國立中正大學
114 學年度碩士班招生考試
試 題

[第 3 節]

科目名稱	軟體設計
系所組別	資訊工程學系-甲組

一作答注意事項一

1. (5%) (Select <u>multiple</u> correct answers) Please select all the possible height(s) for an AVL tree of 100 nodes from the following options. Note that the height of a tree with only one node is 1. (Hint: $\log_{10} 2 \approx 0.3010$)

   (a) 5　(b) 6　(c) 7　(d) 8　(e) 9　(f) 10　(g) None of the above.

2. (5%) (Select <u>multiple</u> correct answers) Please select all the correct statement(s).

   (a) A 2-3-4 tree is a B-tree of order 5.

   (b) A red-black tree is a binary tree form of a 2-3 tree.

   (c) All the external nodes in a B-tree are on the same level.

   (d) Any internal node (excluding the root) has at least $\lceil \frac{m}{2} \rceil$ children in a B-tree of order m.

   (e) None of the above.

3. (5%) (Choose <u>one</u> best answer) Consider the integer array $\{52, 21, 40, 33, 88, 57, 46, 71\}$. What will the array look like after heapifying it to a Max Heap? Note that we use the bottom-up method that runs in $O(n)$ time.

   (a) $\{88, 71, 57, 52, 21, 40, 46, 33\}$

   (b) $\{88, 71, 57, 52, 46, 40, 33, 21\}$

   (c) $\{21, 33, 40, 46, 52, 57, 71, 88\}$

   (d) $\{88, 71, 57, 52, 33, 40, 46, 21\}$

   (e) None of the above.

4. (5%) (Choose <u>one</u> best answer) Consider the red-black tree resulting from sequentially inserting the following numbers into an empty red-black tree: 40, 60, 55, 15, 20, 5, 25, 30. What is the sum of the numbers in the red nodes in the red-black tree?

   (a)　　145　(b) 125　(c) 110　(d) 90　(e) None of the above.

5. (5%) (Choose <u>one</u> best answer) Consider the integer array $\{52, 21, 40, 88, 33, 57, 46, 71\}$. Using the two-pointer version of quicksort, what will the array look like after moving the first pivot (i.e., 52) to its correct position? Note that the first and the second pointers start at the positions of 21 and 71, respectively.

   (a) $\{21, 40, 33, 46, 52, 71, 57, 88\}$

   (b) $\{21, 33, 40, 46, 52, 57, 71, 88\}$

   (c) $\{33, 21, 40, 46, 52, 57, 88, 71\}$

   (d) $\{46, 21, 40, 33, 52, 57, 88, 71\}$

   (e) None of the above.

6. (5%) (Select <u>multiple</u> correct answers) Which of the following statements is (are) true?

   (a) Given a dense graph with negative weight edges but no negative weight cycles, applying Johnson's algorithm on this graph will be faster than running Floyd-Warshall algorithm.

   (b) The class NP contains problems that are solvable in polynomial time.

   (c) The halting problem is NP-hard problem.

   (d) Ford-Fulkerson method can be used to find a maximum matching from the graph at the right side

   (e) Following (d), the graph has maximal cardinality 4.

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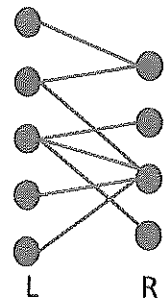
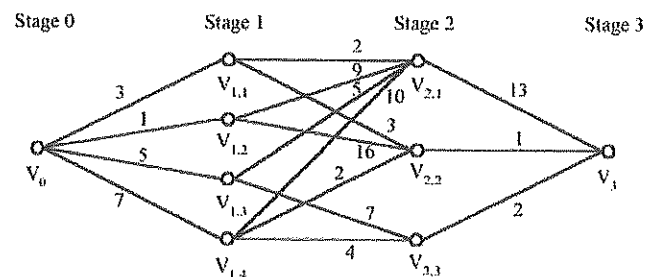7. (5%) (Select <u>multiple</u> correct answers) Which of the following statements is (are) true?

   (a) Insertion sort performs in-place sorting operations.

   (b) Finding the longest simple path from an unweighted graph can be solved by divided and conquer strategy.

   (c) Recursion tree is a full binary tree.

   (d) Quicksort is not an asymptotically optimal algorithm.

   (e) An algorithm with fewer lines of codes has lower time complexity than the one with more lines of codes.

8. (5%) (Select <u>multiple</u> correct answers) Which of the following statements is (are) true?

   (a) The solution of the recurrence $T(n)=16T(n/4) + n^2$ is $O(n^2)$.

   (b) The solution of the recurrence $T(n)=4T(n/5) + n^{4/3}$ is $O(n^{4/3})$.

