

# **CSSE 490 Model-Based Software Engineering: Cougaar Model-Driven Architecture Example**



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INSTITUTE OF TECHNOLOGY

# Learning Outcomes: MBE Discipline

*Relate Model-Based Engineering as an engineering discipline.*

- Discuss more Milestone 3
- Examine the Cougar Model-Driven Architecture Project
- Short exercise with Books Online
- Topics for Term Papers (if time)



**Recall MBSE for Software Defined Radios – complexity was in the low-level details of the representations.**

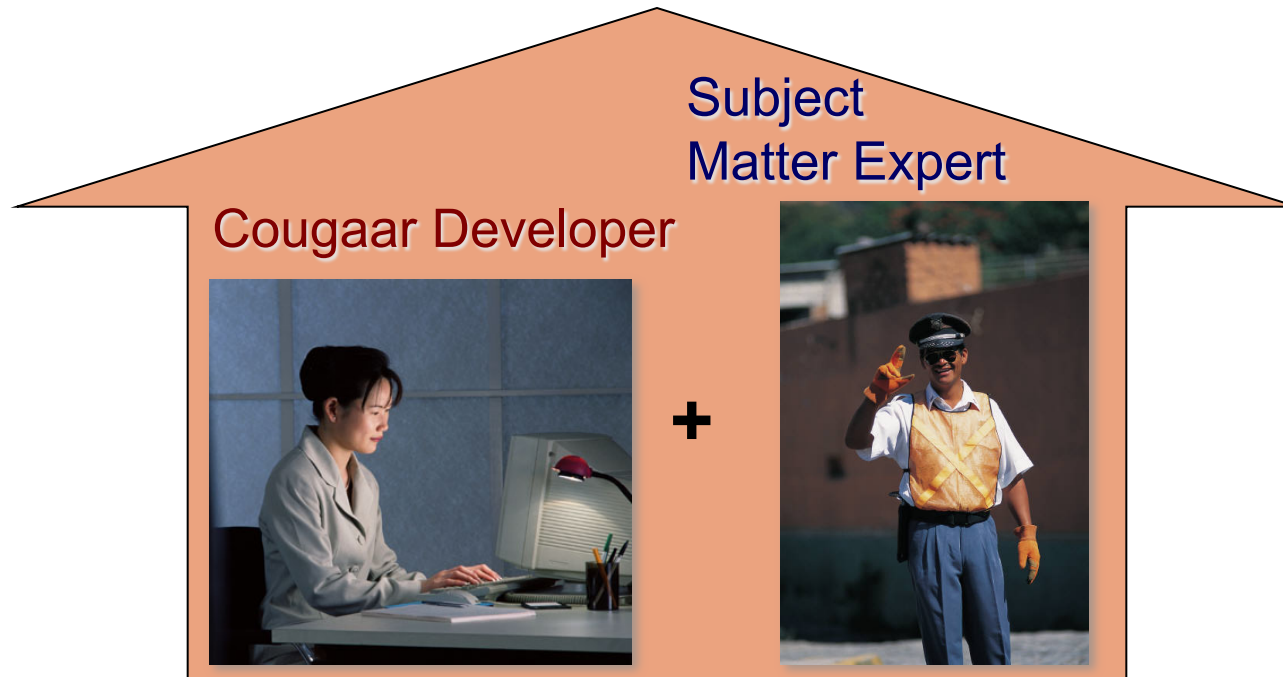
**Can MBSE be used when the complexity is in the behavior sophistication (e.g. Agents)?**

- Think for 15 seconds...
- Let's talk...



