## *COMPS203F*

## *Topic 07: XML, JSON and Maven*

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# *XML*

- XML (eXtensible Markup Language)
- markup language for documents, similar to HTML with pairs of tags, but
  - meaning of tags not predefined
  - user can use their own tags (e.g., `<phone>`, `</phone>`)
- designed for
  - data storage/transmission
  - machine-readable, and also human-readable
- reasons to study:
  - used in many documents/systems (e.g., Word .docx files)
  - you may need to processing it

# *Example*

- Student information (file: `university.xml`)

```
<university>
  <student>
    <name>Ben Wong</name>
    <phone>99887766</phone>
  </student>
  <student>
    <name>Cat Lee</name>
    <phone>99112233</phone>
  </student>
</university>
```

- It has a tree-like structure with a root (draw diagram)

# *More Details*

- An XML file can **optionally** have an XML prolog as in its first line (and no space before "<?")

```
<?xml version="1.0" encoding="UTF-8"?>
  <!-- this is a comment -->
  <university>
    <student>
      <name>Ben Wong</name>
      <phone>99887766</phone>
    </student>
  </university>
```

- Comment: same as HTML
- Case sensitive
- 5 reserved characters (<, >, &, ', "): need to use "&lt;", "&gt;", "&amp;", "&apos;", and "&quot;" instead

# *Processing Using Java*

- We uses JDOM (Java Document Object Model), an open source Java library
- Whole document is stored in memory
- needs the jar file (e.g., `jdom.jar`) in your classpath, please replace "jdom.jar" with your actual file name
- In Crimson, add "-cp jdom.jar" in "Tools > Conf. User Tools > Argument" part
- Web site: `http://www.jdom.org`

- Other alternatives: SAX, DOM, StAX, ...

# *Useful classes*

- Useful classes `Document` and `Element`

```
import org.jdom2.*;
```

- To create an XML document `xmlDoc` with root element `university`:

```
Element root = new Element("university");
Document xmlDoc = new Document(root);
<university></university>
```

- To add an element `student` under `root`:

```
Element student = new Element("student");
root.addContent(student);
<university>
  <student>
  </student>
</university>
```

# *Useful classes*

- To add element and data to `student` :

```
student.addContent(new Element("name")
                   .setText("Ben Wong"));

<university>
  <student>
    <name>Ben Wong</name>
  </student>
</university>

student.addContent(new Element("phone")
                   .setText("99887766"));
   ...
   <phone>99887766</phone>
   ...
```

# *Exercise*

- Create the following XML document

```
<shop>
  <item>
    <name>Apple</name>
    <price>5.5</price>
  </item>
</shop>
```

# Answers

```
Element root = new Element("shop");
Document xmlDoc = new Document(root);
Element item = new Element("item");
root.addContent(item);
item.addContent(new Element("name")
                .setText("Apple"));
item.addContent(new Element("price")
                .setText("5.5"));
```

