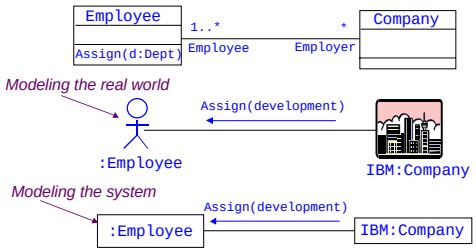
IX. Sequence and Collaboration Diagrams

Interaction Diagrams
Sequence Diagrams
Examples
Collaboration Diagrams

Interaction Diagrams

- Interactions among objects are modeled by ***interaction diagrams.***
- An interaction between two objects A and B involves object A sending a message requesting an action that object B can perform.
- There are two types of interaction diagrams:
  - ✓ Sequence diagrams;
  - ✓ Collaboration diagrams.
- We discuss each in detail in the rest of this lecture unit.

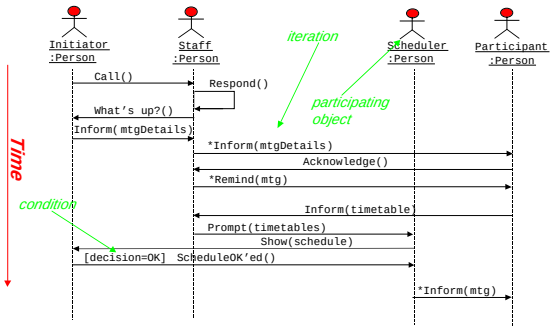
The Nature of an Interaction



Sequence Diagrams

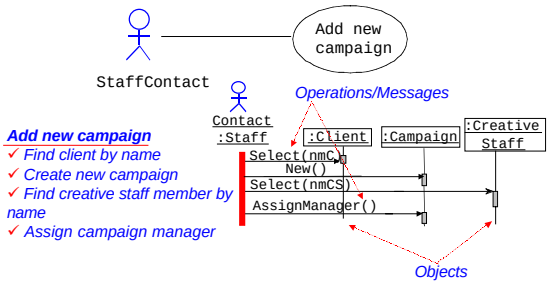
- Sequence diagrams describe in detail how actors use use cases; they can also model external business processes the new system will support (e.g., processing a book order)
- An ***interaction*** is a behavior that consists of a set of messages exchanged between external and system objects.
- Interactions consist of one or more ***messages.*** Interactions may be synchronous (e.g., calling someone on the phone), or asynchronous (e.g., sending someone email).
- Sequence diagrams defined during requirements analysis should ***not***:
  - ✓ include design objects;
  - ✓ specify message signatures in any detail;

The Basic Idea



Example: Add a New Campaign

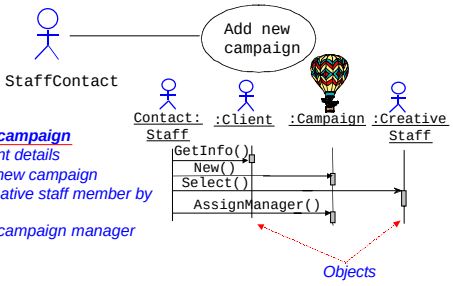
- Getting back to the use case "Add a new campaign"



Add new campaign
- ✓ Find client by name
- ✓ Create new campaign
- ✓ Find creative staff member by name
- ✓ Assign campaign manager

Add another New Campaign

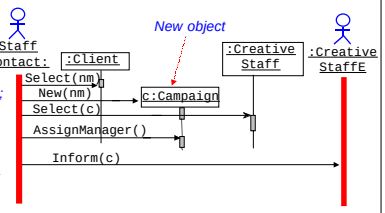
- Getting back to the use case "Add a new campaign"



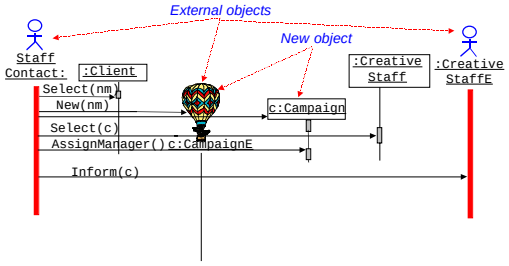
Add new campaign
- ✓ Get client details
- ✓ Create new campaign
- ✓ Find creative staff member by name
- ✓ Assign campaign manager

