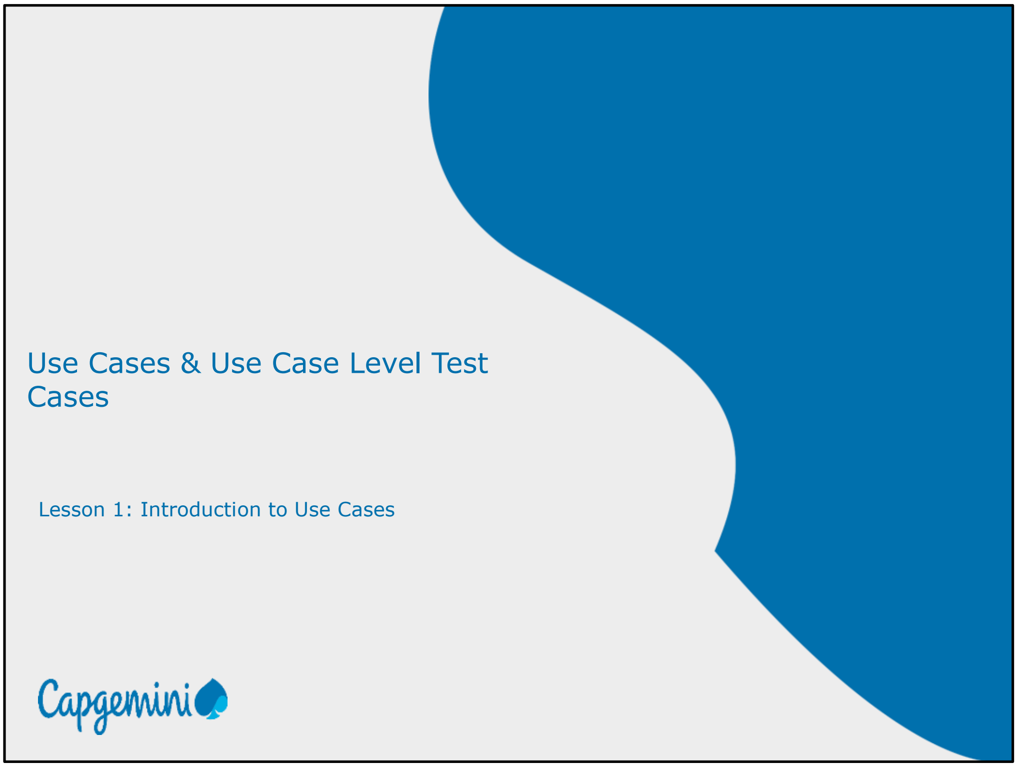
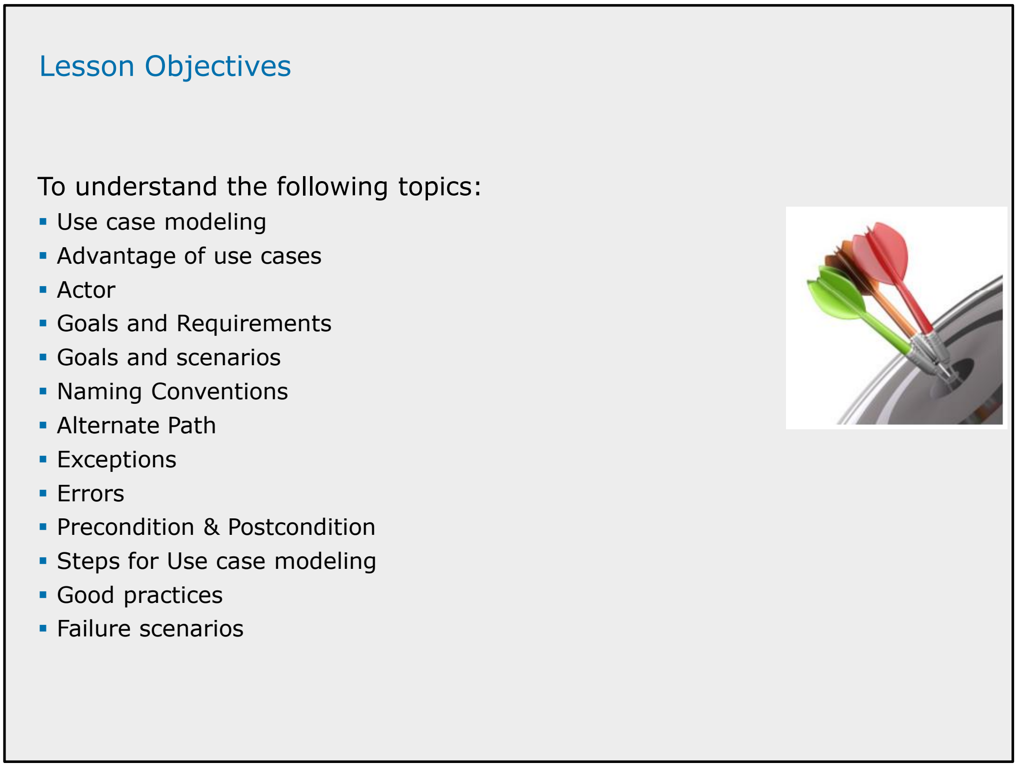


Use Cases & Use Case Level Test Cases

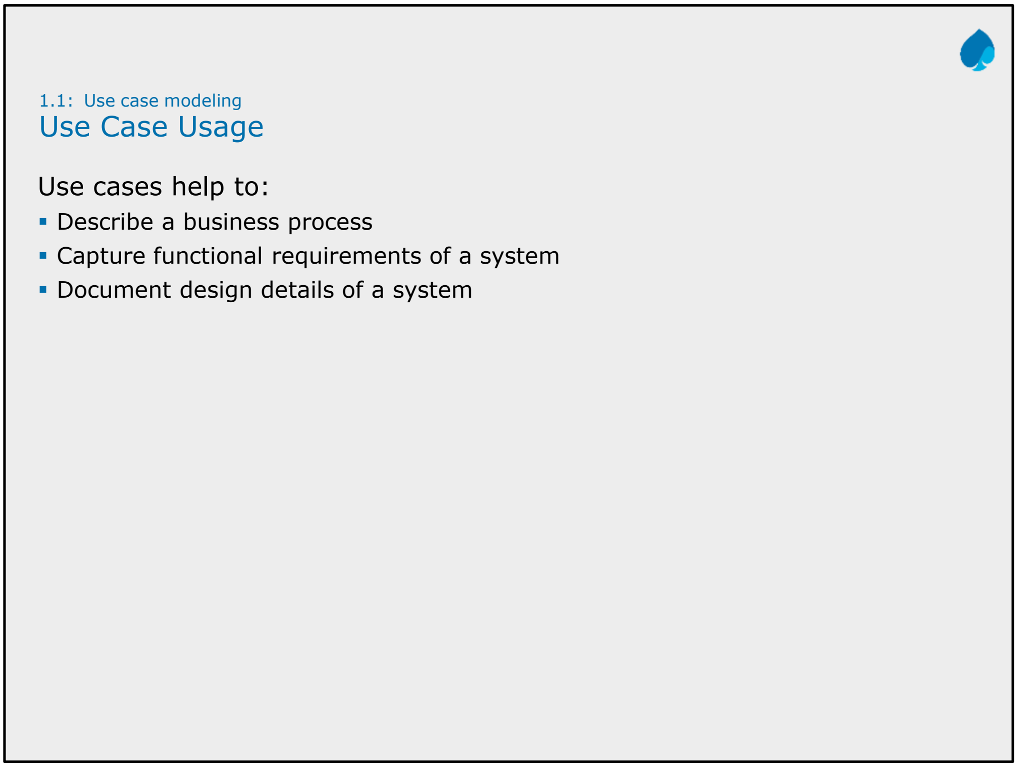
Lesson 1: Introduction to Use Cases



Lesson Objectives

To understand the following topics:

- Use case modeling
- Advantage of use cases
- Actor
- Goals and Requirements
- Goals and scenarios
- Naming Conventions
- Alternate Path
- Exceptions
- Errors
- Precondition & Postcondition
- Steps for Use case modeling
- Good practices
- Failure scenarios



1.1: Use case modeling

Use Case Usage

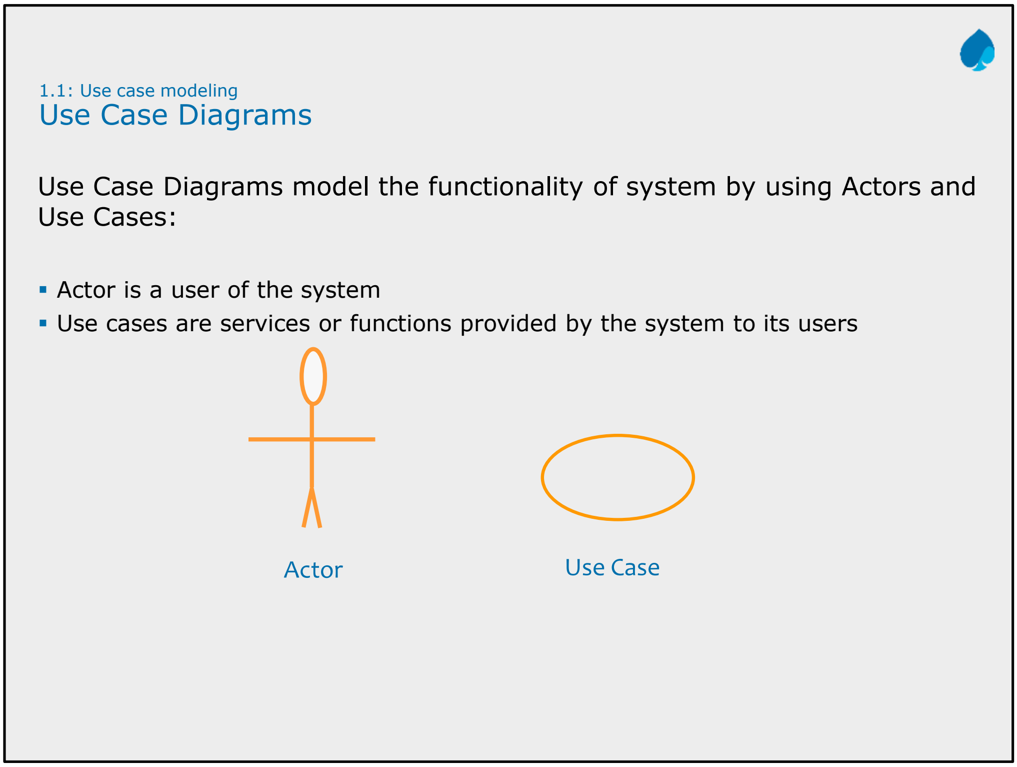
Use cases help to:

- Describe a business process
- Capture functional requirements of a system
- Document design details of a system

Consider the example of ATM machine. If we have to design an application to create an ATM system then we will have to first understand stepwise working of ATM system.

1. Swipe your card
2. System will ask you for the pin no
3. Provide the pin no
4. System will authenticate your pin and provide the options
5. Select the option eg. Withdraw
6. System will prompt you to enter the amount
7. Provide the amount
8. System will check available balance and dispense money
9. Collect money and collect receipt

This describes the steps followed to perform withdrawal transaction in ATM machine.
Now we have to find out what function do we expect from the ATM system? We would want the ATM to provide us with functionalities like withdrawal, deposit, funds transfer, mini statement etc. These are called as the functional requirements. These functional requirements should be captured and detailed steps (like the one given above) should be known. This can be done with the help of USE CASES. USE CASE captures the functional requirements of a system. Thus the Use case document will provide the design details of the system.



1.1: Use case modeling

Use Case Diagrams

Use Case Diagrams model the functionality of system by using Actors and Use Cases:

- Actor is a user of the system
- Use cases are services or functions provided by the system to its users

Actor

Use Case

Use Case Diagrams:

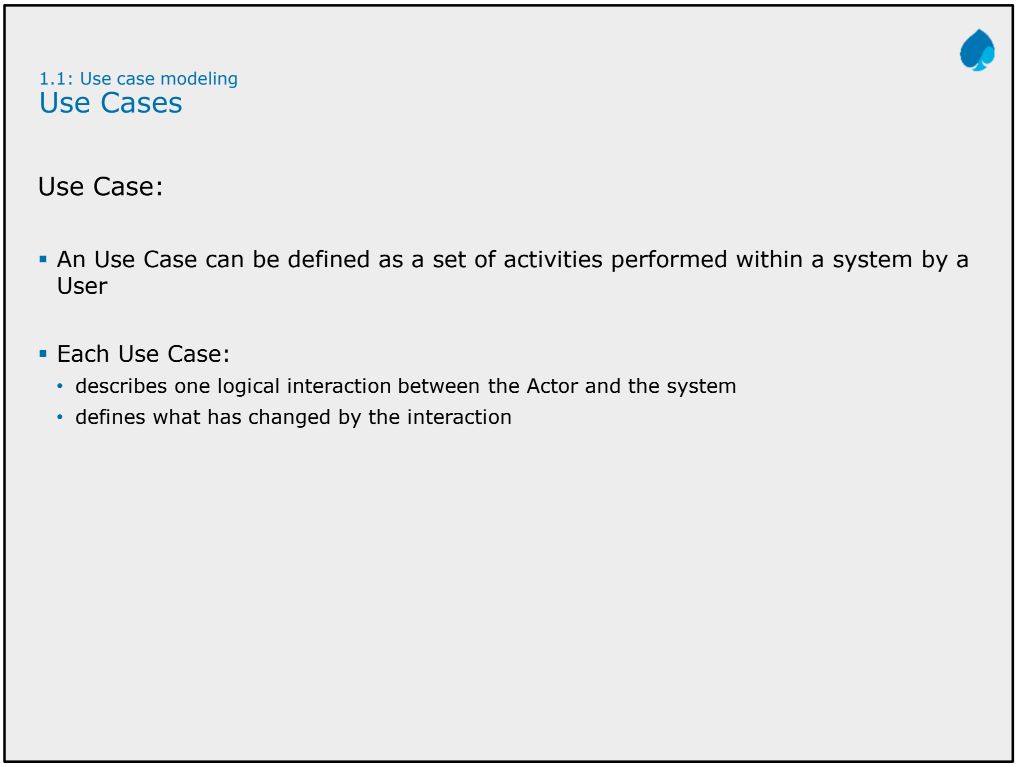
Use Case is a description of a system’s behavior from a user’s point of view. It is a set of scenarios that describe an interaction between a user and a system. It also displays the relationship among Actors and Use Cases.

Two main components of Use Case diagram are Use Cases and Actors.

