

作業系統 資格考題 (101 年度第 1 學期)

1. (20%) Briefly describe the two IPC models: shared memory and message passing.
2. (20%) The Fibonacci sequence is the series of numbers 0, 1, 1, 2, 3, 5, 8, Formally, it can be expressed as:

$$\text{fib}_0 = 0$$

$$\text{fib}_1 = 1$$

$$\text{fib}_n = \text{fib}_{n-1} + \text{fib}_{n-2}$$

Write a C program using the `fork()` system call that generates the Fibonacci sequence in the child process. The number of the sequence will be provided in the command line. For example, if 5 is provided, the first five numbers in the Fibonacci sequence will be output by the child process.

3. (20%) Explain the difference between internal fragmentation and external fragmentation. Which one occurs in paging system? Which one occurs in systems using pure segmentation?
4. (20%)
 - (a) Please describe the 3 requirements for solving the critical section problem.
 - (b) Assume that a system has two processes P_i and P_j . The codes of P_i and P_j are shown in the following. Please explain which requirements are satisfied and which are not.

<pre>Process P_i: do { flag[i] = true; while(flag[j]); <i>critical section</i> flag[i] = false; <i>remaining section</i> } while(1);</pre>	<pre>Process P_j: do { flag[j] = true; while(flag[i]); <i>critical section</i> flag[j] = false; <i>remaining section</i> } while(1);</pre>
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5. (20%) Please describe the following terms

(a) TLB

(b) system calls

Ph.D. Qualify Examination 2012
Theory of Computation

- This examination is closed books. Please turn off your cell phones.
- Remember that there are 2 pages of the examination.

1. Deterministic Finite Acceptors (DFAs) (5 pts each)

Draw Deterministic Finite Automata to accept the following sets of strings over the alphabet $\{a,b\}$:

- (a) all the strings with exactly two a's and more than two b's.
- (b) the set of all strings over $\{a, b\}$ that do not contain the substring aaa.

2. Nondeterministic Finite Acceptors (NFAs) (5 pts each)

Draw Non-deterministic Finite Automata with the specified number of states to accept the following sets:

- (a) All strings that the third symbol from the right end is a "0". For example, 1011 and 0011 are accepted, but 0100 cannot be accepted. (use a "4 states" solution)
- (b) The language $0^*1^*0^*$. (use a "3 states" solution)

3. Give a regular expression for the following language on $\Sigma = \{a, b\}$. (10 pts)

$L = \{w : n_a(w) \bmod 3 = 0\}$, where $n_a(w)$ denotes the number of a in W .

4. Please use the pumping lemma to prove that the language is nonregular: (10 pts)

$L = \{a^n b a^n : n \geq 0\}$.

5. Show that the following grammar is ambiguous. (10 pts)

$S \rightarrow AB|aaB$

$A \rightarrow a|Aa$

$B \rightarrow b$

6. Convert the NFA in Figure 1 into an equivalent DFA. (10 pts)

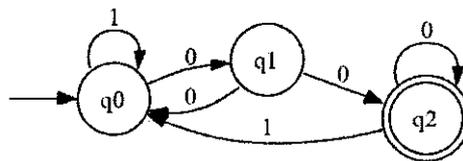


Figure 1: The NFA case.

7. Transform the grammar with productions into Chomsky normal form. (10 pts)

$S \rightarrow abAB$

$A \rightarrow bAB|\lambda$

$B \rightarrow BAa|A|\lambda$

8. Construct a nondeterministic pushdown automata that accept the following language on $\Sigma = \{a, b, c\}$ (use a NPDA with 5 states) (10 pts)
 $L = \{a^n b^{n+m} c^m : n \geq 0, m \geq 1\}$.
9. Using the pumping lemma to prove that $L = \{a^n b^{2^n} a^n : n \geq 0\}$ is not a context-free language. (10 pts)
10. Construct a nondeterministic pushdown automata that accepts the language generated by the grammar. (10 pts)
 $S \rightarrow aSbb|aab$

10/2012 博士班資格考： 機率與統計 Show All Details.

1. (20%) Given an exponential density function $f(x)$ with parameter, λ .
 - (a) Give $f(x)$.
 - (b) Find the characteristic function of $f(x)$.
 - (c) Find the first moment and the second moment.
 - (d) Use the result in (c) to find the mean and the variance of $f(x)$.

2. (20%) Let $X_1, X_2, X_3, \dots, X_{n-1},$ and X_n be a random sample of size n .
 - (a) Give the definition of sample variance, S^2 , and sample standard deviation.
 - (b) Let the random samples be taken from a normal population with variance σ . What is the distribution of $X^2 = (n-1)S^2 / \sigma^2$?
 - (c) In what condition one would like to use the statistics in (b)?

3. (20%) Let X and Y be two random variables with uniform distribution in the interval $[0,1]$. Let $Z=X+Y$. Find the probability distribution of Z .

