SAPIENZA
UNIVERSITÀ DI ROMA

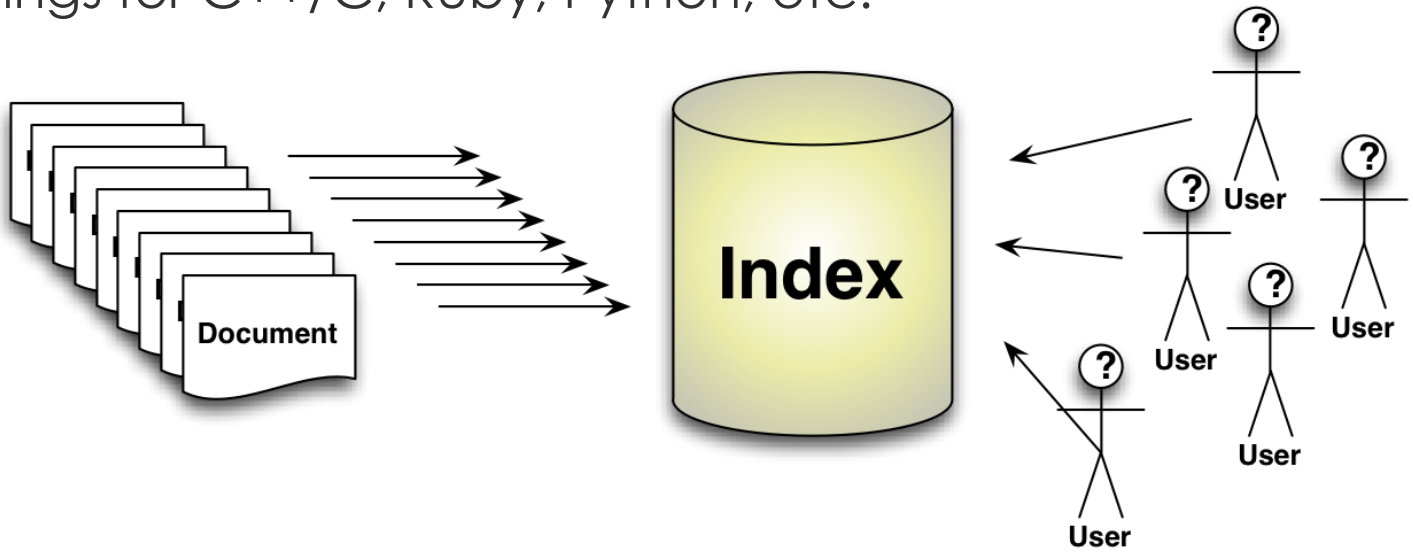
Giovanni Stilo, Ph.D.
stilo@di.uniroma1.it