Use case diagrams, which render the User View of the system, describe the functionality (Use Cases) provided by the system to its users (Actors).

An Actor represents a user or another system that will interact with the system you are modeling.

An Use Case is an external view of a system that represents some action that the user might perform in order to complete a task.



1.1: Use case modeling

Use Cases

Use Case:

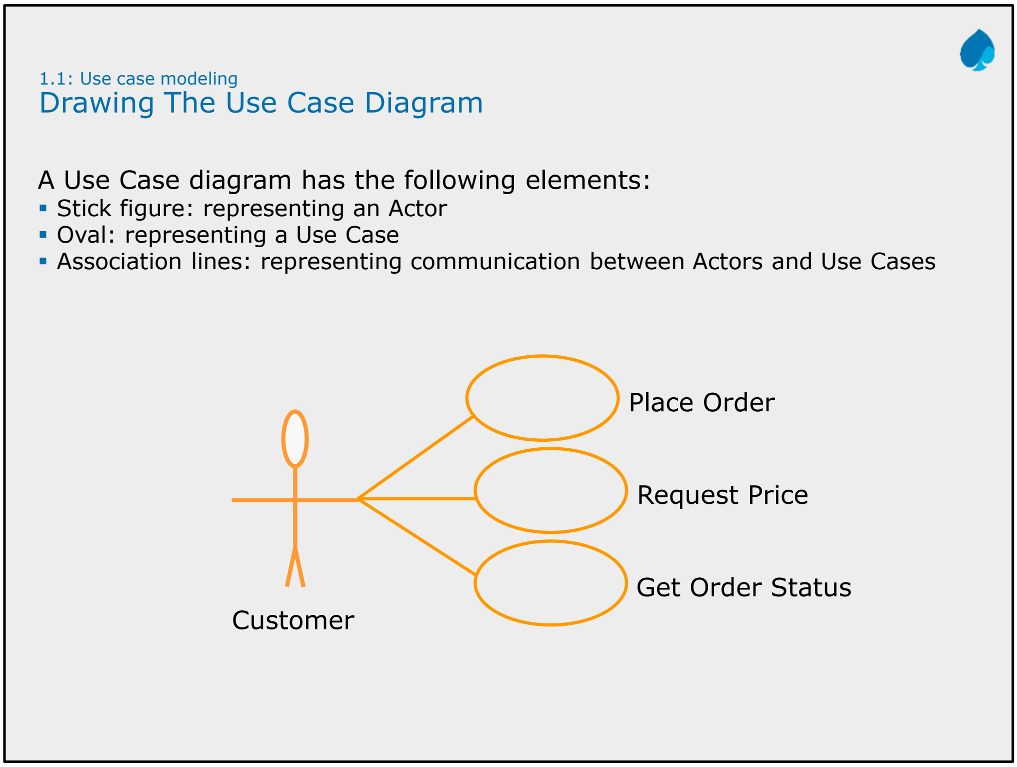
- An Use Case can be defined as a set of activities performed within a system by a User
- Each Use Case:
  - describes one logical interaction between the Actor and the system
  - defines what has changed by the interaction

Use Cases:

The Use Cases define “units of functionality” provided by system. They model “work units” that the system provides to its outside world.
A Use Case is one usage of the system. It is a generic description of a use of the system. It allows interactions in a specific sequence.
At the lowest level, they are nothing but methods which need to be implemented by various classes in the system.
Use Cases determines everything that the Actor wants to do with the system.
A Use Case performs the following functions:

Defines main tasks of the system
Reads, writes, and changes system information
Informs the system of real world changes

A Use Case needs to be updated / informed about system changes.



1.1: Use case modeling

Drawing The Use Case Diagram

A Use Case diagram has the following elements:

- Stick figure: representing an Actor
- Oval: representing a Use Case
- Association lines: representing communication between Actors and Use Cases

Drawing the Use Case Diagram:

The Use Case Diagram has the following elements:

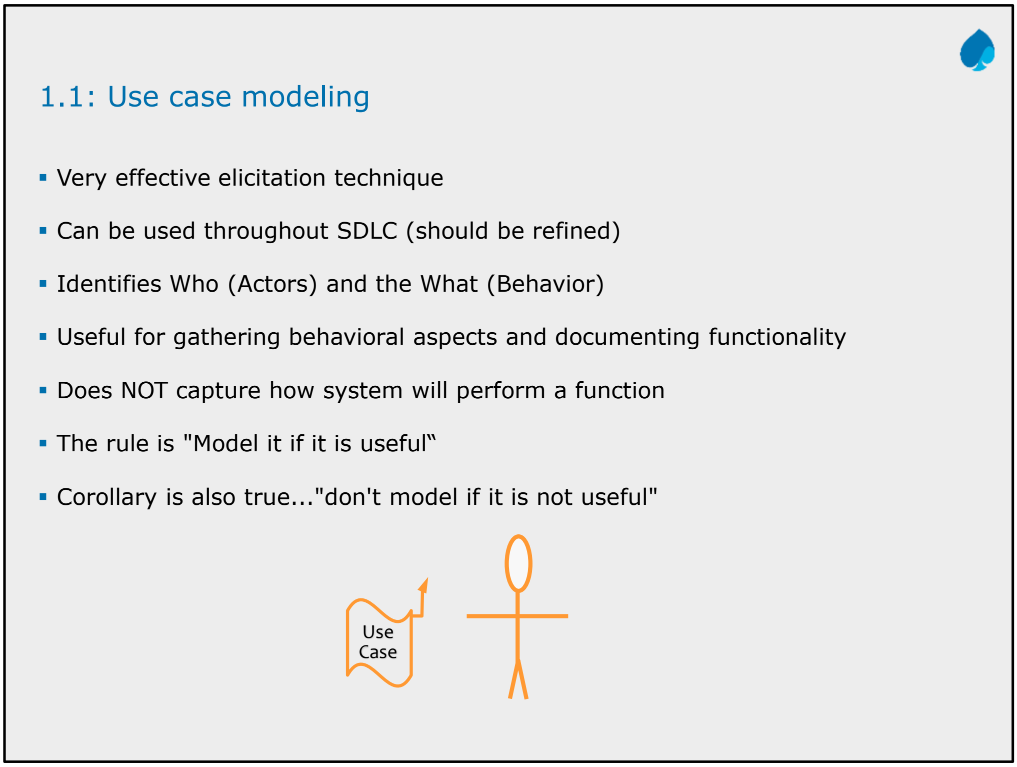
A stick figure, which represents Actors (sometimes stereotyped classes, as explained later, are also used to represent Actors). They differ from tool to tool.

Ovals or ellipses, which represent Use Cases

Association lines, which indicate interactions between Actors and Use Cases.

Use Cases will have description of what the Use Case is supposed to do when it is used.

An example of use case description is given.



1.1: Use case modeling

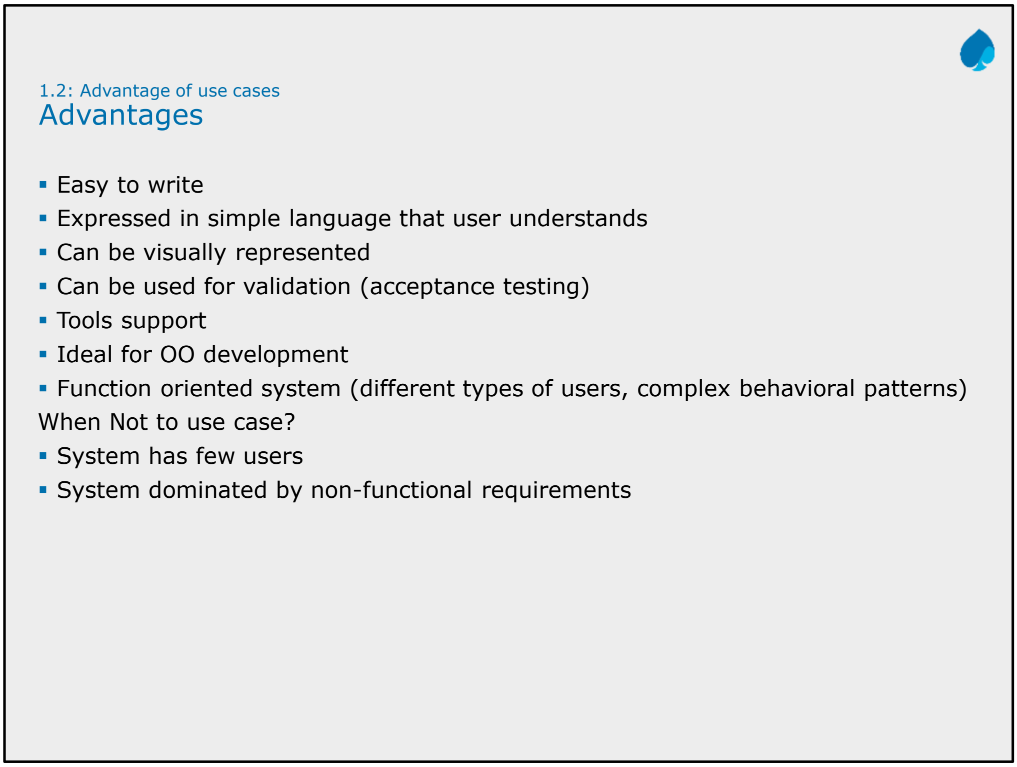
- Very effective elicitation technique
- Can be used throughout SDLC (should be refined)
- Identifies Who (Actors) and the What (Behavior)
- Useful for gathering behavioral aspects and documenting functionality
- Does NOT capture how system will perform a function
- The rule is "Model it if it is useful‟
- Corollary is also true..."don't model if it is not useful"

To Understand detailed system requirements Use Cases are created and they can be used during entire software development life cycle.

For E.g. Use case – Place Order
User enters item number in the system
System displays item details.
User enters quantity.
System displays price and total value for the order.

Steps 1 to 4 can be repeated.
User enters payment details in the system.
This Use case shows steps for normal behavior. What if, item does not exist? Or if quantity is more than quantity on hand? Use case will capture these as different scenarios.

Use Case is a collection of possible scenarios between the system and external actors, characterized by the goal the primary actor has toward the system’s declared responsibilities, showing how the primary actor’s goal might be delivered or might fail.



1.2: Advantage of use cases

Advantages

- Easy to write
- Expressed in simple language that user understands
- Can be visually represented
- Can be used for validation (acceptance testing)
- Tools support
- Ideal for OO development
- Function oriented system (different types of users, complex behavioral patterns)

When Not to use case?

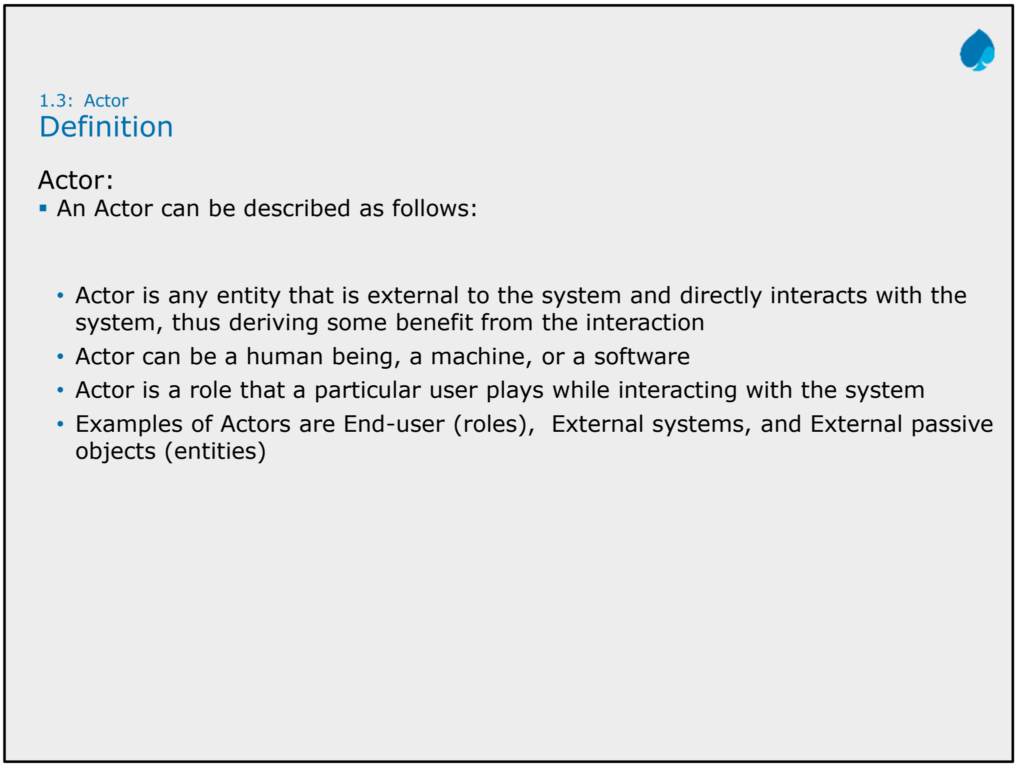
- System has few users
- System dominated by non-functional requirements

Advantages of Use Cases:

Use cases are written in simple users language and are easy to write. Its visual representation has uniform interpretation. Use cases will capture validation requirements and hence will be useful for acceptance testing.

Different tools like Rational Rose, Rational Software Architect, Star UML etc. can be used to create Use case diagrams. They are ideal for object oriented development as we have a clear representation of objects in the form of Actors, external systems etc. Use cases are ideal for systems that have many functional requirements.

We cannot create Use cases for systems which have few users or systems which have more non-functional requirements.



