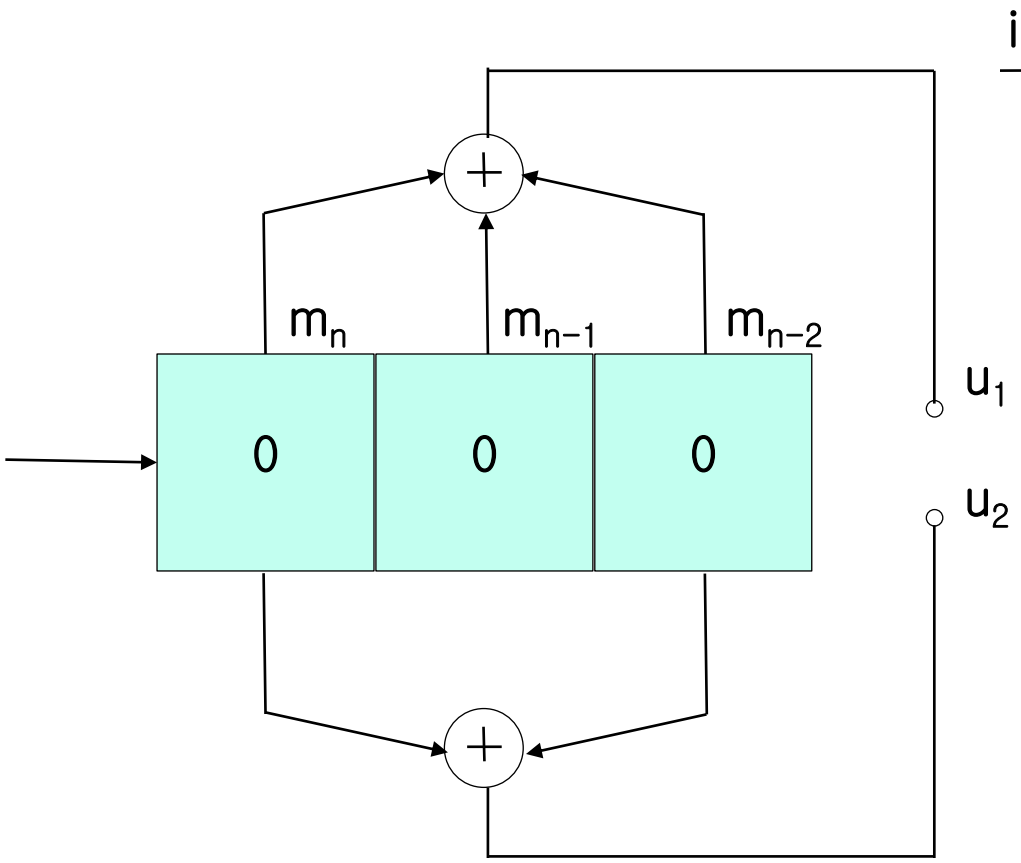
Convolutional Code

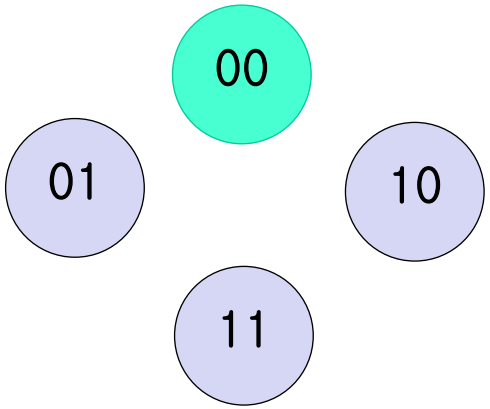
- State diagram (pp. 2-21),
- Trellis diagram (pp.22-69),
- Viterbi decoding (pp.70 ~)

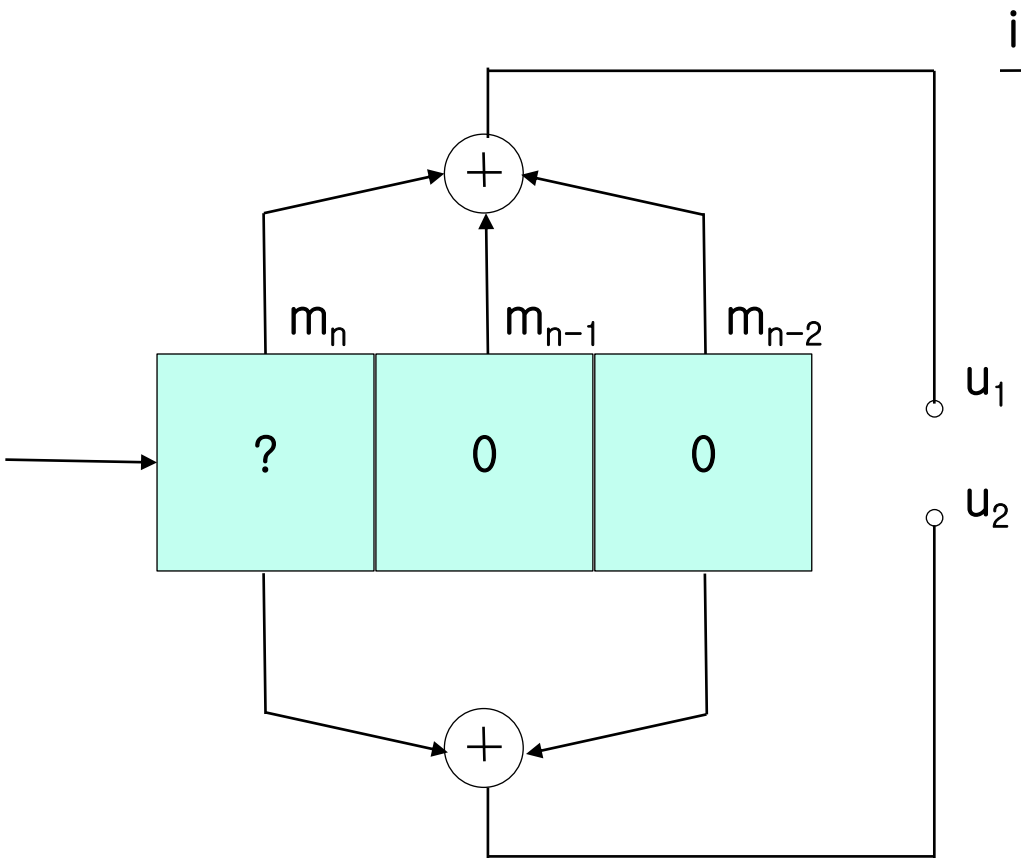
State diagram



input bit = 0 → input bit = 1

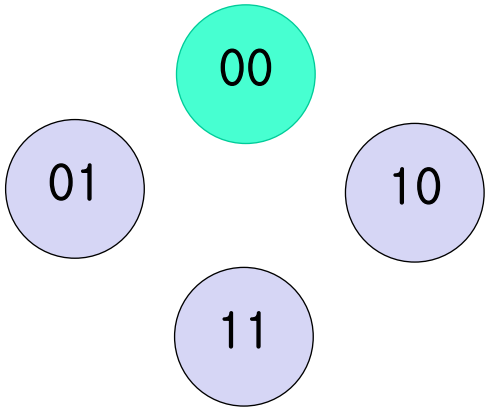
starting from '00'

