, \dots, x_n, \dots$ be a sequence of i.i.d. random variables with uniform distributed pdf in the interval $[-0.5, 0.5]$. (20%)
 - a. Let $z = x_1 + x_2$, find the pdf of z .
 - b. Let $z = \sum_{i=1}^{\infty} x_i$, find the pdf of z .
3. Prove that $E\{E\{y|x\}\} = E\{y\}$. (20%)
4. Let x and y be two RVs with joint density function as follows. (20%)
$$f(x, y) = \begin{cases} 8xy & , 0 \leq x, y \leq 1 \\ 0 & , \text{otherwise} \end{cases}$$
 - a. Find the covariance.
 - b. Find the correlation coefficient.
5. The light bulbs produced by a company have the life that is normally distributed with a standard deviation of 100 hours. Prior experience tells us that its **mean** is also normally distributed with its mean equal to 800 hours and its variance equal to 10 hours. For a random sample of 25 bulbs from the company, they have average life of 780 hours. Please find the 95% Bayesian interval for the **mean**. (20%)

Hint: $\mu^* - z_{\alpha/2}\sigma^* < \mu < \mu^* + z_{\alpha/2}\sigma^*$, where $z_{\alpha/2} = 1.96$ if 95%

Bayesian interval is required.

演算法資格考 2007 05

1. (30%) Answer each part TRUE or FALSE for the little o notation.
 - a) $n = o(2n)$.
 - b) $2^n = o(n^2)$.
 - c) $2^n = o(3^n)$.
 - d) $1 = o(n)$.
 - e) $n = o(\log n)$.
 - f) $1 = o(\frac{1}{n})$.
2. (25%) Describe how to show the problem is NP-complete.
3. (20%) Give an asymptotic solution for $T(n) = 9T(\frac{n}{3}) + n$.
4. (25%) Describe a $\Theta(n \lg n)$ -time algorithm that, given a set S of n integers and another integer x , determine whether or not there exist two elements in S whose sum is exactly x .

Theory of Computation 資格考 2007/05

1. (30%) Give formal definitions of DFA, NFA, and the Turing machine.
2. (25%) Let $\Sigma = \{0,1,2,\langle RESET \rangle\}$. For each $i \geq 1$ let A_i be language of all strings where the sum of the numbers is a multiple of i , except that the sum is reset to 0 whenever the symbol $\langle RESET \rangle$ appears. Show that A_i is a regular language.
3. (20%) Show that the language $\{0^n 1^n \mid n \geq 0\}$ is not regular.
4. (25%) Show that $A_{TM} = \{\langle M, w \rangle \mid M \text{ is a TM and } M \text{ accepts } w\}$ is undecidable.

DSP 資格考

* Close Book *

May 25, 2007

1. (20%) Determine if the systems described by the following input-output equations are (1) stable and (2) causal.

- (a) $y[n] = 4x[n] + 5$
(b) $y[n] = \log(x[n] - 2)$

Justify your answer.

2. (20%) Consider the system described by the difference equation

$$y[n] = ay[n-1] + bx[n]$$

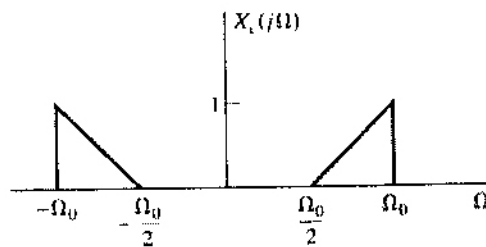
- (a) Determine b in terms of a so that

$$\sum_{n=-\infty}^{\infty} h[n] = 1$$

where $h[n]$ is the impulse response of the system.

- (b) Find the frequency response $H(e^{j\omega})$ in terms of a .

3. (20%). A continuous-time signal $x_c(t)$, with Fourier transform $X_c(j\Omega)$ shown in the following figure, is sampled with sampling period $T = 2\pi / \Omega_0$ to form the sequence $x[n] = x_c(nT)$.



- (a) Sketch the Fourier transform $X(e^{j\omega})$ for $|\omega| < \pi$.
(b) In terms of Ω_0 , for what range of values of T can $x_c(t)$ be recovered from $x[n]$.

4. (20%) When the input to a causal LTI system is

$$x[n] = -\frac{1}{3}\left(\frac{1}{2}\right)^n u[n] - \frac{4}{3}2^n u[-n-1],$$

the z-transform of the output is

$$Y(z) = \frac{1 + z^{-1}}{(1 - z^{-1})(1 + \frac{1}{2}z^{-1})(1 - 2z^{-1})}.$$

- (a) What is the region of convergence of $Y(z)$?
(b) Find the impulse response of the system.

5. (20%). Suppose that we wish to design a highpass filter satisfying the following specification:

$$-0.04 < |H(e^{j\omega})| < 0.04, \quad 0 \leq \omega \leq 0.2\pi,$$

$$0.995 < |H(e^{j\omega})| < 1.005, \quad 0.3\pi \leq \omega \leq \pi.$$

The filter will be designed using the bilinear transformation and $T=2$ ms with a prototype continuous-time filter. State the specification that should be used to design the prototype continuous-time filter to ensure that the specification for the discrete-time filter are met.