# Create XML class

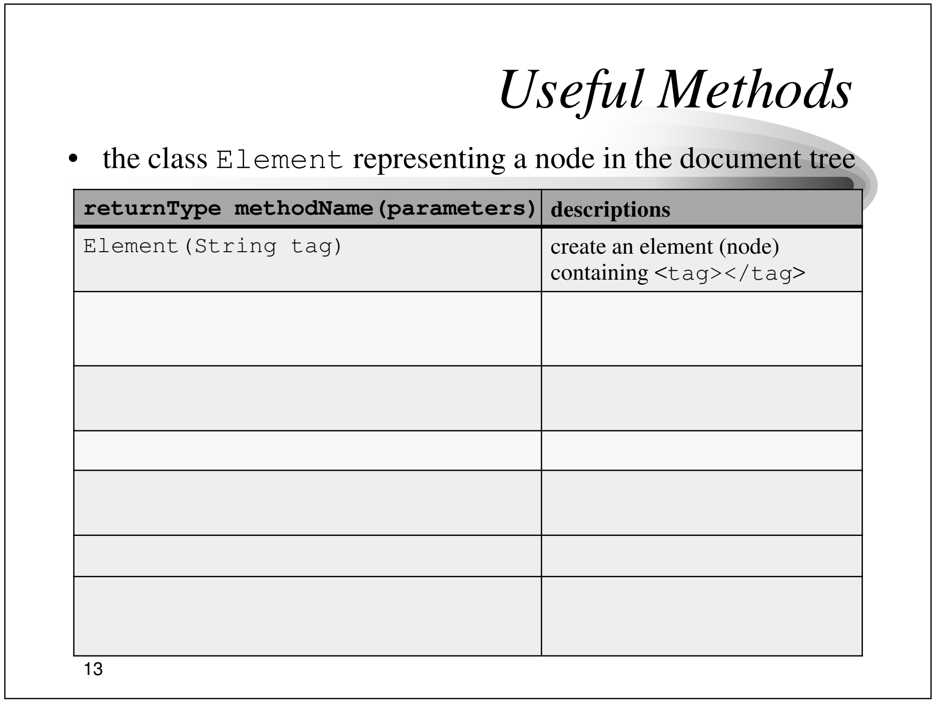
```
import org.jdom2.*;
import org.jdom2.output.*;
import java.io.*;

public class CreateXML {
  public static void main(String[] args) {
    try {
      // for printing in pretty format
      XMLOutputter xmlOutput = new XMLOutputter();
      Format format = Format.getPrettyFormat();
      format.setExpandEmptyElements(true);
      xmlOutput.setFormat(format);

      Element root = new Element("university");
      Document xmlDoc = new Document(root);
      xmlOutput.output(xmlDoc, System.out);
```

# Create XML class

```
      Element student = new Element("student");
      root.addContent(student);
      xmlOutput.output(xmlDoc, System.out);

      student.addContent(new Element("name")
                         .setText("Ben Wong"));
      student.addContent(new Element("phone")
                         .setText("99887766"));
      xmlOutput.output(xmlDoc, System.out);
    } catch (IOException e) {
      e.printStackTrace();
    }
  }
}
```

# Output

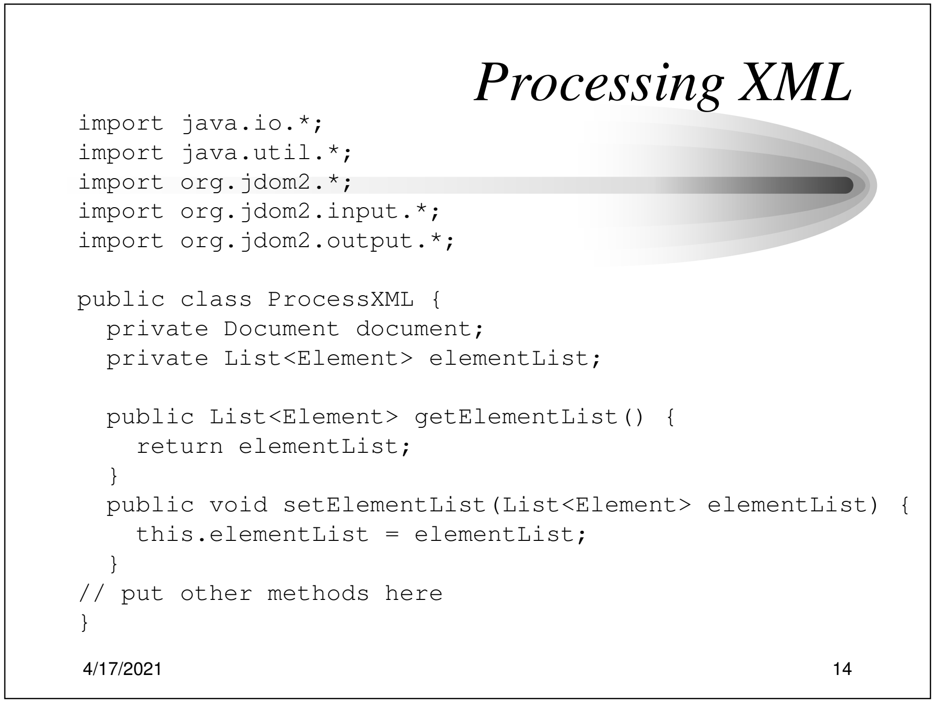
```
<?xml version="1.0" encoding="UTF-8"?>
<university></university>

<?xml version="1.0" encoding="UTF-8"?>
<university>
  <student></student>
</university>

<?xml version="1.0" encoding="UTF-8"?>
<university>
  <student>
    <name>Ben Wong</name>
    <phone>99887766</phone>
  </student>
</university>
```



