2c. Object-Oriented Modeling

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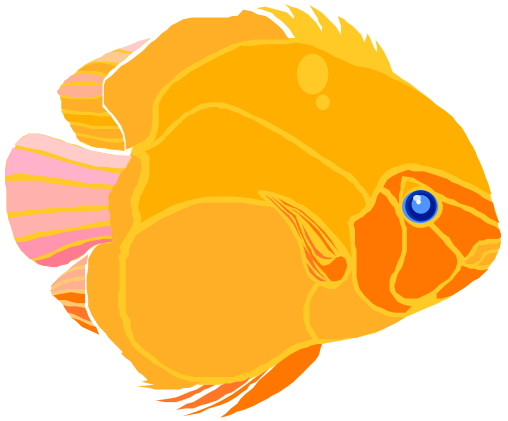
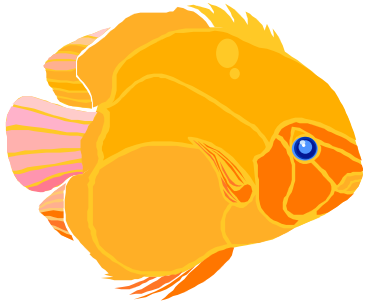


Object-Oriented Analysis

- OOA is a collection of like-minded requirements modeling and analysis techniques for software systems.
- Proposed in the late '80s, such techniques have been influenced primarily by object-oriented programming, but also semantic data models and semantic networks.
- *Basic idea:* streamline software development by making *objects*, *classes*, *methods* and the like the atomic units out of which one builds requirements, designs and implementations.

Basic Concepts

- Such techniques focus on the *things* that exist within the application domain, model them with *objects*.
- These techniques use *classification*, *generalization*, *aggregation* to structure object assemblies.
- *Actions* (services/activities) are associated with objects.
- *State changes* are effected by actions performed on objects.

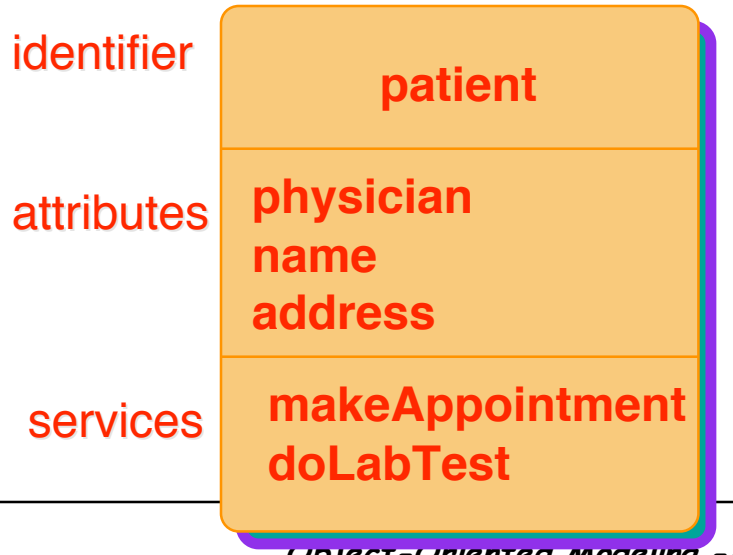


Origins of Object-Oriented Analysis

- *Object-Oriented Programming* -- tries to adopt as many of the O-O programming features to O-O design and analysis [Booch86]
- *Database Design* -- adopts semantic data modeling ideas, including E-R diagrams and generalization, aggregation, classification [Chen76]
- *Structured Analysis* -- including SADT and other structured analysis techniques [Ross77]
- *Knowledge Representation* -- uses ideas from frame-based and semantic network representations [Borgida85]

