M8 (a) – Inversion of Control

Jin L.C. Guo

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Objective

- Be able to Use Callback to achieve decoupling
- Be able to use the Observer design pattern effectively;
- Event Handling in GUI applications
- Understand the concept of an application framework;
- Understand the Model-View-Controller Decomposition;
- Be able to use the Visitor Design Pattern effectively;
- Be able to determine when to used different design patterns effectively.

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Job Hunting Example

```
public interface JobSeeker
{
	public void noticeMe();
}
```

```
public interface JobProvider
{
	public void acceptApplication(JobSeeker pJobSeeker);
	public void noticeCandidates();
}
```

```
public class Company implements JobProvider
{
   private JobSeeker aJobseeker;
   private boolean applicationAccepted=false;
   @Override
   public void acceptApplication(JobSeeker pJobseeker)
   {
      assert pJobseeker != null;
      aJobseeker = pJobseeker;
      applicationAccepted = true;
   }
   @Override
   public void noticeCandidates() {
      if(applicationAccepted)
         aJobseeker.noticeMe();
   }
}
```

Callback method

```
public class UndergradJobSeeker implements JobSeeker
{
    private int aSkillLevel = 5;

    @Override
    public void noticeMe()
    {
        practiceDesignPatterns();
    }

    private void practiceDesignPatterns()
    {
        aSkillLevel++;
    }
}
```

Provide the interview schedule to JobSeeker?

```
public class Company implements JobProvider
{
    private LocalDateTime aInterviewSchedule;
    ……
    @Override
    public void noticeCandidates() {
        if(applicationAccepted)
            aJobseeker.noticeMe(); //Callback method
    }
    /**
    * Setup interview date is three days from today
    */
    private void scheduleInterview() {
        aInterviewSchedule = LocalDateTime.now().plusDays(3);
    }
}
```

Provide the interview schedule to JobSeeker?

```
public class Company implements JobProvider
{
    private LocalDateTime aInterviewSchedule;
    ……
    @Override
    public void noticeCandidates() {
        if(applicationAccepted)
            aJobseeker.noticeMe(aInterviewSchedule); //Callback method
    }
    /**
    * Setup interview date is three days from today
    */
    private void scheduleInterview() {
        aInterviewSchedule = LocalDateTime.now().plusDays(3);
    }
}
```

Provide the interview schedule to JobSeeker?

```
public class Company implements JobProvider
{
    private LocalDateTime aInterviewSchedule;
    ……
    @Override
    public void noticeCandidates() {
        if(applicationAccepted)
            aJobseeker.noticeMe(this); //Callback method
    }
    /**
    * Setup interview date is three days from today
    */
    private void scheduleInterview() {
        aInterviewSchedule = LocalDateTime.now().plusDays(3);
    }


}
```