1.3: Actor

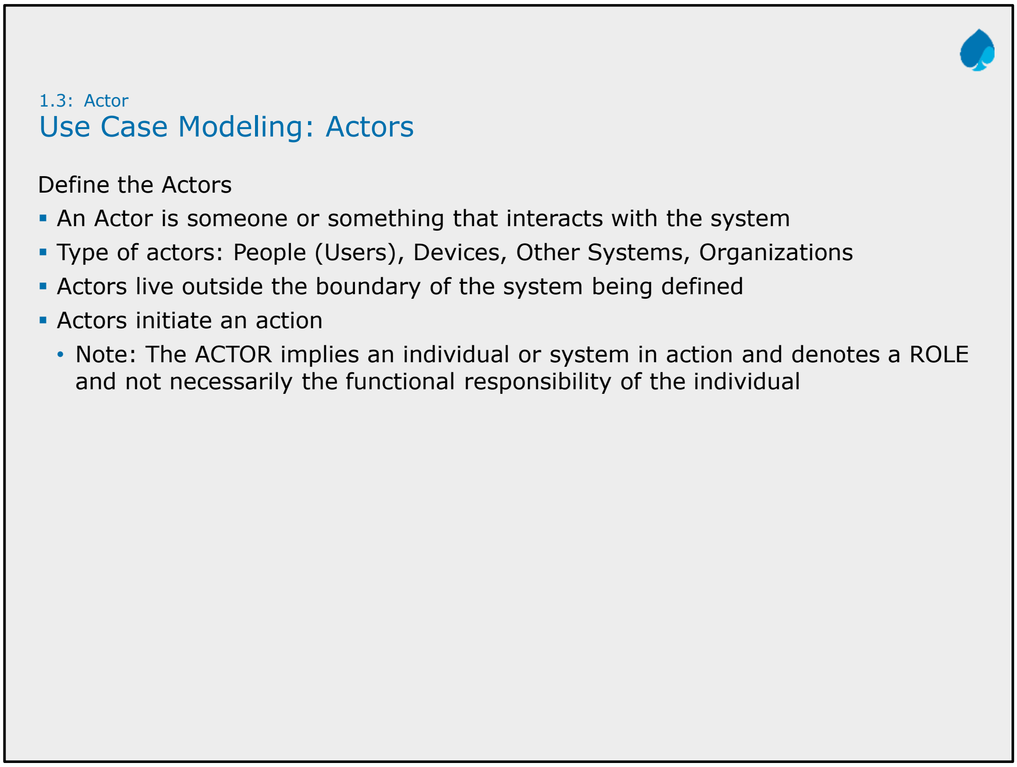
Definition

Actor:

- An Actor can be described as follows:
  - Actor is any entity that is external to the system and directly interacts with the system, thus deriving some benefit from the interaction
  - Actor can be a human being, a machine, or a software
  - Actor is a role that a particular user plays while interacting with the system
  - Examples of Actors are End-user (roles), External systems, and External passive objects (entities)

Actor:

Actors are people, organizations, systems, or devices which use or interact with our system. The system exists to support that interaction. Therefore, the important part of the project is to identify the Actors and find out what they want from the system.
Actors are characterized by their external view rather than their internal structures. It is a role that the user plays to get something from the system.
Role and organization Actors only require logical interactions with the system. Ask who wants what from our system, rather than who operates the system.
For example: ABC and XYZ are users who wish to buy from an online store. For the online stores system, they play the role of a customer, and hence customer is the Actor for the system. The database for this system may already be existing, and hence this may be another Actor (note that user in this case is not a human).
The Actors will finally be used to describe classes, which will interact with other classes of the system.



1.3: Actor

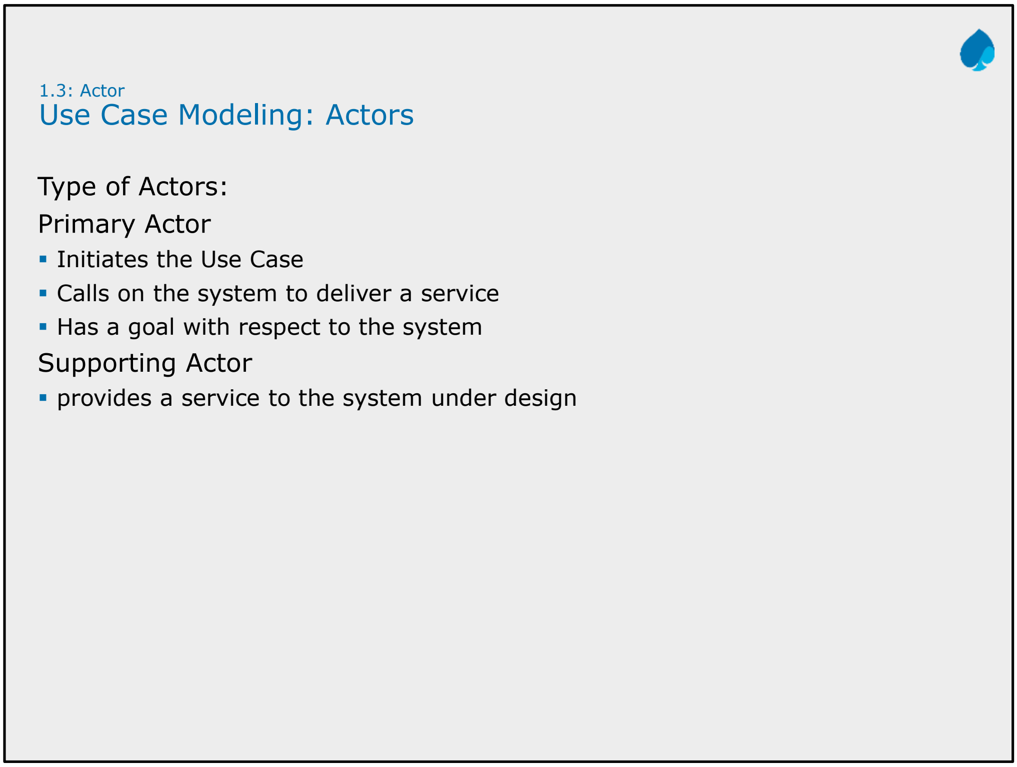
Use Case Modeling: Actors

Define the Actors

- An Actor is someone or something that interacts with the system
- Type of actors: People (Users), Devices, Other Systems, Organizations
- Actors live outside the boundary of the system being defined
- Actors initiate an action
  - Note: The ACTOR implies an individual or system in action and denotes a ROLE and not necessarily the functional responsibility of the individual

An actor is always outside the system. An actor characterizes role of a system. The actor starts the use case because it wants something from the system.

A use case answers a question of the form, “How do I get money out of that banking machine?” You, the primary actor, have a goal, to get money out the system, which is that banking machine. There are a number of situations you could find yourself in. The use case collects them into one place. It breaks down your goal into sub goals, eventually individual message actions, plus the interactions between various actors as they try to reach that goal, or eventually fail to reach it.



1.3: Actor

Use Case Modeling: Actors

Type of Actors:

Primary Actor

- Initiates the Use Case
- Calls on the system to deliver a service
- Has a goal with respect to the system

Supporting Actor

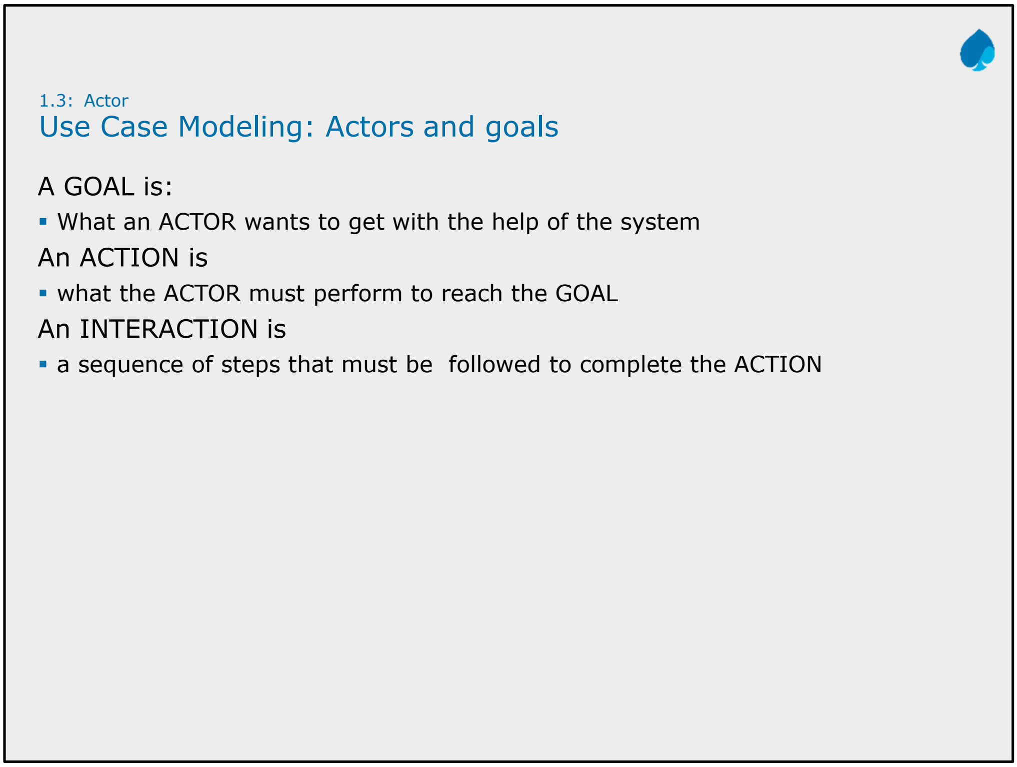
- provides a service to the system under design

PRIMARY ACTOR

A PRIMARY ACTOR is one who calls on the system to deliver a service
A PRIMARY ACTOR is typically who triggers the use case
Examples: A caller initiating a telephone call, a customer withdrawing money from the ATM
Note: Use cases help identify Primary actors early in the lifecycle
For e.g. The customer requests to open a bank account, the bank clerk collects the customer’s details and those of the requested account. This information is validated. If validation is ok the account is created otherwise the request is rejected. In this scenario, Customer is a primary actor and bank clerk is supporting actor.

SUPPORTING ACTOR

A SUPPORTING ACTOR is an external actor that provides a service to the system under design.
Examples: A high-speed printer, a web service
Note: We can use supporting actors to identify external interfaces and the protocols the system will use. An actor can be primary in one use case and supporting in another
For e.g. In ATM system, if user wants a to print a statement of his transaction, printer in this scenario acts as a supporting actor, which is outside the system for supporting print utility.



1.3: Actor

Use Case Modeling: Actors and goals

A GOAL is:

- What an ACTOR wants to get with the help of the system

An ACTION is

- what the ACTOR must perform to reach the GOAL

An INTERACTION is

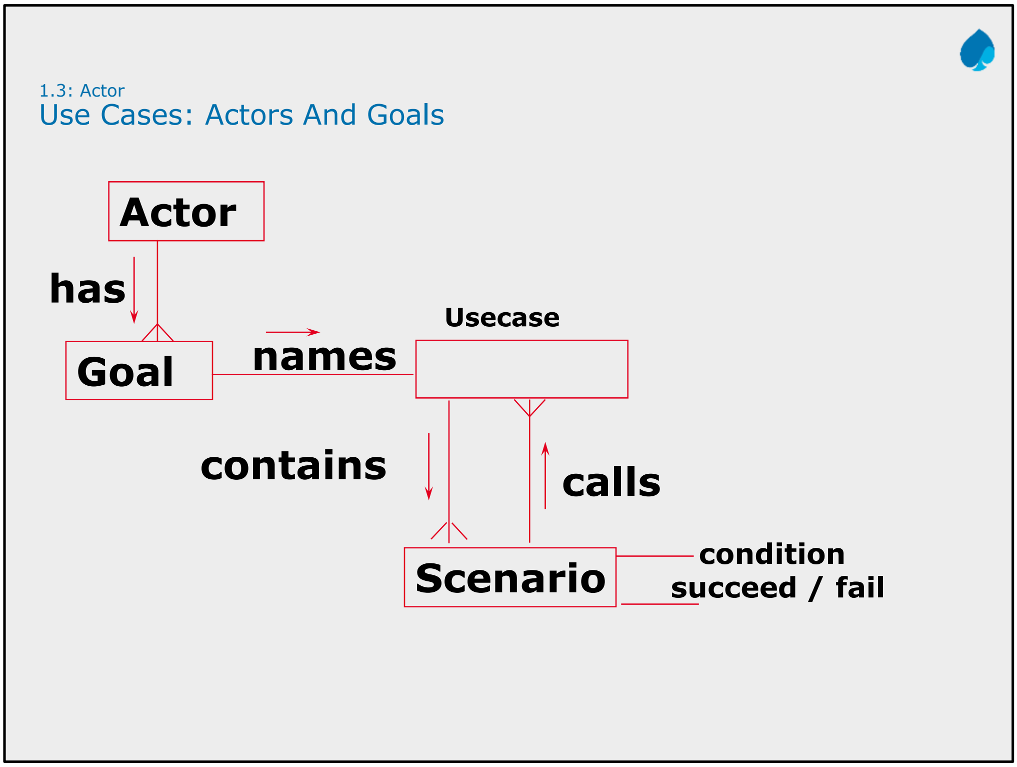
- a sequence of steps that must be followed to complete the ACTION

Each actor has a set of “responsibilities”. To carry out this responsibility, it sets some goals. To reach a goal, it performs some actions. An “action” is the trigger of an interaction with another actor, calling upon one of the responsibilities of the other actor.

An interaction also could be a “sequence of interactions”. This is a recursive definition. At the bottom level, it consists of messages. We sometime want to bundle a sequence of messages into a single interaction item.

A collection of scenarios is a “use case”.

A use case answers a question of the form, “How do I get money out of that banking machine?” You, the primary actor, have a goal, to get money out the system, which is that banking machine. There are a number of situations you could find yourself in. The use case collects them into one place. It breaks down your goal into sub goals, eventually individual message actions, plus the interactions between various actors as they try to reach that goal, or eventually fail to reach it.



