Object Oriented Modeling

Overview of the Object Management Group (OMG)

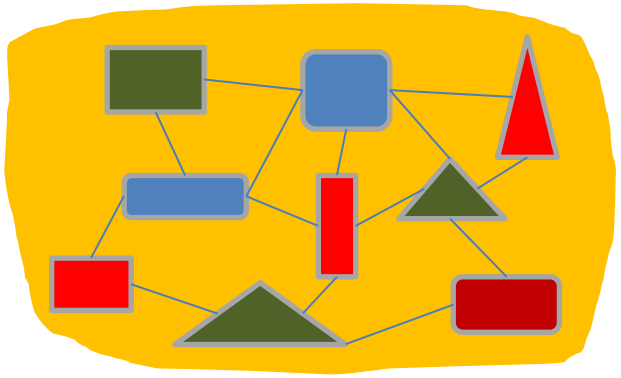
"A model is the explicit interpretation of one's understanding of a situation, or merely of one's ideas about that situation. It can be expressed in mathematics, symbols or words, but it is essentially a description of entities, processes or attributes and the relationships between them. It may be prescriptive or illustrative, **but above all, it must be useful.**"

Brian Wilson. Systems: Concepts, Methodologies and Applications. John Wiley and Sons, 1990, 2nd Edition, page 11

Structure and Behaviour

"The structural schema defines the types of the facts contained in the information base. These facts change over time, but they cannot change in any arbitrary way. Only some changes of the information base are permissible. These changes are called **domain events**. **The definition of the domain event types is the most important part of the behavioral schema**."

Conceptual Modeling of Information Systems, page 247

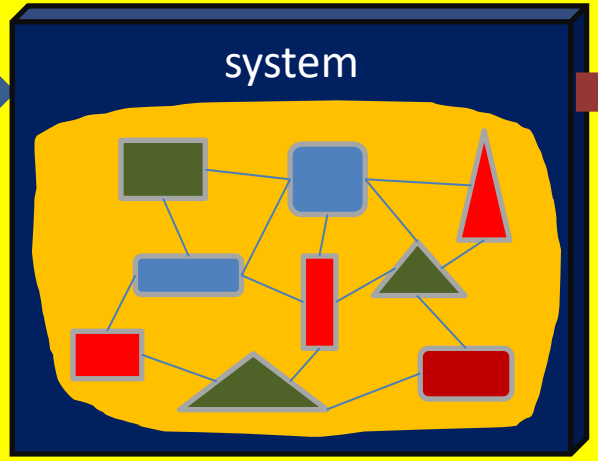


Systems and States

- **Memorize**: to maintain a representation of the state of its **domain**.
- **Inform**: to provide information about the state of its **domain**.
- **Act**: to perform actions that change the state of its **domain**.

http://www.logos-cards.com/game-details/rules

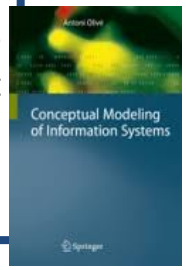
input



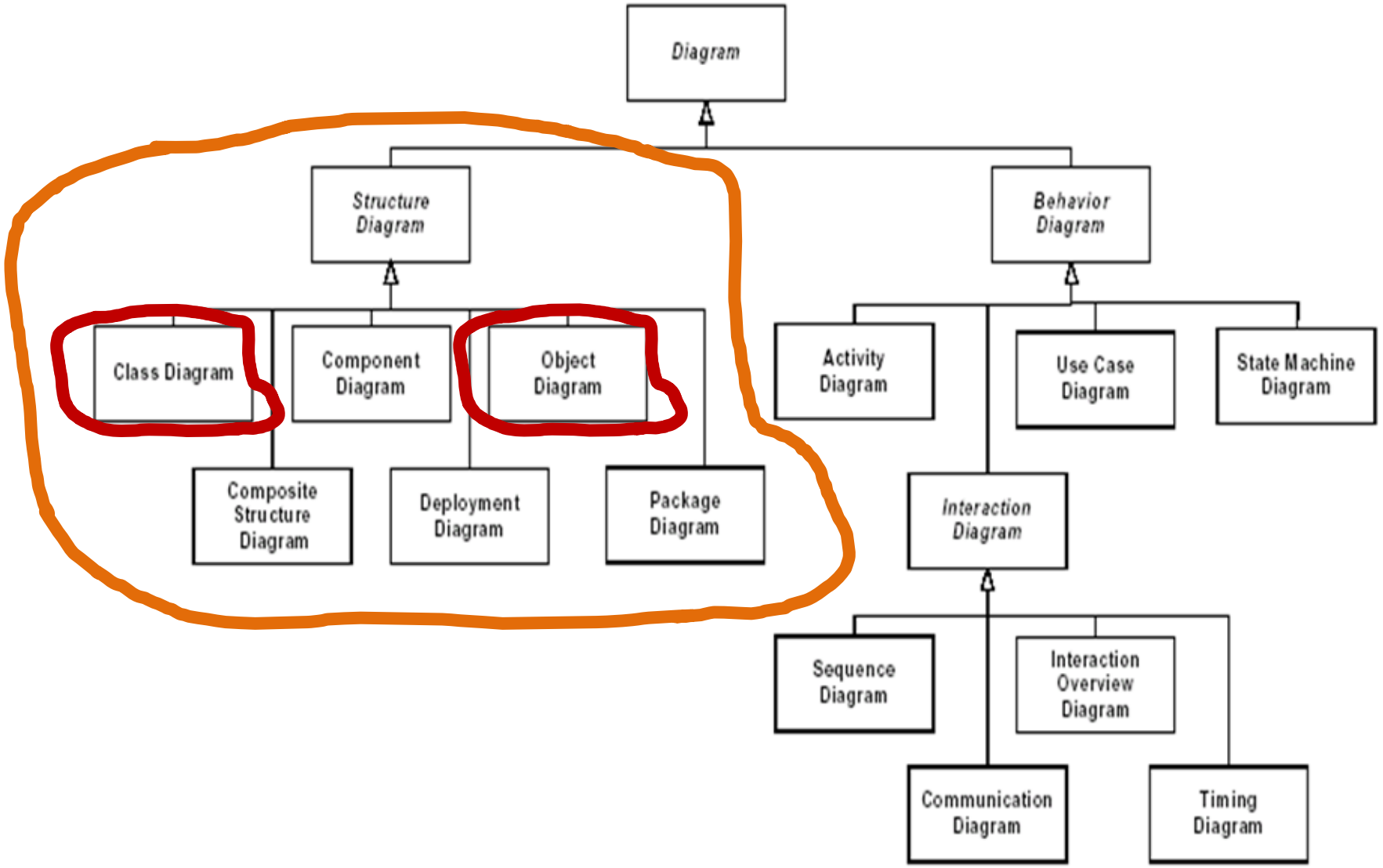
output

(…) The **state of a domain** at any given point in time is the set of instances of the relevant entity and relationship types that exist in the domain at that time. (…) Most domains change over time, and therefore their state changes too. When the state of a domain changes, the information base must change accordingly. Of course, a domain cannot change in an arbitrary way. Only some changes are acceptable. The acceptable changes are called **domain events**. This concept (of a domain event) can be defined precisely in terms of a more basic concept, called a structural event (…)