Take to Wife Lucene

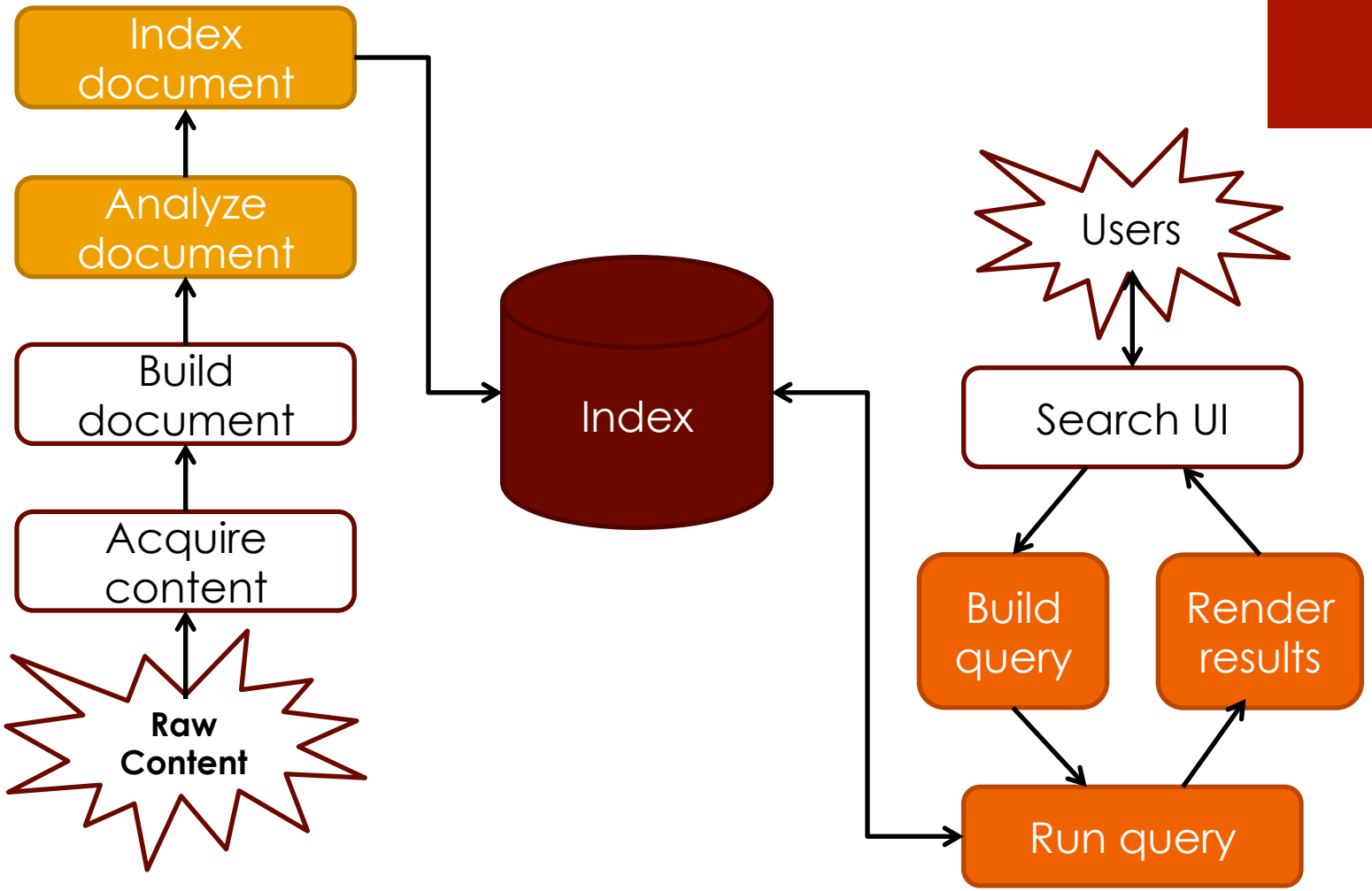
Lucene Basic Principles

Lucene ?

- Name **Lucene** came from Doug Cutting's (founder) wife's middle name.
- **Free-text** indexing library
- Implements standard **IR/search** functionality
  - Query models, ranking, indexing
- **Core API** is implemented in Java
  - Bindings for C++/C, Ruby, Python, etc.



Main Flow


Index document
Analyze document
Build document
Acquire content
Raw Content
Index
Users
Search UI
Build query
Render results
Run query

Document

- a Document is the **basic unit** for *indexing* and *searching*
  (**note**: it is different from the notion of document as file)
- each Document is a **list** of Field(s)
- each Field has a **name** and a text value
- **It is up to us to decide what to include in a Document**

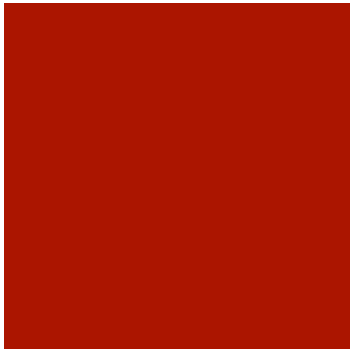
```
…
Document doc = new Document();
doc.add(new Field(…));
doc.add(new Field(…));
doc.add(new Field(…));
…
```

