

Responsibilities

- Two kinds of responsibilities
 - knowledge maintained by object *attributes*.
 - actions a class can perform *behaviours/operations*.
- Should represent purpose of the class in system.
- Define services provided by the class to system.
- Two rough ideas for types of classes:
 - Information objects can store information and be returned to client code.
 - Action objects can perform operations for client code.
- Only **public** services count.
- **private** knowledge may need to be implemented by a class, but definition delayed.
- Concentrate on **what** the class does not **how** it's done.
- I.e., How it interacts with other classes.

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Identifying Classes and Responsibilities

- Examine **nouns** in requirements specification:

- May become a class.

- May become an attribute of a class, or a part of a composite class.

- Information words can imply "how much, how many, how big", etc.

- Examine **verbs** in requirements specifications:

- Active voice verb may indicate a responsibility.

- Turn passive voice sentences into active voice and examine.

- <https://writing.wisc.edu/handbook/GCS/activevoice.html>

- Perform a system walk-through (Use Case Diagrams in UML terms):
 - Make sure that all system responsibilities identified.

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Assign Responsibilities

- Identified responsibilities must be assigned to classes.
- Examine context in which responsibility was identified.
 - Use requirements specification, as well as class definitions.
- Some assignments will be obvious, others will require some thought.
 - Distribute system intelligence evenly.
 - State responsibilities as generally as possible.
 - Keep behaviour (actions) with related information.
 - Keep information about one thing in one place.
 - Responsibilities can be shared among related objects.
- Each class should have one main purpose, one idea, one main responsibility.

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- System Intelligence:
 - What the system knows – information it stores.
 - What actions the system can perform – its functions.
 - Relation to other systems.

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- Class intelligence:
 - What does the class know – information it stores.
 - What services does it provide (server view).
 - What services does it use (client view).

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- State responsibilities as generally as possible.
 - Instead of stating that a LineElement knows how to draw a line and RectangleElement knows how to draw a rectangle. We say that both know how to draw themselves.
- May lead to more general classes (i.e., superclasses)
- If an object maintains particular information, it should be responsible for operations on that data and vice versa.

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Responsibility Guidelines (2)

- Keep information about one thing in one place.
- Maintenance of specific information should not be shared.
 - Leads to duplication of information, which may lead to inconsistency.

- If more than one object must know the information
 1. Assign the information to one object/class if there is one that has few other responsibilities.
 2. If classes requiring the information have few responsibilities, collapsed into a single class?
 3. Create a new class to take the responsibility of managing the information. Other classes can collaborate with this new class to access the information.

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- Some responsibilities need to be shared among several classes.

They are compound responsibilities.

- Split into more specific components to distribute intelligence.
- Indicative of **relationships** between the classes.

- Composition or Aggregation relationships.

- Hierarchical relationships.

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- Difficulties in assigning responsibilities can occur:

1. A class is missing:

- May need to add a class to handle a set of unassigned responsibilities. Have you identified a new sort of entity?

2. Responsibility could be assigned to more than one class:

- Sometimes the assignment is not obvious. Make a tentative arbitrary assignment. Try a walk-through. See how it works. Try an alternative. See how that works.

Specifying Responsibilities: CRC Cards

- **Class Responsibility Cards (CRC)** help with the design of classes and their collaborations.

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<http://www.agilemodeling.com/artifacts/crcModel.htm>

- **Responsibilities** – attributes and behaviours/operations for this class.
- **Collaborations** – other classes that it needs to work with.

Student	
Student number	Seminar
Name	
Address	
Phone number	
Enroll in a seminar	
Drop a seminar	
Request transcripts	

<http://www.agilemodeling.com/artifacts/crcModel.htm>

(Maybe you decide Address should be its own class and then Student would also collaborate with the Address class.)

CRC Example 2

LibraryMember	
Responsibilities	Collaborators
Maintain data about copies currently borrowed	Copy
Meet requests to borrow and return copies	
Copy	
Responsibilities	Collaborators
Maintain data about a particular copy of a book	Book
Inform corresponding Book when borrowed and returned	
Book	
Responsibilities	Collaborators
Maintain data about one book	
Know whether there are borrowable copies	

Using UML, P. Stevens and R. Pooley

Note: Do not based your A1 design off this. The spec for A1 might be very different to the spec of the library here.

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1. Think about what data and operations belong together.
 - These are your candidate classes.
2. Draw up CRC cards for your preliminary class design.
3. Think about and reflect on the design:
 - If a class has too many responsibilities, divide it up.
 - If it has too few responsibilities, may be it should be merged with other classes.
4. When settled, begin a UML design to precisely specify responsibilities and collaborations.

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Designing an object oriented system for the game of Connect 4.

- Write CRC cards specifying the classes in the system.
- Choose one of your classes and draw it in UML.

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- You designing an object oriented system to manage purchases in a store.
 - Customers can come in and place an order of items.
 - Items have a price and the cost of the customer's order can be calculated.
 - Customers have personal information: name, address etc.
 - There is also facilities to check the inventory of items.
- Write CRC cards specifying the classes in the system.
- Choose one of your classes and draw it in UML.

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