Inheritance & Polymorphism

derived classes

virtual methods

dynamic_cast operator

Inheritance (derived classes)

```cpp
class FeupPerson {
public:
   FeupPerson(int id, string name, string address);
   void showRecord();
   void changeAddress(string newAddress);
protected:
   int id;
   string name;
   string address;
};
```

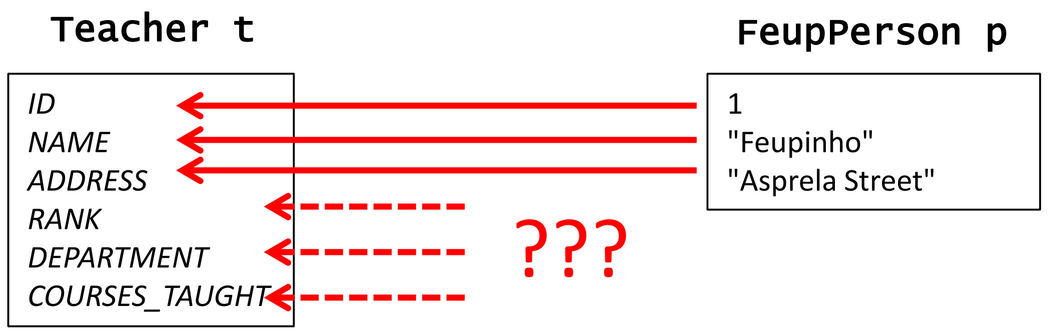
```cpp
class Student : public FeupPerson {
public:
   Student(int id, string name, ... , int year);
   void showRecord(); //redefinition
   void addCourseTaken(Course *newCourse);
   ...
private:
   string programme;
   int year;
   vector<Course *> coursesTaken;
};
```

```cpp
class Teacher : public FeupPerson {
public:
 Teacher(int id, string name, ...,
         string department);
   void showRecord(); //redefinition
   void addCourseTaught(Course *newCourse);
   ...
private:
   string rank;
   string department;
   vector<Course *> coursesTaught;
};
```

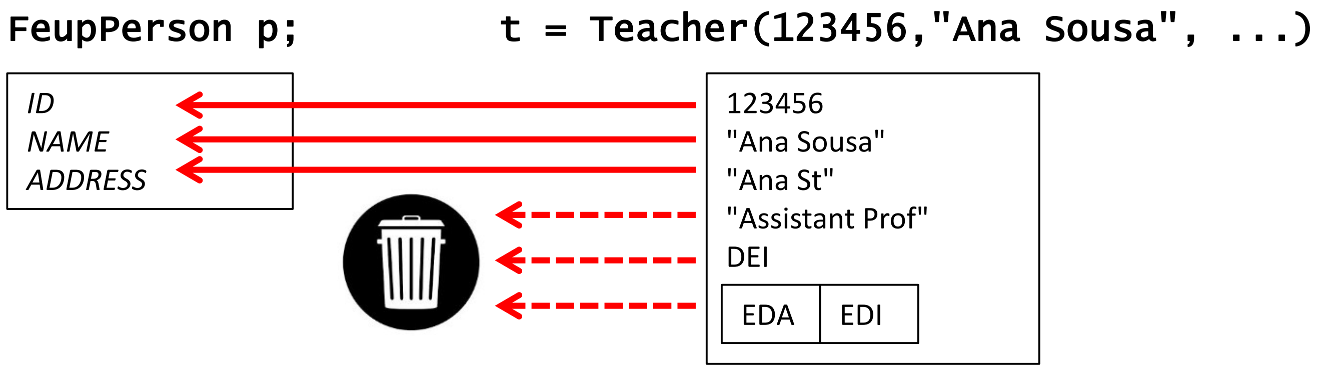
NOTE the type of the **coursesTaken** and **coursesTaught** vectors elements

Slicing problem

- `FeupPerson p(1,"Feupinho","Asprela Street");`
- `Student s(201500007,"Jaime B.","B. Street", "MIB", 3);`
- `Teacher t(208785,"Rui Sousa","Sousa Street",..., "DEI");`
- ~~`...`~~
- ~~`t = p;`~~ `// IMPOSSIBLE`
- ~~`s = p;`~~ `// IMPOSSIBLE`
- ~~`...`~~

