Lab 2: Introduction to Object-Oriented Programming

1) Review: Working with tweets

Your first task is to download the Twitter starter code (tweet.py) the document into your **lab2** folder, and open it in PyCharm.

Review the code from class, and if you have any questions, ask your TA.

Then, complete each of the TODOs found in that file in the following order (we've arranged these roughly by difficulty).

1. Implement the **User.verbosity** method.
2. Discuss with your partner which class the **retweet** function should go into, and then move it. (You'll have to make some minor modifications to the code as well.)
3. Implement the **User.hack** method.

2) Designing Classes

Create a new Python file in your lab2 folder and name it **registry.py**. Your task is to perform an object-oriented analysis of a problem specification, outlined in the steps below.

Note: design is often harder and more time-consuming than implementation! Work with a partner, and don't be afraid to take up the rest of the lab time to get a really solid design done. You'll find that if you spend your efforts today on the class design, actually implementing your design will be comparatively straight-forward.

Don't begin implementation until your design is complete.

1. *Read the problem description.*

   Download **specs.txt** (See Figure 1) the document into your **lab2** folder and read through the problem description.

```
Race Registry
=============

Context: a system for organizing a 5K running race.

When runners register for a race, they provide their name, email address and their speed
category. A speed category indicates how quickly they estimate that they can finish
the race. This allows organizers to start the runners in groups of roughly equivalent
running speed so that faster runners aren't stuck behind slower runners. The possible
speed categories are: under 20 minutes, under 30 minutes, under 40 minutes, and 40
minutes or over. We need to be able get a list of runners in a given speed category. We
also need to be able to look up a runner to find their speed category. Finally, a runner
should be able to change their email address and speed category, or withdraw from the
race entirely.
```

Figure 1: specs.txt

2. *Decide what classes you need to design.*

   In a basic object-oriented design, each class usually models some noun in the problem description—but not every noun needs a class to model it. For example, an email address can be modelled by a simple str.

   The one class you need for sure is a class to represent the race registry as a whole. You can design a reasonable solution that has only that class. Decide whether you wish to have any other classes.

3. *Sample usage.*

   Next, picture how your class(es) will be used by writing some doctests in the class docstring of one of your new classes. Your doctests should illustrate the following behaviour:

   - Create a race registry.
   - Register the following runners:
     - Gerhard (with time under 40 minutes)
     - Tom (with time under 30 minutes)
     - Toni (with time under 20 minutes)
     - Margot (with time under 30 minutes)
     - Gerhard again (with time under 30 minutes—he's gotten faster)
     - Report the runners in the speed category of under 30 minutes.

   Remember, you haven't written the class(es) yet!

   Just like function doctests help illustrate the purpose of a function, your class docstring helps the user (and yourself!) understand how your class should be used.

4. *Designing the interface.*

   Use **Part 1** of the Class Design Recipe the document to create the public interface of each class.

   (You've already started doing this in the previous step.) Note that this involves a lot of documentation and writing of basic examples and tests, but still no implementation whatsoever. That will come later.

   This analysis will require a fair amount of thought. Don't worry about getting it completely right. If you find any ambiguities in the specifications, write them down, and try to come up with a solution you think is reasonable.

   A good skill to develop in this course is identifying ambiguities and proposing multiple solutions for such ambiguities in problem descriptions you receive. There's no "one right answer" to this task!

3) Implementing Your Design

If you still have time, take your design and implement all of the methods in each of the classes you defined.

We've provided code in the "main" block at the bottom of the file to run **doctest** to check your doctest examples. You should have already written a doctest example in your class docstring by following the above instructions; make sure you add some further examples to individual methods to help check the correctness of your code.