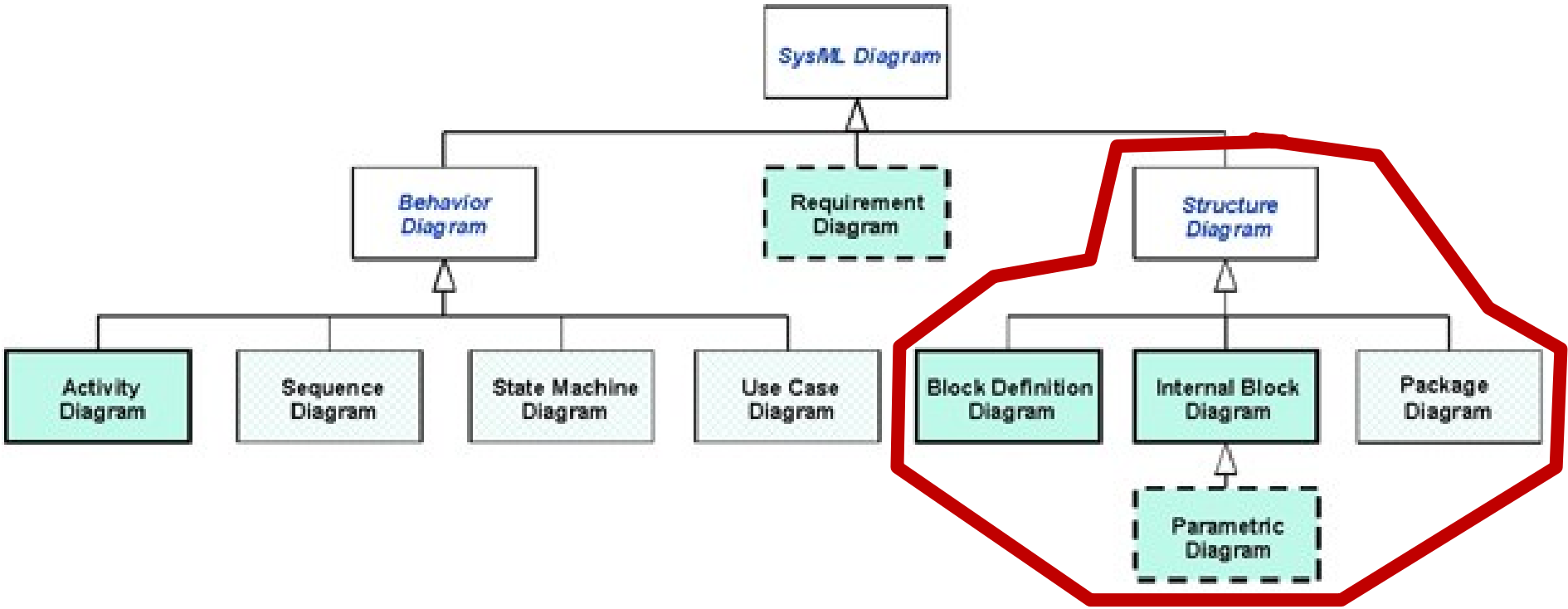
Conceptual Modeling of Information Systems, page 248



