

# Software Analysis

Software Engineering  
Prof. Maged Elaasar

# Learning Objectives

- Learn the motivations for software analysis
- Learn the basics of object-oriented software analysis
- Learn how to capture software specification using the UML notation

# Why is it important to analyze a problem?



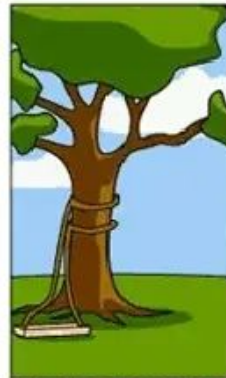
How the customer explained it



How the project leader understood it



How the engineer designed it



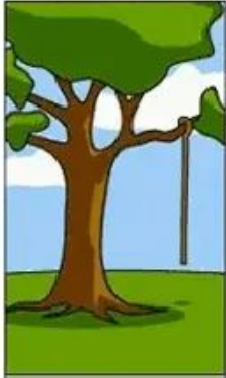
How the programmer wrote it



How the sales executive described it



How the project was documented



What operations installed



How the customer was billed



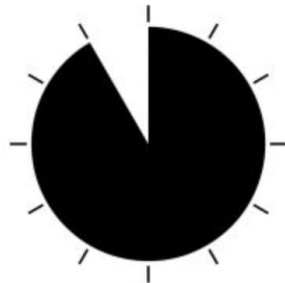
How the helpdesk supported it



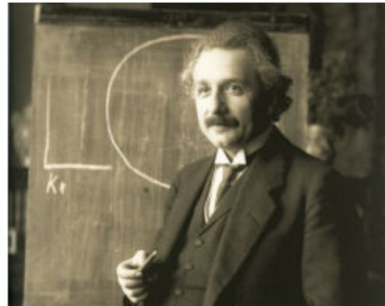