# Original Cougaar Development Problem

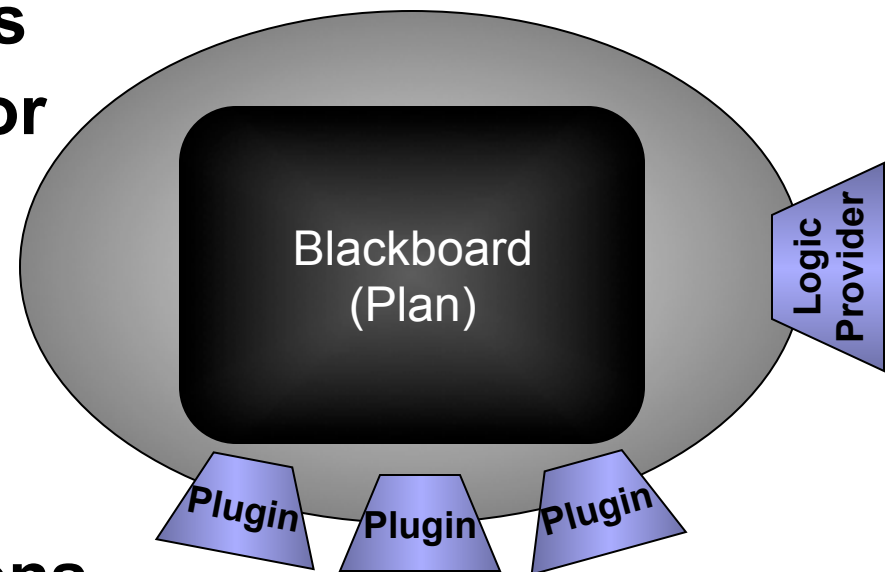
Domain Specific Application



Cougaar Components

# Cougaar Agent Internals in a Nutshell

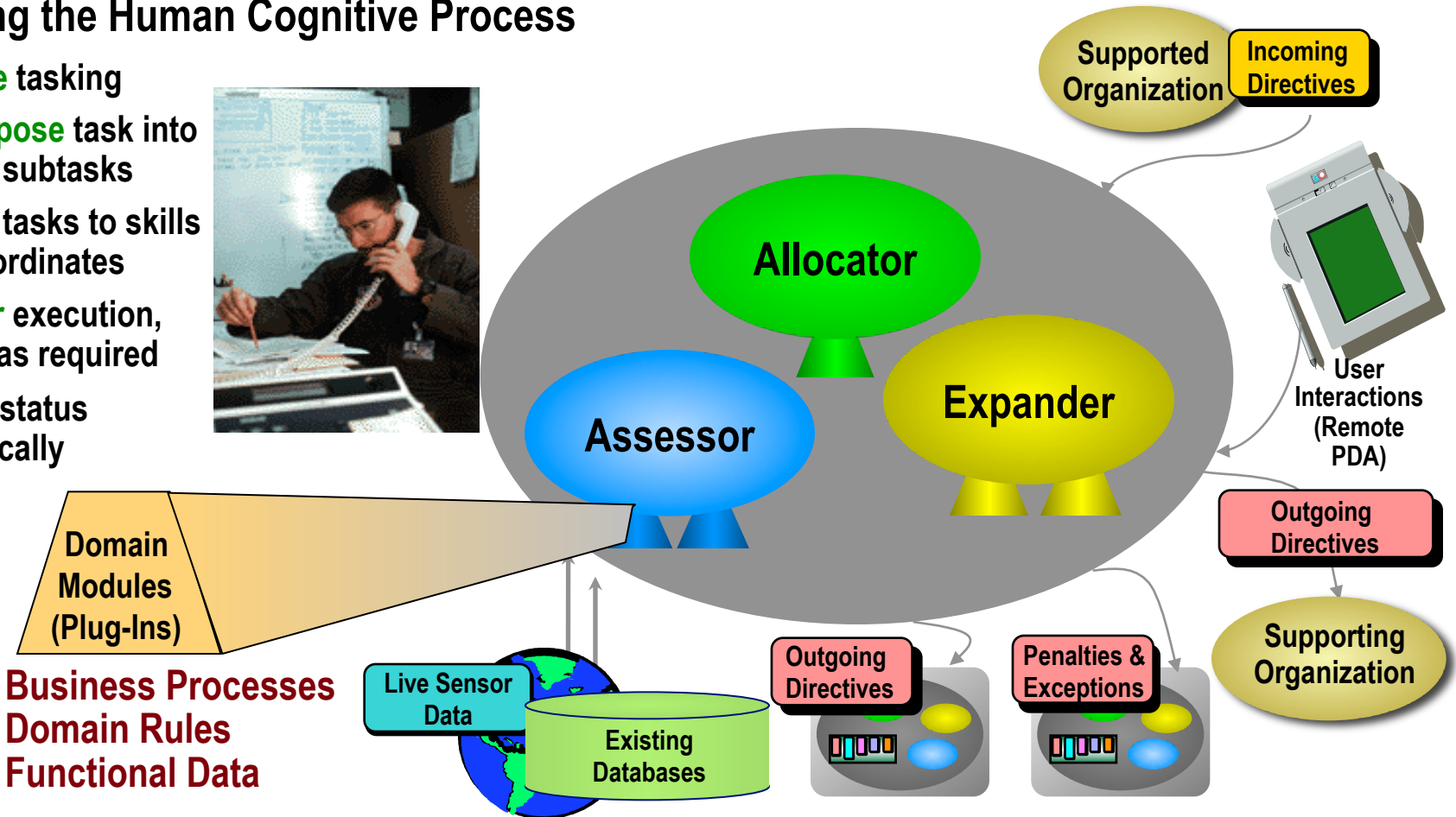
- **Agent** is logical collection of Plugins
- **Blackboard** - shared areas
- **Plugins** – provide behavior for agents and can subscribe to receive objects from Blackboard or publish to Blackboard
- **Message system** handles inter-agent communications
- **Community** of one or more agents on each node