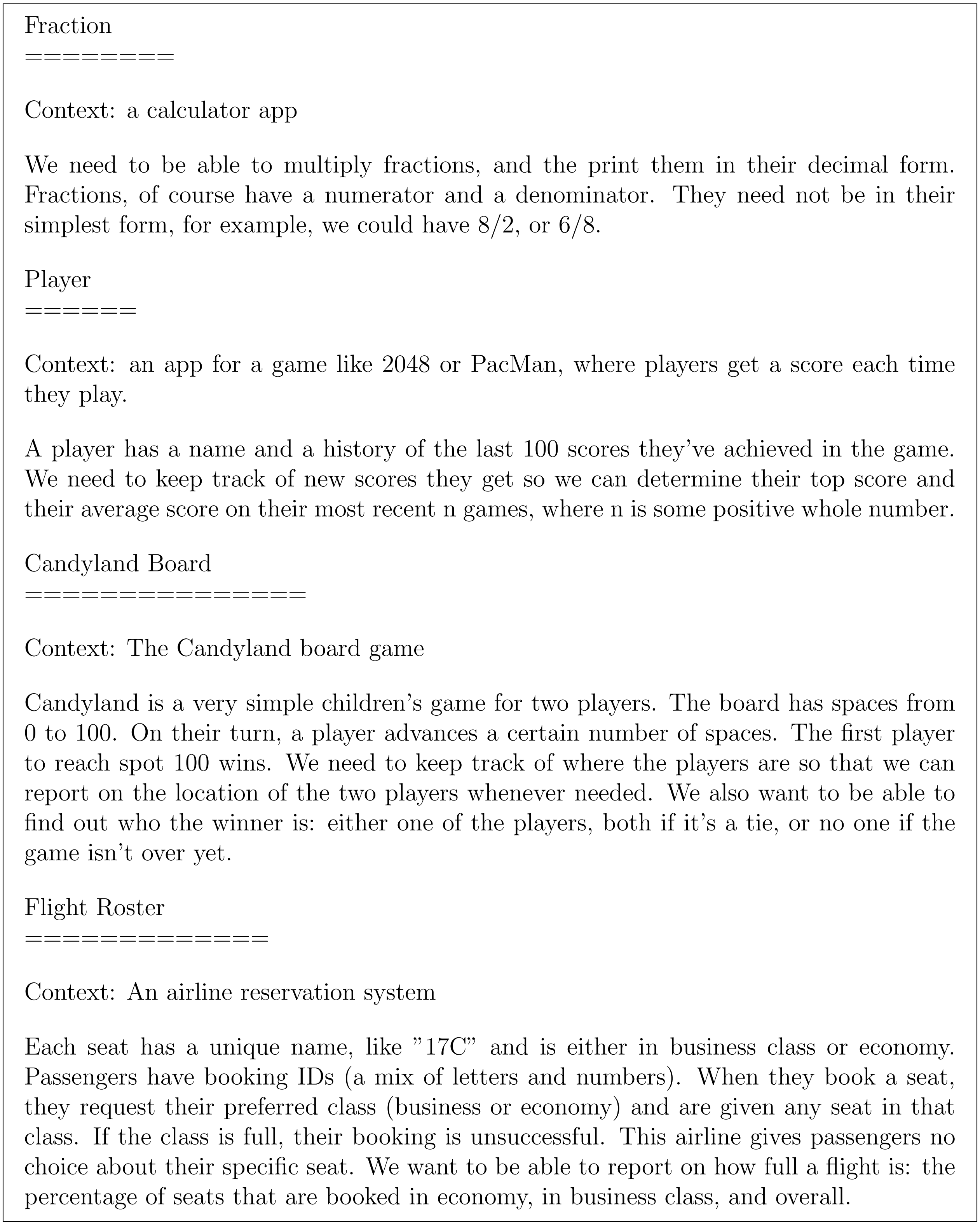
4) Extra exercises for later

More small exercises

Here are some additional exercises (See figure 2) the document in designing and implementing classes. Each section in that file is a problem description for you to model using an object-oriented design.

