DCCL LAB1

matlab

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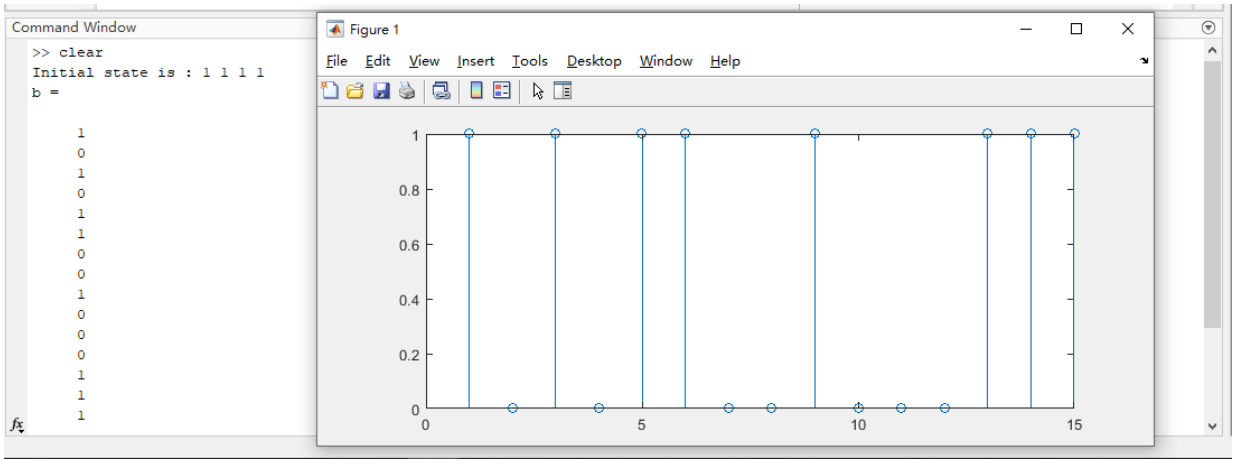
1. Write down the initial state. Print out the m-sequence.(Use command “stem”)
   The initial state is: [1 1 1 1]

