Generating Data Phase:

```
x = zeros(100, 1); % # of iterations
y = zeros(100, 1); % # of iterations
s = zeros(2, 100);
x(1) = 1;
y(1) = 1;
s(:,1) = [x(1) ; y(1)];

f = 2;
g = 0;
h = 2;

u = zeros(100, 1); % # of iterations
for i = 1:100 % # of iterations
    if i == 1
        u(i) = 1;
    else
        u(i) = 0;
    end
end
```

I am assuming x_i-1, y_i-1, s_i-1 equal to 1, 1, [1; 1], respectively.

I called them x(1), y(1), s(1) due to matlab notations.

Also, I am assuming f, g, h as 2, 0, 2, repectively.

For u, I used the impulse reponse, such as u_1 (which repesents u at time 0) equals 1, and all other values of u equals 0.

```
for i = 2:100 % # of iterations
    x(i) = f*x(i-1) + g*u(i);
    y(i) = h*x(i);
    s(:, i) = [x(i) ; y(i)];
end
```

Below, I showed 10 values from x and y, respectively.

```
disp(x(1:10, 1));
```

```
     1
     2
     4
     8
    16
    32
    64
   128
   256
   512
```

```
disp(y(1:10, 1));
```

```
     1
     4
```

```
     8
    16
    32
    64
   128
   256
   512
  1024
```

Also, below are 5 columns of s, which is made up of [x ; y] combined.

```
disp(s(:, 1:5))
```

```
     1     2     4     8    16
     1     4     8    16    32
```

Estimating the system parameters:

Note: I used the explicit scheme.

```
n = 0.1; % learning rate
f = zeros(100, 1); % # of iterations
g = zeros(100, 1); % # of iterations
h = zeros(100, 1); % # of iterations
f(1) = 0;
g(1) = 0;
h(1) = 0;
```

I set the leaning rate to be 0.1

Moreover, I assumed the initial condition for f, g, h to be zeros.

```
I = [0 1];
e = zeros(100, 1); % # of iterations
d = zeros(100, 1); % # of iterations

for i = 1:100 % # of iterations
    d(i) = y(i) .* 1.17;
end
```

In the previous code, I tried to generate d (desired output) randomly based on the results we got for y.

```
for i = 2:100 % # of iterations
    e(i) = d(i) - y(i);
    f(i) = f(i-1) + n*e(i)*I*s(:, i-1);
    g(i) = g(i-1) + n*e(i)*h(i-1)*u(i);
    h(i) = h(i-1) + n*e(i)*y(i-1) + n*e(i)*g(i-1)*u(i);
end

Results = [f g h];
table(Results)
```

```
ans = 100×1 table
```

	Results		
1	0	0	0

	Results		
2	0.068	0	0.068
3	0.612	0	0.612
4	2.788	0	2.788
5	11.492	0	11.492
6	46.308	0	46.308
7	185.572	0	185.572
8	742.628	0	742.628
9	2970.852	0	2970.852
10	11883.748	0	11883.748
11	47535.332	0	47535.332
12	190141.668	0	190141.668
13	760567.012	0	760567.012
14	3042268.388	0	3042268.388
15	12169073....	0	12169073....
16	48676295....	0	48676295....
17	194705183...	0	194705183...
18	778820736...	0	778820736...
19	311528294...	0	311528294...
20	124611317...	0	124611317...
21	498445271...	0	498445271...
22	199378108...	0	199378108...
23	797512434...	0	797512434...
24	319004973...	0	319004973...
25	127601989...	0	127601989...
26	510407957...	0	510407957...
27	204163183...	0	204163183...
28	816652732...	0	816652732...
29	3.2666109297...	0	3.2666109297...
30	1.3066443718...	0	1.3066443718...
31	5.2265774875...	0	5.2265774875...
32	2.0906309950...	0	2.0906309950...
33	8.3625239800...	0	8.3625239800...
34	3.3450095920...	0	3.3450095920...

	Results		
35	1.3380038368...	0	1.3380038368...
36	5.3520153472...	0	5.3520153472...
37	2.1408061389...	0	2.1408061389...
38	8.5632245556...	0	8.5632245556...
39	3.4252898222...	0	3.4252898222...
40	1.3701159288...	0	1.3701159288...
41	5.4804637155...	0	5.4804637155...
42	2.1921854862...	0	2.1921854862...
43	8.7687419449...	0	8.7687419449...
44	3.5074967779...	0	3.5074967779...
45	1.4029987111...	0	1.4029987111...
46	5.6119948447...	0	5.6119948447...
47	2.2447979379...	0	2.2447979379...
48	8.9791917516...	0	8.9791917516...
49	3.5916767006...	0	3.5916767006...
50	1.4366706802...	0	1.4366706802...
51	5.7466827210...	0	5.7466827210...
52	2.2986730884...	0	2.2986730884...
53	9.1946923536...	0	9.1946923536...
54	3.6778769414...	0	3.6778769414...
55	1.4711507765...	0	1.4711507765...
56	5.8846031063...	0	5.8846031063...
57	2.3538412425...	0	2.3538412425...
58	9.4153649701...	0	9.4153649701...
59	3.7661459880...	0	3.7661459880...
60	1.5064583952...	0	1.5064583952...
61	6.0258335808...	0	6.0258335808...
62	2.4103334323...	0	2.4103334323...
63	9.6413337294...	0	9.6413337294...
64	3.8565334917...	0	3.8565334917...
65	1.5426133967...	0	1.5426133967...
66	6.1704535868...	0	6.1704535868...
67	2.4681814347...	0	2.4681814347...

	Results		
68	9.8727257389...	0	9.8727257389...
69	3.9490902955...	0	3.9490902955...
70	1.5796361182...	0	1.5796361182...
71	6.3185444729...	0	6.3185444729...
72	2.5274177891...	0	2.5274177891...
73	1.0109671156...	0	1.0109671156...
74	4.0438684626...	0	4.0438684626...
75	1.6175473850...	0	1.6175473850...
76	6.4701895402...	0	6.4701895402...
77	2.5880758161...	0	2.5880758161...
78	1.0352303264...	0	1.0352303264...
79	4.1409213057...	0	4.1409213057...
80	1.6563685223...	0	1.6563685223...
81	6.6254740892...	0	6.6254740892...
82	2.6501896356...	0	2.6501896356...
83	1.0600758542...	0	1.0600758542...
84	4.2403034171...	0	4.2403034171...
85	1.6961213668...	0	1.6961213668...
86	6.7844854673...	0	6.7844854673...
87	2.7137941869...	0	2.7137941869...
88	1.0855176747...	0	1.0855176747...
89	4.3420706991...	0	4.3420706991...
90	1.7368282796...	0	1.7368282796...
91	6.9473131185...	0	6.9473131185...
92	2.7789252474...	0	2.7789252474...
93	1.1115700989...	0	1.1115700989...
94	4.4462803958...	0	4.4462803958...
95	1.7785121583...	0	1.7785121583...
96	7.1140486334...	0	7.1140486334...
97	2.8456194533...	0	2.8456194533...
98	1.1382477813...	0	1.1382477813...
99	4.5529911254...	0	4.5529911254...
100	1.8211964501...	0	1.8211964501...