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Object Oriented Architectures and Secure Development

(File) Input and Output (IO)

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Standard IO

```
Scanner in = new Scanner(System.in);
System.out.println("What is your name?");
String name = in.nextLine();
System.out.println("Hello " + name);
```

```
What is your name?
>
```

Standard IO

```
Scanner in = new Scanner(System.in);
System.out.println(“What is your name?”);
String name = in.nextLine();
System.out.println(“Hello ” + name);
```

```
What is your name?
> Alice
```


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Standard IO

```
Scanner in = new Scanner(System.in);
System.out.println("What is your name?");
String name = in.nextLine();
System.out.println("Hello " + name);
```

```
What is your name?
> Alice
Hello Alice
```


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Standard IO

```
Scanner in = new Scanner(System.in);
System.out.println("What is your name?");
String name = in.nextLine();
System.out.println("Hello " + name);
```

What are `System.in` and `System.out`?

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PrintStream

```
System.out.println(“Hello World”);
```

- This is plain Java.
- Classes, objects, and methods.

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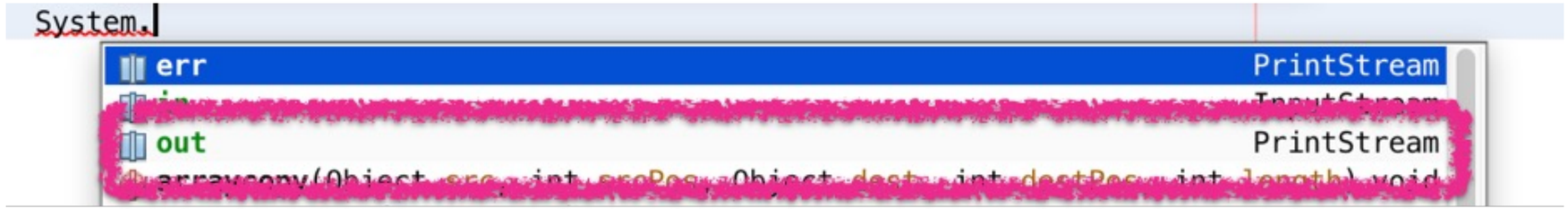
PrintStream

```
System.out.println("Hello World");
```

class field (object) method argument (String)

All objects have a type




```
PrintStream ps = System.out;
ps.println("Hello World");
```

PrintStream

```
public void foo( PrintStream ps ) {
    ps.println("Hello World");
}

public void bar() {
    foo( System.out );
}
```

PrintStream to Standard Output

```
private void run() {
    Product p1 = new Product("smartphone", 599);
    printProduct(System.out, p1);
}

private void printProduct(PrintStream ps, Product p)
{
    ps.printf("Name:\t%s%n", p.getName());
    ps.printf("Price:\t%.2f%n", p.getPrice());
}
```

PrintStream to Error

```
private void run() {
    Product p1 = new Product("smartphone", 599);
    printProduct(System.err, p1);
}

private void printProduct(PrintStream ps, Product p)
{
    ps.printf("Name:\t%s%n", p.getName());
    ps.printf("Price:\t%.2f%n", p.getPrice());
}
```

