

Assignment 2, Due 2020-09-18, *Estimated time: 30 minutes*

Question 1 (Recursive functions): The sequence of Fibonacci numbers $F(n)$ (for all $n \geq 0$):

$$F(n) := \begin{cases} 0, & \text{if } n = 0, \\ 1, & \text{if } n = 1, \\ F(n-2) + F(n-1), & \text{if } n \geq 2 \end{cases}$$

We compute the remainders of $F(n)$, when divided by $p = 2000000011$ (just some large prime):

$$G(n) := G(n) \bmod 2000000011, \text{ for } n \geq 0. \quad (1)$$

```
1  #include <iostream>
2
3  const int p = 2000000011;
4
5  int G(int n) {
6      switch(n) {
7          case 0: return 0;
8          case 1: return 1;
9          default: return (G(n-2) + G(n-1)) % p;
10     }
11 }
12
13 int main() {
14     using namespace std;
15     int n; cin >> n;
16     cout << "G(" << n << ")=" << G(n) << endl;
17 }
```

Please give YES/NO answers:

- (A) The integer `p` (Line 3) should be defined in some class or function; cannot have a variable without a scope.
- (B) The `switch` statement should have `break` after every case (Lines 7,8).
- (C) The ‘`using namespace`’ has to be before a method, not inside it (Line 14).
- (D) The C++ function `G(int n)` uses incorrect algorithm to compute $G(n)$.
- (E) The program might be slow for some arguments.

Question 2 (Overloading functions):

```
1  #include <iostream>
2
3  using namespace std;
4  class Square {
5      public:
6          int square(int a) {
7              cout << "squaring int" << endl;
8              return (a*a);
9          }
10         double square(double b) {
11             cout << "squaring double" << endl;
12             return b*b;
13         }
14 };
15
16 int main() {
17     using namespace std;
18     Square ss;
19     cout << ss.square('7') << endl;
20 }
```

Please give YES/NO answers:

- (A) Two functions with the same name `square(...)` should have the same return value (either `double` or `int`, but not two at the same time).
- (B) Output on Line 19 happens before outputs on Lines 7 and 11.
- (C) Char parameter cannot be passed to functions, if their input type is either `int` or `double` (Line 19); you need to write yet another function to square char values. E.g. `double square(char c) { ... }`
- (D) Squaring char `'7'` computes $7^2 = 49$, since it is converted to number 7.

Question 3 (Parameters by Value and by Reference):

Write the output produced by this program.

```
1  #include <iostream>
2
3  using namespace std;
4  void fun(int a, int& b) {
5      a += 10;
6      b += 10;
7      cout << "in fun: (a,b) = (" <<
8          a << "," << b << ")" << endl;
9  }
10
11 int main() {
12     int a = 5;
13     int b = 3;
14     fun(++b,a);
15     cout << "in main: (a,b) = (" <<
16         a << "," << b << ")" << endl;
17 }
```

Question 4 (Arrays and Pointers):

```
1  #include <iostream>
2  #include <algorithm>
3
4  int rows = 4, cols = 4;
5
6  using namespace std;
7  void f(int*& a) { a[1] = 101; }
8  void g(int* a) { a[2] = 102; }
9  void h(int*& a) {
10     a = new int[cols];
11     // a call to initialize array with 103:
12     fill_n(a, cols, 103);
13 }
14 void i(int* a) {
15     a = new int[cols];
16     // a call to initialize array with 104:
17     fill_n(a, cols, 104);
18 }
19
20 int main() {
21     int** arr = new int*[rows];
22     for (int i=0; i<rows; i++) {
23         arr[i] = new int[cols];
24         f(arr[0]);
25         g(arr[1]);
26         h(arr[2]);
27         i(arr[3]);
28
29         for (int i=0; i<rows; i++) {
30             for (int j=0; j<cols; j++)
31                 cout << arr[i][j] << " ";
32             cout << endl;
33         }
34 }
```

What values of `arr` are printed near the end of `main()` function (Lines 29-33)?

Use asterisk `*` to denote those values in the array which may be uninitialized.
