

## OS 資格考題 (104 學年度第一學期)

- (20%) Which of the following memory mechanisms can avoid the problem of internal fragmentation? Please explain your answers briefly.
  - demand paging
  - segmentation
  - pre-paging
  - TLB
- (15%) Please describe the clock page replacement algorithm (i.e., the second-chance algorithm). Which kind of hardware support is required in this algorithm?
- (10%) Please describe the 9-bit file access control in UNIX.
- (15%) A system consists of 5 processes P0 to P4, and 3 resource types A, B and C.

Snapshot at time T0:

	<u>Allocation</u>	<u>Max</u>	<u>Available</u>
	A B C	A B C	A B C
P0	0 1 0	7 5 3	0 2 1
P1	2 0 0	3 2 2	
P2	3 0 2	9 0 2	
P3	2 1 1	2 2 2	
P4	0 0 2	4 3 5	

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

- (20%) Consider the following set of processes:

<u>Process</u>	<u>Burst Time</u>	<u>Priority</u>	<u>Arrival Time</u>
P1	10	3	0
P2	5	4	2
P3	3	1	3
P4	1	5	5
P5	2	2	6

What is the **average waiting time** if the **preemptive SJF** scheduling algorithm is used?

- (20%) What's convoy effect? Do the following scheduling algorithms have

convoy effect? Why or why not?

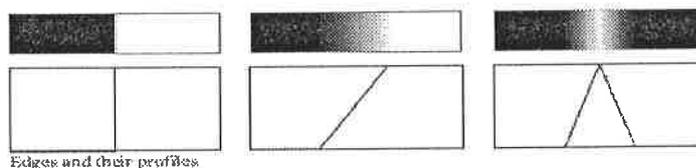
(a) Round Robin

(b) Shortest Job First

*Digital Image Processing*  
*Ph.D. Qualification Examination,*  
*Department of CSIE*

*November 2015*

1. (a) What is the 1-D convolution theorem of a continuous variable? (4%) please prove it. (6%) (b) What is aliasing? (4%) Will the shrinking and zooming operations cause aliasing? (Shrinking? zooming? or both?) Why? (6%)
2. You are given a medical image and asked to filter the image in frequency domain. Please give the steps that you use to perform image filtering and explain the function of each step. (12%) Please also explain how you can put the origin of frequency image at the image center and prove it. (8%)
3. Please refer to three vertical edge models and intensity profiles given below.
  - i. Using the horizontal Sobel operator to detect the vertical edge, please sketch the horizontal intensity profiles of the three resulting gradient images. (5%)
  - ii. Please sketch the results of using Laplacian gradient operator. (5%)
  - iii. Please sketch the results of using Marr-Hildreth edge operator. (5%)
  - iv. Please explain what are the zero-crossing point and the spaghetti effect. (5%)



4. 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%)
5. If the following thresholding condition is used, [ $G(x,y)=1$ , if  $f(x,y) > T$ ;  $G(x,y)=0$  if  $f(x,y) \leq T$ , where  $f(.)$  is input intensity,  $g(.)$  is output intensity &  $T$  is the threshold.] (a) please give the algorithm of Basic Global Thresholding. (10%) (b) Please explain why the initial threshold must be between the maximum and minimum values in the image. (Give an example which shows that the algorithm fails when condition is not satisfied. 10%)

# Discrete-Time Signal Processing 資格考

November 2015

1. (20%) A causal and stable LTI system  $S$  has its input  $x[n]$  and output  $y[n]$  related by the linear constant-coefficient difference equation

$$y[n] + \sum_{k=1}^{10} \alpha_k y[n-k] = x[n] + \beta x[n-1],$$

Let the impulse response of  $S$  be the sequence  $h[n]$

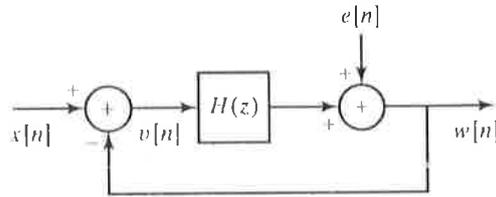
(a) Show that  $\alpha_1$  can be determined from the knowledge of  $h[0]$  and  $h[1]$ .