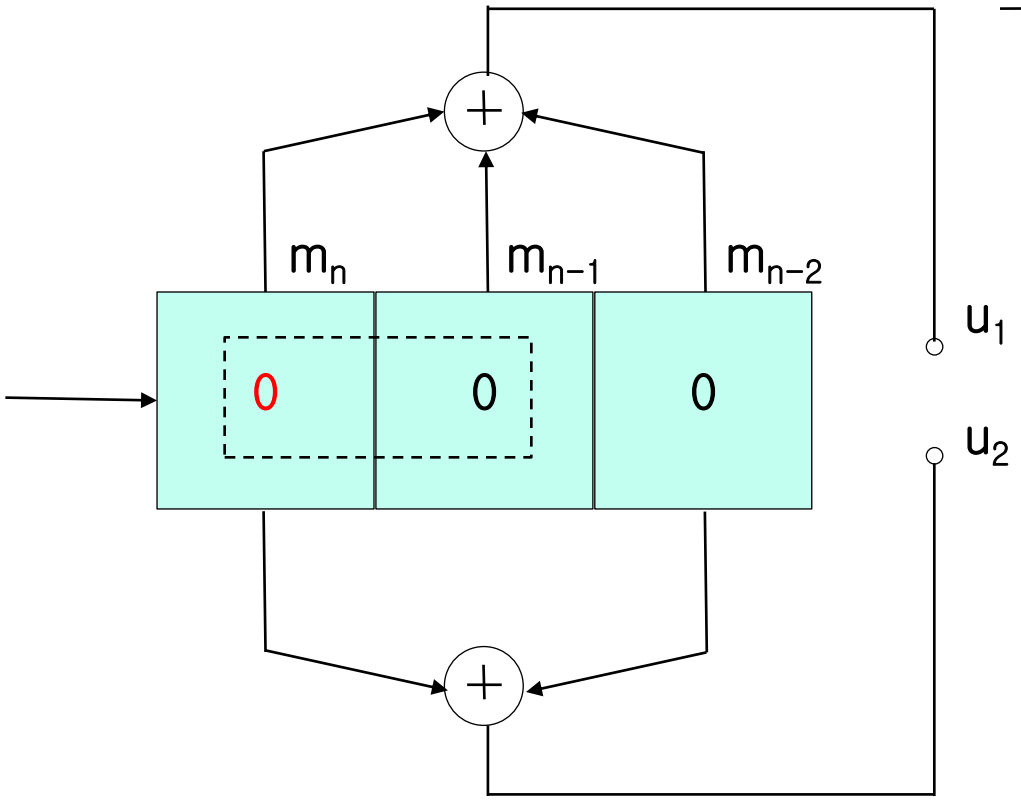




input bit = 0 → input bit = 1

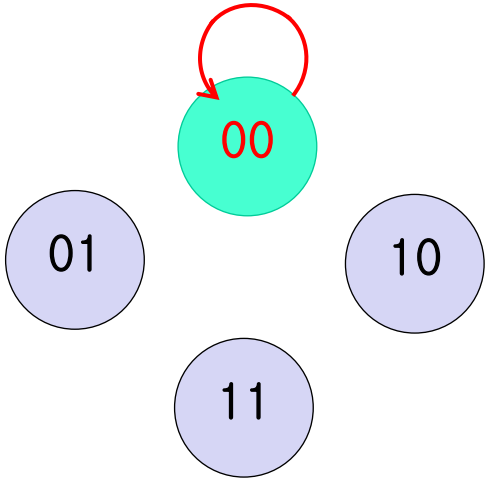
starting from '00'

