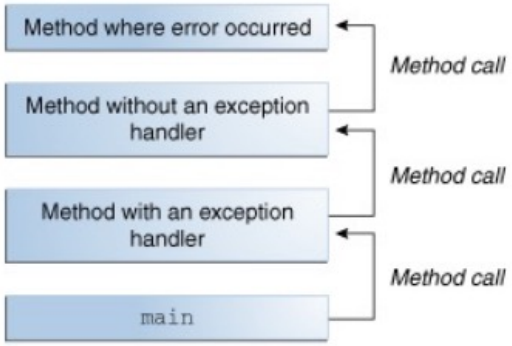
Exceptions in Java

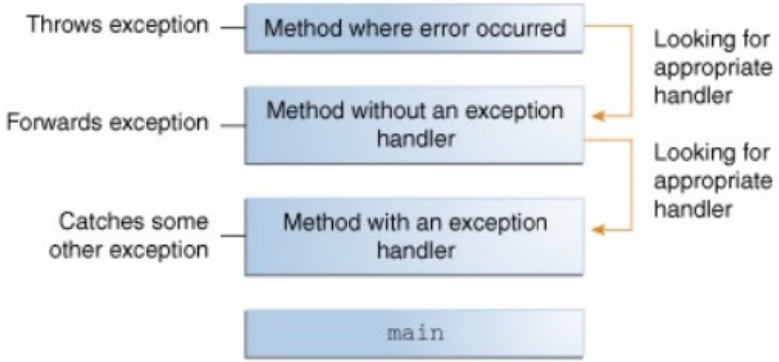
UNSW
SYDNEY

Exceptions in Java

- An exception is an event, which occurs during the execution of a program, that disrupts the normal flow of the program's instructions.
- When error occurs, an *exception* object is created and given to the runtime system, this is called throwing an exception.
- The runtime system searches the call stack for a method that contains a block of code that can handle the exception.
- The exception handler chosen is said to catch the exception.



The call stack.



Searching the call stack for the exception handler.

Exceptions in Java

The Three Kinds of Exceptions

- Checked exception (IOException, SQLException, etc.)
- Error (VirtualMachineError, OutOfMemoryError, etc.)
- *Runtime exception (*ArrayIndexOutOfBoundsExceptions, ArithmeticException, etc.)

Checked vs. Unchecked Exceptions

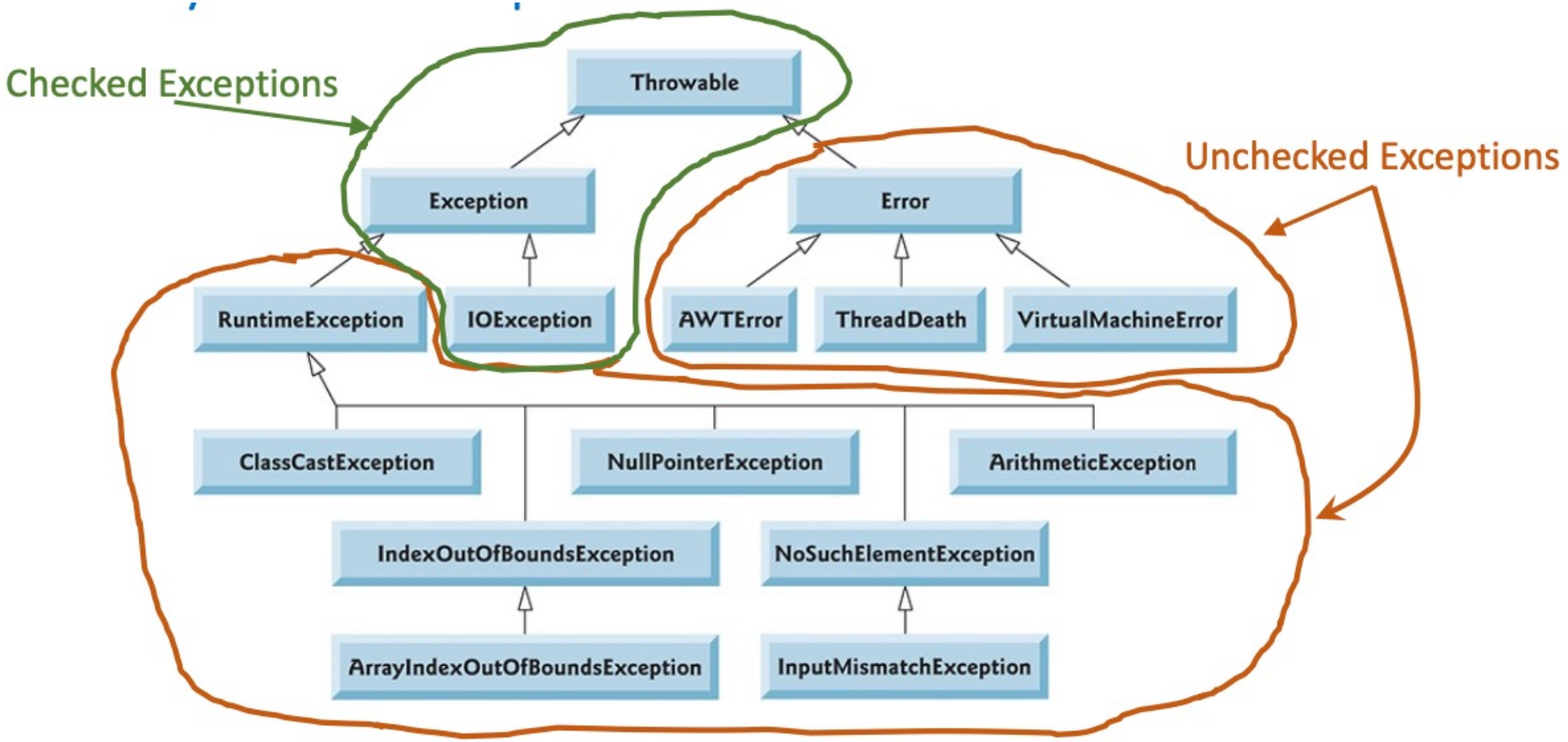
- An exception's type determines whether it's checked or unchecked.
- All classes that are subclasses of *RuntimeException* (typically caused by defects in your program's code) or *Error* (typically 'system' issues) are **unchecked** exceptions.
- All classes that inherit from class *Exception* but not directly or indirectly from class *RuntimeException* are considered to be **checked** exceptions.

