

CISC 3115 TY2

Exceptions and Errors

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Outline

- Error and error handling
 - Two approaches
- Exception
- The throwable class hierarchy
 - System errors and semantics
 - Runtime exceptions and semantics
 - Checked errors and semantics

Runtime Error

- When the JVM detects that an operation cannot be carried out
- Example: the divide-by-zero error

The Divide-by-Zero Error

```
import java.util.Scanner;

public class Quotient {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);

        System.out.println("Enter two integers: ");
        int n1 = input.nextInt();
        int n2 = input.nextInt();
        System.out.println(n1 + " / " + n2 + " is " + (n1 / n2));
    }
}
```

Handling Error: the What-IF Approach

- Use an if statement to check whether the input is valid
- Example:

```
if (number2 != 0) {  
    System.out.println(number1 + " / " + number2 + " is " +  
        (number1 / number2));  
} else {  
    System.out.println("Divisor cannot be zero ");  
}
```

The What-IF Approach: Disadvantage?

- Use an if statement to check whether the input is valid
- Is there any disadvantage?
- Example:

```
if (number2 != 0) {  
    System.out.println(number1 + " / " + number2 + " is " +  
        (number1 / number2));  
} else {  
    System.out.println("Divisor cannot be zero ");  
}
```

You must handle the error at the point where you detects it.

Handling Error: the Exception Approach

- Java supports Exception, representing an error or a condition that prevents execution from proceeding normally
- Example:

```
try {  
    int result1 = quotient(n1, n2);  
    ...  
    int result2 = quotient(n3, n4);  
    .....  
} catch (ArithmeticException e) {  
    System.out.println("Divisor cannot be zero");  
}
```

The Exception Approach: Advantage

- Separate notifying error from handling error

```
public static int quotient(int n1, int n2) {  
    if (n2 == 0) {  
        throw new ArithmeticException(  
            "Divisor cannot be zero.");  
    }  
    return n1 / n2;  
}
```

Notifying the caller an error occurred

```
public static void main(String[] args) {  
    .....  
    try {  
        int result = quotient(n1, n2);  
        System.out.println(n1 + " / " + n2 +  
            " is " + result);  
    } catch (ArithmeticException e) {  
        System.out.println("Exception: " +  
            e.getMessage());  
    }
```

Handling the error upon receiving the notification

Notifying Error

- Using throws
- Example

```
throw new ArithmeticException("Divisor cannot be zero.");
```