1.3: Actor

Use Cases: Actors And Goals

Actor

has

Goal

names

Usecase

contains

calls

Scenario

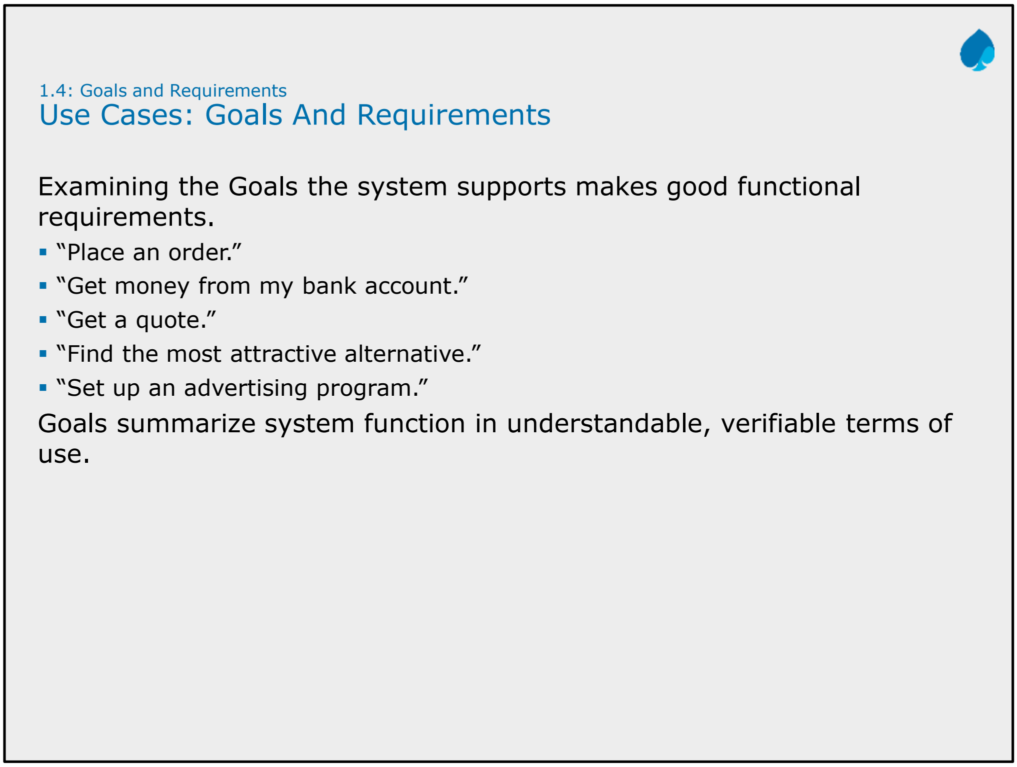
condition

succeed / fail

Actor has some goal with respect to the system. This goal is identified as Use case. Use cases contains different scenarios. For different scenarios, separate use case is prepared. The scenarios are either successful or failure scenarios. Test engineer has to consider successful as well as failure scenarios.

For E.g. The insurance company
Primary Actor: the claimant
Goal: Get paid for car accident
Conditions: Everything is in order
Outcome: Insurance company pays claim

1. Claimant submits claim with substantiating data.
2. Insurance company verifies claimant owns a valid policy
3. Insurance company assigns agent to examine case
4. Agent verifies all details are within policy guidelines
5. Insurance company pays claimant



1.4: Goals and Requirements

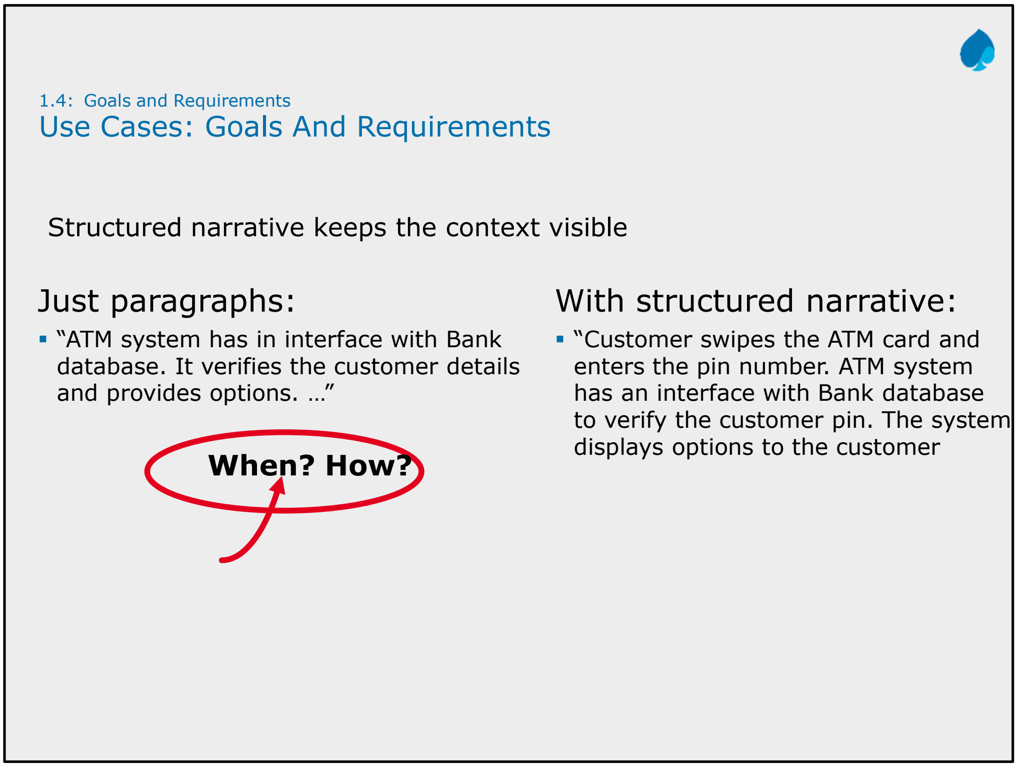
Use Cases: Goals And Requirements

Examining the Goals the system supports makes good functional requirements.

- “Place an order.”
- “Get money from my bank account.”
- “Get a quote.”
- “Find the most attractive alternative.”
- “Set up an advertising program.”

Goals summarize system function in understandable, verifiable terms of use.

Functional requirements capture the intended behavior of the system. This behavior may be expressed as services, tasks or functions the system is required to perform.



1.4: Goals and Requirements

Use Cases: Goals And Requirements

Structured narrative keeps the context visible

Just paragraphs:

- "ATM system has in interface with Bank database. It verifies the customer details and provides options. …"

When? How?

With structured narrative:

- "Customer swipes the ATM card and enters the pin number. ATM system has an interface with Bank database to verify the customer pin. The system displays options to the customer

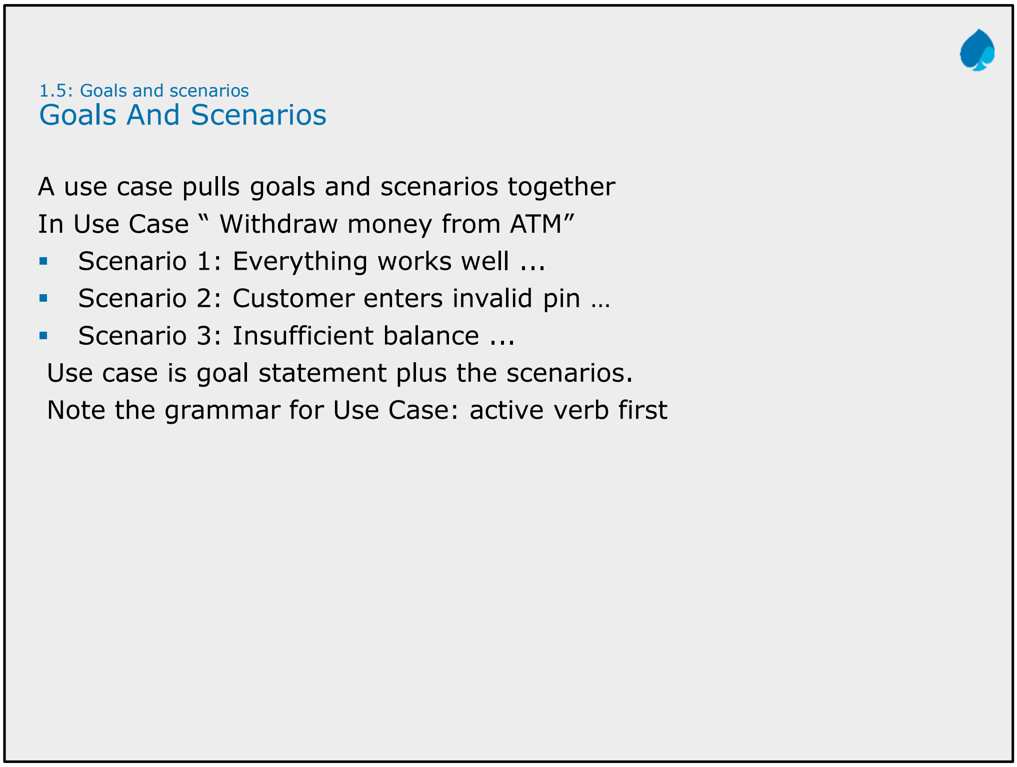
Many times requirements are captured in the form of a paragraph. These paragraphs are written in a structured or unstructured format.

There are two paragraphs mentioned in the above slide, one is just a normal unstructured paragraph which does not give us clear information about when does the customer verification happen? Or how does it happen?

Another one is structured paragraph:
Eg: "The order entry system has an interface to system EBMS and to a terminal. It computes and displays the sum of the order items' cost.

Unstructured will not give us details about when is the "sum of ordered items" displayed? Or how is it calculated. It simply gives us some information but not complete information.

Eg: The person who enters order identifies the name of the customer & the items on the order. The system displays the cost of the total order. If the items are in stock and the client has sufficient credit"
Structured paragraph on the other hand will give us unambiguous information about the same function.



1.5: Goals and scenarios

Goals And Scenarios

A use case pulls goals and scenarios together

In Use Case ‟ Withdraw money from ATM”

- Scenario 1: Everything works well ...
- Scenario 2: Customer enters invalid pin …
- Scenario 3: Insufficient balance ...

Use case is goal statement plus the scenarios.

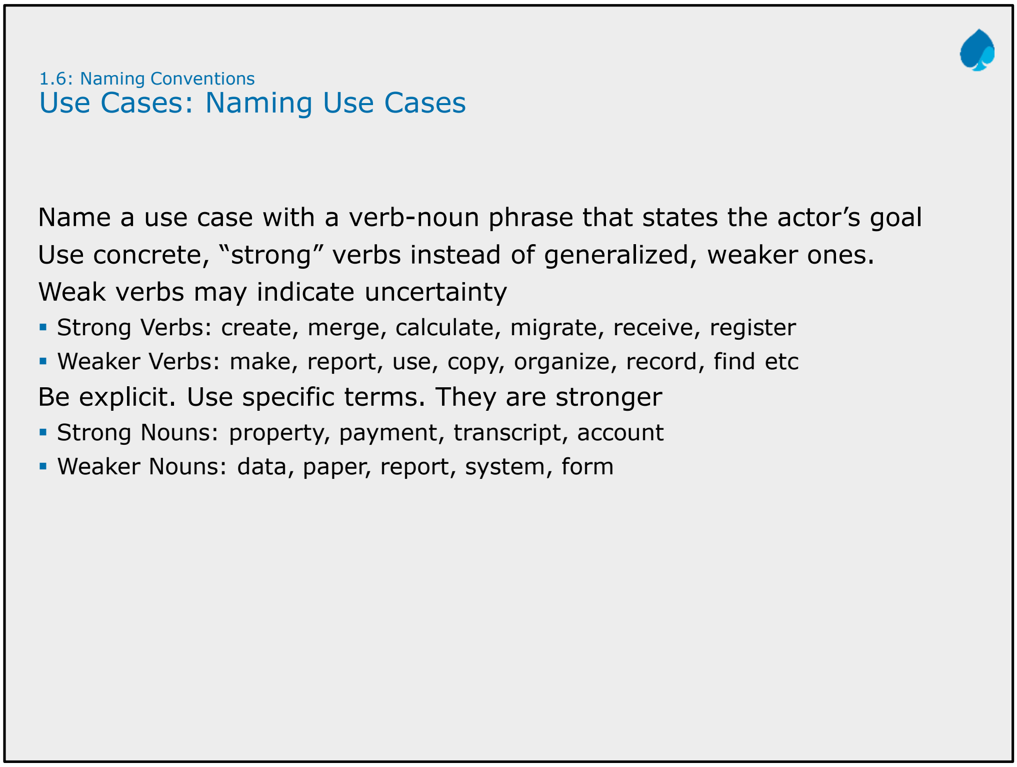
Note the grammar for Use Case: active verb first

Example: “ Order product from catalog”
Scenario 1: Everything works out well ...
Scenario 2: Insufficient credit ...
Scenario 3: Product out of stock ..

Use case is goal statement plus the scenarios.
A sequence has no branching or alternatives. It therefore is used to describe the past or a definite future, with conditions stated. Such a sequence is known as a “scenario”. So “Sequence of Interactions” is the same as “scenario”.

Scenario is a sequence of interactions happening under certain conditions, to achieve the primary actor’s goal, and having a particular result with respect to that goal. The interactions start from the triggering action and continue until the goal is delivered or abandoned, and the system completes whatever responsibilities it has with respect to the interaction.

A scenario is an instance of a use case, and represents a single path through the use case. Thus, one may construct a scenario for the main flow through the use case, and other scenarios for each possible variation of flow through the use case (e.g., triggered by options, error conditions, security breaches, etc.). Scenarios may be depicted using sequence diagrams.



1.6: Naming Conventions

Use Cases: Naming Use Cases

Name a use case with a verb-noun phrase that states the actor’s goal

Use concrete, “strong” verbs instead of generalized, weaker ones.

Weak verbs may indicate uncertainty

- Strong Verbs: create, merge, calculate, migrate, receive, register
- Weaker Verbs: make, report, use, copy, organize, record, find etc

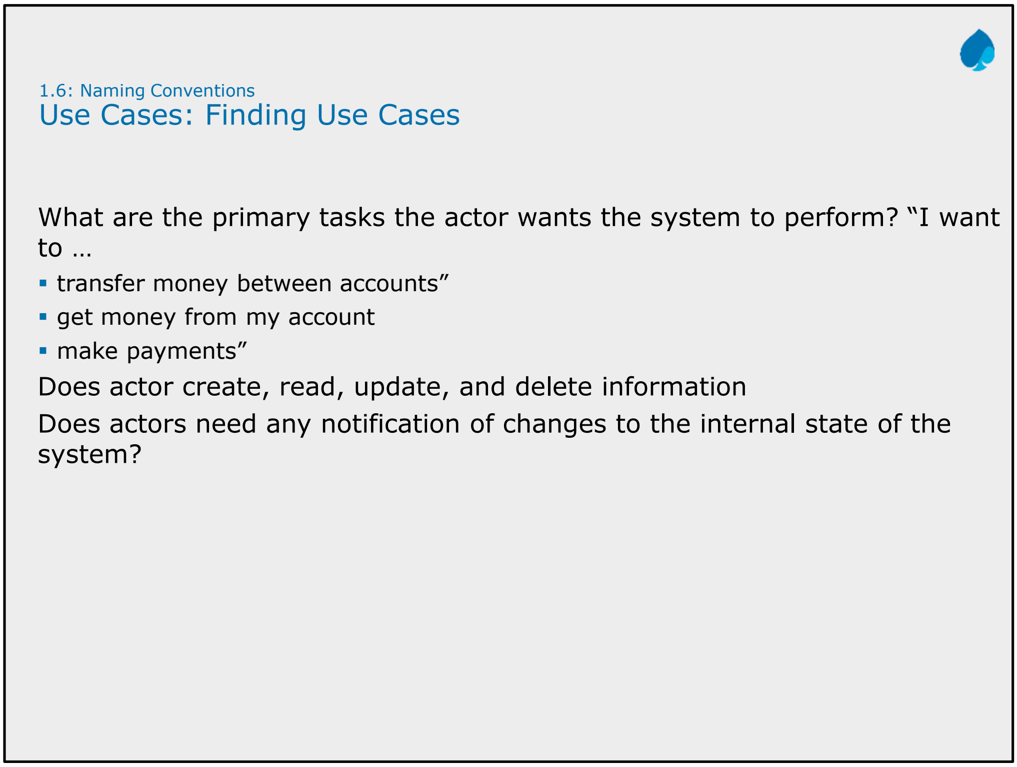
Be explicit. Use specific terms. They are stronger

- Strong Nouns: property, payment, transcript, account
- Weaker Nouns: data, paper, report, system, form

How to name a Use Case?