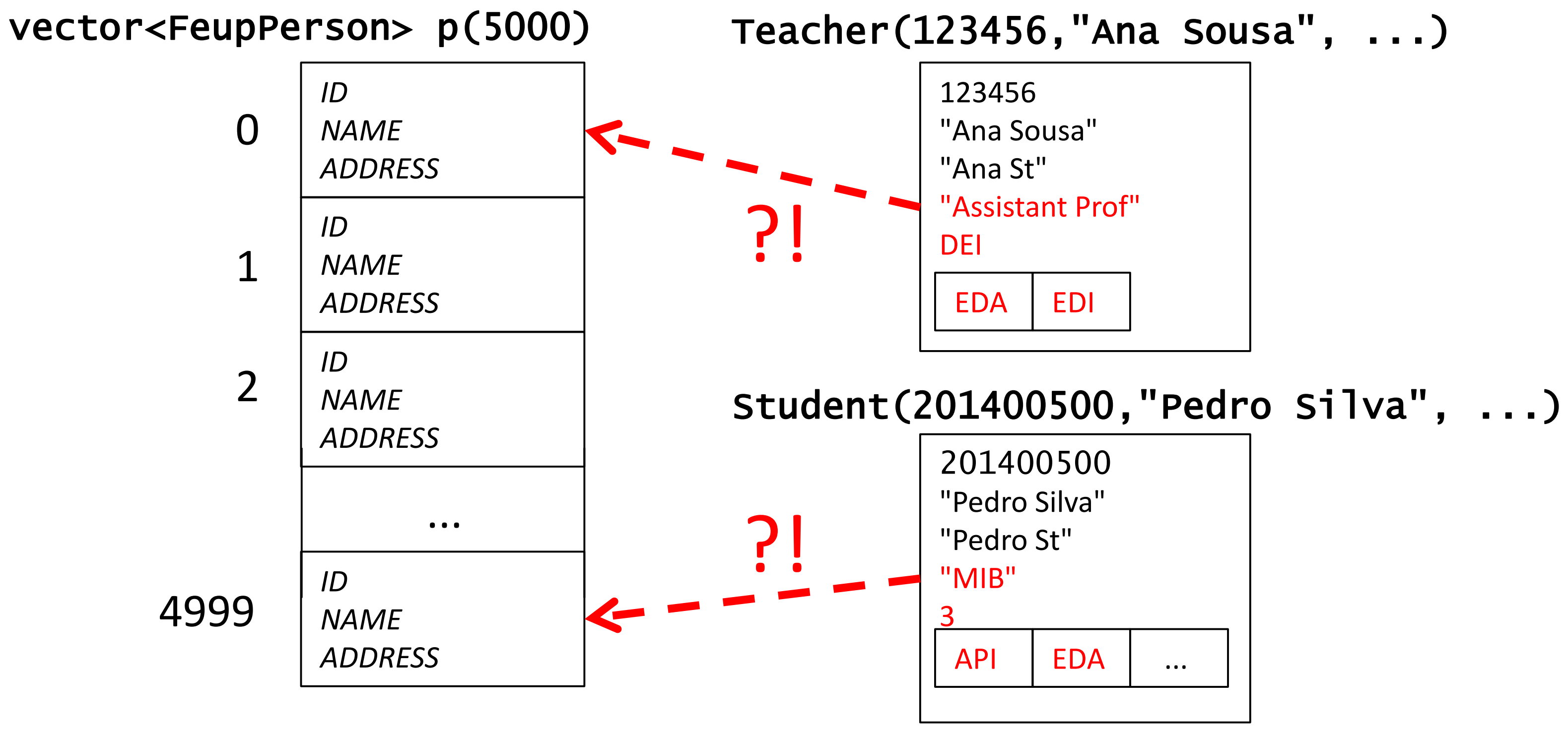


- `p = s; // possible ...` **BUT SOME DATA IS <u>SLICED</u> AWAY**
- `p = t; // possible ...` **BUT SOME DATA IS <u>SLICED</u> AWAY**