Handling Error

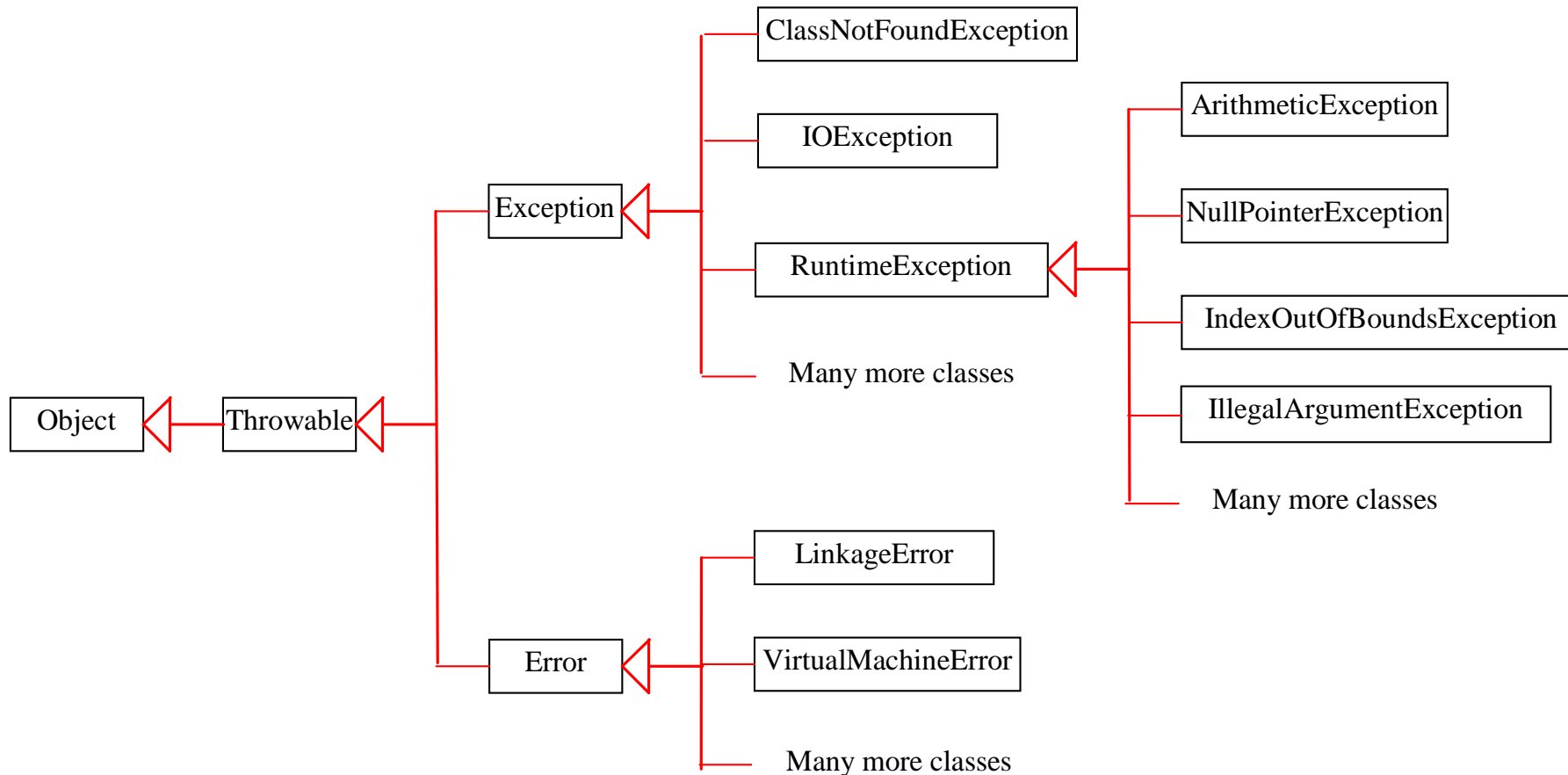
- Use try ... catch ...
- Example

```
try {  
    int result = quotient(n1, n2);  
    System.out.println(n1 + " / " + n2 +  
        " is " + result);  
} catch (ArithmeticException e) {  
    System.out.println("Exception: " + e.getMessage());  
}
```