Use case names should describe the functionality of the system. Some of the tips are given in above slide will help you give appropriate names to the Use Cases
Eg: ATM system Use cases can be:

1. Withdraw money – (use of strong verb and strong noun)
2. View Mini statement



1.6: Naming Conventions

Use Cases: Finding Use Cases

What are the primary tasks the actor wants the system to perform? “I want to …

- transfer money between accounts”
- get money from my account
- make payments”

Does actor create, read, update, and delete information

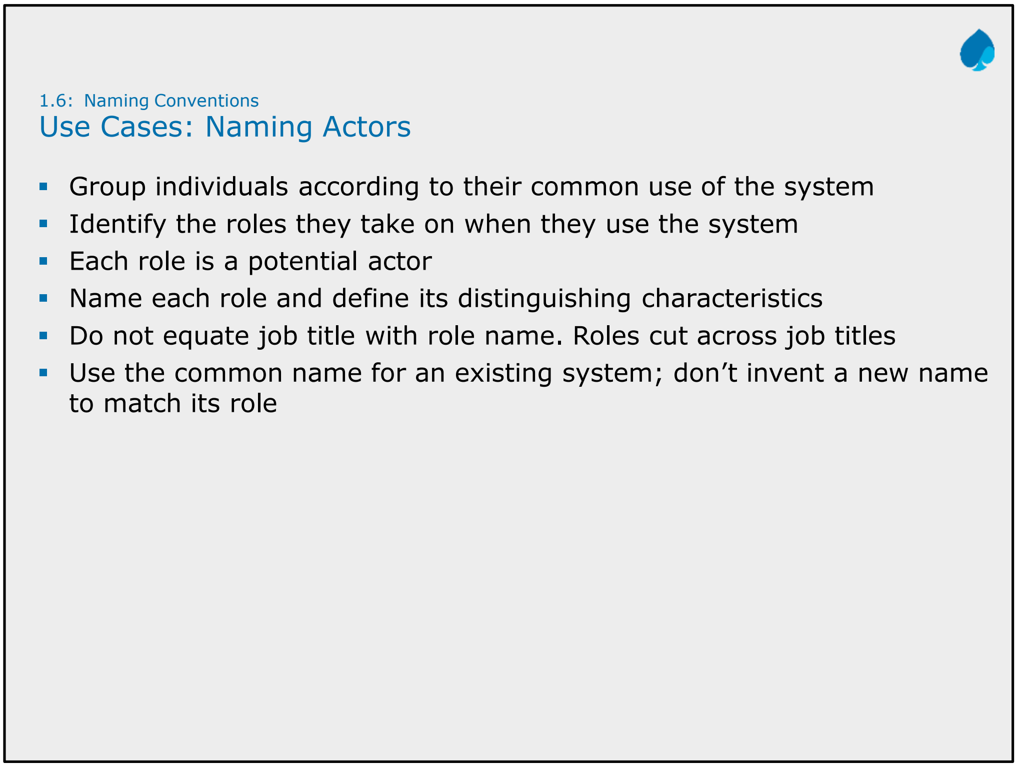
Does actors need any notification of changes to the internal state of the system?

Identify the type of functions are expected by each actor from the system under design:

In the ATM example :
We expect ATM to perform following functions for us (Customer)
1. Withdraw Money
2. Deposit Money
3. Maintain Customer Account (“Maintain” will take care of create, modify, remove)
4. Funds Transfer
5. View Mini statement

The system exists only for its use, and therefore it should be based on users needs.

Ask the questions on the slide and answers to these questions represent the flow of events that identify candidate use cases.

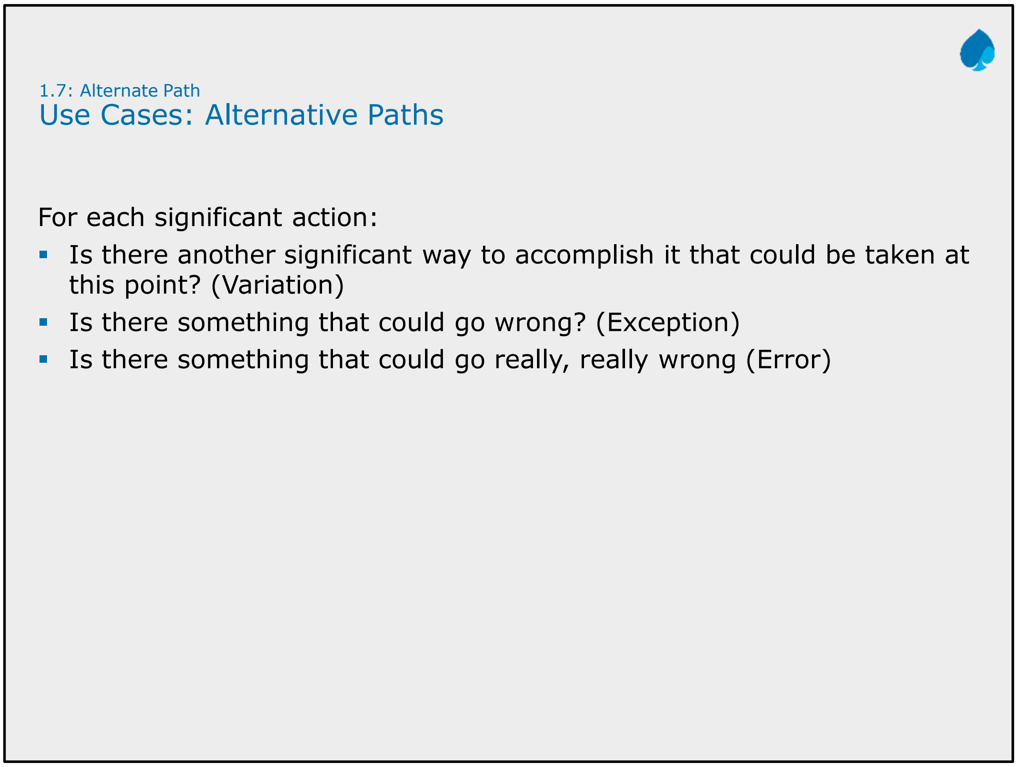


1.6: Naming Conventions

Use Cases: Naming Actors

- Group individuals according to their common use of the system
- Identify the roles they take on when they use the system
- Each role is a potential actor
- Name each role and define its distinguishing characteristics
- Do not equate job title with role name. Roles cut across job titles
- Use the common name for an existing system; don’t invent a new name to match its role

OMG gives the description of Actor as follows:
Actors may represent roles played by human users, external hardware, or other subjects. Note that an actor does not necessarily represent a specific physical entity but merely a particular facet (i.e., “role”) of some entity that is relevant to the specification of its associated use cases. Thus, a single physical instance may play the role of several different actors and, conversely, a given actor may be played by multiple different instances.



1.7: Alternate Path

Use Cases: Alternative Paths

For each significant action:

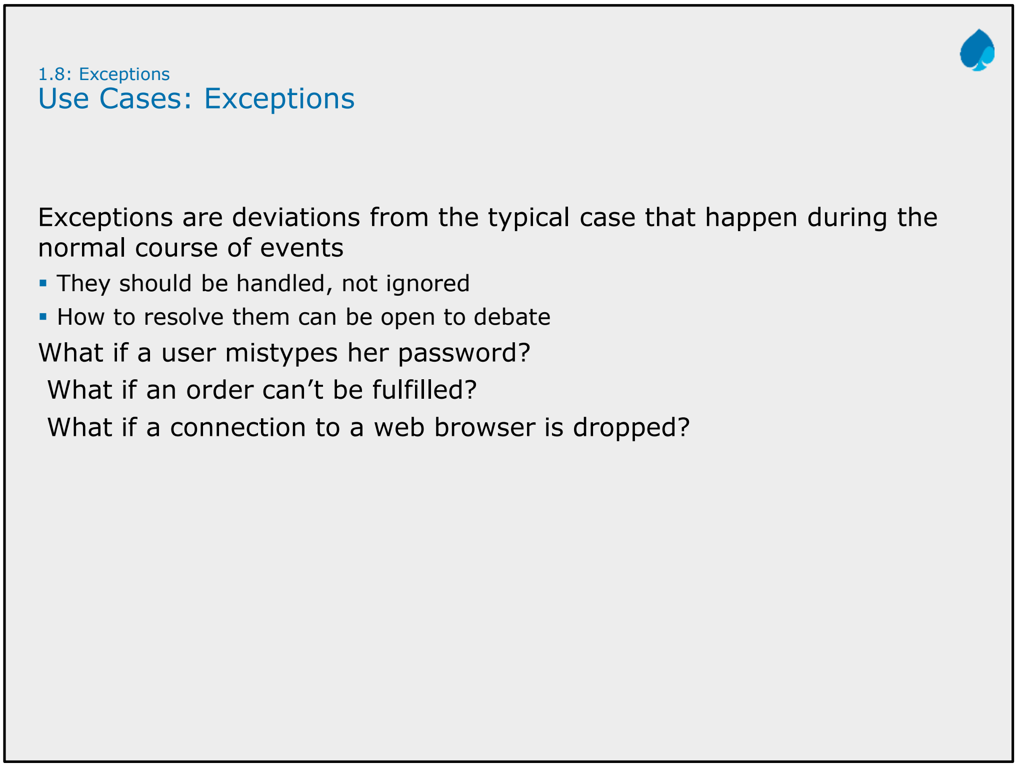
- Is there another significant way to accomplish it that could be taken at this point? (Variation)
- Is there something that could go wrong? (Exception)
- Is there something that could go really, really wrong (Error)

When you have a particular task that can be accomplished in two ways. One normal way is the basic path and the other way is alternate path.

While following the basic path, there is a possibility of occurrence of some problems which will be captured in the exception flow.

And if some error occur, which cannot be handled, then it is error flow.
Example

In a human resources system, for the “Hire Employee”
use case, the following scenarios may apply:
Typical success scenario: Hire a person from outside of the company, for example, from another company
Alternative success scenario: Hire a person from within the same company, for instance, from another division
Exceptional failure scenario: No qualified person could be hired



1.8: Exceptions

Use Cases: Exceptions

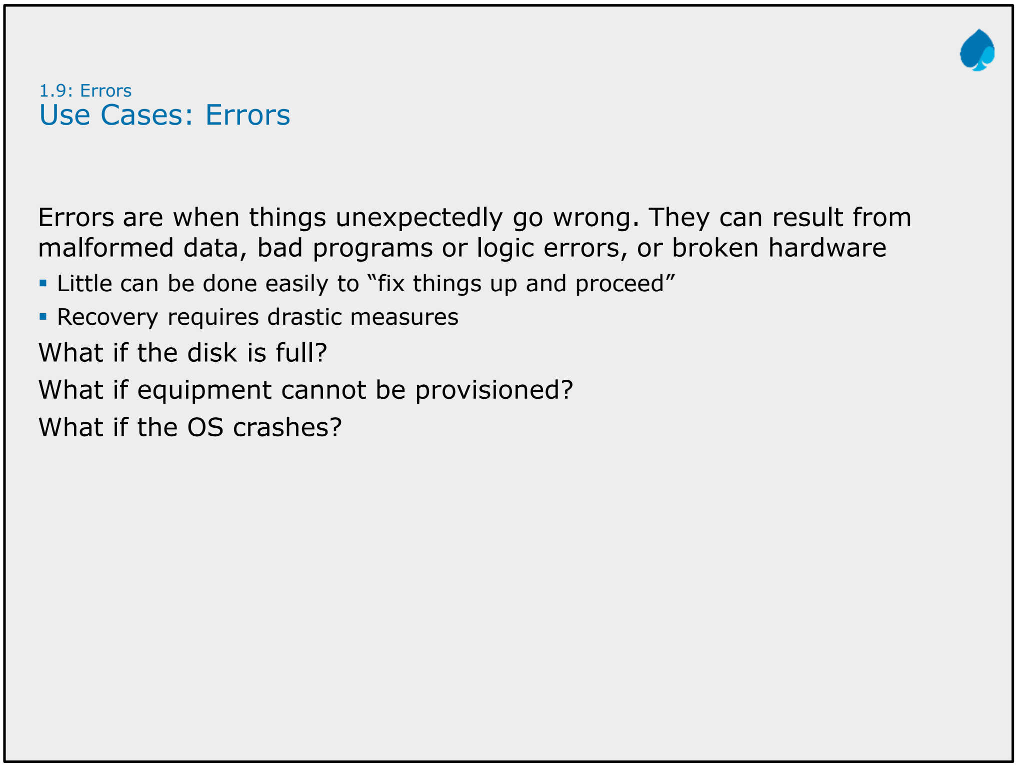
Exceptions are deviations from the typical case that happen during the normal course of events

- They should be handled, not ignored
- How to resolve them can be open to debate

What if a user mistypes her password?

What if an order can’t be fulfilled?

What if a connection to a web browser is dropped?