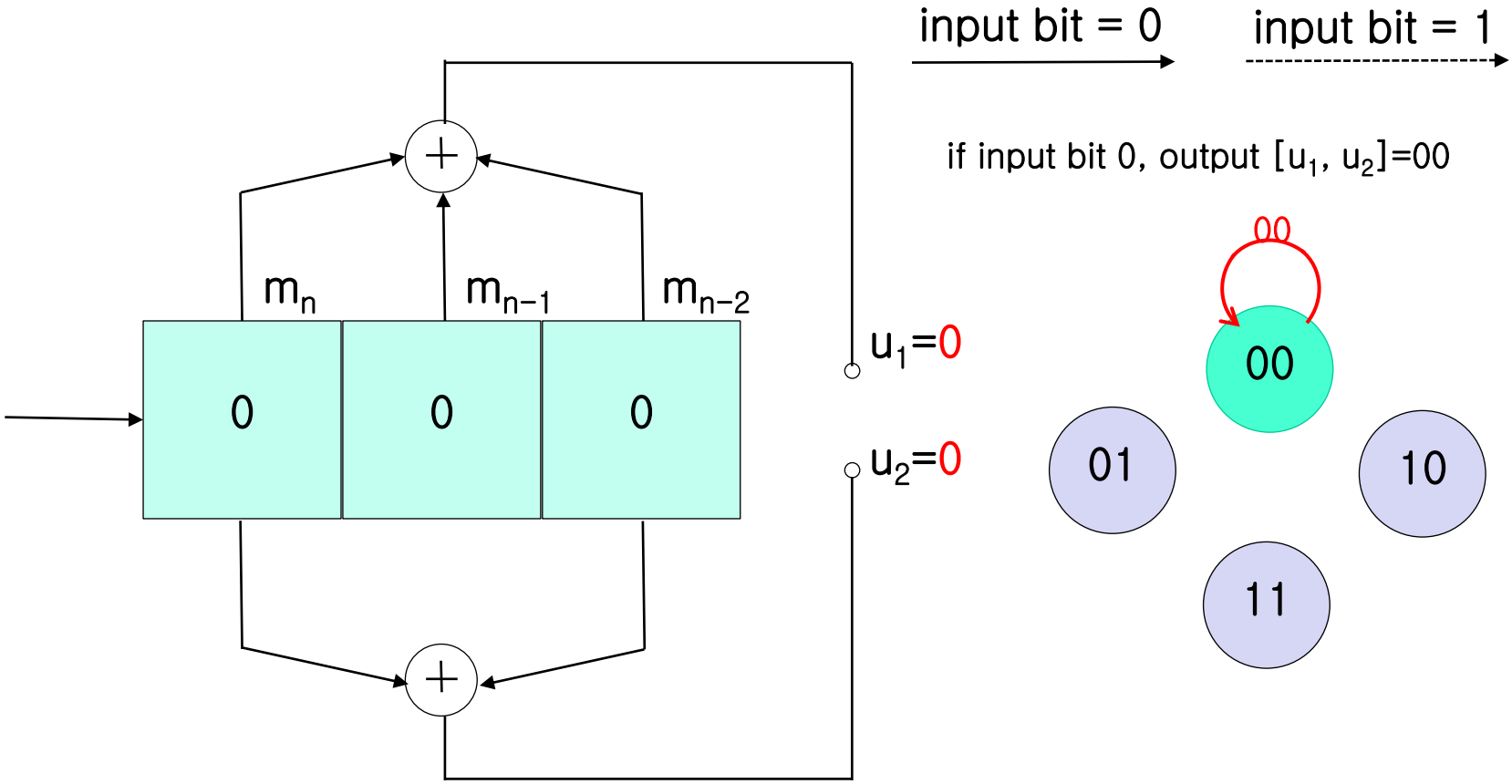


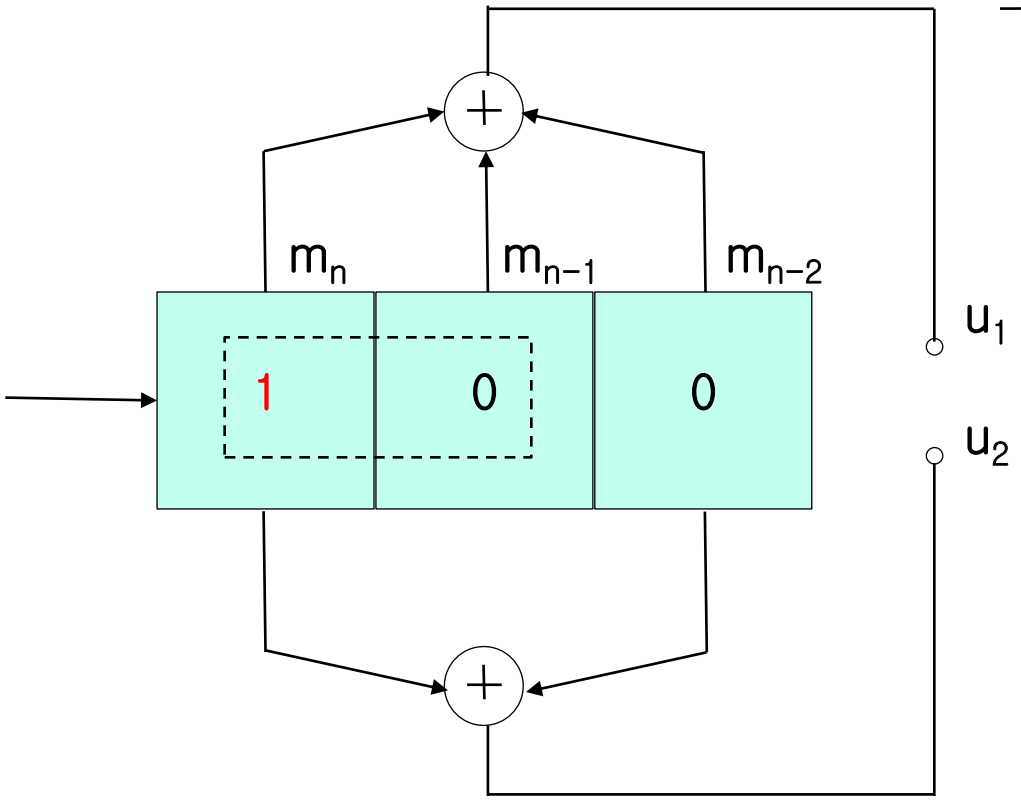


input bit = 0 → input bit = 1

from $[m_{n-1}, m_{n-2}]$=00
if input bit 0, next $[m_{n-1}, m_{n-2}]$=00

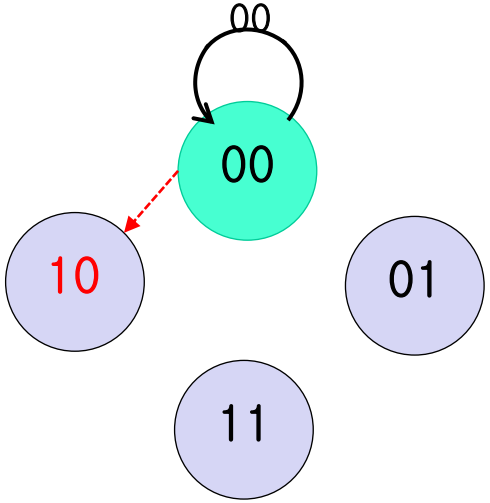


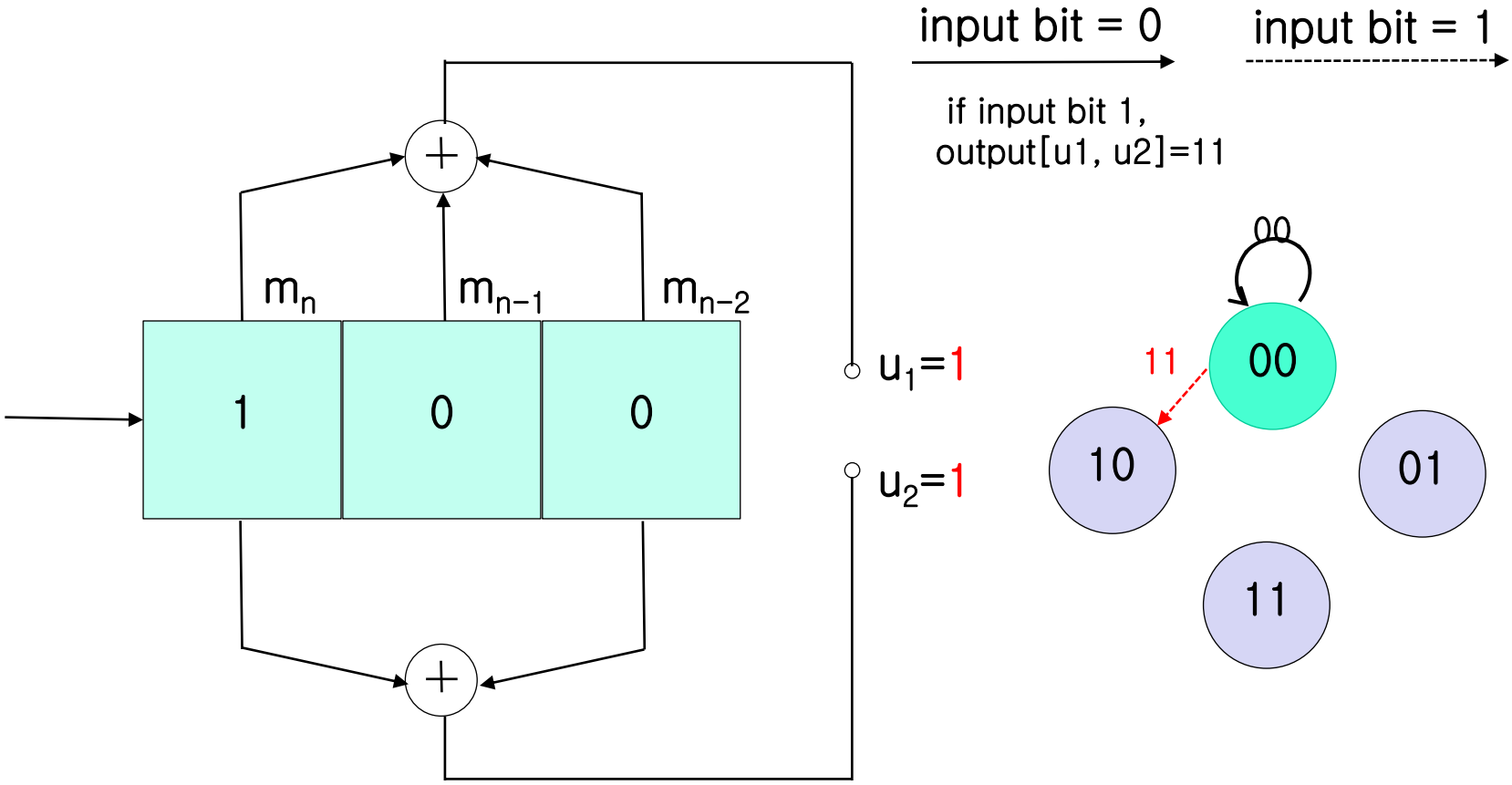

input bit = 0
input bit = 1
if input bit 0, output [u1, u2]=00
mn
mn-1
mn-2
0
0
0
u1=0
u2=0
00
00
01
10
11