Structure Modelling in UML

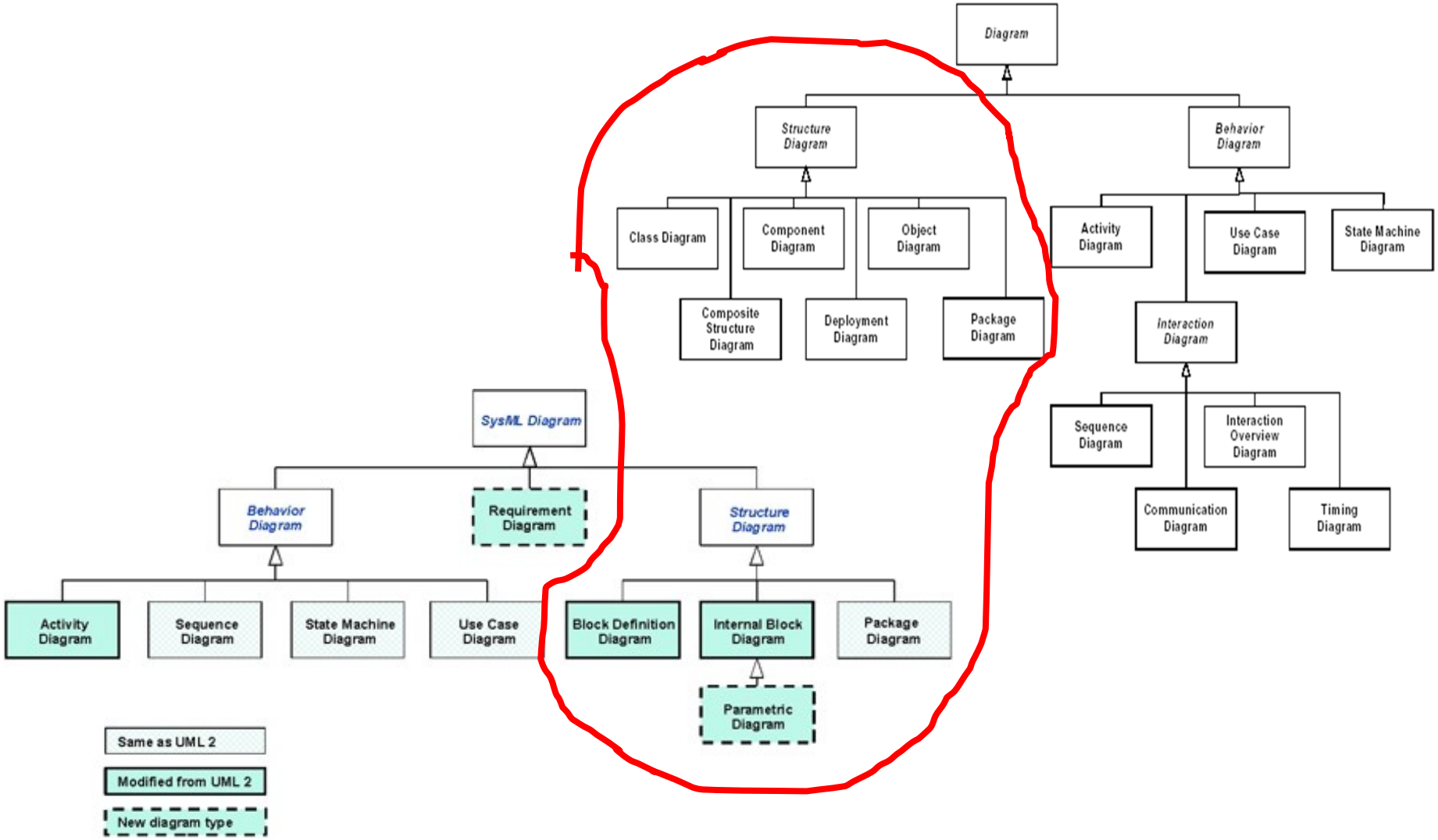


Structural Diagrams in SysML

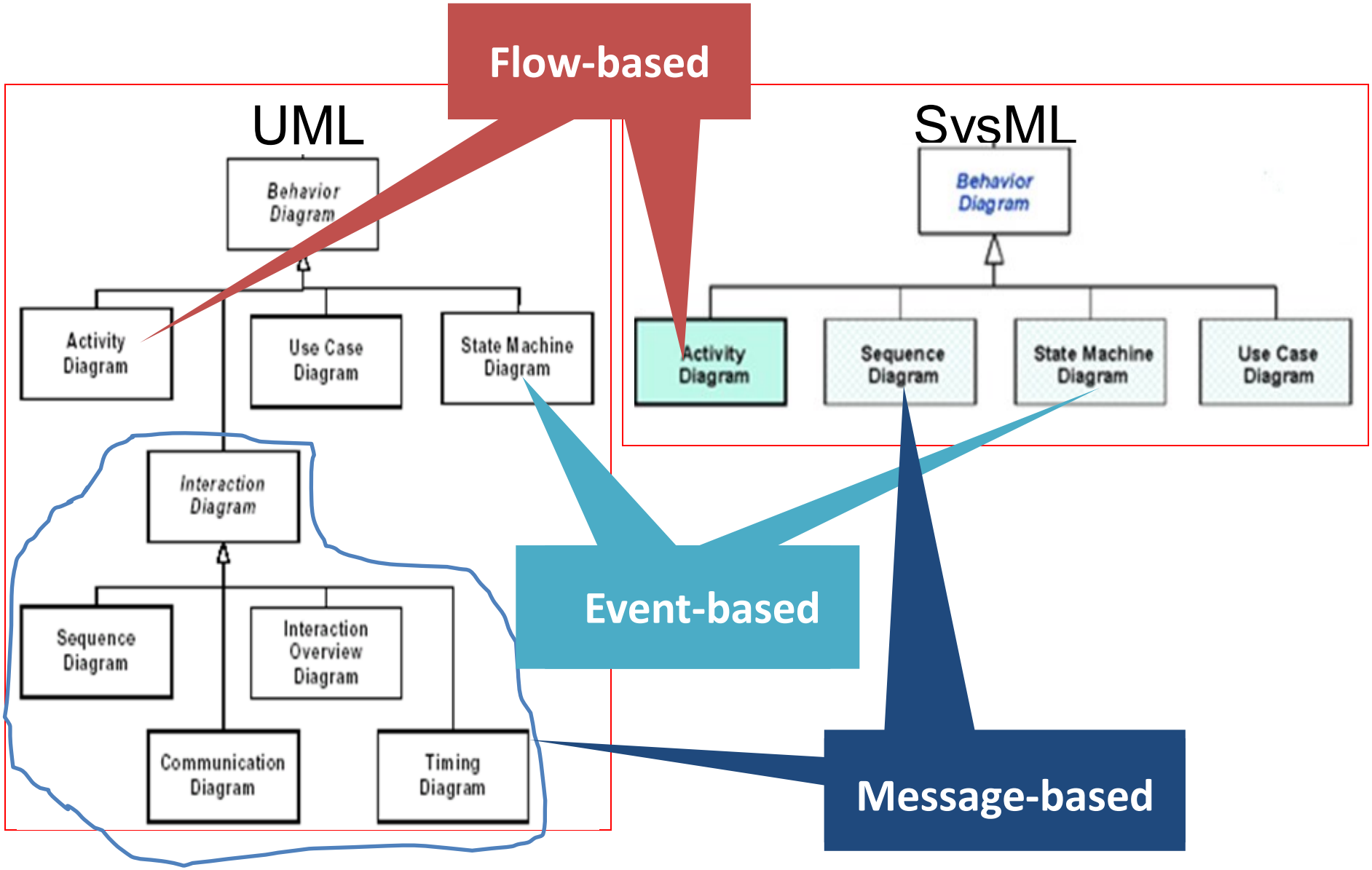


- The **«block»** is the basic unit of structure in SysML.
- It can be used to represent any kind of hardware (including facilities, persons, etc.), software, or any other system element.
- The system structure is represented by **block definition diagrams** and **internal block diagrams**.

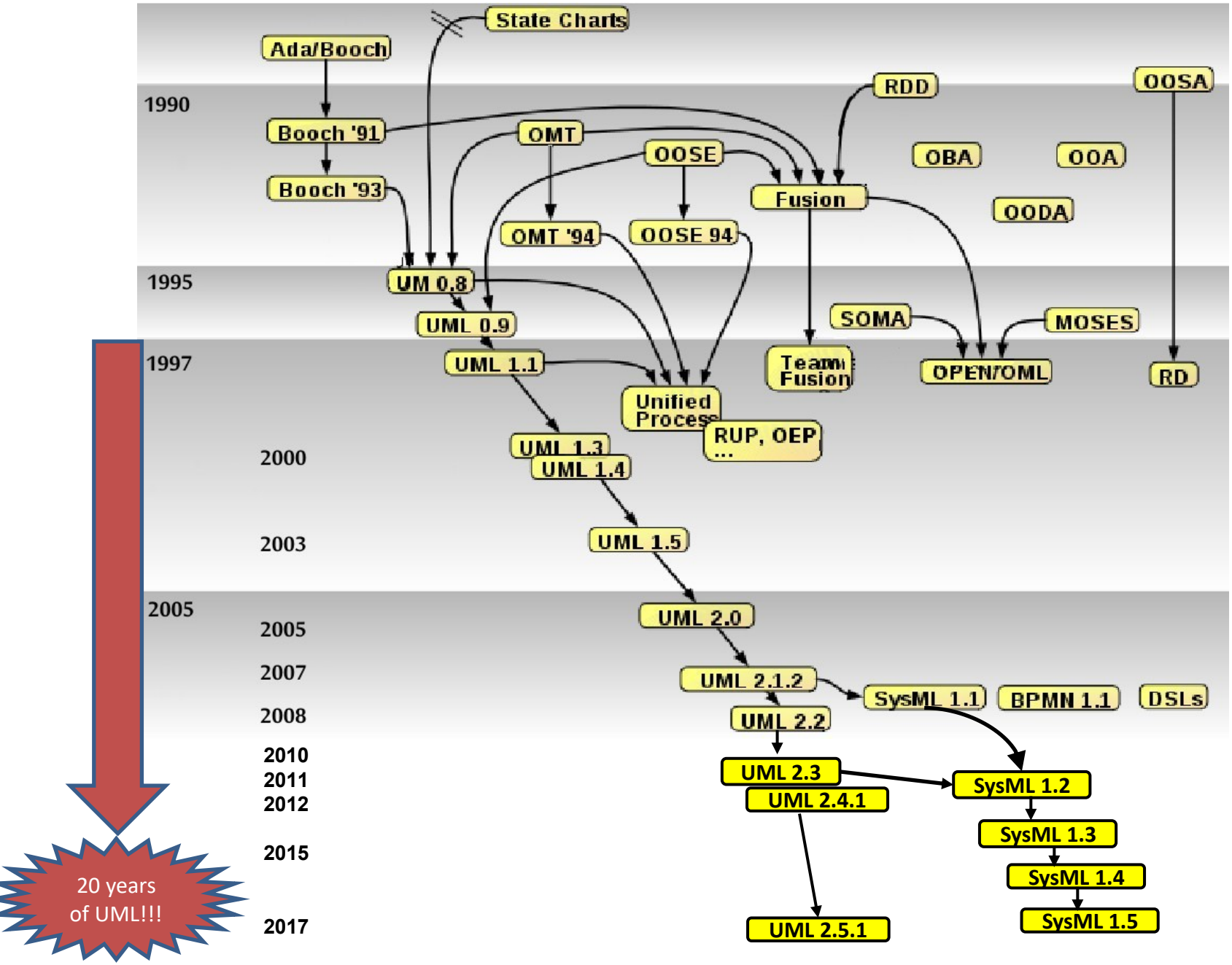
Structural diagrams in UML and SysML



Behavior in UML and SyML



The path towards UML and SysML:

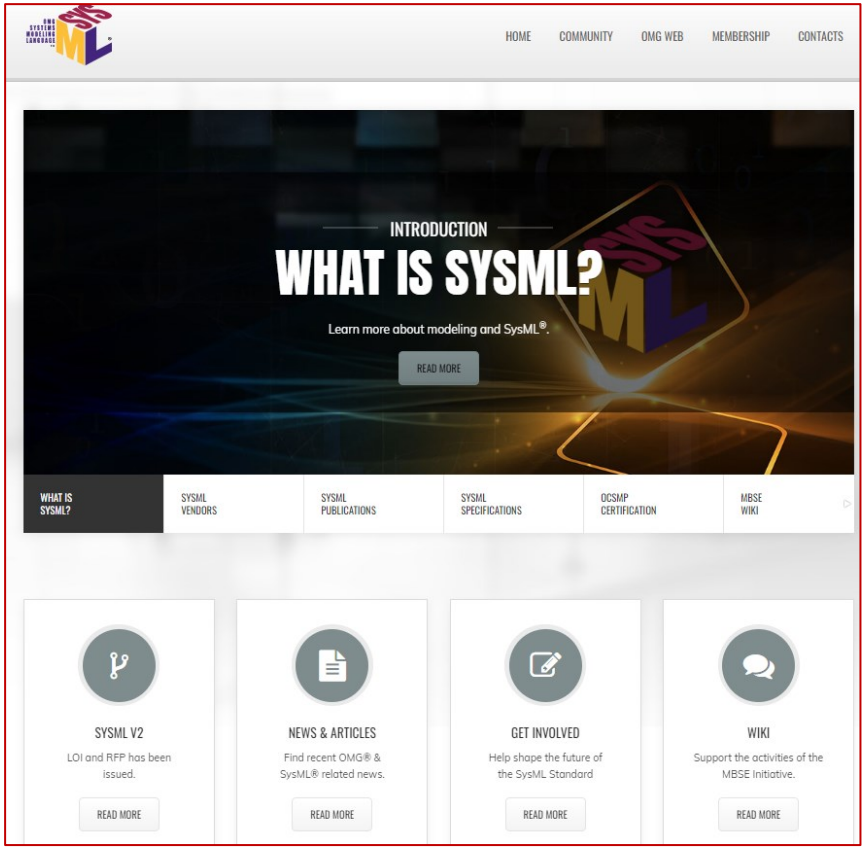


Unified Modeling Language

- A general-purpose modelling language focused on supporting software engineering concerns.
- Proposes a graphic notation to create visual models of software-intensive systems.
- Strongly influenced by object orientation.

