New Diagrams in UML 2.x, Model Driven Architecture (MDA), Executable UML

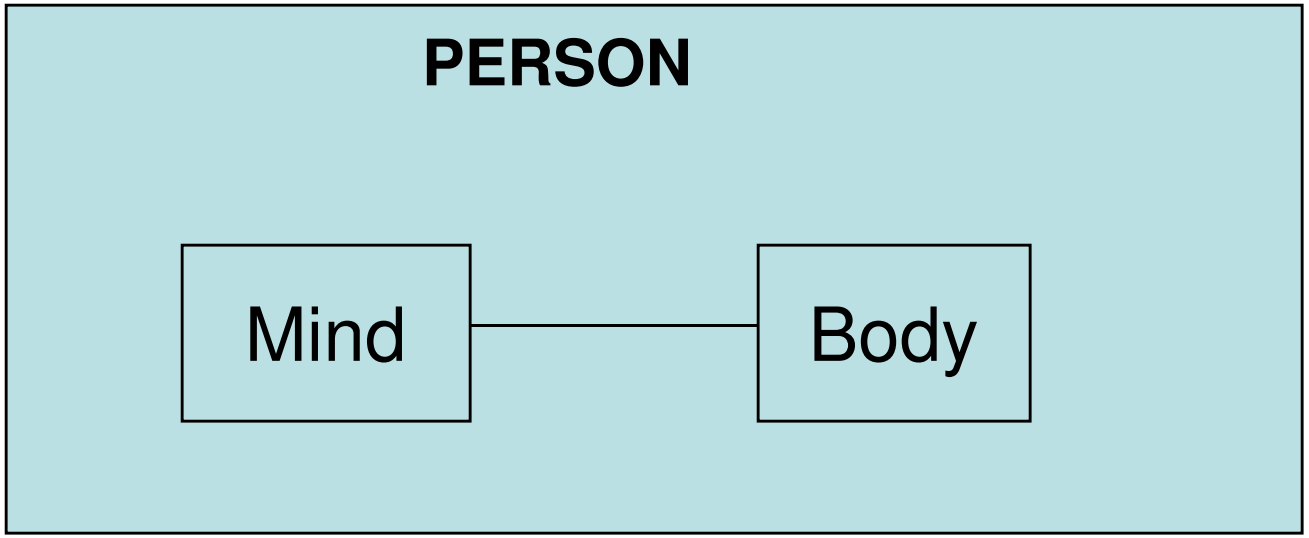
What is New in UML 2.0

- **New Diagrams**

  Composite Structure Diagram

  – **Show classes internal structure**

eg.



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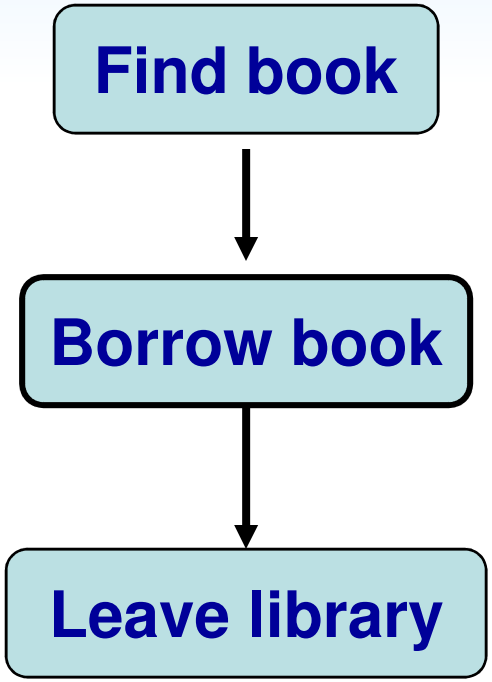
- **Interaction Overview Diagram**
  - **Expands the Activity Diagram**