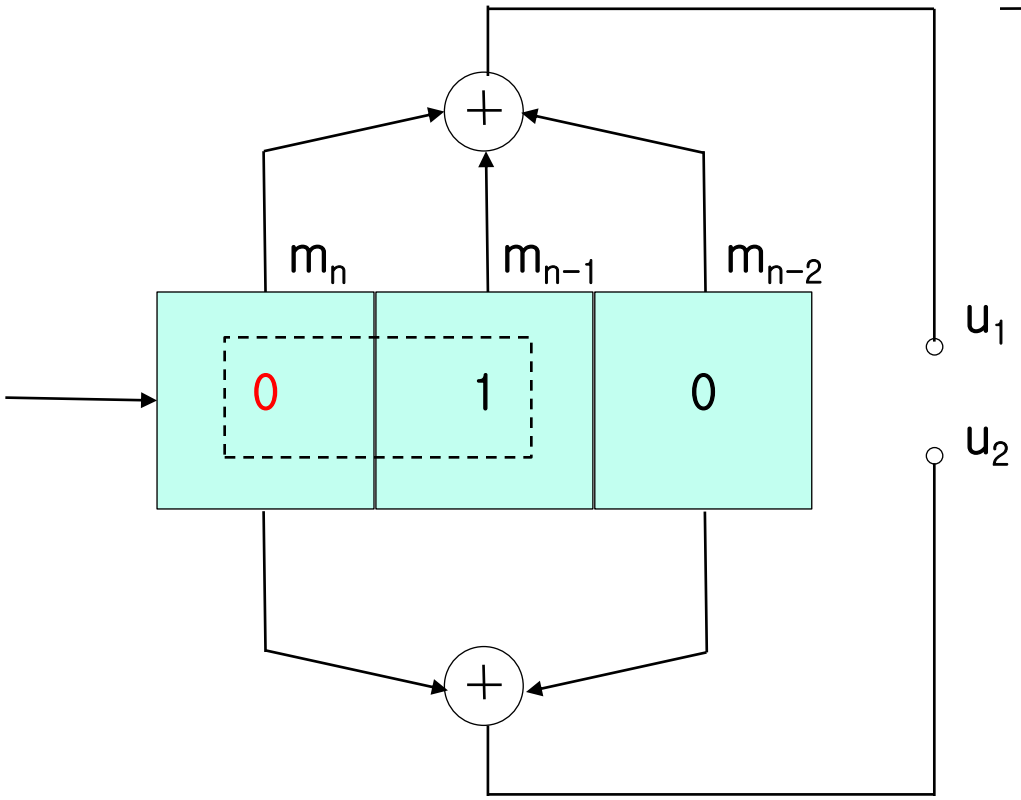


input bit = 0 input bit = 1

From $[m_{n-1}, m_{n-2}]$=00
if input bit 1, next $[m_{n-1}, m_{n-2}]$=10

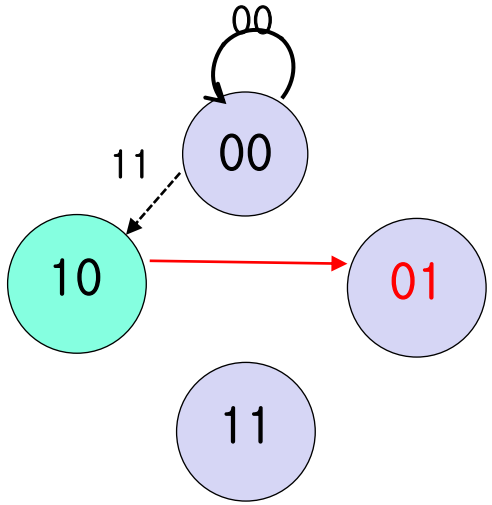


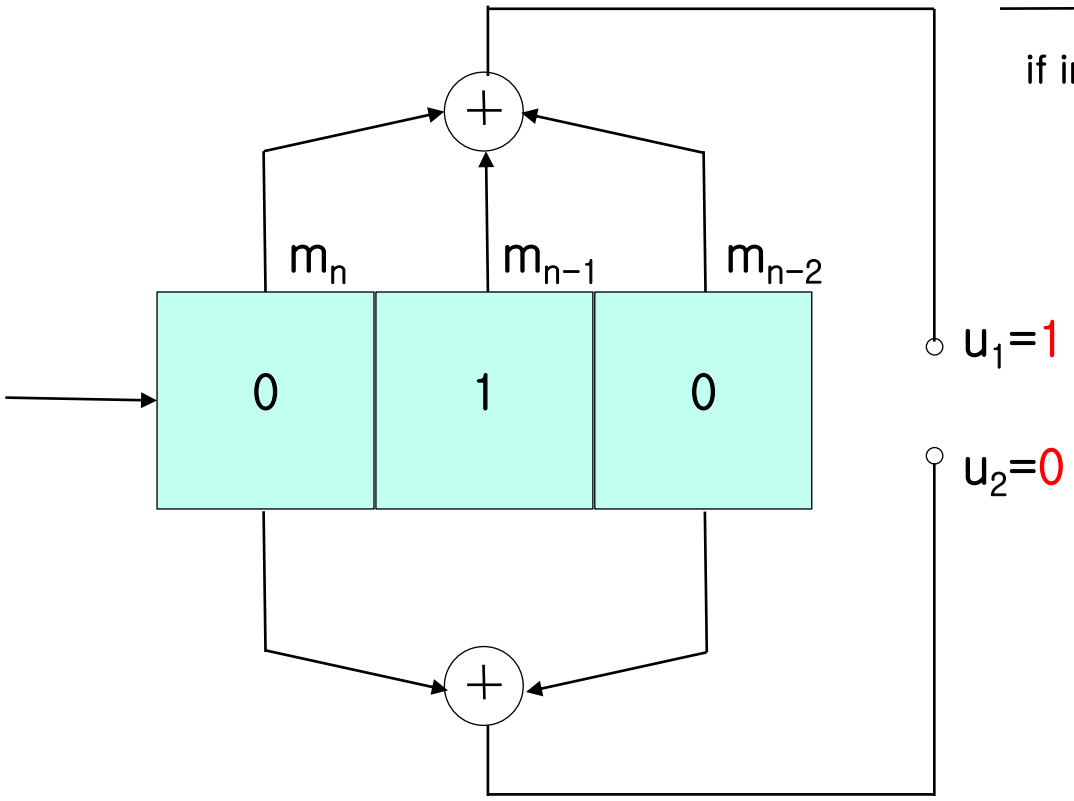

input bit = 0
input bit = 1
if input bit 1,
output[u1, u2]=11
m_n
m_{n-1}
m_{n-2}
1
0
0
u_1=1
u_2=1
00
11
00
10
01
11