   (c) The solution of the recurrence $T(n)=T(n/4) + T(n/2) + n^2$ is $O(n\log n)$.

   (d) The solution of the recurrence $T(n) = 2T(\sqrt[4]{n}) + \sqrt{\log n}$ is $O((\log n)(\log\log n))$.

   (e) The solution of the recurrence $T(n)=T(n-1) + 1/n$ is $O(\log n)$.

9. (5%) (Select <u>multiple</u> correct answers) Given a graph at the right side, which of the following statements is (are) true?

   (a) To find the shortest path (i.e., path with minimum weight) from V_0 to V_3 correctly, greedy algorithm is applicable.

   (b) Following the same task as (a), dynamic programming is applicable.

   (c) From the stage perspective, the problem of finding the shortest path between the 4 stages shows optimal substructure.

   (d) The path from V_0 to V_3 has minimum weight 7.

   (e) The path from V_0 to V_3 has minimum weight 6.

Stage 0　　　Stage 1　　　Stage 2　　　Stage 3

10. (5%) (Select <u>multiple</u> correct answers) Given a graph at the right side, which of the following statements is (are) true?

(a) Kruskal algorithm is applicable to find a correct answer.

(b) Given the necessary inputs, executing Floyd-Warshall algorithm on this graph takes more time than executing Bellman-Ford algorithm.

(c) If specifying node A as the source and node D as the sink, executing Edmonds-Karp algorithm will return us '24' as an answer.

(d) Topological sort is applicable to find a correct answer.

(e) Node B, C, E, F form a strongly connected component.
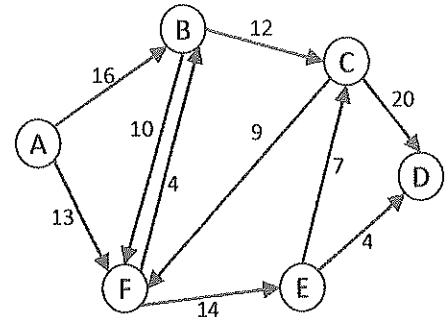
11. (5%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果

```c
#include <stdio.h>

int main() {
    int num1 = 025;
    int num2 = num1;

    printf("%X\n", num2);

    return 0;
}
```

12. (10%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果

```c
#include <stdio.h>

void modifyValues(const int *ptr1, int *const ptr2) {
    *ptr2 *= 2;
}

int main() {
    int a = 10;
    int b = 20;
    const int *p1 = &a;
    int *const p2 = &b;
    const int *const p3 = &a;
    modifyValues(p1, p2);
    printf("%d, %d\n", a, b);

    return 0;
}
```

13. (10%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果

```c
#include <stdio.h>

int main(void) {
    unsigned int a = 0xFFFF0101;
    unsigned char b = (unsigned char)a;
    char *c = (char *) &a;

    unsigned int *p = (unsigned int *)c;
    *p <<= 6;

    printf("%x, %x", b, *c);
    return 0;
}
```

14. (9%) Match the concepts on the left with the (simplistic) definitions on the right by writing a letter from 1 to 4 in each of the blanks.

A. (2%) overloading _____   1. able to work with multiple types

B. (2%) coercion _____   2. converting automatically to the desired type

C. (2%) aliasing _____   3. multiple things with the same name

D. (3%) polymorphism_____   4. multiple names for the same thing

15. (16%)

```cpp
#include <iostream>
#include <string>
using namespace std;

class B {
public:
  B( ) { }
  ~B( ) { }

  virtual void m(int i) {
    cout << "B1" << endl; }

  virtual void m(double f) {
    cout << "B2" << endl; }};

class D : public B {
public:
```

```cpp
int main (int argc, char * argv[ ]) {

  D* dP = new D( );
  B* bP = dP;
  B bo = *dP;
  B& br = *dP;

  dP->m(1);        // Line A
  dP->m(2.0);      // Line B
  bP->m(1);        // Line C
  bP->m(2.0);      // Line D
  br.m(1);         // Line E
  br.m(2.0);       // Line F
  bo.m(1);         // Line G
  bo.m(2.0);       // Line H
```

```
    D( ) { }                              }
    ~D( ) { }

    void m(int i) { cout << "D" << endl; }};
```

A. (2%) What is printed by **Line A**?

B. (2%) What is printed by **Line B**?

C. (2%) What is printed by **Line C**?

D. (2%) What is printed by **Line D**?

E. (2%) What is printed by **Line E**?

F. (2%) What is printed by **Line F**?

G. (2%) What is printed by **Line G**?

H. (2%) What is printed by **Line H**?