M4 (b) – Design for Robustness

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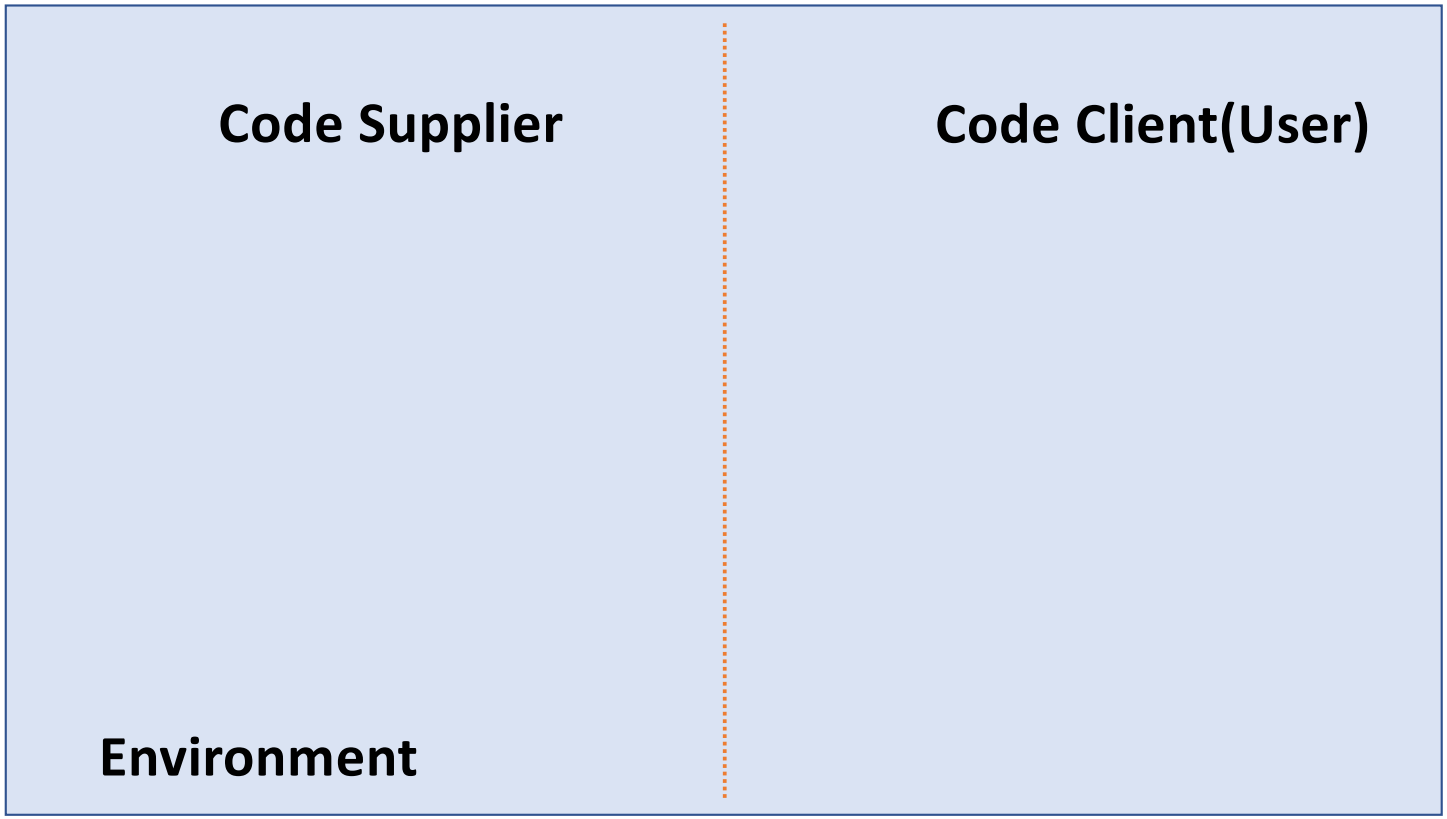
Where things can go wrong?



Java Convention for Checking Preconditions

Explicit checks that throw particular, specified exceptions

Use assertion to test a *nonpublic* method's precondition that you believe will be true no matter what a client does with the class.