input bit = 0 input bit = 1

From $[m_{n-1}, m_{n-2}]=[1\ 0]$
if input bit 0, next $[m_{n-1}, m_{n-2}]=01$

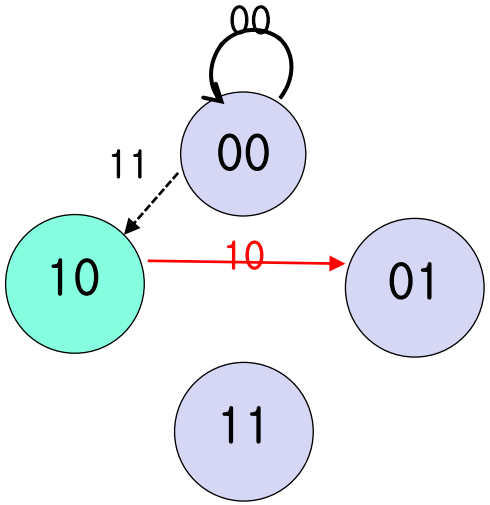


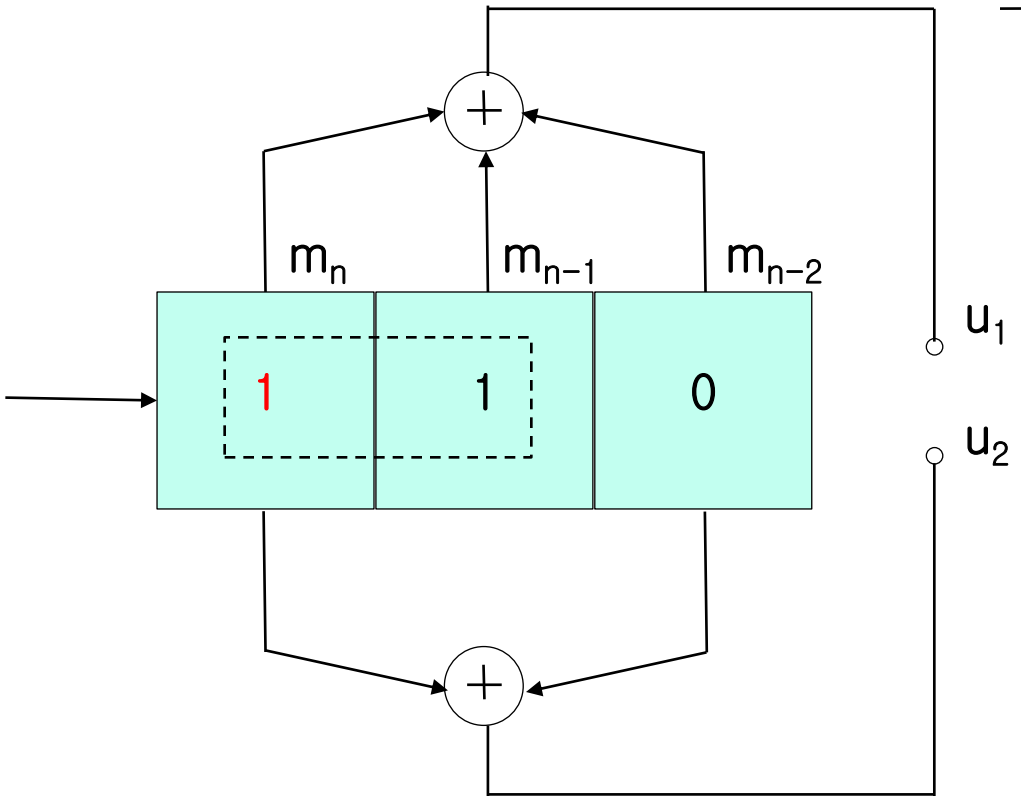


input bit = 0

input bit = 1

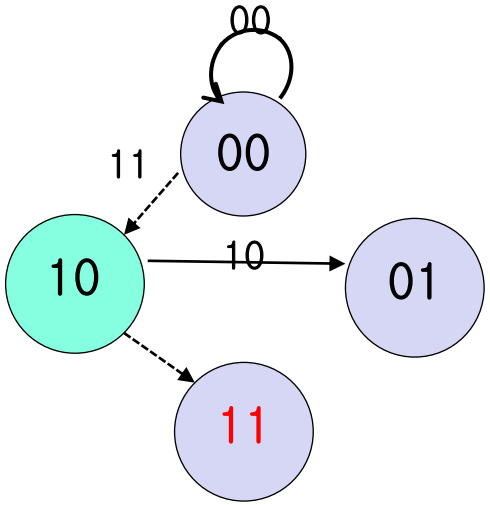
if input bit 0, output[u_1, u_2]=10

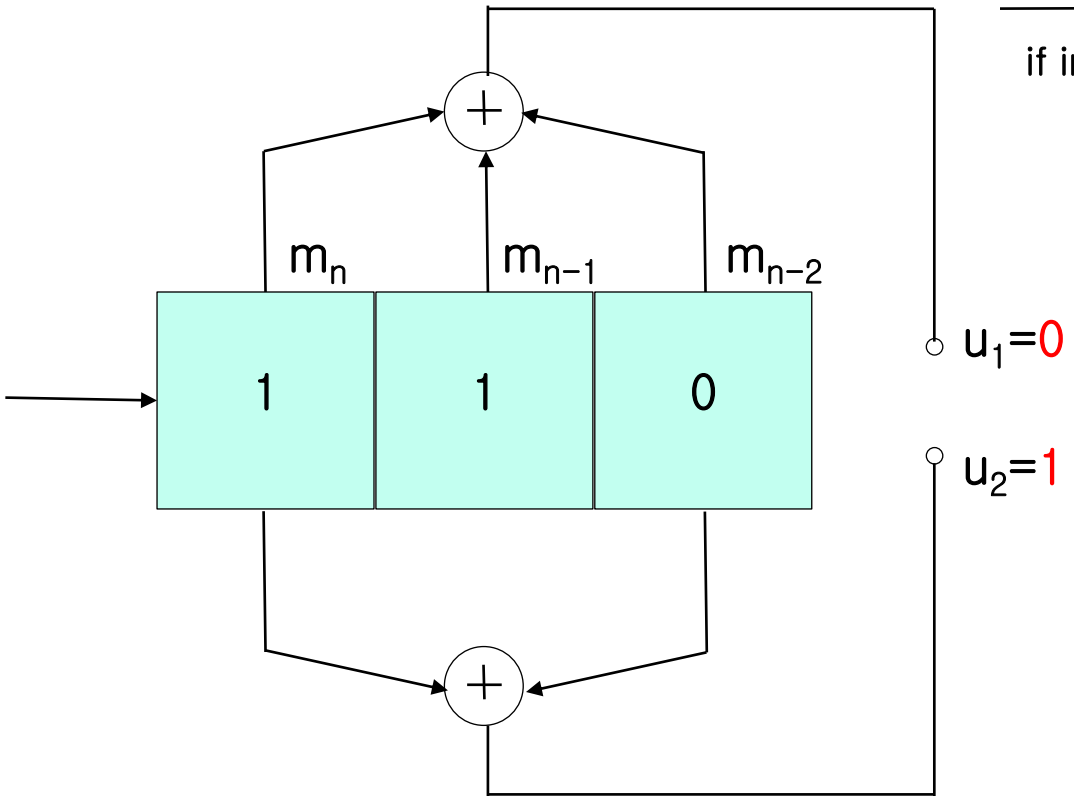




input bit = 0 → input bit = 1

From $[m_{n-1}, m_{n-2}]=[1\ 0]$