   The PN sequence is:
   `b = [1 0 1 0 1 1 0 0 1 0 0 0 1 1 1];`

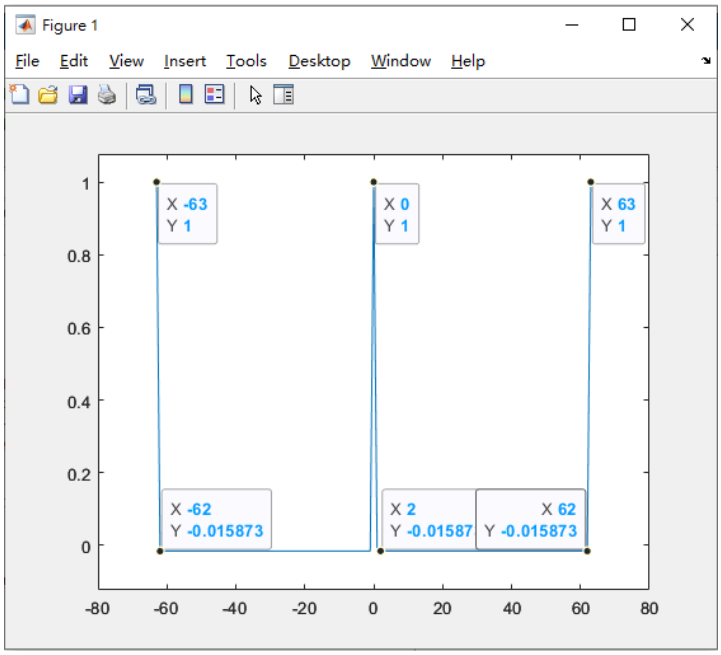


2. Draw the autocorrelation result.
   Use 103_{oct} and initial state [1 1 0 0 1 1] to generate sequence b.

`The autocorrelation result is:`

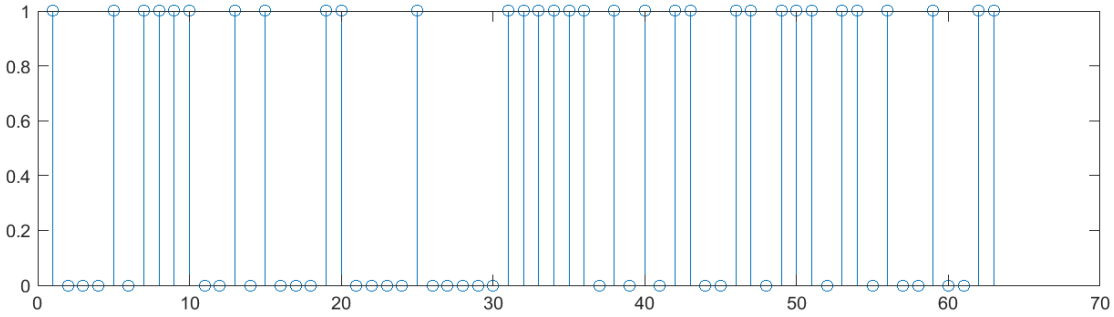
$$\Theta_N(k) = \frac{1}{N}\sum_{i=0}^{N-1} a_i a_{(i+k)}$$

$$\Theta_N(k) = \begin{cases} 1 & k = lN \\ -1/N & k \neq lN \end{cases}$$

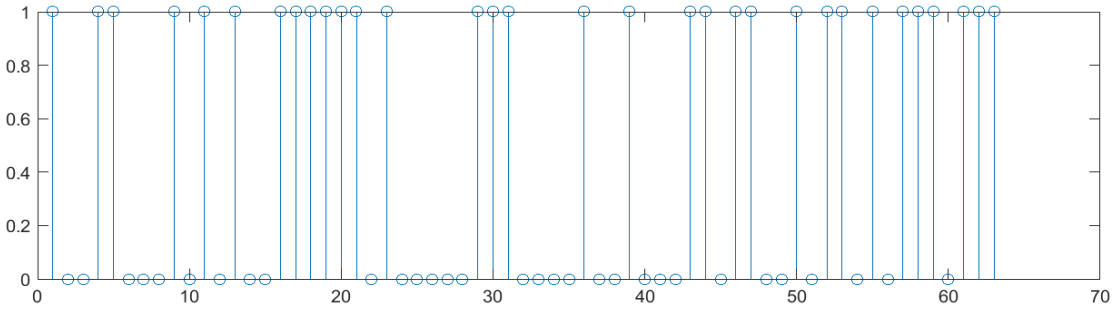


3. Write down the initial state that you use to generate sequence
   Use 103_{oct} and initial state [1 1 0 0 1 1] to generate sequence b.
   Use q=13 to generate sequence b'.

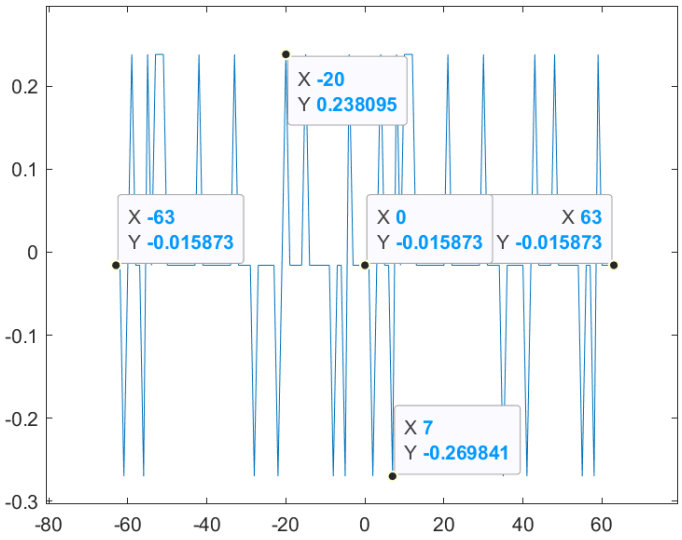
```
b = [1 0 0 0 1 0 1 1 1 1 0 0 1 0 1 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 1 1 1 ...
     1 1 1 0 1 0 1 0 1 1 0 0 1 1 0 1 1 1 0 1 1 0 1 0 0 1 0 0 1 1];
```



```
b_prime = [1 0 0 1 1 0 0 0 1 0 1 0 1 0 0 1 1 1 1 1 1 0 1 0 0 0 0 0 1 1  ...
           0 0 0 0 1 0 0 1 0 0 0 1 1 0 1 1 0 0 1 0 1 1 0 1 0 1 1 1 0 1 1 1];
```



b and b_prime's full-period cross-correlation:

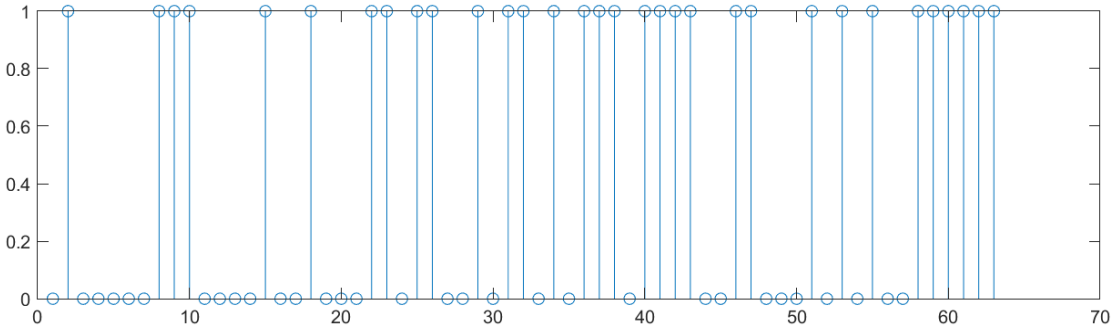


$$t(r) = \begin{cases} 1 + 2^{0.5(r+1)}, & for\ odd\ r \\ 1 + 2^{0.5(r+2)}, & for\ even\ r \end{cases}$$,three possible values: $\begin{cases} -\frac{1}{N} * t(r) = -0.2698 \\ -\frac{1}{N} = -0.01587 \\ \frac{1}{N} * (t(r) - 2) = 0.2381 \end{cases}$

4. Write down the initial state that use to generate sequence b”.

Use 133_{oct} and initial state [1 1 0 1 1 0] to generate sequence b”.

```
b'' = [0 1 0 0 0 0 0 1 1 1 0 0 0 0 1 0 0 1 0 0 0 1 1 0 1 1 0 0 1 0 1 1 ...
       0 1 0 1 1 1 0 1 1 1 1 0 0 1 1 0 0 0 1 0 1 0 1 0 0 1 1 1 1 1 1];
```



The way to check if b’ and b” are the same sequence:

```
%% To check if b' and b'' are same sequence
ans = zeros(63,1);
for i = 1:63

    b_test = circshift(b_pp,i);
    equ = isequal(b_p,b_test);
    if(equ)
        fprintf("b_prime and b_prime_prime is same sequence\n")
        fprintf("offset is %d\n", i)
        ans(i,1) = 1;
    else ans(i,1) = 0;
    end
end
```

1. 假設 b’與 b”為同一 sequence，但是具有不同的 offset。
2. 使用 circshift 函式移動(右移)其中一個陣列，一共移動 N=63 次。
3. 使用 isequal 函式逐一比對移動過的陣列是否相等，一共比對 63 次。
   如果相等則在 ans 陣列中標註為 1 並輸出其 offset 位置

結果:

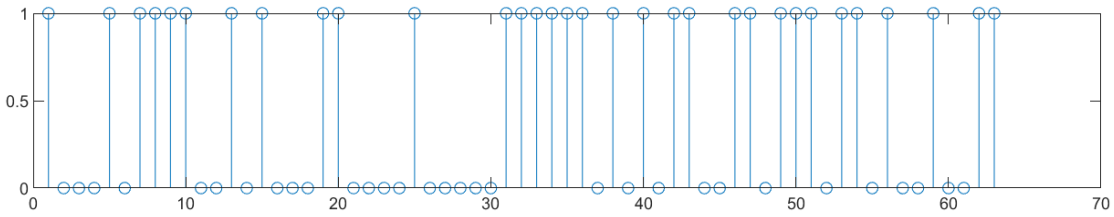
b’ 與 b” 為相同的 sequence，其 offset 為右移 21 個位元。

```
b_prime and b_prime_prime is same sequence
offset is 21
```