A More Realistic Example

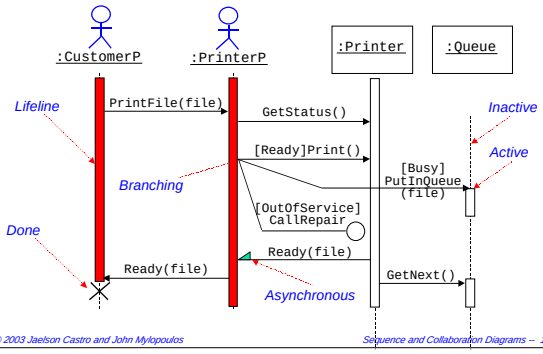
Add new campaign
- ✓ Find client by name;
- ✓ Create new campaign c;
- ✓ Assign creative staff member to c;
- ✓ Assign campaign manager;
- ✓ Inform the creative staff person.



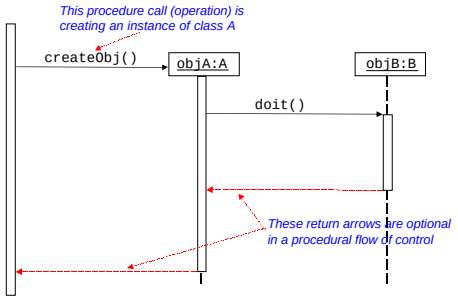
An Even More Realistic Example



Another Example: Print Shop

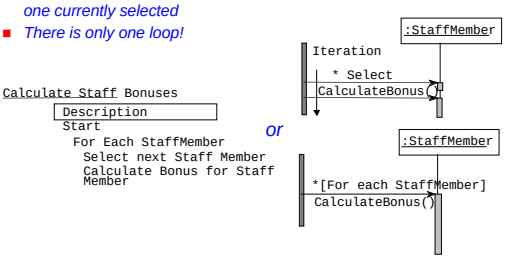


Flow of Control



Iteration

- Iteration (repetition of an operation) is shown with an asterisk
- Each `StaffMember` will be selected in turn
- Once selected, the `CalculateBonus` message will be sent to the one currently selected
- There is only one loop!

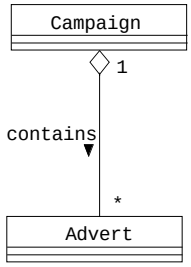


Drawing Sequence Diagrams

- For a particular use case, start by identifying which objects and actors might be involved.
- You may not get this right, but you can always change it.
- Imagine that there is a use case required by Agate called `Check Campaign Budget`
- Each `Campaign` has an `EstimatedCost` attribute and each `Advert` has an `EstimatedCost` attribute.
- The purpose of the use case is to check that the total estimated cost of all the adverts is less than that for the campaign as a whole.
- ...Which objects are involved here?

Campaign and Advert

Class diagram showing aggregation



The Campaign Class

Campaign
+Title:String +CampaignStartDate:Date +CampaignFinishDate:Date +EstimatedCost:Money +ActualCost:Money +CompletionDate:Date +DatePaid:Date -StaffCount:Integer = 0
+Completed(CompletionDate:Date,ActualCost:Money) +SetFinishDate(FinishDate:Date) +RecordPayment(DatePaid:Date) +CostDifference():Money +GetCampaignContribution():Money +CheckBudget():Money

The Advert Class

Advert
#Title:String #Type:String #TargetDate:Date #CompletedDate:Date #EstimatedCost:Money
+SetCompleted(CompletedDate:Date=Today) +GetTitle():String +GetType():String +GetTargetDate():Date +GetCompletedDate():Date +GetCost():Money

Getting a Sequence Diagram

- Where do we start?
- Select the relevant `Campaign`, probably using its name.
- How we select it is something we leave for the design phase:
  - ✓ it could be from a list box
  - ✓ it could involve a separate window on the screen
  - ✓ it could involve some kind of index
- These are design issues, which we shall leave for now, although we should document them if the customer expressed a preference at this stage.

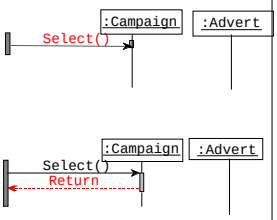
Creating a Sequence Diagram

`Check Campaign Budget`

`Description`

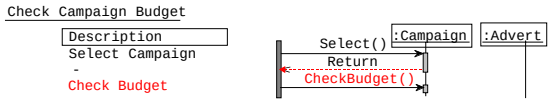
`Select Campaign`

- We can also add in a `Return`



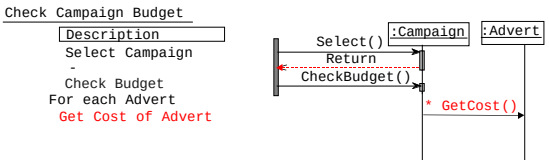
Creating a Sequence Diagram

- We then need to send a message to the Campaign to check its budget.