if input bit 1, next $[m_{n-1}, m_{n-2}]=11$

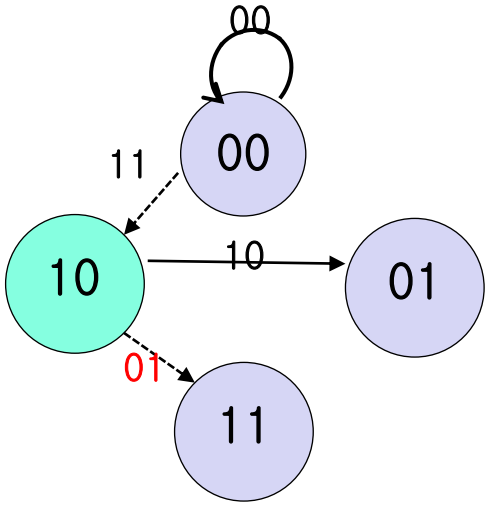


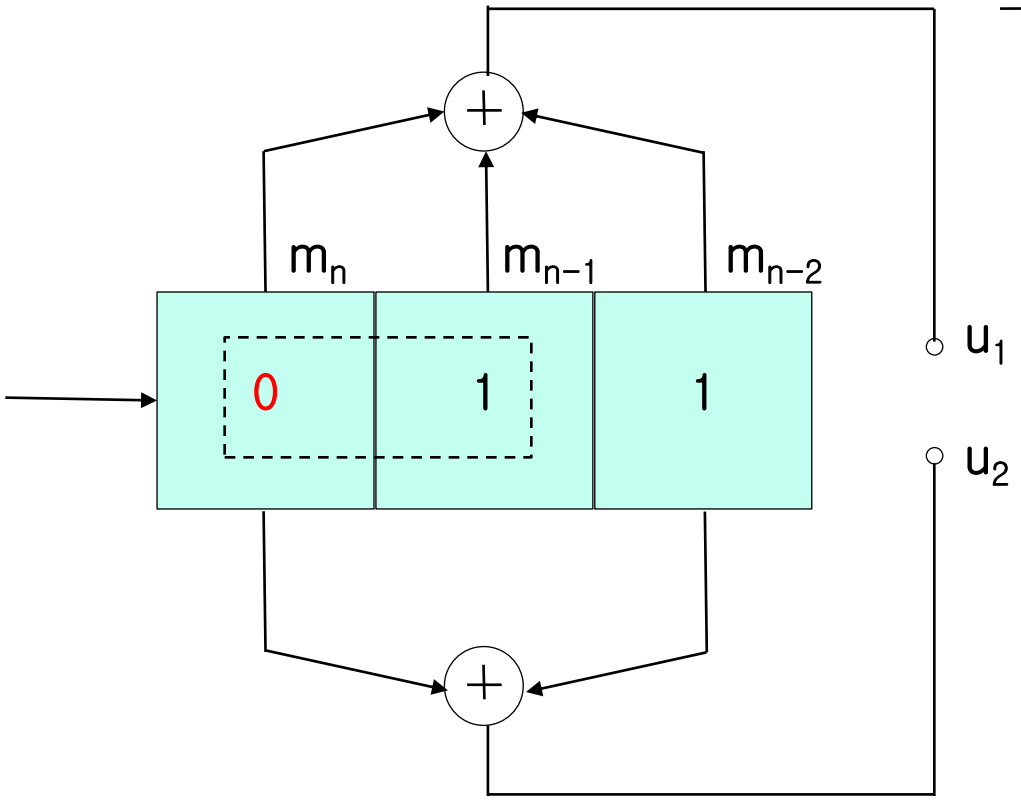


input bit = 0

input bit = 1

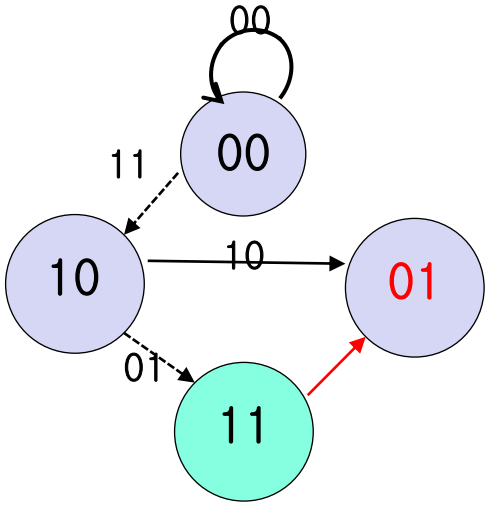
if input bit 1, output[u_1, u_2]=01

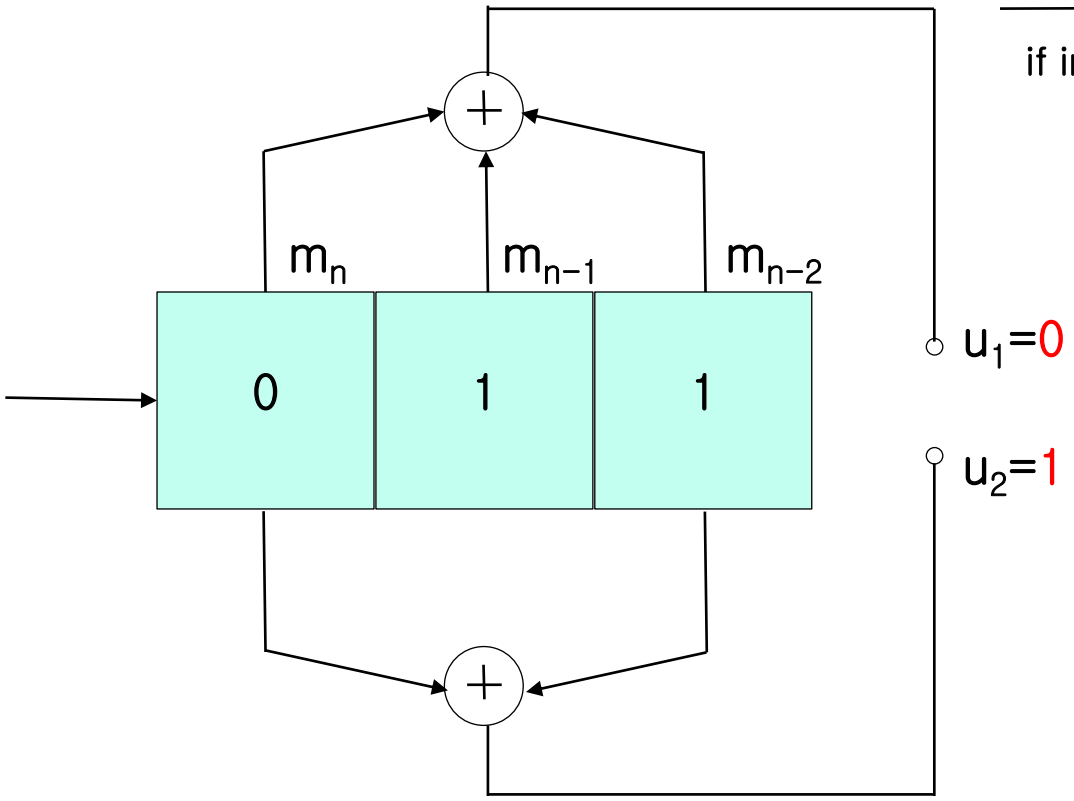




input bit = 0 input bit = 1

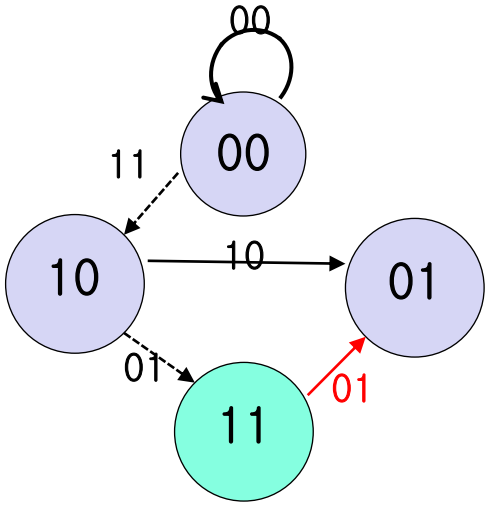
From $[m_{n-1}, m_{n-2}]=[1\ 1]$
if input bit 0, next $[m_{n-1}, m_{n-2}]=01$

