A Taste of UML
with text-processing flavour added!

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Acknowledgements: some material drawn from lectures by several colleagues at Edinburgh: Perdita Stevens, Nigel Goddard, Paul Jackson

Outline

- Software Engineering and UML
- Practical interlude: making some UML diagrams
- Text processing to extract UML diagrams

Introduction

Software Engineering is the application of the principles of engineering to building (large) software systems.

Who's this?

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Margaret Hamilton
in 1969.

Led team that developed
Apollo space mission
software.

That's its source code!
(About 145,000 lines.)

`http://news.mit.edu/2016/scene-at-mit-margaret-hamilton-apollo-code-0817`

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Using SE techniques can be useful even for small-ish systems – *especially* if it's not just you!

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A text processing system might contain a *tokenizer*, *POS-tagger*, *ontology engine*, *semantic analyser* and many others.

The ontology engine does not need to know how the tokenizer works; and the tokenizer should not be able to update the ontology!

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- They also have methods – functions that do something to, or return information from, the object. E.g. check out the book, or query its current loan status.
- The class of an object defines its attributes and methods. (The actual values of attributes belong to individual objects; methods belong to the class.) E.g. the class of book copies, the class of library users.

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E.g. a 'book' might inherit 'publisher' and 'date' from a more general 'publication' class; 'magazines' also inherit from 'publications'.

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Many classes depend in various ways on other classes – how to document that?

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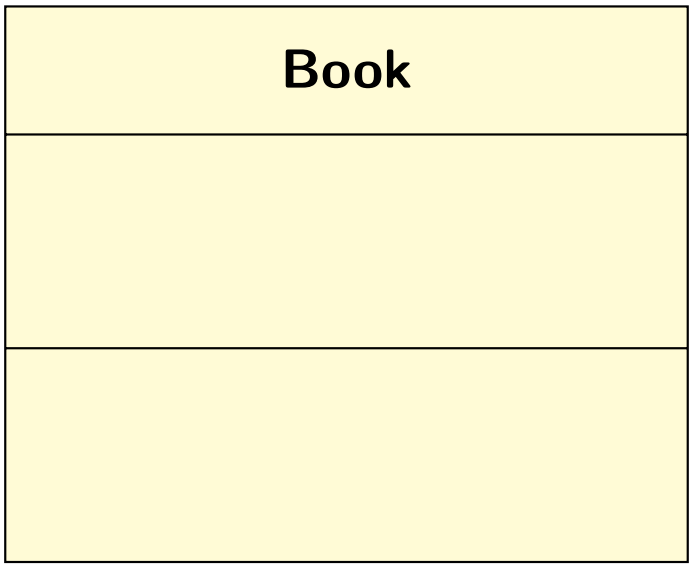
Today: just class diagrams.

Classes



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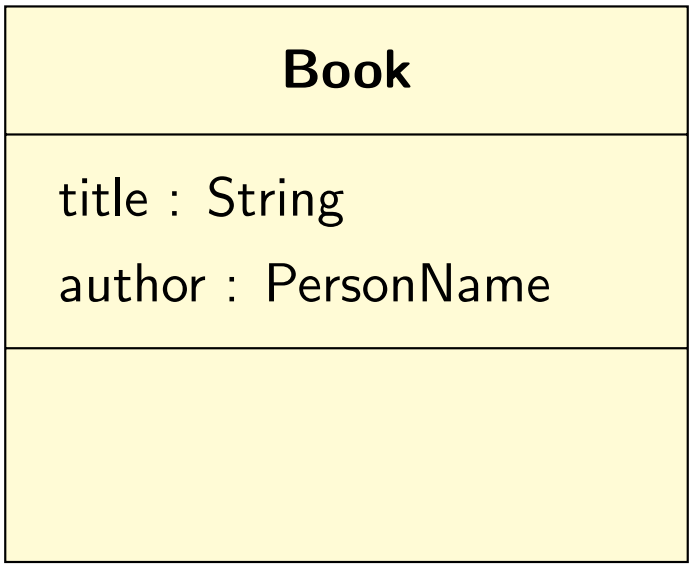

