Fundamentals Of Software Engineering

Use-case and Application

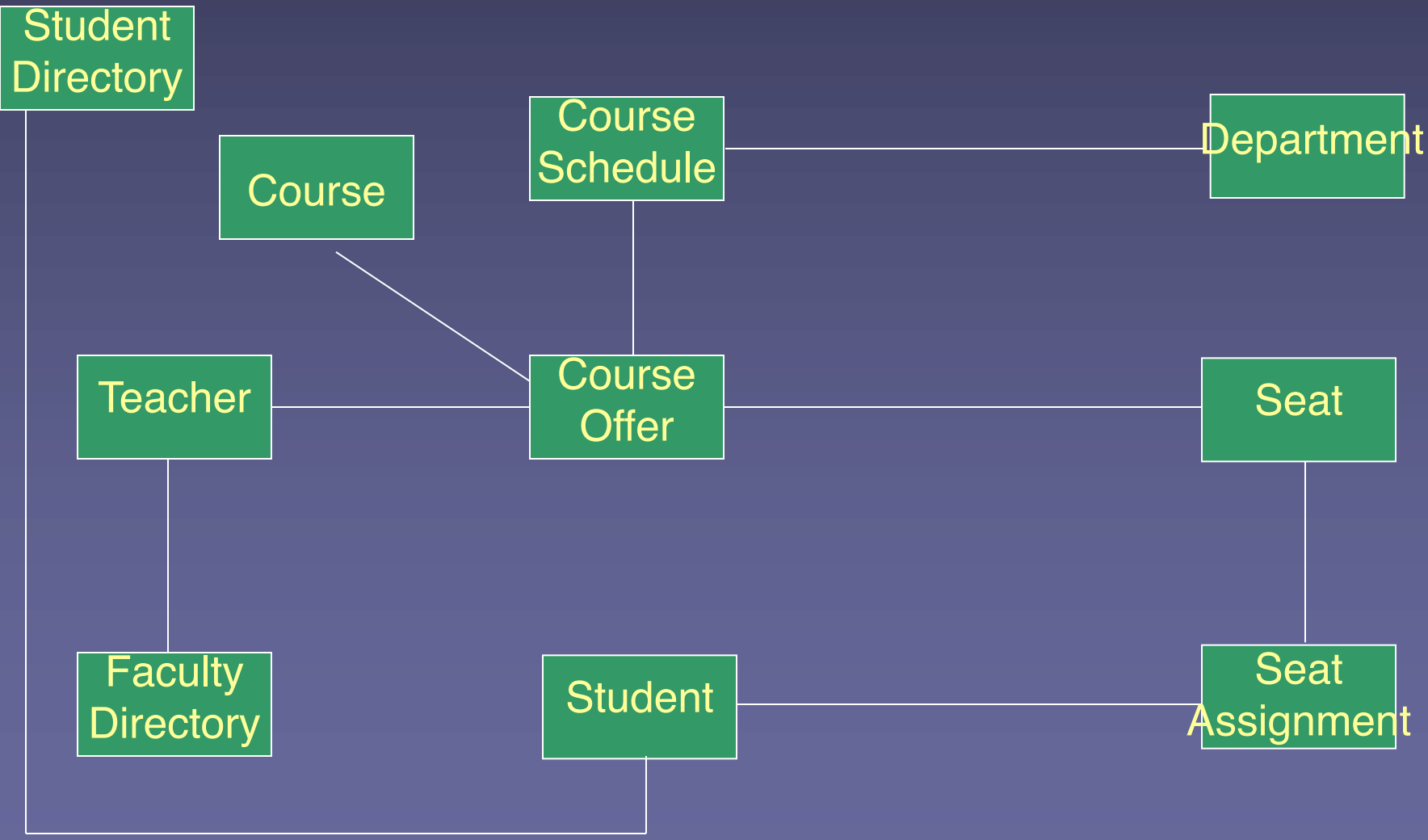
A University Example

Want a registration system to calculate number of registered students at the department, college, and university levels

Key Ideas

University
College
Department
Students
Course
Course Offering
Teacher
Semester
Student
Student course Load
Transcript
etc

An Object Model



University:

Responsible for

academic matters such as colleges and students

Business matters such as marketing, financials, course pricing, etc.