5. Print out 5 sequence among 65 Gold code sequences according to procedure 5.

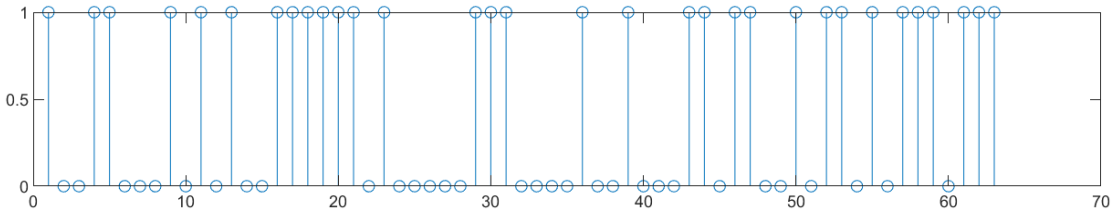
First sequence in Gold code(i.e. b):

```
[1 0 0 0 1 0 1 1 1 1 0 0 1 0 1 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 1 1 1 1 ...
 1 1 0 1 0 1 0 1 1 0 0 1 1 0 1 1 1 0 1 1 0 1 0 0 1 0 0 1 1];
```



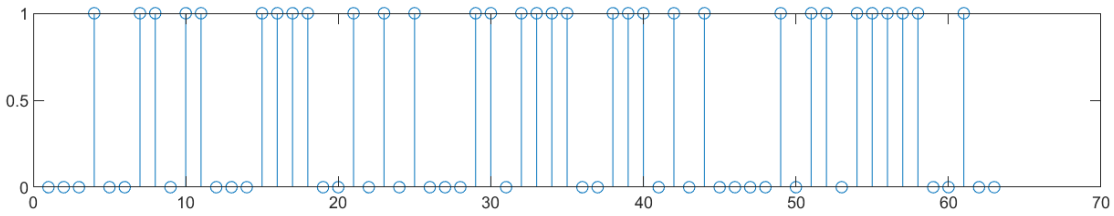
Second sequence in Gold code(i.e. b'):

```
[ 1 0 0 1 1 0 0 0 1 0 1 0 1 0 0 1 1 1 1 1 1 1 0 1 0 0 0 0 0 1 1 1 0 0 0 ...
 0 1 0 0 1 0 0 0 1 1 0 1 1 0 0 1 0 1 1 0 1 0 1 1 1 0 1 1 1];
```



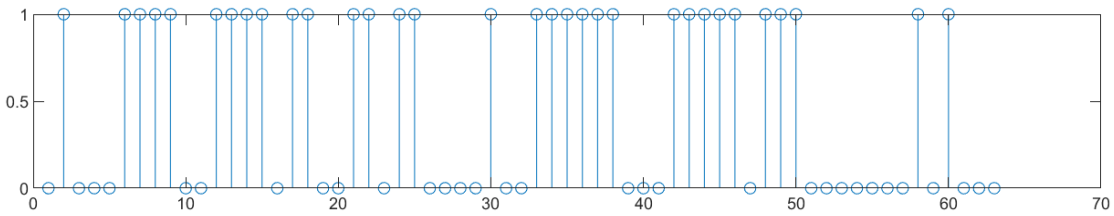
Third sequence in Gold code(i.e. b+b'):

```
[0 0 0 1 0 0 1 1 0 1 1 0 0 0 1 1 1 1 0 0 1 0 1 0 1 0 0 0 1 1 0 1 1 1 ...
 1 0 0 1 1 1 0 1 0 1 0 0 0 0 1 0 1 1 0 1 1 1 1 1 0 0 1 0 0];
```



Fourth sequence in Gold code(i.e. b+Db'):