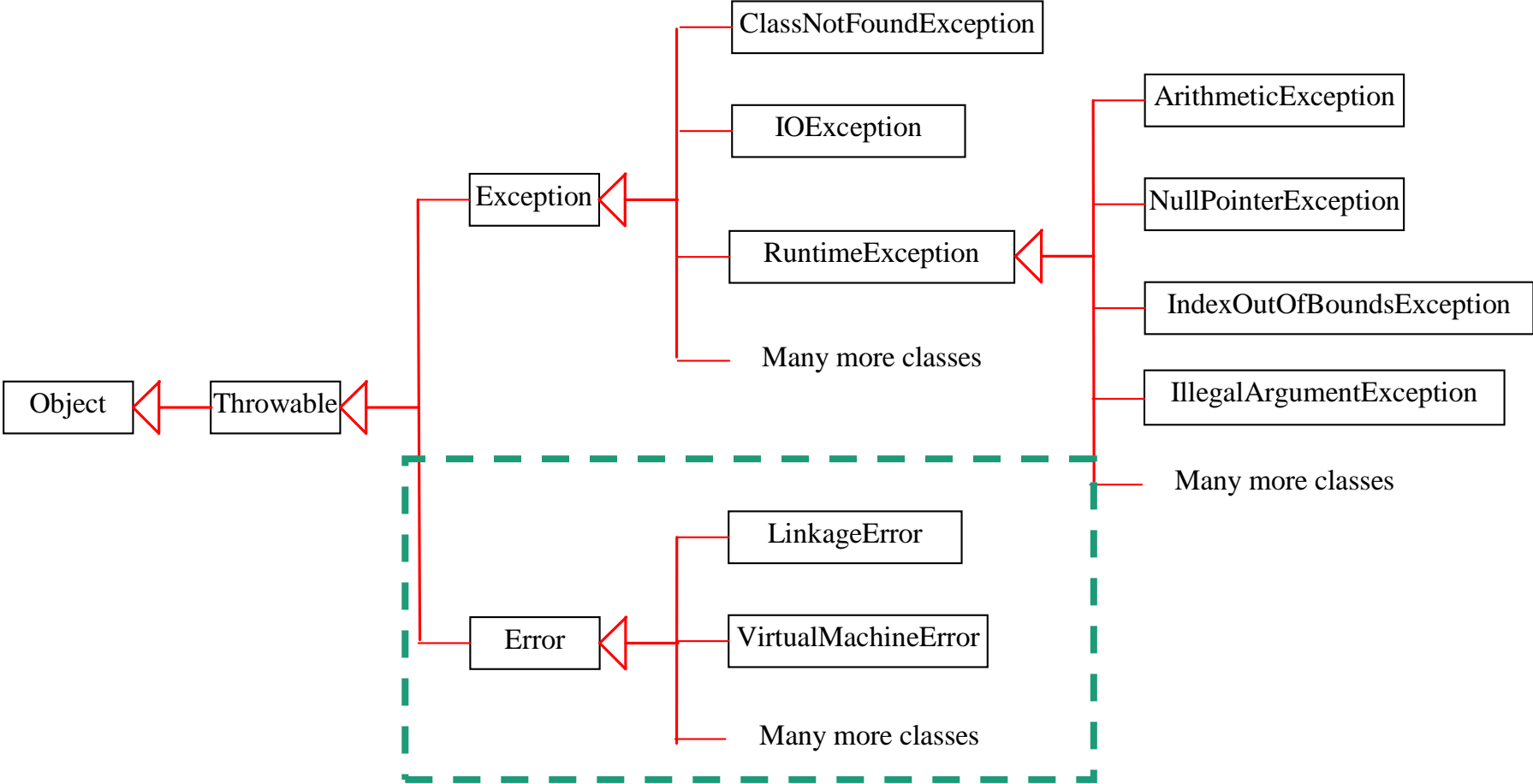
Types of Exceptions

- Java defines a list of exceptions and errors called Throwables that forms a class hierarchy
 - System Error
 - Runtime Exception