Java Convention for Private Method

```
 * … …
 * @pre pStudent != null && !isFull()
 * @post aEnrollment.get(aEnrollment.size()-1) == pStudent()
 */
```

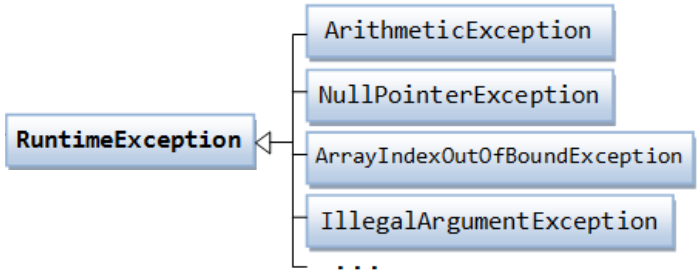
When this is private

```
public void enroll(Student pStudent) {
    assert pStudent != null && !isFull() : this;
    aEnrollment.add(pStudent);
}

public boolean isFull() {
    return aEnrollment.size() == aCap;
}
```

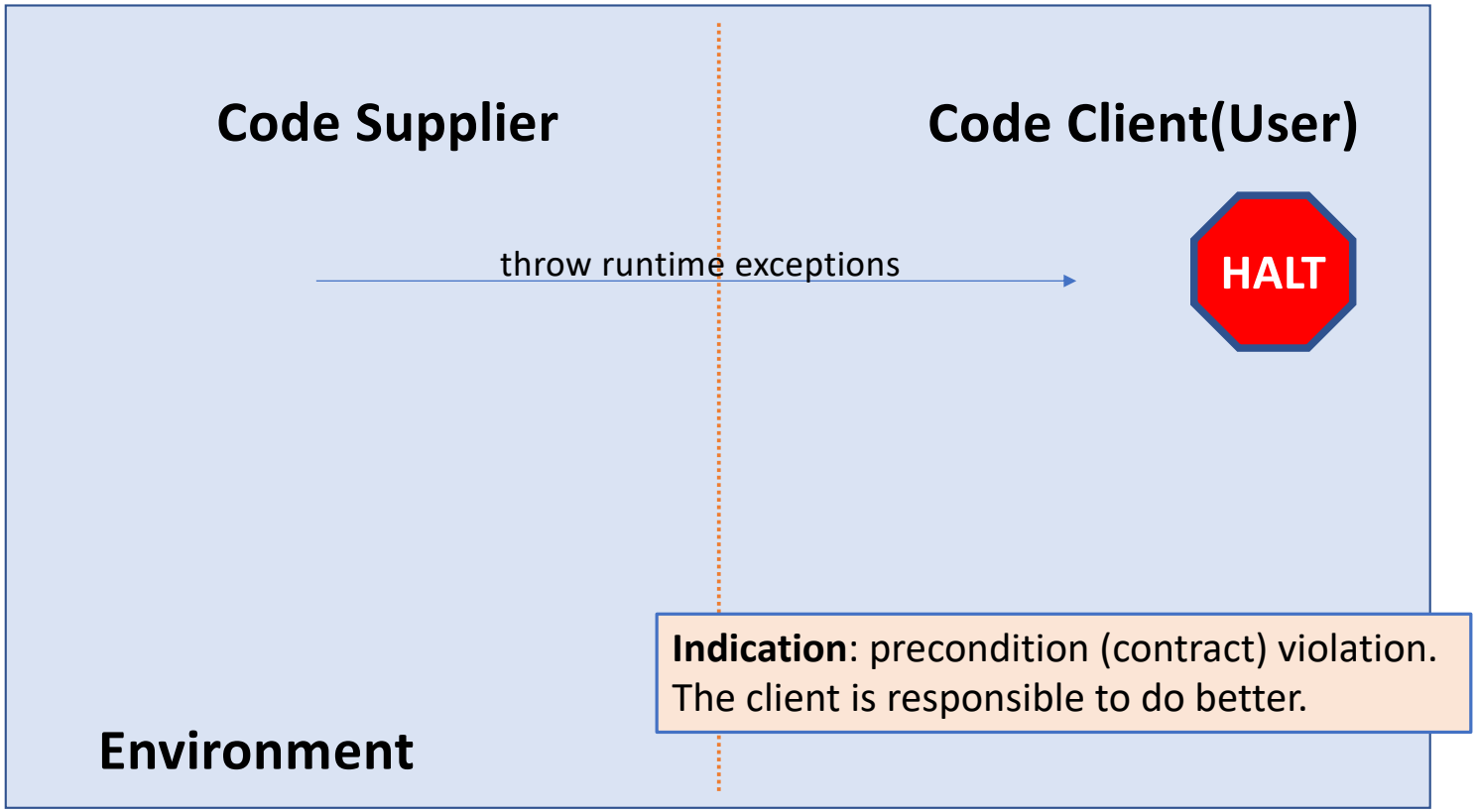
Java Convention for Public Method

```
/**
 * … …
 * @param Student to be enrolled to the Course
 * @throws IllegalArgumentException if pStudent == null
 *         IllegalStateException    if isFull()
 */

public void enroll(Student pStudent) {
    if (pStudent == null)
        throw new IllegalArgumentException();
    if (isFull())
        throw new IllegalStateException();

    aEnrollment.add(pStudent);

}
```

