

# Computer Information Systems 23 - Homework 3

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## Problem 1

Consider the class `studentType`:

```
class studentType: public personType
{
public:
    void print();
    void calculateGPA();
    void setID(long id);
    void setCourses(const string c[]);
    void setGrades(const char cG[], int noOfC);

    void getID();
    void getCourses(string c[], int noOfC);
    studentType(
        string fName = "", string lName = "", long id = -1,
        string *c = nullptr, char *cG = nullptr, int noOfC = 0
    )
}
```

### 1. Is this a concrete class?

As written, yes, `studentType` is a concrete class. It does not have virtual functions, and as such there are no issues with instantiation.

### 2. How would you change the definition of the class `student` so that the functions `print` and `calculateGPA` are pure virtual functions?

To make them virtual functions, we would need to add the `virtual` modifier to their prototypes. To make them *pure* virtual functions, we need to remove all declarations of those functions and end those declarations with `= 0`:

```
virtual void print() = 0;
virtual void calculateGPA() = 0;
```

**3. With this change, is `studentType` a concrete class? Can you create `studentType` objects?**

By definition, the existence of at least one pure virtual function makes this class an abstract class, not a concrete one. As such, we cannot instantiate `studentType`, so we cannot create `studentType` objects.