# Useful Methods

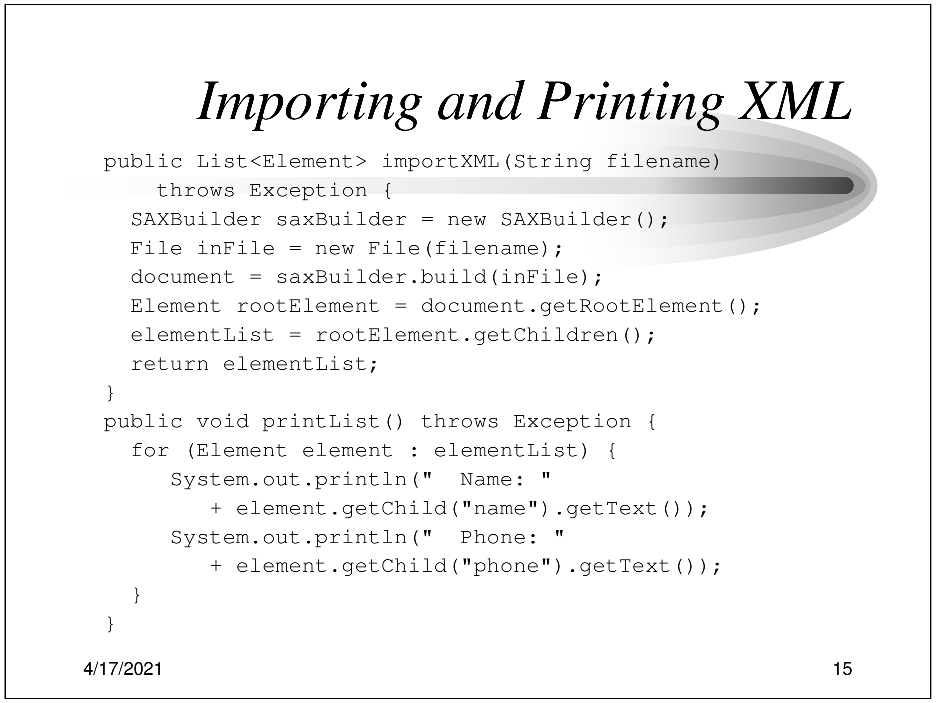
- the class `Element` representing a node in the document tree

| **`returnType methodName(parameters)`** | **descriptions** |
|---|---|
| `Element(String tag)` | create an element (node) containing `<tag></tag>` |
| | |
| | |
| | |
| | |
| | |
| | |



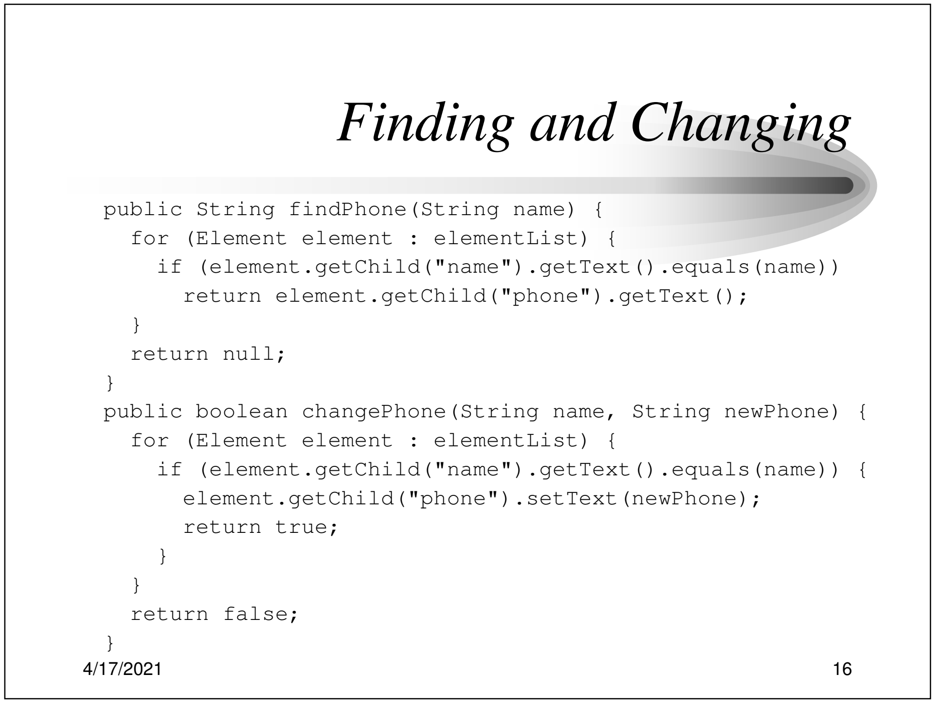
# Processing XML

```
import java.io.*;
import java.util.*;
import org.jdom2.*;
import org.jdom2.input.*;
import org.jdom2.output.*;

public class ProcessXML {
  private Document document;
  private List<Element> elementList;

  public List<Element> getElementList() {
    return elementList;
  }
  public void setElementList(List<Element> elementList) {
    this.elementList = elementList;
  }
// put other methods here
}
```