(b) If  $h[n] = (0.9)^n \cos(\pi n/4)$  for  $0 \leq n \leq 10$ , sketch the pole-zero plot for the system function of  $S$ , and indicate the region of convergence.

2. (20%) In the following figure,  $H(z)$  is the system function of a causal LTI system. As shown in the figure,  $W(z)$  can be expressed in the form

$$W(z) = H_1(z)X(z) + H_2(z)E(z)$$

For the case  $H(z) = \frac{z^{-1}}{(1-z^{-1})}$ , determine  $H_1(z)$  and  $H_2(z)$ .

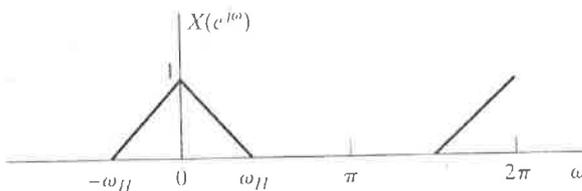


3. (20%) Consider the sequence  $x[n]$  whose Fourier transform  $X(e^{j\omega})$  is shown in the following figure.

Define

$$x_s[n] = \begin{cases} x[n], & n = Mk, \quad k = 0, \pm 1, \pm 2, \dots \\ 0, & \text{Otherwise} \end{cases}$$

and  $x_d[n] = x_s[Mn] = x[Mn]$



(a) Sketch  $X_d(e^{j\omega})$  for  $M=3$  and for  $\omega_H = \frac{\pi}{2}$ .

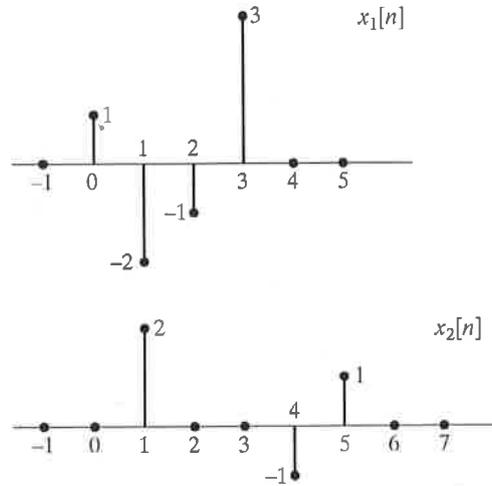
(b) What is the minimum value of  $\omega_H$  that will avoid aliasing when  $M=3$ ?

4. (20%) Let  $X(e^{j\omega})$  denote the Fourier transform of the sequence  $x[n] = (\frac{1}{2})^n u[n]$ .

Let  $y[n]$  denote a finite-duration sequence of length 10; i.e.,  $y[n] = 0, n < 0$ , and  $y[n] = 0, n \geq 10$ . The 10-point DFT of  $y[n]$ , denoted by  $Y[k]$ ,

corresponds to 10 equally spaced samples of  $X(e^{j\omega})$ ; i.e.,  $Y[k] = X(e^{j2\pi k/10})$ . Determine  $y[n]$ .

5. (20%) The following figure shows two finite-length sequences  $x_1[n]$  and  $x_2[n]$ . What is the smallest  $N$  such that the  $N$ -point circular convolution of  $x_1[n]$  and  $x_2[n]$  are equal to the linear convolution of these sequences, i.e., such that  $x_1[n] \circledast_N x_2[n] = x_1[n] * x_2[n]$ ?