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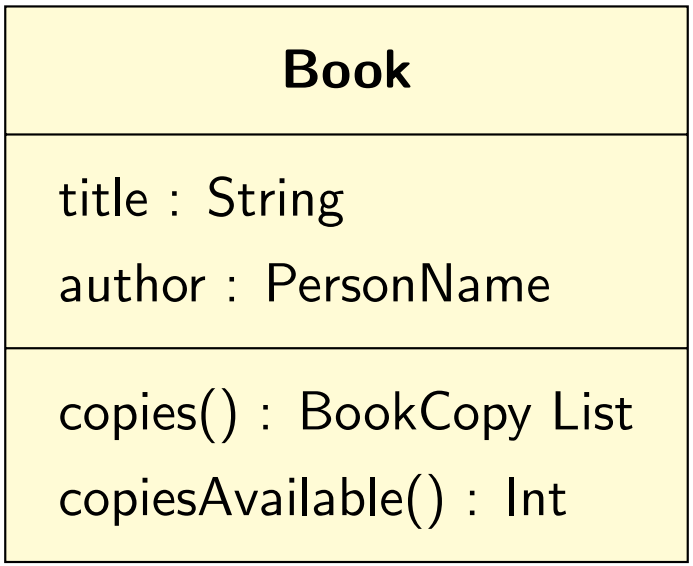

- The name of the class
- its data attributes
- its methods

Associations

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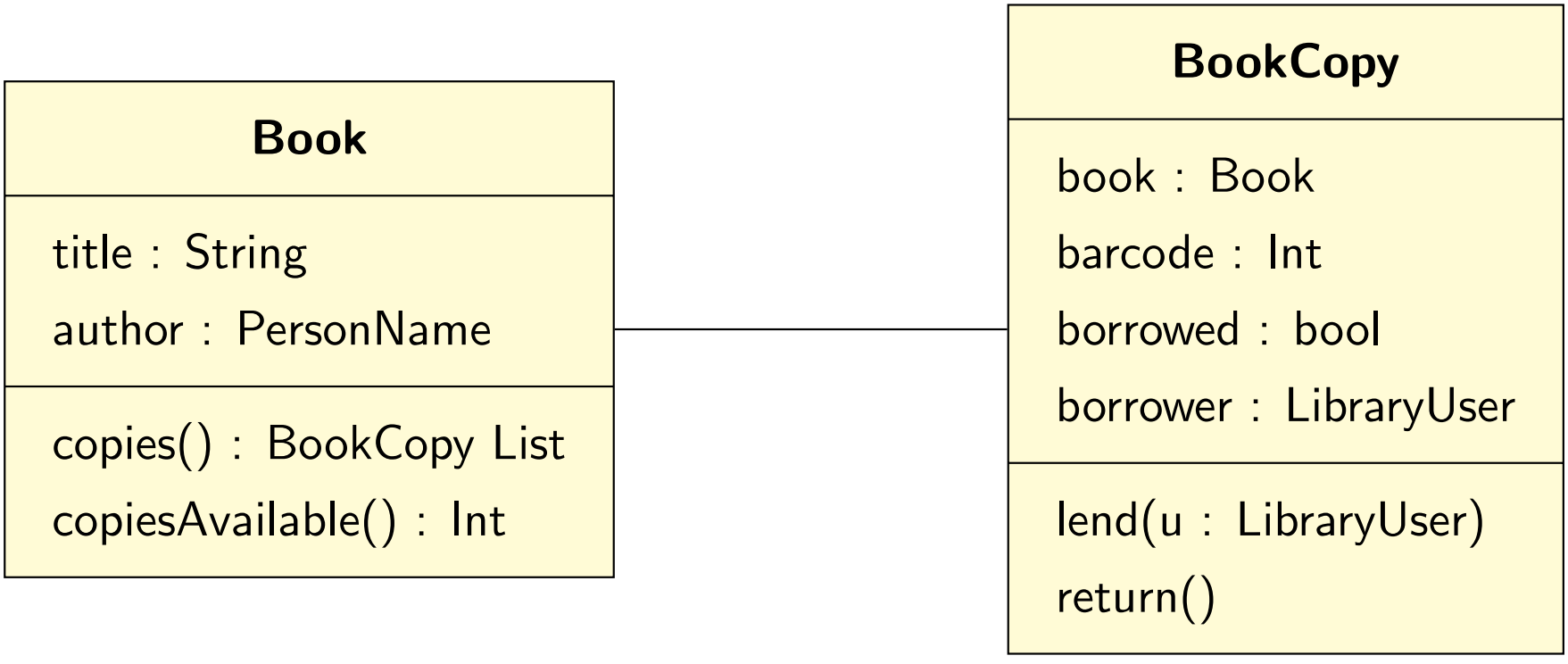

