Tutorial -2

Question:

1. Define the *hashcode*?

   Source: https://docs.oracle.com/javase/7/docs/api/java/lang/Object.html#hashCode()

   Test code:

```
public class App {

	public static void main(String[] args) {

		String str1 = "alice";
		String str2 = "bob";

		/* hashcode for String object */
		System.out.println( String.join(":", str1,
			String.valueOf(str1.hashCode())) );
		System.out.println( String.join(":", str2,
			String.valueOf(str2.hashCode())) );

	}

}
```

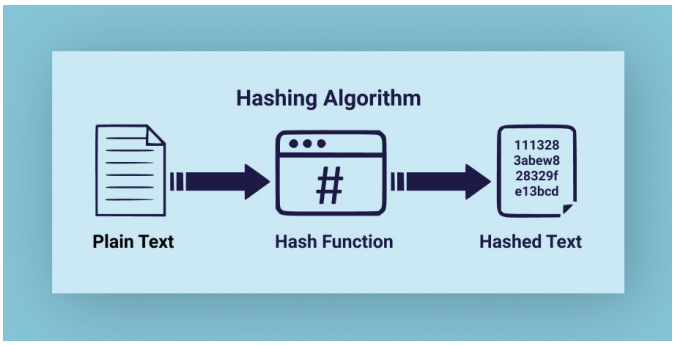
2. Demonstrate the hashcode of a given data structure such as LinkedList.

   Test code:

```
public class App {

	public static void main(String[] args) {

		String str1 = "alice";
		String str2 = "bob";

		/* string collection */
		List<String> lst = new ArrayList<>();
		lst.add(str1); lst.add(str2);
		System.out.println( "List = "+lst );
		System.out.println( "hashcode = "+ lst.hashCode() );

	}

}
```

   Discuss the result when you're to add/remove the elements in the data structure.

3. What is the hashing function? Explain the following diagram.



4. Explain the characteristic of the hashing.
   Source: https://en.wikipedia.org/wiki/Secure_Hash_Algorithms

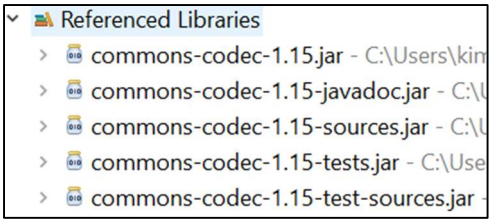
5. Test out the code.

```
/* -hash(String, String) : String */
private static String hash(String input, String algorithm)
{
	String hashCode = "";
	try {
		MessageDigest md = MessageDigest.getInstance(algorithm);
		md.update( input.getBytes() );
		//digesting...
		byte[] hashBytes = md.digest();
		//convert the byte[] to String
		//1)
		hashCode = Base64.getEncoder().encodeToString(hashBytes);
		//2) hex format output - recommended!
		//hashCode = Hex.encodeHexString(hashBytes);
	} catch (Exception e) {
		e.printStackTrace();
	}
	return hashCode;
}
```

Note:

- Student may convert the hashBytes to the hex format. Consider this external library.
  External libary: https://commons.apache.org/proper/commons-codec/download_codec.cgi

- Add this API into the project. In Eclipse, right-click project -> Build path -> Configure build path -> Libraries tab -> Classpath -> Add external JARs -> *select the jar files*
- Then, the JARs will be referenced as follows.



- Insert the following code for MD5 hashing method.

```
/* +md5(String) : String */
public static String md5(String input)
{
	return hash( input, "MD5" );
}
```

- Continue to try out the following…

```
/* sha256 */
public static String sha256(String input)
{
	return hash( input, "SHA-256" );
}

/* sha384 */
/* sha512 */
```

- Discuss the final results.