# Importing and Printing XML

```
public List<Element> importXML(String filename)
    throws Exception {
  SAXBuilder saxBuilder = new SAXBuilder();
  File inFile = new File(filename);
  document = saxBuilder.build(inFile);
  Element rootElement = document.getRootElement();
  elementList = rootElement.getChildren();
  return elementList;
}
public void printList() throws Exception {
  for (Element element : elementList) {
     System.out.println("  Name: "
        + element.getChild("name").getText());
     System.out.println("  Phone: "
        + element.getChild("phone").getText());
  }
}
```



# Finding and Changing

```
public String findPhone(String name) {
  for (Element element : elementList) {
    if (element.getChild("name").getText().equals(name))
      return element.getChild("phone").getText();
  }
  return null;
}
public boolean changePhone(String name, String newPhone) {
  for (Element element : elementList) {
    if (element.getChild("name").getText().equals(name)) {
      element.getChild("phone").setText(newPhone);
      return true;
    }
  }
  return false;
}
```

# Deleting

```
public boolean deleteStudent(String name) {
   for (Element element : elementList) {
     if (element.getChild("name").getText().equals(name)) {
       elementList.remove(element);
       return true;
     }
   }
   return false;
 }
```

# Adding

```
public List<Element> addStudent(String name, String phone) {
   Element element = new Element("student");
   element.addContent(new Element("name").setText(name));
   element.addContent(new Element("phone").setText(phone));
   elementList.add(element);
   return elementList;
 }
```

# Exporting

```
//import org.jdom2.output.*;

 public void exportXML(String filename) throws Exception {
    PrintStream outStream = new PrintStream(
                            new File(filename));
    XMLOutputter xmlOutput = new XMLOutputter();
    xmlOutput.setFormat(Format.getPrettyFormat());
    xmlOutput.output(document, outStream);
    outStream.close();
  }
```

# Full Testing Code

```
public static void main(String[] args) {
   ProcessXML xml = new ProcessXML();
   try {
     String xmlFile = "university.xml";
     System.out.println("import xml file: "+xmlFile);
     xml.importXML(xmlFile);
     System.out.println("print element list...");
     xml.printList();
     String aName = "Cat Lee";
     System.out.println("find phone number of "+aName);
     System.out.println("  "+aName + "'s Phone no.: "
                        + xml.findPhone(aName));
     System.out.println("change phone number of Cat...");
     xml.changePhone(aName, "66778899");
     xml.printList();
```

# Full Testing Code

```
    System.out.println("delete student Ben...");
    xml.deleteStudent("Ben Wong");
    xml.printList();
    System.out.println("add student Dick...");
    xml.addStudent("Dick Chan", "99001122");
    xml.printList();
    String outFile = "out.xml";
    System.out.println("export to XML file: "+outFile);
    xml.exportXML(outFile);
    //xml.exportXML(xmlFile);
  } catch(JDOMException e) {
    System.out.println("JDOM exception: "+e.getMessage());
    e.printStackTrace();
  } catch(Exception e) {
    System.out.println(e.getMessage());
  }
}
```

