Object Oriented Processes

R.K.Joshi
Dept of Computer Science and Engg.
IIT Bombay

Life Cycle Models

Waterfall

Spiral

Fountain

Extreme

Model Driven

Phases and their relations with object orientation

requirements modeling

analysis of requirements and the domain

domain modeling

design of solution space

implementation

develop-test-build

refactoring

deploying the solution

Requirements modeling

functional requirements

core business logic,

business protocols etc.

non-functional requirements

performance, distribution, security etc.

OOSE

Transforming requirements into OO implementation applying object orientation in modeling

There is also a process called OOSE, which is use case driven (Jacobson)

We will look into 3 aspects of OOSE

early requirements

part-whole analysis

CRC

Methods of organization

- Differentiation of experience into objects and their attributes
- Distinction between whole objects and their parts
- Formation of classes of objects and distinction/similarities between the classes
  - [Classification theory]
  - OOA builds upon these three organizational methods

Primitives for organization

- Abstraction
- Encapsulation
- Inheritance
- Association
- Communication with messages

Major approaches to analysis

- Functional decomposition
  - Subfunctions + function interfaces
- Dataflow Analysis
  - Data and control flows
  - Data transformations, transformers
  - Data and control stores
- Information modeling: Entity Relationships
  - Entities, relations, subtypes, associations
- Object Oriented
  - Classes and objects, inheritance, associations, messages

Coad and Yourdon’s OOA Process

Major activities (Layers) in an OOA process

- Finding classes and objects
- Identifying structures
- Identifying subjects
- Defining attributes
- Defining services

Layer 1: Finding classes and objects

- Objects are abstractions in problem domain

- Classes describe one or more objects with uniform set of attributes and behavior

Where to look for?

- Observe first hand – go to the site of use
- Listen to problem domain experts
- Reuse previous OOA results
- Reuse results from similar systems
- Read the requirements document
- Ask the client for a concise summary

What to look for?

- Roles
  - E.g. supervisor, clerk, student, faculty, manager, account holder, member
- Things and Structures in the problem domain
  - E.g. Types of vehicles, types of operators for the system
- Devices
  - E.g. sensor, port, modem
- Operational procedures
  - E.g. registration, drop a course, pay fees, issue book
- Events remembered
  - E.g. successful Registration, update, login session
- Places, locations
  - Machine a.b.c.d, branch of a bank

How to name?

- Use
  - Nouns in singular
  - Nouns with adjectives
  - Activity names
  - Standard vocabulary in problem domain

Layer 2: Identifying Structures

- What's structure?
- Why structure?
- What to structure?
  - Objects, activities
- How to structure?
  - Inheritance, part-whole, client-server, peer-peer

Layer 3: Identifying Subjects

- What are they?
  - e.g. organization, persons, vehicles, sensors
- Why?
- How
  - select
  - refine
  - construct
  - add

Layer 4: Attribute Layer

- what?
- how?
  - attributes,instance connections etc.
- Visibilities

Layer 5: Service Layer

- what?
  - req/response, state machines, protocols
- Why?
- How?

The Part-Whole Relationship (Partalogy Analysis)

Odell's Classification Criteria

- Configuration
  - Whether parts have functional/structural relationship with the whole
- Homeomerous
  - Whether parts are same kind as that of whole
- Invariance
  - Whether parts can be separated from whole

Kinds of Aggregation Relations

- Component-Integral Object
- Material-Object
- Portion-Object
- Place-Area
- Member-Bunch
- Member-Partnership

Component-Integral Object

- Defines configuration of parts within a whole
- Wheels part of cart
- Bristles part of tooth brush
- Scenes part of film

Material-Object (made of)

- Describes invariant configuration of parts within a whole
  - Car is partly iorn
  - Bread is partly flour
  - Kheer is partly milk

Portion-Object

- Defines a homeomeric configuration of parts within whole
  - Slice of bread
  - Meter part of kilometer

Place-Area

- Homeomeric and invariant configuration of parts within a whole
  - Powai part of Bombay
  - Everest part of Himalayas
  - Boundary line part of cricket field

Member-Bunch

- Defines a collection of parts as a whole
  - Tree is a part of forest
  - Employee is part of forum
  - Ship part of fleet

Member-Partnership

- Defines an invariant collection of parts as a whole
  - Laurel part of laurel and hardy
  - Maruti is a partner in maruti-suzuki

Classification criteria

	Configurational	homeromeric	Invariant
Component-Object			
Material-Object			
Portion-Object			
Place-Area			
Member-bunch			
Member-partnership			

Classification criteria

	Configurational	homeromeric	Invariant
Component-Object	Yes	No	no
Material-Object	Yes	No	no
Portion-Object	Yes	Yes	no
Place-Area	Yes	Yes	yes
Member-bunch	No	No	No
Member-partnership	No	No	yes

Non-agrregational relations

- Topological inclusion
  - Customer is in the store
  - Meeting is in the noon
- Classification inclusion
  - Ramayana is a book
  - UML is a modeling notation
- Attribution
  - Weight of the box is 50 kg
- Attachment
  - Earrings are attached to ears
- Ownership
  - Bicyle is owned by subhash

Transitivity in Part-whole

- A relates to B, B relates to C
- Does A relate to C?
  - Car-engine-piston
  - Maths-bob-bob's arm

If it's the same kind of relation, transitivity applies.