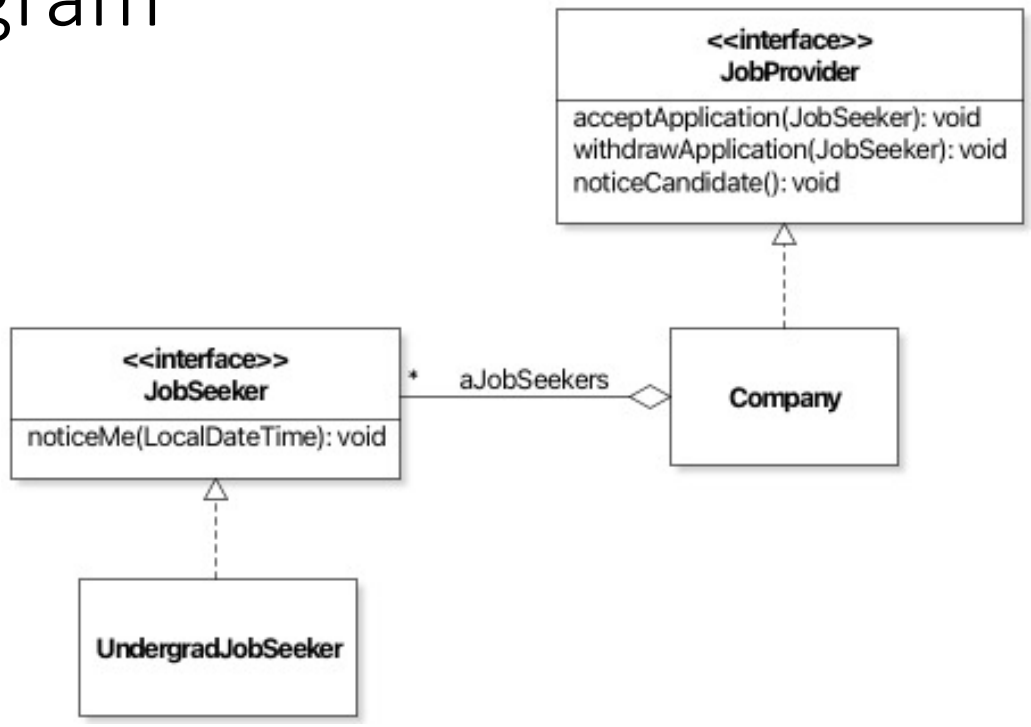
Plus, a public method to get `aInterviewSchedule`

JOBSEEKER CAN WITHDRAW APPLICATION

JOBPROVIDER ACCEPT MORE THAN ONE APPLICATIONS

Activity 1: Add additional functions to the current design.

Class diagram



JobSeeker and JobProvider are loosed-coupled

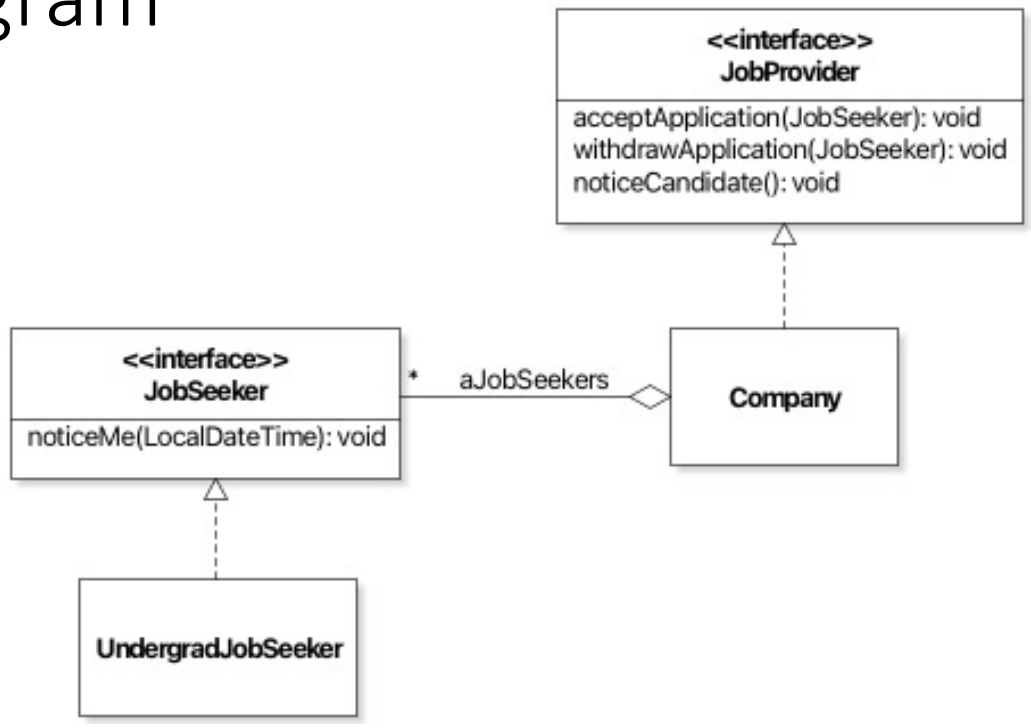
Observer Pattern

- Intent

Define a one-to-many dependency between objects so that when one object changes state, all its dependents are notified and updated automatically.