Administrative matters such as Human Resources

Issues important at this level

Are we profitable?

What is the faculty/student ratio per class broken down by college? What is the current student enrollment in our university broken down by college?

College:

Responsible for

Academic matters such as departments and students

Business matters such as staff, faculty, etc.

Issues important at this level

What is the faculty/student ratio per class broken down by Department? How do we compare with other colleges?

What is the average number of students per class? Largest class? Smallest class?

What is the current student enrollment in our college broken down by department?

What is the administrative staff to faculty ratio?

What is the ratio of full time faculty vs part-time?

What is the percentage of faculty with Ph.Ds?

Dept

Responsible for

Academic matters such as students and courses

Business matters such as staff, faculty, etc.

Maintain course catalog and schedule courses

Issues important at this level

What are the courses we teach?

What are the courses we offer at any given semester?

Which courses are core and which ones are electives? What are the course requirements?

What are the degree requirements?

What is our current capacity? How many seats are empty?

What is our faculty/student ratio per class? How do we compare with other depts in the college?

What is the average number of students per class? Largest class? Smallest class?

What is the current student enrollment in our department?

What is the administrative staff to faculty ratio?

What is the ratio of full time faculty vs part-time?

What is the percentage of faculty with Ph.Ds?

Operations Examples

Department

Department.getTotalNumberOfRegisteredStudents (Semster)

getTotalNumberOfAvailableSeats()

getAllCoursesWithEmptySeats()

Course Catalog

Manage the department course catalog which represent all the courses the department has to offer

CourseCatalog.findCourseByName(name);

CourseCatalog.findCourseByNumber();

CourseCatalog.getAllCourses();

Course Schedule

Manage the department course schedule for a given semester:

CourseSchedule.findScheduledCourseByName(name);

CourseSchedule.findScheduledCourseByNumber();

CourseSchedule.getAllScheduledCourses();

Student Directory

Manage students: StudentDirectory.findStudentByName()

Define operation detail

Course Offer

CourseOffer.getCourseFilledSeats():

total_filled_seats = 0;
For each seat associated with CourseOffer
    if seat is assigned then add one to total_filled_seats;
Return total_filled_seats

CourseOffer.getCourseEmptySeats():

total_unfilled_seats = 0;
For each seat
    if seat is unfilled then add one to total_unfilled_seats;
Return total_filled_seats

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Assign Operations

Seat

Represents an available seat in a class

Operations: getCourse()
IsSeatAssigned()

Seat Assignment

Represents the fact that a specific seat in a course is assigned to a *student*. The class is responsible for the student status in the class as well as the student grades (midterm, final, homework solutions, etc.

What is the course? SeatAssignment.getCourse()

Who is the student? SeatAssignment.getStudent()

What is the grade the student got in the class?

SeatAssignment.getStudentGrade();

SeatAssignment.setStudentGrade();

Assign Operations

Course Offer

Represents a course that is being offered in a given semester

What is the course being offered? CourseOffer.getCourse()
What are the open seats? CourseOffer.getTeacher()

CourseOffer.getCourse()
CourseOffer.getEmptySeats()
CourseOffergetCourseFilledSeats()
CourseOffer.hasEmptySeats()
CourseOffer.getTotalNumberOfSeats()
CourseOffer.getTotalNumberOfFilledSeats()