## 圖論資格考 2015 Fall

1. (10%) Give the definition that graph  $G$  is isomorphic to graph  $H$ .
2. (10%) Show that every graph with  $n$  vertices and  $k$  edges has at least  $n-k$  connected components.
3. (10%) For a set  $S \subseteq N$  of size  $n$ , determine the number of trees with vertex set  $S$ .
4. (10%) Let  $Q_k$  be a  $k$ -dimensional hypercube. Determine that  $\kappa(Q_k)$ .
5. (10%) Prove that every  $u, v$ -walk in a graph contains a  $u, v$ -path.
6. (10%) Give a graph  $G$  such that  $\kappa(G) < \kappa'(G) < \delta(G)$ .
7. (20%) Show that a graph is bipartite if and only if it has no odd cycle.
8. (10%) Let  $d_G(v)$  be the number of edges incident to  $v$  in  $G$  except that each loop at  $v$  counts twice. Show that if  $G=(V,E)$  is a graph, then  $\sum_{v \in V} d_G(v) = 2|E|$ .
9. (10%) If  $k > 0$ , then a  $k$ -regular bipartite graph has the same number of vertices in each partite set.

## 工程用解剖生理學

1. What are the bones containing paranasal sinuses? Explain the function of these sinuses (10%)
2. Describe the phases and the corresponding events during Mitosis after the chromosomes are replicated. (20%)
3. Describe the contraction process of a skeletal muscle fiber, the sliding filament mechanism, after the muscle fiber is depolarized. (20%)
4. Explain the mechanism of sinus nodal rhythmicity. (20%)
5. Give 5 factors to stimulate secretion of Growth Hormone (10%)
6. What are the vessels contributing to form Circle of Willis, an arterial anastomosis? (10%)
7. Name FOUR of the substances excreted by liver into bile? (10%)

11/2015 博士班資格考： 機率與統計 Show All Details.

1. (20%) A RV  $X$  has the distribution as  $P(X = k) = pq^k$ ,  $k = 0, 1, \dots$ 
  - (a) Find the characteristic function  $\Gamma(z)$
  - (b) Use your result in (a) to find the mean and variance.
  
2. (20%) Let  $X$  and  $Y$  be two RVs.  $X$  is a Poisson distribution with parameter  $\lambda$ . If  $y = x^2$ , find the *p.d.f.* of  $Y$ .
  
3. (20%) Let  $X_1, X_2, \dots, X_N$  denote the independent random variables taken from a discrete probability distribution,  $f(X, \theta)$ , where  $\theta$  is a single parameter of the distribution.
  - (a) Define the likelihood function.
  - (b) Explain the function of a maximum likelihood estimator.
  - (c) For a Normal distribution  $N(\mu, \sigma)$ , find the maximum likelihood estimators for  $\mu$  and  $\sigma$
  
4. (20%) A pollution investigation was made upon a river based on a certain chemical substance measured in milligrams per liter. 20 samples were collected from station 1 and 30 samples were obtained from station 2. The average in station 1 is 3.0 milligrams per liter and a standard deviation being 1.5 milligrams per liter and 1.5 milligrams per liter and 0.5 milligrams per liter for station 2. Find the 95% confidence interval for the difference in the true average substance at the two stations, assuming the observations are all normally distributed.
  
5. (20%) Let  $X_1, X_2, \dots, X_N$  denote a sequence of random variables. Given  $S$ , one would like to estimate  $S$  in terms of the sequence of the random variables.
  - (a) What is the linear MS (Mean Square) estimate of  $S$ , denoted by  $\tilde{S}$ ?
  - (b) Give the objective function  $P$  in order to find the parameters of the linear MS estimate.
  - (c) Show that the estimation error, given by  $\tilde{S} - S$ , is orthogonal to  $X_i$ , for all  $i$ .

Ph.D. Qualify Examination 2015  
Theory of Computation

- This examination is closed books.
- Please turn off your cell phones.
- Remember that there are 2 pages of the qualify examination.
- Answer all questions as possible. You may have a partial score if you answer the correct direction.

1. Deterministic Finite Acceptors (DFAs) (10 pts)

For  $\Sigma = \{0, 1\}$ , construct DFA that accepts the set consisting of:  
All strings whose binary interpretation is divisible by 5.

2. Nondeterministic Finite Acceptors (NFAs) (20pts. 10 pts each)

Draw NFA to accept the following sets of strings over  $\{a, b\}$ :

(a) Find an NFA with three states that accepts the language  
 $L = \{a^n : n \geq 1\} \cup \{b^m a^k : m \geq 0, k \geq 0\}$ .

