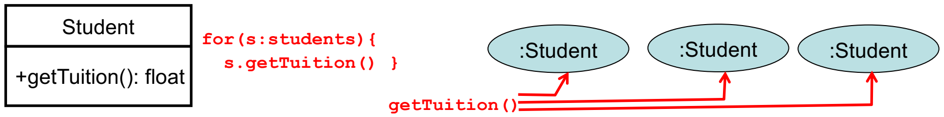
***Visitor* Design Pattern**

***Visitor* Design Pattern**

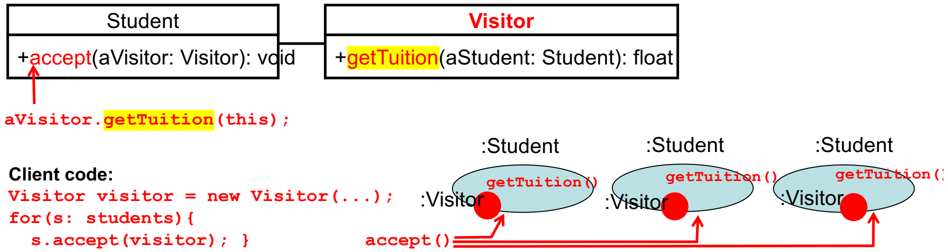
- Intent
  - Separate (or decouple) a set of objects and the operations to be performed on those objects.

- In a traditional (or normal) design, if an operation is performed on some objects, it is defined as a method of a class for those objects.



```
for(s:students){
  s.getTuition() }
```

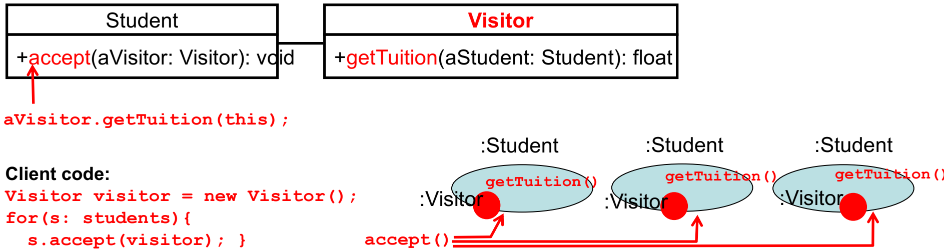
- With *Visitor*, the operation is defined as a method of a Visitor class.



```
aVisitor.getTuition(this);
```

Client code:

```
Visitor visitor = new Visitor(...);
for(s: students){
  s.accept(visitor); }
```

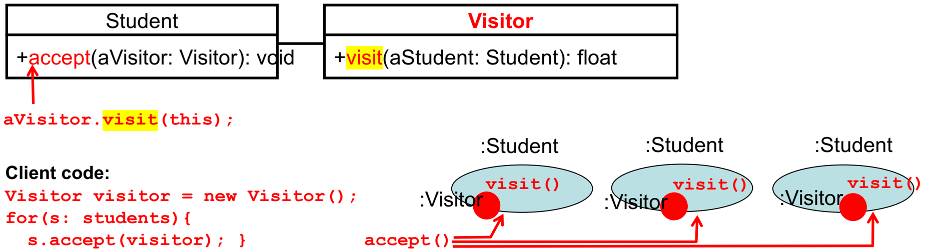


```
aVisitor.getTuition(this);
```

Client code:

```
Visitor visitor = new Visitor();
for(s: students){
  s.accept(visitor); }
```

- A method(s) in a Visitor class are often named `visit()`.



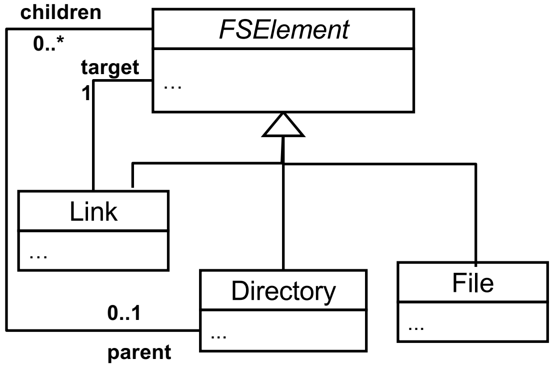
```
aVisitor.visit(this);
```

Client code:

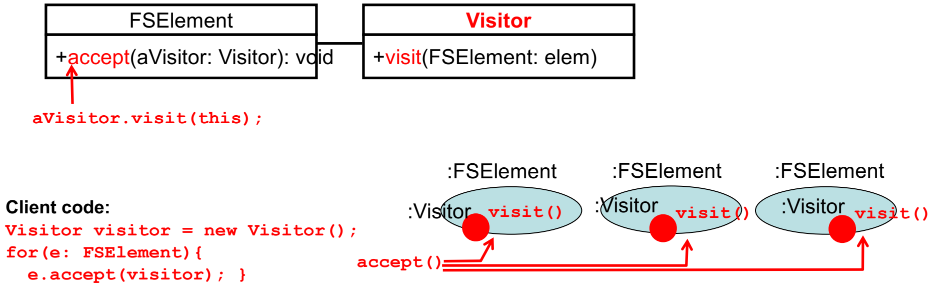
```
Visitor visitor = new Visitor();
for(s: students){
  s.accept(visitor); }
```

File System Examples (1)

- Count the number of directories, the number of files and the number links in a file system



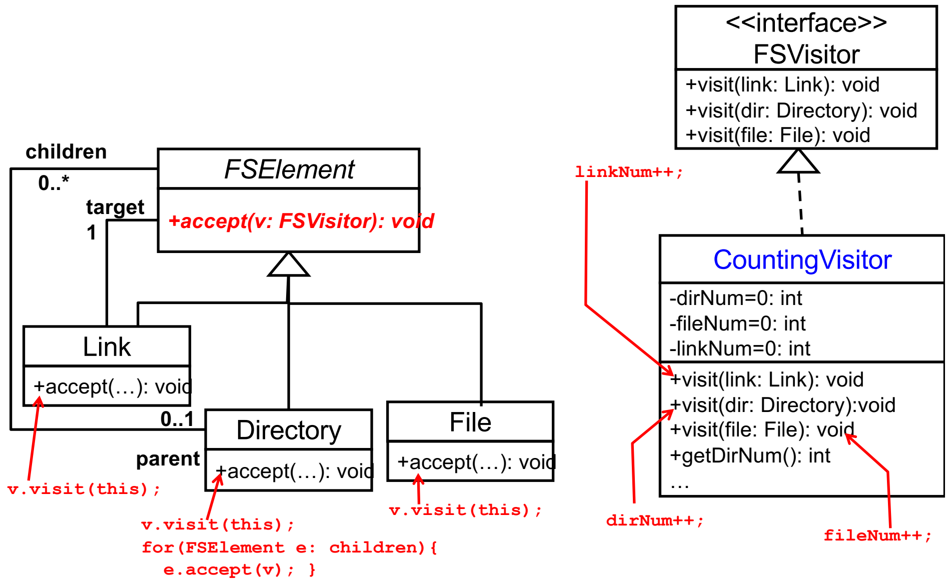
- With *Visitor*, an operation to count FS elements can be implemented as a method of the Visitor class.



```
aVisitor.visit(this);
```

Client code:

```
Visitor visitor = new Visitor();
for(e: FSElement){
  e.accept(visitor); }
```



```
linkNum++;
```

```
v.visit(this);
```

```
v.visit(this);
for(FSElement e: children){
  e.accept(v); }
```

```
v.visit(this);
```

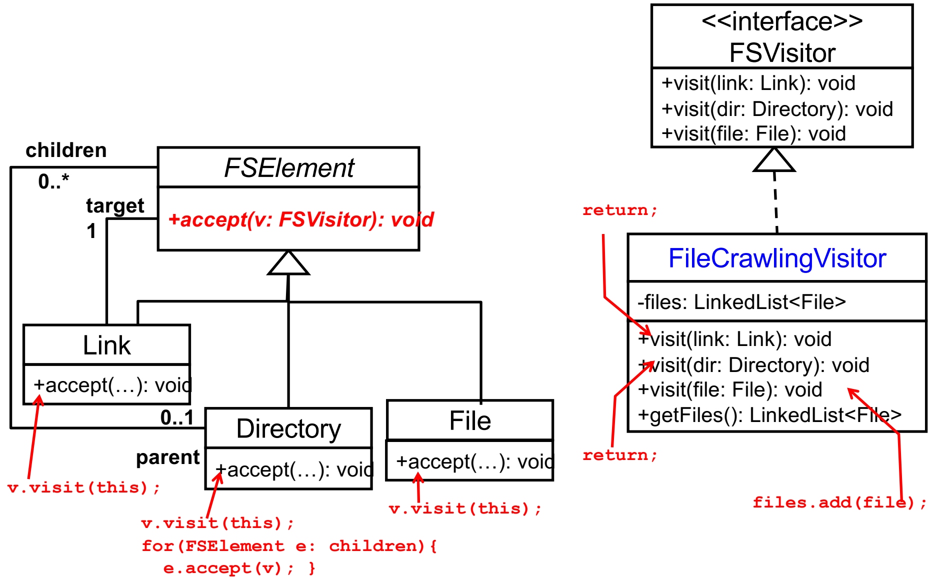
```
dirNum++;
```

```
fileNum++;
```

```
CountingVisitor visitor = new CountingVisitor();
rootDir.accept( visitor );
visitor.getDirNum(); visitor.getFileNum(); visitor.getLinkNum();
```