Exception Hierarchy



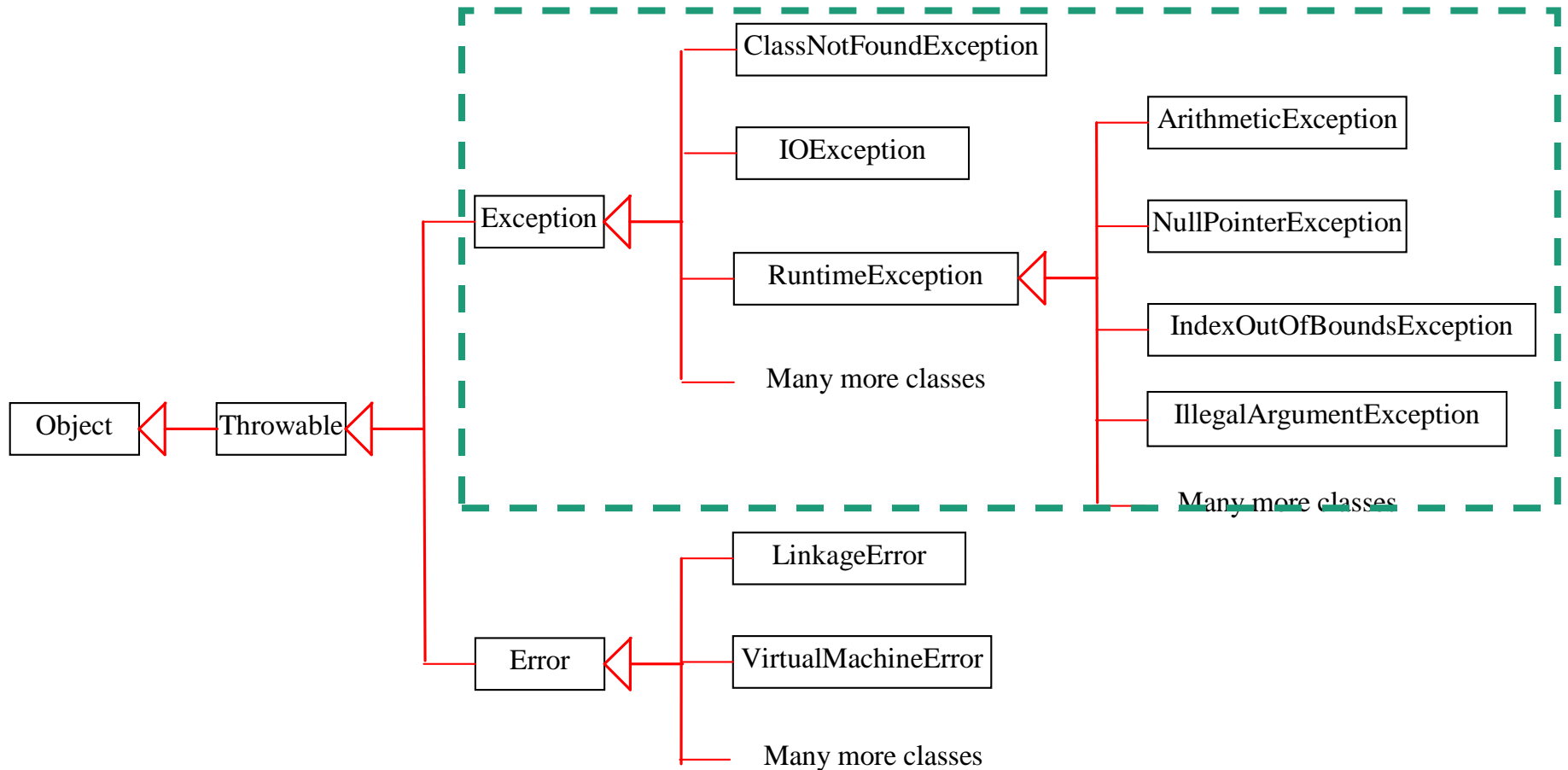
System Errors



Semantics of System Errors

- System errors are thrown by JVM
- System errors extend the Error class.
- Semantics: internal system error
 - Such errors rarely occur. If one does, there is little one can do beyond notifying the occurrence of the error and handling the termination of the program in a graceful manner.