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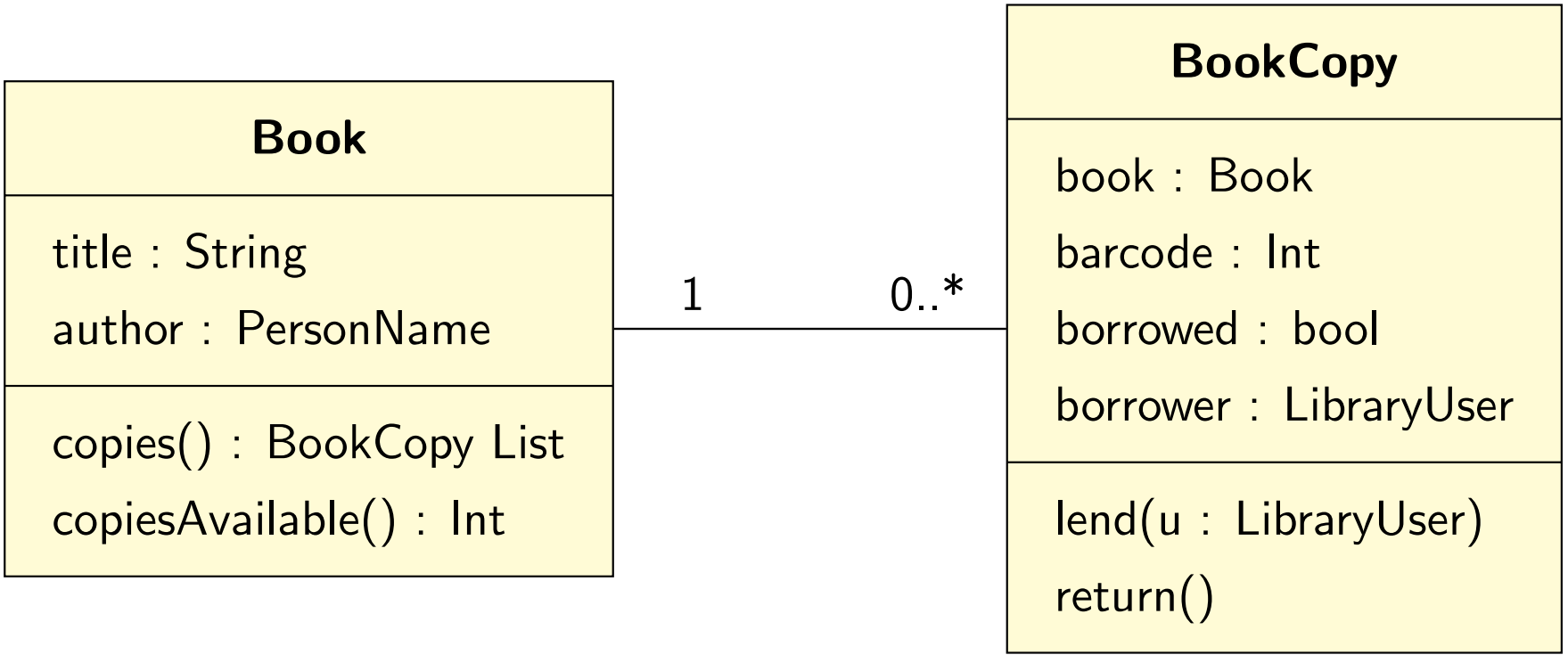