Exceptions in Java

- Good **introduction on Exceptions** at
  https://docs.oracle.com/javase/tutorial/essential/exceptions/index.html

- **Unchecked Exceptions** — The Controversy
  https://docs.oracle.com/javase/tutorial/essential/exceptions/runtime.html

Hierarchy of Java Exceptions



From the book "Java How to Program, Early Objects", 11th Edition, by Paul J. Deitel; Harvey Deitel

Example

```
public void writeList() {
    PrintWriter out = null;

    try {
        System.out.println("Entering" + " try statement");

        out = new PrintWriter(new FileWriter("OutFile.txt"));
        for (int i = 0; i < SIZE; i++) {
            out.println("Value at: " + i + " = " + list.get(i));
        }
    } catch (IndexOutOfBoundsException e) {
        System.err.println("Caught IndexOutOfBoundsException: " + e.getMessage());

    } catch (IOException e) {
        System.err.println("Caught IOException: " + e.getMessage());

    } finally {
        if (out != null) {
            System.out.println("Closing PrintWriter");
            out.close();
        } else {
            System.out.println("PrintWriter not open");
        }
    }
}
```

try

catch

finally

User Defined Exceptions in Java

- We can also create user defined exceptions.
- All exceptions must be a child of `Throwable`.
- A checked exception need to extend the `Exception` class,

  but not directly or indirectly from class `RuntimeException`.
- An unchecked exception (like a runtime exception) need to extend the

  `RuntimeException` class.

User Defined / Custom Checked Exception

- Normally we define a *checked* exception, by extending the Exception class.

```
class MyException extends Exception {

    public MyException(String message){

        super( message );

    }

}
```

User Defined / Custom Exceptions: A Simple Example

```
try {
        out = new PrintWriter(new FileWriter("myData.txt"));
        for(int i=0; i<SIZE; i++){

                int idx = i + 5;

                if(idx >= SIZE){
                        throw new MyException("idx is out of index range!");
                }
                out.println(list.get(idx));
        }

}
catch(IOException e){
        System.out.println(" In writeln ....");
}
catch(MyException e){
        System.out.println(e.getMessage());
}
catch(Exception e){
        System.out.println(" In writeln, Exception  ....");

}
```

Exceptions in Inheritance

- If a subclass method overrides a superclass method,

  a subclass's *throws* clause can contain a subset of

  a superclass's *throws* clause.

  It must not throw more exceptions!

- Exceptions are part of an API documentation and contract.

Demo: Exceptions in Java

Demo ……

Assertions in Java

- An assertion is a statement in the Java that enables you to test your assumptions about your program. Assertions are useful for checking:
  - Preconditions, Post-conditions, and Class Invariants (DbC!)
  - Internal Invariants and Control-Flow Invariants
- You should not use assertions:
  - for argument checking in public methods.
  - to do any work that your application requires for correct operation.
- Evaluating assertions should not result in side effects.
- The following document shows how to use **assertions in Java** :
  https://docs.oracle.com/javase/8/docs/technotes/guides/language/assert.html

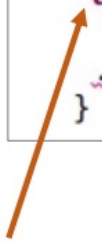
Important: for backward compatibility, by **default,** Java **disables** assertion validation feature. It needs to be explicitly **enabled** using the following command line argument:

- `-enableassertions` command line argument, or
- `-ea` command line argument

Assert : Example

```
/**
 * Sets the refresh interval (which must correspond to a legal frame rate).
 *
 * @param  interval refresh interval in milliseconds.
*/
 private void setRefreshInterval(int interval) {
  // Confirm adherence to precondition in nonpublic method
  assert interval > 0 && interval <= 1000/MAX_REFRESH_RATE : interval;

  ... // Set the refresh interval
 }
```



Exceptions: Summary Points

- Consider your exception-handling and error-recovery strategy in the design process.
- Sometimes you can prevent an exception by validating data first.
- If an exception can be handled meaningfully in a method, the method should catch the exception rather than declare it.
- If a subclass method overrides a superclass method, a subclass's *throws* clause can contain a subset of a superclass's *throws* clause. It must not throw more exceptions!
- Programmers should handle checked exceptions.
- If unchecked exceptions are expected, you must handle them gracefully.
- Only the first matching catch is executed, so select your catching class(es) carefully.
- Exceptions are part of an API documentation and contract.
- Assertions can be used to check preconditions, post-conditions and invariants.