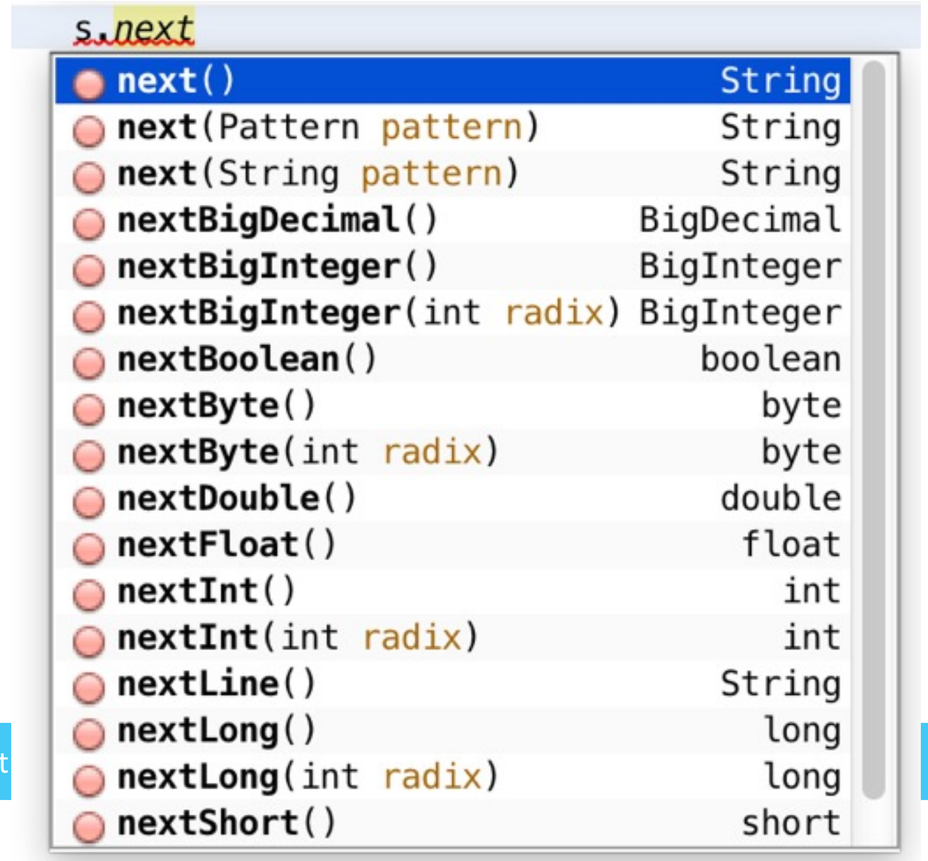
Printf and String.format *(need more control? Search the internet!)*

```
System.err.printf("Name:\t%s%nPrice:\t%.2f%n",
      p.getName(),
      p.getPrice()
);
```

%s	any	String, or implicitly object.toString()
%d	Simple number	[byte, short, int, long]
%f	Decimal Number	[float, double]
%4d	Simple Number	Occupies 4 positions
%.2f	Decimal Number	Always 2 numbers after the decimal point
%n	none	OS independent newline

Scanner

```
Scanner in = new Scanner( System.in );
while( in.hasNextLine() ) {
    System.out.println( in.nextLine() );
}
```



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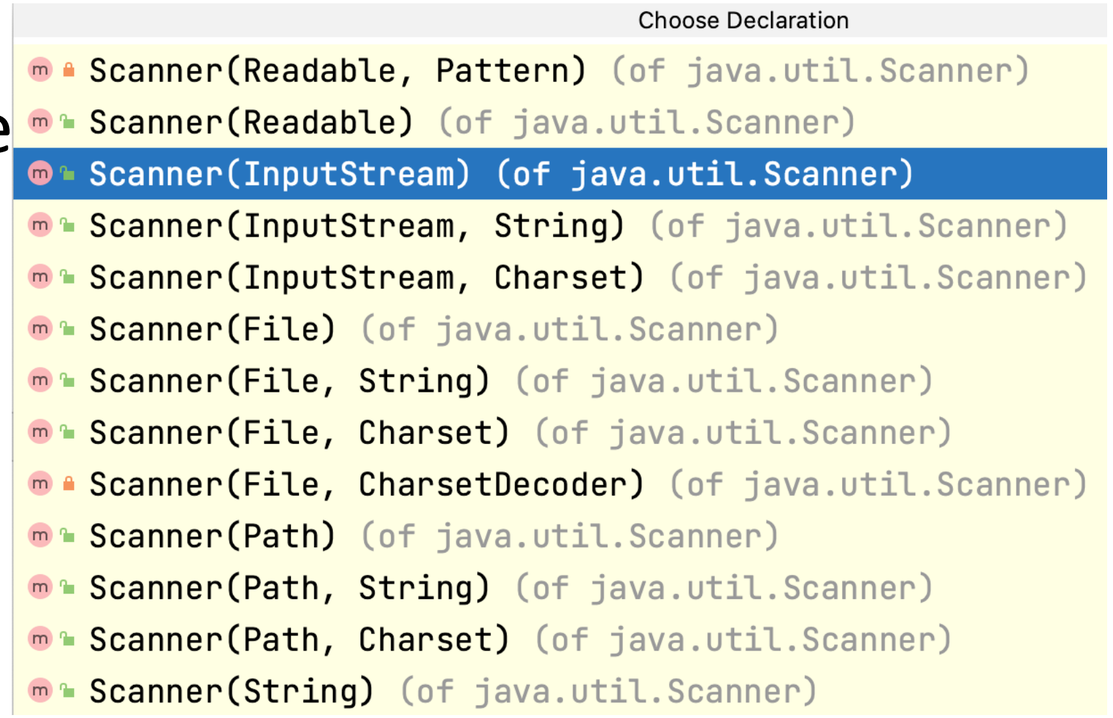
Scanner

```
Scanner in = new Scanner( System.in );
while( in.hasNextLine() ) {
    System.out.println( in.ne
}
```