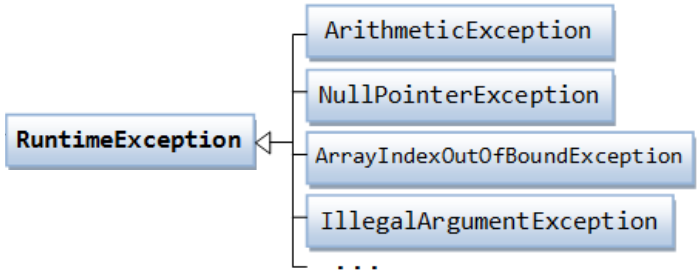
Runtime Exceptions



Code Interaction

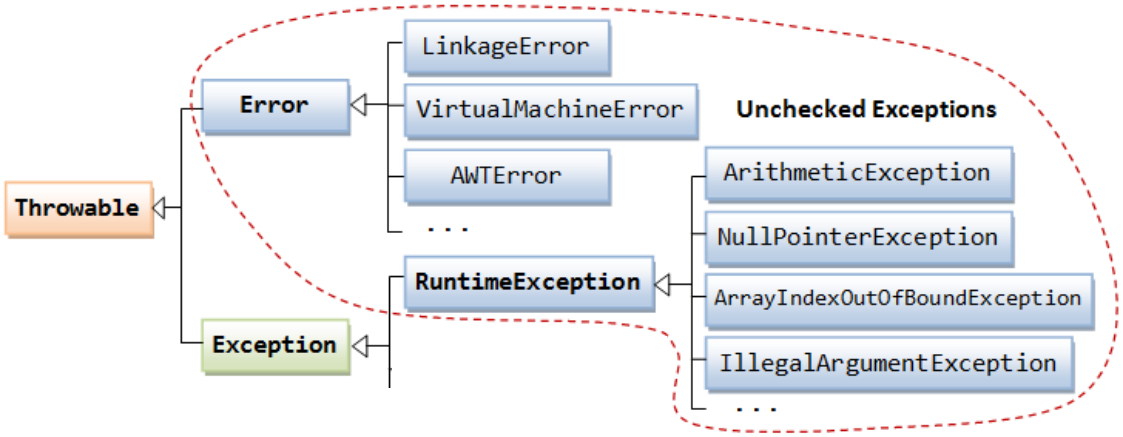


Runtime Exceptions



Unchecked Excaptions

They all cause the program to halt.