What the customer really needed

# Even Einstein agrees

**I Would Spend 55 Minutes  
Defining the Problem and then  
Five Minutes Solving It**



**55 Minutes**



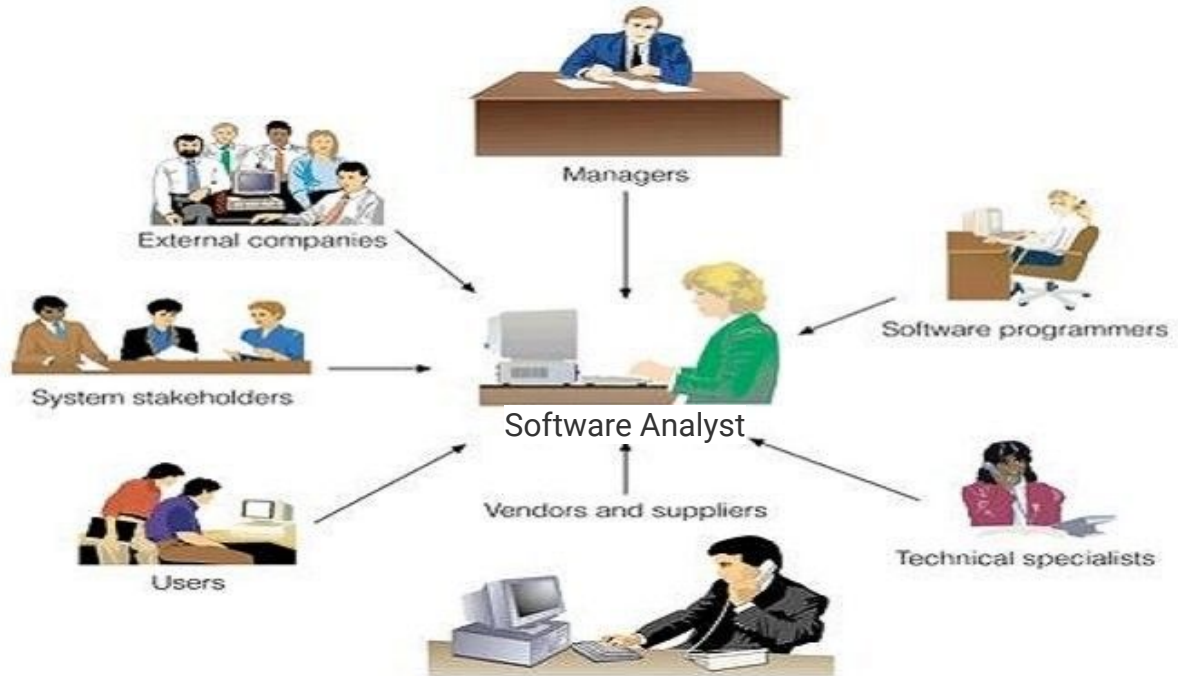
**Albert Einstein**

# Why do we analyze software?

- Scope description
- Cost estimating
- Project scheduling
- Software design
- Software testing
- User documentation

# What does a software analyst do?

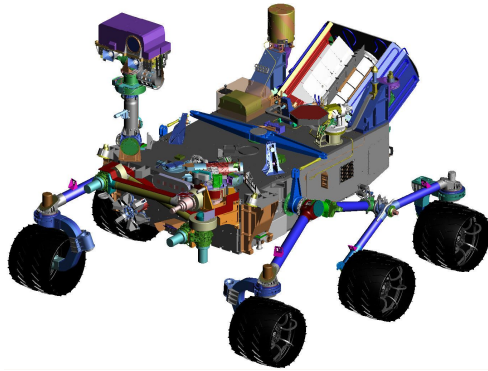
- Solicit Requirements
- Document Requirements
- Review Requirements



# Software Analysis Quiz

- How would you solicit requirements?
- How would you document requirements?
- How would you review requirements?

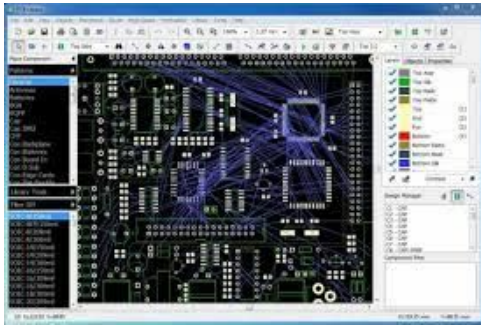
# How do engineers analyze requirements?



Mechanical



Construction



Electronic

Model

?