# Output

```
import xml file: university.xml
print element list...
  Name: Ben Wong
  Phone: 99887766
  Name: Cat Lee
  Phone: 99112233
find phone number of Cat Lee
  Cat Lee's Phone no.: 99112233
change phone number of Cat...
  Name: Ben Wong
  Phone: 99887766
  Name: Cat Lee
  Phone: 66778899
```

# Output

```
delete student Ben...
  Name: Cat Lee
  Phone: 66778899
add student Dick...
  Name: Cat Lee
  Phone: 66778899
  Name: Dick Chan
  Phone: 99001122
export to XML file: out.xml
```

# Exercise

- Write a method `findName(String phone)` to return the name of the student having phone number `phone`

## *Answers*

- Write a method `findName(String phone)` to return the name of the student having phone number `phone`

```
public String findName(String phone) {
  for (Element element : elementList) {
    if (element.getChild("phone").getText().equals(phone))
      return element.getChild("name").getText();
  }
  return null;
}
```

## *More...*

- Each element of XML can have attributes
- they are usually for storing meta-data
- If `student` has an attribute "id", the following statement can get its value:

  `student.getAttribute("id");`
- See https://www.tutorialspoint.com/java_xml/java_jdom_parse_document.htm

## *JSON*

- JSON (JavaScript Object Notation)
- contains text written in certain format
- for data storage and exchange
- light-weight
- both human and machine readable
- mainly use to transmit information between server and Web applications
- needs a jar file, get it at http://central.maven.org/maven2/org/json/json/20180813/json-20180813.jar

## *JSON Data Types*

- JSON has six data types
- string: `"JSON"`, `"new line\n"`
- number: `12`, `3.14`
- boolean: `true`, `false`
- null: `null`
- array (in square brackets): `[5, 6, 7]`, `[8, "nine", true]`
- object (in curly brackets): `{"id": 23, "name": "John", "hobbies": ["cycling", "reading"]}`

# *XML Example Recall*

- Student information (file: `university.xml`)

```
<university>
  <student>
    <name>Ben Wong</name>
    <phone>99887766</phone>
  </student>
  <student>
    <name>Cat Lee</name>
    <phone>99112233</phone>
  </student>
</university>
```

# *Example*

- To write the same data in JSON (file: `university.json`)

```
{ "university" : {
    "student": [
      { "name": "Ben Wong",
        "phone": "99887766"
      },
      { "name": "Cat Lee",
        "phone": "99112233"
      }
    ]
  }
}
```

- 2 key-value pairs of data form a student object

# *Processing Using Java*

- needs a jar file (e.g., `json.jar`) in your classpath, please replace "json.jar" with your actual file name
- In Crimson, add "-cp json.jar" in "Tools > Conf. User Tools > Argument" part
- Web site (`org.json`): `http://github.com/stleary/JSON-java`
- jar file: http://central.maven.org/maven2/org/json/json/20180813/json-20180813.jar
- An alternative: org.json.simple

# *Useful classes*

- Useful classes `JSONObject` and `JSONArray`

```
import org.json.*;
```

- To create a `JSONArray` and add a `JSONObject` with data:

```
JSONArray studentArray = new JSONArray();
studentArray.put(new JSONObject()
                 .put("name", "Ben Wong")
                 .put("phone", "99887766") );
[{"name": "Ben Wong","phone": "99887766"}]

studentArray.put(new JSONObject()
                 .put("name", "Cat Lee")
                 .put("phone", "99112233") );
[{"name": "Ben Wong","phone": "99887766"},
 {"name": "Cat Lee","phone": "99112233"}
]
```

# Useful classes

- To add the array to a JSONObject :

```
JSONObject student = new JSONObject()
                   .put("student", studentArray);
{student:[{"name": "Ben Wong","phone": "99887766"},
          {"name": "Cat Lee","phone": "99112233"}]
}
```

- To add the object to another JSONObject :

```
 JSONObject university = new JSONObject()
                       .put("university", student);
{university:
  {student:[{"name": "Ben Wong","phone": "99887766"},
            {"name": "Cat Lee","phone": "99112233"}]
  }
}
```

# Exercise

- Create the following JSONObject

```
{"shop":
   {"item":
     [{"name": "Apple",
       "price": 5.5}]
   }
}
```