The following equations are for your reference :

$$s = \frac{2}{T} \left(\frac{1-z^{-1}}{1+z^{-1}} \right), \quad \Omega = \frac{2}{T} \tan(\omega/2), \quad \omega = 2 \arctan(\Omega T / 2)$$

SOFTWARE ENGINEERING

1. Illustrate why a high-quality software process should lead to high-quality software products? And, how a high-quality software process can be achieved?
2. What is **Risk**? Explain why adaptors are usually needed when systems are constructed by integrating COTS (commercial-off-the-shelf) products?
3. One should start planning system validation and verification early in the development process. Please illustrate a software development process model that shows test plans should be drive from the system specification and design.
4. Explain the advantages and disadvantages of the **linear sequential model** and the **evolutionary model**, and the differences between these two models.

Software Engineering Qualifying Examination May 25, 2007

1. Describe the advantages of software with service-oriented architectures. (10%)
2. Describe concisely the process of object-oriented design of software development. (15%)
3. State the development process for web-based applications. (15%)
4. What's the **design pattern** (explain briefly) in object-oriented software engineering? Write a sample pattern (must contain the information of context, problem, ... ect.)? (10%)

Operating System 資格考

1. What is the main advantage of multiprogramming? What is the degree of multiprogramming? (10%)
2. What is the time-sharing system? (10%)
3. What is the purpose of a bootstrap program? (10%)
4. One important principle for OS implementation is the separation of policy from mechanism. Describe the differences between policy and mechanism? (10%)
5. What is an I/O-bound process? What is a CPU-bound process? Describe the drawbacks if most processes running in the system are I/O-bound or CPU-bound processes. (20%)
6. Describe the following terms (20%)
(a) external fragmentation (b) page thrashing
7. Explain the main idea of virtual memory in detail. (20%)

2007 May NCKU CSIE PH.D. Qualification Examination
Computer Architecture

1. Some operations on two operands (e.g., subtraction) are not commutative. What are the advantages and disadvantages of the stack, accumulator, and load-store architectures when executing noncommutative operations? (15 points)
2. The classical approach to improving cache behavior is to reduce miss rates. Please summarize the techniques that can reduce miss rates. (15 points)
3. Assume that a (3, 2) two-level branch predictor is used. The total number of the entries of this branch history table is 1024.
 - a. Show the organization of this branch history table. (5 points)
 - b. Explain how an entry in the table is filled up from the beginning assuming that the table is reset to zero initially which indicates not taken. (10 points)
4. Describe the cache coherency problem for a distributed shared memory multiprocessor. In a cache coherent non-uniform memory access machine (CC-NUMA), the existing directory schemes fall into two categories, bit-map and linked list protocols. For each category, describe one popular protocol and its read and write operations for hits and misses in the local cache. (20 points)
5. Describe what are the RAW, WAW, and WAR hazards. (15 points)
6. List all the dependences (output, anti, and true) in the following code fragment. Indicate whether the true dependences are loop carried or not. Show why the loop is not parallel. (20 points)

```
for (i=2; i<100; i++) {  
    a[i] = b[i] + a[i];    /* S1 */  
    c[i - 1] = b[i] + d[i]; /* S2 */  
    a[i - 1] = 2 * b[i];    /* S3 */  
    a[i + 1] = 2 * b[i];    /* S4 */  
}
```

圖論資格考(2007/05)

1. (20%) For a set $S \subseteq N$ of size n , determine the number of spanning trees with vertex set S .
2. (20%) Show that an edge is a cut-edge if and only if it belongs to no cycle.
3. (20%) Determine the values of m and n such that $K_{m,n}$ is Eulerian.
4. (20%) Prove or disprove: If T is a minimum-weight spanning tree of a weighted graph G , then u,v -path in T is a minimum-weight u,v -path in G .
5. (10%) Show that the minimum number of edges in a connected graph with n vertices is $n-1$.
6. (10%) Show that every u,v -walk contains a u,v -path.

DBMS Qualify

1. (20%) Consider the following schema for a suppliers-and-parts database:

SUPPLIER(SupNo, SName, Status, City)

PART(PartNo, Color, Weight, City)

PROJECT(ProjNo, PName, City)

SHIPMENT(SupNo, PartNo, ProjNo, Qty)

Answer the following queries in SQL.

- (a) Get the supplier numbers for those suppliers that either supply no parts to any project or supply a part to all projects.
- (b) Get part numbers for parts supplied to more than five projects.

2.(20%) Answer the above two queries in relational algebra.

3.(20%)

- (a) What is the condition for a relation being in 2NF?
- (b) What is the condition for a relation being in 3NF?
- (c) What is the condition for a relation being in BCNF?
- (d) Explain why a relation satisfying BCNF must be a 3NF relation.

4.(20%)

- (a) Explain what serializability is.
- (b) What is two-phase locking protocol?
- (c) Is two-phase locking a necessary or sufficient condition for serializability? Explain why.

5.(20%) Give the ER diagram of the relation schema given in Question 1.

Cryptography

Qualify Examination

Close Book

May 2007

1. What are the security services and the security mechanisms defined in X.800? What is the relationship between them. 30%
2. What is the X.509 Authentication Service? 20%
3. Describe all what you know about Digital Signatures. (Definitions, security requirements, types, usefulness and etc.) 30%
4. Let N_a , N_b , N_c be the RSA modulus for users A, B, and C respectively ($N_c > N_a > N_b$). Describe a multi-signature scheme for them to sign a document M. 20%