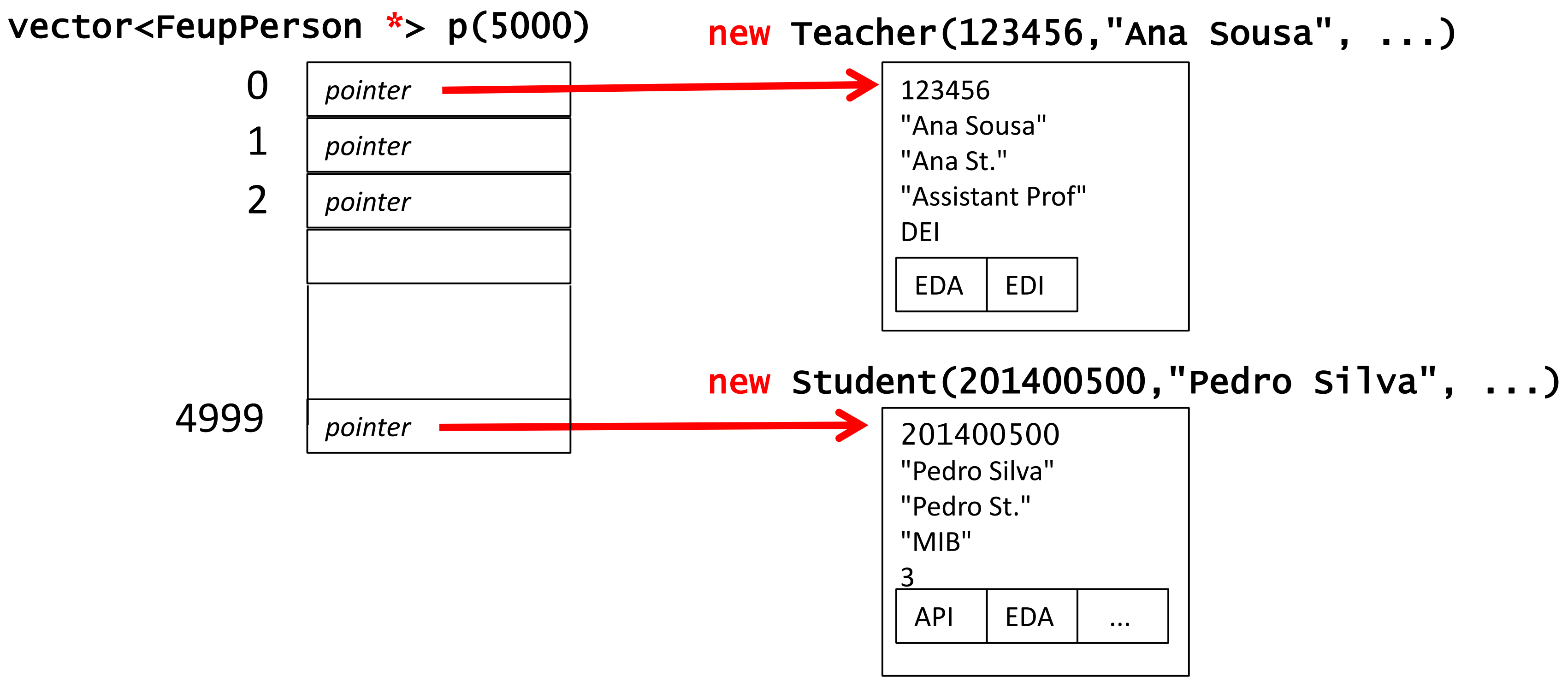
Slicing problem

- `vector<FeupPerson> p(5000);`
- `p[0] = Teacher(123456,"Ana Sousa", ...);`
- `p[1] = Teacher(123457,"Rui Castro", ...);`
- `...`
- `p[4999] = Student(201400500,"Pedro Silva", ...);`