Field

- a field is the **basic unit** composing *Documents* - each Document is a list of Field(s).
- for each field, you need to **specify**
  - Name
  - Value
  - Options (almost storing)

```
…
Document doc = new Document();
Field f1 = new Field("fieldName1", "fieldContent1", FieldOptions1);
Field f2 = new Field("fieldName2", "fieldContent2", FieldOptions1);
doc.add(new Field(…));
…
```

Field Types



- **Numeric types:**
  - FloatField
  - DoubleField
  - IntField
  - LongField
- **Text types:**
  - StringField
  - TextField
- **Expert types:**
  - Field

Directory

- At its core, a list of files.
- RAMDirectory
  - in-memory volatile dir
  - useful for “on-the-fly” indexes

```
…
Directory dir= new RAMDirectory();
…
```

- RAMDirectory
  - file-based, persistent dir

```
…
Directory dir= new SimpleFSDirectory(new File("index"));
…
```

Indexing Documents

- Is the process of Writing the Index
- We need an IndexWriter

```
…
Directory dir= new RAMDirectory();
Analyzer analyzer = new StandardAnalyzer(LUCENE_41);
IndexWriterConfig cfg= new     IndexWriterConfig(LUCENE_41,analyzer);
IndexWriter writer = new IndexWriter(dir, cfg);
…
Document doc = new Document();
…
for(all documents) {
  field.setLongValue(value of doc);
  writer.addDocument(document);
}
writer.commit();
writer.close();
…
```

LongField*

- Field that indexes long values for **efficient** range *filtering* and *sorting*:

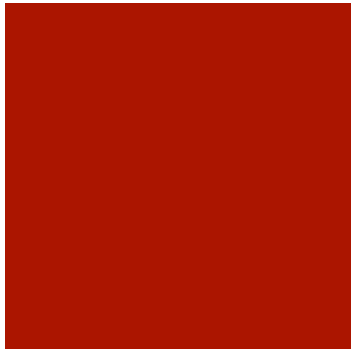
```
…
document.add(new LongField(name, 6L, Field.Store.NO));
…
```

- For optimal performance, **re-use** the **LongField** and **Document** instance for more than one document:

```
LongField field = new LongField("fieldName", 0L, Field.Store.NO);
Document document = new Document();
document.add(field);
for(all documents) {
  field.setLongValue(value of doc);
  writer.addDocument(document);
}
```

* other fields of numeric types works in the same way

Textual Fields



- **StringField**: a field that is indexed but *not tokenized*; the entire String value is indexed as a single token.
  - For example this might be used for a 'country' field or an 'id' field.

```
…
doc.add(new StringField("fieldName", content,Field.Store.YES));
…
```

- **TextField**: A field that is indexed and *tokenized*, without term vectors.
  - For example this would be used on a 'body' field, that contains the bulk of a document's text.

```
…
doc.add(new TextField ("fieldName", content,Field.Store.YES));
…
```

Field

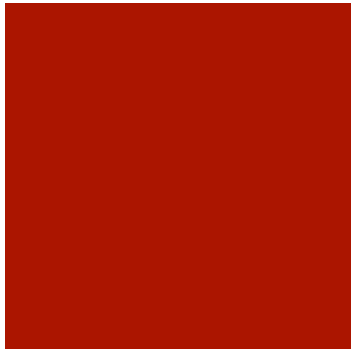
- **Expert**: *directly* create a field for a document. Most users should use one of the sugar subclasses:
  - IntField, LongField, FloatField, DoubleField, StringField, TextField.

```
FieldType MY_FLD_TYPE = new FieldType();
MY_FLD_TYPE.setIndexed(true);
MY_FLD_TYPE.setTokenized(true);
MY_FLD_TYPE.setStored(true);
MY_FLD_TYPE.setStoreTermVectors(true);
MY_FLD_TYPE.setStoreTermVectorPositions(true);
MY_FLD_TYPE.freeze();
…
doc.add(new Field("fieldName", content,MY_FLD_TYPE ));
…
```