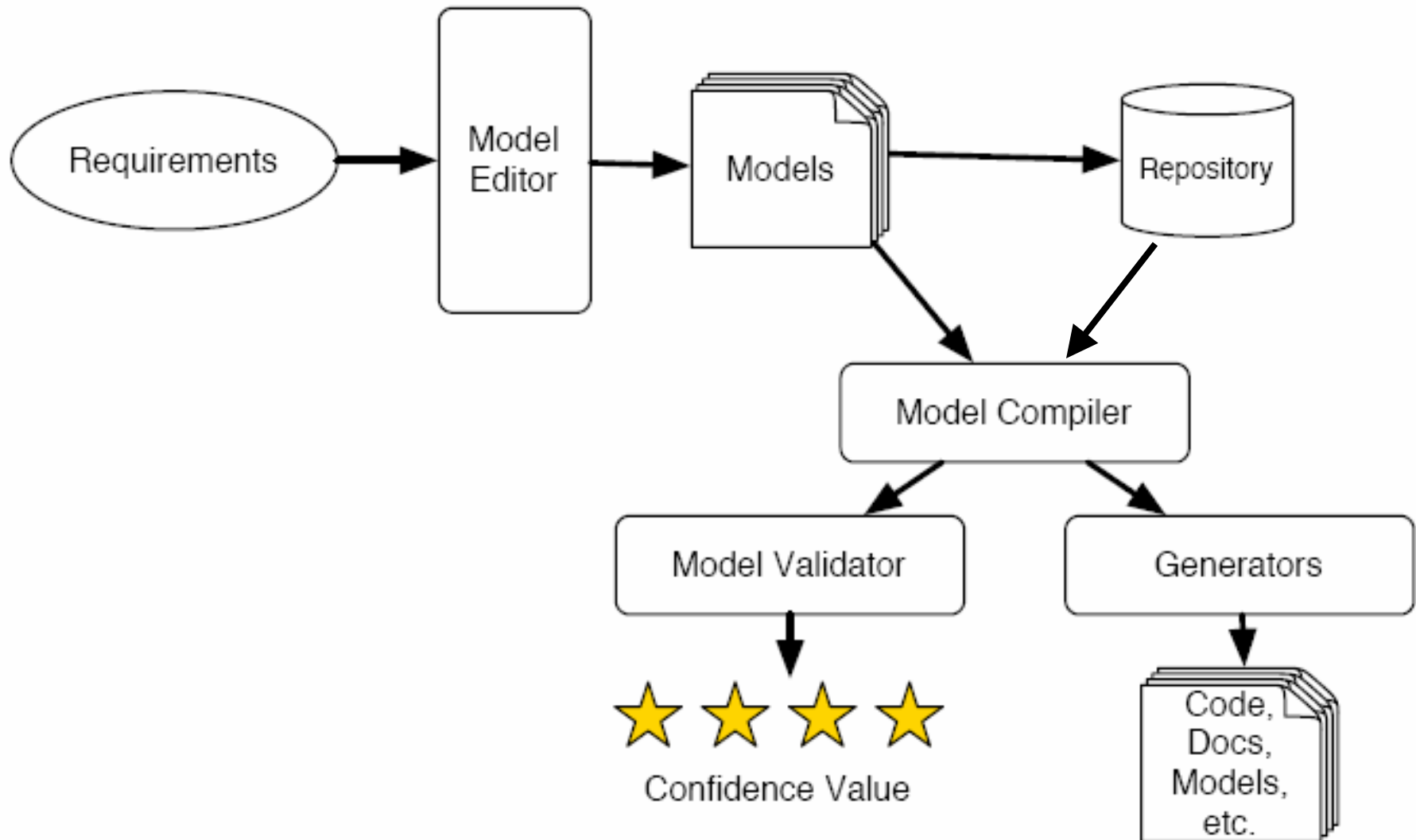
# Complexity: Cougar Agents in Systems

## Capturing the Human Cognitive Process

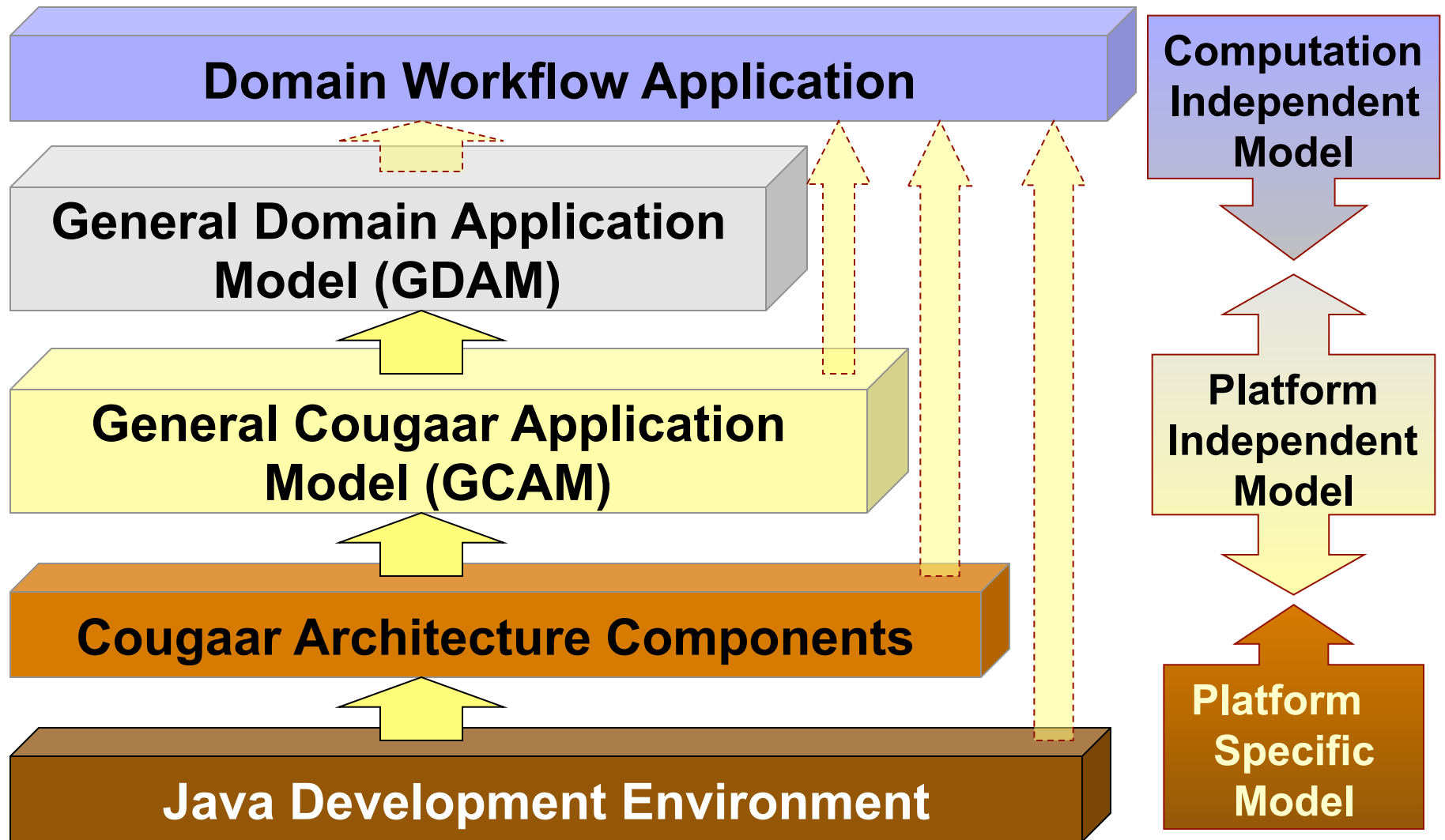
1. **Receive** tasking
2. **Decompose** task into doable subtasks
3. **Assign** tasks to skills or subordinates
4. **Monitor** execution, replan as required
5. **Report** status periodically