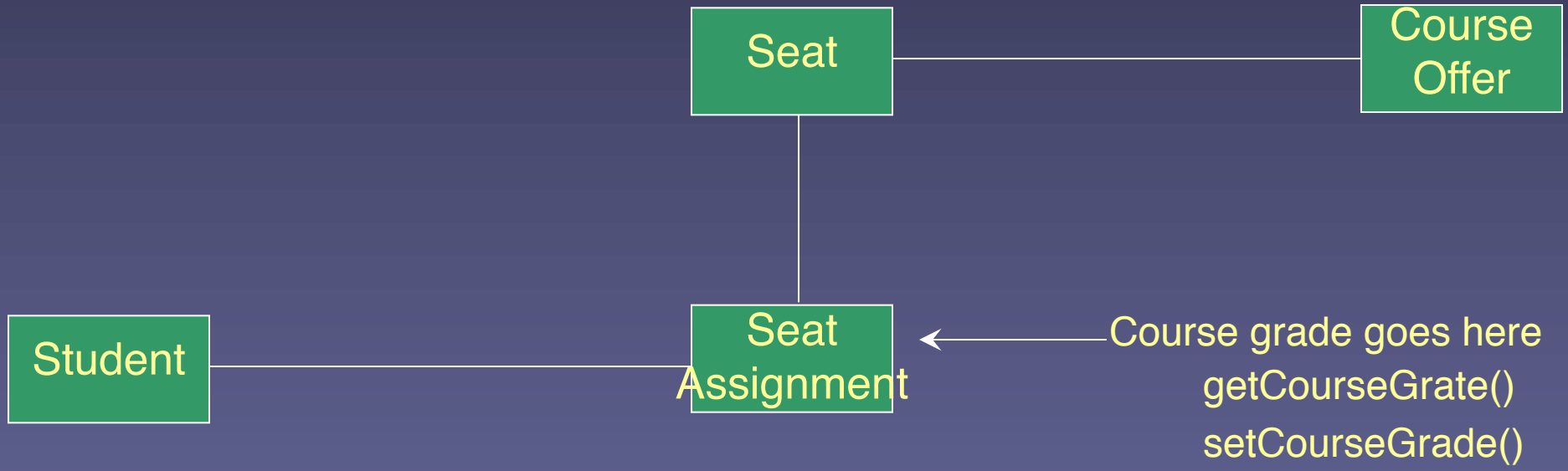
Assign Operations

Student

Person authorized to get a college degree from the university
Has a record of all courses taken during their stay
Has a grade point average (GPA)
A customer

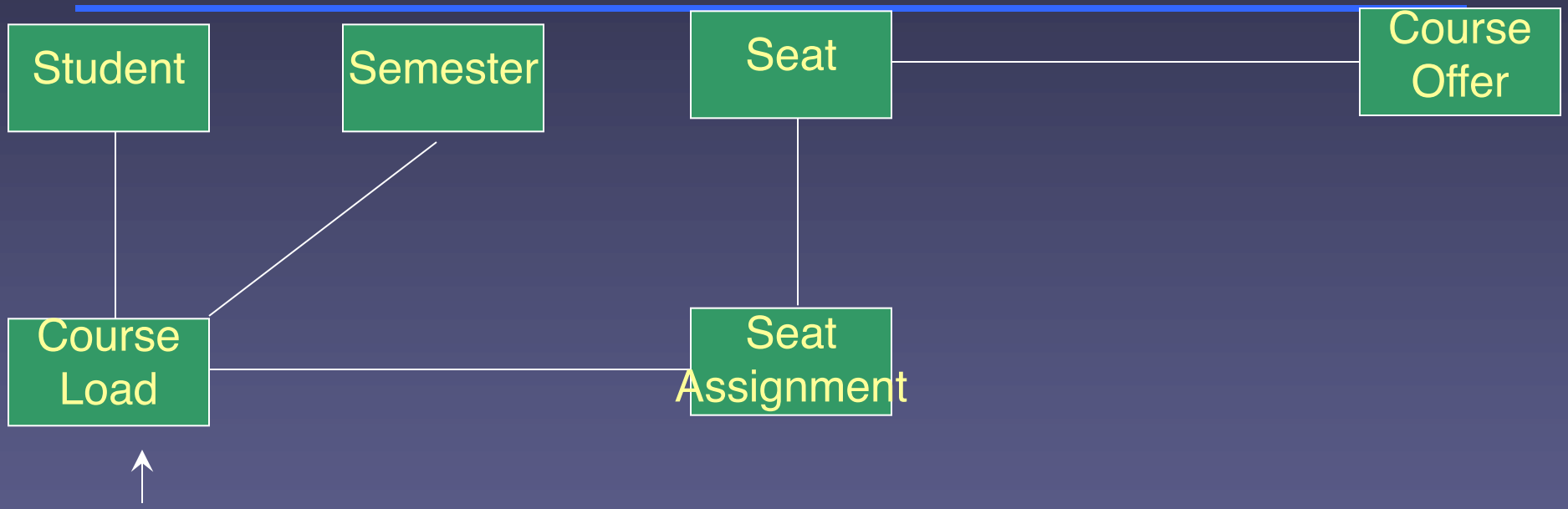
Operation Example:

```
Student.getRegisteredCourses():
{
set list of registered courses to empty
for each seat assigned to student invoke
    seat.getCourse() and add the course to the list of ;
    when done return the list of courses.
   }
```