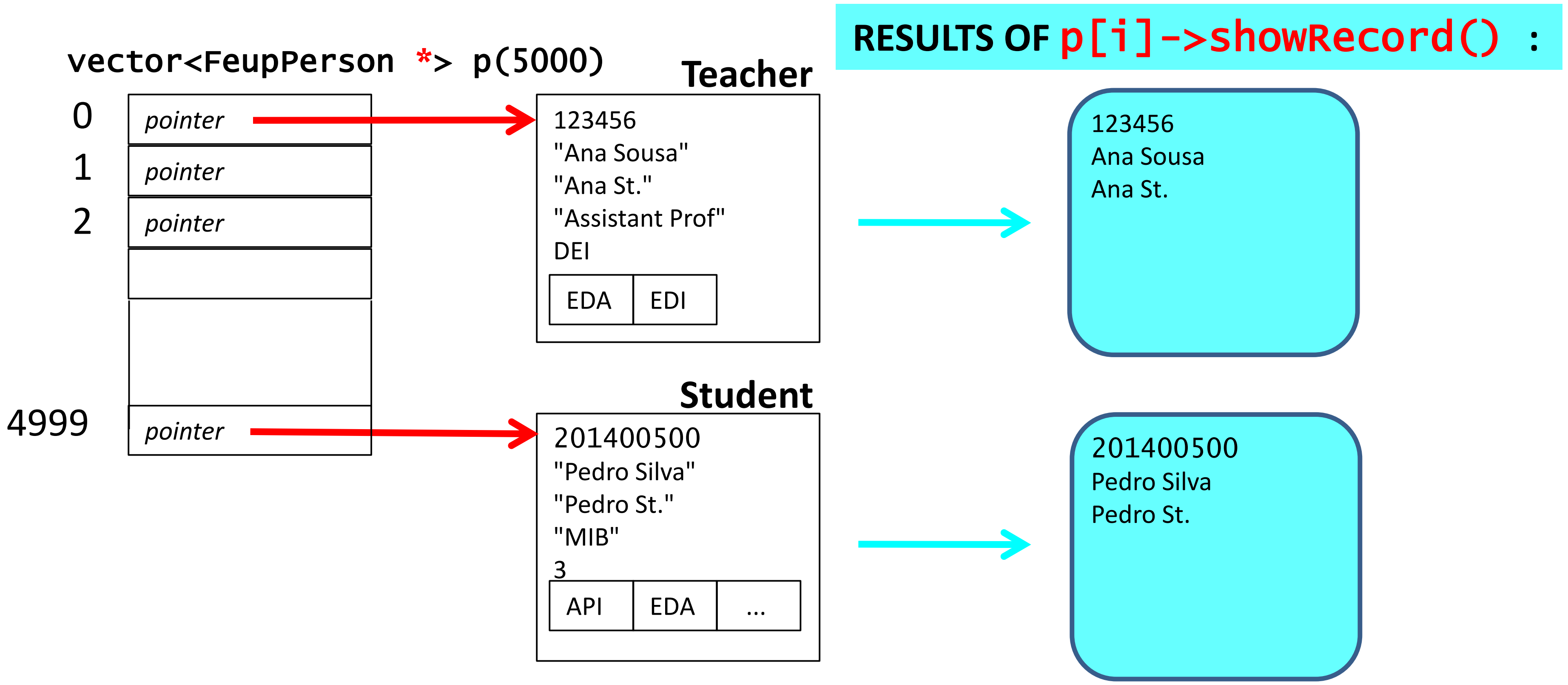


Solution to slicing problem

```
vector<FeupPerson *> p(5000);
p[0] = new Teacher(123456,"Ana Sousa", ...);
p[1] = new Teacher(123457,"Rui Castro", ...);
...
p[4999] = new Student(201400500,"Pedro Silva", ...);
```



... but ...!


vector<FeupPerson *> p(5000)
RESULTS OF p[i]->showRecord() :
Teacher
0
pointer
1
pointer
2
pointer
4999
pointer
123456
"Ana Sousa"
"Ana St."
"Assistant Prof"
DEI
EDA
EDI
123456
Ana Sousa
Ana St.
Student
201400500
"Pedro Silva"
"Pedro St."
"MIB"
3
API
EDA
...
201400500
Pedro Silva
Pedro St.

Solution: make showRecord() "virtual"