Object-oriented analysis

As the problems get larger, it becomes more important to be able to focus on high level design before getting into details. We can record a high-level design with a simple drawing. Here is a design for our Twitter example the document in this style (see Figure 3).



```
Fraction
========

Context: a calculator app

We need to be able to multiply fractions, and the print them in their decimal form.
Fractions, of course have a numerator and a denominator. They need not be in their
simplest form, for example, we could have 8/2, or 6/8.

Player
======

Context: an app for a game like 2048 or PacMan, where players get a score each time
they play.

A player has a name and a history of the last 100 scores they've achieved in the game.
We need to keep track of new scores they get so we can determine their top score and
their average score on their most recent n games, where n is some positive whole number.

Candyland Board
================

Context: The Candyland board game

Candyland is a very simple children's game for two players. The board has spaces from
0 to 100. On their turn, a player advances a certain number of spaces. The first player
to reach spot 100 wins. We need to keep track of where the players are so that we can
report on the location of the two players whenever needed. We also want to be able to
find out who the winner is: either one of the players, both if it's a tie, or no one if the
game isn't over yet.

Flight Roster
=============

Context: An airline reservation system

Each seat has a unique name, like "17C" and is either in business class or economy.
Passengers have booking IDs (a mix of letters and numbers). When they book a seat,
they request their preferred class (business or economy) and are given any seat in that
class. If the class is full, their booking is unsuccessful. This airline gives passengers no
choice about their specific seat. We want to be able to report on how full a flight is: the
percentage of seats that are booked in economy, in business class, and overall.
```

Figure 2: additional_exercise.txt

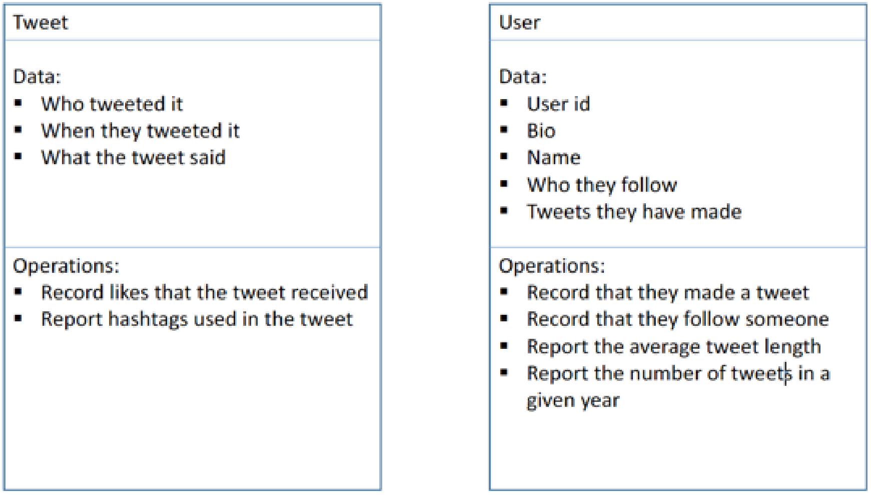

Tweet
Data:
Who tweeted it
When they tweeted it
What the tweet said
Operations:
Record likes that the tweet received
Report hashtags used in the tweet
User
Data:
User id
Bio
Name
Who they follow
Tweets they have made
Operations:
Record that they made a tweet
Record that they follow someone
Report the average tweet length
Report the number of tweets in a given year

Figure 3: Design for twitter example

Notice that this drawing omits details such as what type we should use for each piece of data, what parameters each method should have, and so on. We can decide on these later, once we have settled on the overall design.

- Read the specifications for this larger problem in *specs_larger.txt* (see figure 4)the document. Circle the nouns and underline the verbs.

Using the same diagram style as in the example above, come up with a design for this software. There is a lot of judgment involved, and there are multiple good solutions. The point here is to think about and debate some options, and start to get comfortable with the process.

Doctor’s Office
===============

A doctor’s office needs software for scheduling appointments. It is a large practise with 10 to 15 doctors and several thousand patients. Patients can make an appointment with a doctor, and all appointments last 1 hour. Doctors schedule blocks of time when they are available for appointments. Each patient has a primary doctor. If their primary doctor is available on t he hour and day when they wish to book they must see them; otherwise, they can see any doctor. A patient may cancel an appointment,but if they cancel more than 10, they are no longer allowed to book appointments (ever!). Doctors can cancel a block of time when they had said they were available; any patients who had appointments during that block get rescheduled at the earliest possible time, regardless of which doctor they get.

Figure 4: specs_larger.txt