The whole hierarchy

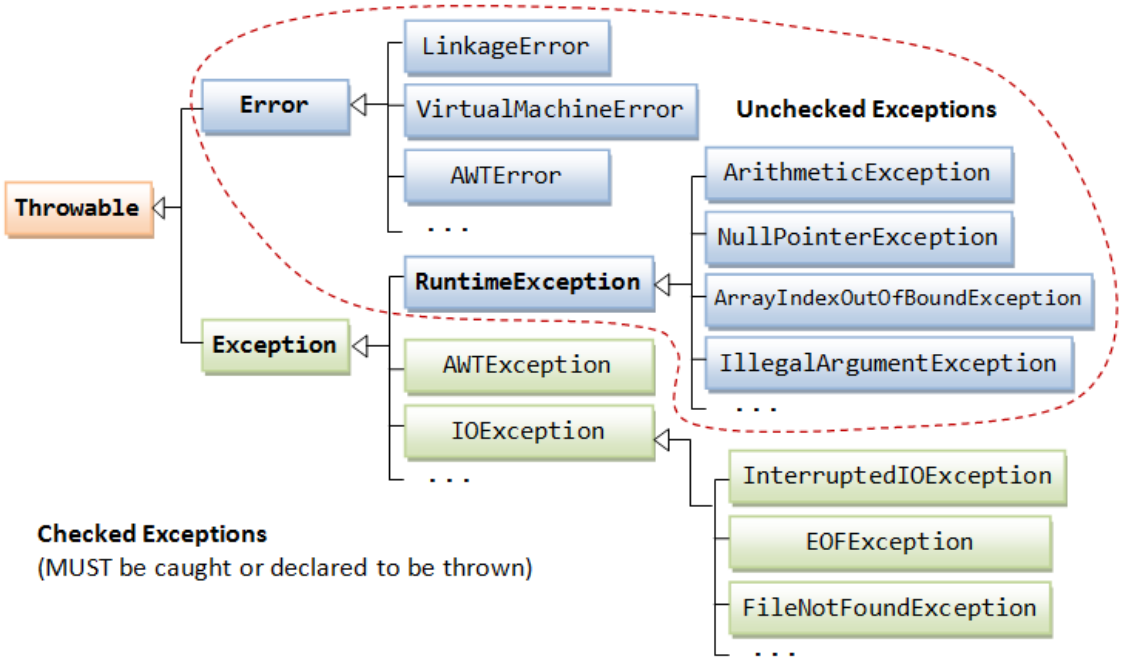
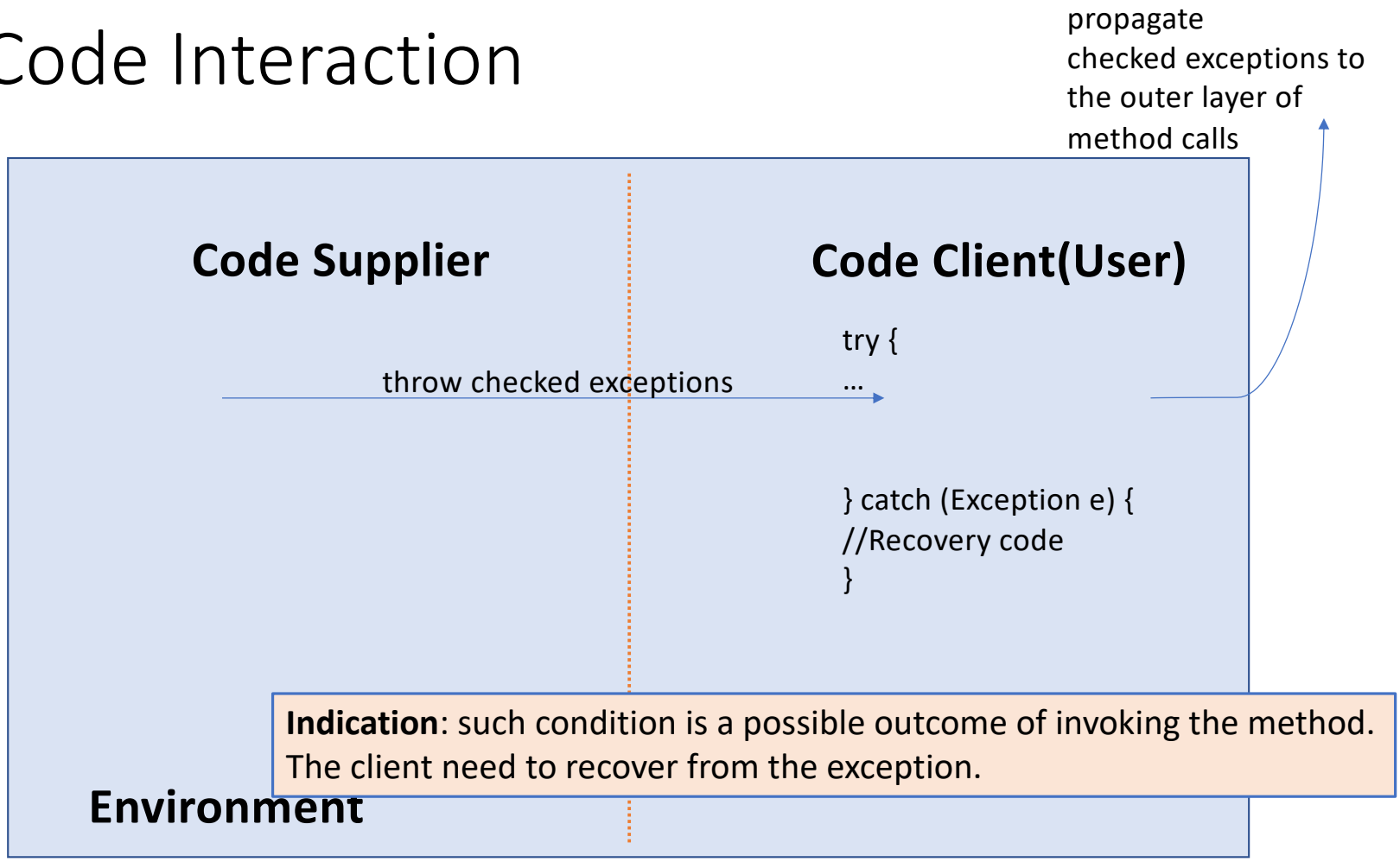