Software



# Modeling a problem

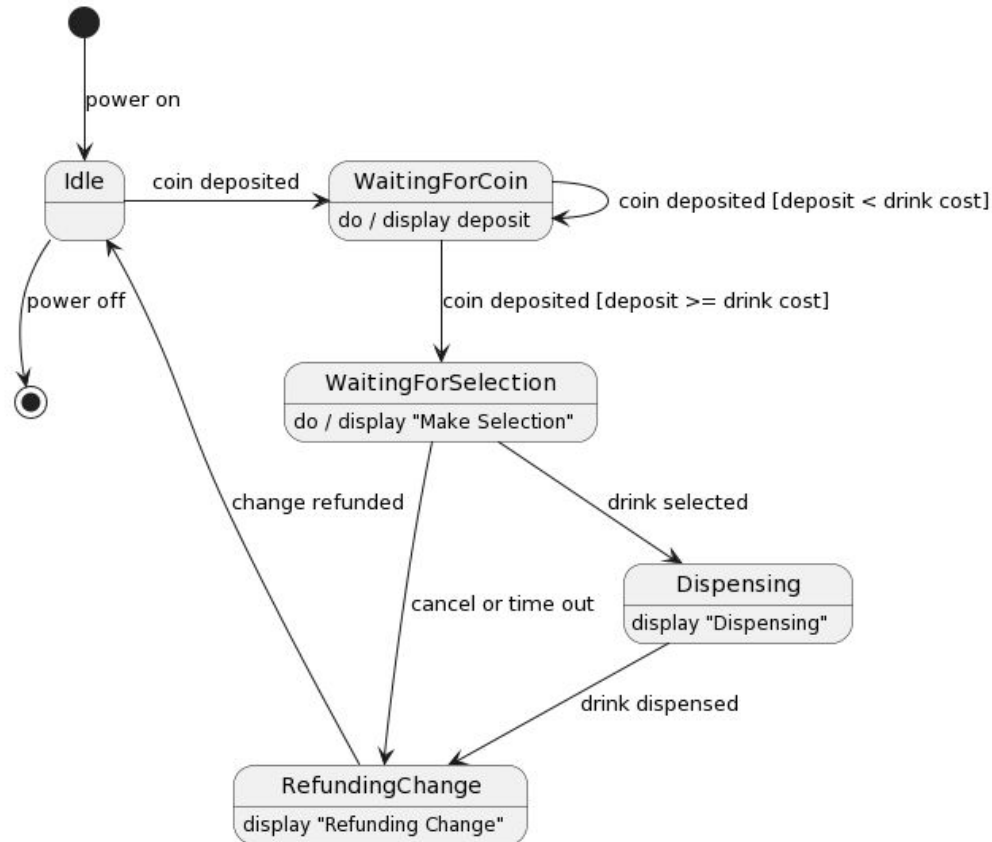
- **Model selectively:** you need not (and should not) model all details
- **Model collaboratively:** use models to think, share, learn and understand
- **Model smartly:** start rough and refine as needed

# Class Exercise: Soda Vending Machine

1. As a software analyst, take a few minutes to sketch a simple model of how a soda vending machine should work.  
[ assume all drinks cost the same]
2. Give the model to the person next to you and ask them to explain it back to you



# Soda Vending Machine Behavior



# Unified Modeling Language

- A family of graphical notations to describe and analyze software systems, especially those using an object-oriented approach
- Based on standards managed by the Object Management Group (OMG)
- Releases: UML1 (1997), UML2 (2005), UML 2.5 (2015)
- <https://www.omg.org/spec/UML/About-UML/>