eg. Consider three activities in visiting a library



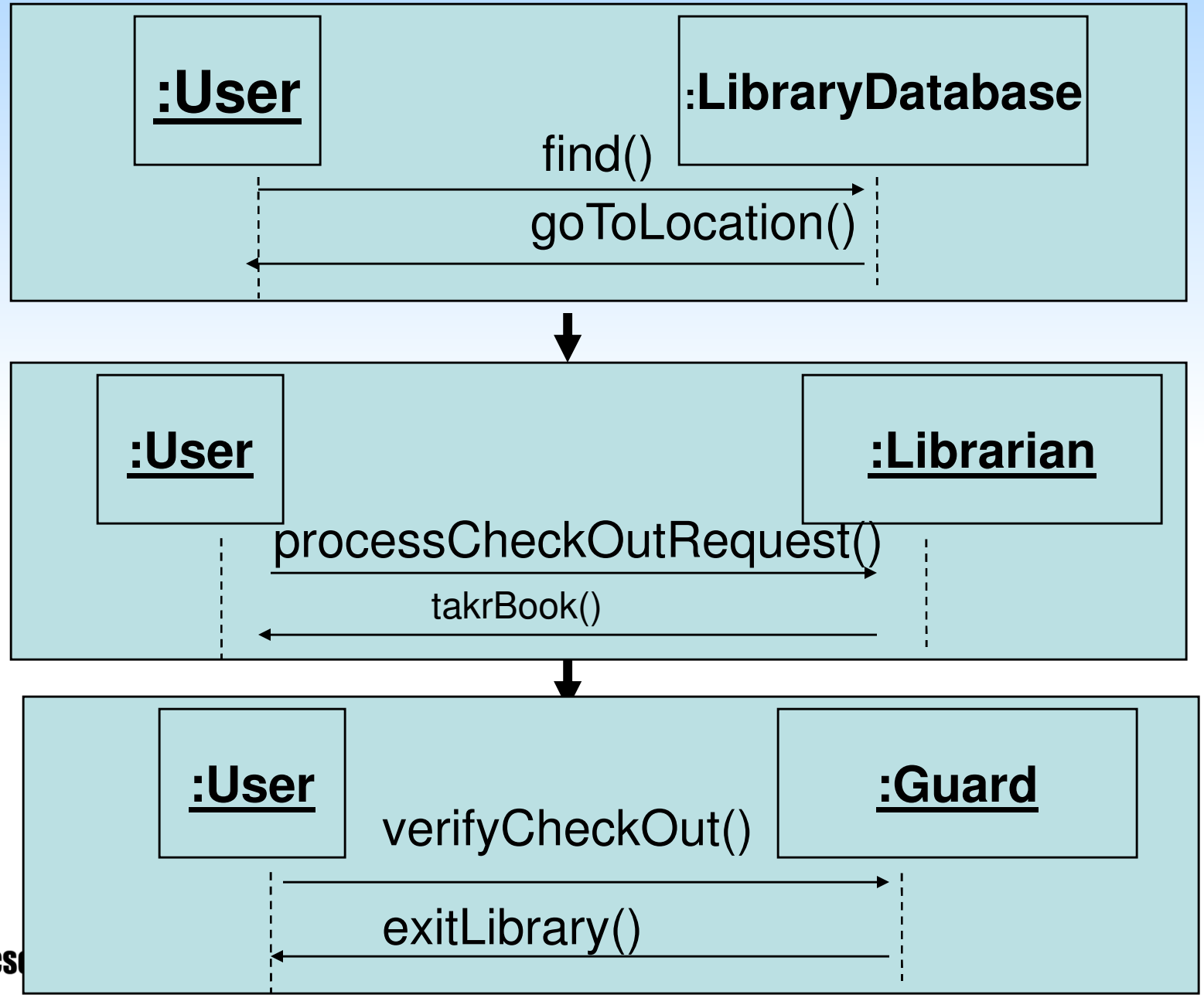
- Lets analyze each activity

  Find Book : Ask library database to locate the book. Database responds by telling you to go to the books location.

  Borrow Book : Ask the librarian to check the book out to you. After checkout, the librarian tells you to take the book.

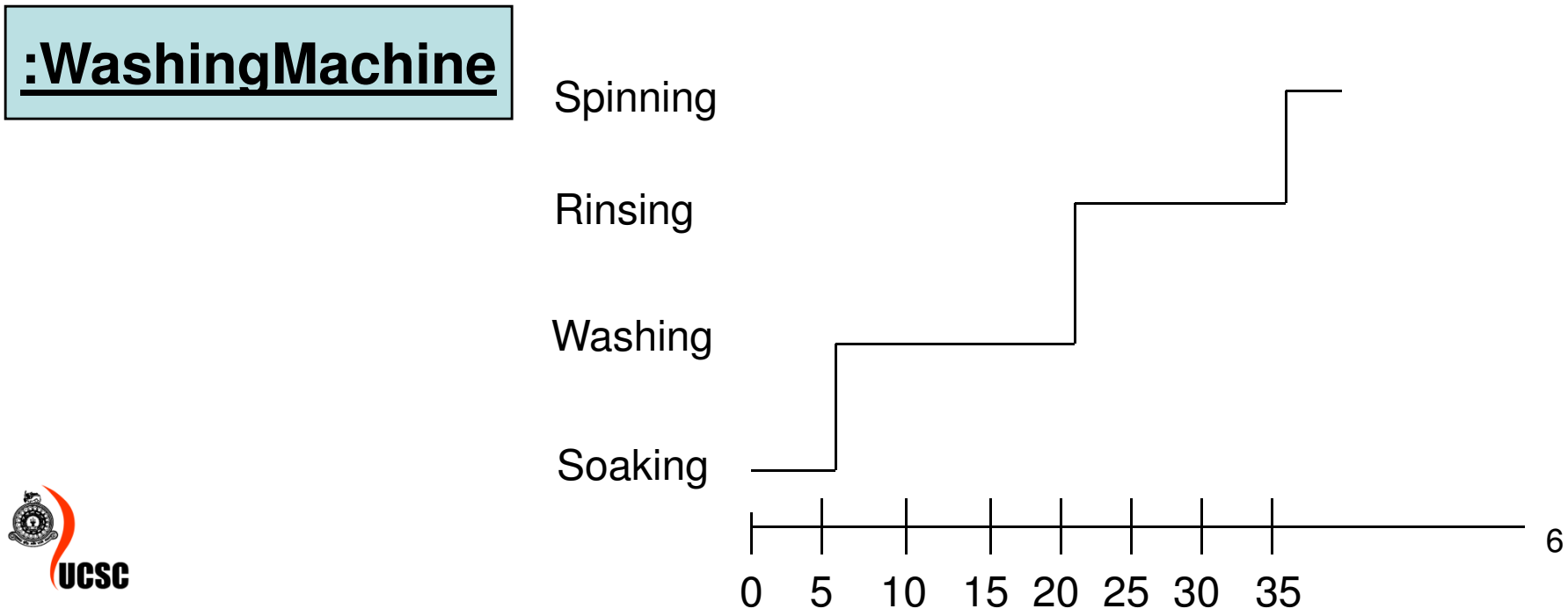
  Leave Library : You can leave the library only if a guard verifies that you have checked out the book.

Interaction Overview Diagram



Timing Diagram

- Design to show how long an object is in a state.
- Sequence diagrams does not show the durations explicitly.



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UML Profiles

- A lightweight extension mechanism for UML
- Concepts partially present in earlier versions
  - Stereotypes. <<entity>>
  - Tagged Values {author=Siman Silva}
- Established as a specific meta-modeling technique in UML 2.0
  - Contains mechanisms that allow meta classes from existing meta models to be extended.
  - ability to tailor the UML meta model for different platforms or domains.

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UML Profile Diagrams

- **Profile diagram** is **structure diagram**
- Describes **lightweight extension mechanism** to the UML by defining custom **stereotypes**, **tagged values**, and constraints.
- Profiles allow adaptation of the UML metamodel for different:

  - **platforms** (such as J2EE or .NET), or
  - **domains** (such as real-time or business process modeling).