Standard IO

Both `System.in` and `System.out` are IO-streams.
(not to be confused with the stream-API of map filter and reduce!)

They represent the command-line from the System. If we can link them to the data of a file we can replace Standard IO with file IO.

PrintStream to File

```
private void run() {
    Product p1 = new Product("smartphone", 599);
    printProduct(System.err, p1);

    printProduct(new PrintStream("product.txt"), p1);
    printProduct(new PrintStream("/product.txt"), p1);
    printProduct(new PrintStream("./product.txt"), p1);

}

private void printProduct(PrintStream ps, Product p) {
    ps.printf("Name:\t%s%n", p.getName());
    ps.printf("Price:\t%.2f%n", p.getPrice());
}
```

Figure out where Java stores the file on your HD.

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PrintStream to File

```
String fileName = "test.txt";
PrintStream ps = new PrintStream("test.txt");
```

```
public PrintStream(String fileName) throws FileNotFoundException {
    this(false, new FileOutputStream(fileName));
}
```

```
public FileOutputStream(String name) throws FileNotFoundException {
    this(name != null ? new File(name) : null, false);
}
```

PrintStream to File

```
PrintStream ps = new PrintStream(
    "test.txt"
);
```

Just the file name …

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PrintStream to File

```
PrintStream ps = new PrintStream(
    new FileOutputStream(
        "test.txt"
    )
);
```

New file outputstream (with filename)

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PrintStream to File

```
PrintStream ps = new PrintStream(
    new FileOutputStream(
        new File("test.txt")
    )
);
```

Pass a file to the file outputstream

PrintStream to File

```
PrintStream ps = new PrintStream(
    new FileOutputStream(
        new File("test.txt")
    )
);
```

Different versions, to give the developer more or less control (default vs configuration).

PrintStream to File

```
PrintStream ps = new PrintStream(
    new FileOutputStream(
        new File("test.txt")
    )
);
```

Create: add data to file, if it exists, clear the file first.

PrintStream to File

```
PrintStream ps = new PrintStream(
    new FileOutputStream(
        "test.txt"
    )
);
```