# Simple Cougaar MDA Vision



# Cougaar Model Driven Architecture



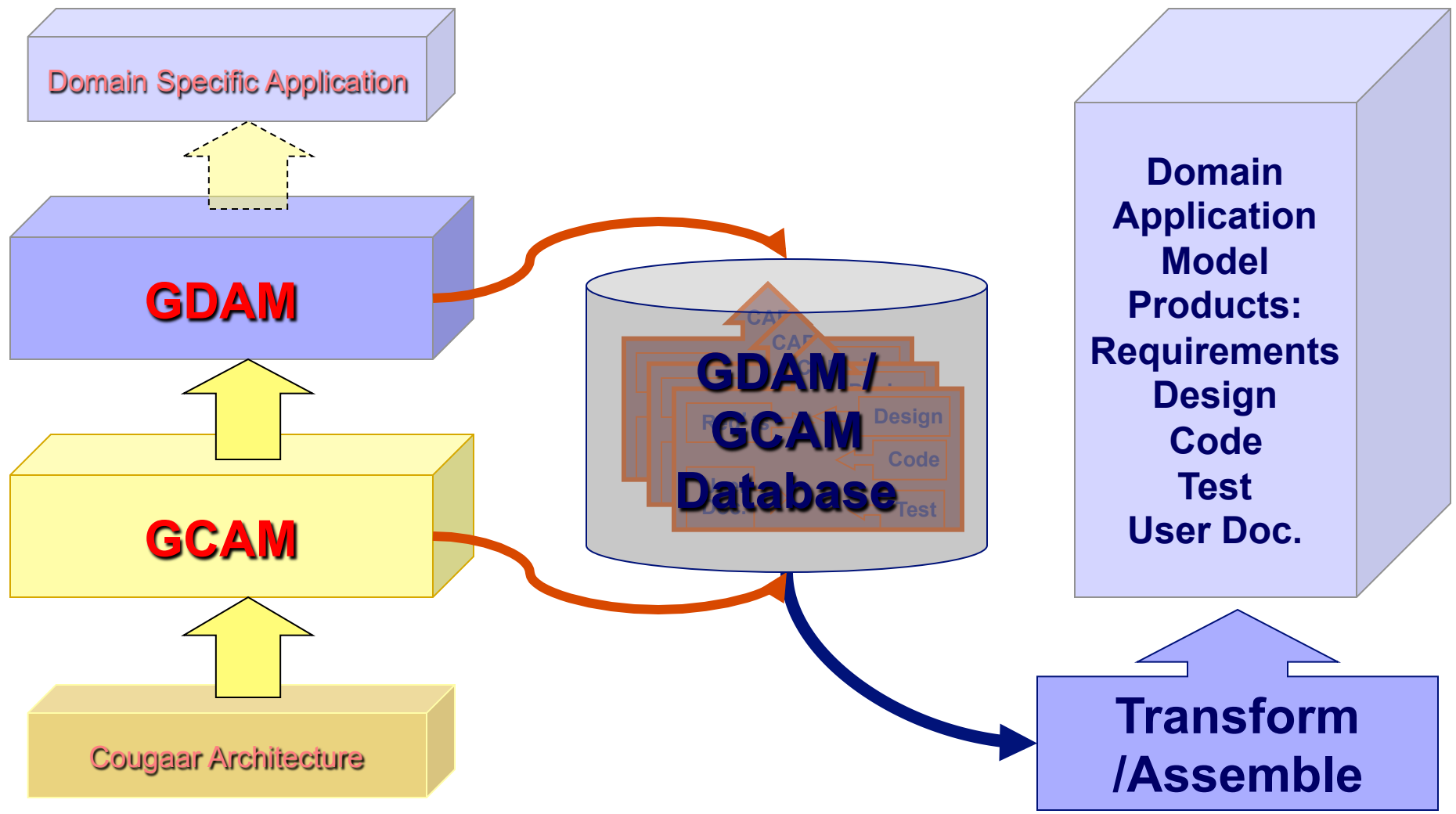


# So, what is a reasonable mental model of the major components for doing CMDA?

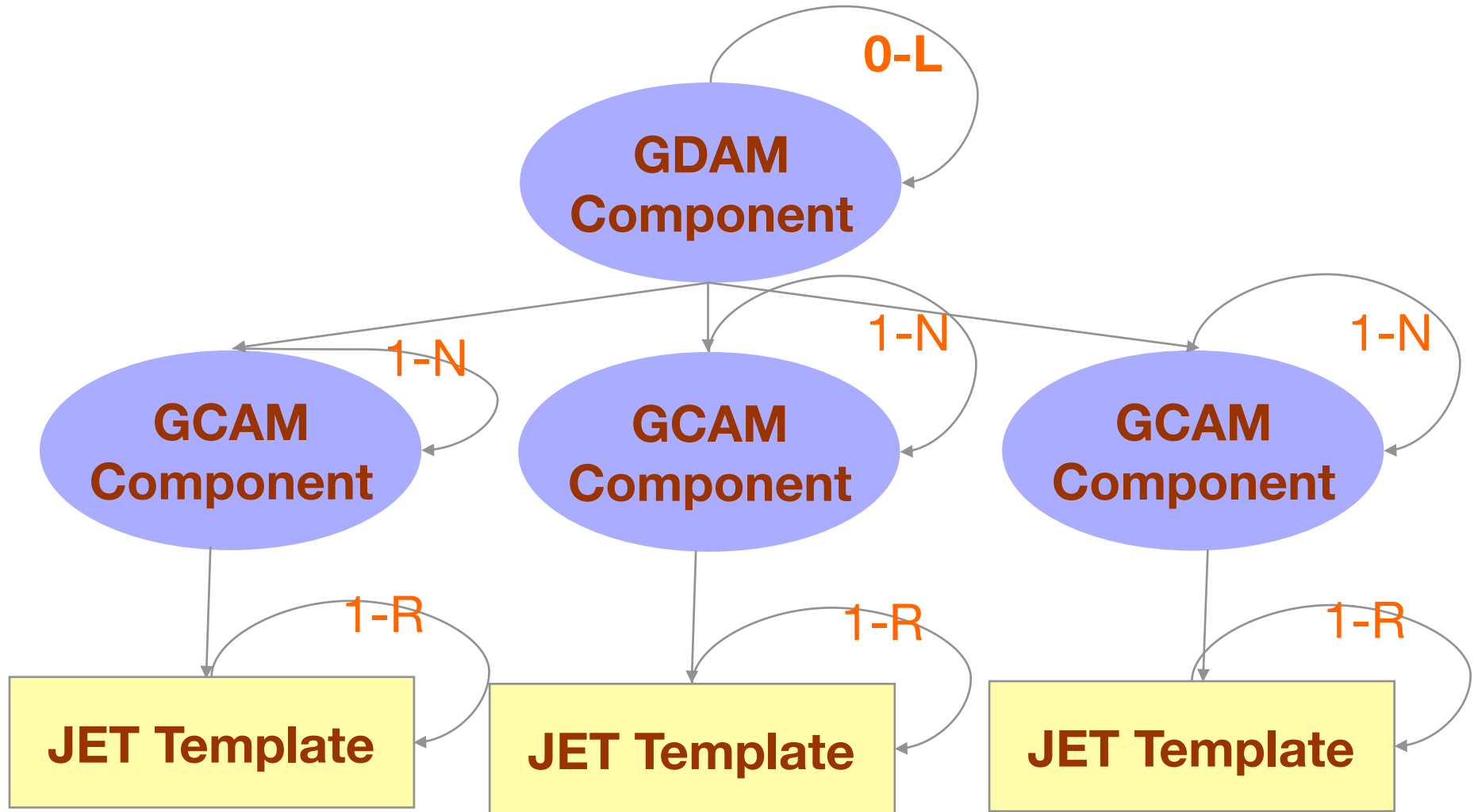
- Again, think for 15 seconds...
- Let's talk...