(b) All strings where every odd position is "b".

3. Please use the pumping lemma to prove that the language is nonregular: (15 pts)

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

4. In the derivation of using pumping lemma to prove a language  $L$  is not regular, we will give an assumption "A DFA  $M$  with the number of states  $|M|$  exists for  $L$ ". Can you replace the assumption with "An NFA  $M'$  with the number of states  $|M'|$ "? Please justify your answer. (15 pts)

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

$S \rightarrow aSbS|bSaS|\lambda$ .

6. Construct an NPDA that accepts the following language (use a NPDA with 5 states): (10 pts)

$L = \{a^n b^{n+m} c^m : n \geq 0, m \geq 1\}$

背面有題

7. Fill the following languages into the language hierarchy (If  $L_i$  is a regular language and also a context-free language, please fill  $L_i$  in the set of regular languages): (20 pts)

$$L_1 = \{a^n b^m : n \geq m\},$$

$$L_2 = \{a^n b^n c^n : n \geq 0\},$$

$$L_3 = L(a^* b^*),$$

$$L_4 = \{a^n w w^R a^n : n \geq 0, w \in \{a, b\}^*\},$$

$$L_5 = \{ww : w \in \{a, b\}^*\},$$

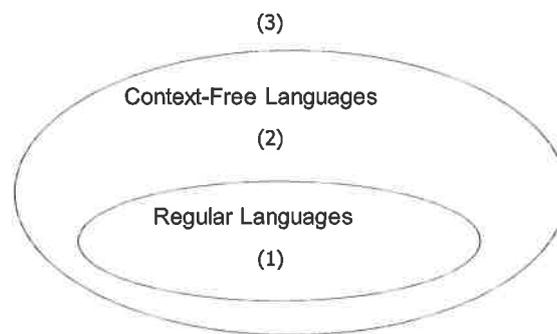
$$L_6 = \{a^{n!} : n \geq 0\},$$

$$L_7 = \{ab, ad, a\},$$

$$L_8 = \{a^n b^j a^j b^n : n \geq 0, j \geq 0\},$$

$$L_9 = \{a^n b^m c^{n+m} : n \geq 0, m \geq 0\},$$

$$L_{10} = \{a^3 b^n c^n : n \geq 0\}.$$



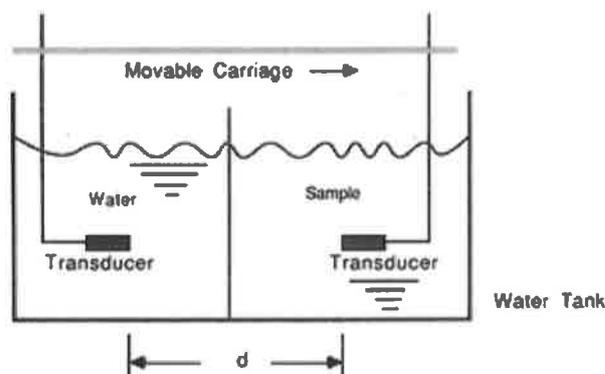
國立成功大學資訊工程系一〇四學年度第一學期博士班資格考命題紙

科目名稱：生醫超音波訊號與成像技術

考試時間：一〇四年十一月十三日

本試題共 1 張，本張為第 1 張

- (a). Plot typical components of a single element transducer, and then describe functions of each component inside the transducer. (10%); (b). For a round shape single element non-focus transducer with the diameter of 10 cm and 2 MHz frequency, calculate the wavelength, the focal point of the acoustic field, and the divergence angle. (12%); (c). Describe methods and modalities to measure acoustic field of an ultrasound transducer. (8%); (d). What are the six definition of ultrasound intensity? (6%)
- (a). What is the ultrasound bio-effect? (5%); (b). Design an arrangement to apply ultrasound energy to stimulate cells (10%). What is your considerations on the use of ultrasound energy level if you would like those insonified cells to be better growing? (5%)
- (a). Describe reasons to cause ultrasound attenuation. (8%); (b). Ultrasound attenuation is frequency dependent. As the ultrasound frequency increases, the attenuation would affect the penetration depth of image greatly. Provide methods to measure and to compensate ultrasound attenuation. (15%); (c). For the following arrangement, the water and the sample liquid are separated by a thin membrane. The attenuation of thin membrane is negligible. Two transducers are mounted on a movable carriage with a fixed distance  $d$  between them. Suppose the attenuation coefficient of water is given by  $\beta_0$ . The attenuation of the sample liquid,  $\beta$ , can be estimated by observing the change in received pressure after a displacement of carriage, say, to the right, by  $\Delta d$ . Provide the relationship between frequency, wavelength, and sound velocity (3%); Derive an expression for  $\beta$  in terms of  $\beta_0$ ,  $\Delta d$ ,  $d$ , and the measured pressures before and after carriage displacement. (18%)