http://www.uml.org

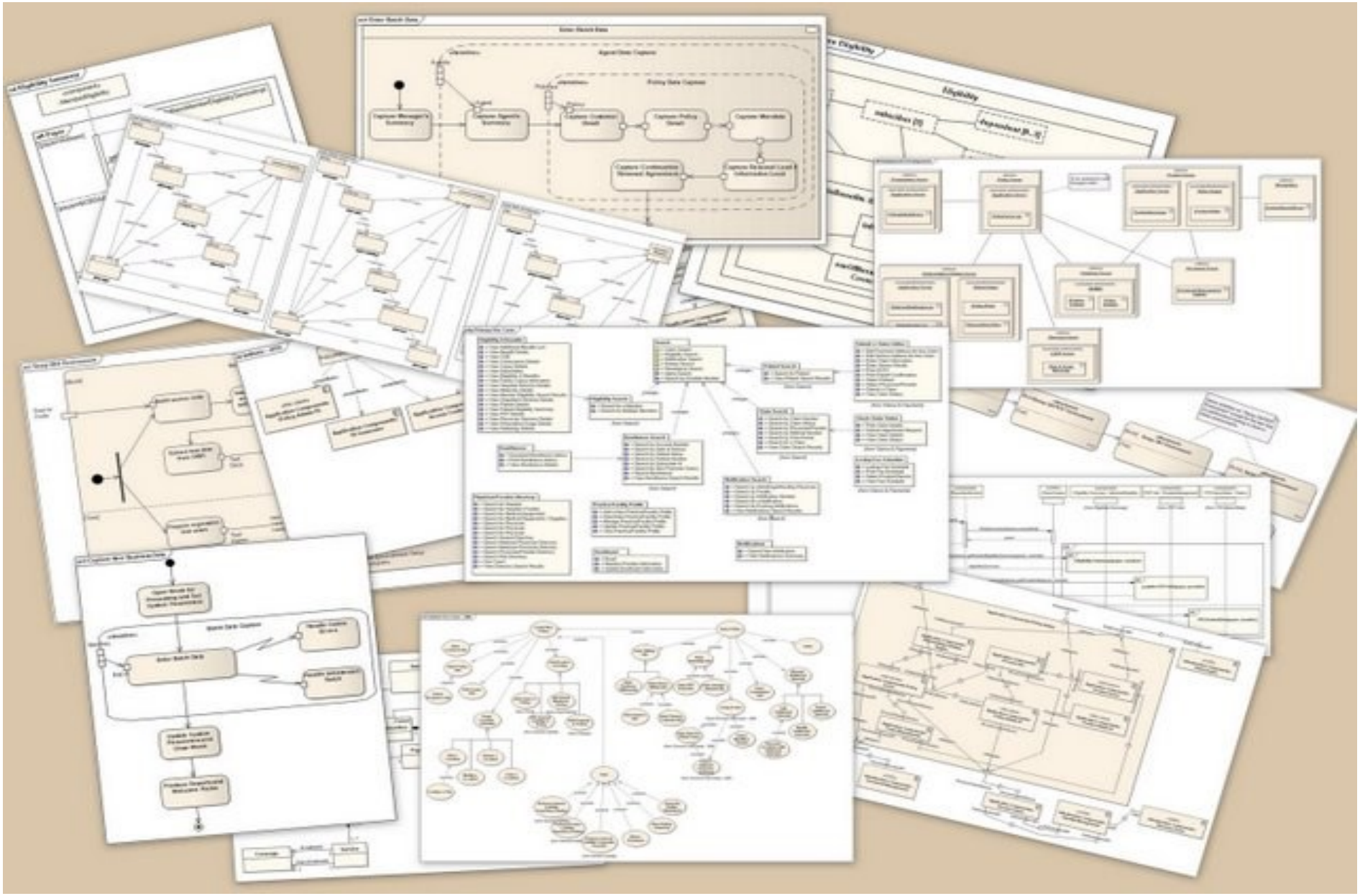
http:/www.omgsysml.org



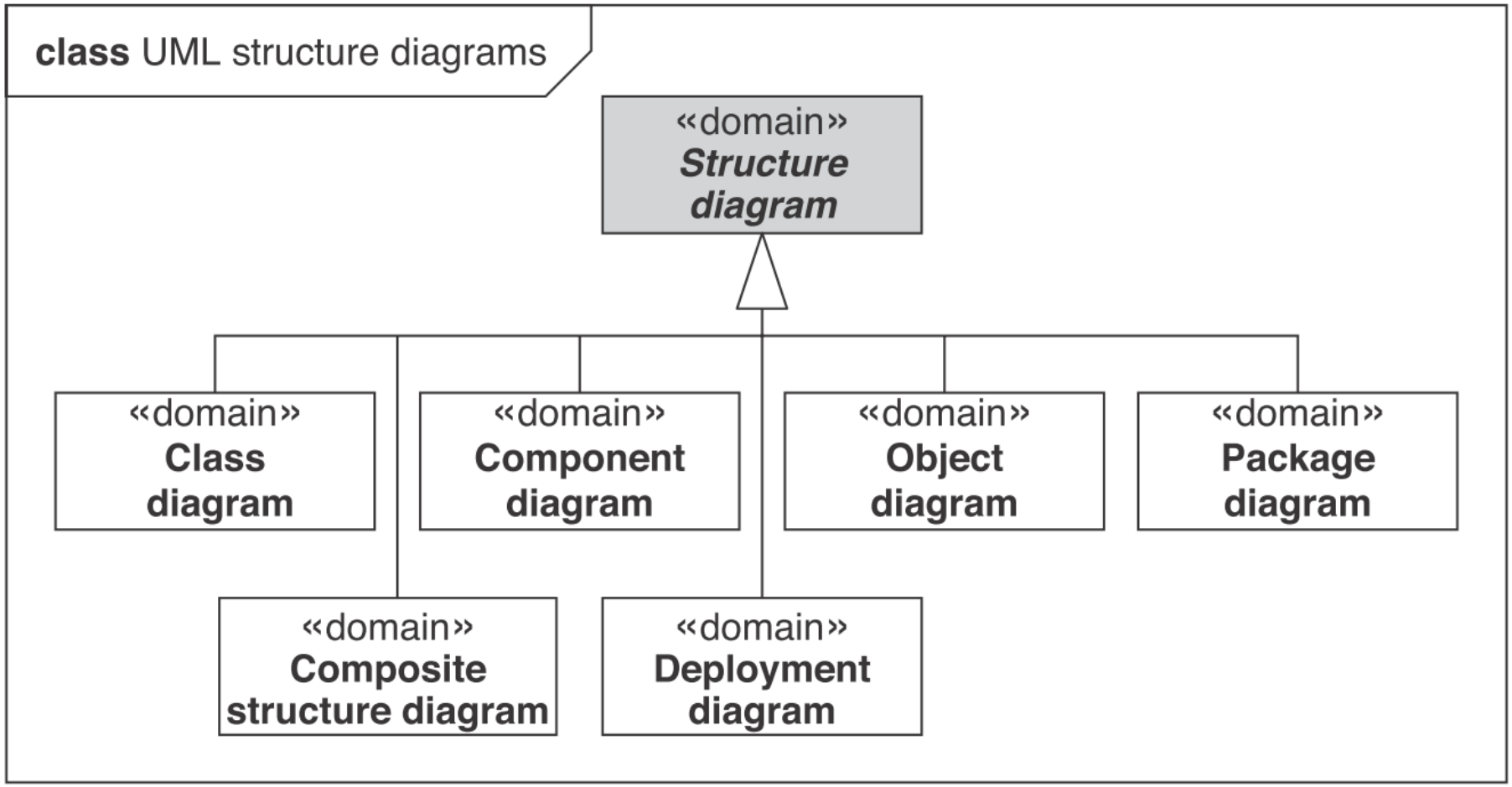
UML

- The UML 2.x specification has four parts.
  - **Superstructure** defines the notation and semantics for diagrams and their model elements.
  - **Infrastructure** defines the core metamodel on which the UML Superstructure is based.
  - **Object Constraint Language (OCL)** for defining rules for model elements.
  - **UML Diagram Interchange** that defines how diagram layouts are exchanged.