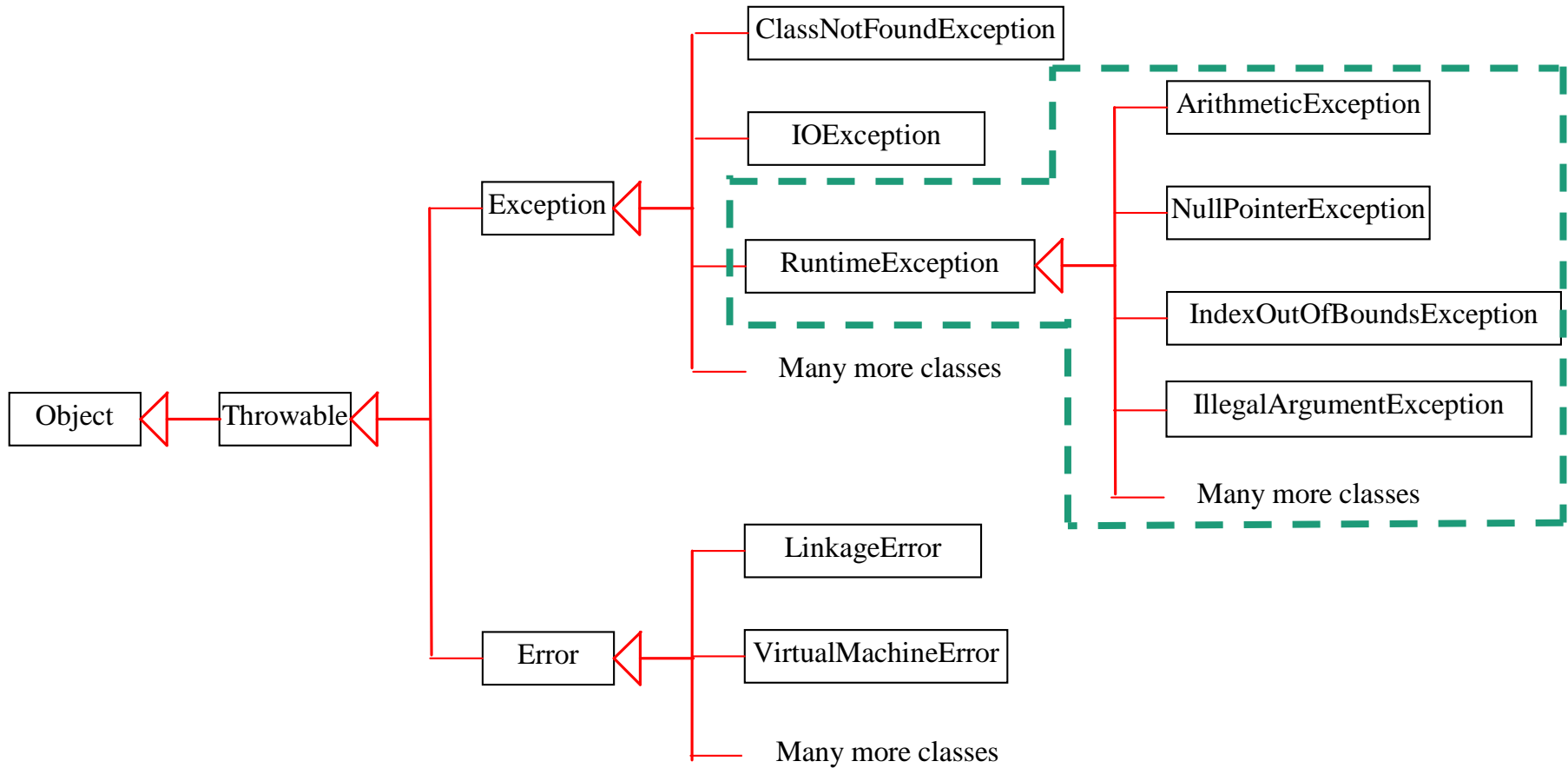
Exceptions



Semantics of Exceptions

- Exception describes errors caused by your program and external circumstances.
- It is expected that one may recover from these errors or provide a meaningful intervention from careful handling of the errors.

Runtime Exceptions



Semantics of Runtime Exceptions

- RuntimeException is caused by programming errors, such as bad casting, accessing an out-of-bounds array, and numeric errors.
- That is to day, if we, as programmers did not make any mistakes, they should not have occurred.
 - How is it my mistake when a user of my program enters 0 for n2 in n1/n2?
 - As an awesome programmer as you are, you should have anticipated that a user may enter whatever she or he wishes to enter.
- *Ideally*, RuntimeExceptions should never occur to users when the users are running your program