# UML Diagram Types

1

## Structure

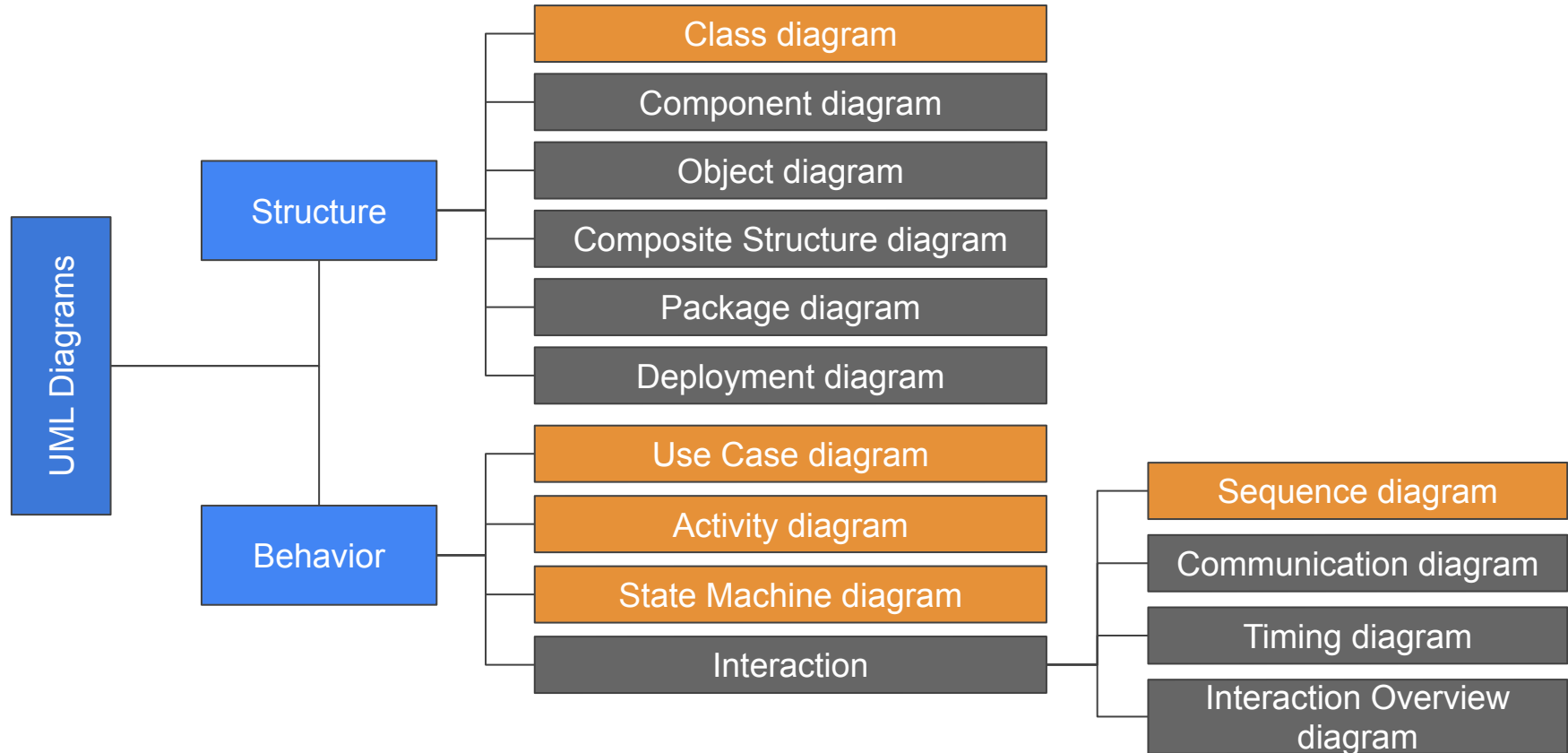
Represents static  
view of the system  
and its components