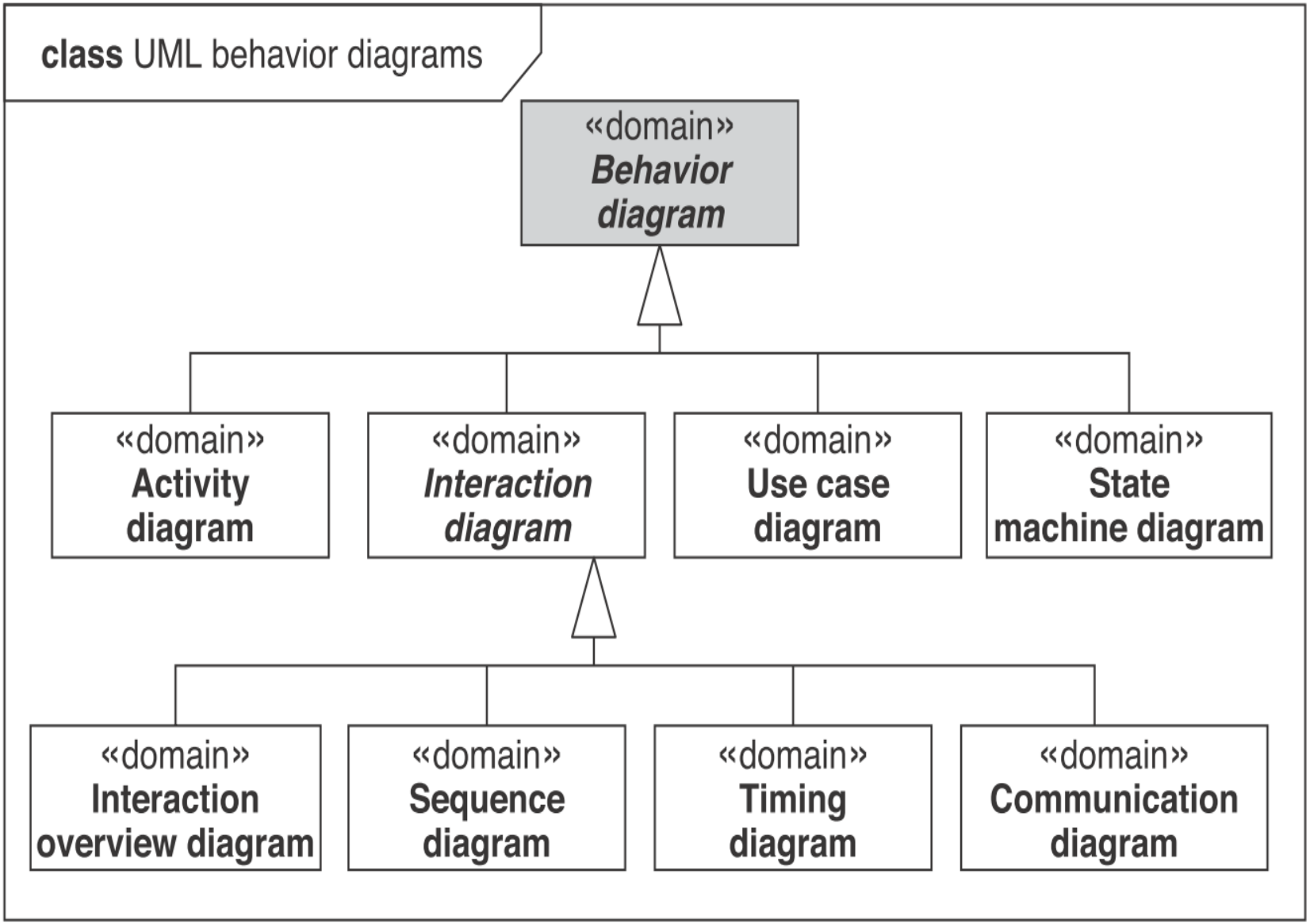
Views & Viewpoints in UML 2.x



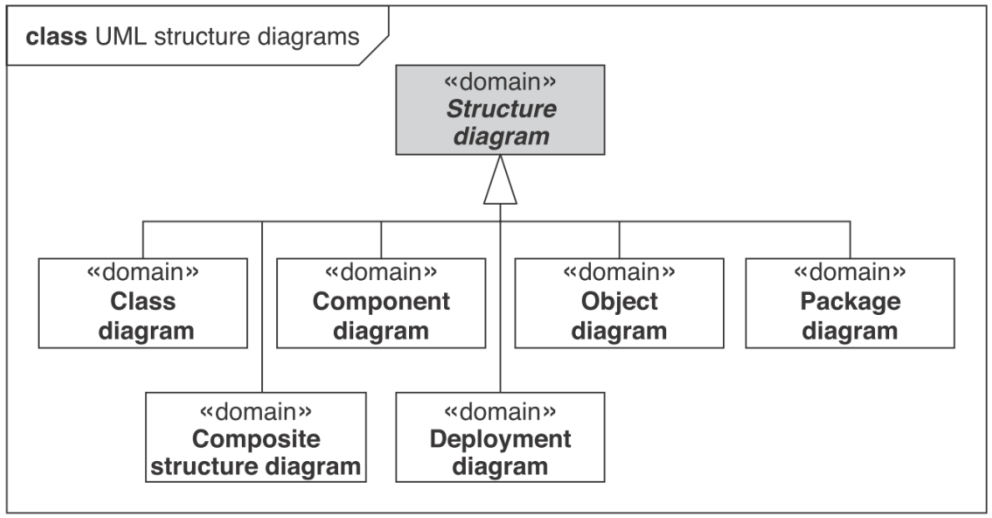
UML 2.x structure diagrams

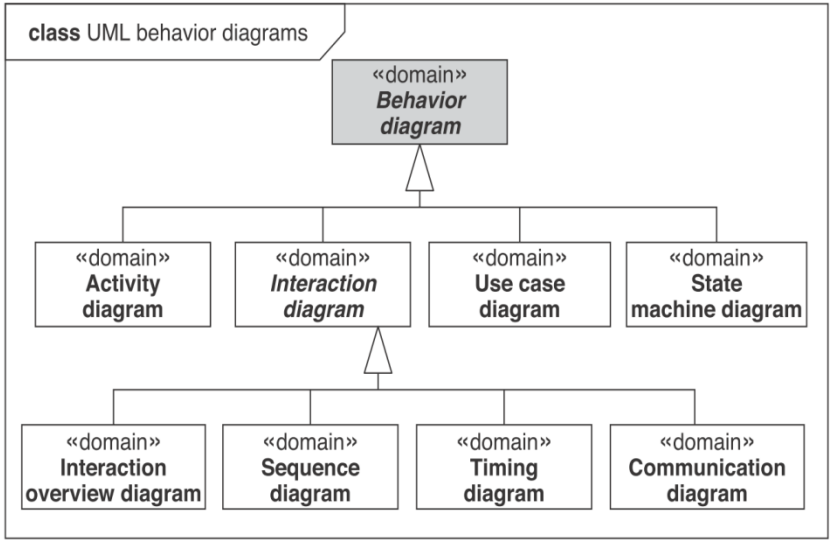


UML 2.x behaviour diagrams

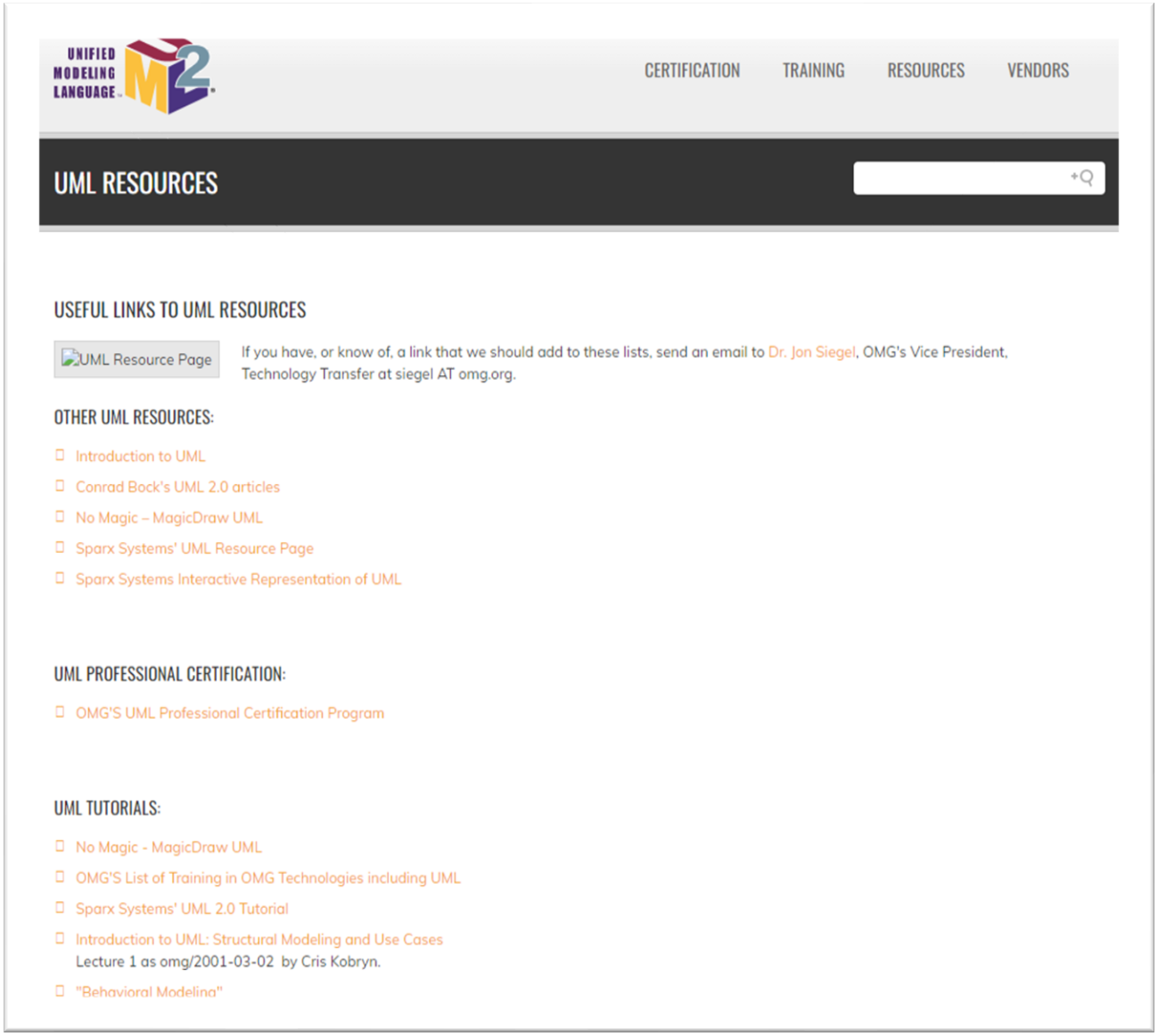


All UML 2.x diagrams





http://www.uml.org/resource-hub.htm



UNIFIED MODELING LANGUAGE

CERTIFICATION TRAINING RESOURCES VENDORS

UML RESOURCES

USEFUL LINKS TO UML RESOURCES

UML Resource Page

If you have, or know of, a link that we should add to these lists, send an email to Dr. Jon Siegel, OMG's Vice President, Technology Transfer at siegel AT omg.org.

OTHER UML RESOURCES:

- Introduction to UML
- Conrad Bock's UML 2.0 articles
- No Magic – MagicDraw UML
- Sparx Systems' UML Resource Page
- Sparx Systems Interactive Representation of UML

UML PROFESSIONAL CERTIFICATION:

- OMG'S UML Professional Certification Program

UML TUTORIALS:

- No Magic - MagicDraw UML
- OMG'S List of Training in OMG Technologies including UML
- Sparx Systems' UML 2.0 Tutorial
- Introduction to UML: Structural Modeling and Use Cases
  Lecture 1 as omg/2001-03-02 by Cris Kobryn.
- "Behavioral Modeling"

http://umlnotation.sparxsystems.eu/

Systems Modelling Language

- In January 2001 the International Council on Systems Engineering (INCOSE) adopted UML as a language for systems engineering applications.
- UML was then adapted and extended to systems engineering using UML Profiles.