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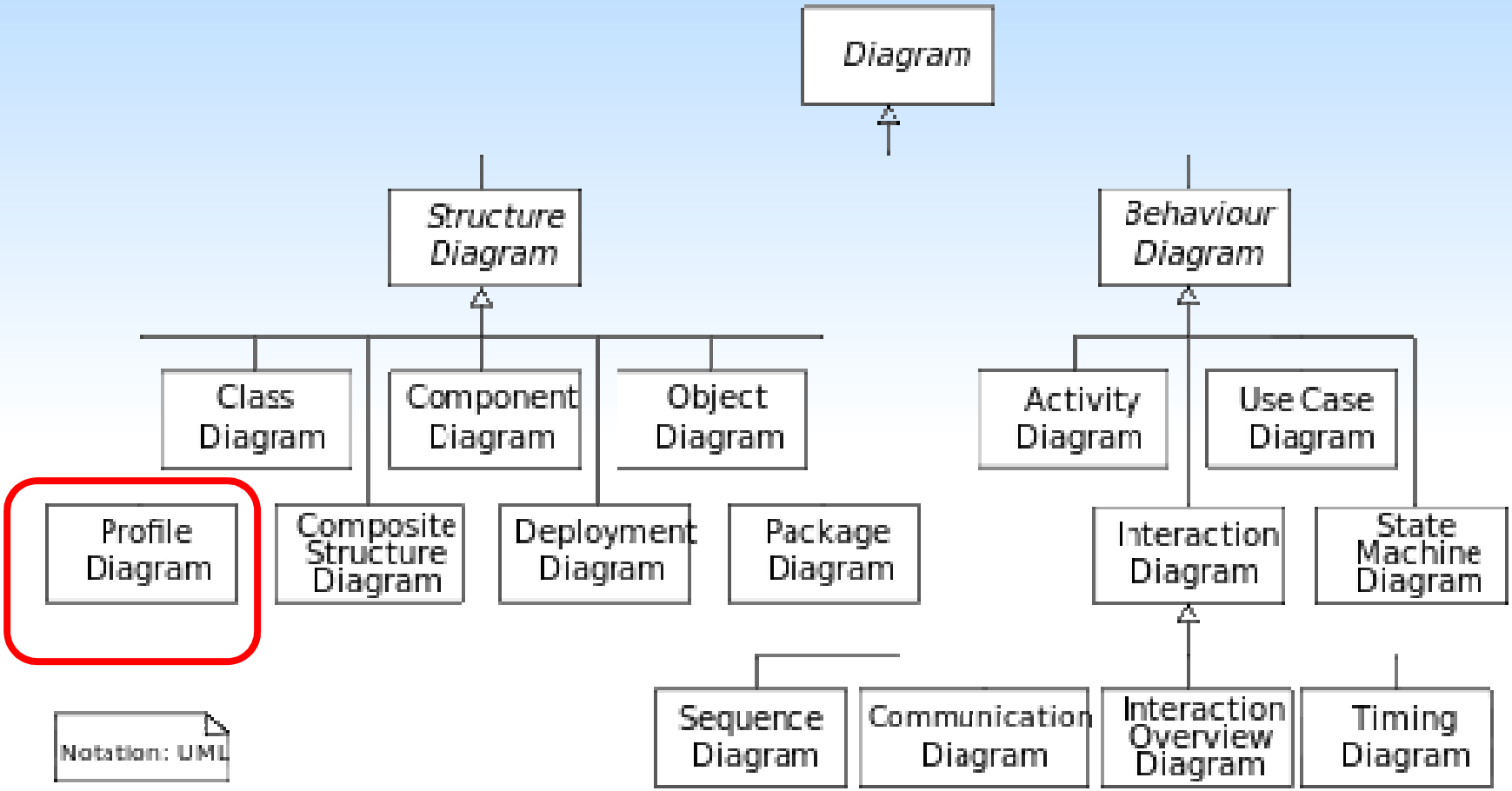
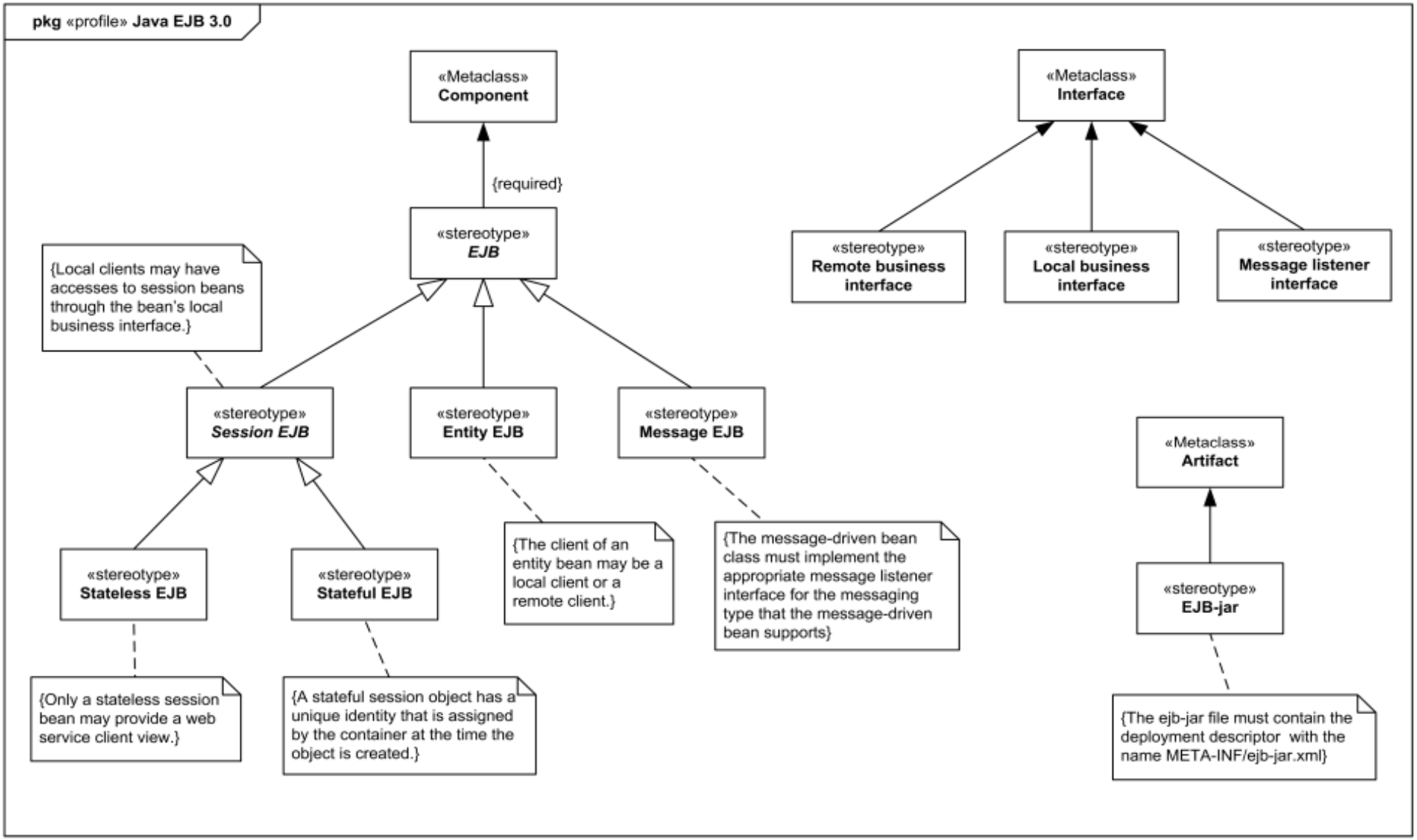
UML Diagrams