2

## Behavior

Represents dynamic  
view of the system  
and its components

# UML Diagrams

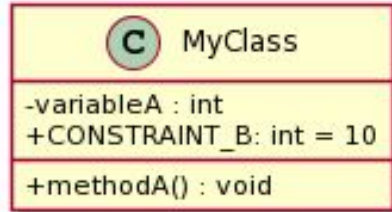


# UML Tools

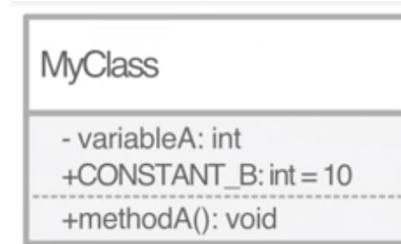
Name	Creator	Platform / OS	First public release	Latest stable release	Open source	Software license	Programming language used
ArgoUML	Tigris.org	Cross-platform (Java)	1998-04	2011-12-15 <sup>[1]</sup>	Yes	EPL	Java, C++ (as module)
Astah	ChangeVision, Inc. <sup>[2]</sup>	Cross-platform (Java)	2009-10-19	2019-11-27 (v8.2) <sup>[3]</sup>	No	Commercial. Free education edition, subscription model	Java
ATL	Obeo, INRIA Free software community	Cross-platform (Java)	Unknown	2020-06-22 (4.2.1) <sup>[4]</sup>	Yes	EPL	Java
Micro Focus Together	Micro Focus	Cross-platform (Java)	Unknown	2008 (v12.6) <sup>[5]</sup>	No	Commercial	Unknown
Draw.io	NOME Office	Cross-platform	2005-02-26	2020-03-01	No	Free from v7.0, Commercial starting from v5.0 up to v6.12,GPL before v5.0 <sup>[6]</sup>	C++/Qt and Java ("plug-out")
		Windows 7+, Mac OS X	2010-10	Website frequently updated	No	Commercial, Free edition available	HTML5
		Windows	2004	2020 (v15)	No	Commercial	C#
		Windows, macOS	1993	2017-11-07 (v11) <sup>[7]</sup>	No	Commercial	Unknown
		Cross-platform (GTK+)	1998-08-31 <sup>[8]</sup>	2014-09-05 (v0.97.3) <sup>[9]</sup>	Yes	GPL	C
Eclipse UML2 Tools <sup>[10]</sup>	Eclipse Foundation	Cross-platform (Java)	2007	2020-03-02 (v5.5.1) <sup>[11]</sup>	Yes	EPL <sup>[12]</sup>	Java
Edraw Max	Edrawsoft	Windows, Linux, macOS	2004	2020-07-30 (v10.0.5) <sup>[13]</sup>	No	Commercial	C++
Enterprise Architect	Spice Systems	Windows (supports Linux and macOS installation)	2000	2020-06-09 (v15.1 Build 1529) <sup>[14]</sup>	No	Commercial	C++
PlantUML	Systèmes company	Chrome, Safari, Firefox, Internet Explorer 9+	2006-08-01	Website frequently updated	No	Commercial, Free trial	HTML5 and JavaScript
		Cross-platform (Java)	2015-01-23	2020-09-03 (v3.0.1) <sup>[15]</sup>	Yes	GPL	Java
		Cross-platform (Java)	Unknown	2019-09 (v12c 12.2.1 4.0) <sup>[16]</sup>	No	Freeware	Java
		Windows, macOS, Linux, Solaris	2008-12	Website updated frequently	No	Commercial / Free (educational)	HTML5 and JavaScript
		Windows Vista SP2 and later, OS X Mountain Lion and later, or Linux <sup>[17]</sup>	1998	2006-06-29 (v19.0 LTR SP4) <sup>[18]</sup>	No	Commercial	Java
Microsoft Visio	Microsoft	Windows	1992	2016 (v16.0)	No	Commercial	Unknown
Microsoft Visual Studio	Microsoft	Windows	1997-02	2016-06-27	No	Community & Express editions: Registerware, Enterprise, Professional & Others editions: Trialware	C++, C#
Modelo	Modelosoft (SOFTAM Group)	Windows, Linux, macOS	2009	2020-02-03 (4.0.1) <sup>[19]</sup>	Yes	Core tool: GPL, Extensions: Apache License <sup>[20]</sup>	Java <sup>[21]</sup>