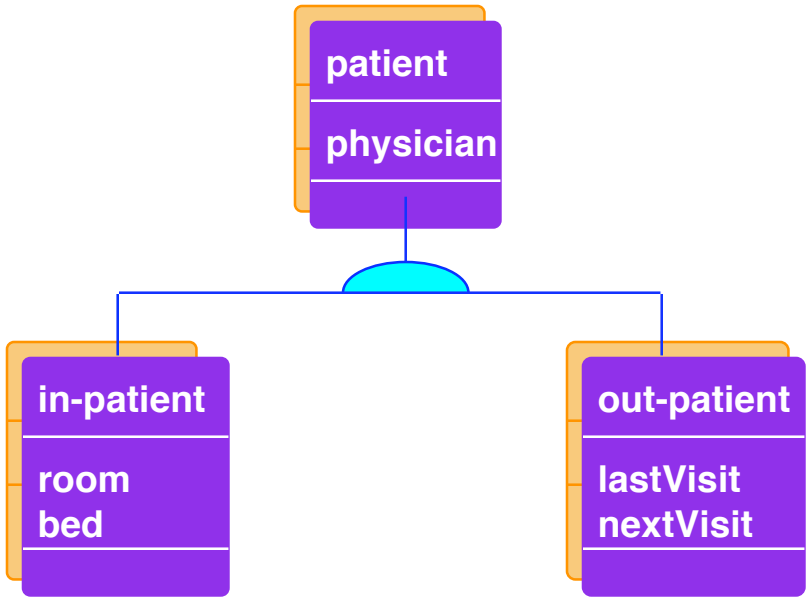
Coad's Object-Oriented Analysis

- Proposed by Peter Coad [Coad91].
- An *object* is defined as a real world entity related to the problem domain, with "crisply defined boundaries".
- Objects are encapsulated with attributes and behaviour.
- OOA offers five kinds of concepts: *objects*, *attributes*, *structures*, *services* and *subjects*.



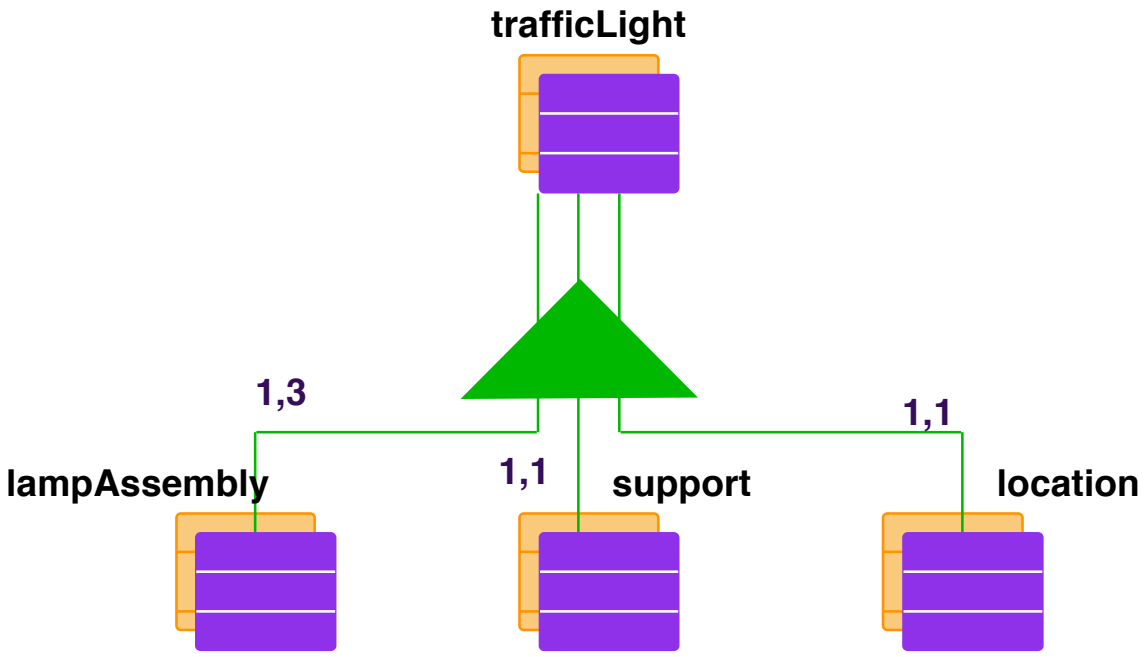
Gen-Spec Structures

Gen-Spec (generalization/specialization) structures organize classes into taxonomies. *Patients* are either *in-patients* or *out-patients*. The *physician* attribute of *patients* is inherited by both *in-patients* and *out-patients*.



Whole-Part Structures

Whole-Part structures describe an object as an assembly of other objects. A *traffic light* consists of 0 to 3 *lampAssemblies*, a single *support* and a single *location*.