UML Profile Diagrams



Ref. http://**www.uml-diagrams.org/profile-diagrams.html**

Model Driven Engineering (MDE)

- An approach to Software Development
- **Models** rather than programs are the principal outputs of the development process.
- Programs that execute on a Hardware/ Software platform are generated automatically from models.

Ref. Software Engineering, Ian Somerville, 9th edition , ISBN 978-81-317-6216-5 ,Pearson , 2011,

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Model Driven Engineering (MDE)

Adv. :

- Allows engineers to think about systems at a high level of abstraction, without concern of implementation.
- This reduces the likelihood of errors, speeds up the design and implementation process,
- Allows creation of reusable Platform Independent Models (PIM)
- Using tools, implementation can be generated for different platforms from the same model.

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D1 DELL, 5/8/2014

Model Driven Engineering (MDE)

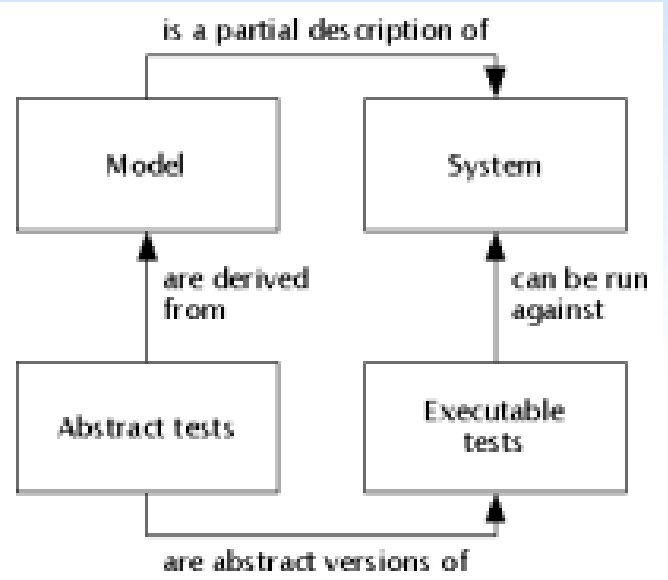
Dis Adv. :

- The abstraction that are supported by the model may not be the right abstraction for implementation.
- You may create informal design models, but implement the system using an off the shelf configurable package.

Model Driven Engineering (MDE)

Topics that are part of MDE

Model-based requirements engineering, Software processes for model based development, Model-based testing etc.



- The first tools to support MDE were the Computer-Aided Software Engineering (CASE) tools developed in the 1980s.

http://www.omg.org/mda/products_success.htm

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A Success Story of MDE

- The **National Cancer Institute** (**NCI**)

(part of the National Institutes of Health (NIH), which is one of eleven agencies that are part of the U.S. Department of Health and Human Services)

http://www.omg.org/news/whitepapers/caBIG_Case_Study_approved.pdf

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A Success Story of MDE cont…

- The **National Cancer Institute** (**NCI**)

The initial interoperability project involved three steps:

- 1. Analyze what was needed and develop use cases
- 2. Use UML to standardize model representations and artifacts, often using class and sequence diagrams
- 3. Use meta-models to generate code

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What is Model Driven Architecture?