This model captures that fact the student tool a number of courses (two, three, four, etc). It also captures the grades the student got in each of these courses. It does not capture what courses the student signed up for in any given semester.

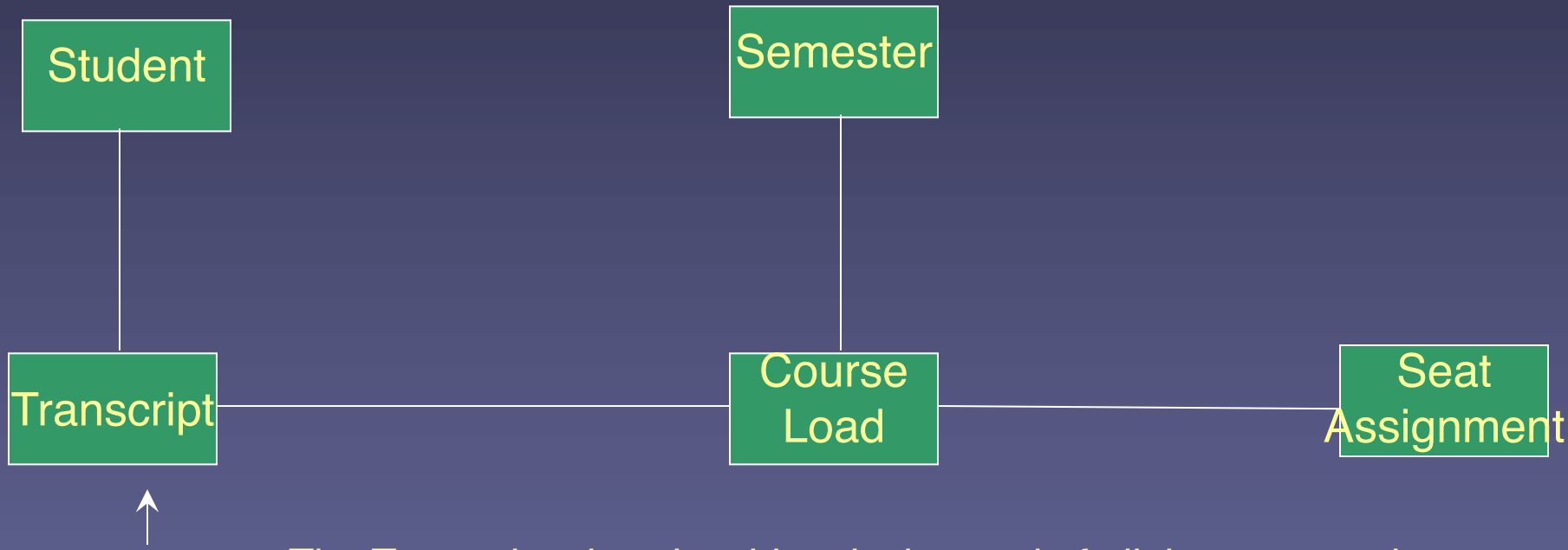
For example, what courses did “John the student” take in the spring semester? What is John’s grade average for the fall semester of 2004?



Semester grade average goes here

The Course Load class is responsible for the student courses in any given semester. It is the set or collection of courses the student took in a semester. It answers the question “What courses did the student complete in a given semester. Without the Course Load it will very difficult to answer such a reasonable question.