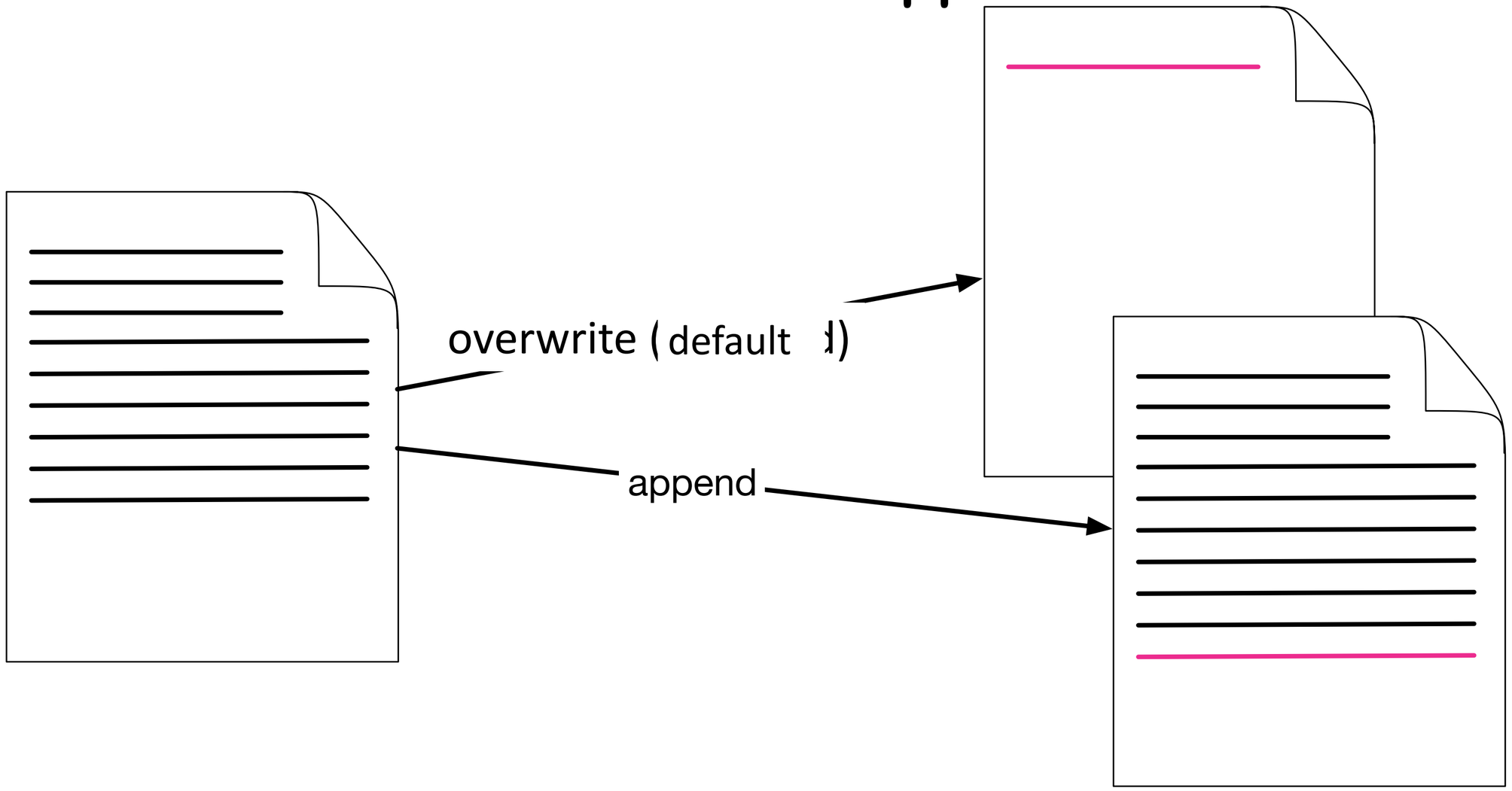
Create: add data to file, if it exists, clear the file first.

PrintStream to File: append

```
PrintStream ps = new PrintStream(
    new FileOutputStream(
        "test.txt", true
    )
);
```

Append: default is false, when true data is added at the end of the file instead of “clearing” the file first.