- **Model-driven architecture** (MDA) is a software design and Implementation approach for the development of software systems .(has been in use since 2001)
- A New Way to Specify and Build Systems
  - *Based on modeling with UML*
  - Builds in Interoperability and Portability
  - Lowers initial cost and maximizes ROI
  - Applies directly to the mix you face:
    - Programming language
    - Operating system
    - Network
    - Middleware

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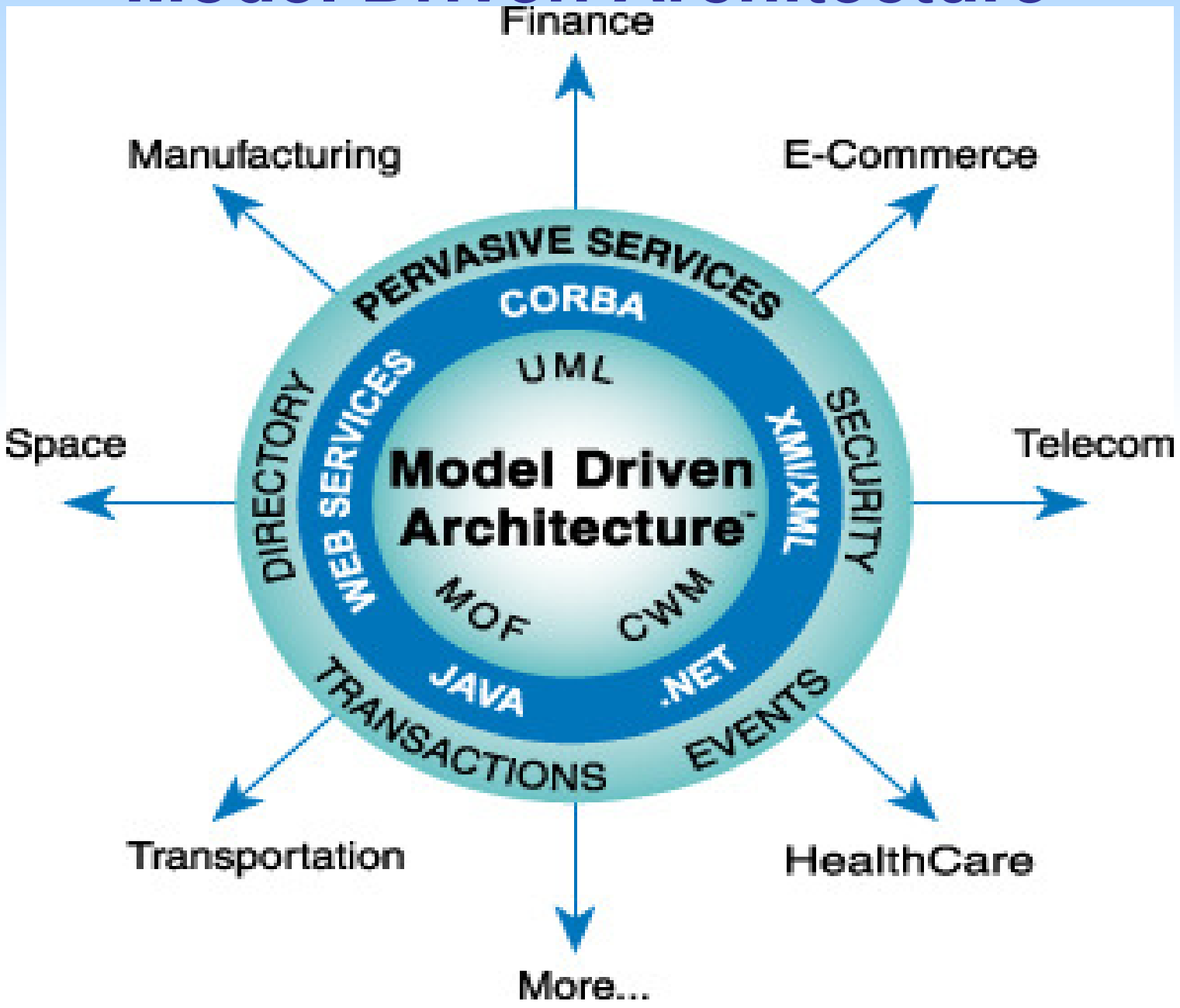
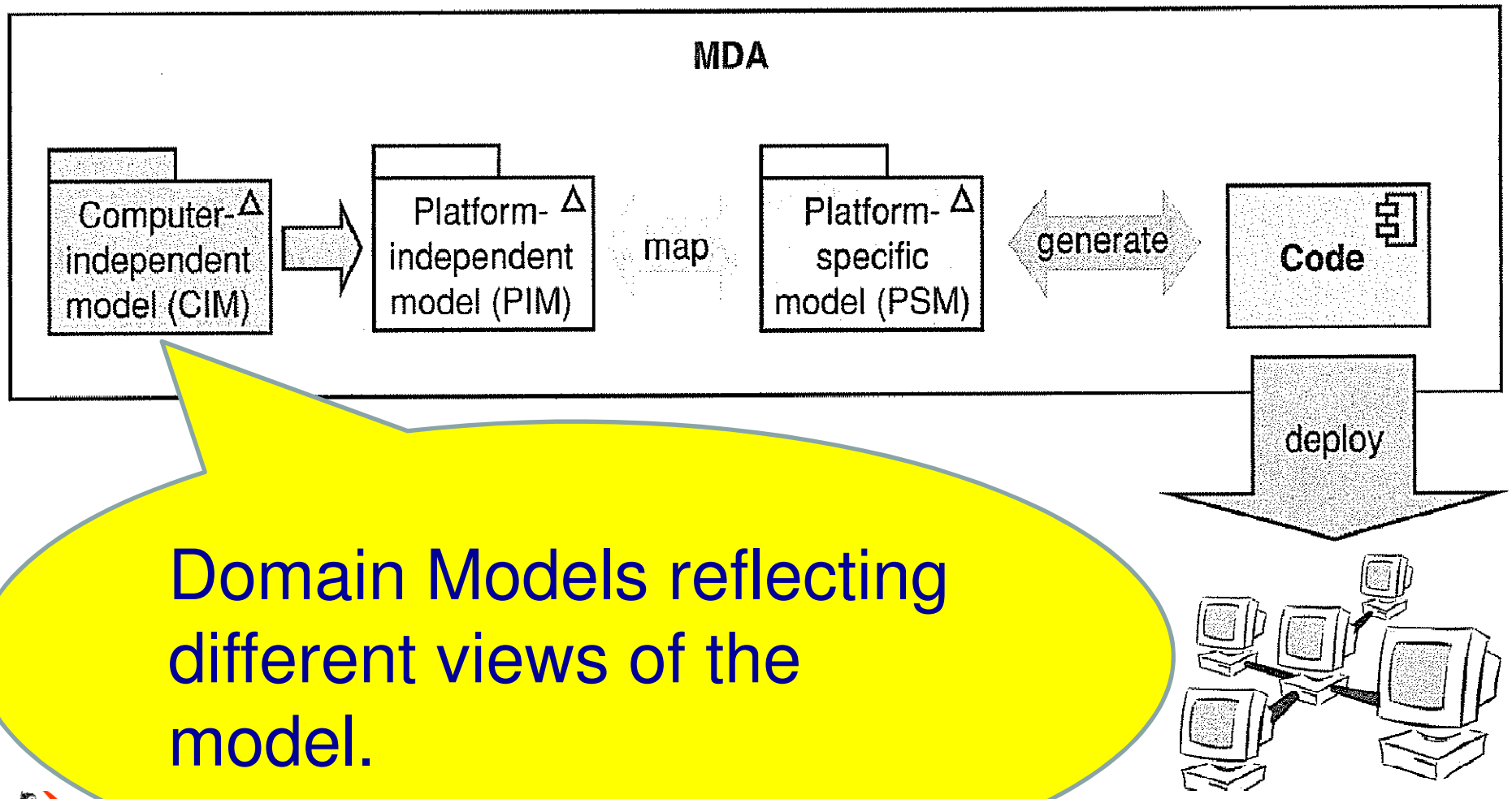
Model Driven Architecture