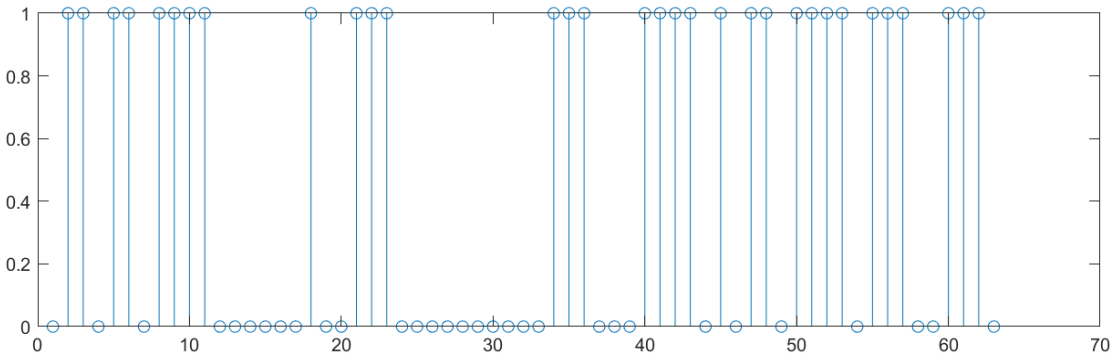
```
[0 1 0 0 0 1 1 1 1 0 0 1 1 1 1 0 1 1 0 0 1 1 0 1 1 0 0 0 0 1 0 0 1 1 ...
 1 1 1 1 0 0 0 1 1 1 1 1 0 1 1 1 0 0 0 0 0 0 0 1 0 1 0 0 0];
```



(Fifth sequence in Gold code is print on next page)

Fifth sequence in Gold code(i.e. b+D²b'):

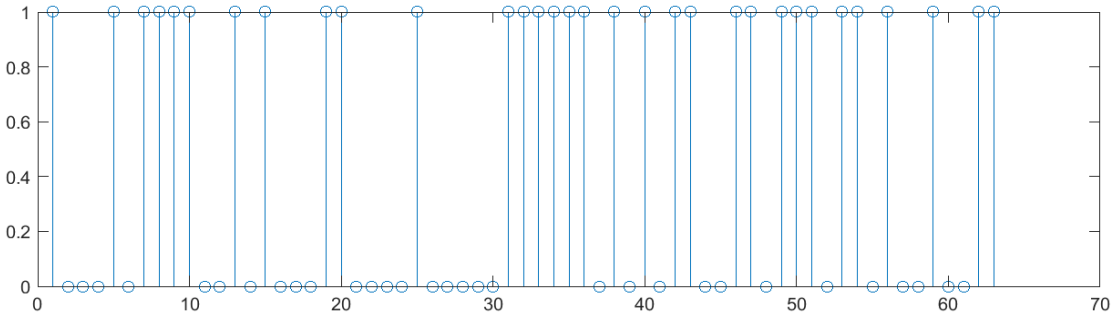
```
[0 1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0 1 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 1 ...
1 1 0 0 0 1 1 1 1 0 1 0 1 1 0 1 1 1 1 0 1 1 1 0 0 1 1 1 0];
```



6. Write down the base sequence.

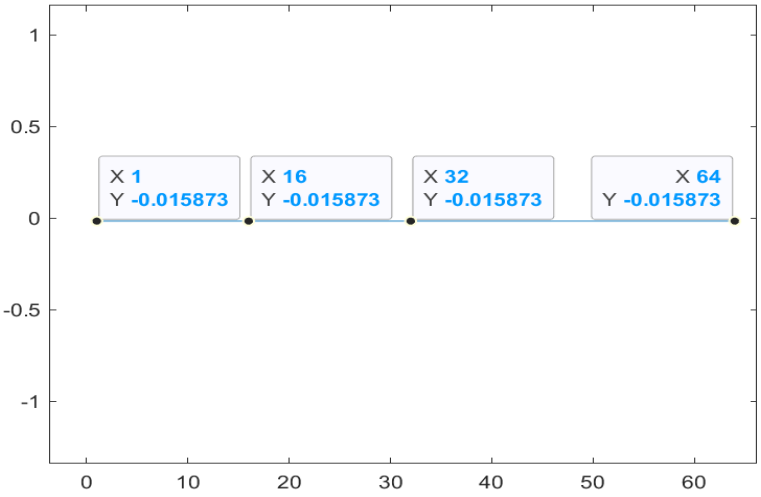
The base sequence is same as result 3.

```
b = [1 0 0 0 1 0 1 1 1 1 0 0 1 0 1 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 1 1 1 ...
     1 1 1 0 1 0 1 0 1 1 0 0 1 1 0 1 1 1 0 1 1 0 1 0 0 1 0 0 1 1];
```



Draw the result of full-period cross-correlation in a figure.