- The **Systems Modelling Language (SysML 1.0)** was approved by the OMG in July 2006
  - based on UML 2.1.1 …

Why SysML? Is UML not enough?

- UML lacks **requirements modelling**.
  - Whereas requirements modelling is an explicit component of systems engineering (and thus is part of SysML).

- UML has a rather **software and information-specific.** scope as it focus on modelling **logical** systems.
  - SysML as a wider system-specific scope enabling it to model both *logical* and *physical* systems.

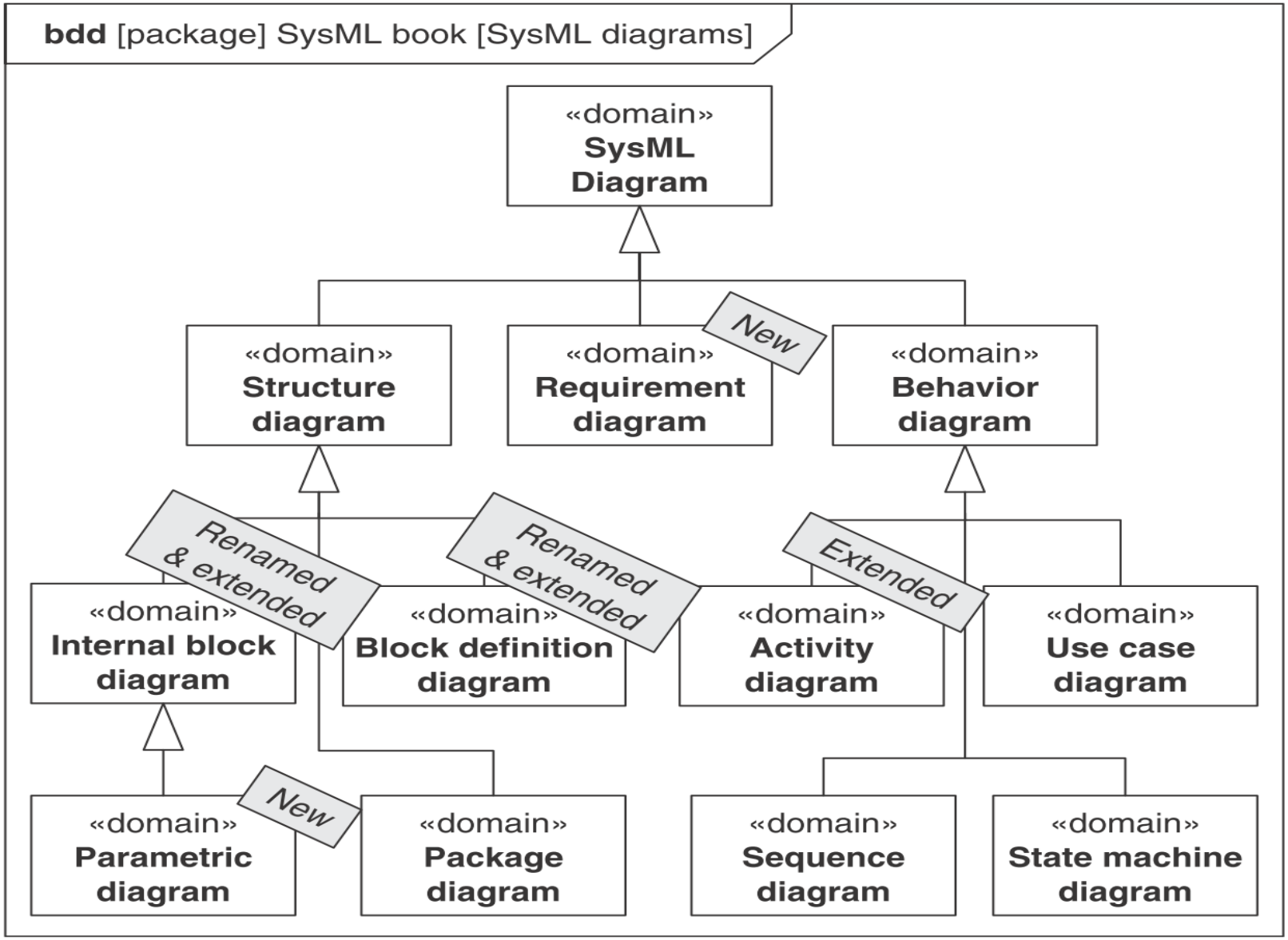
- UML is strongly influenced by **object orientation**.
  - SysML is neutral regarding the abstraction paradigm.

About “Logical” and “Physical” Systems

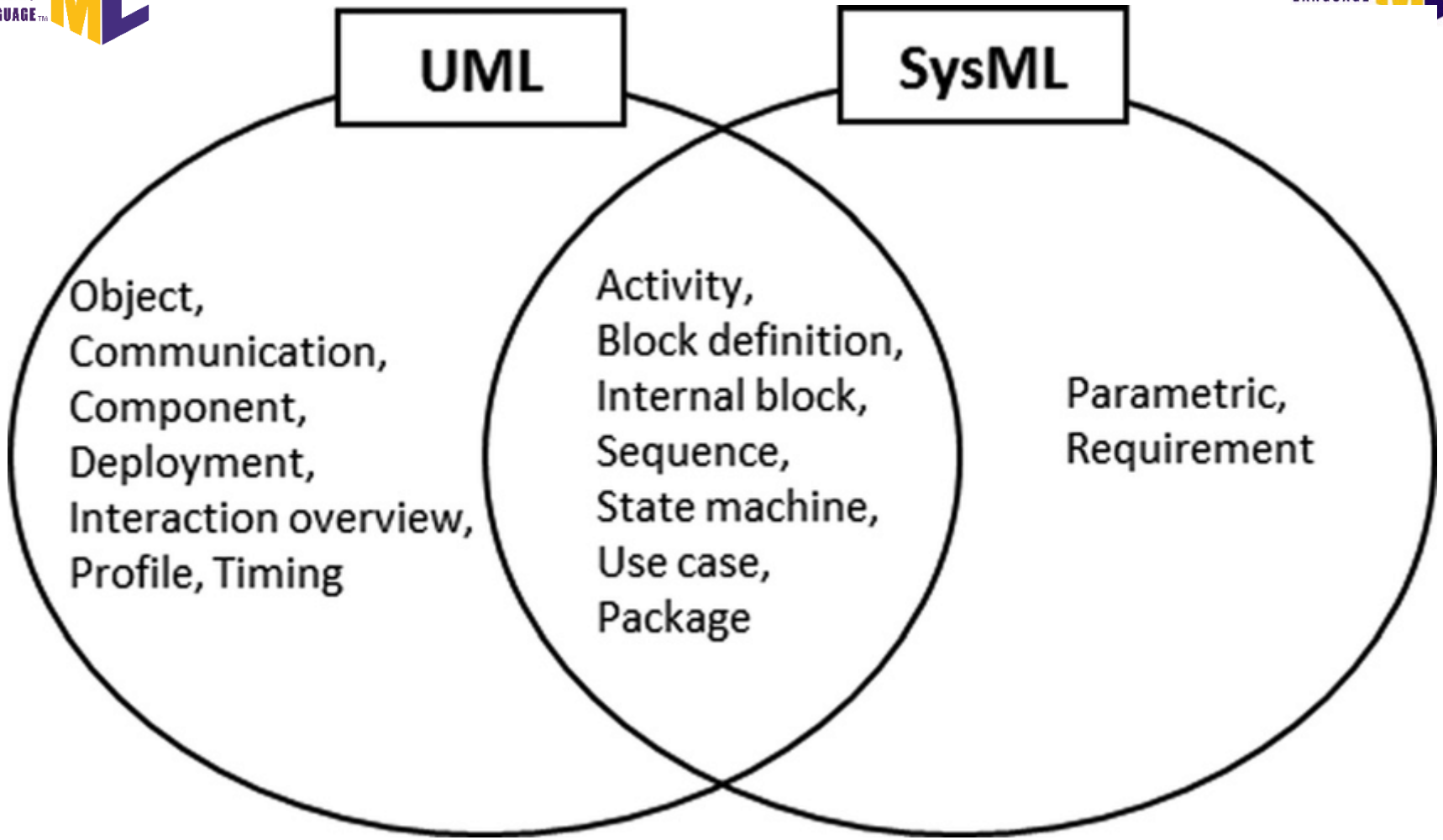
- “Logical” systems are typically realized as software artefacts.
  - Focus on “**concept**” representation.
  - These concepts can be modelled using object orientation principles such as abstraction, classification and generalization.
  - UML specializes in modelling these systems.