- UML is usable with Model Driven Architecture (MDA)
  - Better support for the automatic transformation of a Platform Independent Model (PIM) into a Platform Specific Model (PSM)
  - the mapping from a PIM to a PSM is implemented by tools

Model Driven Architecture



MDA Model Transformation Chain

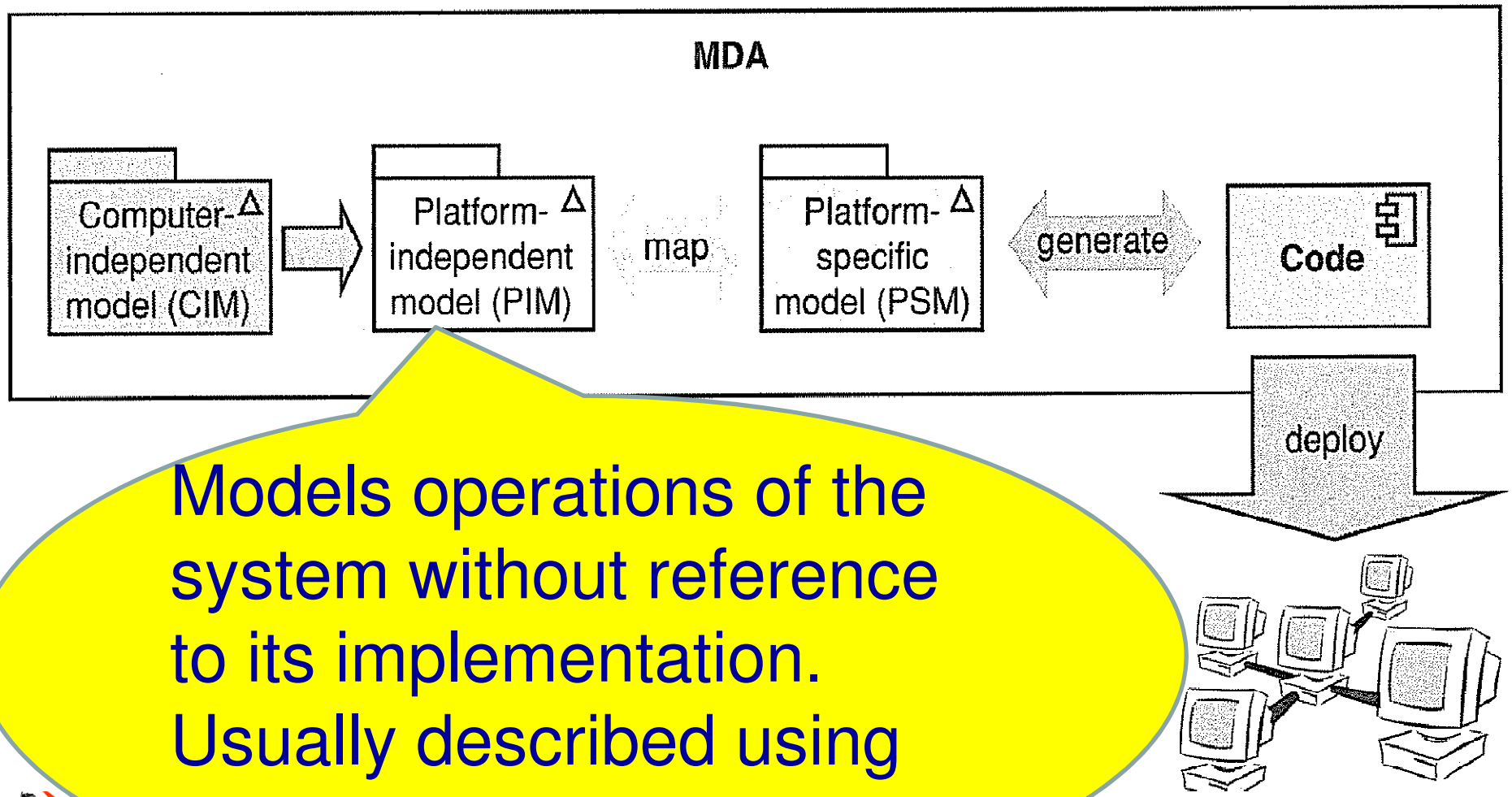


Domain Models reflecting different views of the model.