PrintStream to File: create versus append



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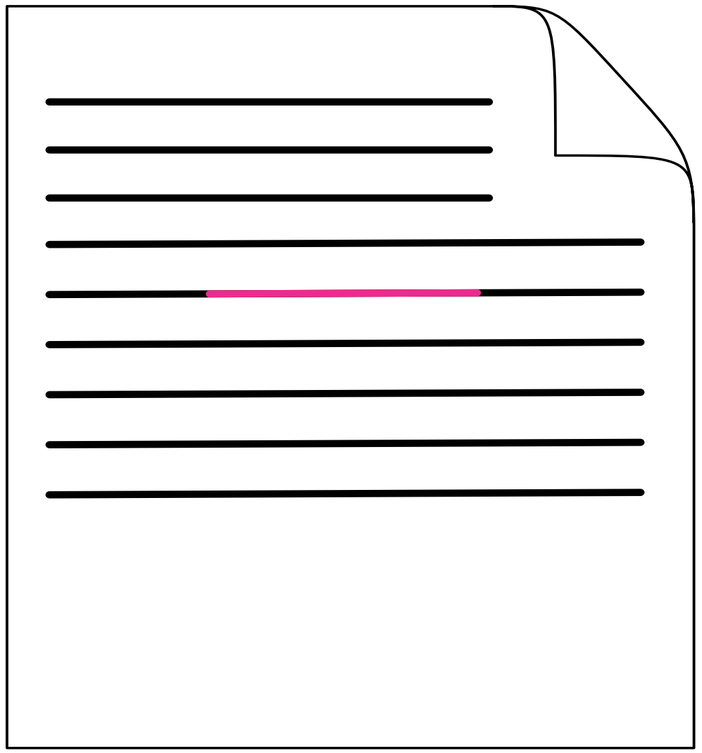
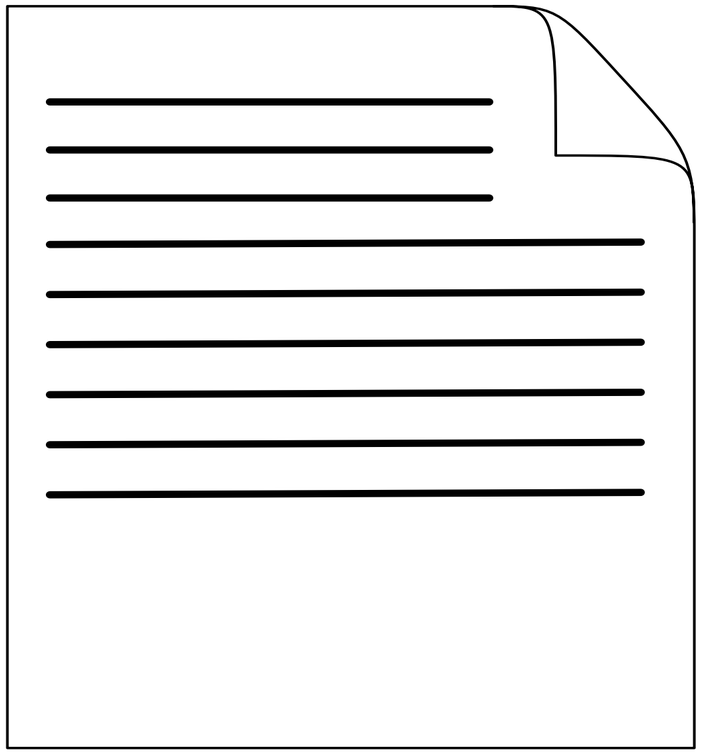
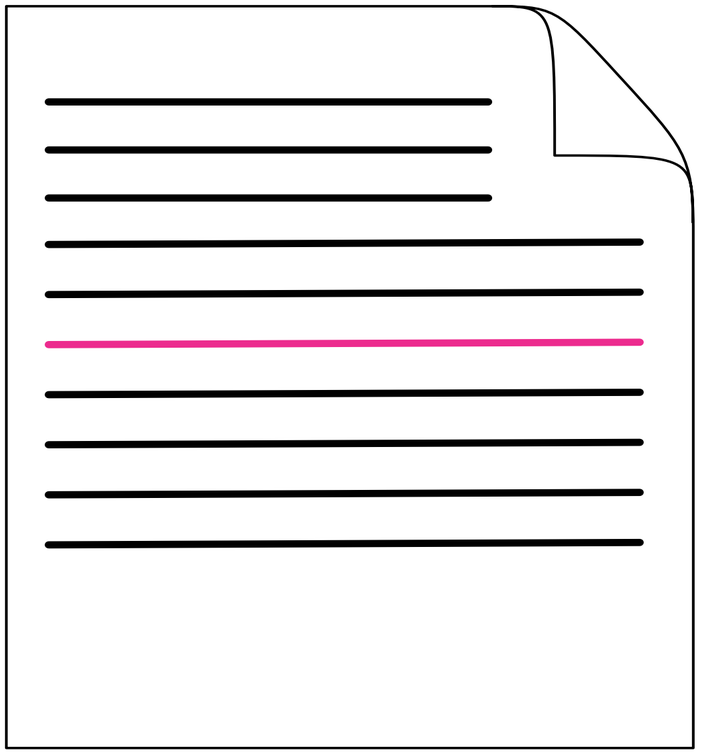
Random access