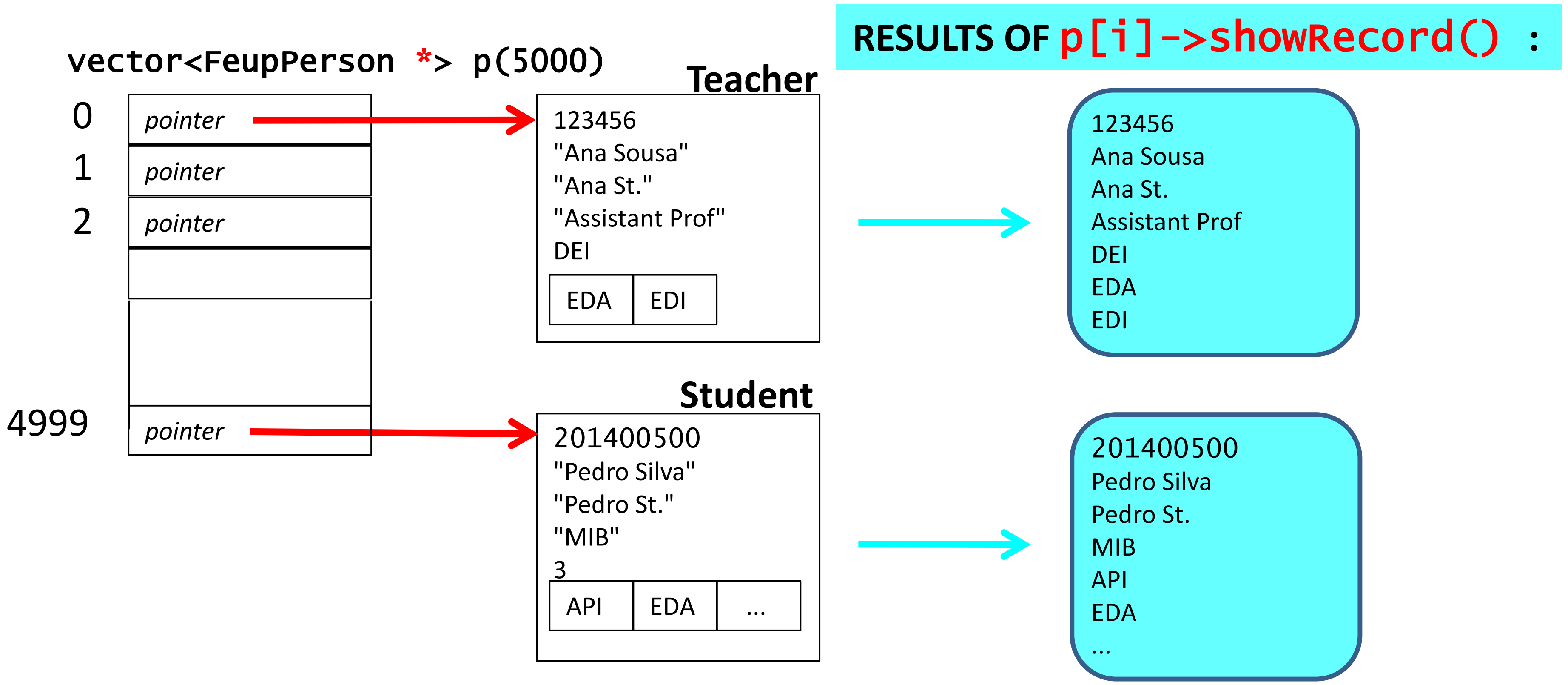
```cpp
class FeupPerson {
public:
  FeupPerson(int id, string name, string address);
  virtual void showRecord();
  void changeAddress(string newAddress);
private:
  int id;
  string name;
  string address;
};
```

These are not mandatory

```cpp
class Student : public FeupPerson {
public:
  Student(int id, string name, ... , int year);
  virtual void showRecord();
  void addCourseTaken(Course* newCourse);
  ...
private:
  string programme;
  int year;
  vector<Course*> coursesTaken;
};
```

```cpp
class Teacher : public FeupPerson {
public:
 Teacher(int id, string name, ...,
         string department);
  virtual void showRecord();
  void addCourseTaught(Course* newCourse);
  ...
private:
  string rank;
  string department;
  vector<Course*> coursesTaught;
};
```

Solution: make `showRecord()` "virtual"



... but ...!

```
vector<FeupPerson *> p(5000);

p[0]->addCourseTaught(...);
```

OR

```
p[4999]->addCourseTaken(...);
```

NOT POSSIBLE ...! WHY?

```
class FeupPerson {
public:
  FeupPerson(int id, string name, string address);
  virtual void showRecord();
  void changeAddress(string newAddress);
private:
  int id;
  string name;
  string address;
};
```

```
class Student : public FeupPerson {
public:
  Student(int id, string name, ... , int year);
  virtual void showRecord();
  void addCourseTaken(Course* newCourse);
  ...
private:
  string programme;
  int year;
  vector<Course*> coursesTaken;
};
```

```
class Teacher : public FeupPerson {
public:
 Teacher(int id, string name, ...,
         string department);
  virtual void showRecord();
  void addCourseTaught(Course* newCourse);
  ...
private:
  string rank;
  string department;
  vector<Course*> coursesTaught;
};
```

Solution: dynamic_cast

```
vector<FeupPerson *> p(5000);

Course *c1 = new Course("EDA");
Course *c2 = new Course("EDU");
...

for (unsigned int i=0; i<p.size(); i++)
  {
    Teacher *t = dynamic_cast<Teacher *> (p[i]);
    if (t != NULL)
      t->addCourseTaught(c1);
    else
    {
      Student *s = dynamic_cast<Student *> (p[i]);
      if (s != NULL)
        s->addCourseTaken(c2);
    }
  }
```