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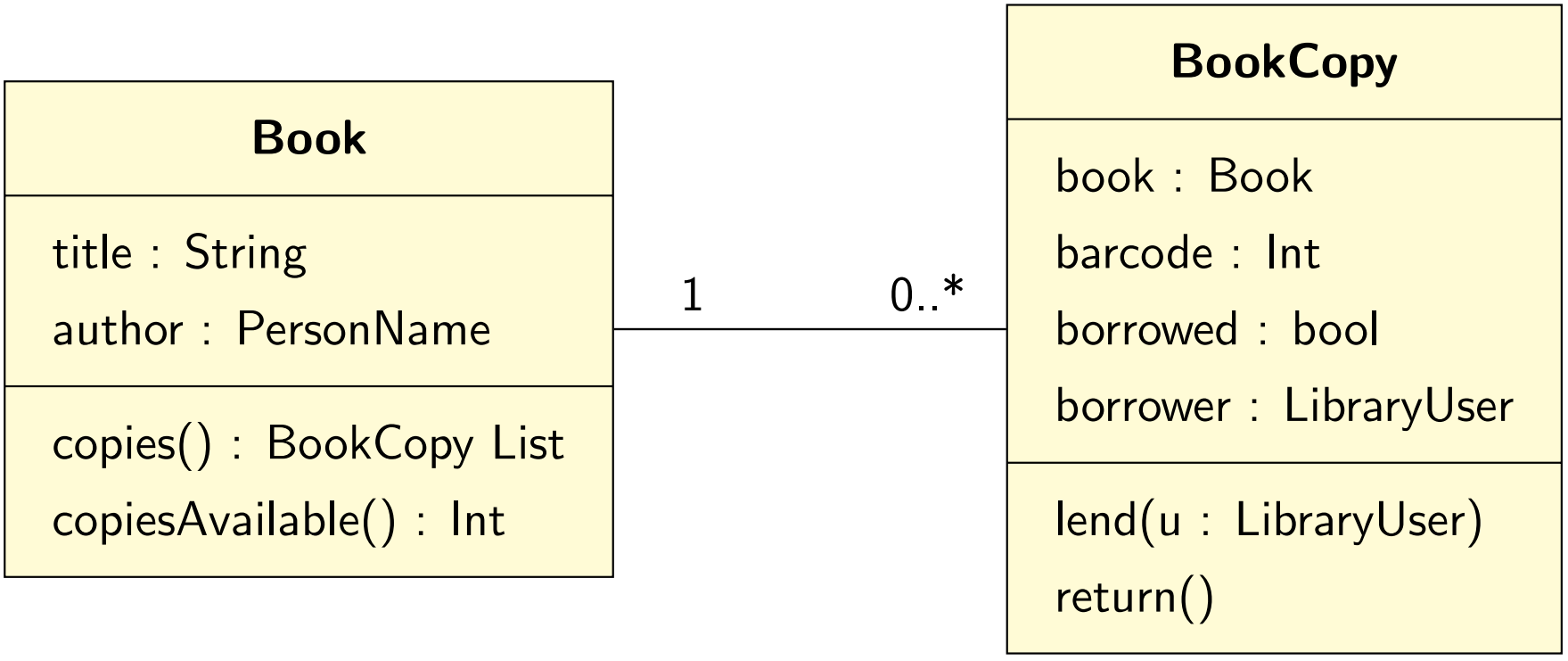