- Participants:
  - Subject
  - Observer
  - Concrete Subject
  - Concrete Observer

Class diagram



JobSeeker and JobProvider are loosed-coupled

Activity 2: Matching Participants with (potential) Responsibilities

Subject **Observer** **Concrete Subject** **Concrete Observer**

defines an updating interface for objects that should be notified of changes in a subject.

implements the updating interface to keep its state consistent with the subject's.

stores state that should stay consistent with the subject's.

maintains a reference to a ConcreteSubject object.

sends a notification to its observers when its state changes.

provides an interface for attaching and detaching Observer objects

stores state of interest to ConcreteObserver objects.

Observer Pattern for more complex situations

- Different departments/teams in the company need the information of jobseekers:

Design team in SE development department

Needs candidates who are specialized in design with minimal 5-year experience

Testing team in SE development department

Needs candidate who are specialized in testing with reference letters.

HR departments

Performs analysis on the statistics of all job seekers

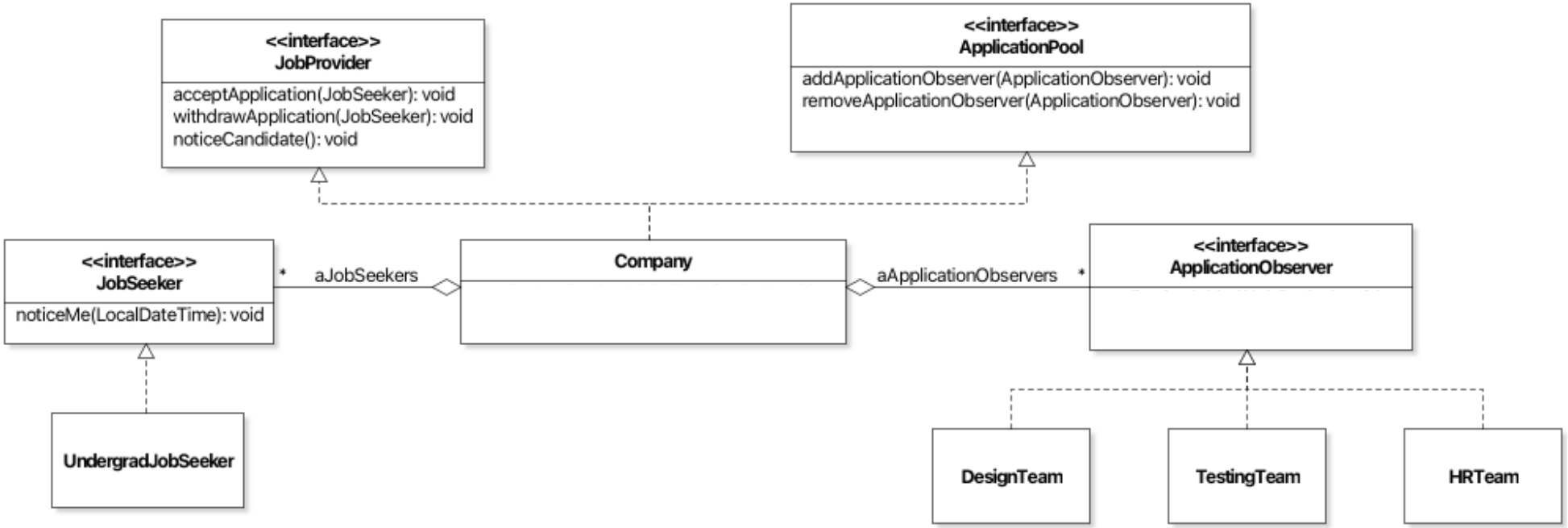
`ApplicationObserver`

```
public interface JobSeeker
{
   public void noticeMe(LocalDateTime date);
   public TechSpecialty getTechSpecialty();
   public int getYearOfExperience();
   public boolean haveReference();
}
```

provides an interface for attaching and detaching Observer objects?

```
public class Company implements JobProvider , ApplicationPool
{
    List<JobSeeker> aJobseekers;
    boolean acceptApplication=false;
    Map<JobSeeker, LocalDateTime> aInterviewSchedules;
    private List<ApplicationObserver> aApplicationObservers;

    @Override
    public void addApplicationObserver(ApplicationObserver pApplicationObservers)
    {


    }

    @Override
    public void removeApplicationObserver(ApplicationObserver pApplicationObservers)
    {


    }
```

