Tutorial 1 – C/C++ Primer

I - Required

**Question 1:** What is the output of the following code? Explain your answer.

```cpp
char str[5] = "ABC";
cout << str[3];
cout << str;
```

(a) A  
(b) AB  
(c) ABC  
(d) Compile time error

**Answer:** Choice (c)

**Question 2:** What is the output of the following code? Explain your answer.

```cpp
int a = 5, b = 10, c = 15;
int *arr[3] = {&a, &b, &c};
cout << *arr[*arr[1] - 9];
```

(a) 5  
(b) 10  
(c) Garbage value  
(d) Compile time error

**Answer:** Choice (b)

**Question 3:** What is the difference between struct and class in C++?

**Answer:** Members of a class are private by default and members of struct are public by default. When deriving a struct from a class/struct, default access-specifier for a base class/struct is public and when deriving a class, default access specifier is private.

**Question 4:**

(a) Declare a dynamic array of pointers (to integers) of size 10?  
(b) What happens when `delete` is use with a NULL pointer? What if we call `delete` twice on the same pointer?

**Answer:**  
(a) `int **p = new int*[10];`  
(b) Call delete twice on the same pointer yields an undefined behavior, the program might crash or nothing happen.
**Question 5:** Consider the following recursive function fun(x, y). What is the value of fun(3, 2)? List the recursive function calls.

```c
int fun(int x, int y) {
    if (x == 0)
        return y;
    return fun(x - 1, x + y);
}
```

**Answer:** 8

fun(3, 2) -> fun(2,5) -> fun(1,7) -> fun(0,8) -> 8

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**II – Advanced (required for honor classes)**

**Question 1:** "For" loops can always be re-written as "while" loops, and vice-versa. Are the following two codes equivalent, and what is their output? Explain your answer, and run the codes to check.

(a)

```c
int count = 1;
for (; count <= 5 ; count++)
{
    int count = 1;
    cout << count << "\n";
}
return 0;
```

(b)

```c
int count = 1;
while (count <= 5)
{
    int count = 1;
    cout << count << "\n";
    count++;
}
return 0;
```

**Answer:**
(a) This program exits after printing five ‘1’ to the screen.
(b) This program never finishes and continue printing ‘1’ to the screen.

**Question 2:** Given int x = 0 and the following functions:

```c
void f(int x) {
    x++;
    return;
}
```
```c
void g(int &x) {
    x++;
    return;
}
void h(const int &x) {
    x++;
    return;
}
```

What is the value of x after each function call f(x), g(x) and h(x)?

**Answer:**
- The value of x after call to f(x) is unchanged, thus x remains 0
- The value of x after call to g(x) is increased, since x is passed into g(x) by reference.
- The function call h(x) yields an error because const pointer cannot be modified.

**Question 3:** What is the output of the following program? Correct the program if there is any compile time error.

```c
#include <iostream>
using namespace std;

class Test { 
    int x;
    Test() { x = 5; }
};

int main() {
    Test *t = new Test;
    cout << t->x;
}
```

**Answer:** There is a compile time error. Because by default, attribute x of class Test has private access.

**Question 4:** What is the value of q[2] and p[1][2] after each call to delete?

```c
#include <iostream>
using namespace std;

int main() {
    int **p = new int*[5];
    int *q = new int[5];
    for (int i = 0; i < 5; i++) {
        q[i] = i;
    }
    p[1] = q;
```
delete p;
delete q;
delete [] q;
}

**Answer:**
- After `delete p`, q[2] remains 2, access to p[1][2] yields undefined behavior (Result depends on how operating system handle memory access, may cause segfault or allow access variable normally)
- After `delete q`, access to both q[2] p[1][2] yields undefined behavior
- `delete [] q` caused a runtime error

**Question 5:** Given `int x = 15`, and the following recursive function `fun(n, &ptr)`.

What is the value of `fun(5, &x)`?

```c
int fun(int n, int *f_p) {
    int t, f;
    if (n <= 1)
    {
        *f_p = 1;
        return 1;
    }
    t = fun(n-1, f_p);
    f = t+ * f_p;
    *f_p = t;
    return f;
}
```

**Answer:** 8