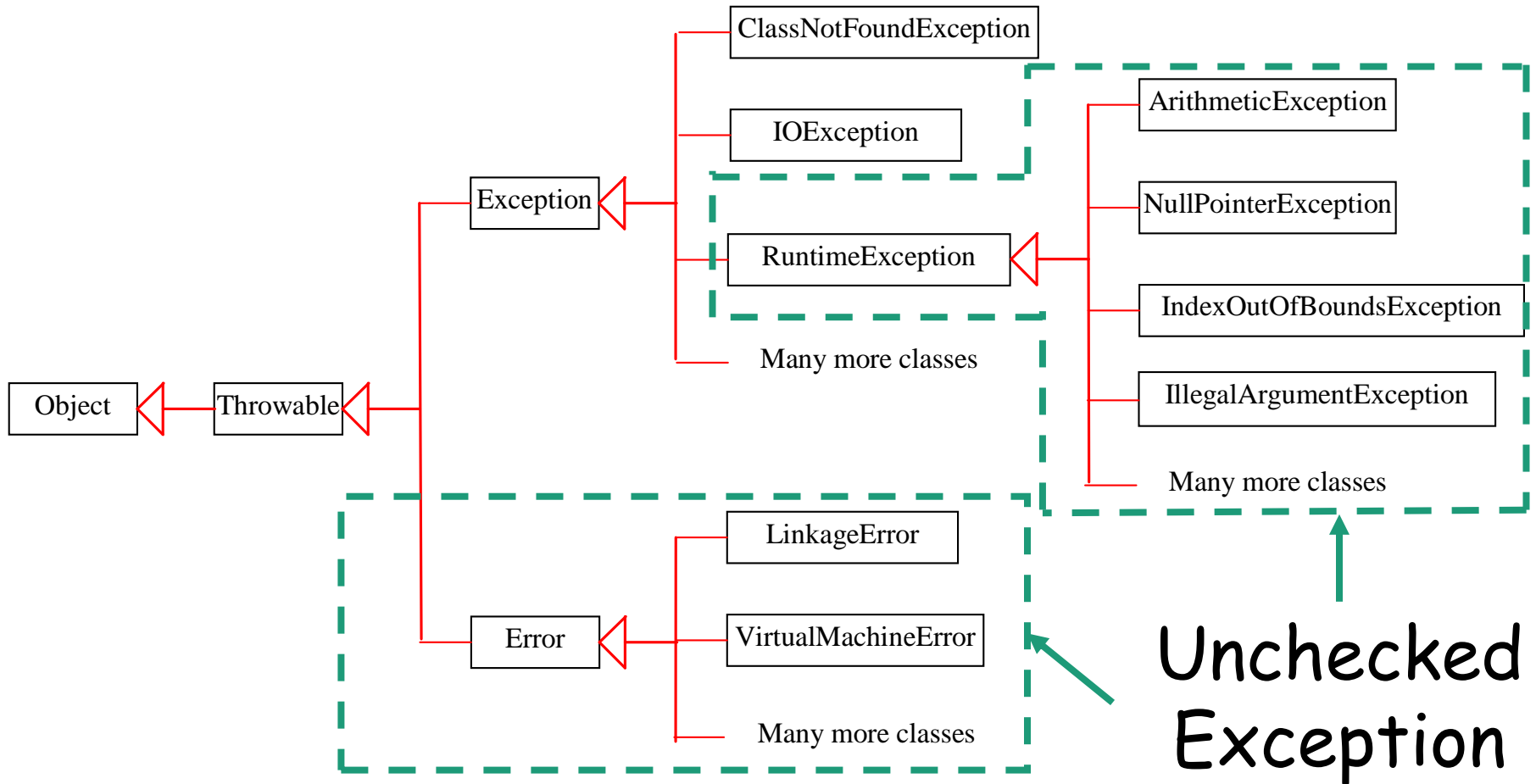
Questions?

- Class hierarchy of Throwable and subclasses
- Semantics of SystemError,
- Semantics of RuntimeException
- throws and try...catch...

