OS 資格考題 (96 年度第一學期)

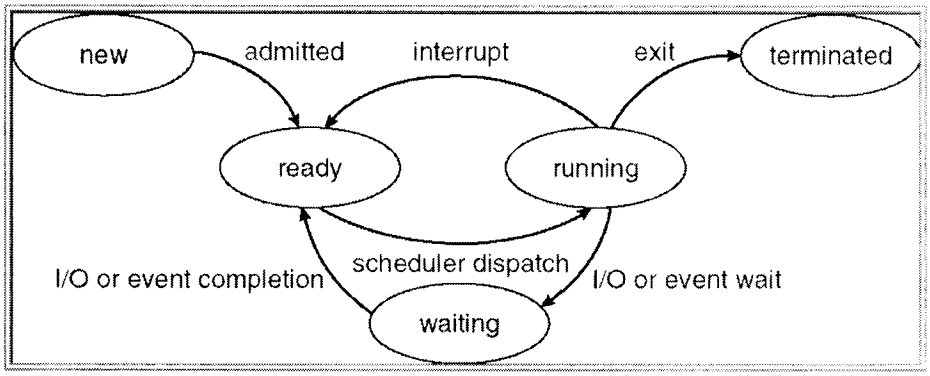
1. (15%) Explain the four necessary conditions for a deadlock to occur, and suggest a method to break one of the conditions so as to prevent deadlocks.

2. (10%) What's processor affinity? Does it have any effect on the benefits of the processor-load balancing?

3. (10%) What's convoy effect? Does shortest job first scheduling algorithm have convoy effect? Why or why not?

4. (10%) 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?

5. (15%) Please redraw the following figure by adding five components: short-term scheduler, long-term scheduler, job queue, ready queue, and device queue into it. Explain each state and transition in detail.



6. (20%) Four processes, W, X, Y, Z, arrive at a computer at time 2, 3, 0 and 5, respectively. The CPU burst time of them is listed in the following table (time unit: milliseconds). Assuming that the system only has a single processor (with a single core) and the context switch time can be ignored, please draw the Gantt chart and determine the average waiting time for each of the following scheduling algorithms: (a) FCFS scheduling, (b) non-preemptive SJF scheduling, (c) preemptive SJF scheduling, (d) RR scheduling (time qutuam = 4 ms)

Process	Burst Time (ms)
W	5
X	2
Y	8
Z	7

7. (20%) Suppose a system contains 3 types of resources and 5 processes. Three resources X, Y and Z have 5, 2, 7 instances, respectively. The snapshot of the system is as follows:

Process	Current Allocation			Maximum Demand		
	X	Y	Z	X	Y	Z
P0	1	1	1	3	1	1
P1	1	0	0	1	0	2
P2	0	0	1	1	1	2
P3	0	1	1	1	1	2
P4	3	0	2	4	1	3

Answer the following questions using the banker's algorithm:

(a) Is the system in a safe state? Why or why not?

(b) If a request from process 2 arrives for resource (0, 0, 1), can the request be granted immediately? Why or why not?

(c) If a request from process 1 arrives for resource (0, 0, 1), can the request be granted immediately? Why or why not?

Software Engineering Qualifying Examination Dec 14, 2007

1. Describe concisely the united (UML) approach to object-oriented design of software development. (15%)
2. State the four types of analysis work that should be conducted during Web-based software engineering. (10%)
3. Explain how to examine the correctness and consistency of OOA and OOD models. (15%)
4. Explain statistical use testing adopted in cleanroom software engineering. (10%)

Theory of Computation 資格考 2007 Fall

1. (30%) Give formal definitions of DFA, NFA, and the Turing machine.

2. (25%) Show that the set of real numbers is uncountable.

3. (20%) Show that the language $\{0^n1^n \mid n \geq 0\}$ is not regular.

4. (25%) Show that $REGULAR_{TM} = \{\langle M \rangle \mid M \text{ is a Turing Machine and } L(M) \text{ is a regular language}\}$ is undecidable.

Graph Theory 資格考 2007 Fall

1. (25%) For a set $S \subseteq N$ of size n, determine the number of spanning trees with vertex set S.

2. (25%) Show that the isomorphism relation is an equivalence relation on the set of (simple) graphs.

3. (25%) Show that for $k>0$, every k-regular graph has a perfect matching.

4. (25%) Determine the vertex connectivity of an n-dimensional hypercube.