4. (30%) If the RVs X and Y are jointly normal, then
 - (a) Show that $f(y|x) = \frac{1}{\sigma_y \sqrt{2\pi(1-r^2)}} \exp\left[-\frac{(y-r\sigma_y x/\sigma_x)^2}{2\sigma_y^2(1-r^2)}\right]$ if X and Y are of zero mean.
 - (b) Show that $E[Y|x] = \eta_y + r\sigma_y \frac{x-\eta_x}{\sigma_x}$ if X and Y have means, η_x and η_y , respectively.

5. (10%) The average lifetime of LED bulbs from A maker is 5 years and its standard deviation is 6 months. The average lifetime of LED bulbs from B maker is 4.5 years and its standard deviation is 8 months. Let's take 40 bulbs from A maker and 50 bulbs from B maker. What is the probability that the average lifetime of A' 40 bulbs is greater than the average lifetime of B's 50 bulbs? Please apply Central Limit Theorem.

Algorithms 資格考 2012 Fall

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. (30%) (10%)何謂 "Sorted in place". (20%)各說出一種排序演算法是屬於 sorted in place 和非 sorted in place.

3. (30%) (10%) Define $O(g(n))$. (10%) Define $\Theta(g(n))$. (10%) Define $\Omega(g(n))$.

4. (10%) Describe a quick sort algorithm and shows its time complexity.

Graph Theory 資格考 2012 Fall

1. (25%) Define the concept of “isomorphism”.
2. (25%) Determine the connectivity of an n -dimensional hypercube.
3. (25%) Show that every graph has an even number of vertices of odd degree.
4. (25%) Show that every connected graph contains a spanning tree.

VLSI

資格考

- 1. Describe the advantages and disadvantages between ASIC and FPGA implementation. (20%)**
- 2. Describe the difference between full custom and Cell-based design flow. (20%)**
- 3. Explain the following terms in detail: (60%)**
 - (a) hold time (b) testbench file**
 - (c) design for testability (d) clock skew problem**
 - (e) setup time (f) RTL code**

無線通訊網路 資格考

1. Please explain the below terms in details. [20%]
 - A. Block Linear Codes
 - B. Diffraction
 - C. Inter Symbol Interference (ISI)
 - D. Reuse Distance
 - E. Doppler Shift

2. Consider a cruise boat with two passengers. Each passenger will make 2 calls per hour with each call of 6-minute duration. There is only one telephone set on the boat. Please calculate the probability of the phone being occupied by one person while the other person wishes to make a call. (Namely, please calculate the blocking probability.) (In your answer, please provide the drawing of Markov Chain as well.) [20%]

3. Please describe the following protocol in Pseudo code. [20%]
 - A. Slotted Aloha
 - B. non-persistent CSMA
 - C. CSMA/CD
 - D. CSMA/CA

4. Please calculate the maximum transmission rate for a transmission system when the delay spread is 5 ns (nano-seconds). [10%]

5. Please explain the following terms in details. [20%]
 - A. System architecture of GSM
 - B. TDMA/FDMA/CDMA
 - C. FHSS and DSSS in IEEE 802.11
 - D. NAV mechanism in IEEE 802.11

6. Define the **first-meter path loss** as the received signal strength (in dB) when the receiver stands one meter away from the transmitter. Now, consider the case when the first-meter path loss is -25 dB . Please calculate the free-space path loss for a receiver if the distance between the transmitter and receiver is [10%]
 - A. 10 meters,
 - B. 100 meters,
 - C. 1 KM.

Qualify Exam - Data Mining 資料探勘

Notice: Close book. 總分: 100 分

(共 1 頁)

1. (25%) Answer the following questions:
 - A. Explain the general steps involved in the data mining process.
 - B. Explain what are *closed itemsets* and *maximal itemsets*, respectively.
 - C. Explain in details how the *FP-Growth* method works.
 - D. Give an efficient way to do incremental mining of association rules.
 - E. Explain what is "overfitting" problem in classification modeling.

2. (30%) Answer the following questions on clustering methods:
 - A. Explain in details how *k-means* and *DBSCAN* work respectively.
 - B. Give comparisons on advantages and drawbacks between the above two clustering methods.
 - C. Given a dataset D , for a clustering result conducted by some clustering algorithm A , explain how to validate the quality of the clustering result.
 - D. Give an efficient way to store a clustering result.

3. (30%) Given a dataset D of m records, with attributes A_1, A_2, \dots, A_n in each record, where the value of any A_i ($1 \leq i \leq n$) is a real number. Answer the following questions about classification modeling:
 - A. If the class distribution in D is uniform, in general cases, which of *Decision Tree* and *SVM (Support Vector Machine)* will perform best for building a classification model on D ? Explain why.
 - B. If the class distribution in D is imbalanced such that the classification accuracy is low, explain how to deal with D for improving the accuracy.
 - C. Explain how "*K-fold cross validation*" works for evaluating a classification model.

4. (15%) Answer the following questions:
 - A. Explain in details how "*Ensemble*" and "*Boosting*" methods work for building a classifier, respectively.