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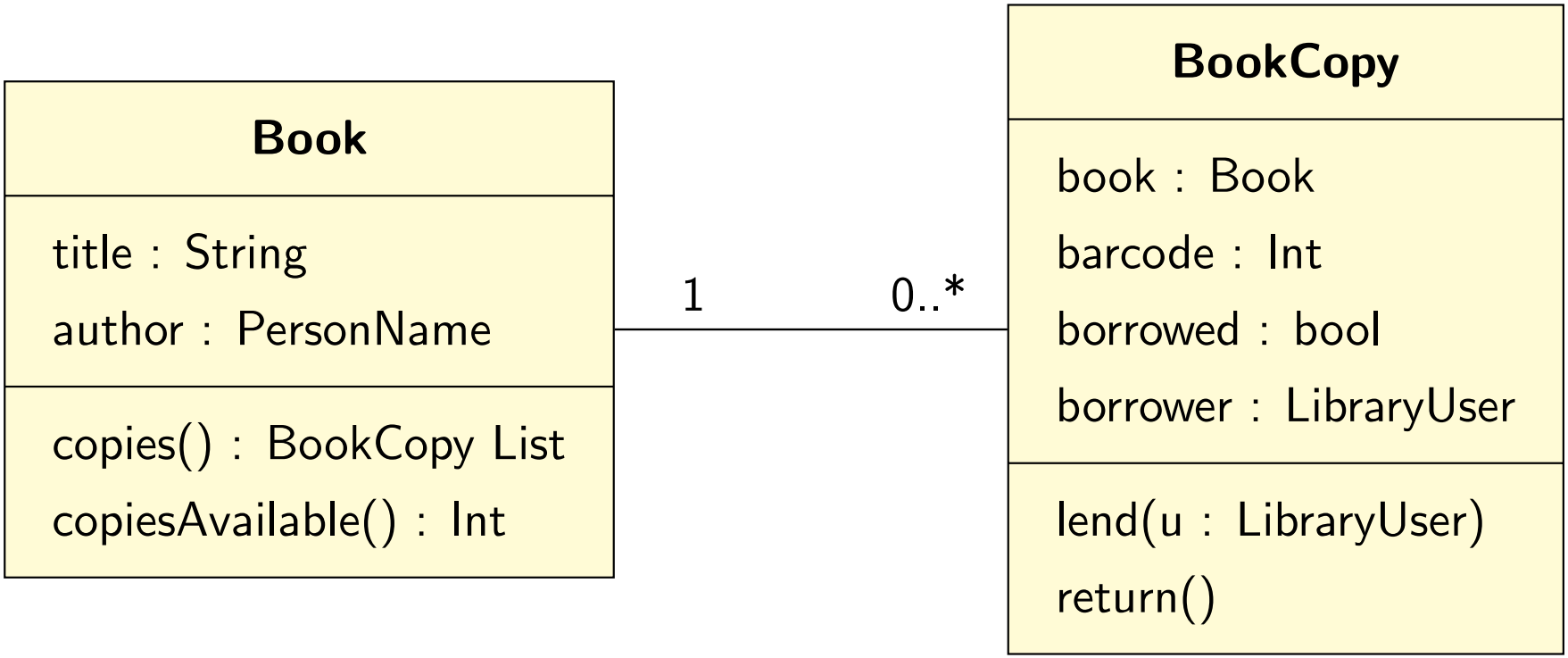
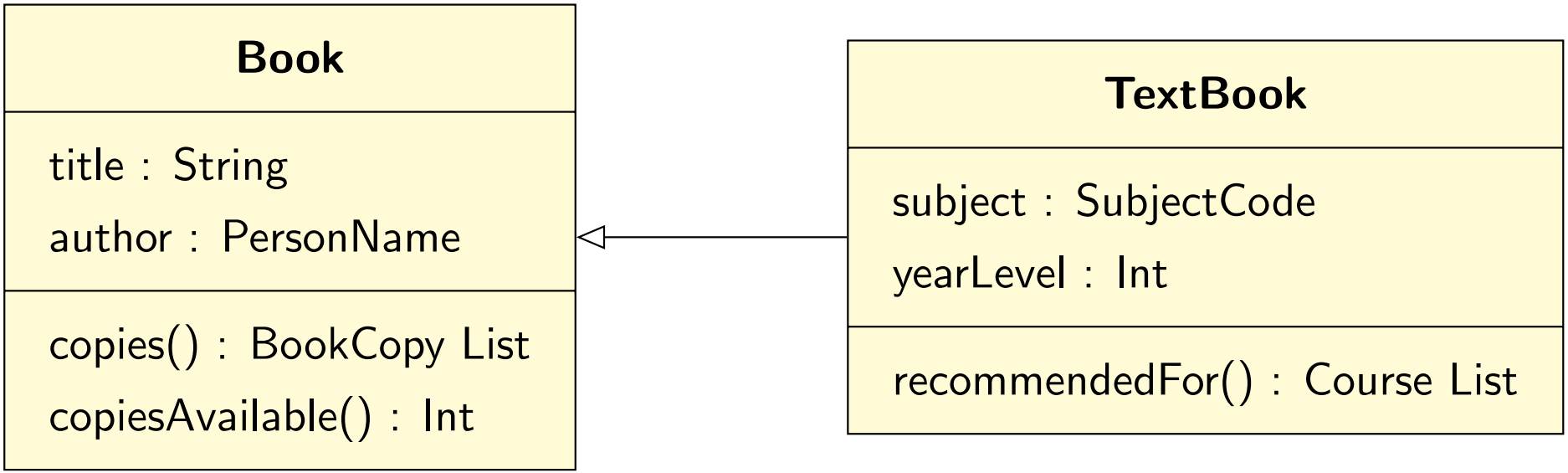