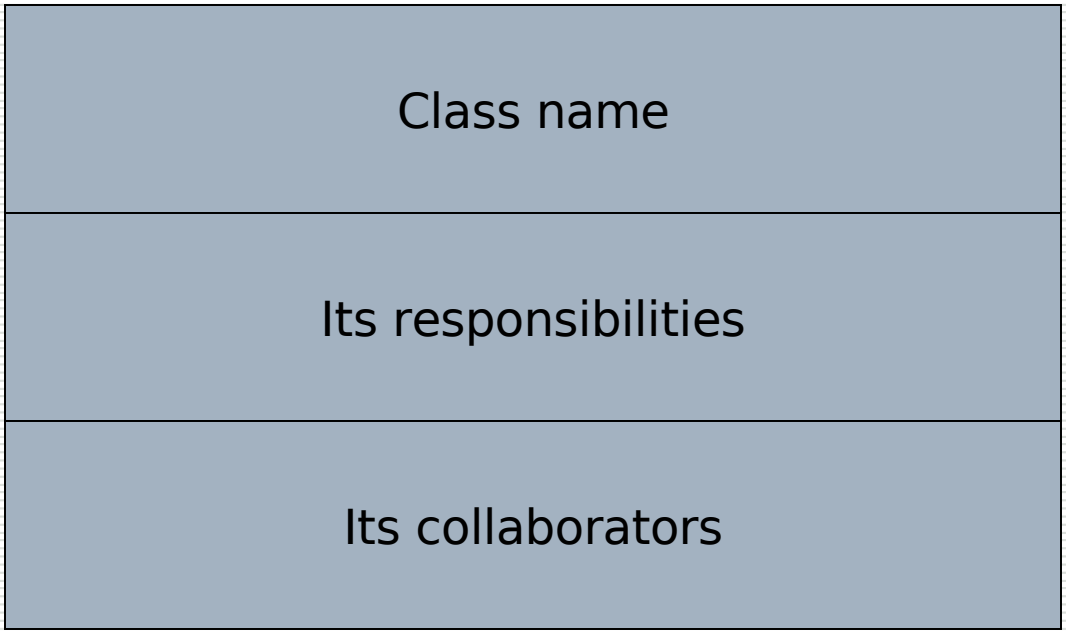
e.g. apply this to compositional objects

- rotate, move, delete

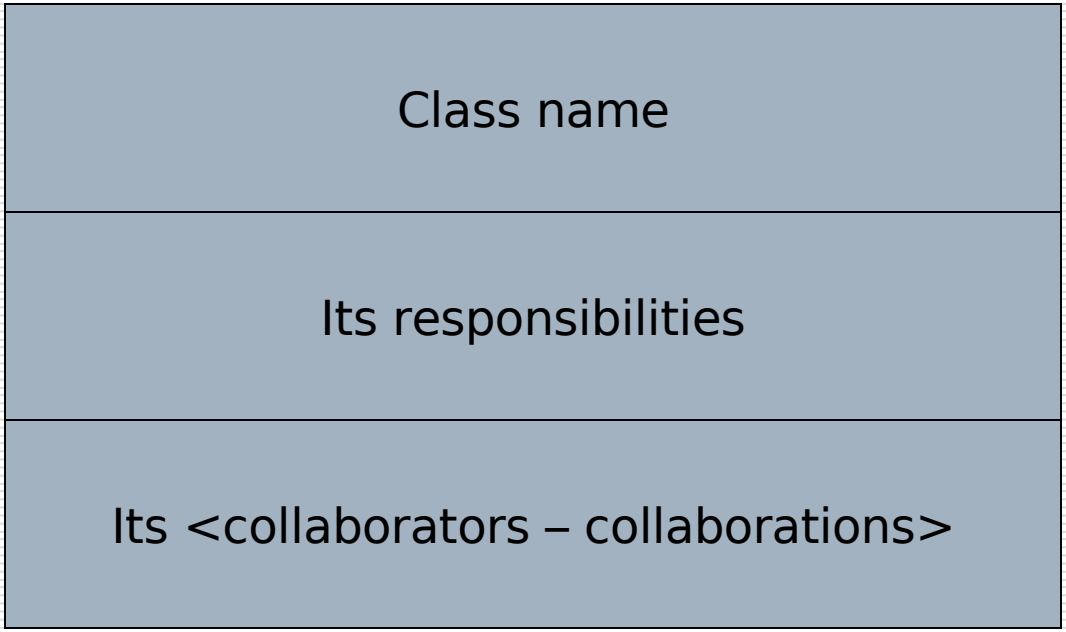
Beck and Cunningham's CRC Method of Object Identification