What is the state of interest for those teams


<<interface>>
JobProvider
acceptApplication(JobSeeker): void
withdrawApplication(JobSeeker): void
noticeCandidate(): void
<<interface>>
ApplicationPool
addApplicationObserver(ApplicationObserver): void
removeApplicationObserver(ApplicationObserver): void
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JobSeeker
noticeMe(LocalDateTime): void
*
aJobSeekers
Company
aApplicationObservers
*
<<interface>>
ApplicationObserver
UndergradJobSeeker
DesignTeam
TestingTeam
HRTeam

When and how to send Notification

- Requirements:

Design team in SE development department

Needs candidates who are specialized in design with minimal 5-years experience

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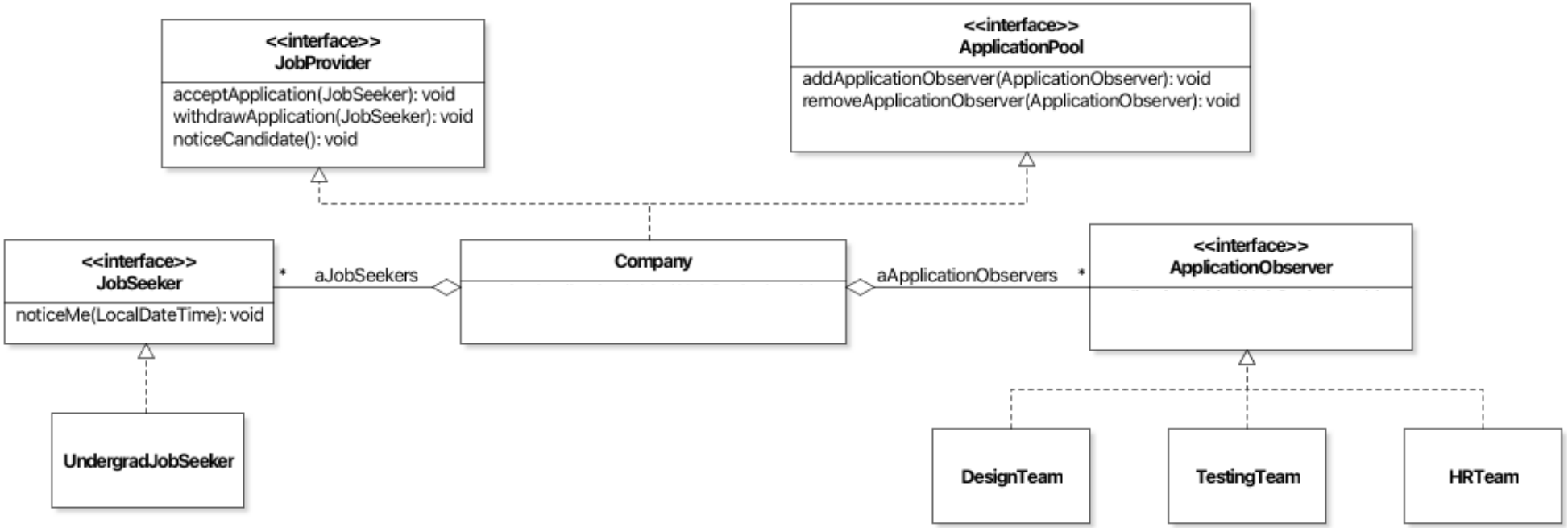
When and how to send Notification

Who should trigger the notification?

`ApplicationPool` sends notification as soon as an application is added or removed.