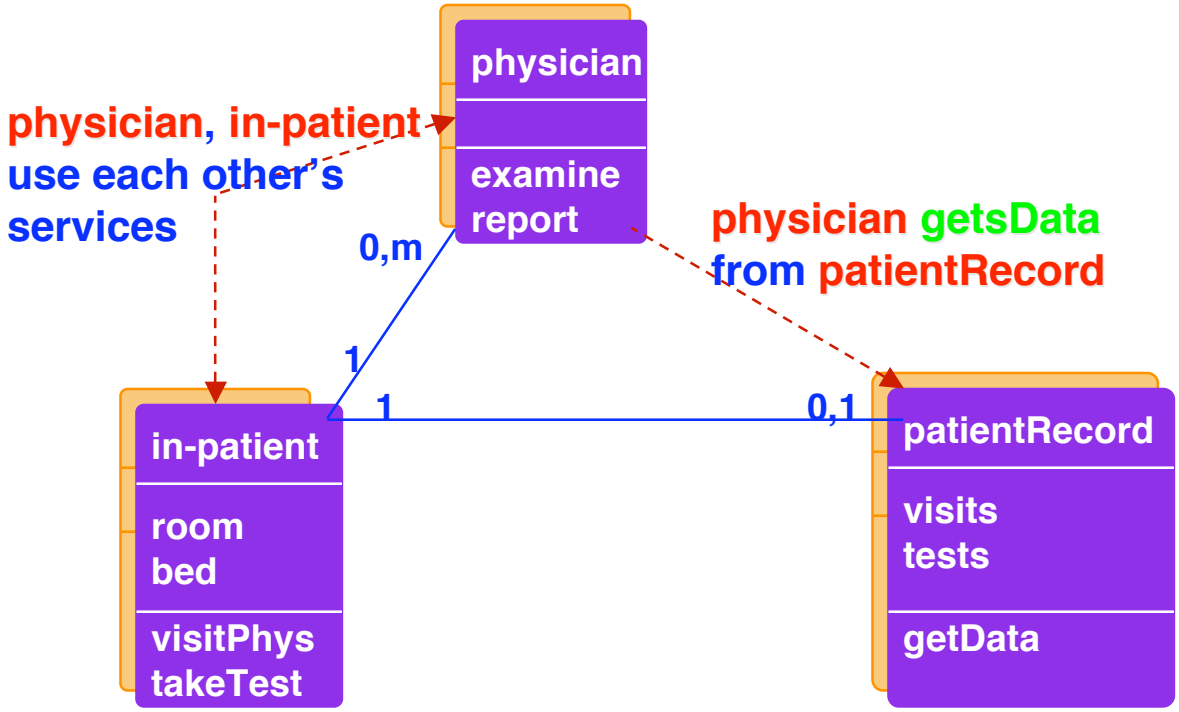


Services

- Objects provide *services* to other objects in their environments. For example, a physician object may provide services *examine*, *report*.
- Coad distinguishes three types of services:
  - ✓ *Occurence services,* whereby objects are created, destroyed, changed,...;
  - ✓ *Calculate services*, where an object performs a calculation for some other object;
  - ✓ *Monitor services*, where an object is monitoring some process to see if some condition applies;
- A special notation is used (dashed-line arrow) to indicate that an object is using services from another object.

OOA views the world with Smalltalk glasses...

Services and Relationships



Methodology

- Identify objects and *classes* (i.e., generic objects)
- Identify *structures* and build generalization, aggregation hierarchies.
- Define *subjects*. These partition all the objects and classes of an object model into subject layers, which represent the application from a particular perspective. Often whole Gen-Spec or Part-Whole structures are grouped under one subject.
- Identify information that should be associated with each object. Place *attributes* at the right structural level.
- Define *services* for each class.

Terminology

OOA	OOSE (Jacobson)	OOD (Booch)	OMT (Rumbaugh)
		Metaclass	
Object	Instance Object		Object
Gen-Spec	Inheritance	inherits	Generalization
Whole-Part	Consists-of		Aggregation
Instance conn.	Acquaintance		Link
Message Stimuli		Message Event	
Message conn.	Communication		
Attribute	Attribute		Attribute
Service	Operation		Operation
Subject	~View (subsystem)		Sheet
(Execution thread)	Use case		~Scenario
(User)	Actor		

What is Good About OOA?