Maven Artifacts

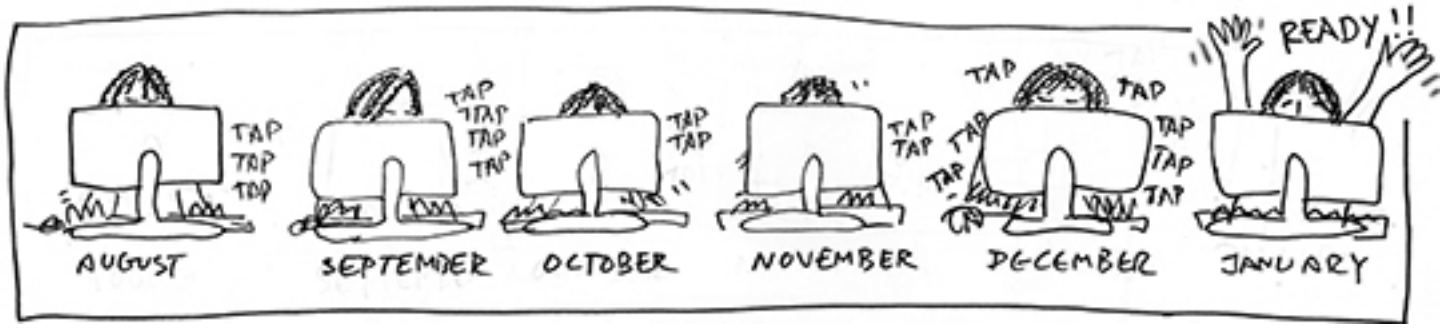
```
<dependency>
        <groupId>org.apache.lucene</groupId>
        <artifactId>lucene-core</artifactId>
        <version>4.1.0</version>
</dependency>
<dependency>
        <groupId>org.apache.lucene</groupId>
        <artifactId>lucene-queryparser</artifactId>
        <version>4.1.0</version>
</dependency>
<dependency>
        <groupId>org.apache.lucene</groupId>
        <artifactId>lucene-queries</artifactId>
        <version>4.1.0</version>
</dependency>
<dependency>
        <groupId>org.apache.lucene</groupId>
        <artifactId>lucene-analyzers-common</artifactId>
        <version>4.1.0</version>
</dependency>
```

Excercise



- Create a class that allow to index many Identity Card Documents.
- Each documents have the following fields (choosing the best type of field):
  - IC Number;
  - Name;
  - Surname;
  - Birth Date
  - State
  - City
  - Height (expressed in meter for example 1.75)

Let's Try?!?!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DECEMBER
READY!!
JANUARY

Searching

- We already have the index but we want to perform queries on it.
- We need to read it; so we need a IndexReader.

```
…
Directory dir= new RAMDirectory();
IndexReader ir= DirectoryReader.open(dir);
…
```

- We need to use an IndexSearcher that use IndexReader to perform a Query.

```
…
IndexSearcher searcher = new IndexSearcher(ir);
…
```

Querying

- At this point we need a Query q.
- We can manually build a query.

```
…
Query q = new TermQuery( new Term("fieldName","termToSearch");
…
```

- Or it is possible to build the query using a query parser and submit to it a string that satisfy the Query Language[1] QL.