MDA Model Transformation Chain
CIM (Computation Independent Model)

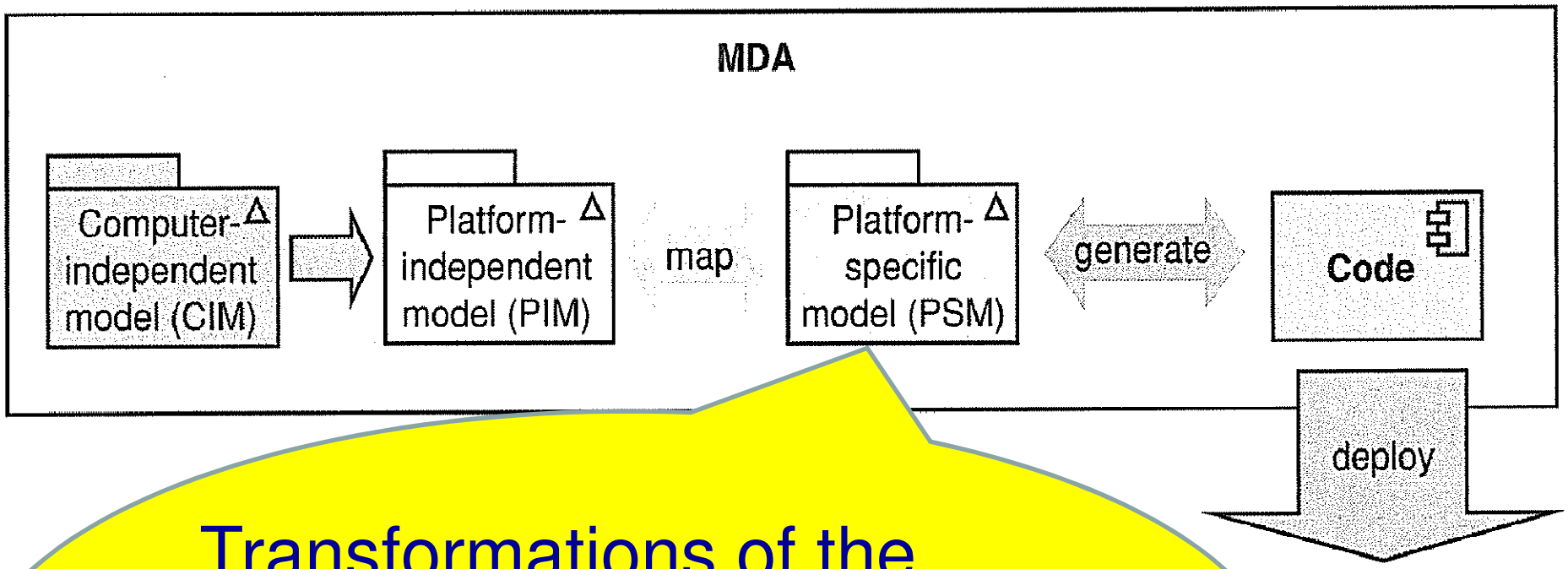
- You may develop several different CIMs reflecting different view of the system.
  - You may Identify important security abstraction eg. asset and a role
  - You may Identify abstractions such as patients, consultations in a patient record CIM

MDA Model Transformation Chain

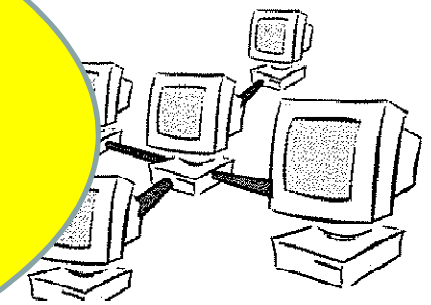


Models operations of the system without reference to its implementation. Usually described using UML models.

MDA Model Transformation Chain



Transformations of the platform independent model with a separate PSM for each application platform.