image source:http://www.ntu.edu.sg/home/ehchua/programming/java/images/Exception_Classes.png

Code Interaction



Another design of the `enroll` method

Assume `CourseFullException` is a Checked Exception

```
/**
 * Enroll the student to the course if the course currently is not full
 * @param pStudent to be enrolled to the Course
 * @throws IllegalArgumentException if pStudent == null
 *         CourseFullException if isFull()
 */

public void enroll(Student pStudent) throws CourseFullException {
    if (pStudent == null)
        throw new IllegalArgumentException();
    if (isFull())
        throw new CourseFullException();
    aEnrollment.add(pStudent);
}
```

Impact to the Client

The client is not obliged to check `isFull()` anymore. However…

```
Course comp303 = new Course("COMP 303", 1);
Undergrad s1 = new Undergrad("00009", "James", "Harris");
Undergrad s2 = new Undergrad("00002", "Benny", "Will");

comp303.enroll(s1);
comp303.enroll(s2);

System.out.println("Done with enrolling students.");
comp303.printEnrolledStudent();
```

Impact to the Client

Have to catch the potential exception or propagate it

```
Course comp303 = new Course("COMP 303", 1);
Undergrad s1 = new Undergrad("00009", "James", "Harris");
Undergrad s2 = new Undergrad("00002", "Benny", "Will");
try {
    comp303.enroll(s1);
    comp303.enroll(s2);
    System.out.println("Done with enrolling students.");
} catch (CourseFullException e){
    … … // Handle the exception
    e.printStackTrace();
}
comp303.printEnrolledStudent();
```

Summary: Checked vs Unchecked Exception

- Checked Exceptions

Code supplier needs to declare in the method signature.

Code client needs to catch or declare.

Used for abnormal cases but can be recovered at runtime

- Unchecked Exceptions

Code supplier does **not** declare it

Code client does **not** catch nor declare it.

Used for programming errors or things should not happen at runtime.

Any problem with this method?

```
public void writeToFile(Course pCourse, String pFilePath) {
    File file = new File(pFilePath);

    try {
         FileWriter fileWriter = new FileWriter(file);
        for (Student s : pCourse) {
            fileWriter.write(s.toString());
            fileWriter.write("\n");
        }
      fileWriter.close();
    } catch (IOException e) {
        e.printStackTrace();
    }
}
```

If exceptions happen here

The `final` block

```
public void writeToFile(Course pCourse, String pFilePath) {
    File file = new File(pFilePath);
    FileWriter fileWriter = null;
    try {
        fileWriter = new FileWriter(file);
        for (Student s : pCourse) {
            fileWriter.write(s.toString());
            fileWriter.write("\n");
        }
    } catch (IOException e) {
        e.printStackTrace();
    } finally {
         try {

             fileWriter.close();

             } catch (IOException e) {
                  e.printStackTrace();
             }
    }
}
```

Alternative: try-with-Resources statement

```
public void writeToFile2(Course pCourse, String pFilePath) {
    File file = new File(pFilePath);
    try (FileWriter fileWriter = new FileWriter(file)){
        for (Student s : pCourse) {
            fileWriter.write(s.toString());
            fileWriter.write("\n");
        }
    } catch (IOException e) {
        e.printStackTrace();
    }
}
```

`close()` will be called when the try block exits.

Case study:

```
if(!comp303.isFull())
    comp303.enroll(s2);
```

vs

```
try {
    comp303.enroll(s2);
} catch (CourseFullException e){
    … … // Handle the exception
}
```