# Answers

```
JSONArray itemArray = new JSONArray();
itemArray.put(new JSONObject()
              .put("name", "Apple")
              .put("price", 5.5) );
JSONObject item = new JSONObject()
                  .put("item", itemArray);
JSONObject shop = new JSONObject()
                  .put("shop", item);
```

# Create JSON class

```
import org.json.*;

public class CreateJSON {
  public static void main(String[] args) {
    JSONArray studentArray = new JSONArray();
    studentArray.put(new JSONObject()
                     .put("name", "Ben Wong")
                     .put("phone", "99887766") );
    System.out.println(studentArray);
    studentArray.put(new JSONObject()
                     .put("name", "Cat Lee")
                     .put("phone", "99112233") );
    System.out.println(studentArray);
    JSONObject student = new JSONObject().put("student", studentArray);
    System.out.println(student);
    JSONObject json = new JSONObject().put("university", student);
    System.out.println(json);
  }
}
```

## Output

```
[{"phone":"99887766","name":"Ben Wong"}]
[{"phone":"99887766","name":"Ben
Wong"},{"phone":"99112233","name":"Cat Lee"}]
{"student":[{"phone":"99887766","name":"Ben
Wong"},{"phone":"99112233","name":"Cat Lee"}]}
{"university":{"student":[{"phone":"99887766","name":"
Ben Wong"},{"phone":"99112233","name":"Cat Lee"}]}}
```

## Useful Methods

- …

| **returnType methodName(parameters)** | **descriptions** |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |

## Processing JSON

```
import java.io.*;
import java.util.*;
import org.json.*;

public class ProcessJSON {
  private JSONArray jsonArray;

  public JSONArray getJsonArray() { return jsonArray; }
  public void setJsonArray(JSONArray jsonArray) {
    this.jsonArray = jsonArray;
  }

// put other methods here
}
```

## Importing JSON

```
public JSONObject importJSON(String filename) throws Exception {
   try {
     String content = readFile(filename);
     if (content == null) return null;
     return new JSONObject(content);
   } catch (JSONException e) {
     System.out.println("Import JSON problem: "
                       +e.getMessage());
   }
   return null;
 }
```

# Importing JSON

```
public String readFile(String filename) {
    String content = "";
    try {
      BufferedReader in = new BufferedReader(
                          new FileReader(filename));
      String line;
      while ((line = in.readLine()) != null)
        content += line;
      in.close();
    } catch (IOException e) {
      System.out.println("File read problem: "+e.getMessage());
      return null;
    }
    return content;
  }
```

# Printing

```
public void printArray() {
  JSONObject element;
  for (int i=0; i<jsonArray.length(); i++) {
    element = (JSONObject) jsonArray.get(i);
    System.out.println("  name: "+element.get("name"));
    System.out.println("  phone: "+element.get("phone"));
  }
}
```

# Finding

```
public String findPhone(String name) {
    JSONObject element;
    for (int i=0; i<jsonArray.length(); i++) {
      element = (JSONObject) jsonArray.get(i);
      if (element.get("name").equals(name))
        return (String) element.get("phone");
    }
    return null;
  }
```

# Changing

```
public boolean changePhone(String name,
                           String newPhone) {
  JSONObject element;
  for (int i=0; i<jsonArray.length(); i++) {
    element = (JSONObject) jsonArray.get(i);
    if (element.get("name").equals(name)) {
      element.put("phone", newPhone);
      return true;
    }
  }
  return false;
}
```

## Deleting

```
public JSONObject deleteStudent(String name) {
   JSONObject element;
   for (int i=0; i<jsonArray.length(); i++) {
     element = (JSONObject) jsonArray.get(i);
     if (element.get("name").equals(name)) {
       return (JSONObject)jsonArray.remove(i);
     }
   }
   return null;
 }
```

## Adding

```
public JSONArray addStudent(String name,
                           String phone) {
  return jsonArray.put(new JSONObject()
                       .put("name", name)
                       .put("phone", phone)
                       );
}
```

## Exporting

```
public JSONObject exportJSON(String filename) {
   try {
     PrintWriter out = new PrintWriter(new BufferedWriter(
                     new FileWriter(filename)));
     JSONObject jsonObject = new JSONObject()
           .put("university", new JSONObject()
           .put("student", jsonArray));
     out.println(jsonObject);
     out.close();
     return jsonObject;
   } catch (IOException e) {
     System.out.println("Export JSON problem: "
                      +e.getMessage());
   }
   return null;
 }
```