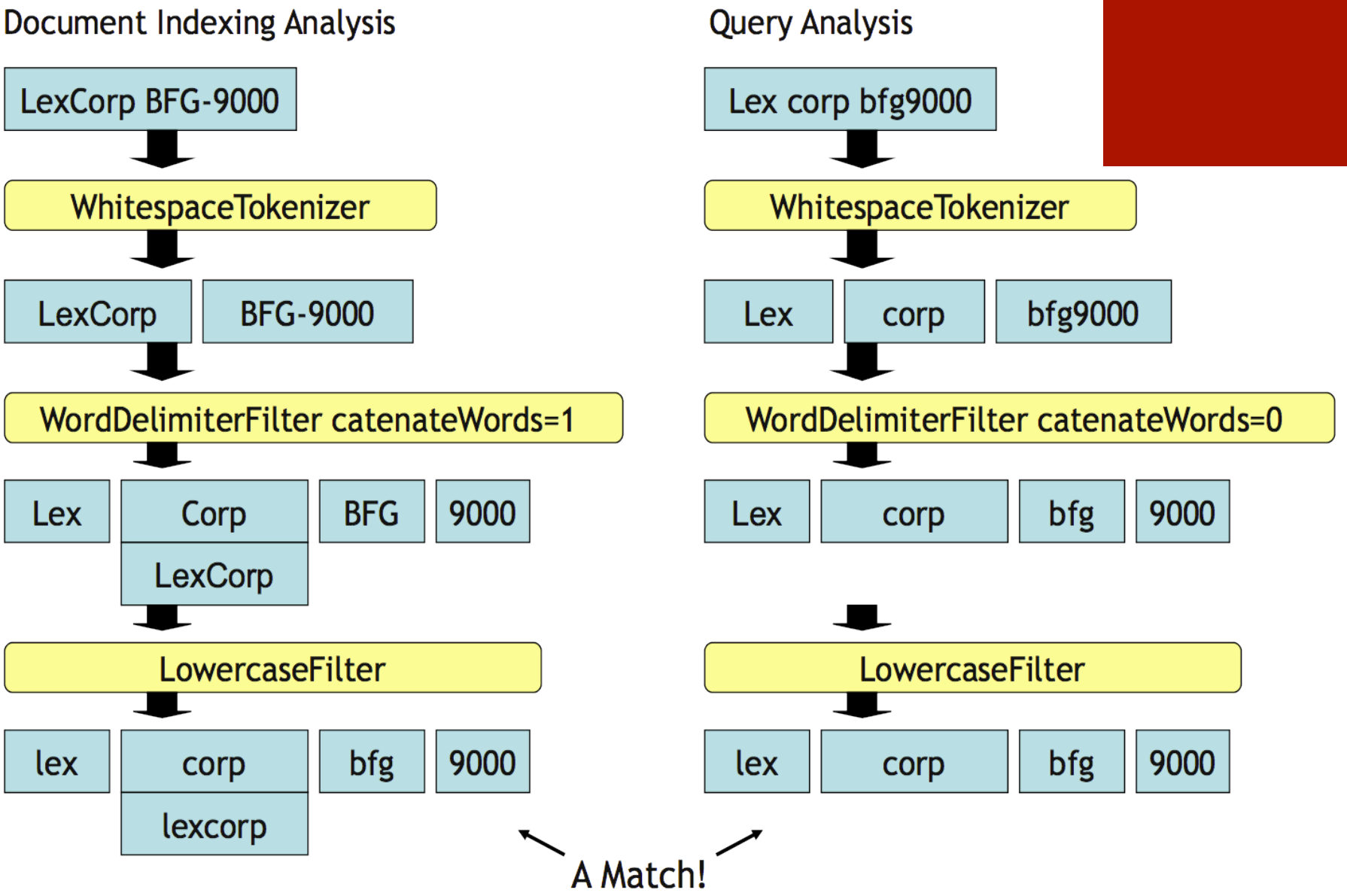
```
…
QueryParser parser = new QueryParser(USED_VERSION,
                                     "defaultFieldName", analyzer);
Query q = parser.parse(query);
…
```

1- http://lucene.apache.org/core/4_0_0/queryparser/org/apache/lucene/queryparser/classic/package-summary.html#package_description