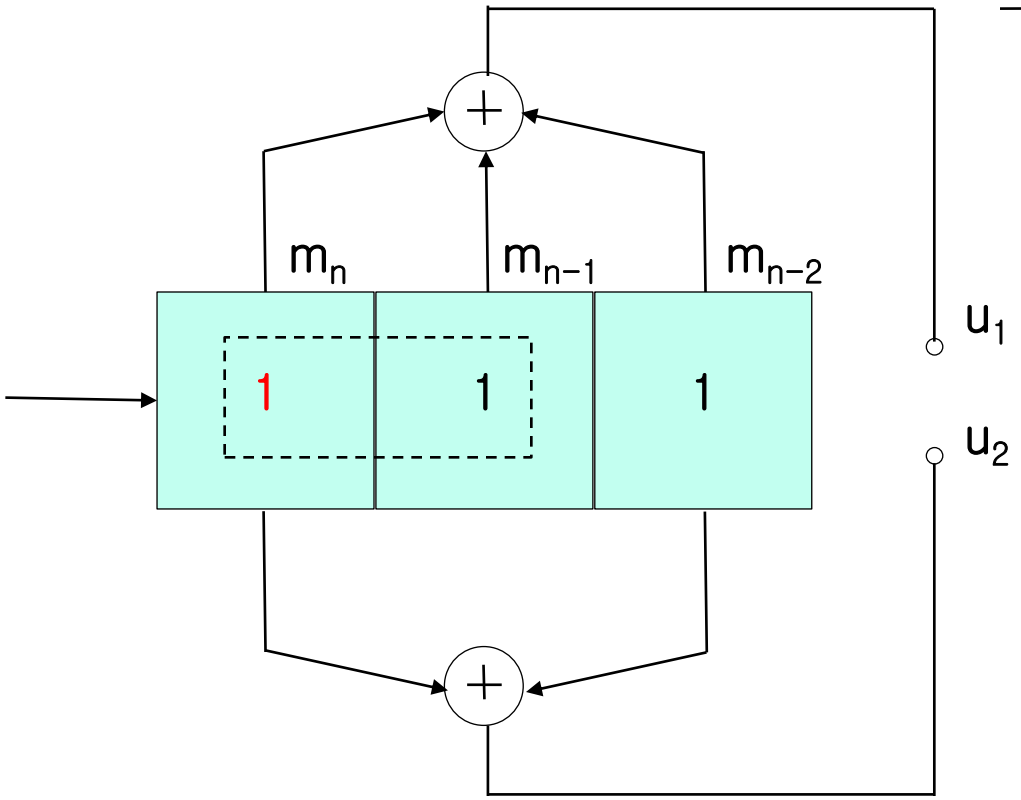




input bit = 0 input bit = 1

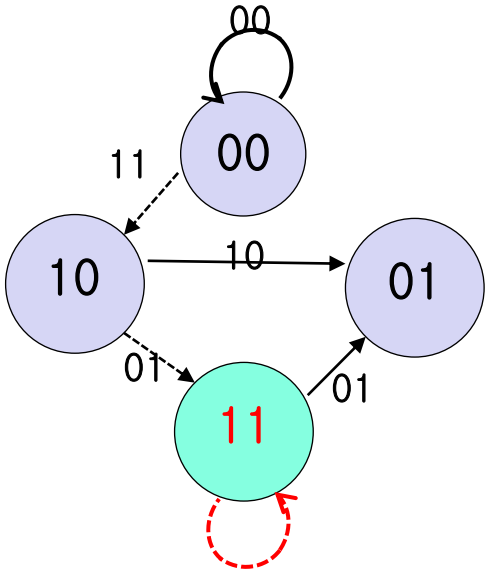
if input bit 0, [u_1, u_2]=01

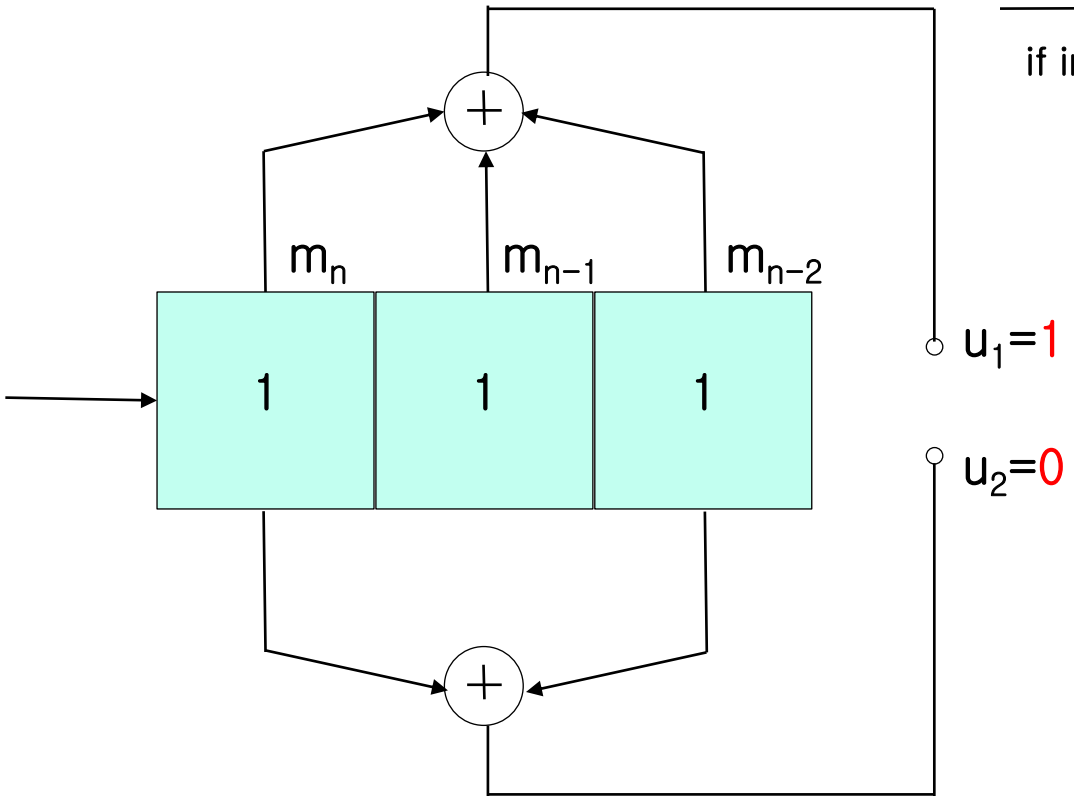




input bit = 0 → input bit = 1

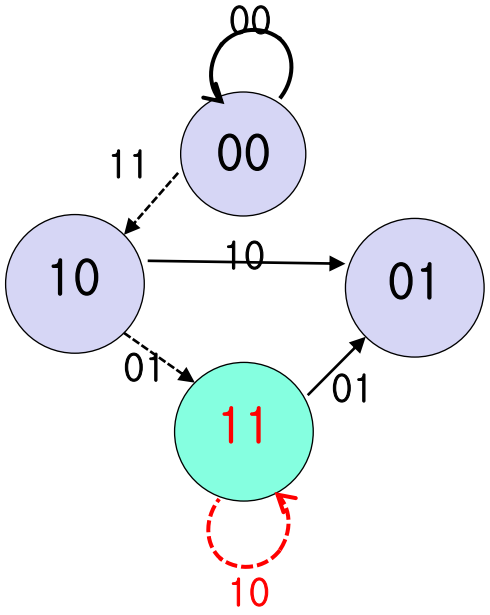
From $[m_{n-1}, m_{n-2}]=[1\ 1]$
if input bit 1, next $[m_{n-1}, m_{n-2}]=11$

