

國立台灣科技大學九十八學年度碩士班招生試題

系所組別：資訊工程系碩士班

科目：資訊工程概論

(總分為 100 分)

1. For each of the following technologies,
 - Pipelining
 - Very long instruction word (VLIW)
 - Single instruction multiple data (SIMD)
 - A. Explain in brief how they can be used to implement instruction level parallelism (ILP). (12%)
 - B. Which of these technologies is/are used in the Intel Core 2 Duo processor? (3%)
2. Consider a handheld computer of the following specification:

CPU structure	RISC
Width of machine word (also the instruction length)	32 bit
Primary memory data bus	32 bit
Pipeline stage	7
Instruction issued per cycle	1
Maximum working frequency	300MHz
L1 I-cache	8 KB
L1 D-cache	16 KB
L2 cache	1 MB, 16 way set associative

- A. What is the most possible instruction per clock (IPC) when the processor is running on its peak performance? (2%)
 - B. If the length of cache line, or cache block, in L2 cache is 16 words, how many bits in total are required to store tags? Note that the 1 MB memory is used only for data field. (8%)
 - C. Suppose that main memory takes 400ns to read the first word and 150ns for every subsequential word. What is the miss penalty (in units of clock cycle) the L2 cache would suffer in order to load the first instruction of a program? (6%)
 - D. Explain the primary reason why modern processors tend to have L1 cache separated into I-cache and D-cache? (4%)
3. A minimum spanning tree of a graph G is a spanning tree of least cost. It must satisfy the following constraints:
 - It contains exactly $n - 1$ edges, where n is the number of nodes in G
 - It does not produce a cycle
 - A. Briefly write down the pseudo code of the *Kruskal's algorithm* and then use this algorithm to construct a minimum spanning tree of the following graph.



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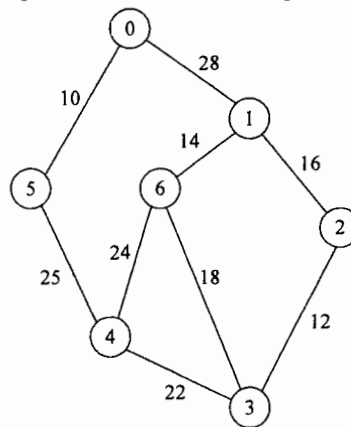
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Please show every step of the tree construction process. (6%)

- B. Briefly write down the pseudo code of the **Prim's algorithm** and then use this algorithm to construct a minimum spanning tree of following graph. Please show every step of the tree construction process. (6%)



4. Answer the following questions.
- A. Assume that we have $n \geq 1$ distinct integers that are already sorted and stored in the array $a[0..n-1]$. Please write a pseudo code of the **binary search** algorithm that determines if integer x is present. It returns the index i when it finds $a[i] = x$. Otherwise, it returns *middle* when it terminates without finding x and $x < a[\text{middle}]$, or $\text{middle} + 1$ when $a[\text{middle}] < x$. (6%)
- B. It is trivial to find the median of the integers in the sorted array a with $\text{median} = a[\lfloor n/2 \rfloor]$. Suppose we have $3n$ distinct integers that are randomly stored in arrays $a[0..n-1]$, $b[0..n-1]$, and $c[0..n-1]$, and each array is sorted independently. Write an algorithm to find the median of these $3n$ distinct integers. Please note that you are not allowed to merge arrays a , b , and c into a $3n$ -integer array and then perform sorting. (12%)
5. Please explain three general methods of passing parameters to the operating system when a system call is invoked. (9%)
6. Please define the following terminologies: (16%)
- Buffering
 - Caching
 - Multiprogramming
 - Time sharing
7. **Buddy system** and **slab allocation** are two strategies for managing free memory that is assigned to kernel processes. Please explain how buddy system and slab allocation work. (10%)

