

Class relations: has-a

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1. Has-a relationship

A class usually contains data members. These can be simple types or other classes. This allows you to make structured code.

```
class Person {
    string name;
    ....
};
class Course {
private:
    Person the_instructor;
    int year;
};
```

This is called the has-a relation:

Course has-a *Person*

2. Literal and figurative has-a

A line segment has a starting point and an end point.

A Segment class can store those points:

```
class Segment {
private:
    Point
        starting_point, ending_point;
public:
    Point get_the_end_point() {
        return ending_point; };
}
int main() {
    Segment somesegment;
    Point somepoint =

        somesegment.get_the_end_point();
}
```

or store one and derive the other:

```
class Segment {
private:
    Point starting_point;
    float length, angle;
public:
    Point get_the_end_point() {
        /* some computation
        from the
        starting point */ };
}
```

Implementation vs API: implementation can be very different from user

3. Constructors in has-a case

Class for a person:

```
class Person {
private:
    string name;
public:
    Person( string name ) {
        /* ... */
    };
};
```

Class for a course, which contains a person:

```
class Course {
private:
    Person instructor;
    int enrollment;
public:
    Course( string instr,int n )
    {
        /* ??? */
    };
};
```

You want to use this as `Course("Eijkhout",65);`

4. Constructors in the has-a case

Possible constructor:

```
Course( string teachname,int nstudents ) {  
    instructor = Person(teachname);  
    enrollment = nstudents;  
};
```

Preferred:

```
Course( string teachname,int nstudents )  
    : instructor(Person(teachname)),  
      enrollment(nstudents) {  
};
```

Exercise 1

1. Make a class `Rectangle` (sides parallel to axes) with a constructor:

```
Rectangle(Point botleft, float width, float height);
```

The logical implementation is to store these quantities. Implement methods:

```
float area(); float righedge_x(); float topedge_y();
```

and write a main program to test these.

2. Add a second constructor

```
Rectangle(Point botleft, Point topright);
```

Can you figure out how to use member initializer lists for the constructors?

Optional exercise 2

Make a copy of your solution of the previous exercise, and redesign your class so that it stores two `Point` objects. Your main program should not change.