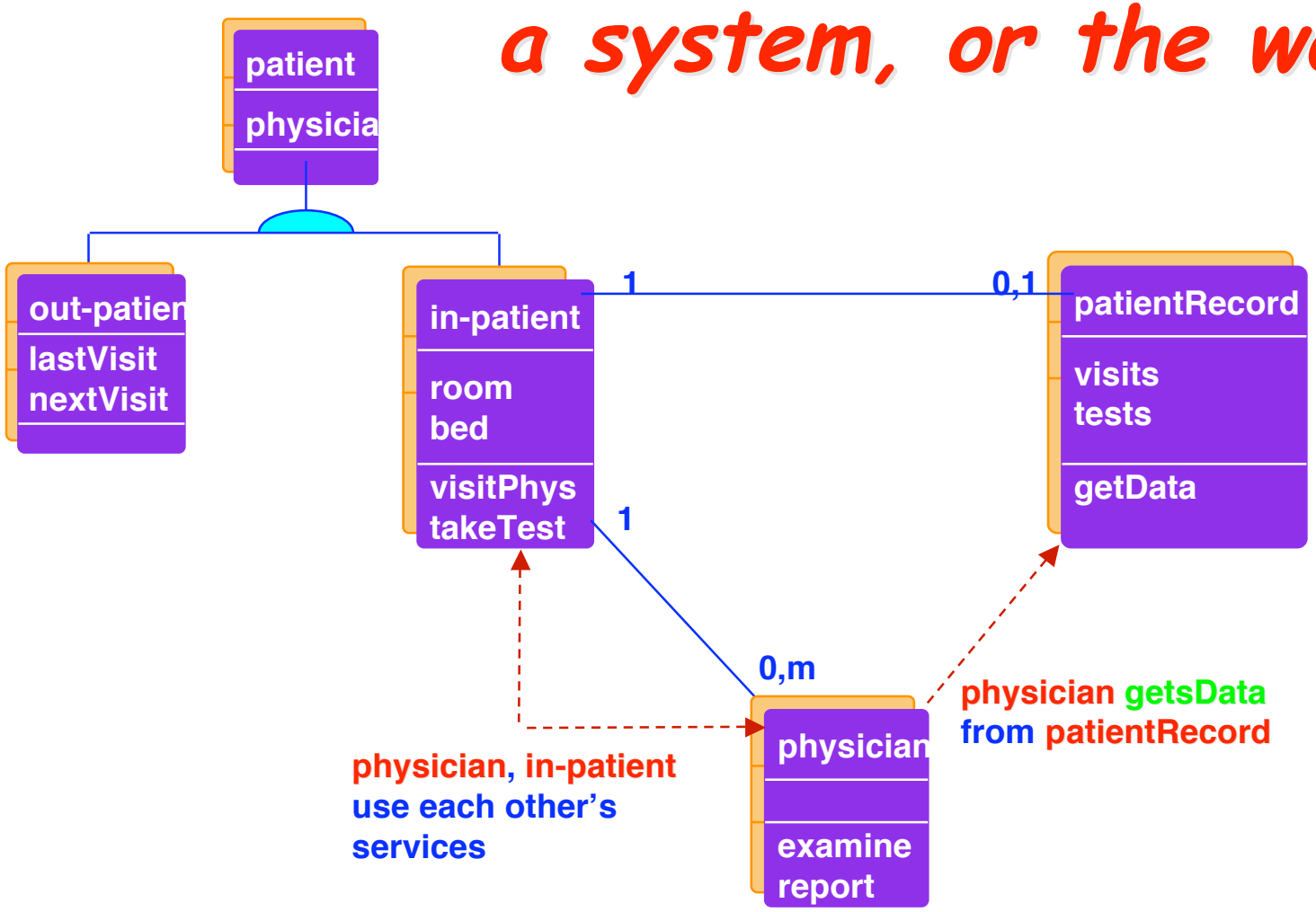
Advances the state-of-practice! Earlier prevalent modeling techniques, such as structured analysis (SA), data flow diagrams (DFD), entity-relationship diagrams (ERD),... were:

- ✓ fragmented, e.g., use of data flow and entity-relationship diagrams
- ✓ weakly structured: see DFD and ERD
- ✓ informal : see DFD
- ✓ based on an outdated programming paradigm (structured programming)

What is Questionable About OOA?

- Is OOA intended for modeling software, or applications? If only the former, then it is not meant for requirements modeling!
- Its ontological assumptions. Who says that objects, relationships, services and the like constitute a good set of primitive concepts for modeling the real world? ...organizations? ...people? ...industrial processes?
- The promise of easier design and implementation won't work for large systems where requirements, design and implementation have drastically different architectures and are based on very different concepts.