Microsoft Visio	Age Atomique, Atos Origin	Windows, Linux	2003 <sup>[22]</sup>	Unknown	No	Commercial	Java
		Windows, macOS, Linux, Unix	2006-10-15	2019-09-27 (v2.7.0) <sup>[23]</sup>	Yes	GPL <sup>[24]</sup>	C# <sup>[25]</sup>
		Windows, macOS, Linux, Unix	1996	2013-02-21	Yes	CC0 or GPL2	Java
		Cross-platform (Java)	2002-02	2009-11-04	Yes	GPL	Java
		Windows, Linux, macOS (Java)	2013-06-27	2020-06 (v4.8.0) <sup>[27]</sup>	Yes	EPL	Java
PlantUML	Arnaud Roques	Cross-platform (Java)	2009-04-17	2020-06-28 (v1.2020.15) <sup>[28]</sup>	Yes	GPL	Java
Posideon for UML	Genteware	Cross-platform (Java)	Unknown	2009	No	Commercial	Java
PowerDesigner	Sybase	Windows	1989	2018	No	Commercial	Unknown
Eclipse Papyrus	Eclipse Atomique, Atos Origin	Windows, Linux, OS X	2002	2018-02-07	No	Free, Commercial	Python, C, C++
		Windows	1996	2013-10-19	No	Commercial	C/C++
		Windows, Linux	1996	2019-04-23 (8.4.0) - 2019-12-15 (8.4 Interim Fix 2)	No	Commercial	C, C++, Java, Ada
		Windows, Linux, Unix	Unknown	Unknown	No	IBM EULA	Unknown
		Windows, Linux	Unknown	2015-09-18	No	IBM EULA	Java/C++
Rational Software Modeler	IBM	Windows, Linux	2004-10-13	2008-09	No	IBM EULA	Unknown
Rational System Architect	IBM	Windows	Unknown	2013-03-15	No	Commercial	Unknown
Reactive Blocks	Bitreactive	Windows, macOS, Linux	2011-11-13	2016-09-16	No	Commercial, Free Community Edition	Java
Magic Draw	GISE to Blockchain Software	Windows (.NET)	2008	2010-09-03	No	Freeware	C#
		Windows (.NET), Linux (Mono)	2009-08-06 <sup>[29]</sup>	2020-09-22 <sup>[30]</sup>	No	Commercial, Freeware for non-commercial use	C#
		Windows, macOS, Linux	2005-11-01	2018-08-17	No	Commercial	Delphi
		Unix-like: Windows	2003-01-24 <sup>[31]</sup>	2020-08-20 (v2.32) <sup>[32]</sup>	Yes	GPL	C++, KDE
		Windows, macOS, Linux	2012	2019-01-30 (v9.0.0) <sup>[33]</sup>	Yes	EPL	Java, Sirius
UModel	Altova	Windows, macOS, Linux	2005-11-05 <sup>[34]</sup>	2018-08-05 (v14.3) <sup>[35]</sup>	Yes	GPL	Java
		Windows	2005-05	2019-10-9	No	Commercial	Java, C#, Visual Basic
		Cross-platform: Java/Eclipse	2008	2020-07-23 (v1.30.0) <sup>[36]</sup>	Yes	MIT License	Java, PHP, JavaScript
		Cross-platform (Java)	2002-06-20	2020-07-23 (v16.2) <sup>[37]</sup>	No	Commercial, Free Community Edition	Java, C++
		Windows 7-10	2011-12-18	2018-03-25 (v5.8.1) <sup>[38]</sup>	Yes	GPL2	Delphi
WhiteStarUML	janszpiewski	Windows, macOS, Linux, Unix	Unknown	2020-05-04 (v3.20) <sup>[39]</sup>	No	Free	Java
yEd	yWorks GmbH	Windows, macOS, Linux, Unix	Unknown	2020-05-04 (v3.20) <sup>[39]</sup>	No	Free	Java
Name	Creator	Platform / OS	First public release	Latest stable release	Open source	Software license	Programming language used

