IMPERIAL COLLEGE LONDON

TIMED REMOTE ASSESSMENTS 2021-2022

MSc Computing
for Internal Students of the Imperial College of Science, Technology and Medicine

PAPER COMP70055=COMP97121

SOFTWARE ENGINEERING DESIGN (MSC)

Thursday 12 May 2022, 10:00
Writing time: 120 minutes
Upload time: 15 minutes

Answer ALL TWO questions
Open book assessment

Paper contains 2 questions

General Information

This is a remote assessment involving programming. To do it you will need:

- a computer with internet connection
- a Java development environment installed (IntelliJ IDEA is recommended)

AnswerBook

All your answers should be submitted electronically by accessing the AnswerBook website using a standard web browser. Log in to AnswerBook using your standard College username and password.

All work that you want marked should be entered into AnswerBook. Paste your code into the boxes on AnswerBook. Do not try to upload PDFs or images. You should not upload anything to CATE or push anything to GitLab.

Skeleton Code

Download https://www.doc.ic.ac.uk/~rbc/2122-exams/SED-exam.zip which contains code related to the exam questions. Unzip this file and work on this code on your computer using your IDE.

Using IntelliJ IDEA

If you open the project in IntelliJ IDEA, you should see two directories, Q1 and Q2, each of which should contain a blue src directory and a green test directory. **You will probably have to set the JDK**. See https://www.doc.ic.ac.uk/~rbc/SED/ for details.

The project should already be configured with all the testing libraries that we used during the course, in case you need to use them in answering the questions.

There is no build.sh or suite of automated tests/checks for you to pass, but do aim to use good code style and clear formatting in your solutions. The code will not be auto-tested, it will be read by a human.

Answer the questions on the following pages using the downloaded code. When you are happy with your answer for each part, paste your code into the relevant boxes on the AnswerBook site. Use the button top-right to save your work. You can update your answer and save again as often as you want. We recommend saving after you have answered each part.

When You Have Finished

At the end of the exam, or when you have finished, check that you are happy with your work and that all your answers are saved in AnswerBook.

1 **Test Driven Design**

For this question, look at the Sequence Diagram on the next page and the code given in the Q1 directory (there is not much code there).

Using test-driven development and mock objects, iteratively develop an implementation of an auction manager according to the illustrated scenario.

Hint: you do not need to implement Seller and Bidder.

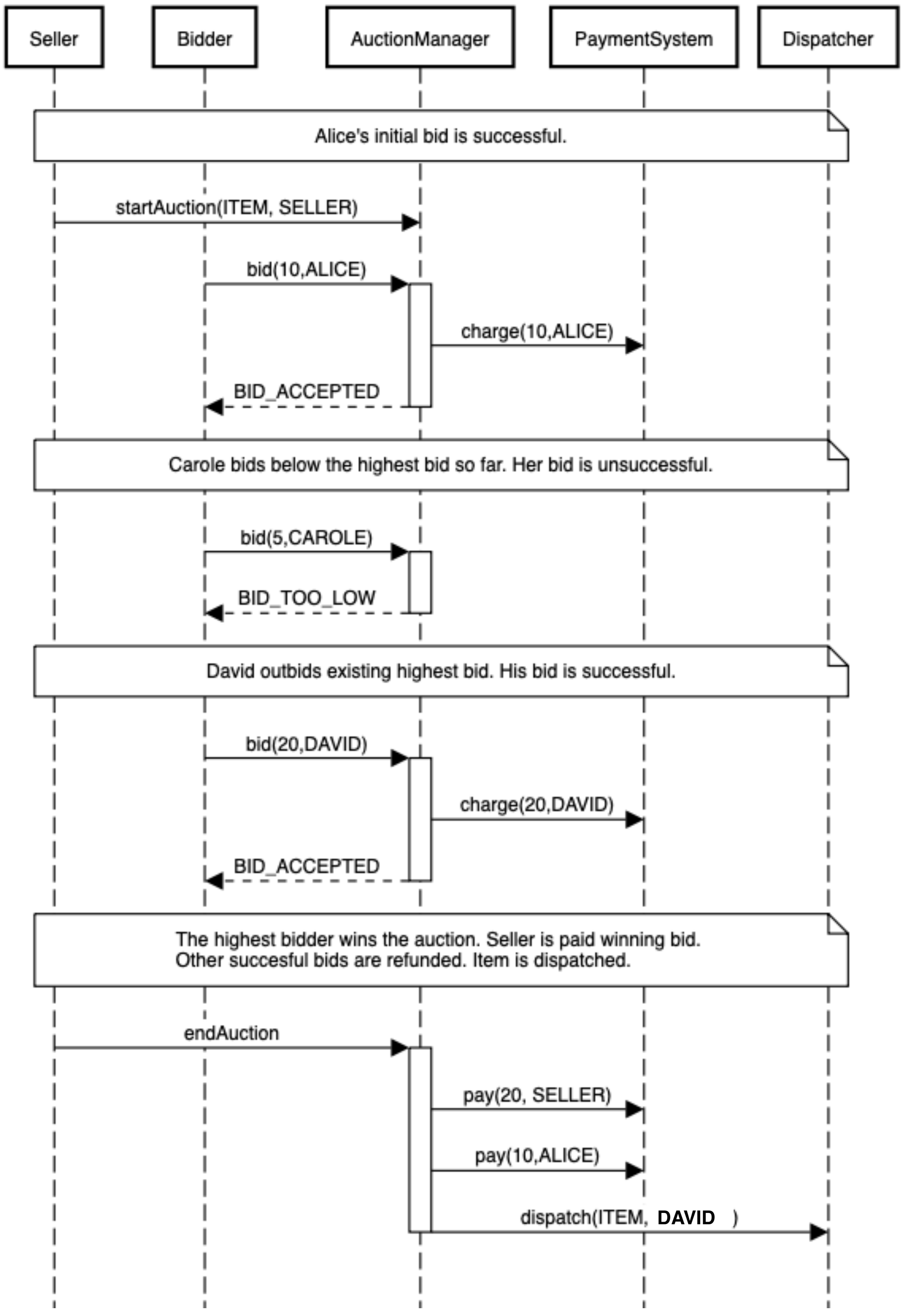
a) Show your first test and the implementation to make it pass.