1.9: Errors

Use Cases: Errors

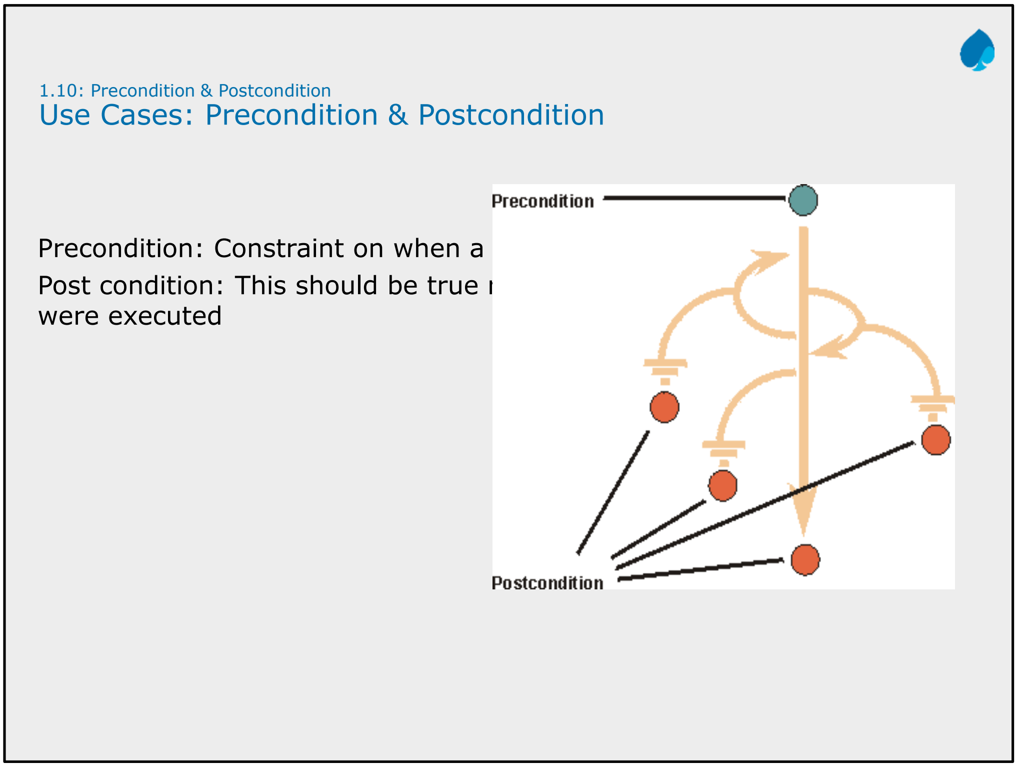
Errors are when things unexpectedly go wrong. They can result from malformed data, bad programs or logic errors, or broken hardware

- Little can be done easily to “fix things up and proceed”
- Recovery requires drastic measures

What if the disk is full?

What if equipment cannot be provisioned?

What if the OS crashes?



1.10: Precondition & Postcondition

Use Cases: Precondition & Postcondition

Precondition: Constraint on when a

Post condition: This should be true r
were executed

The states described by pre- or postconditions should be states that the user can observe. "The user has logged on to the system" or "The user has opened the document" are examples of observable states.

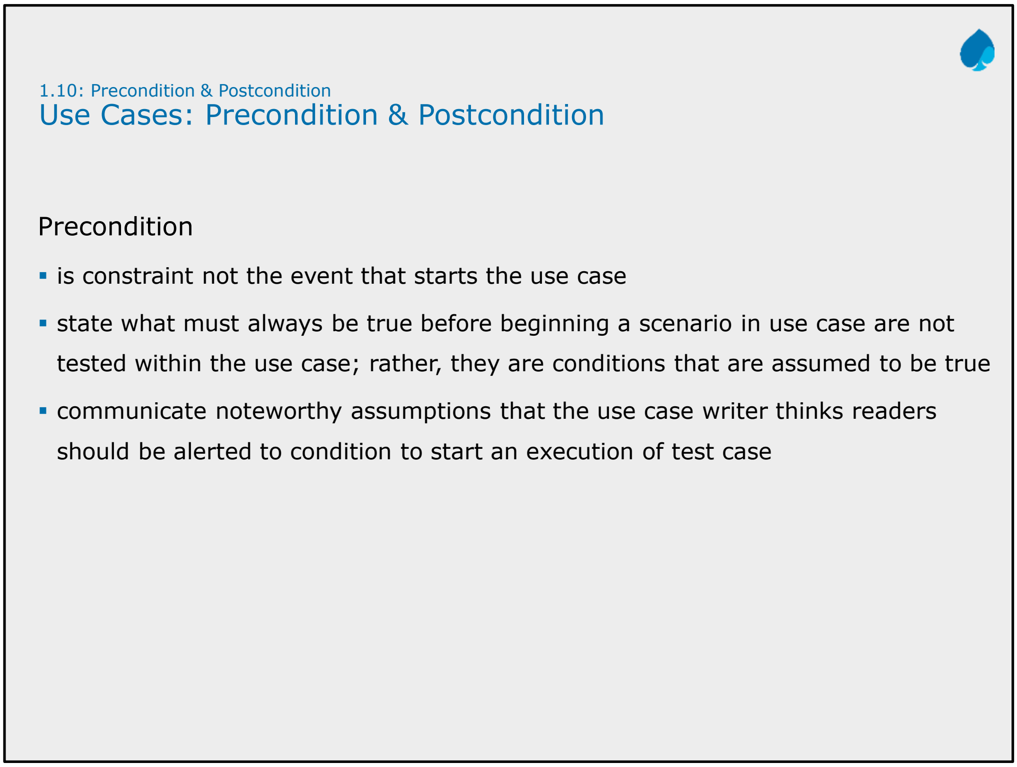
A precondition is a constraint on when a use case can start. It is not the event that starts the use case.

A precondition for a use case is not a precondition for only one subflow, although you can define preconditions and postconditions at the subflow level.

A postcondition for a use case should be true regardless of which alternative flows were executed; it should not be true only for the main flow. If something could fail, you would cover that in the postcondition by saying "The action is completed, or if something failed, the action is not performed", rather than just "The action is completed".

When you use postconditions together with extend-relationships, you should take care that the extending use case does not introduce a subflow that violates the postcondition in the base use case.

postconditions can be a powerful tool for describing use cases. You first define what the use case is supposed to achieve, the postcondition. You can then describe how to reach this condition (the flow of events needed).



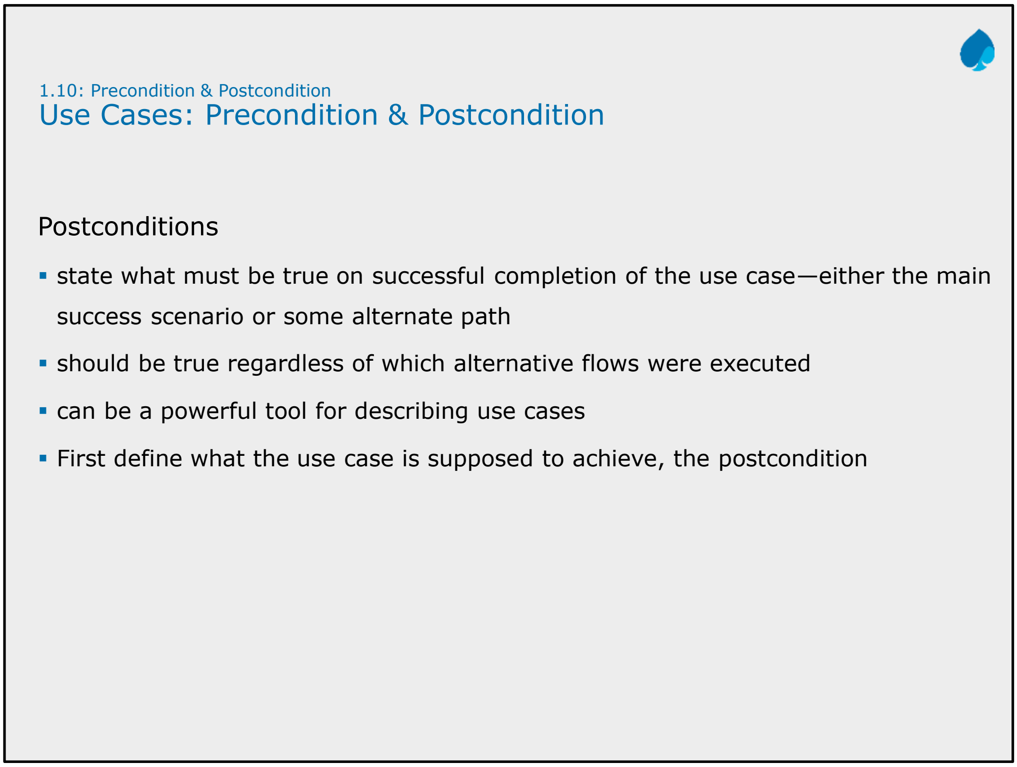
1.10: Precondition & Postcondition

Use Cases: Precondition & Postcondition

Precondition

- is constraint not the event that starts the use case
- state what must always be true before beginning a scenario in use case are not tested within the use case; rather, they are conditions that are assumed to be true
- communicate noteworthy assumptions that the use case writer thinks readers should be alerted to condition to start an execution of test case

For e.g. To open a new bank account, some pre conditions or constraints are applied as follows.
Applicant must be 18 years of age or older and reside in the European Union.
E.g “Cashier is identified and authenticated”



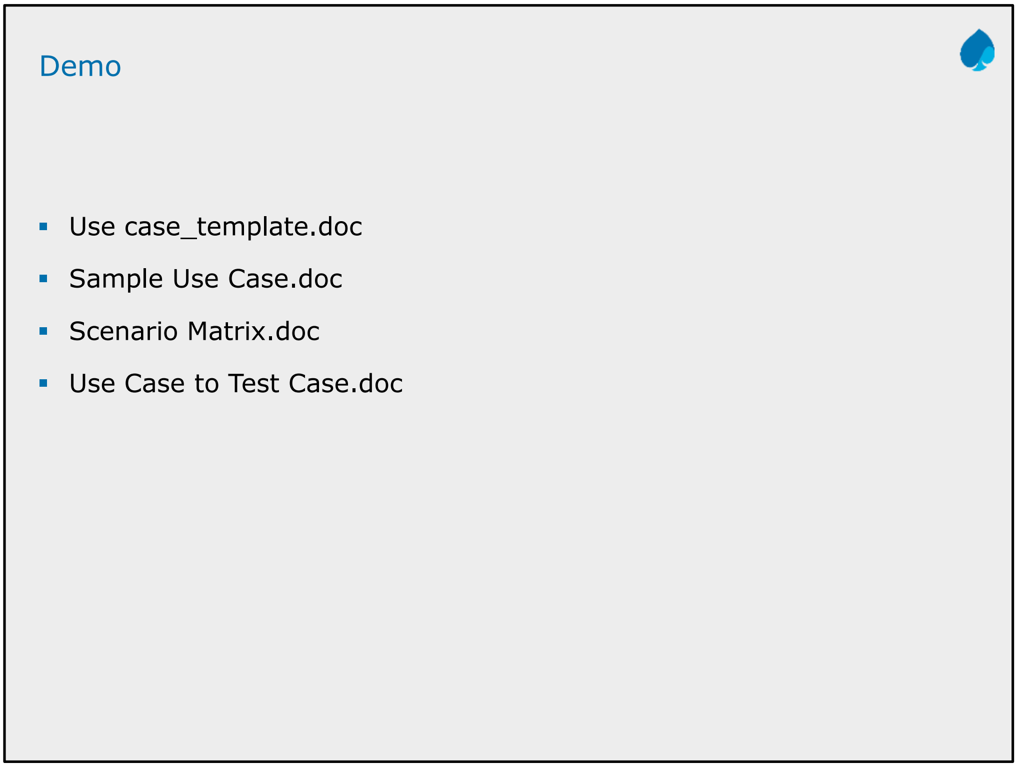
1.10: Precondition & Postcondition

Use Cases: Precondition & Postcondition

Postconditions

- state what must be true on successful completion of the use case—either the main success scenario or some alternate path
- should be true regardless of which alternative flows were executed
- can be a powerful tool for describing use cases
- First define what the use case is supposed to achieve, the postcondition

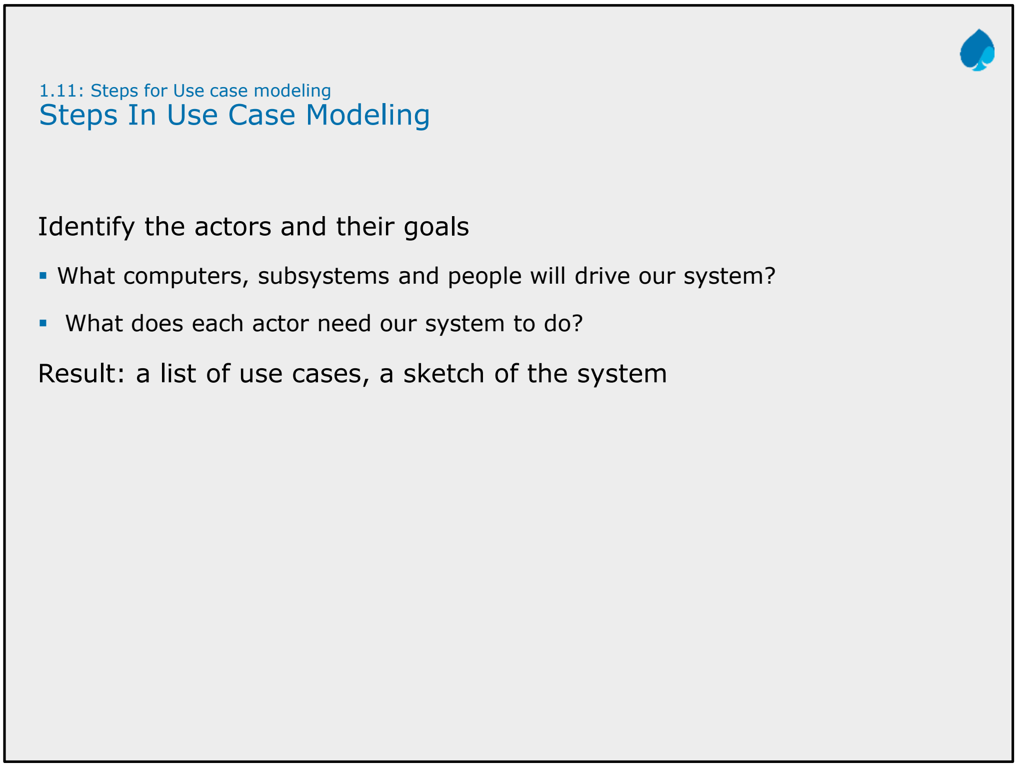
For e.g. After the business process for opening an account is done, Customer is informed of creation of new account or Customer is informed of rejected application. This is the post condition for the scenario.



Demo

- Use case_template.doc
- Sample Use Case.doc
- Scenario Matrix.doc
- Use Case to Test Case.doc

Add the notes here.



1.11: Steps for Use case modeling

Steps In Use Case Modeling

Identify the actors and their goals

- What computers, subsystems and people will drive our system?
- What does each actor need our system to do?