## 演算法資格考 November 2015

1. (15%) Give formal definitions of  $\Theta(g(n))$ ,  $O(g(n))$ , and  $\Omega(g(n))$ .
2. (10%) Give an asymptotic upper bound for  $T(n) = 2T(\lfloor \sqrt{n} \rfloor) + \lg n$  (please make your bound as tight as possible).
3. (10%) Show that  $f(n) = \Theta(g(n))$  if and only if  $g(n) = \Theta(f(n))$ .
4. (10%) Show that any comparison sort algorithm requires  $\Omega(n \lg n)$  comparisons in the worst case.
5. (15%) Is the sequence  $\langle 23, 17, 14, 6, 13, 10, 1, 5, 7, 12 \rangle$  a max-heap?
6. (10%) Present the quick sort algorithm and analyze the complexity.
7. (10%) Present the topological-sort algorithm and analyze the complexity.
8. (10%) Using the master theorem to solve  $T(n) = 9T(\frac{n}{3}) + n$ .
9. (10%) 解釋何謂“Sorted in Place”?

**2015 Nov 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. 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 \*/  
}
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. Explain why the cache miss penalties increase as the processor becomes much more faster than DRAMs? Briefly describe five optimizations to reduce cache miss penalty. (20 points)
5. Describe two major instruction set characteristics that can further divide general purpose register (GPR) instruction set architecture into three classes, based on whether the instruction operands are used explicitly or implicitly. And show the advantages and disadvantages of these three further divided classes. (15 points)
6. 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)

Qualify Exam -- Data Mining, 2015

1. (20 points) Please briefly describe the following terminologies. (1) Sequential Pattern (2) Data Cube (3) Data warehouse (4) Ensemble method (5) OLTP
2. (20 points) What is “overfitting” problem in classification modeling? How to do “overfitting”? How to deal with it?
3. (20 points) Please compare K-means and hierarchical clustering algorithms and list their advantages and disadvantages.
4. (20 points) (a) AprioriAll and AprioriSome are the well-known methods for mining sequential patterns. Describe how do they work respectively, and point out the main differences between them briefly. (b) Describe an approach for mining sequential patterns without generating candidates.
5. (20 points) For the example in the following table, the multinomial parameters we need to classify the test document are the priors  $P(c) = 3/4$ ,  $P(\text{not } c) = 1/4$ . Please find the value of  $P(\text{“Chinese”}|\text{not } c)$ ,  $P(\text{“Japan”}|\text{not } c)$ ,  $P(c|d_5)$  and  $P(\text{not } c|d_5)$ . [Hint:  $P(\text{“Chinese”}|c)=(5+1)/(8+6)=3/7$ ]

	<i>docId</i>	<i>Words in document</i>	<i>in c = China?</i>
Training set	1	Chinese, Beijing, Chinese	<i>Yes</i>
	2	Chinese, Chinese, Shanghai	<i>Yes</i>
	3	Chinese, Macao	<i>Yes</i>
	4	Tokyo, Japan, Chinese	<i>No</i>
Test set	5	Chinese, Chinese, Chinese, Tokyo, Japan	?