2007 Dec. NCKU CSIE PH.D. Qualification Examination
Computer Archtecture

1. Suppose that we are considering an enhancement to the processor of a server system used for Web serving. The new CPU is 10 times faster on computation in the Web serving application than the original processor. Assuming that the original CPU is busy with computation 40% of the time and is waiting for I/O 60% of the time, what is the overall speedup gained by incorporating the enhancement. (15 points)

2. Compare the ISA architecture of stack, accumulator, register-memory, and register-register (load-store) respectively, Point out their respective features in terms of advantages and disadvantages. (20%)

3. The classical approach to improving cache behavior is to reduce miss rates. Please summarize the techniques that can reduce miss rates. (15 points)

4. 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)

5. Describe what are the RAW, WAW, and WAR hazards. (15 points)

6. The following loop has multiple types of dependences. Find all the true dependences, output dependences, and antidependences, and eliminate the output dependences and antidependences by renaming (20 points)

```
for (i=1; i<100; i++) {
    y[i] = x[i] / c;    /* S1 */
    x[i] = x[i] + c;    /* S2 */
    z[i] = y[i] + c;    /* S3 */
    y[i] = c – y[i];    /* S4 */
}
```

進化計算論

1. Once the high performance regions of the search space are identified by a genetic algorithm, it may be useful to invoke a local search routine to optimize the members of the final population. Please discuss how to improve the fine local tuning capabilities of a genetic algorithm.

2. Compare **iterative hillclimbing** and **simulated annealing** with **GA**s.

3. Describe the following **Sampling Mechanism.**
   - Stochastic Universal Sampling
   - Brindle's remainder stochastic sampling
   - Crowding factor model

4. How many strings matched by a schema, S = (**10****1**), will be in the 3rd generation, if the expected number is at least 64 strings matching it in the 10th generation time? Which kind schema; above, average, or below schema, does it belong to? Why? (Please refer to the following notations.)

   $\overline{F(t)}$: the average performance (or average fitness) of the entire population $P(t)$

   $o(S)$: the order of a schema S

   $\delta(S)$: the defining length of the schema S

   $\zeta(S,t)$: the number of strings in a population at the time t, matched by schema S

   $eval(S,t)$: the average fitness of all strings in the population matched by the schema S

12/2007 博士班資格考: 機率與統計 Show All Details.

1. (20%) Let X and Y be two RVs. X is $N(\mu,\sigma)$. If $y=e^x$, find the *p.d.f.* of Y.

2. (20%) Let $\bar{X}$ be the sample mean and S^2 be the sample variance of a series of random samples, $X_1, X_2, \cdots, X_N$, of size N from a normally distributed event (Gaussian).
   (a) What is the definition of an unbiased estimator of the parameters of the event?
   (b) Is S^2 the unbiased estimator of the variance? Prove your answer.

3. (25%) Let **y** is estimated by a**x,** where **y** and **x are RVs.** Show that the MS error $e=E\{(y-ax)^2\}$ is minimized when a is such that $E\{(y-ax)x\}=0$.

4. (25%) A RV X has the distribution as
   $$P(X=k)=pq^k, \quad k=0,1,....$$
   Find $\Gamma(z)$ and use this to find the mean and variance.

5. (10%) Let $F_n(x)$ be a sequence of distribution function's for the RV X_n, defined by
   $$F_n(x)=\begin{cases} 0 & ,x<0 \\ 1-\dfrac{1}{n} & ,0\le x<n, \\ 1 & ,x\ge n \end{cases} \quad \text{for } n>0.$$
   a. Let $F(x)=\lim_{n\to\infty} F_n(x)$, find $F(x)$.
   b. Show that $E\{X^k\}\neq E\{(X_n)^k\}$ for any k.

Digital Image Processing

Final Examination

Department of CSIE, NCKU

Dec., 2007

1. Please define and describe morphological dilation and erosion operations for both binary and grey level images. Please explain what the top-hat transformation is and give an example of its major applications. (20%)

2. If a color image is given and you are asked to detect (or segment) a target area from the image, you then have to develop an image processing program to solve this problem. Suppose you have to do three main color image processing steps which are smoothing, color and tone correction, and color segmentation, please explain how you want to accomplish these three steps and why you select these approaches. (20%)

3. Please describe histogram equalization and histogram specification. Assume continuous quantities and please mathematically illustrate the histogram specification from the current histogram g(r) to a desired histogram h(z) (in terms of r and z) for a given image I. (20%)

4. Consider the images shown. The image on the right was obtained by (a) multiplying the image on the left by $(-1)^{x+y}$; (b) computing the DFT; (c) taking the complex conjugate of the transform; (d) computing the inverse DFT; and (e) multiplying the real part of the result by $(-1)^{x+y}$. Please explain (each of the five steps) mathematically why the image on the right appears as it does. (20%)

5. What is the deformable model (or snake) algorithm? In comparison with the edge-linking based methods, what are their major similarities and differences? Please describe at least one advantage and one disadvantage of snake. Please also describe at least one of the modified snake algorithm which is an extension of the conventional snake. (20%)

電腦繪圖

1. Please describe the **standard graphics pipeline**. Note, for each stage of the pipeline, you need to describe its functionality, input and output. (30%)
2. Please compare **global** and **local** illuminating effects. For example: **Raytracer v.s. OpenGL render**. (20%)
3. Please summarize your current research topics in computer graphics, research issues in this topics, and possible solutions for this topics (50%).

SOFTWRAE ENGINEERING

1. What are the testing objectives? Will the exhaustive testing (even if it is possible for very small programs) guarantee that the program is 100 percent correct?