Result: a list of use cases, a sketch of the system

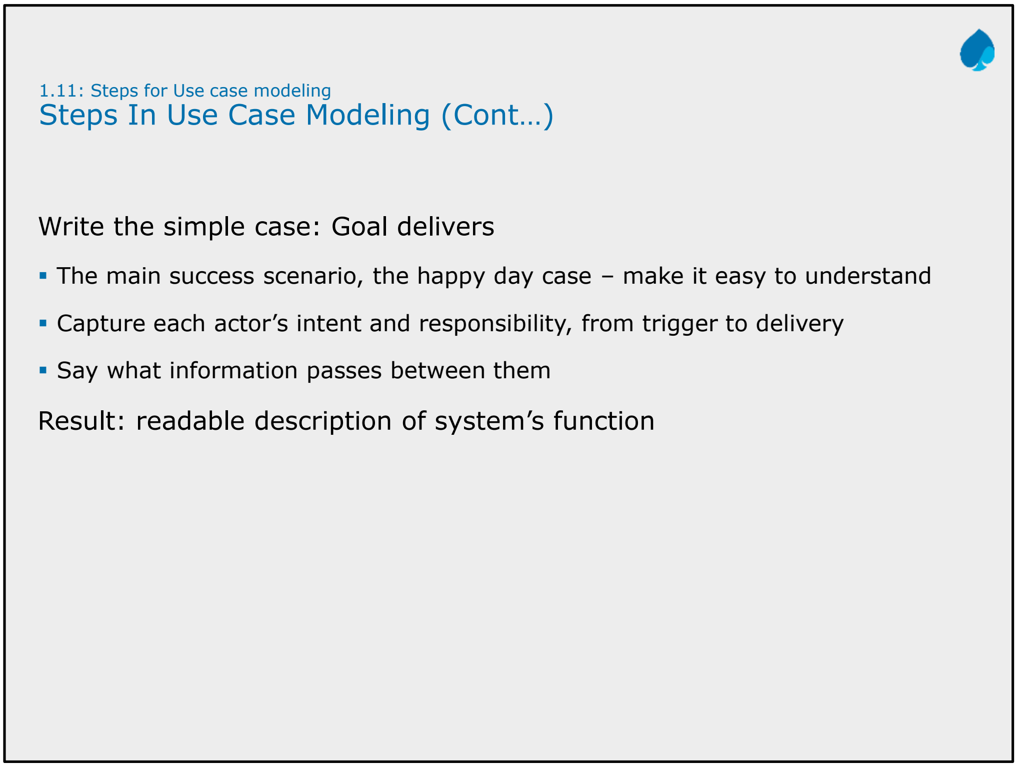
Tips: Identifying actors

Who uses the system?
Who gets information from this system?
Who provides information to the system?
Who installs, maintains the system?
Example:
Order management System:
Customer wants to place Order
Sales representative wants to view Orders
Customer wants to view Order status
Sales representative enters/modifies/deletes Order details
Administrator manages master data
Managers want to generate Sales Reports

So The Use cases are

Place Order
View Orders
Manage Orders
Generate Sales Reports

Actors:
Customer, Sales Rep., Administrator



1.11: Steps for Use case modeling

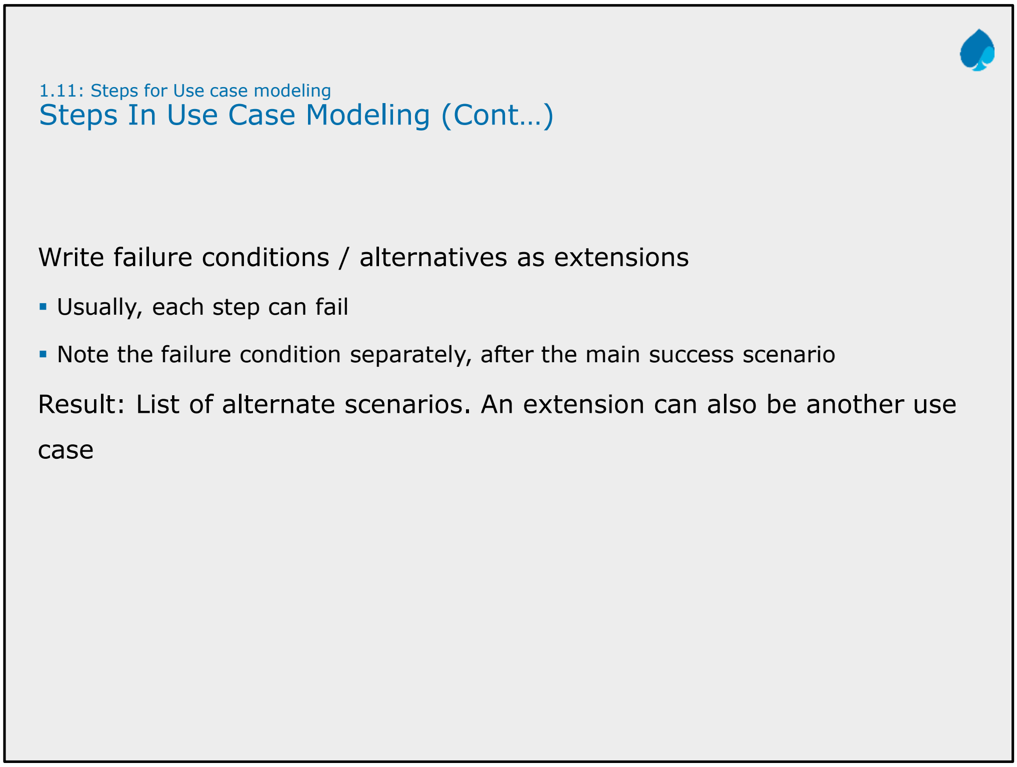
Steps In Use Case Modeling (Cont…)

Write the simple case: Goal delivers

- The main success scenario, the happy day case – make it easy to understand
- Capture each actor’s intent and responsibility, from trigger to delivery
- Say what information passes between them

Result: readable description of system’s function

Tips:
Show actor intent, not precise movements
Example: “User enters ID and Password” instead of “User enters ID, User enters Password”
Write actions that move the process forward
Example: “Validate” as opposed to “Check whether”



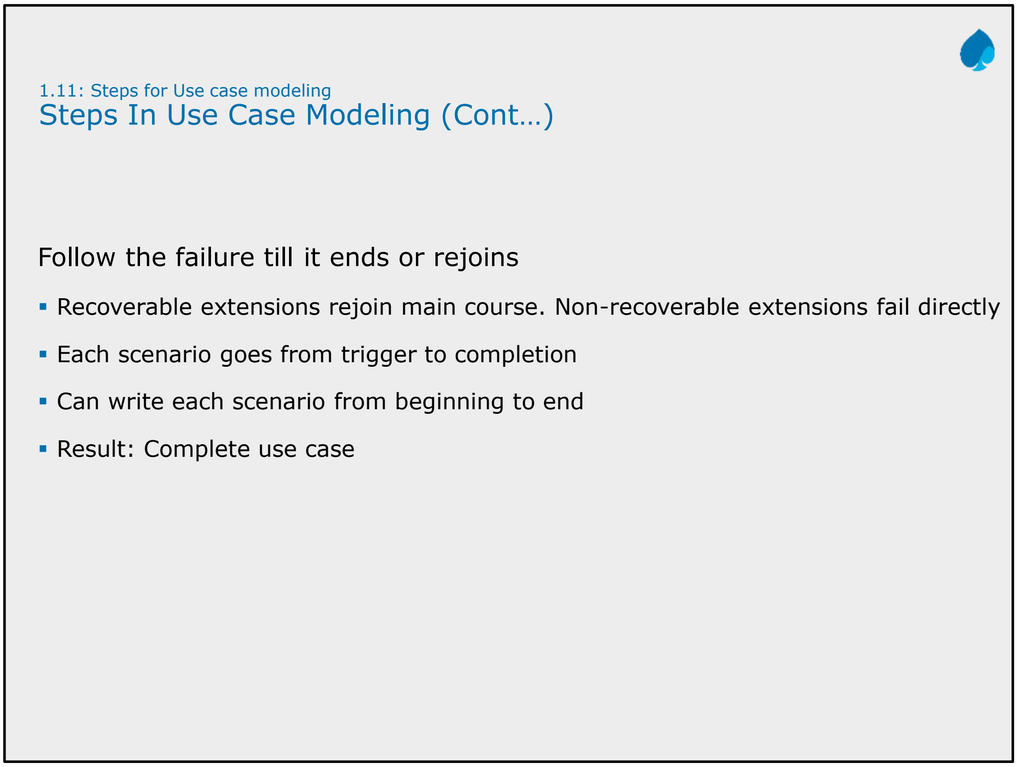
1.11: Steps for Use case modeling

Steps In Use Case Modeling (Cont…)

Write failure conditions / alternatives as extensions

- Usually, each step can fail
- Note the failure condition separately, after the main success scenario

Result: List of alternate scenarios. An extension can also be another use case

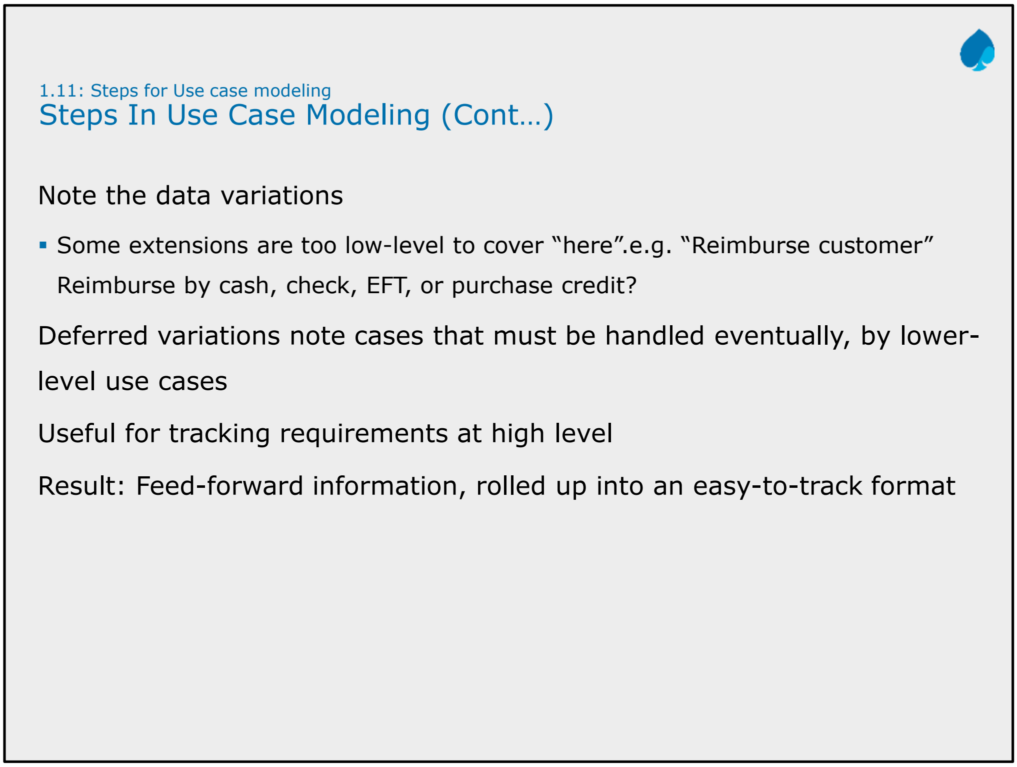


1.11: Steps for Use case modeling

Steps In Use Case Modeling (Cont…)

Follow the failure till it ends or rejoins

- Recoverable extensions rejoin main course. Non-recoverable extensions fail directly
- Each scenario goes from trigger to completion
- Can write each scenario from beginning to end
- Result: Complete use case



1.11: Steps for Use case modeling

Steps In Use Case Modeling (Cont…)

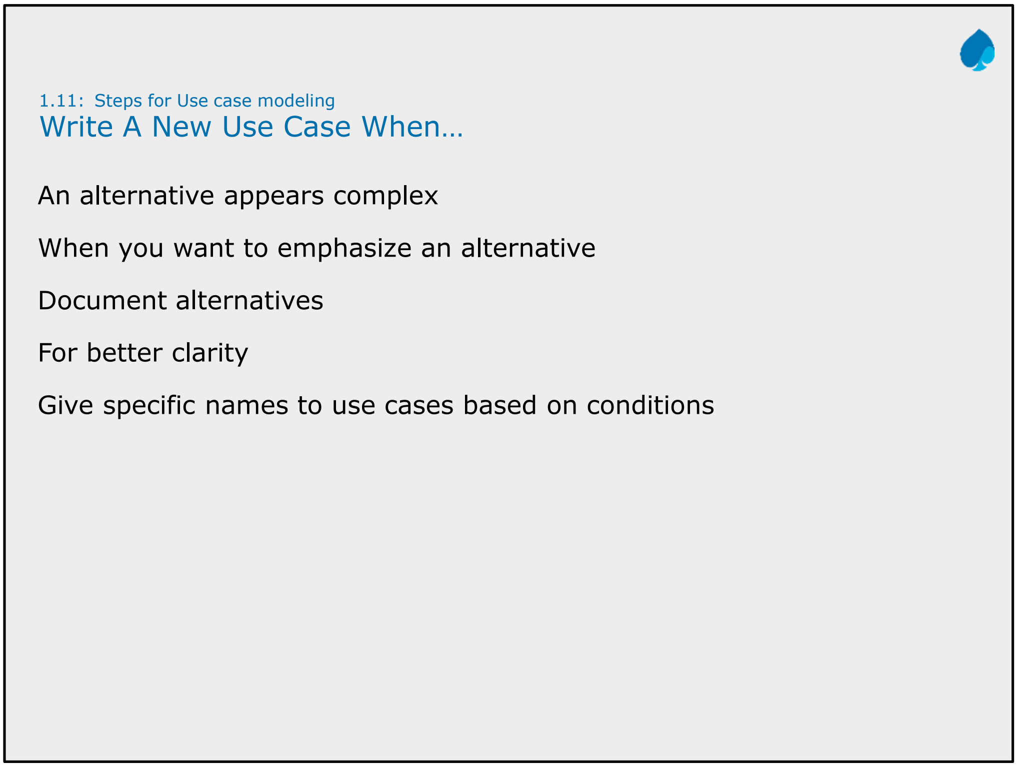
Note the data variations

- Some extensions are too low-level to cover "here".e.g. "Reimburse customer" Reimburse by cash, check, EFT, or purchase credit?