File System Examples (2)

- Index files in a file system
  - c.f. OS indexing service
    - e.g., Windows indexing service and Mac/iOS Spotlight
  - Key functionalities
    - Crawl a file system to identify files
    - Extract and keep each file’s metadata for later searches.
      - e.g., Path, name, size, creation time, owner’s name, last-modified timestamp, checksum
- With *Visitor*, the file-crawling operation can be implemented as a method of the Visitor class.



```
return;
```

```
return;
```

```
v.visit(this);
```

```
v.visit(this);
for(FSElement e: children){
  e.accept(v); }
```

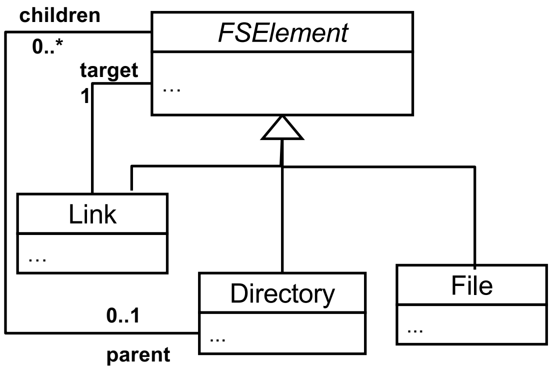
```
v.visit(this);
```

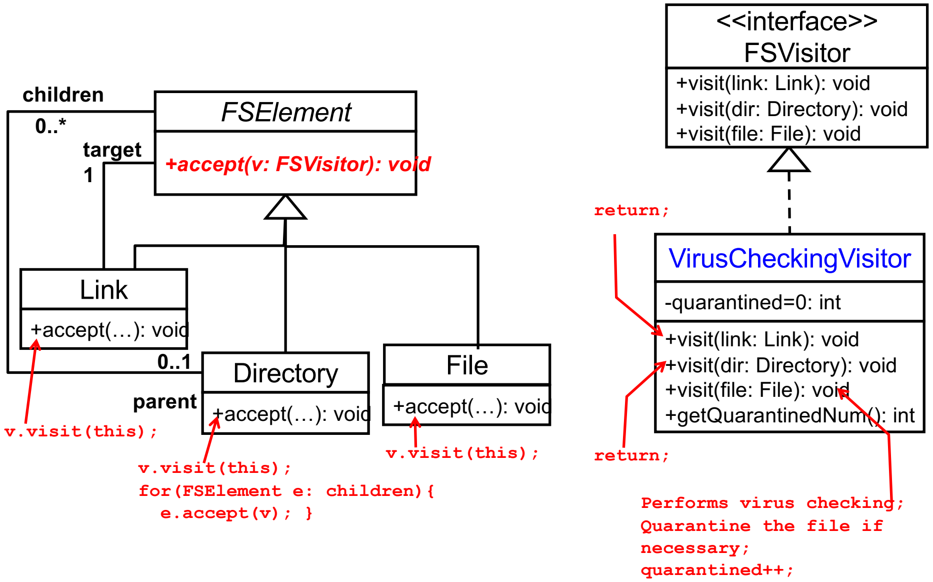
```
files.add(file);
```

```
FileCrawlingVisitor visitor = new FileCrawlingVisitor();
rootDir.accept( visitor );
visitor.getFiles();
```

File System Examples (3)

- Perform virus check for each file in a file system
  - With *Visitor*, the virus-checking operation can be defined in a visitor.





```
return;
```

```
return;
```

```
v.visit(this);
```

```
v.visit(this);
for(FSElement e: children){
  e.accept(v); }
```

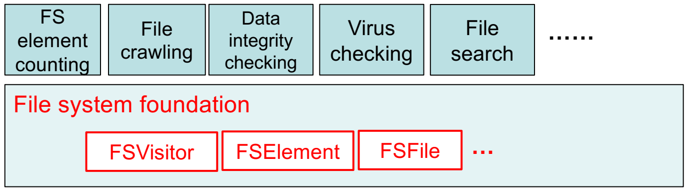
```
v.visit(this);
```

```
Performs virus checking;
Quarantine the file if
necessary;
quarantined++;
```

```
VirusCheckingVisitor visitor = new VirusCheckingVisitor();
rootDir.accept( visitor );
visitor.getQuarantinedNum();
```

What's the Point?

- *Visitor* can separate FS data structures and the operations to be performed on those data structures.
  - Allows those operations to be pluggable.
  - Makes it easy to add, modify and remove those operations without changing FS data structures.