## Full Testing Code

```
public static void main(String[] args) {
   ProcessJSON json = new ProcessJSON();
   String jsonFile = "university.json";
   System.out.println("import json file: "+jsonFile);
   JSONObject jsonObject = null;
   try {
     jsonObject = json.importJSON(jsonFile);
   } catch(Exception e) {
     System.out.println(e.getMessage());
   }
   System.out.println("All: \n  "+jsonObject);
   JSONObject university = (JSONObject)
                         jsonObject.get("university");
   System.out.println("university: \n  "+university);
   JSONArray student = (JSONArray) university.get("student");
   json.setJsonArray(student);
   json.printArray();
```

# *Full Testing Code*

```
    String aName = "Cat Lee";
    System.out.println("find phone number of "+aName);
    System.out.println("  "+aName + "'s Phone no.: "
                       + json.findPhone(aName));
    System.out.println("change phone number of Cat...");
    json.changePhone(aName, "66778899");
    json.printArray();
    System.out.println("delete student Ben: "
                       +json.deleteStudent("Ben Wong"));
    json.printArray();
    System.out.println("add student Dick... ");
    json.addStudent("Dick Chan", "99001122");
    json.printArray();
    String newJsonFile = "out.json";
    System.out.println("exporting to "+newJsonFile);
    System.out.println("  "+json.exportJSON(newJsonFile));
  }
```

# *Output*

```
import json file: university.json
All:

{"university":{"student":[{"phone":"99887766","name":"
Ben Wong"},{"phone":"99112233","name":"Cat Lee"}]}}
university:
  {"student":[{"phone":"99887766","name":"Ben
Wong"},{"phone":"99112233","name":"Cat Lee"}]}
  name: Ben Wong
  phone: 99887766
  name: Cat Lee
  phone: 99112233
```

# *Output*

```
find phone number of Cat Lee
  Cat Lee's Phone no.: 99112233
change phone number of Cat...
  name: Ben Wong
  phone: 99887766
  name: Cat Lee
  phone: 66778899
delete student Ben: {"phone":"99887766","name":"Ben Wong"}
  name: Cat Lee
  phone: 66778899
add student Dick...
  name: Cat Lee
  phone: 66778899
  name: Dick Chan
  phone: 99001122
exporting to out.json
  {"university":{"student":[{"phone":"66778899","name":"Cat
Lee"},{"phone":"99001122","name":"Dick Chan"}]}}
```

# *Exercise*

- Write a method `findName(String phone)` to return the name of the student having phone number `phone`

# Answers

- Write a method `findName(String phone)` to return the name of the student having phone number `phone`

```
public String findName(String phone) {
  JSONObject element;
  for (int i=0; i<jsonArray.length(); i++) {
    element = (JSONObject) jsonArray.get(i);
    if (element.get("phone").equals(phone))
      return (String) element.get("name");
  }
  return null;
}
```

# Maven

- Maven
  - from Apache
  - project management tool in Java
- can automate project build and other tasks
- project details written in XML file pom.xml (Project Object Model)
- by default, creates sensible project structure automatically

# Maven

- Download
  - https://maven.apache.org/download.cgi
  - needs JDK 1.7 or above (use **JDK 1.8** to avoid problems!)
  - install instructions: https://maven.apache.org/install.html
- check installation successful:

```
D:\>mvn -v
D:\
Apache Maven 3.6.0 (97c98ec64a1fdfee7767ce5ffb20918da4f719f3; 2018-10-
   25T02:41:
7+08:00)
Maven home: C:\Program Files\Java\apache-maven-3.6.0\bin\..
Java version: 1.8.0_65, vendor: Oracle Corporation, runtime: C:\Program
   Files\J
va\jdk1.8.0_65\jre
Default locale: en_US, platform encoding: MS950_HKSCS
OS name: "windows 7", version: "6.1", arch: "amd64", family: "windows"
```

# Maven Repositories

- directory storing Maven jars and other things
- search order
  - local (created when first run, C:\Users\<userName>\.m2)
  - central (if found, downloaded to local)
  - remote (optional, same organization as local)