Deferred variations note cases that must be handled eventually, by lower-level use cases

Useful for tracking requirements at high level

Result: Feed-forward information, rolled up into an easy-to-track format



1.11: Steps for Use case modeling

Write A New Use Case When…

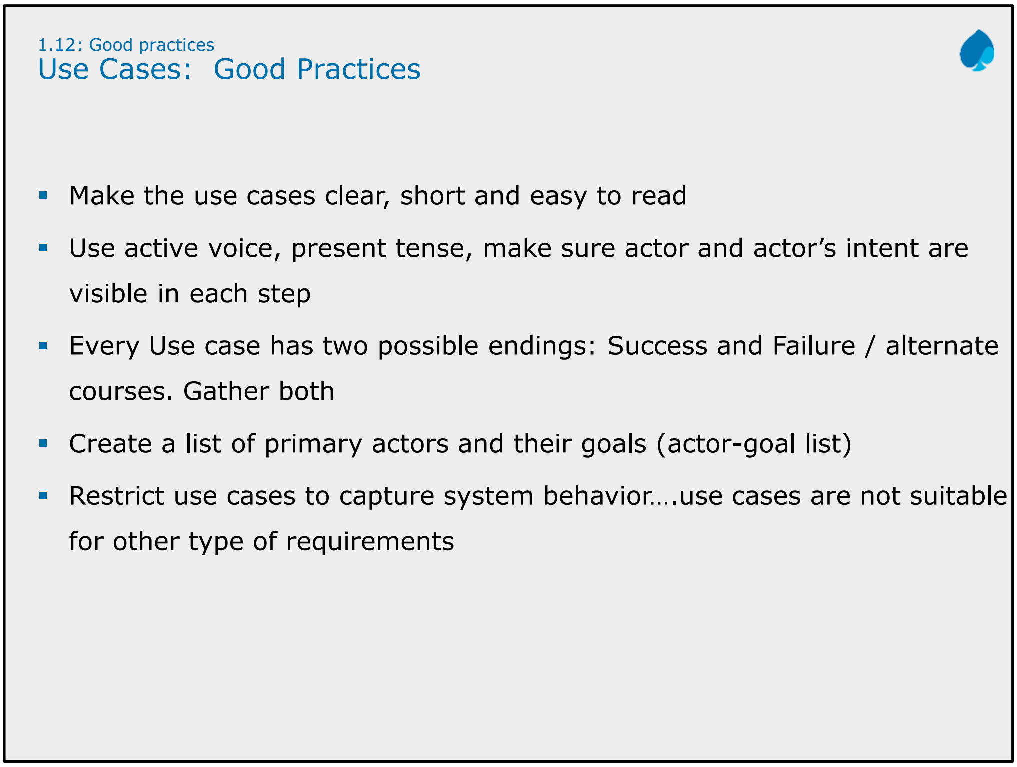
An alternative appears complex

When you want to emphasize an alternative

Document alternatives

For better clarity

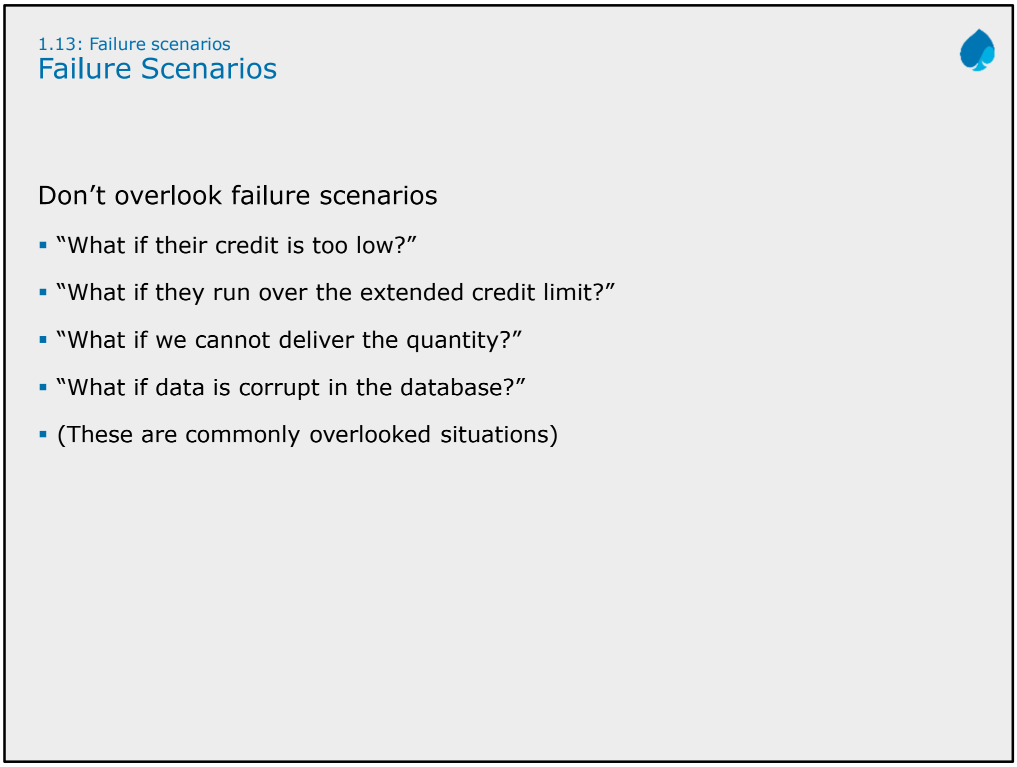
Give specific names to use cases based on conditions



1.12: Good practices

Use Cases: Good Practices

- Make the use cases clear, short and easy to read
- Use active voice, present tense, make sure actor and actor’s intent are visible in each step
- Every Use case has two possible endings: Success and Failure / alternate courses. Gather both
- Create a list of primary actors and their goals (actor-goal list)
- Restrict use cases to capture system behavior….use cases are not suitable for other type of requirements

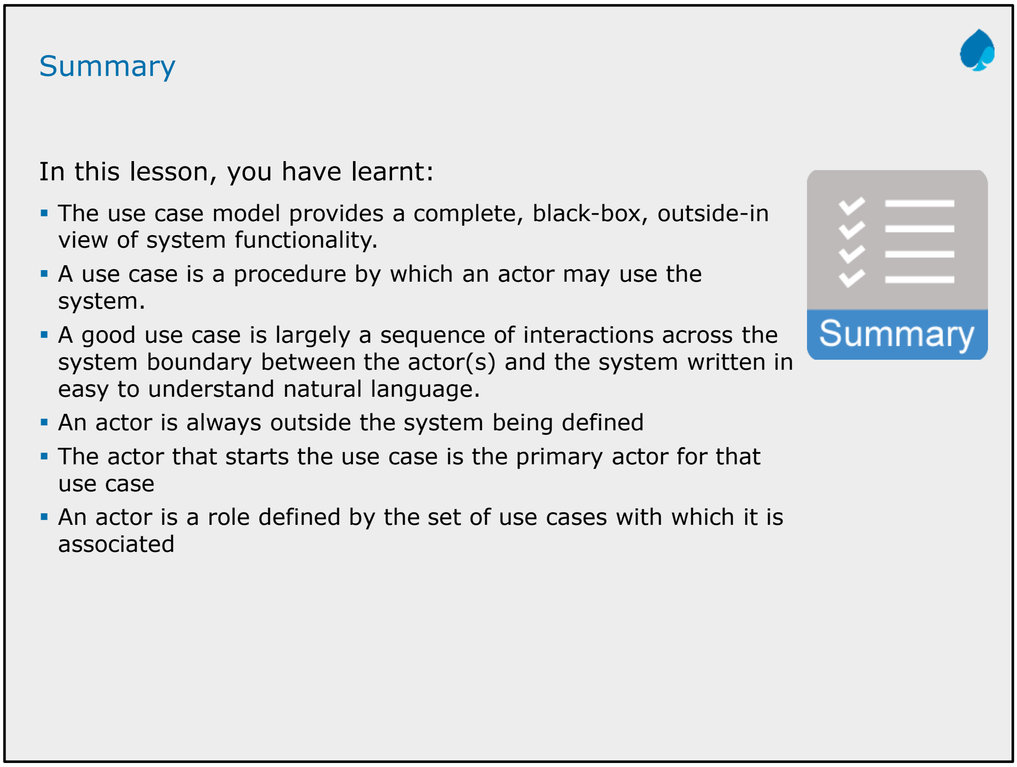


1.13: Failure scenarios

Failure Scenarios

Don’t overlook failure scenarios

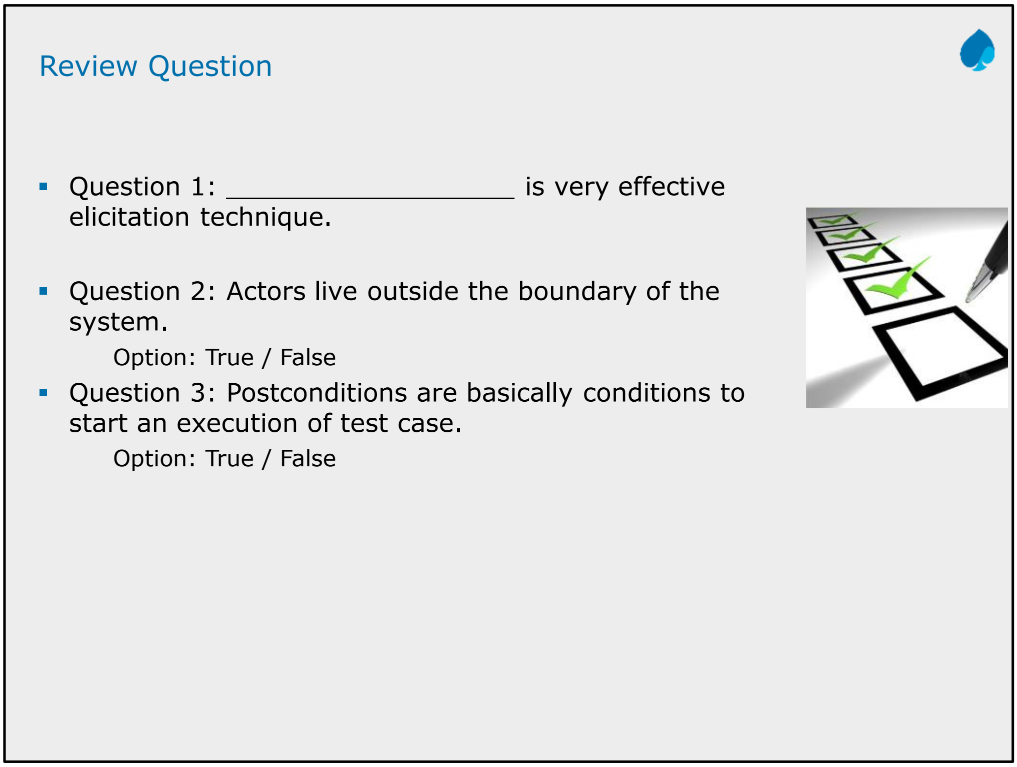
- “What if their credit is too low?”
- “What if they run over the extended credit limit?”
- “What if we cannot deliver the quantity?”
- “What if data is corrupt in the database?”
- (These are commonly overlooked situations)



Summary

In this lesson, you have learnt:

- The use case model provides a complete, black-box, outside-in view of system functionality.
- A use case is a procedure by which an actor may use the system.
- A good use case is largely a sequence of interactions across the system boundary between the actor(s) and the system written in easy to understand natural language.
- An actor is always outside the system being defined
- The actor that starts the use case is the primary actor for that use case
- An actor is a role defined by the set of use cases with which it is associated

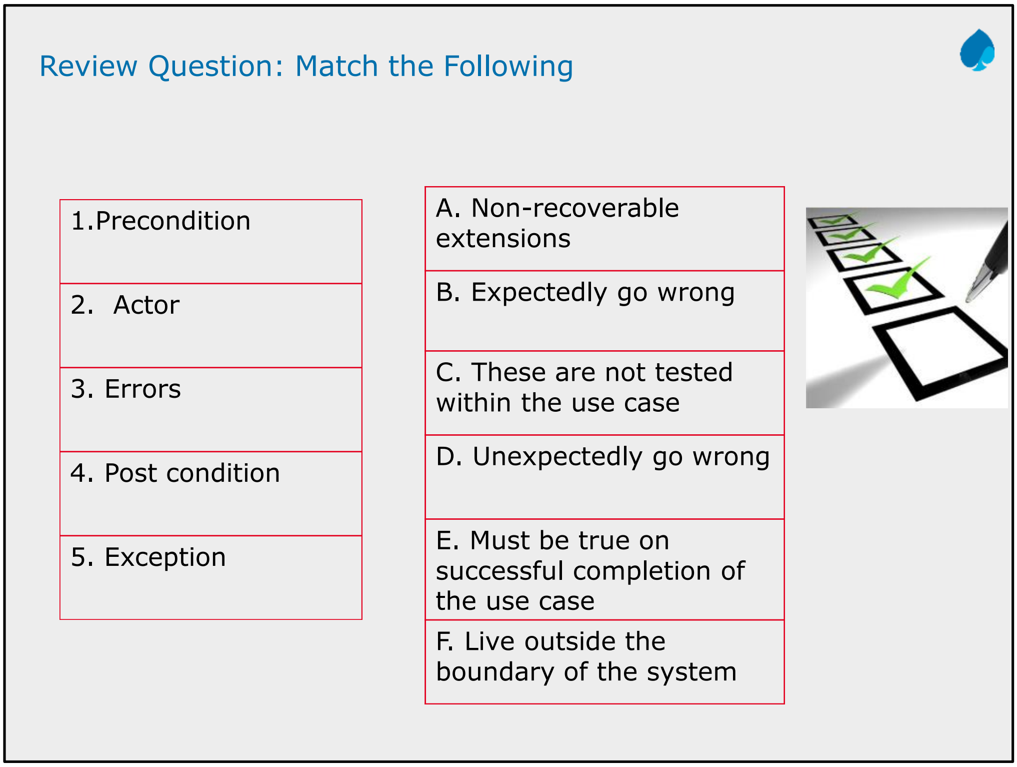


Review Question

- Question 1: ____________________ is very effective elicitation technique.
- Question 2: Actors live outside the boundary of the system.

  Option: True / False
- Question 3: Postconditions are basically conditions to start an execution of test case.

  Option: True / False



Review Question: Match the Following

1.Precondition

2. Actor

3. Errors

4. Post condition

5. Exception

A. Non-recoverable extensions

B. Expectedly go wrong

C. These are not tested within the use case

D. Unexpectedly go wrong

E. Must be true on successful completion of the use case

F. Live outside the boundary of the system