We do not study random access in files

https://lmgtfy.com/?q=java+file+random+access

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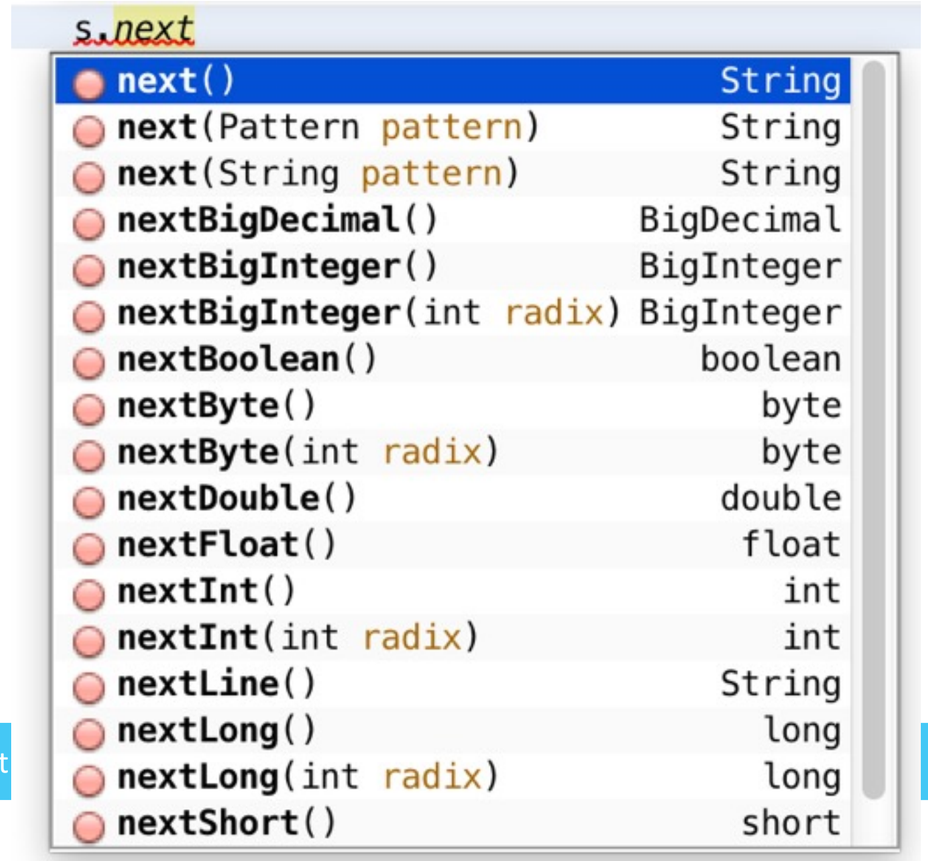
Scanner from File

```
Scanner s = new Scanner( new File("test.txt") );
while( s.hasNext() ) {
    System.out.println( s.next() );
}
```

```
s.hasNextLine()
s.nextLine()
```



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IO operations tend to go wrong sometimes …

```
try {
    Scanner s = new Scanner( new File("test.txt") );
    while( s.hasNext() ) {
        System.out.println(s.next());
    }
} catch (FileNotFoundException e) {
    // handle it !
}
```

