1. (5%) If computer A runs a program in 15 seconds and computer B runs the same program in 25 seconds, how much faster is A than B?

2. (12%) A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts:

<table>
<thead>
<tr>
<th>CPI for each instruction class</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>CPI</td>
</tr>
</tbody>
</table>

For a particular high-level language statement, the compiler writer is considering two code sequences that require the following instruction counts:

<table>
<thead>
<tr>
<th>Instruction counts for each instruction class</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

(a) What is CPI? (3%)
(b) Which code sequence executes the most instructions? (3%)
(c) Which will be faster? (3%)
(d) What is the CPI for each sequence? (3%)

3. (9%) Please explain the following terms:
(a) What are structural hazards? (3%)
(b) What are data hazards? (3%)
(c) What are control hazards? (3%)

4. (5%) Assume that a processor with a 1ns clock cycle time, a miss penalty of 16 clock cycles, a miss rate of 0.07 misses per instruction, and a cache access time (including hit detection) of 1 clock cycle. Note that the read and write miss penalties are the same and ignore other write stalls. What is the average memory access time per instruction?

5. (9%) Please explain the following terms:
(a) What is direct-mapped cache? (3%)
(b) What is fully-associative cache? (3%)
(c) What is set-associative cache? (3%)

6. (10%) Explain the relationship of virtual memory, TLB, and caches in detail.
[資料結構]
7. (20%) Explain the following terms.
   (a) binary search tree (5%)
   (b) hash table (5%)
   (c) recursion (5%)
   (d) time complexity (5%)

8. (10%) Answer the following questions:
   (a) Is heapsort stable? Explain your answer briefly. (5%)
   (b) What kind of data structure you would use for the heap in the heapsort program? Explain your answer briefly. (5%)

9. (10%) Answer the following questions:
   (a) Give an example to illustrate how to represent a graph by an adjacent matrix and by a adjacency list. (5%)
   (b) Discuss the advantages and disadvantages of these two representation methods? (5%)

10. (10%) A degree-$$n$$ polynomial $$p(x)$$ is a function of the form $$p(x) = \sum_{i=0}^{n} a_i x^i$$, where $$x$$ is a real number, each $$a_i$$ is a constant, and $$a_n \neq 0$$. Describe a linear-time algorithm for computing $$p(x)$$ for a particular value of $$x$$. 