2. Software requirements analysis is unquestionably the most communication-intensive step in the software process. Why does the communication path frequently break down?

3. You have been appointed a project manager for a major software products company. Your job is to manage the development of the next generation version of its widely used word-processing software. Because competition is intense. Tight deadlines have been established and announced. What team structure would you choose and why? What software process model(s) would you choose and why?

4. How do you improve the quality of software across your organization when you have been given the responsibility to do it?

5. What is and why do CMMI?

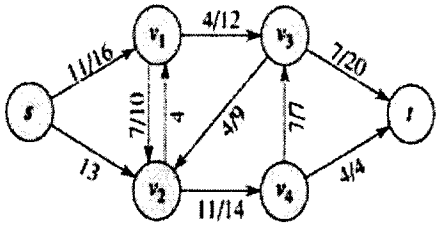
Qualification for Algorithms, 2007 Fall

1. (40 points) For each of the following statements, determine whether it is correct or not. Please explain your answer.
   (1). $2^{2n} = O(2^n)$.
   (2). The Dijkstra algorithm which solves the single-source-shortest-path problem and the Folyd-Warshall algorithm all use the greedy strategy.
   (3). Let C and C' be distinct strongly connected components in directed graph $G = (V, E)$. Suppose that there is an edge $(u, v) \in E^T$, where $u \in C$ and $v \in C'$. Then $f(C) > f(C')$, where $f(U) = \max_{u \in U}\{f[u]\}$ and f[u] means finishing time in the depth-first search algorithm.
   (4). Suppose P_1 and P_2 are problems and P_1 is polynomially reducible to P_2. If P_2 is NP-complete, P_1 is also NP-complete.
   (5). Suppose P_1 and P_2 are problems and P_1 is polynomially reducible to P_2. If P_1 is NP-complete, P_2 is NP-hard.
   (6). CountingSort is a Sort-in-Place sorting algorithm.
   (7). Sorting 6 elements with a comparison sort requires at least 10 comparisons in the worst case.
   (8). A problem is polynomial-time solvable if there exists an algorithm to solve it in time $O(n^k)$ for some constant k.

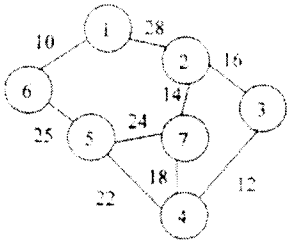
2. (15 points) Give a **tight** asymptotic bound for $T(n)$, where $T(n) = T(2^{\sqrt{\lg n}}) + 1$.

3. (19 points) Let A[1..n] be an array of n distinct numbers. If $i < j$ and A[i] > A[j], then the pair (i, j) is called an inversion of A.
   (1). (4 points) List the five inversions of the array <2, 3, 8, 6, 1>.
   (2). (5 points)What array with elements from the set $\{1,2,\ldots,n\}$ has the most inversions? How many does it have?
   (3). (10 points) Give an algorithm that determines the number of inversions in any permutation on n elements in $\Theta(nlgn)$ worst-case time. (*Hint*: modify merge sort)

4. (10 points) Please (1) draw the residual network for the graph G in the right figure and $f = 11$. (2) What is the maximal flow of G? Please explain.



5. (16%) Given the undirected graph with cost shown in the following. Please use Kruskal's algorithm and Prim's algorithm to find its minimum spanning tree. You should show the progress and the final result respectively.



DBMS Qualify Exam
2007 Fall

1.(15%) Relational algebra, SQL, and relational calculus can all be used to represent a query in a relational database. Then, why do we need three such languages? What are the purposes of having these different languages?

2. (20%) Assume that we have two relations as follows.

R = R(A, B, C)

S = S(D, E, F)

Give the SQL expression that is equivalent to each of the following queries.

(a) $\Pi_{A,B}(\sigma_{C=D}(R \times S))$

(b) R - S

(c) $\Pi_{A,B}(R) / \Pi_{D}(S)$ /* note that "/" represents a division operation */

And give the equivalent relational algebra of the following query.

(d) Select A, D From R, S.

3. (15%) A relation, R(A, B, C, D, E, F, G), whose attributes satisfy the functional dependencies:

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

Normalize the above relation to make it satisfy

(a) 2NF

(b) 3NF

(c) BCNF

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

4. (20%) 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)

(a) Get all supplier-number/part-number/project-number triples such that the indicated supplier, part, and project are all collocated (i.e., all in the same city).

(b) Get all supplier-number/part-number/project-number triples such that the indicated supplier, part, and project are all in different city.

(c) Get the total number of projects supplied by supplier S1.

(d) Get the supplier names for suppliers supplying all parts that are used in project J1.

5. (15%) Explain the following terms.

(a) Two-phase locking protocol.

(b) Impedence mismatch

(c) ACID properties of a database transaction processing system

6. (15%) Explain the following terms

(a) database tuning

(b) object-relational databases

(c) temporal databases