- “Physical” systems are typically realized as tangible artefacts, such as devices, machines and hardware.
  - Focus on **“object/part”** representation alongside with concepts.
  - SysML specializes in modelling these systems…

SysML diagrams (comparing with UML)

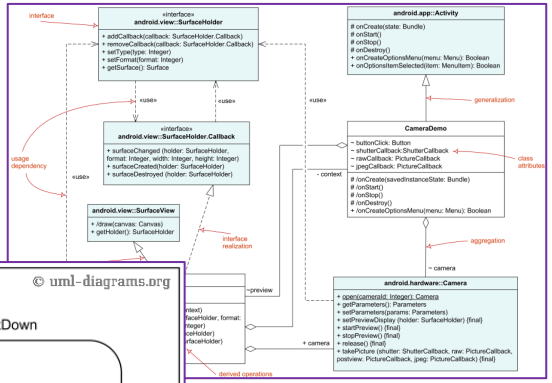


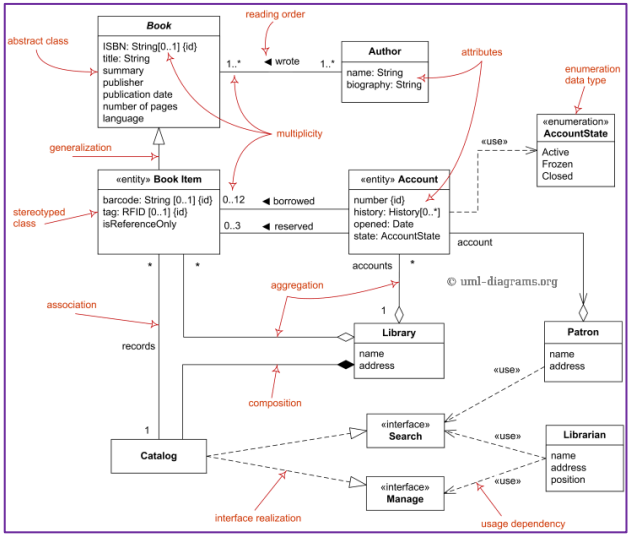
UML and SysML diagrams

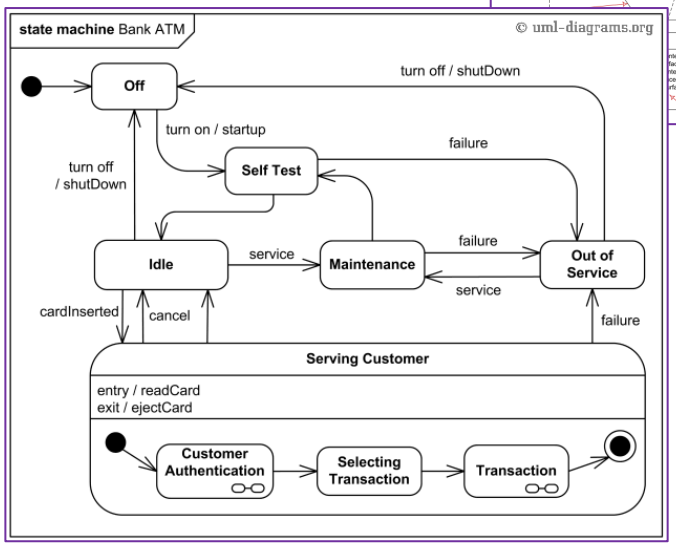


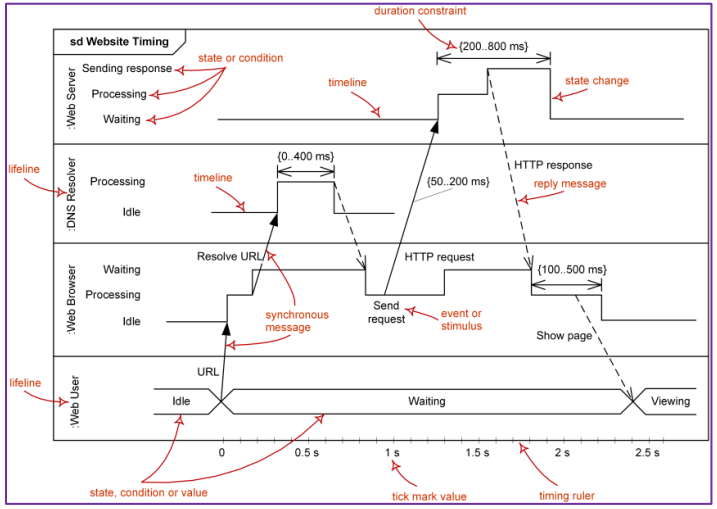
https://www.researchgate.net/publication/303739676_On_Architecting_and_Composing_Engineering_Information_Services_to_Enable_Smart_Manufacturing/figures?lo=1

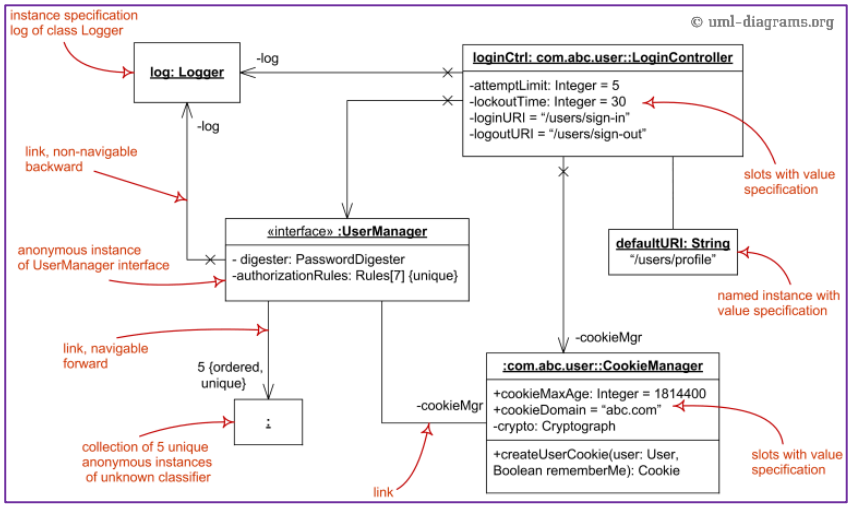
Many examples and clues at https://www.uml-diagrams.org/











UML and SysML as ISO standards…

- UML 2.4.1 is ISO/IEC 19505:2012
  - https://www.iso.org/standard/32624.html
  - https://www.iso.org/standard/52854.html
- SysML1.4 is ISO 19514:2017
  - https://www.iso.org/standard/65231.html