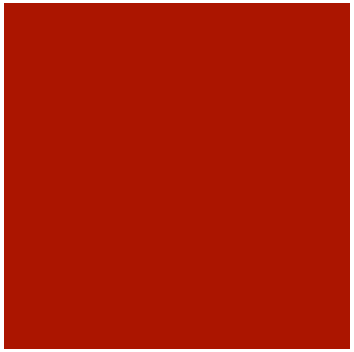
Query Language Examples

Query expression	Document matches if…
java	Contains the term *java* in the default field
java junit java OR junit	Contains the term *java* or *junit* or both in the default field (*the default operator can be changed to* AND)
+java +junit java AND junit	Contains both *java* and *junit* in the default field
title:ant	Contains the term *ant* in the title field
title:extreme – subject:sports	Contains *extreme* in the title and **not** *sports* in subject
(agile OR extreme) AND java	Boolean expression matches
title:"junit in action"	*Phrase matches in title*
title:"junit action"~5	*Proximity matches (within 5) in title*
*java**	*Wildcard matches*
java~	*Fuzzy matches*

Text Analysis



Text Analysers



- WhitespaceAnalyzer
  - splits on whitespace
- SimpleAnalyzer
  - splits on whitespace and special characters; applies lowercase
- StopAnalyzer
  - SimpleAnalyzer + stopword
- StandardAnalyzer
  the most complete (Whitespace+Stop+misc)
- SnowballAnalyzer performs also stemming

Perform Query

- Finally submit the query to the searcher and read results.

```
…
TopDocs top = searcher.search(q, 100); // perform a query and limit results number
ScoreDoc[] hits = top.scoreDocs; // get only the scored documents (ScoreDoc is a tuple)

Document doc=null;

for(ScoreDoc entry:hits){
    // load document in memory (only the stored filed are available)
    doc=searcher.doc(entry.doc); /* the same as ir.document(entry.doc); */

    System.out.println("field1: "+doc.get("field1"));
    System.out.println("field2: "+doc.get("field2"));
    System.out.println("field3: "+doc.get("field3"));
    System.out.println("field4: "+doc.get("field4"));
}
ir.close();
…
```

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Excercise

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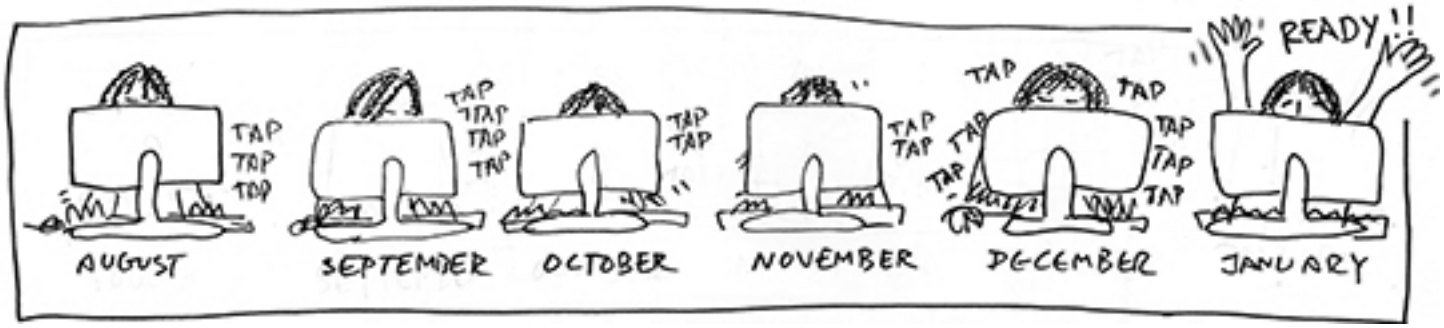
  - IC Number;
  - Name;
  - Surname;
  - Birth Date
  - State
  - City
  - Height (expressed in meter for example 1.75)
- Try to retrieve ID cards using different fields at the same time.

Let's Try?!?!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