CRC A Method for object oriented thinking

Classes Responsibilities and Collaborators

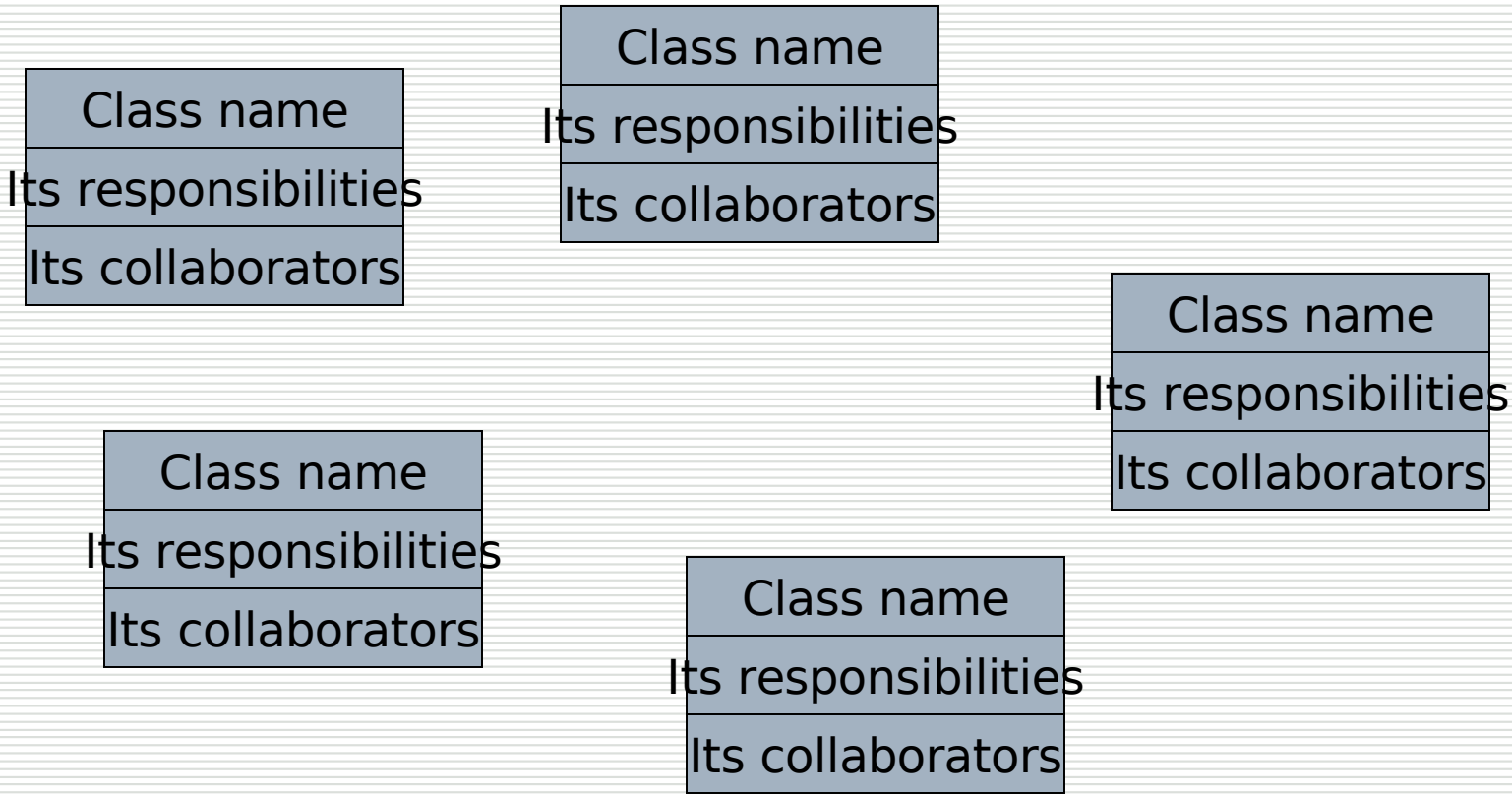


CRC: our recommendation



Collaborators are other CRC cards
Collaborations will be their *responsibilities*

A system decomposed in CRCs



Contributions of CRC

- The authors found that CRC gives a perspective of object-ness in the problem domain
- It’s a good technique to teach object decomposition to novices
- A card is 4X6 inch size (palmtop)

Classroom Case study

- IIT Lan Acadaemic system for courses, registrations, grades

References

- Peter Coad/ Edward yourdon: Object-oriented Analysis, Yourdon press computing series, Pearson education, 1991
- Kent Beck, Ward Cunningham: A laboratory for object oriented thinking, OOPSLA 1989 conference