- Note there is no Return here. Where does control go?

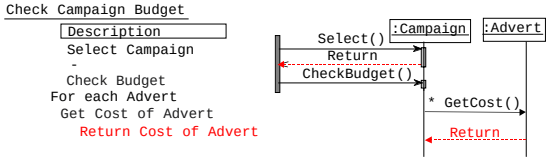
Creating a Sequence Diagram



- Note the * for iteration.
- We are assuming here that :Campaign knows about all the Adverts that are contained in it because of the aggregation association shown earlier.

Creating a Sequence Diagram

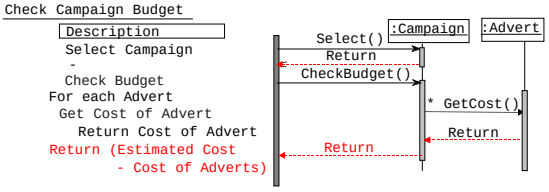
- What happens next?



- Advert returns its cost, in this case the EstimatedCost of the Advert
- Once all the Advert's costs have been fetched and totalled up, the total can be taken away from the EstimatedCost of the Campaign.

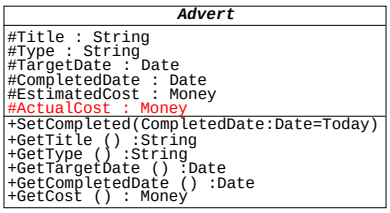
Creating a Sequence Diagram

- This has to happen for every Advert in the Campaign, so there's a loop



- Once all the Advert's costs have been fetched and totalled up, the total can be taken away from the EstimatedCost of the Campaign.

...Back to Class Diagrams...



- We could add a new attribute to Advert called ActualCost, which is set when an Advert has been completed.
- Now GetCost() can return the ActualCost if it exists, otherwise it uses EstimatedCost().

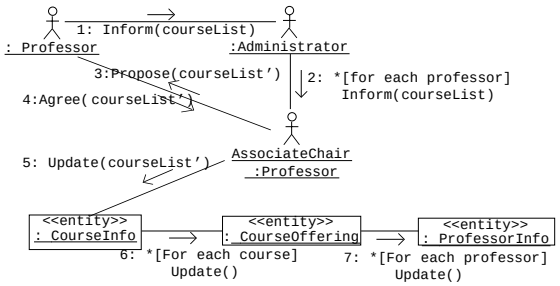
How to Use Sequence Diagrams

- In general, you may need several sequence diagrams to describe a single use case.
- A use case may involve complex control logic; sequence diagrams on the other hand should remain easy to read and understand.
- For a complex use case, use several sequence diagrams, each of which describes a possible scenario for the use case.

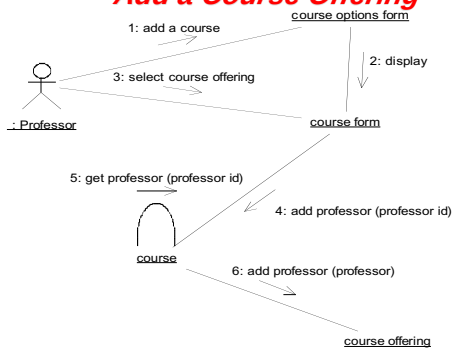
Collaboration Diagrams

- *These diagrams are comparable to sequence diagrams. In fact, you can map every sequence diagram to an equivalent collaboration diagram and vice versa.*
- *Collaboration diagrams show interaction without the time dimension, but do include object links.*
- *Like sequence diagrams, collaboration diagrams are intended to model scenaria; each scenario describes a possible sequence of events and actions.*
- *Sequence diagrams are helpful because they capture visually the sequence of events over time.*
- *Collaboration diagrams capture more directly the interactions between actors and objects.*
- ***Note:** All operations shown on collaboration and sequence diagrams must be present in the destination classes.*

Select Courses to Teach



Add a Course Offering



Additional Readings

- *[Booch99] Booch, G. et al. The Unified Modeling Language User Guide. Chapters 15, 18, 27. Addison-Wesley.*
- *[Fowler00] Fowler, M. UML Distilled: A Brief Guide to the Standard Object Modelling Language. Chapter 5. Addison-Wesley.*