Questions: what is the 'borrower' of an unborrowed copy? What might be a better way to store loan status? (Depends on the programming language.)

Note: association is actually a statement about a relation between *instances* (objects), not between the classes themselves.

Inheritance



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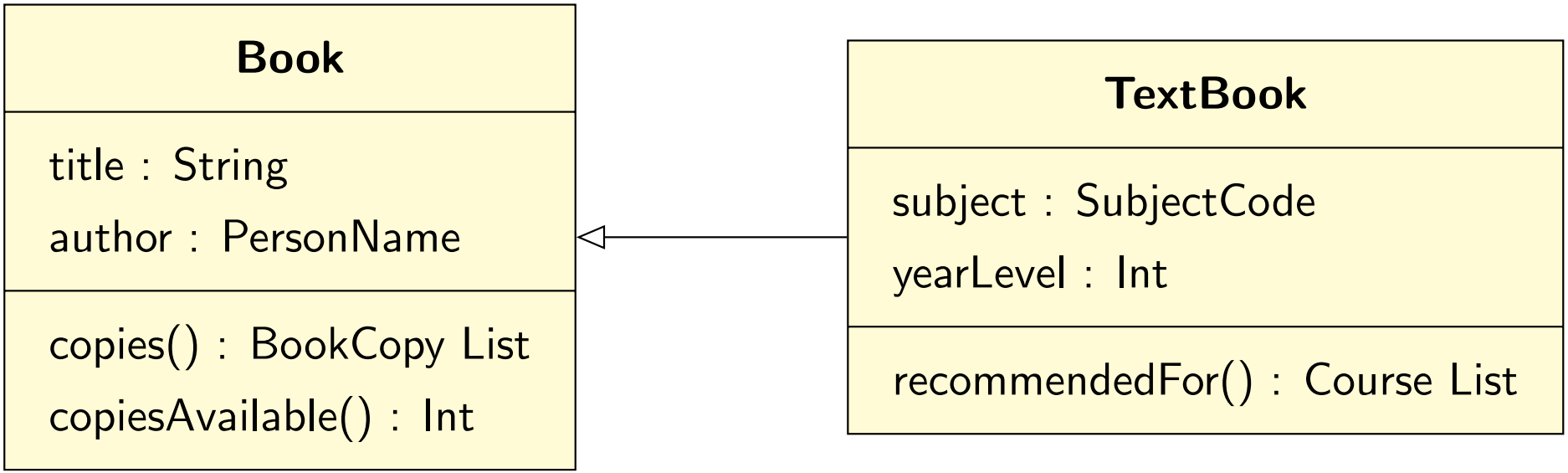