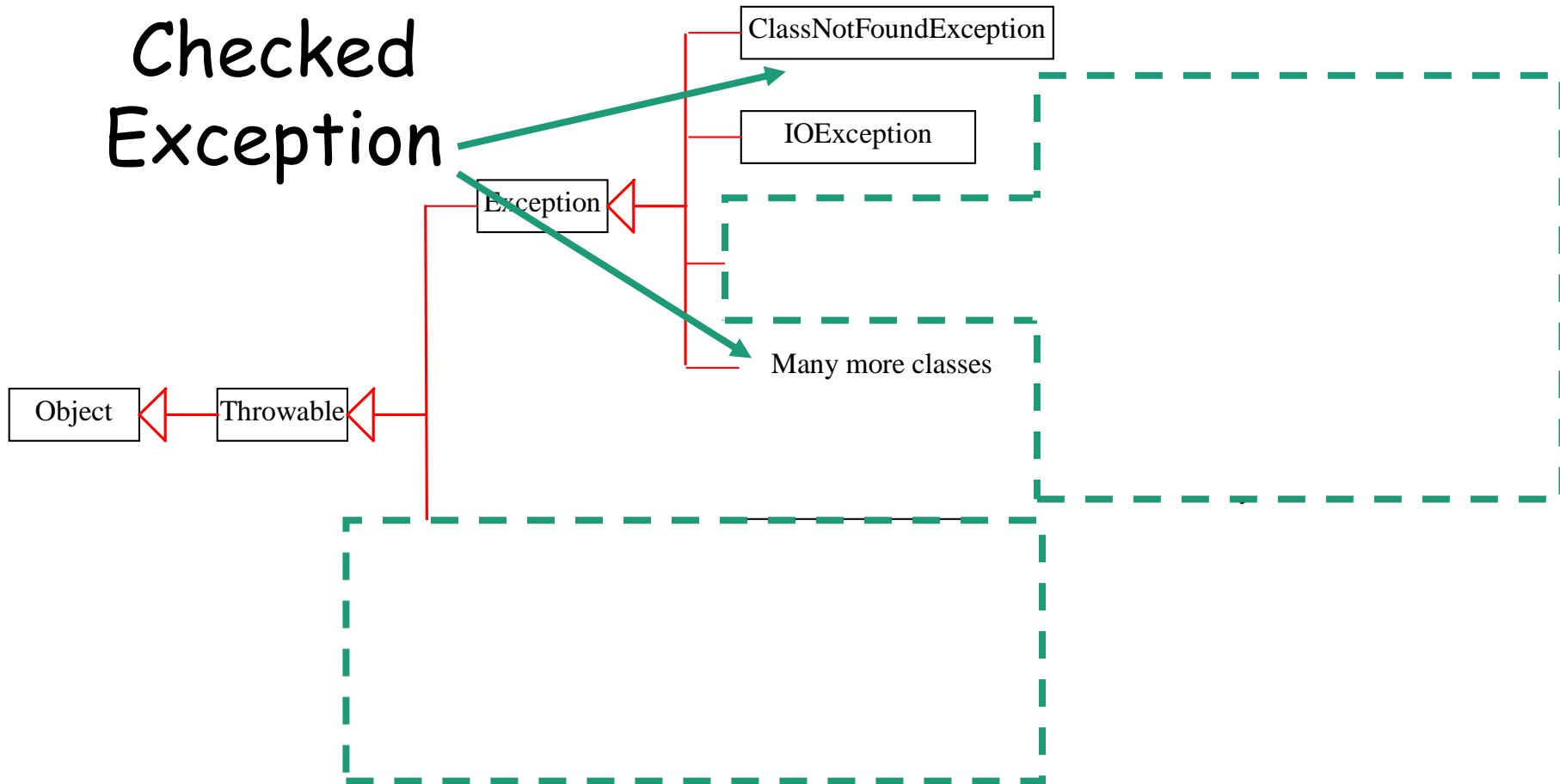
Checked and Unchecked Exceptions

- Unchecked Exceptions
 - RuntimeException, Error and their subclasses
- Checked Exceptions
 - Any others in the Throwable class hierarchy

Unchecked Exceptions



Checked Exceptions



Checked vs. Unchecked Exception

- The Java compiler forces the programmer to check and deal with the checked exceptions.
- The Java compiler does not forces the programmer to check and deal with the unchecked exceptions

Unchecked Exceptions

- Subclasses of Error and RuntimeException
- Programming logic errors that are not recoverable during runtime
- These are the logic errors that should be corrected in the program.
- They may occur anywhere in your program.

Unchecked Exceptions

- Two examples of commonly seen RuntimeExceptions
 - NullPointerException
 - IndexOutOfBoundsException

Questions

- The Throwable class hierarchy
- SystemError, RuntimeException
- Checked and unchecked exceptions
- NullPointerException and IndexOutOfBoundsException