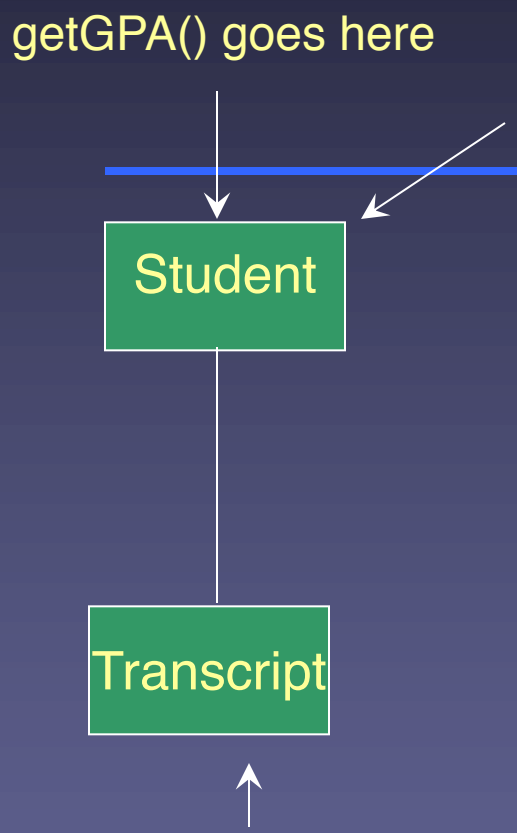
Notice there is no need to link the student to the course load anymore. It is redundant. Given a course load object it is easy to find the student (just follow the transcript then student relationships)



Student GPA goes here. It is a calculated attribute (operation).

The Transcript class is a historical record of all the courses the student took during their stay at the university. The transcript class knows who the student is. It knows the student course load for any given semester.

To find the GPA. retrieve all the course load objects. For each course load object, get all the seat assignments. Iterate over all the seat assignments. For a given seat assignment get the course grade. Total them up grades. Take the average.



The question is usually something like what is Jim's GPA?

Therefore we need to define an operation of the student class tha returns the student GPA. We need to define getGPA() operation o the student class.

The student class has a reference to the transcript instance. The getGPA() operation on the student class calls the operation

transcript.CalculateGPA() which calculates the student GPA when requested. The logic is as follows:

The CalculateGPA() operation retrieves all the course load objects. For each course load object, get all the seat assignments. Iterate over all the seat assignments. For a given seat assignment get the course grade. Total them up grades. Take the average.

How to determine student GPA?

Start her (find student)

Student Directory

Student

Transcript

Course Load

Seat Assignment

Must iterate over all instances. For example, the transcript class has a list of course loads over a number of semesters. So we need to consider all instances of course load.