$$\Phi_{s_1 s_j}(0) = \frac{1}{N}\sum_{i=0}^{N-1} s_{1,i} s_{j,i}$$

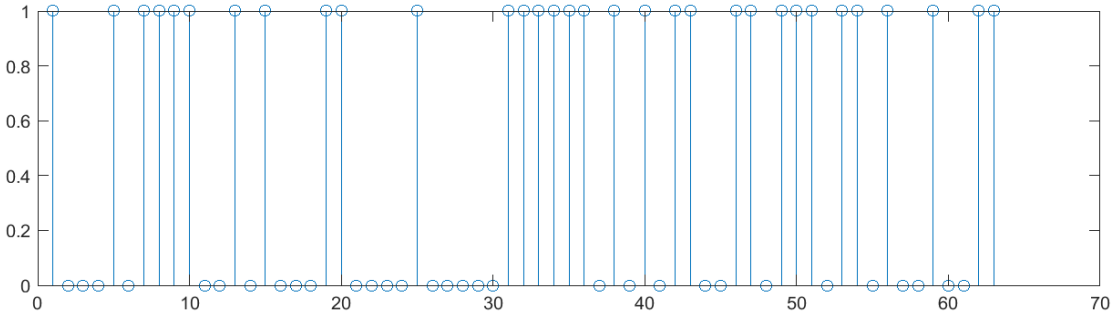


All the result in full-period cross-correlation is -0.0159. i.e. (-1/N),N= 63

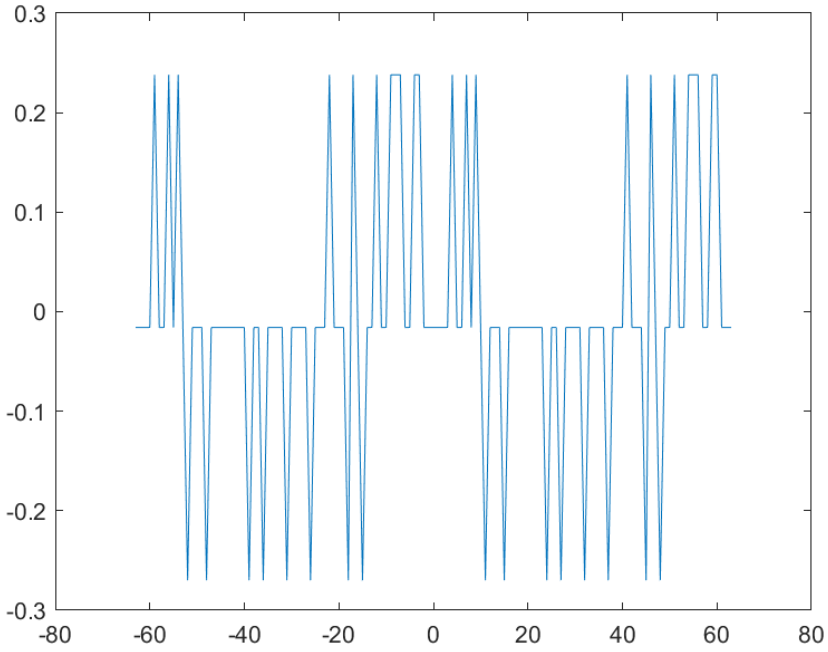
7. Write down the base sequence.

```
The base sequence is same as result 6.
```

```
b = [1 0 0 0 1 0 1 1 1 1 0 0 1 0 1 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 1 1 1 ...
     1 1 1 0 1 0 1 0 1 1 0 0 1 1 0 1 1 1 0 1 1 0 1 0 0 1 0 0 1 1];
```



Draw the result of full-period cross-correlation in a figure.



$$\Phi_{s_l s_{l+50}}(k) = \frac{1}{N}\sum_{i=0}^{N-1} s_{l,i} s_{l+50,i+k}$$

$$\mathrm{t(r)} = \begin{cases} 1 + 2^{0.5(r+1)}, & for\ odd\ r \\ 1 + 2^{0.5(r+2)}, & for\ even\ r \end{cases}$$, three possible values: $\begin{cases} -\frac{1}{\mathrm{N}} * \mathrm{t(r)} = -0.2698 \\ -\frac{1}{\mathrm{N}} = -0.01587 \\ \frac{1}{N} * (t(r) - 2) = 0.2381 \end{cases}$