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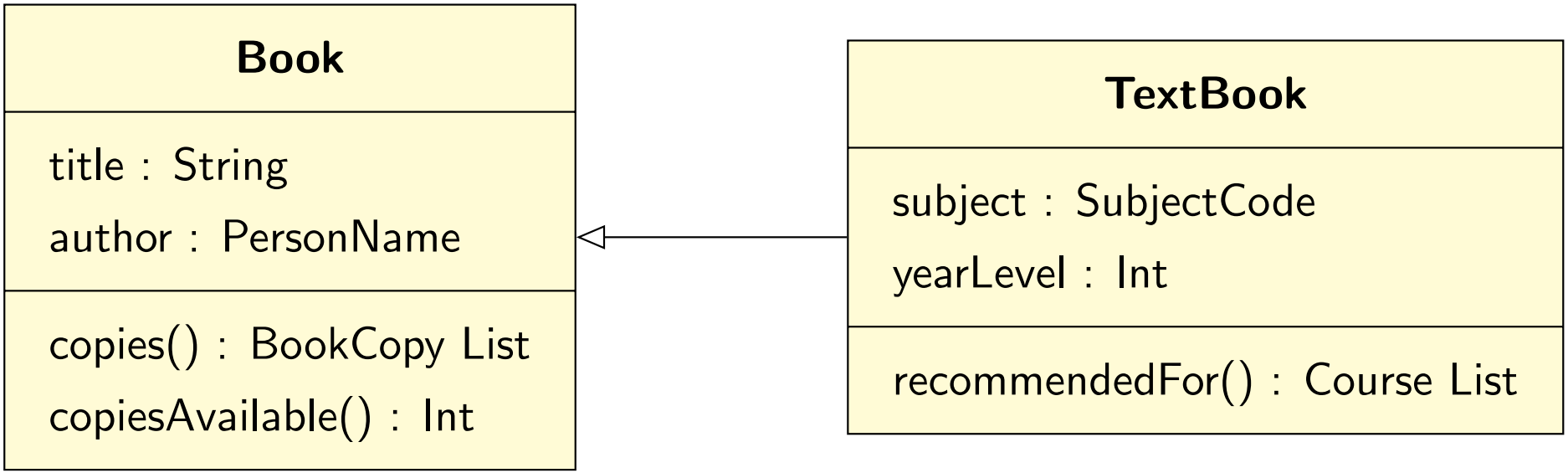

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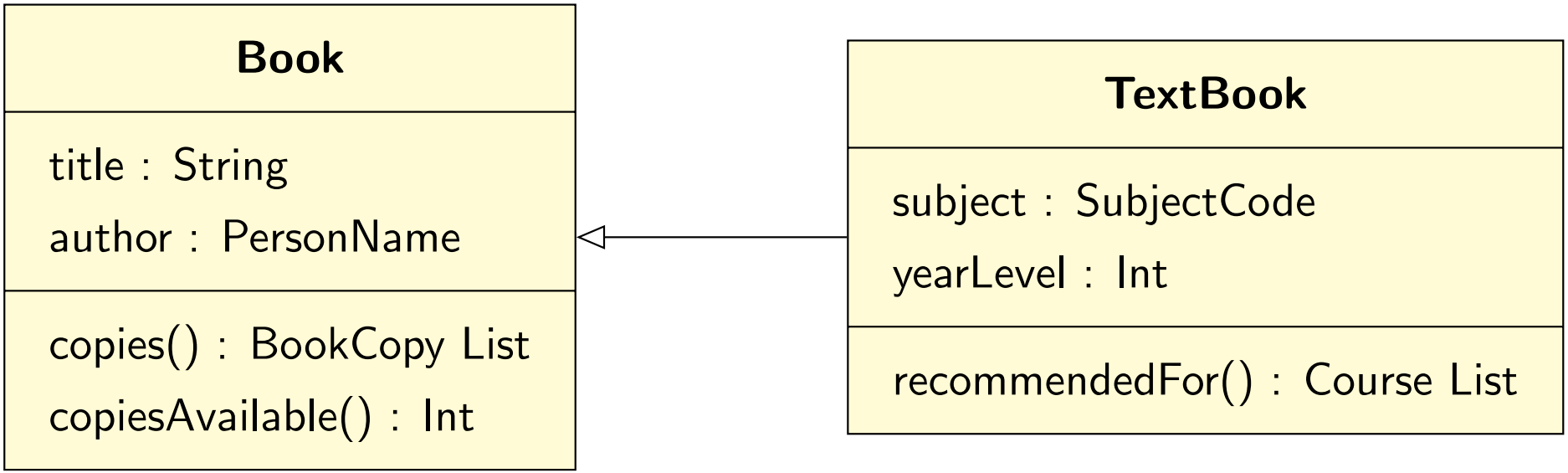