## *OpenIMAJ Installation*

- Set of Java libraries for image analysis
- tutorial: http://openimaj.org/tutorial-pdf.pdf
- Create OpenIMAJ project in folder `openimaj-01`:

```
D:\> mvn -DarchetypeGroupId=org.openimaj -
DarchetypeArtifactId=openimaj-quickstart-archetype -
DarchetypeVersion=1.3.8 archetype:generate

Downloading...
...
Define value for property 'groupId': s358f
Define value for property 'artifactId': openimaj-01
[INFO] Using property: version = 1.0-SNAPSHOT
Define value for property 'package' s358f: : <enter key>
[INFO] Using property: openimajVersion = 1.3.8
```

## *OpenIMAJ*

```
Confirm properties configuration:
groupId: s358f
artifactId: openimaj-01
version: 1.0-SNAPSHOT
package: s358f
openimajVersion: 1.3.8
 Y: : y
```

## *OpenIMAJ*

```
[INFO] Parameter: groupId, Value: s358f
[INFO] Parameter: artifactId, Value: openimaj-01
[INFO] Parameter: version, Value: 1.0-SNAPSHOT
[INFO] Parameter: package, Value: s358f
[INFO] Parameter: packageInPathFormat, Value: s358f
[INFO] Parameter: package, Value: s358f
[INFO] Parameter: version, Value: 1.0-SNAPSHOT
[INFO] Parameter: groupId, Value: s358f
[INFO] Parameter: openimajVersion, Value: 1.3.8
[INFO] Parameter: artifactId, Value: openimaj-01
[INFO] Project created from Archetype in dir: D:\openimaj-01
[INFO] ------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------
```

## *(Further installation and) Compile*

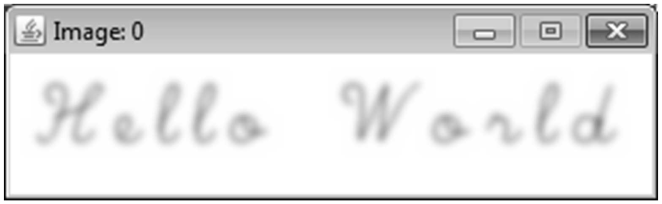
- A folder openimaj-01 bas been created
- Type the commands to **compile** and wait for it to finish (may take 10-50 minutes):

```
D:\> cd openimaj-01
D:\openimaj-01> mvn assembly:assembly

Downloading...
...
[INFO] ----------------------------------------
[INFO] BUILD SUCCESS
[INFO] ----------------------------------------
[INFO] Total time:  37:27 min
[INFO] Finished at: 2019-03-25T17:22:58+08:00
[INFO] ----------------------------------------
```

# OpenIMAJ

- Type the command to **execute** and the window below will be displayed:

```
D:\openimaj-01> java -jar target\openimaj-01-1.0-SNAPSHOT-jar-with-dependencies.jar
```



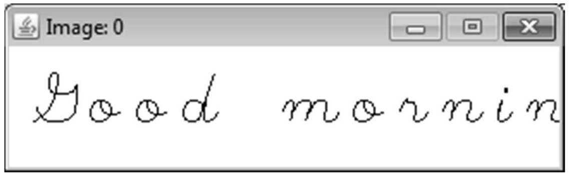
# Source Code

```
// file: D:\openimaj-01\src\main\java\s358f\App.java
// package and import statements not shown
public class App {
    public static void main( String[] args ) {
       //Create an image [with size 320 x 70]
        MBFImage image = new MBFImage(320,70, ColourSpace.RGB);

        //Fill the image with white
        image.fill(RGBColour.WHITE);

        //Render some test into the image
        image.drawText("Hello World", 10, 60,
            HersheyFont.CURSIVE, 50, RGBColour.BLACK);

        //Apply a Gaussian blur
        image.processInplace(new FGaussianConvolve(2f));

        //Display the image
        DisplayUtilities.display(image);
    }
}
```

# Exercise

- Edit the source code with Crimson and change the text to "Good morning" and without any blur.
- Type the command and it takes around 2 minutes

```
D:\openimaj-01> mvn assembly:assembly
D:\openimaj-01> java -jar target\openimaj-01-1.0-SNAPSHOT-jar-with-dependencies.jar
```



- Try to fix any issue of missing character.

# Exercise

- To be added