UML class diagrams

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A class

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UML explicitly separates concerns of actual symbols used vs meaning.

Many other things can be model elements: use cases, actors, associations, generalisation, packages, methods,...
An object

This pattern generalises: always show an instance of a classifier using the same symbol as for the classifier, labelled instanceName : classifierName.
Classifiers and instances

An aspect of the UML metamodel that it’s helpful to understand up front.

An **instance** is to a **classifier** as an object is to a class: instance and classifier are more general terms.

In the metamodel, Class inherits from Classifier, Object inherits from Instance.

UML defines many different classifiers. E.g., UseCase and Actor are classifiers.
Showing attributes and operations

<table>
<thead>
<tr>
<th>Book</th>
</tr>
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<tbody>
<tr>
<td>title : String</td>
</tr>
<tr>
<td>copiesOnShelf() : Integer</td>
</tr>
<tr>
<td>borrow(c:Copy)</td>
</tr>
</tbody>
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Syntax for signature of operations (argument and return types) adaptable for different programming languages. May be omitted
Compartments

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They can be suppressed in diagrams.

They are omitted if empty.

You can have extra compartments labelled for other purposes, e.g., responsibilities of the class...
Visibility

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(Or protected (#), package (∼) or other language dependent visibility.)
Association between classes

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An **object diagram** contains objects and links: occasionally useful.
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Useful when documenting the class: e.g. a class invariant for DirectorOfStudies could refer to the associated Student objects as self.directee (a set, if there can be more than one).
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Can use visibility notation + − etc on role names too.
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May be formal, e.g. $x + y = z$, or informal, e.g. “the attribute docstring describes the action of the button in concise English”. If formal, it can be useful to have class invariants automatically checked.
Commmas for alternatives, two dots for ranges, * for unknown number. E.g. each Copy is a copy of exactly one Book; there must be at least one Copy of every Book.
Navigability

Adding an arrow at the end of an association shows that some object of the class at one end can access some object of the class at the other end, e.g. to send a message.

Crucial to understanding the coupling of the system. NB direction of navigability has nothing to do with direction in which you read the association name.
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Usually, but not necessarily, corresponds to implementation with inheritance.
Abstract operations and classes

An operation of a class is abstract if the class provides no implementation for it: thus, it is only useful if a subclass provides the implementation.

A class which cannot be instantiated directly – for example, because it has at least one abstract operation – is also called abstract. Java...
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Can show abstract operation or class using italics for the name, and/or using the property \{abstract\}.
Interfaces

In UML an interface is just a collection of operations, that can be realised by a class.
Many things other than classes can realise interfaces: can use the lollipop symbol on e.g. components, actors.
In a class diagram, a class may have *compartments* for:

1. attributes
2. operations
3. responsibilities
4. all of the above, but nothing else
5. all of the above, and other items
Identifying objects and classes

Simplest and best: look for noun phrases in the system description!

Then abandon things which are:

- redundant
- outside scope
- vague
- attributes
- operations and events
- implementation classes.

(May need to add some back later, especially implementation classes: point is to avoid incorporating premature design decisions into your conceptual level model.)

Similarly, can use verb phrases to identify operations and/or associations
Suggested: (class diagrams) Stevens ch 5.