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There are several other types of arrow in UML diagrams, and several other ways to annotate them.

Interlude – designing and drawing some diagrams

Please work in pairs for this exercise.

Point your browser at

`http://www.umletino.com/`

and start playing with ...

Classes for a PoS-tagger

You are designing a fast and simple text processing system for Croatian. One of its components will be a Part-of-Speech tagger. The input to the tagger is a *sentence*, already split into *words*. The tagger annotates each word with its part of speech, plus associated information (e.g. case for nouns, tense for verbs).

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Now one member of each pair move to the next group, and try to criticize (positively or negatively!) their design.

Text analysis for UML

Designing new code is hard – understanding old code is harder!

To help understand 'legacy code', there is a desire to generate UML diagrams from existing code.

Or even from existing informal specifications ...

UML from code

Is this a hard problem? Easy problem?

```
public class Book {
 string title;
 PersonName author;
 List<BookCopy> copies () {
   // code to interrogate database...
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Could you write some Python to turn Java into UML class diagrams?

Could you draw it?

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I don't know an open-source equivalent – Doxygen can produce inheritance diagrams that are UML-like, but not UML.

UML from English

Textual analysis for software design goes back at least to Russell Abbott in 1983 ('Program design by informal English Descriptions', *CACM* **26**(11) 882–894).

That paper is a manual, quite detailed, and somewhat English-specific procedure for generating code outlines from text specifications. But the ideas are quite general.

Parts of Speech and Programming Languages

Basic idea:

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- Verbs indicate procedures, methods, functions

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Similarly, can use verb phrases to identify operations and/or associations.

Identifying classes example

The library contains books and journals. It may have several copies of a given book. Some of the books are for short term loans only. All other books may be borrowed by any library member for three weeks. Members of the library can normally borrow up to six items at a time, but members of staff may borrow up to 12 items at one time. Only members of staff may borrow journals.

- Eliminate?: library?, short term loan?, member of the library?, week?, time?
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- books and journals are items, but this is implicit;
- 'for short term loans' identifies an attibute? sub-class? of books;
- are 'members of staff' different from 'members of the library', or a sub-class of them?

Recent work in extracting UML from text

The problem is hard, and is current research.

I'll now outline one recent contribution – if you're interested, its references and citations will lead to others.

Mohd Ibrahim; Rodina Ahmad
Class Diagram Extraction from Textual Requirements Using Natural Language Processing (NLP) Techniques
2010 Second International Conference on Computer Research and Development
DOI: 10.1109/ICCRD.2010.71

They call their system 'RACE' (Requirement Analysis and Class diagram Extraction).

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- use OpenNLP for PoS tagging, chunking and syntax parsing
- Use the WordNet semantic database and a custom ontology to identify words expressing ‘concepts’

Text processing

The input text is processed using open-source tools and some custom algorithms:

- tokenize
- identify and remove stop words, with guidance from morphology analyser
- use OpenNLP for PoS tagging, chunking and syntax parsing
- Use the WordNet semantic database and a custom ontology to identify words expressing 'concepts'

Result is a list of 'concept words' and their PoS tags, e.g. 'library(N), contains(V), book(N)'.

Class identification

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- during this phase, try to identify attribute works, and use them to inform the next pass.

Diagram

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- The user can then adjust the layout.

Postscript: a useful warning

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Be aware of this: distrust any journal or conference with a very broad topic. You can google for a list of suspected predatory journals.