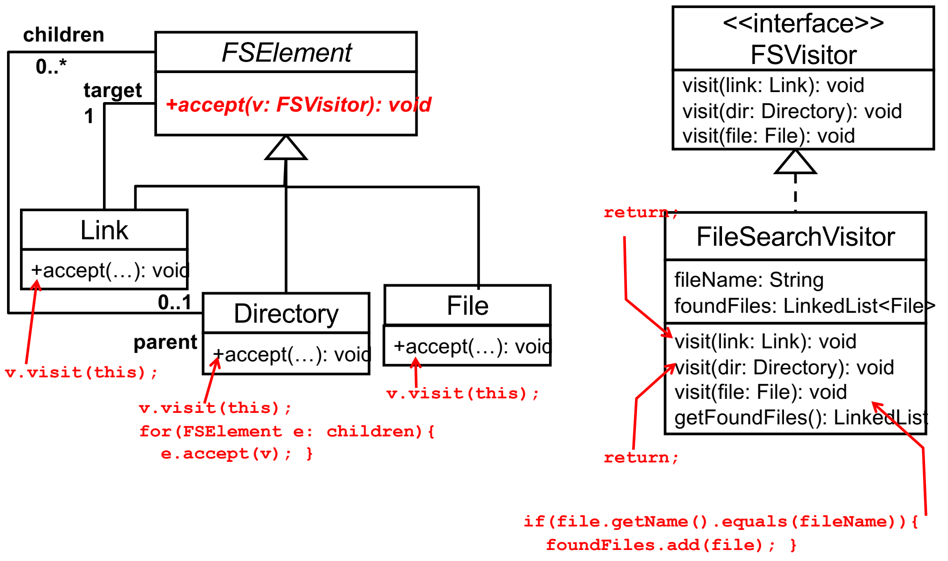


HW 9

- Define **`FSVisitor`**, **`FSElement`**, **`Directory`**, **`File`**, **`Link`** and **`FileSystem`** in the **`edu.umb.cs680.hw09.fs`** package.

- Implement **`FSVisitor`** with 3 visitor classes in an extra package: **`edu.umb.cs680.hw09.fs.util`**
  - **`CountingVisitor`**
  - **`FileCrawlingVisitor`**
  - **`FileSearchVisitor`**
    - Find a file with its name

- Use the 3 visitors with an example FS structure that you have used in HW 7 and 8.



```
v.visit(this);
```

```
v.visit(this);
for(FSElement e: children){
  e.accept(v); }
```

```
v.visit(this);
```

```
return;
```

```
return;
```

```
if(file.getName().equals(fileName)){
  foundFiles.add(file); }
```

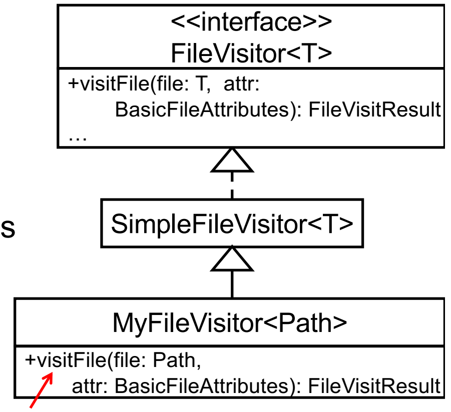
```
FileSearchVisitor visitor = new FileSearchVisitor("example.txt");
rootDir.accept( visitor );
visitor.getFoundFiles().size();
```

Applicability of *Visitor*

- *Visitor* can be applied to any collection of objects, not limited to *Composite*-based tree structures.
  - Set, list, graph, etc.

Visitor in Java API

- **`FileVisitor<T>`** and **`SimpleFileVisitor<T>`** in Java NIO (New I/O) (**`java.nio`**)
  - A visitor for files.
    - In **`java.nio.file`**
  - **`visitFile(file, attr)`**
    - Invoked when a visitor visits a **`file`**.
    - **`attr`**: a set of attributes (metadata) of the **`file`**
    - **`Path`**: Represents a path. See Appendix.


<<interface>>
FileVisitor<T>
+visitFile(file: T, attr: BasicFileAttributes): FileVisitResult
…
SimpleFileVisitor<T>
MyFileVisitor<Path>
+visitFile(file: Path, attr: BasicFileAttributes): FileVisitResult

```
System.out.println(file);
System.out.println(attr.size());
System.out.println(attr.creationTime());
...
```

- **`java.nio.file.Files`**
  - A utility class (i.e., a set of static methods) to process a file/directory.
  - c.f. Appendix

- **`Files.walkFileTree()`**
  - Visits each file in a file tree and calls **`visitFile()`** on a visitor.

  -
    ```
    static Path walkFileTree(Path start,
                             FileVisitor<Path> visitor)
    ```

-
  ```
  Path aDir = ...;
  Files.walkFileTree( aDir, new MyFileVisitor<Path>() );
  ```