C++ Programming
Class Constructor & Destructor Homework

Mostafa S. Ibrahim
Teaching, Training and Coaching since more than a decade!

Artificial Intelligence & Computer Vision Researcher
PhD from Simon Fraser University - Canada
Bachelor / Msc from Cairo University - Egypt
Ex-(Software Engineer / ICPC World Finalist)

Homework 1: Initializer list!

- We learned that it is recommended to use the **initializer list** for constructor
- Assume we have a class of several variables (e.g. a, b, c in order)
- But the initializer list is b, a, c
- **Will** the constructor initialize based on class order or initializer-list order?
- Also, **what** is the order of the destructor?
- It is preferred to learn the answer by reading a book/reference
- But, implement a program that its results can help us answer the 2 questions

Homework 2: Guess me!

```cpp
class ClassA {
public:
    ClassA() {
        cout<<"ClassA Constructor\n";
    }
};

class ClassB {
private:
    ClassA aa;
    int x;
public:
    ClassB(int x) {
        this->aa = ClassA();
        this->x = x;
    }
};

class ClassC {
private:
    int &y;
    ClassB bb;

public:
    ClassC(int &y, const ClassB &bb){
    }
};


int main() {
    int hello = 10;
    ClassB b(5);
    ClassC cc(hello, b);
    return 0;
}
```

- 1) What are the possible ways to finish Class C constructor?
- 2) How many times ClassA Constructor will be called?
  - Why?
  - Give a tip for the coder

Homework 3: Const & In constructor

```
7⊖ class D {
8  private:
9      A aa;
0      B bb;
1      C cc;
2
3  public:
4⊖      D(A a, B b, C c) : aa(a), bb(b), cc(c){
5      }
6
```

- In a recent code review, senior TL asked you to change the constructor to use const and &
- Why do you think so?

```
3  public:
4⊖      D(const A &a, const B &b, const C &c) : aa(a), bb(b), cc(c){
5      }
6 };
7
```

Homework 4: Validations!

```cpp
class OurPrice {
private:
    int price;

    OurPrice(int price) :
            price(price) {
    }
public:
    int GetPrice() {
        return price;
    }

    void SetPrice(int price) {
        if (price < 10)
            price = 0;
        this->price = price;
    }

    int SomeFun() {
        int price = 10;
        int price2 = 20;
        int price3 = 20;

        return price + price2 + price3;
    }
};
```

- Figure out one bug in this code
  - Fix it
  - Provide a tip for the coder!
- Figure out another potential bug
  - Provide a tip for the coder!

Homework 5: Time!

```cpp
class Time {
private:
    int hours, minutes, seconds;

public:
    Time(int hours, int minutes, int seconds) :
            hours(hours), minutes(minutes), seconds(seconds) {
    }
    void SetTime(int hours, int minutes, int seconds) {
        this->hours = hours, this->minutes = minutes, this->seconds = seconds;
    }
    int GetTotalSeconds() {
        return hours * 60 * 60 + minutes * 60 + seconds;
    }
    int GetTotalMinutes() {
        return hours * 60 + minutes;
    }
    void PrintHHMMSS() {
        cout << hours << ":" << minutes << ":" << seconds << "\n";
    }
    string ToSring(string seperator = "-") {
        ostringstream oss;
        oss << hours << seperator << minutes << seperator << seconds;
        return oss.str();
    }
    int GetHours() {.}
    void SetHours(int hours) {
        this->hours = hours;
    }
    int GetMinutes() {.}
    void SetMinutes(int minutes) {.}
    int GetSeconds() {.}
    void SetSeconds(int seconds) {.}
};
```

- Identify 2 changes for code clarity
- Identify a bug
- Identify 2 code duplications
- Identify missing inputs verifications (user mistakes)

Homework 6: Fancy Time!

```cpp
int main() {
    Time t(3, 1, 2);
    t.PrintHHMMSS();     // 3:1:2

    t.SetHours(5).SetMinutes(45).SetSeconds(13);
    t.PrintHHMMSS();     // 5:45:13

    return 0;
}
```

- Change the class to allow this kind of consecutive function calls

Homework 7: Change

```cpp
class Time {
private:
    int hours, minutes, seconds;

public:
    Time(int hours, int minutes, int seconds) :
            hours(hours), minutes(minutes), seconds(seconds) {
    }
    void SetTime(int hours, int minutes, int seconds) {
        this->hours = hours, this->minutes = minutes, this->seconds = seconds;
    }
    int GetTotalSeconds() {
        return hours * 60 * 60 + minutes * 60 + seconds;
    }
    int GetTotalMinutes() {
        return hours * 60 + minutes;
    }
    void PrintHHMMSS() {.}
    string ToString(string seperator = "-") {.}
    int GetHours() {.}
    void SetHours(int hours) {.}
    int GetMinutes() {.}
    void SetMinutes(int minutes) {.}
    int GetSeconds() {.}
    void SetSeconds(int seconds) {.}
};
```

- All the time we do **code changes**. The best code is one changed the minimum
- We got a request to remove the 3 integers and replace with int total_seconds
  - Do necessary coding changes
- Identify one good coding tip if was applied in this code will make us **change less code**

Homework 8: Car Specs Search

```cpp
class CarSpecs {
private:
    string trim;
    string engine_type;
    pair<int, int> horsepower;
    string steering_ratio;
    // and more
public:
    string& GetEngineType()   {}
    void SetEngineType( string& engineType) {}
    pair<int, int> GetHorsepower()   {}
    void SetHorsepower(pair<int, int> horsepower) {}
    string& GetSteeringRatio()   {}
    void SetSteeringRatio( string& steeringRatio) {}
    string& GetTrim()   {}
    void SetTrim( string& trim) {}
};

class AutoTrader {
private:
    vector<CarSpecs> current_cars_vec;
public:
    void LoadDatabase() {
        // Fill current_cars_vec
    }

    bool search_match( CarSpecs &query_car) {
        for(auto available_car : current_cars_vec) {
            if(available_car.GetEngineType() != query_car.GetEngineType())   continue;
            if(available_car.GetHorsepower() != query_car.GetHorsepower())   continue;
            if(available_car.GetSteeringRatio() != query_car.GetSteeringRatio())    continue;
            if(available_car.GetTrim() != query_car.GetTrim())   continue;
            return true;
        }
        return false;
    }
};
```

- This code is working well
- However, it is badly designed. Why?

Homework 9: Guess Me

```cpp
5  class A {
6  private:
7      int *x;
8  public:
9      A() {
10         cout<<"A constructor\n";
11         x = new int;
12         *x = 10;
13     }
14     ~A() {
15         cout<<"A destructor\n";
16     }
17
18 };
19
20 int main() {
21     A *a = new A();
```

- What is the output of this program?
- Find 2 memory leaks!
  - Fix them!

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."