IO operations tend to go wrong sometimes …

```
try {
    PrintStream ps = new PrintStream(new FileOutputStream(
                new File("test.txt")
    ));
    ps.println("I have so much content!");
} catch (FileNotFoundException e) {
    // handle it !
}
```


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IO operations tend to allocate resources (close!!!) …

```
try {
    Scanner s = new Scanner( new File("test.txt") );
    while( s.hasNext() ) {
        System.out.println(s.next());
    }
    s.close(); // NOT SAFE (enough) !!!
} catch (FileNotFoundException e) {
    // handle it !
}
```

IO operations tend to allocate resources (close!!!) …

```
try {
    PrintStream ps = new PrintStream(new FileOutputStream(
                new File("test.txt")
    ));
    ps.println("I have so much content!");
    ps.close(); // NOT SAFE (enough) !!!
} catch (FileNotFoundException e) {
    // handle it !
}
```


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IO operations tend to allocate resources (close!!!) …

```
try (Scanner s = new Scanner( new File("test.txt") )) {
    while( s.hasNext() ) {
        System.out.println(s.next());
    }
} catch (FileNotFoundException e) {
    // handle it !
}
```

IO operations tend to allocate resources (close!!!) …

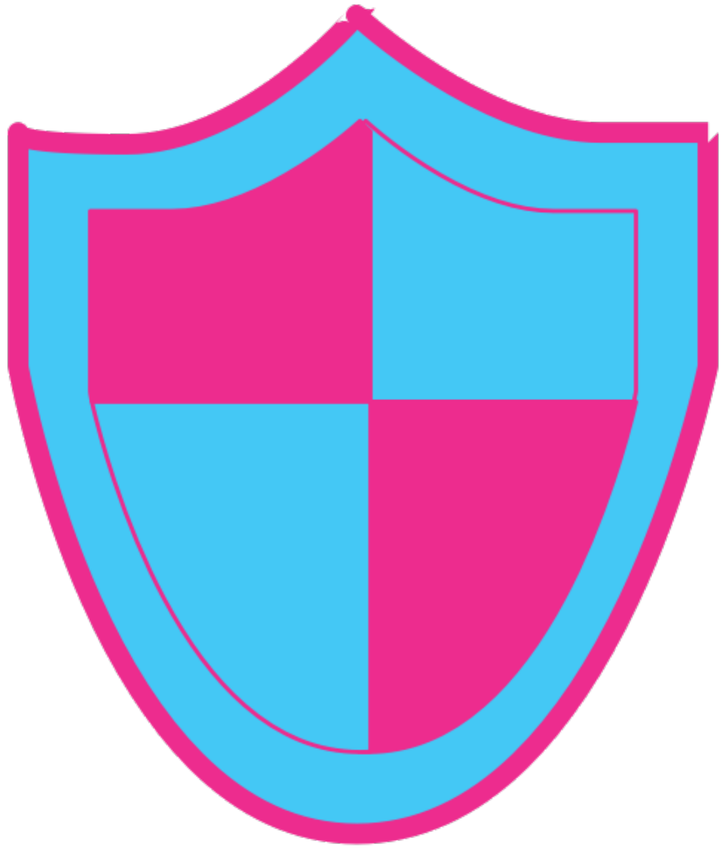
```
try (
    PrintStream ps = new PrintStream(new FileOutputStream(
            new File("test.txt")
        )
)) {
    ps.println("I have so much content!");
} catch (FileNotFoundException e) {
    // handle it !
}
```

Guideline 1-2: Release resources in all cases

https://www.oracle.com/technetwork/java/seccodeguide-139067.html#1-2

```
try (  /* put your resources here */  ) {
    /* put your computations here */
} catch (FileNotFoundException e) {
   // handle it !
}
```

Some objects, such as open files, locks and manually allocated memory, behave as resources which require every acquire operation to be paired with a definite release. It is easy to overlook the vast possibilities for executions paths when exceptions are thrown. Resources should always be released promptly no matter what.



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The File class

https://docs.oracle.com/javase/7/docs/api/java/io/File.html

The File-class represents a file or directory on your hard-disk.

The class contains a lot of handy methods.

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