電腦繪圖

1. Please explain OpenGL standard pipeline (20%)
2. Please compare global and local illumination models, For example, ray tracing v.s. opengl rendering (30%)
3. Please summarize current image resizing and video resizing methods (50%)

101 年度 Ph.D 密碼學 資格考

2012. 10. 19

1. 試設計 - quantum block cipher
(35%) 並 - quantum stream cipher
圖示之並簡要說明設計理念
並安全分析。

2. 試論量子計算對密碼學所造
(50%) 成的影響。

3. 試分析下列 Cipher 之安全強度
(15%) $C = M [S]_{k \times k}$

M : plaintext

C : ciphertext

$[S]_{k \times k}$: $k \times k$ nonsingular matrix,
為 the cipher 的 key.

2012 Oct. NCKU CSIE PH.D. Qualification Examination
Computer Architecture

1. With dynamic hardware prediction for reducing branch costs, what is the disadvantage of a simple 1-bit branch-prediction buffer for a branch that is almost always taken. Explain why the 2-bit prediction scheme can remedy this disadvantage. Also, explain what is correlated predictors by illustrating an example. (20 points)
2. Explain the following synchronization primitives: atomic exchange, test-and-set, and fetch-and-increment. Also, explain what is the pair of instructions, load linked (LL) and store conditional (SC) and how this pair of instructions can be used to implement atomic exchange and fetch-and-increment. (15 points)
3. The classical approach to improving cache behavior is to reduce miss rates. Please summarize the techniques that can reduce miss rates. (20 points)
4. Describe the advantages and disadvantages of dynamic scheduling? What are the key concept of Tomasulo's approach? (15 points)
5. Describe what are the RAW, WAW, and WAR hazards. (15 points)
6. For the memory-hierarchy design, please answer the following questions: (Assuming the cache is n-way set associative and there are $S = 2^s$ sets, and each block is of size $B = 2^b$ bytes) (15 points)
 - A. Where can a block with variable v be placed in a cache? (assume v has the address *addr*)
 - B. How is a block with variable v is found if it is in the cache? (describe the general tag design)
 - C. Which block should be replaced on a cache miss? (make your assumption)
 - D. What happens for a write operation? (describe two basic write policies)

進化計算論

1. (25%) What are motivations for EC (Evolutionary Computation)?

What are advantages of EC? What are disadvantages of EC?

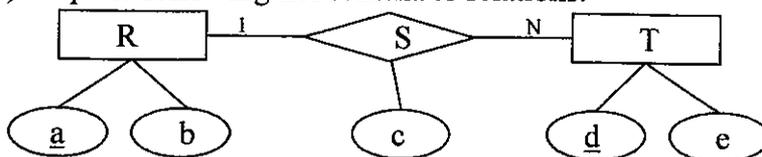
2. (25%) Which techniques belong to the EC? Please show at least two techniques, and explain the techniques and their physical meanings in detail

3. (25%) Please illustrate “exploitation” and “exploration” issues in the evolution process of the genetic search.

4. (25%) What are the problems of applying iterative hill climbing to complex search problems? Comparing iterative hillclimbing with EC, what are the major differences between the two approaches?.

2012 DBMS Qualify Exam

1. (10%) Map the following ER schema to relations.



2. (40%) Answer the following query in SQL using the given schema:

S(S#, Sname, Status, City) /* This is a relation for Supplier */

P(P#, Pname, Color, Weight, City) /* This is a Part relation */

J(J#, Jname, City) /* This is a Project relation */

SPJ(S#, P#, J#, Quantity)

- Get the suppliers that do not supply any part to project J1.
- Get the total number of projects supplied by supplier S1.
- Get the total weight of the parts that are used in project J1.
- For each supplier, list the supplier name, the average weight of the parts supplied by this supplier, and the number of projects supplied by this supplier.

3. (10%) A relation, R(A, B, C, D, E, F, G), whose attributes satisfy the functional dependencies:

(D, E → A, B, C, F, G), (E → C), (B → A), (A → G)

Normalize the above relation to make it satisfy

- 2NF
- 3NF

Note: Don't make unnecessary normalization if it is not required.

4. (10%) What is BCNF? And what's the problem in normalizing a non-BCNF relation?

背面有題

5. (10%) Explain the following terms
 - (a) Referential Integrity Constraint.
 - (b) Two phase locking protocol.

6. (10%) In performing a join operation (such as $R \bowtie_{R.A=S.A} S$), a simple way is to compare each tuple of relation R with every tuple of relation S on their attribute A values. If they are equal (i.e., $R.A = S.A$), then these two tuples will be concatenated into one tuple as a resultant tuple. However, this join method is too costly, as it requires to compare all R tuples with all S tuples. Give a faster join method and explain why your method is faster.

7. (10%) We know that the key integrity constraint means that the values of the key attribute of a relation must all be different. Please define this constraint formally (i.e., give a formal definition) as the definition style you read in a technical paper.