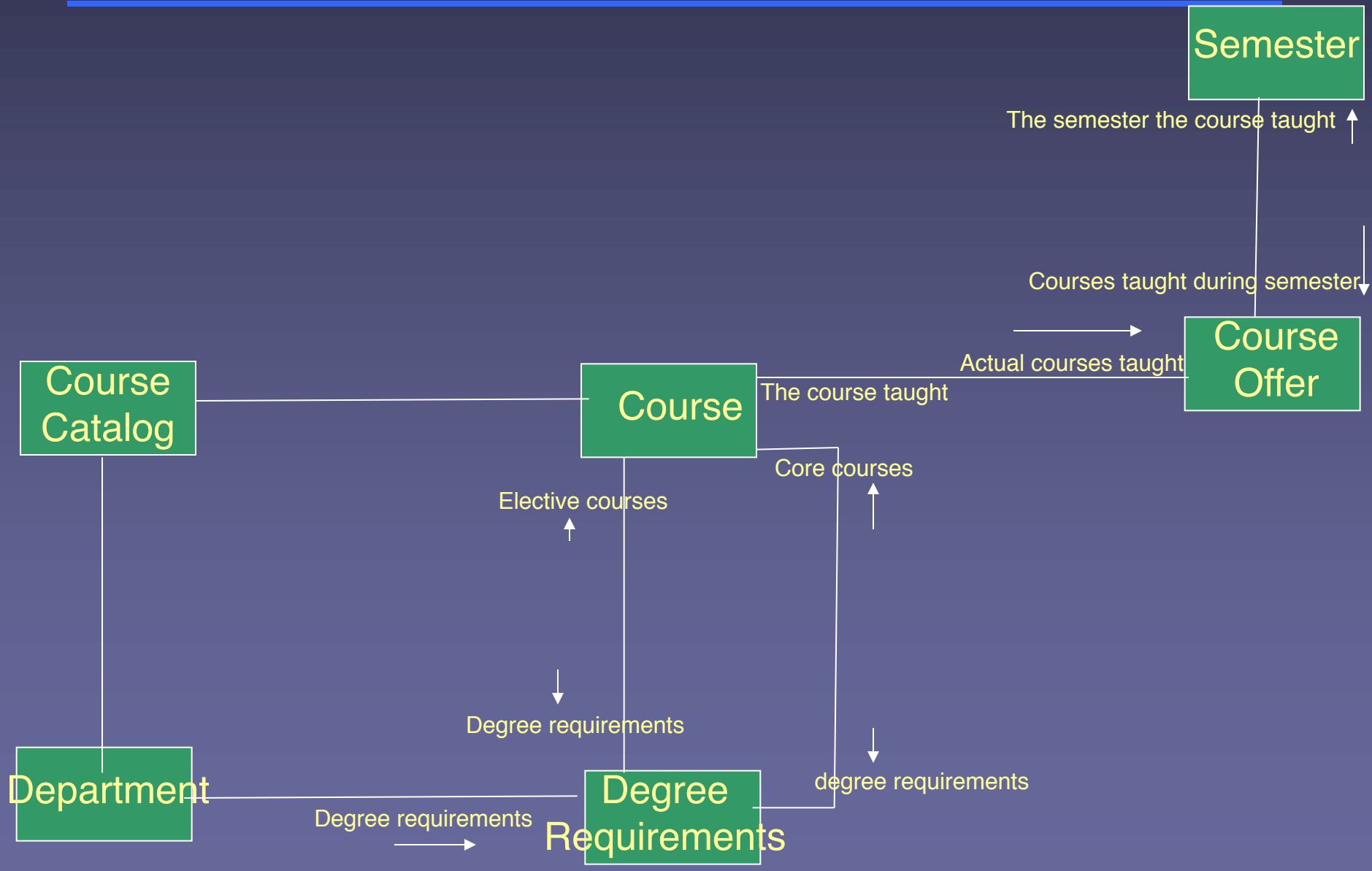
The order of search or navigation

Course

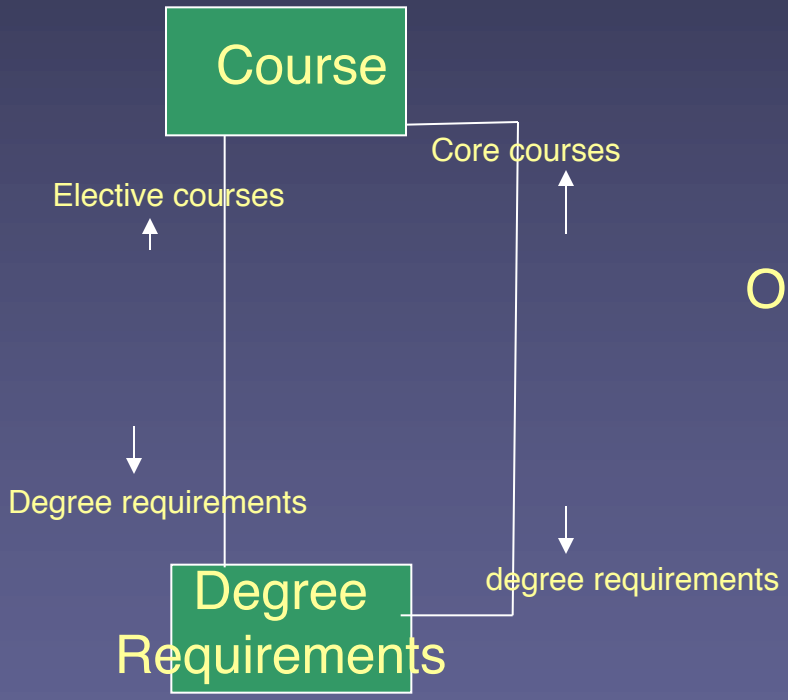
The course description
The number of credit hours for the course
Whether the course is core or elective
It is part of a Course Catalog belonging to a department
Provides link to courses offered at any given time