# UML Notation

Some notation may vary from one tool to the other



Class in PlantUML



Class in MS-Visio



# PlantUML

- An open-source tool to create UML diagrams from a plain text language
- Can be integrated with software such as IDEs, Maven build framework, Github repositories, Java documentation, and Microsoft Word
- Online server at: <https://plantuml.com/plantuml/>

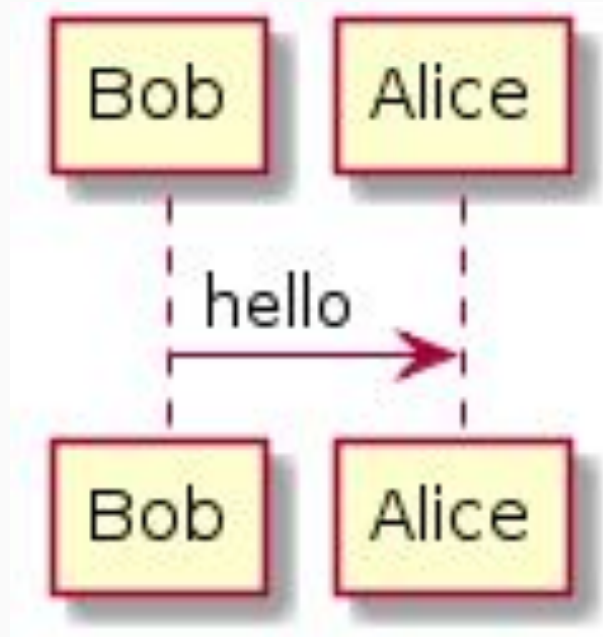


# PlantUML

@startuml

Bob -> Alice : hello

@enduml



# PlantUML

@startuml

actor Actor1

actor Actor2

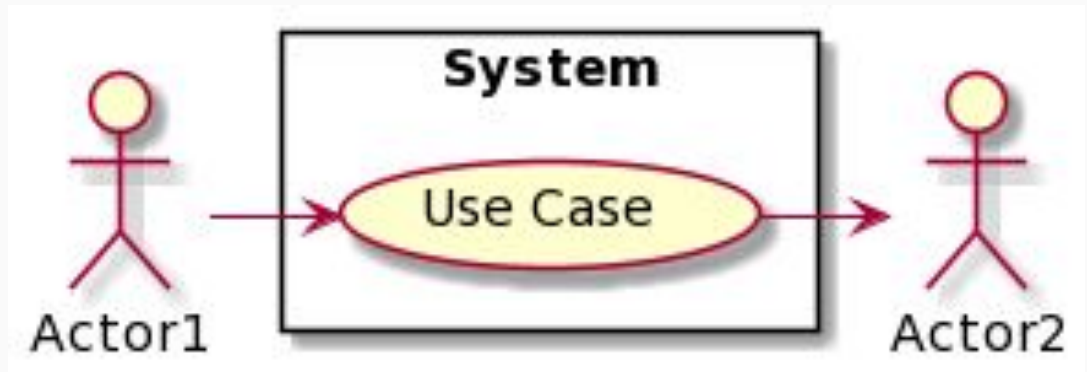
rectangle System {

Actor1 -> (Use Case)

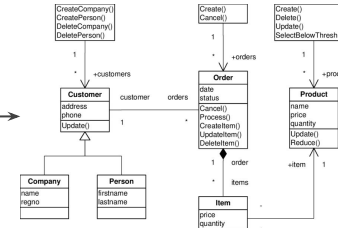
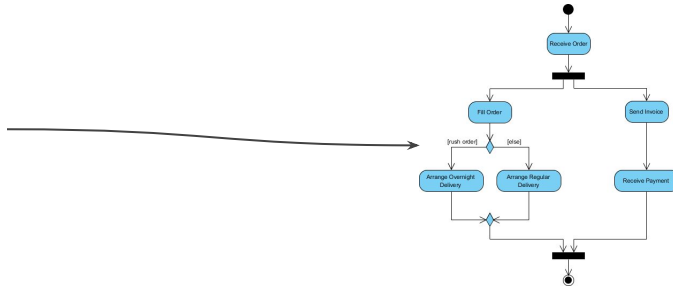
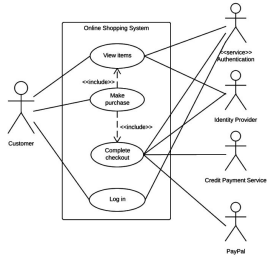
(Use Case) -> Actor2

}

@enduml



# Analysis Method with UML Diagrams



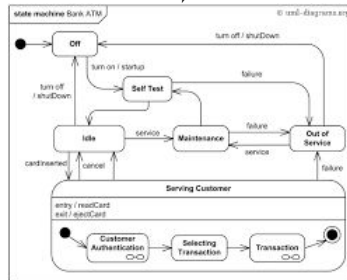
1 Identify system boundary, actors, external systems, and use cases with use case diagrams

2 Identify actions for every system, and the control / data flow between them with activity diagrams

3 Identify classes and interfaces with their attributes, operations and relations with class diagrams

5

Flesh out the internal behavior of complex entities with state machine diagrams



4

Capture how these entities interact with each other via messages using sequence diagrams