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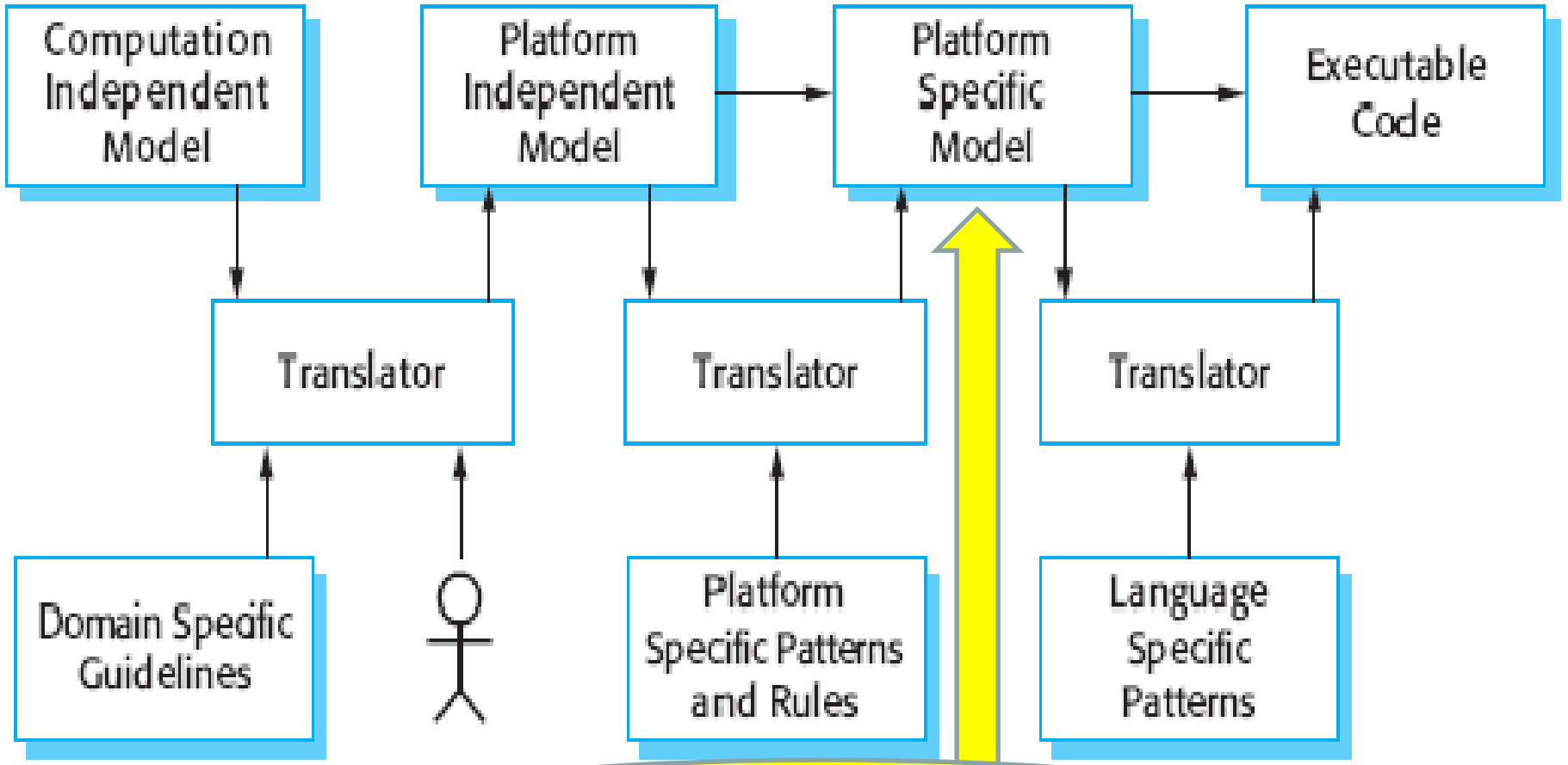
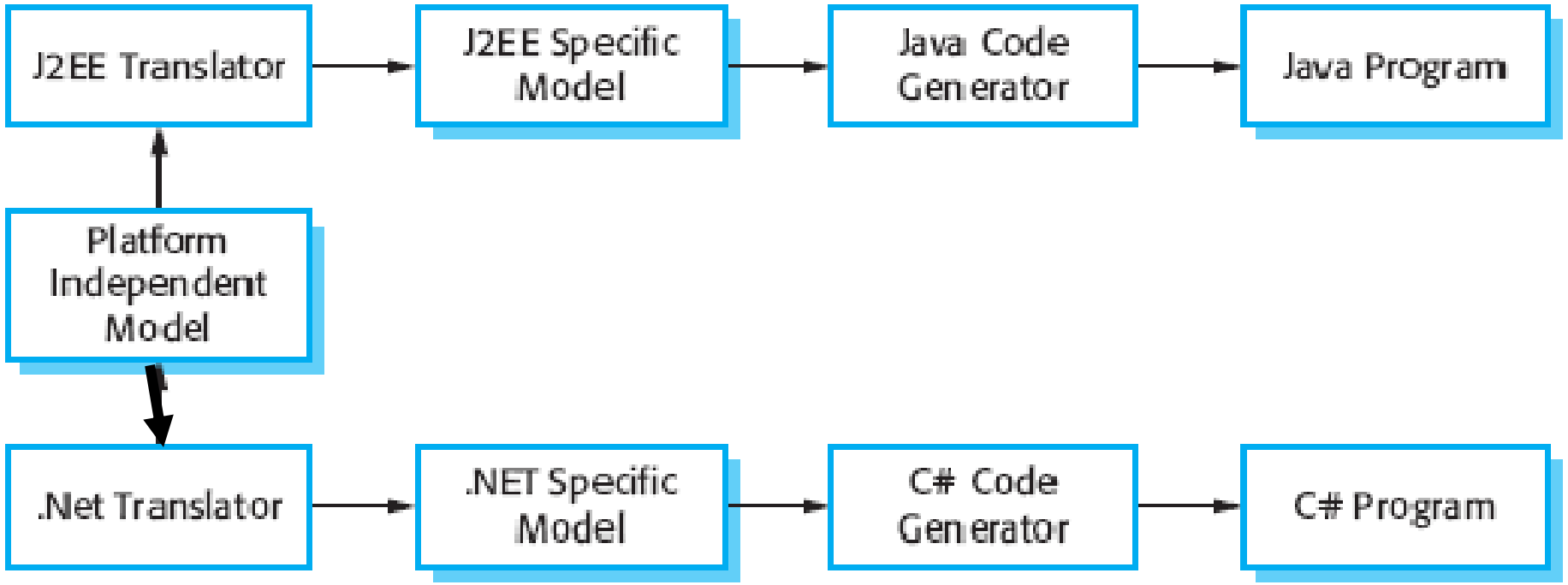
MDA Transformation Cont..



A transformation that runs on the designated software platforms applied to the PSM to generate executable code

MDA Transformation Cont..



MDA Transformation Cont..

- In vast majority of cases, the execution environment for a system is more than the standard execution platform. (eg. J2EE,.NET)
- Includes other application systems, application libraries, that are specific to a company, user interface libraries.
- Getting popular with Agile Methods

  eg. Agile MDA.

Executable UML (xUML)

- Achieve completely automated transformation of models to code, graphical models should be constructed with semantics well defined.
- Also need a way to add information to graphics models so that the operations define in the model are implemented.
- This is possible with a subset of UML 2.0 called Executable UML. or xUML or xtUML.
- Supports MDA

Executable UML (xUML) cont…

- Three key model types needed to create an executable subset of UML.

  - Domain models

    identify the principal concerns in the system

  - Class Models : define classes

  - State models

    Describe the life cycle of objects.

  - The *action language* defines the actions or operations that perform processing on model elements.

To Get More Information

- MDA Information Page
  - http://www.omg.org/mda/
- OMG General Information
  - http://www.omg.org/
- Product list
  - http://www.omg.org/mda/committed-products.htm