`ApplicationPool` provides a notification method to be called by client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ApplicationObserver
UndergradJobSeeker
DesignTeam
TestingTeam
HRTeam

When and how to send Notification

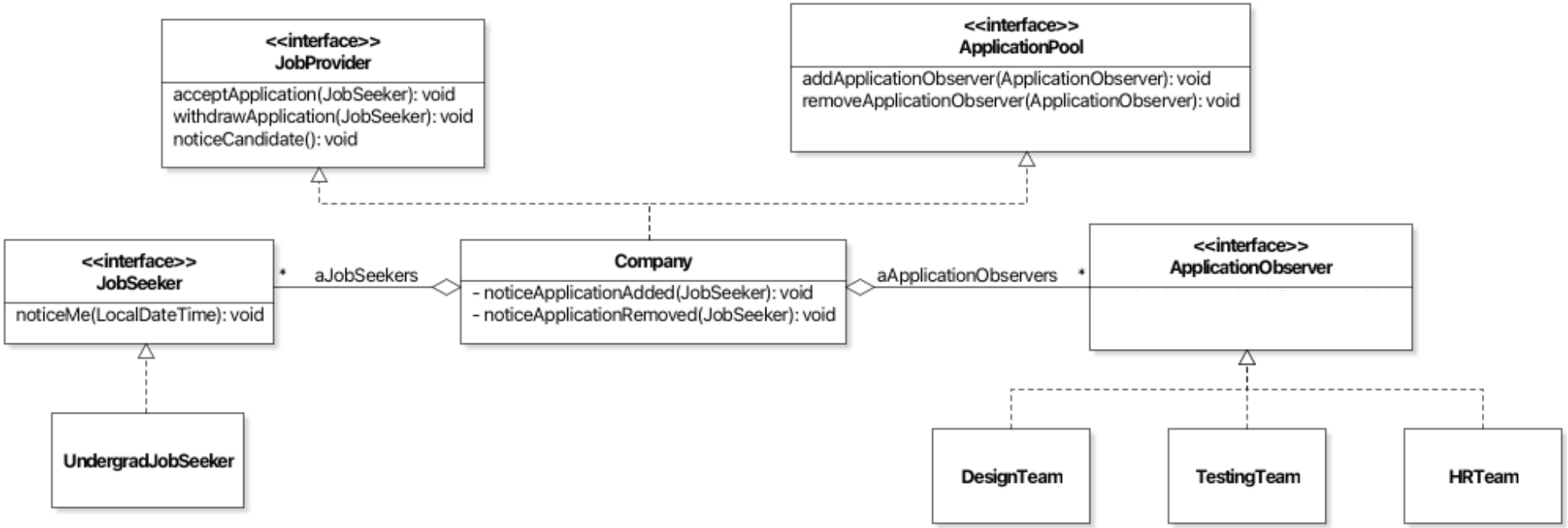
Data Flow Strategy?

`ApplicationPool` sends observers detailed information about the change, whether `ApplicationObserver` want it or not

Push model

`ApplicationPool` sends the most minimal notification, and `ApplicationObserver` ask for details explicitly thereafter.

Pull model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removeApplicationObserver(ApplicationObserver): void
<<interface>>
JobSeeker
noticeMe(LocalDateTime): void
*
aJobSeekers
Company
- noticeApplicationAdded(JobSeeker): void
- noticeApplicationRemoved(JobSeeker): void
aApplicationObservers
*
<<interface>>
ApplicationObserver
UndergradJobSeeker
DesignTeam
TestingTeam
HRTeam