# CMDA Model and Transform Approach

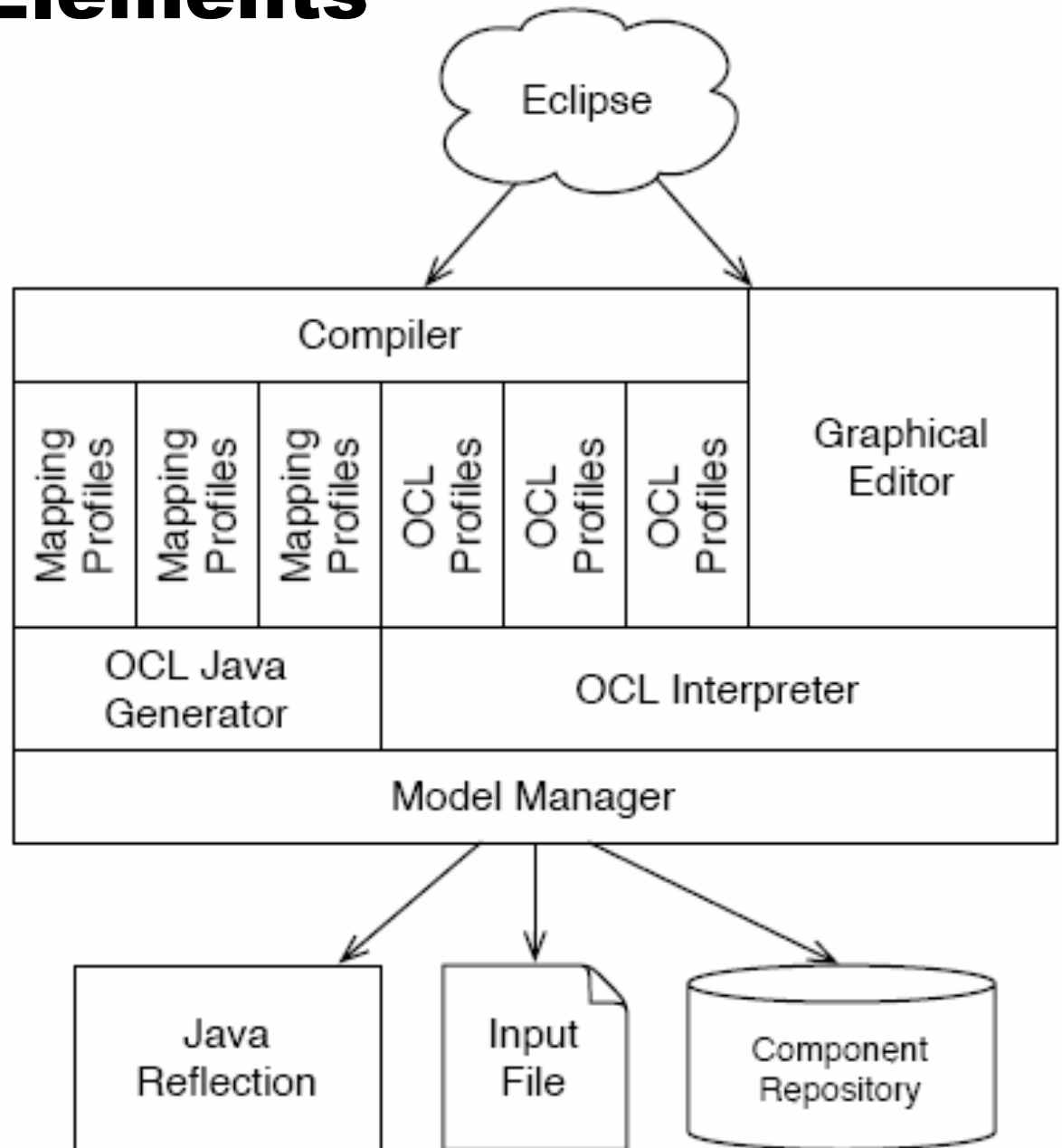


# Recall: CMDA Metamodel



# Basic CMDA Elements

- Graphical Cougaar Model Editor (GCME)
- MetaModel
- Model Manager
- Compiler
- OCL Interpreter
- JET Templates
- Component Model Repository



# CMDA Core Technologies

- Eclipse – Development Platform
- EMF – Modeling Framework
- GEF – Graphical Framework
- JET – Template Framework
- ANTLR – OCL Interpreter Framework
- GFE – Component Editor Framework
- Cougar – Underlying Platform



# Graphical Cougaar Model Editor (GCME)

The screenshot displays the Graphical Cougaar Model Editor (GCME) interface. The main workspace shows a component diagram with the following components and their relationships:

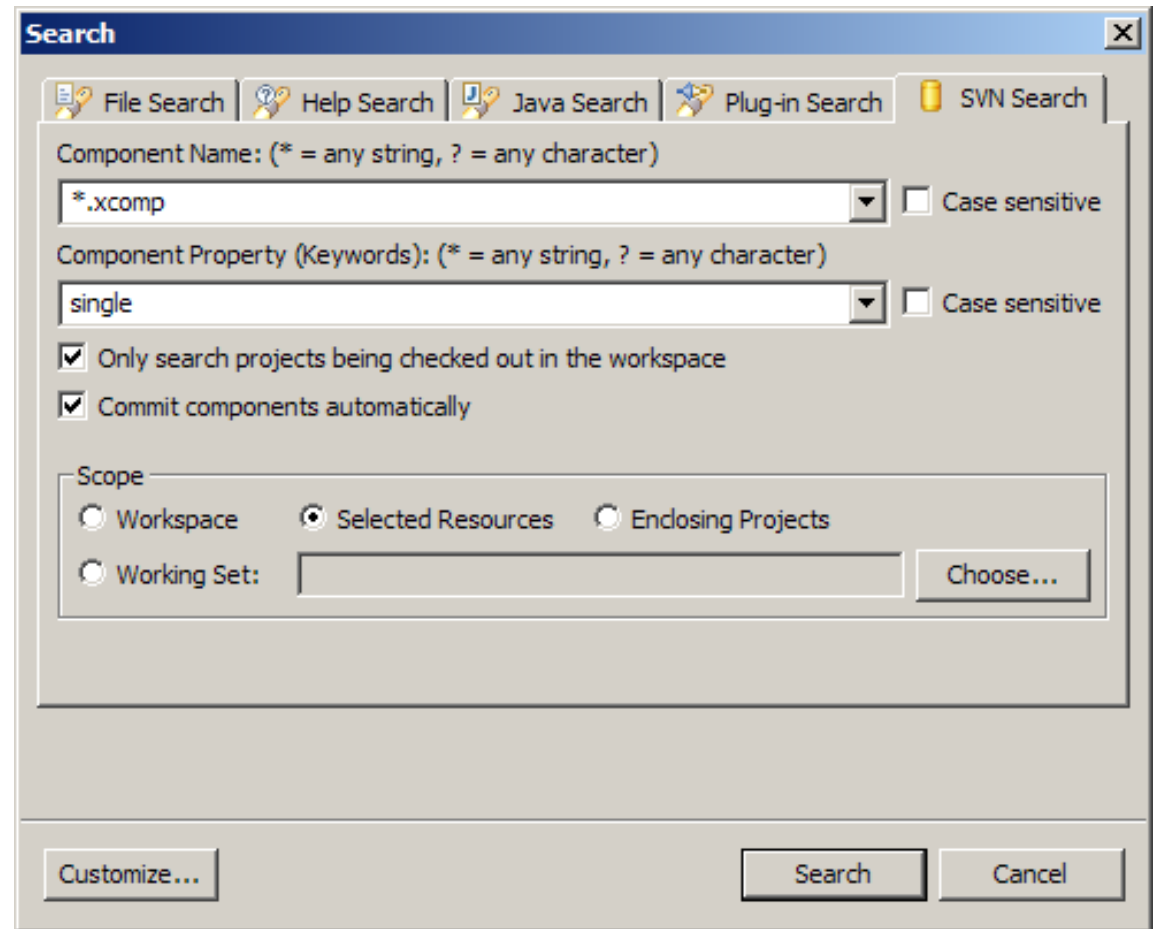
- Order Manager Component** is connected to **Payment Component**, **Bank Component**, **Accounts Component**, **Audit Component**, and **Warehouse Component**.
- Payment Component** is connected to **Bank Component** and **Accounts Component**.
- Bank Component** is connected to **Accounts Component**.
- Publisher Component** is connected to **Audit Component** and **Warehouse Component**.
- Audit Component** is connected to **Warehouse Component**.
- Warehouse Component** is connected to **Shipper Component** and **Transport Manager Component**.
- Shipper Component** is connected to **Transport Manager Component**.
- Client Component** is also present in the diagram.