b) Show your second test and the implementation to make it pass.

c) Show your third test and the implementation to make it pass.

d) Show your fourth test and the implementation to make it pass.

The four parts carry, respectively, 30%, 20%, 20% and 30% of the marks.


Seller
Bidder
AuctionManager
PaymentSystem
Dispatcher
Alice's initial bid is successful.
startAuction(ITEM, SELLER)
bid(10,ALICE)
charge(10,ALICE)
BID_ACCEPTED
Carole bids below the highest bid so far. Her bid is unsuccessful.
bid(5,CAROLE)
BID_TOO_LOW
David outbids existing highest bid. His bid is successful.
bid(20,DAVID)
charge(20,DAVID)
BID_ACCEPTED
The highest bidder wins the auction. Seller is paid winning bid.
Other succesful bids are refunded. Item is dispatched.
endAuction
pay(20, SELLER)
pay(10,ALICE)
dispatch(ITEM, DAVID)

2 **Video Streaming**

Look at the code under the folder Q2, which contains a few different classes forming part of a system for streaming movies, and a couple of simple tests.

a The MediaLibrary could be very large if it contains a large index of movie recommendations. Update the code using an appropriate design pattern to prevent more than one instance of this class being created.

Name the pattern you used and show the relevant parts of your code.

b Now look at class VideoStreamer. VideoStreamerTest shows a simple example of its usage. Apply the dependency inversion principle and hence write a test for the behaviour of getSuggestedMovies() without invoking the (potentially large) MediaLibrary object.

c If a user watches a particular stream for more than 15 minutes, the system logs that they watched the movie (to enhance future suggestions) using a PlaybackEventLog. Make appropriate changes to the code to allow you to write tests that verify this behaviour. Do not change the signatures of the existing public methods in VideoStreamer.

Show the relevant parts of the code that you have changed.

The three parts carry, respectively, 20%, 30% and 50% of the marks.

APPENDIX Provided Code

In the exam this will be provided as a download for candidates to work on. These pages should not appear in the final exam paper, they are for examiners' reference.

Q1

BidResult.java

```
package ic.doc.auction;

public enum BidResult {BID_ACCEPTED, BID_TOO_LOW};
```

AuctionManager.java

```
package ic.doc.auction;


public class AuctionManager {

}
```

AuctionManagerTest.java

```
package ic.doc.auction;


public class AuctionManagerTest {

}
```

APPENDIX Provided Code

In the exam this will be provided as a download for candidates to work on. These pages should not appear in the final exam paper, they are for examiners' reference.

Q2

```
public class VideoStreamer {

  private final Map<VideoStream, StreamTracker> currentStreams = new HashMap<>();
  private final PlaybackEventLog playbackEvents = new ConsolePlaybackEventLog();

  public List<Movie> getSuggestedMovies(User user) {
    List<Movie> recommendations = new MediaLibrary().recommendedMoviesFor(user);

    // sort the list of suggestions in descending order of number of views
    List<Movie> suggestions =  new ArrayList<>(recommendations);
    suggestions.sort(Comparator.comparing(Movie::numberOfViews).reversed());
    return suggestions;
  }

  public VideoStream startStreaming(Movie movie, User user) {
    VideoStream stream = new MediaLibrary().getStream(movie);
    currentStreams.put(stream, new StreamTracker(user));
    return stream;
  }

  public void stopStreaming(VideoStream stream) {
    StreamTracker streamTracker = currentStreams.remove(stream);
    LocalTime endTime = LocalTime.now();
    long minutesWatched = ChronoUnit.MINUTES.between(streamTracker.startTime(), end-
Time);
    if (minutesWatched > 15) {
      playbackEvents.logWatched(streamTracker.user(), stream.movie());
    }
  }

}
```

```
public class MediaLibrary {

    private final List<Movie> topMovies;

    public MediaLibrary() {
        topMovies = List.of(
                new Movie("Jurassic Park", … etc etc ));

    public List<Movie> recommendedMoviesFor(User user) {

        // A sophisticated ML algorithm runs and then recommends...

        if (user.isChild()) {
            return topMovies.stream().filter(Movie::isSuitableForChildren).toList();
        } else {
            return topMovies;
        }
    }
}
```

```java
public class VideoStreamerTest {

    @Test
    public void allowsUserToStreamSuggestedMovies() {

        VideoStreamer streamer = new VideoStreamer();
        User user = new User("Adam", 9);

        List<Movie> movies = streamer.getSuggestedMovies(user);
        VideoStream stream = streamer.startStreaming(movies.get(0), user);

        // adam watches the movie

        streamer.stopStreaming(stream);
    }
}
```