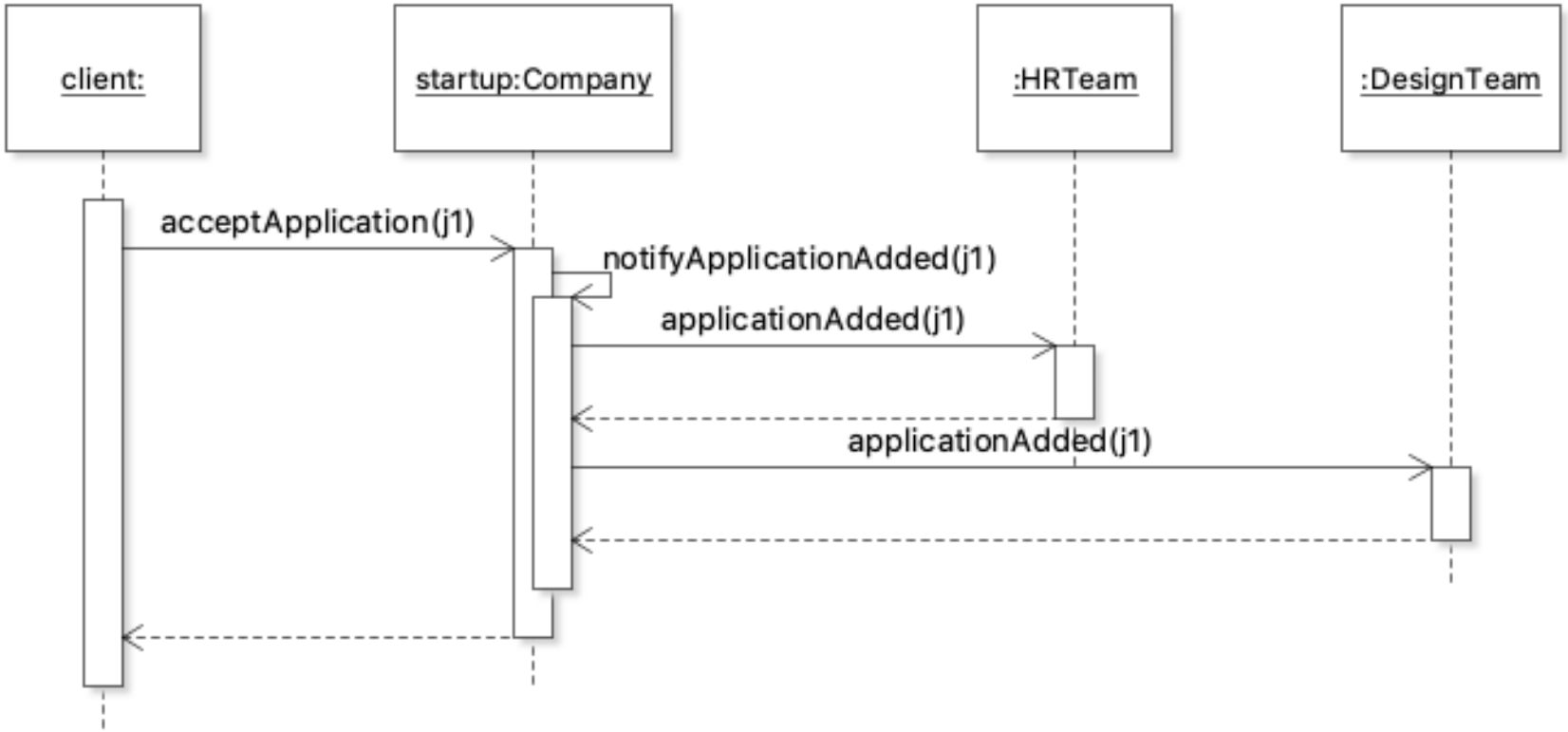
Acitivty3: Draw sequence diagram

```
Company startup = new Company("Frontier");
ApplicationObserver hrTeam = new HRTeam();
ApplicationObserver designTeam = new DesignTeam();
startup.addApplicationObserver(hrTeam);
startup.addApplicationObserver(designTeam);

JobSeeker j1 = new UndergradJobSeeker(TechSpecialty.UI_Design, 10, true);


startup.acceptApplication(j1);
```

<= When this statement is executed


client:
startup:Company
:HRTeam
:DesignTeam
acceptApplication(j1)
notifyApplicationAdded(j1)
applicationAdded(j1)
applicationAdded(j1)

Push model

Recap

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