The interface includes a **Palette** on the left with options: Select, Marquee, Solid connection, GDAM Components, Generic Component, and GCAM Components. The **Outline** on the right shows a hierarchical view of the model. The **Properties** table at the bottom is as follows:

Property	Value
derived	false
editable	true
last modified	10/26/04 4:55 PM
linked	false
location	C:\eclipse\workspace\org.cougaar.xc.editor\src
name	src
path	/org.cougaar.xc.editor/src

# Repository Integration

- Subversion is used as the Repository
- Search function developed to improve user productivity
  - Include Repository Search and Workspace Search
  - Include the option of automatically committing components in workspace to repository





# Property Editor

**Parameter Editor**  
Parameters of the Component are listed here

Name	Value
<input type="checkbox"/> OrderManager's Parameters	
<input type="checkbox"/> subscription	o.isKindOf(Task) && o.oclAsType(Task).getVer...
<input type="checkbox"/> workflow	new_wf
AllocationResultAggregator	AllocationResultAggregator.DEFAULT
<input type="checkbox"/> postTask	ClearPaymentTask
verb	CLEARPAYMENT
Asset	null
<input type="checkbox"/> setPP	(NullValue)
WITHINGENERICWORKFLOW	null
copyPP	WITHCREDITCARD
plan	getPlanningFactory().getRealityPlan()
<input type="checkbox"/> setPreference	(NullValue)
<input type="checkbox"/> Preference	0.5
<input type="checkbox"/> ScoringFunction	createNearOrAbove=.05
AspectType	END_TIME=getblockTillDay()
<input type="checkbox"/> addTask	wareTask
verb	BOOKSFROMWAREHOUSE
Asset	null

Duplicate Save Cancel



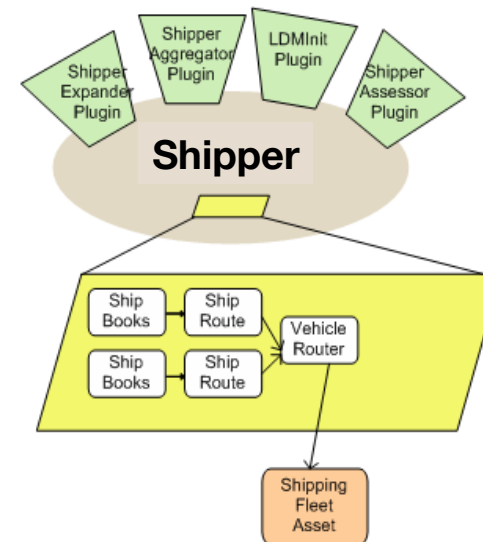
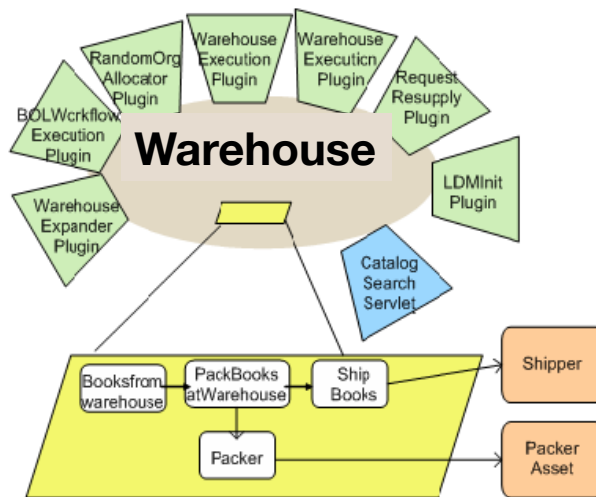
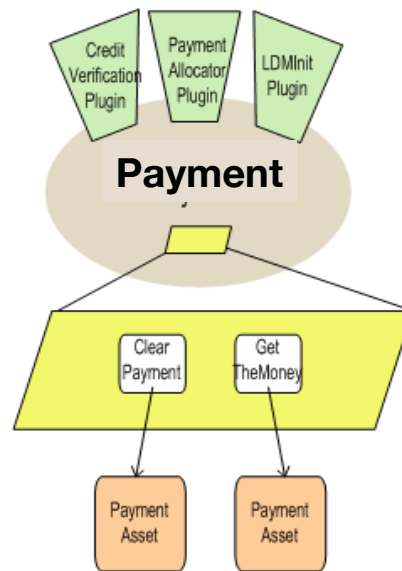
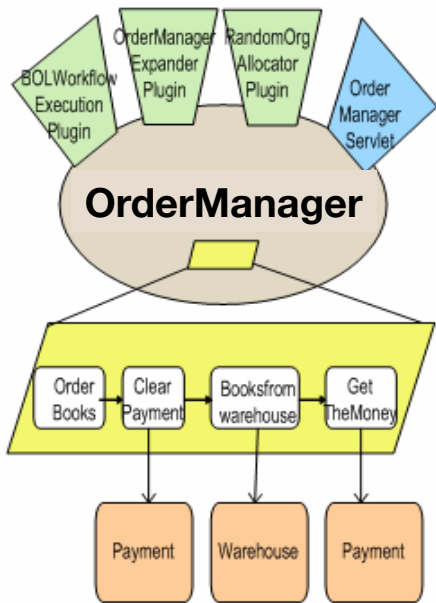
## Short Discussion/Exercise:

*Recall the Online Video Example in CSSE 374? What would that workflow look like for Books-Online using Agents?*

- How do you make an order?
- How do you pay for books?
- How do you ship books?
- How do you store books?
- How do you get books to sell?