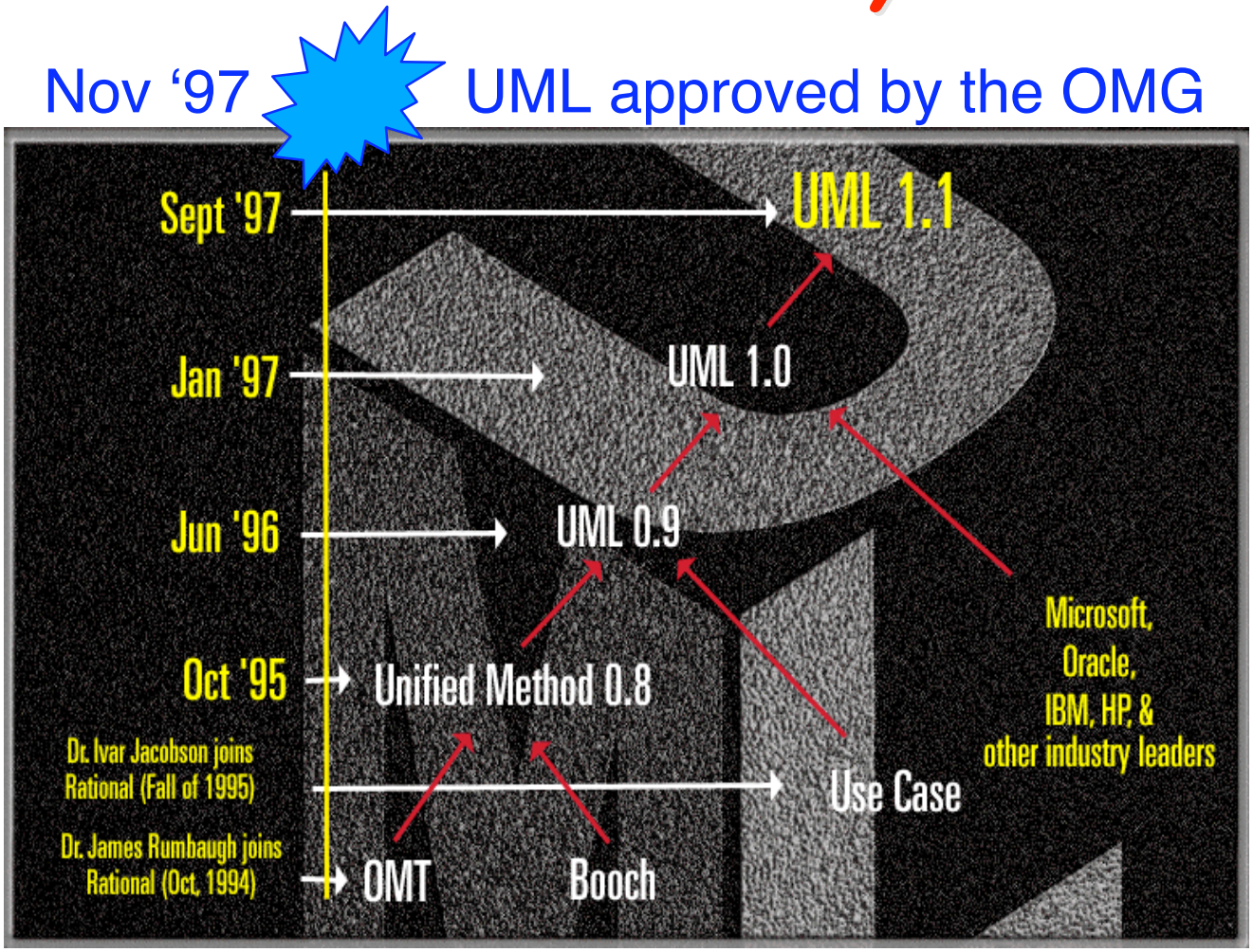
What does this model, a system, or the world?



The Unified Modeling Language (UML)

- Booch and Rumbaugh started working towards a unified modelling language (UML) in 1994 under the auspices of Rational Inc. They were later joined by Jacobson.
- UML only offers a notation, not a methodology for modeling (as various OOA techniques do).
- Combines Jacobson's use cases with Booch and Rumbaugh concepts for object modeling, along with statecharts.
- UML has been adopted by the Object Management Group (OMG) as an (object) modeling standard. OMG UML 1.0 is the first version of this new modeling standard.

UML History


Nov '97
UML approved by the OMG
Sept '97
UML 1.1
Jan '97
UML 1.0
Jun '96
UML 0.9
Oct '95
Unified Method 0.8
Dr. Ivar Jacobson joins Rational (Fall of 1995)
Use Case
Dr. James Rumbaugh joins Rational (Oct, 1994)
OMT
Booch
Microsoft, Oracle, IBM, HP, & other industry leaders

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- [Booch94] Booch, G., *Object-Oriented Analysis and Design*, Benjamin-Cummings, 1994 (2nd edition).
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- [Rumbaugh91] Rumbaugh, J., Blaha, M., Premerlani, W., Eddy, F., Lorensen, W., *Object-Oriented Modeling and Design*, Prentice-Hall, 1991.
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