Operations include
getCourseOffers(Semester)
getCourseDescription()
getCourseCreditHours()
isElective()
isCore()

How to model degree requirements?



Degree Requirements Responsibilities

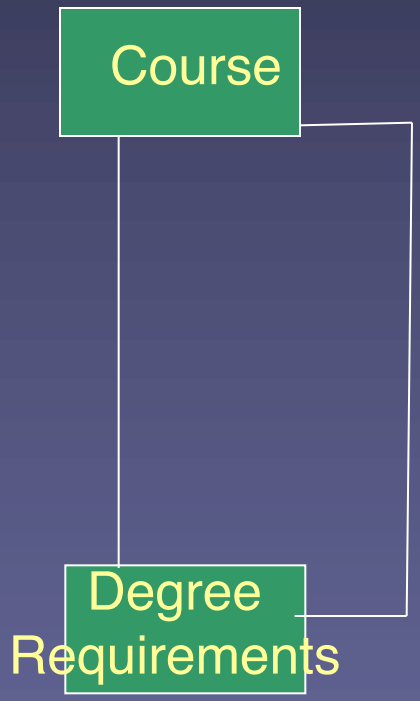


Operations on Degree Requirements

- isCoreCourse(Course)
- isElective(Course)
- getListOfCoreCourses()
- getListOfElectives()

The Degree Requirements class is the only entity that knows whether a course is core or elective.

Additional Course Responsibilities



We can put operations on the Course class

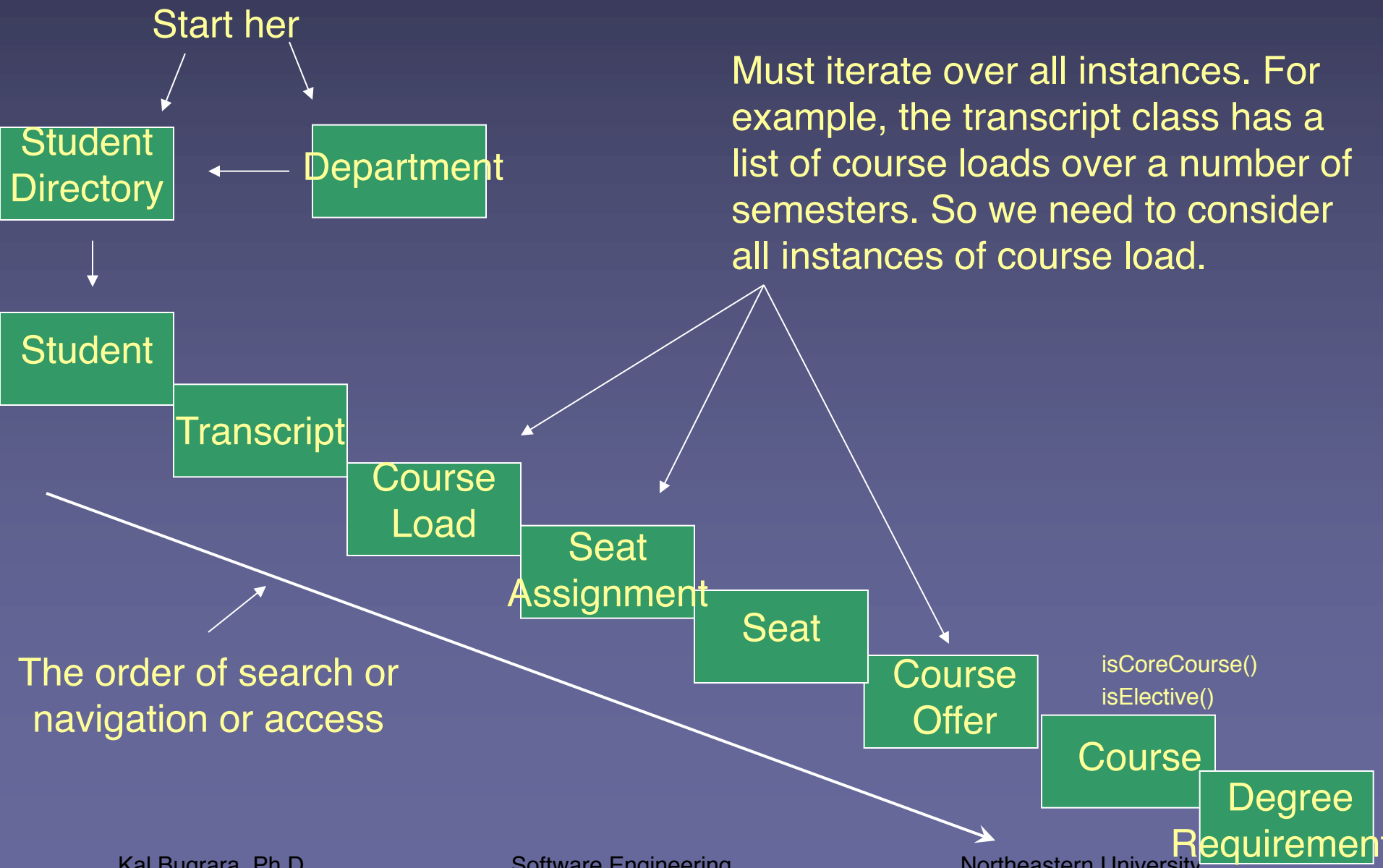
Such as:

isCoreCourse()

isElective()

Since the operations are on the course class we don't need to pass the course as argument. The two operations above will invoke the DegreeRequirements class to answer the question. The DegreeRequirements class is the only entity that knows whether a course is core or elective.

How to determine if a student fulfilled the degree requirements?



Define operation detail

Course Offer

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For each seat associated with CourseOffer
    if seat is assigned then add one to total_filled_seats;
Return total_filled_seats

CourseOffer.getCourseEmptySeats():

total_unfilled_seats = 0;
For each seat
    if seat is unfilled then add one to total_unfilled_seats;
Return total_filled_seats

Additional Operations on the Department class include

getTotalNumberOfRegisteredStudents()
getTotalNumberOfCreditHoursBySemester();
getCourseSchedule(Semester);// returns
getDepartmentRevenueBySemester(Semester)
getCourseCatalog();
..
..

More examples

Department

Department.getTotalNumberOfRegisteredStudents()

Set registered_student_list to empty

for each courseoffer in CourseScedule
for seat in courseoffer
if seat is assigned then
get the assigned student
and add student to the list of
registered_students_list

More examples

Department

Department.getTotalNumberOfCreditHoursBySemseter(Semester)

This function computes the total number of credit hours signed for by students summed over all courses taught in a given semester. The resulting number is multiplied by the price per credit hour to give the department revenues from students for the given semester.

```
Set number_of_credit_hours to zero
course_schedule = Department.getCourseScedule(Semester)

        for each courseoffer in course_schedule
                number_of_students_In_class = courseoffer.getNumberOfAssignedSeats();
                course = courseoffer.getCourse()
                credit_hours=course.getCourseCreditHours()
                 number_of_credit_hours = number_of_credit_hours + credit_hours;
```

Department

Department.getDepartmentRevenueBySemseter(Semester)

This operation returns the total revenue by multiplying the price per credit hour times the total number of credit hours summed over all offered courses.

```
number_of_credit_hours = Department.getTotalNumberOfCreditHoursBySemseter(Semester)
total_revenue = number_of_credit_hours * price_per_credit_hour
return total_revenue
```

How would you calculate total revenue by College? University?

College

University