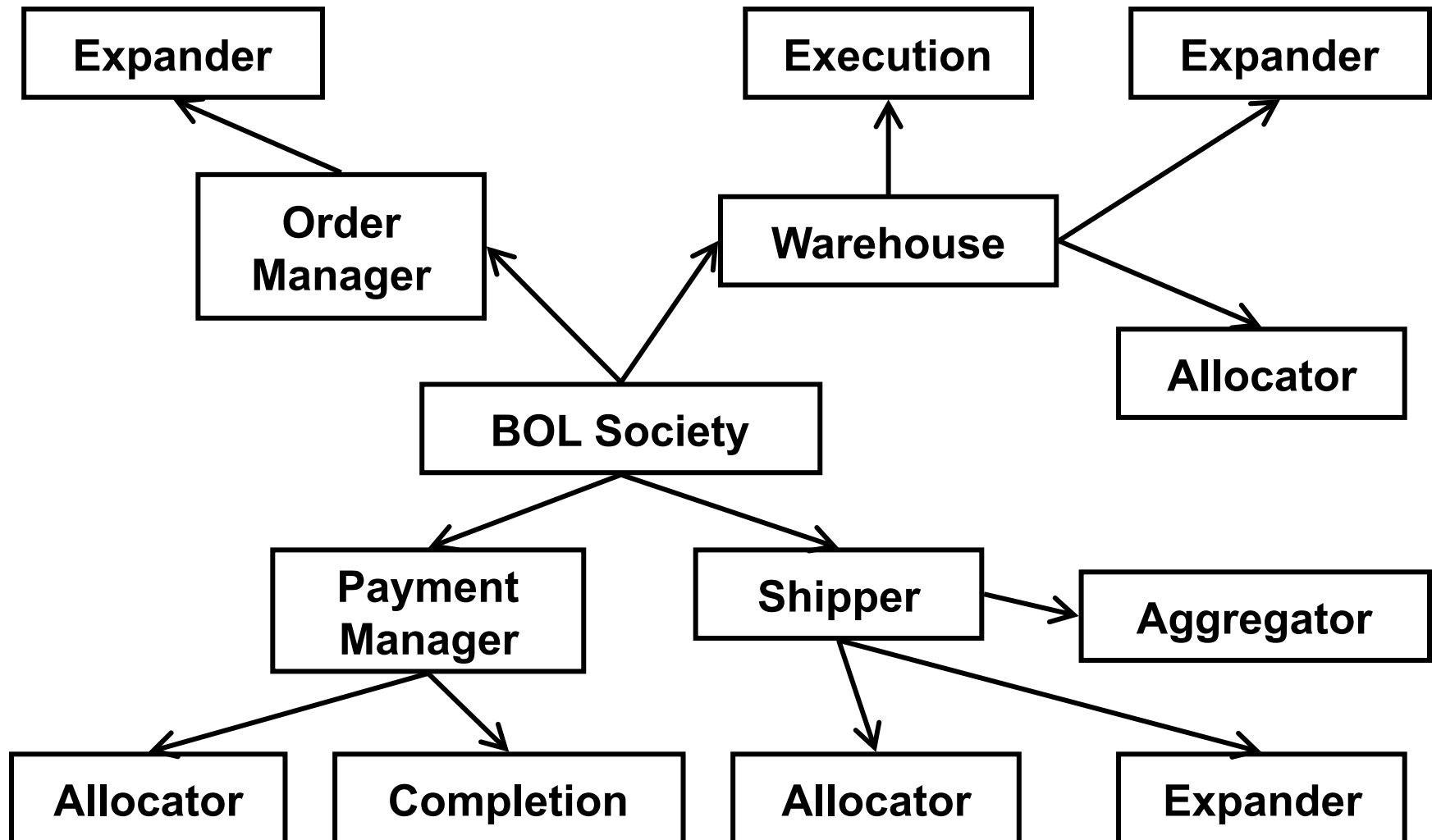
# Example...BooksOnLine



# Beware of Workflow... it could be coming your way 😊



# Cougaar Components in BOL





# **Recall: Write & Present Term Paper**

- **Use IEEE/ACM format for the paper (template provided on Angel)**
- **Include abstract, introduction, background/related work, analysis, and conclusion (along with references)**
- **Target 5-7 pages**
  - **If you are not a strong writer, use a lot of tables and figures to organize your work**
- **Use your own words - copied elements without reference are considered plagiarism**
- **Paper due May 17<sup>th</sup>, 2011**
- **Presentation on May 19<sup>th</sup>, 2011**



# **Recall: Topics for Term Paper**

- 1) Critically analyze the state of software productivity and the potential for Model-Based Engineering to make an impact.**
  - 2) Conduct a survey of Model-Based Engineering approaches (e.g., MDA/MDD, MBSE, DSL, MIC, etc.) to compare and contrast them.**
  - 3) Survey Model-Based Engineering in other disciplines (e.g., civil, mechanical,) comparing them with MBSE.**
  - 4) From a macro-economic perspective, evaluate the cost-benefit of Model-Based Engineering for software.**
  - 5) Critically analyze advances in automatic programming from a feasibility perspective and outline how these implications are relevant for software today.**
  - 6) Survey applications of “Product-Lines” to software systems and present arguments for a Model-Based Engineering approach.**
  - 7) Critically analyze transformation technology in the production of Model-Based/Driven Engineering software solutions.**
  - 8) Survey studies of Model-Driven Architecture (MDA) for the state-of the practice and outline key criteria for success and failures.**
  - 9) Suggest one that you would be more motivated to do!**
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# Homework and Milestone Reminders

- **Read Case Study Paper “Model-Driven Systems Engineering” by Balmelli et. al.**
  - To be discussed in Class this Thursday
  - Do assigned questions and bring document to class
  - Be prepared to discuss and even lead the discussion
- **Term Paper Proposal due tonight by 11:55pm**
- **Milestone 3: Light-Weight Transformation Environment (see Milestone 3 assignment)**
  - Due by 11:55pm, Friday, April 29<sup>th</sup>, 2011.