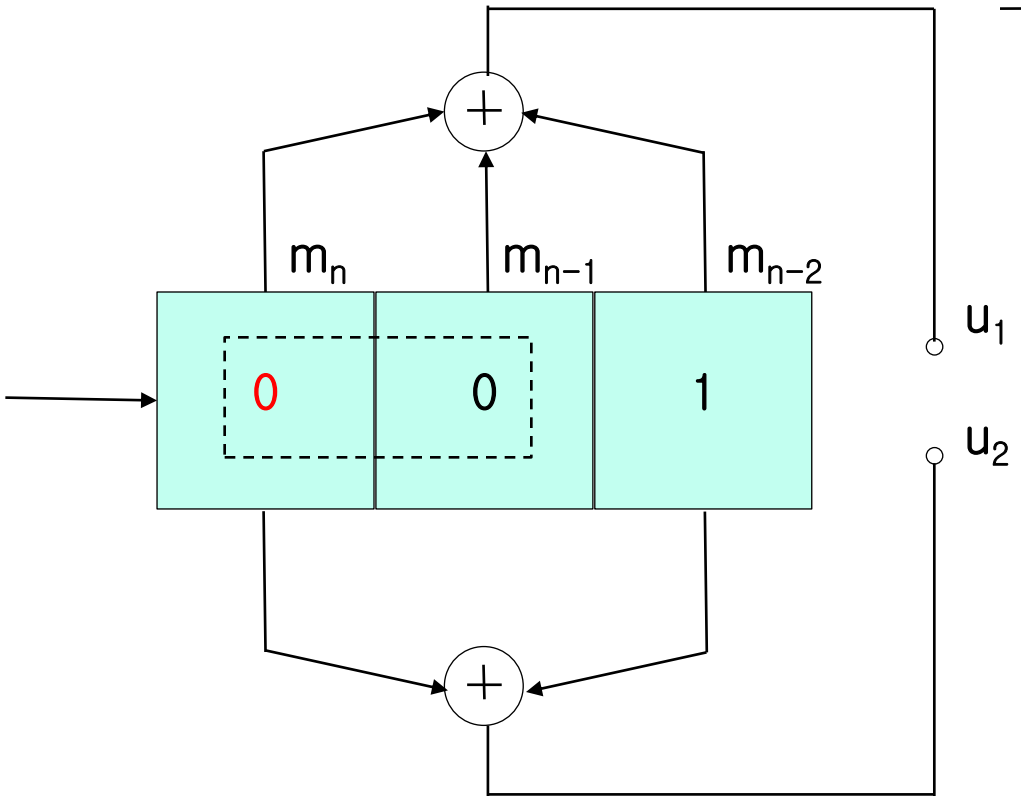




input bit = 0 input bit = 1

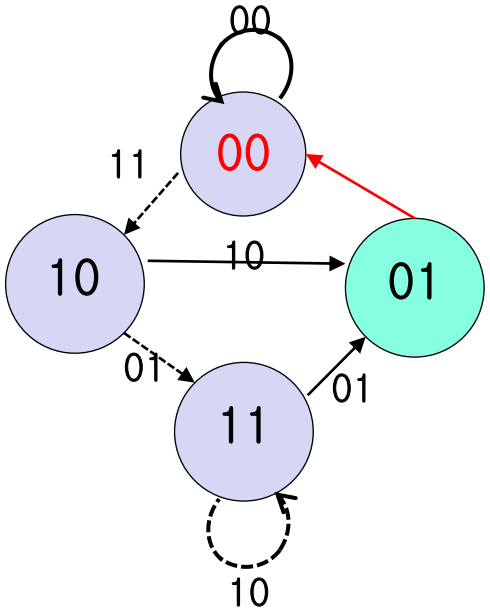
if input bit 1, output [u_1, u_2]=10

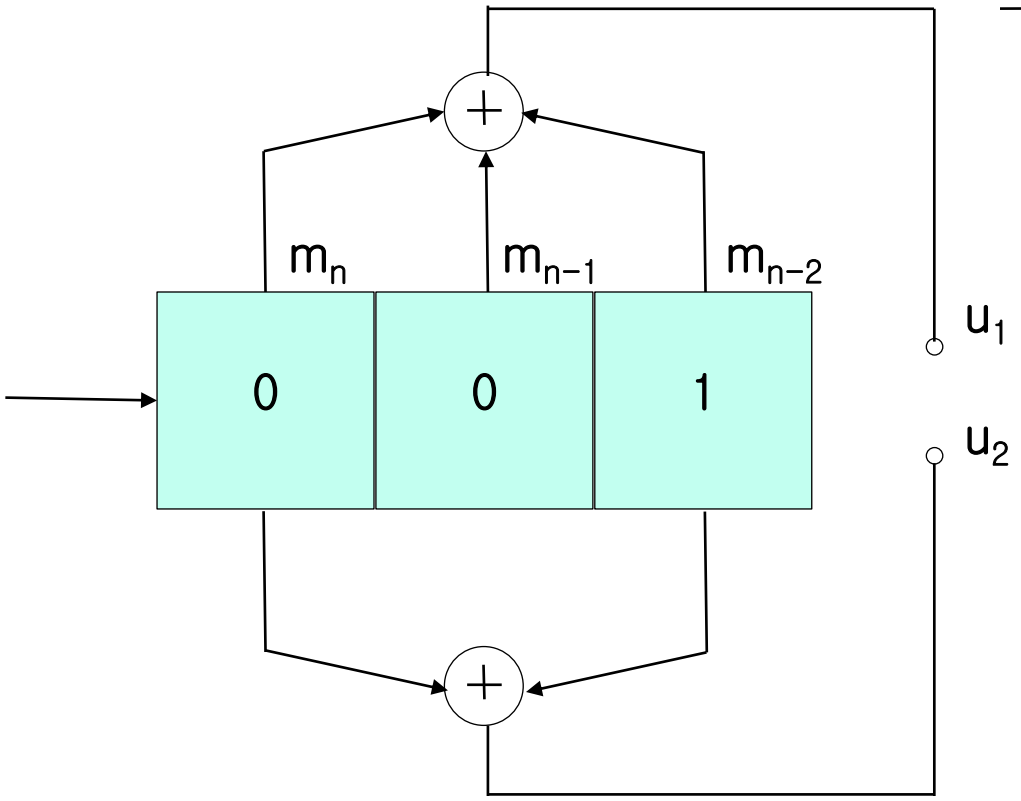




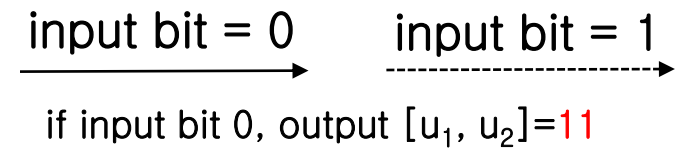
input bit = 0 → input bit = 1

From $[m_{n-1}, m_{n-2}]=[0\ 1]$
if input bit 0, next $[m_{n-1}, m_{n-2}]=00$

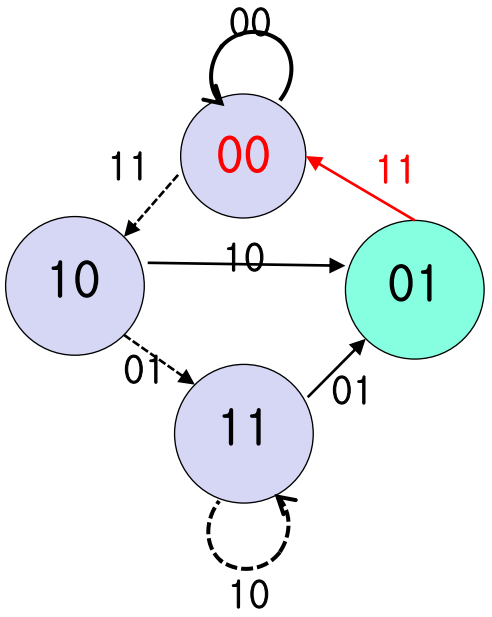




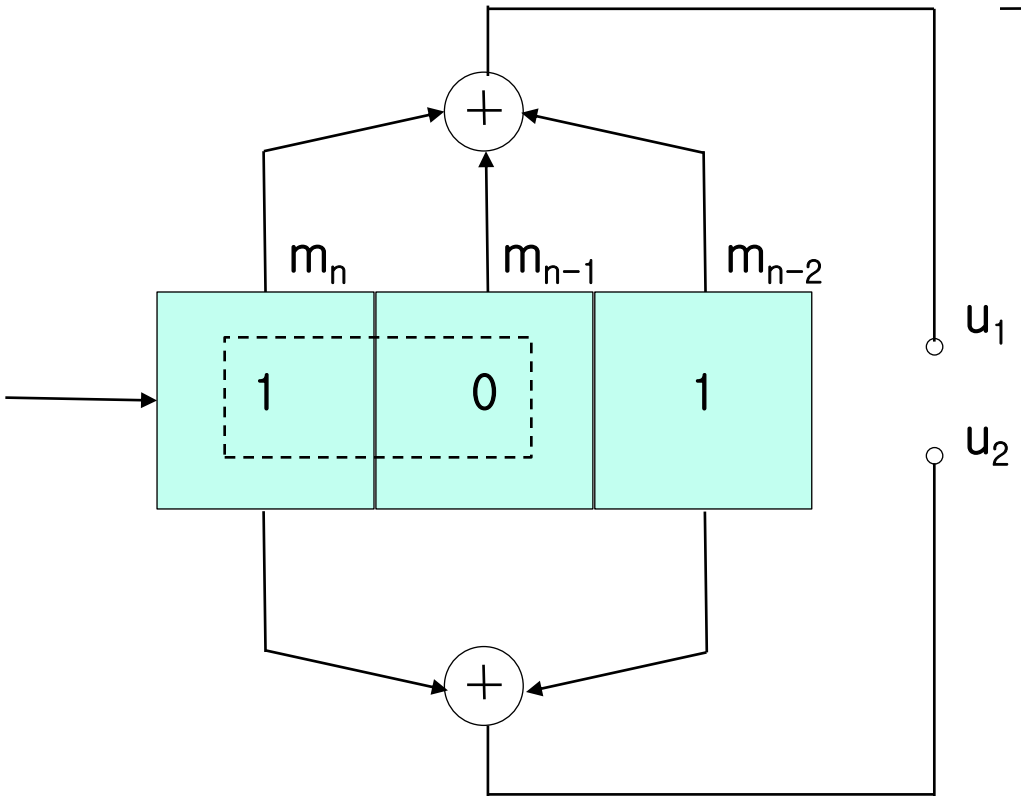
m_n
m_{n-1}
m_{n-2}
0
0
1
u_1
u_2



input bit = 0
input bit = 1
if input bit 0, output [u_1, u_2]=11

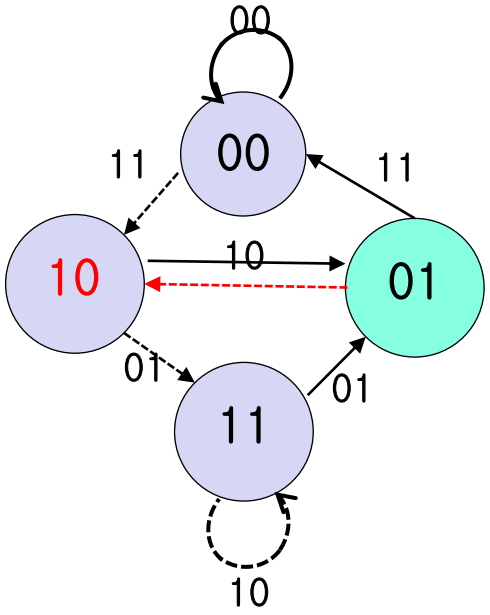


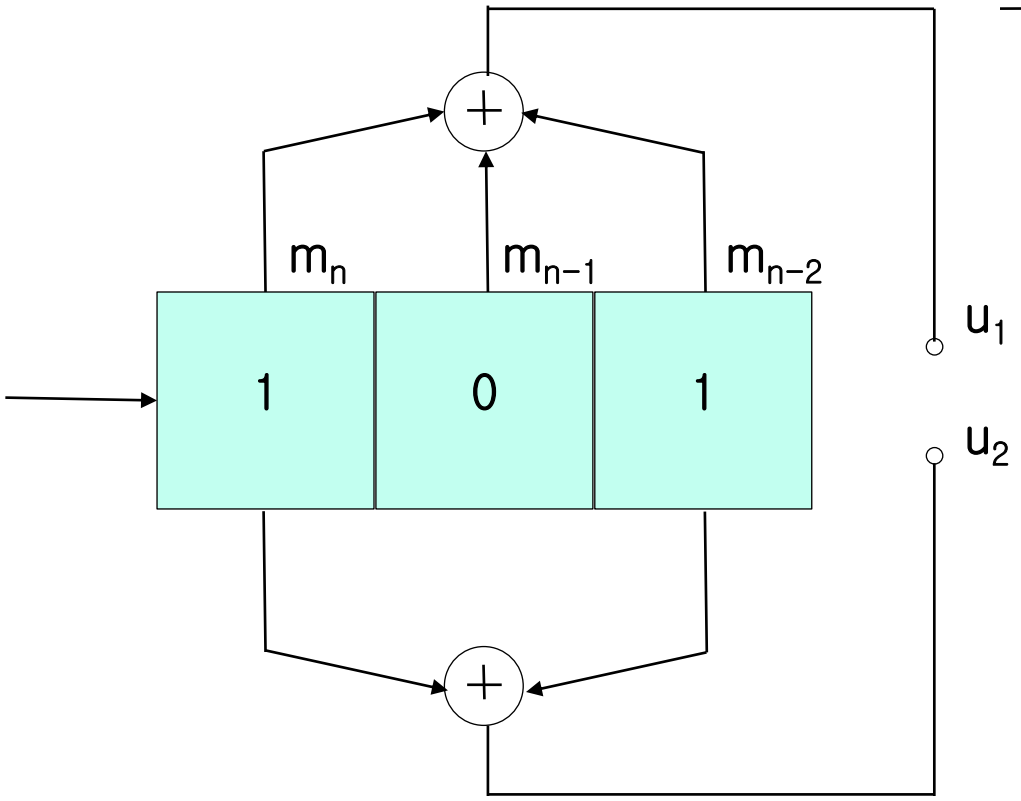
00
00
11
11
10
10
01
01
01
11
10



input bit = 0 input bit = 1

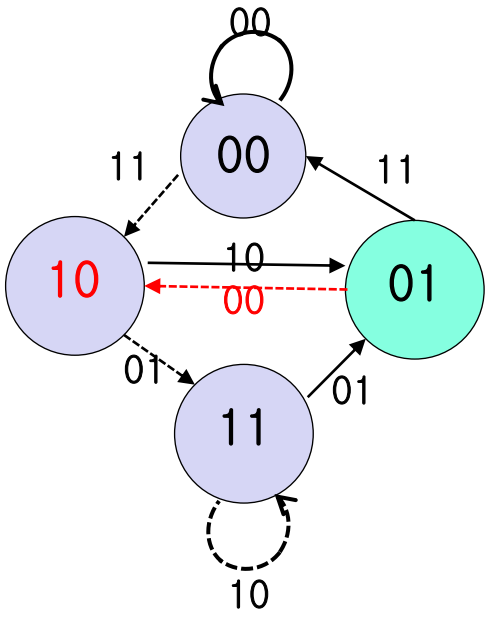
From $[m_{n-1}, m_{n-2}]=[0\ 1]$
if input bit 1, next $[m_{n-1}, m_{n-2}]=10$

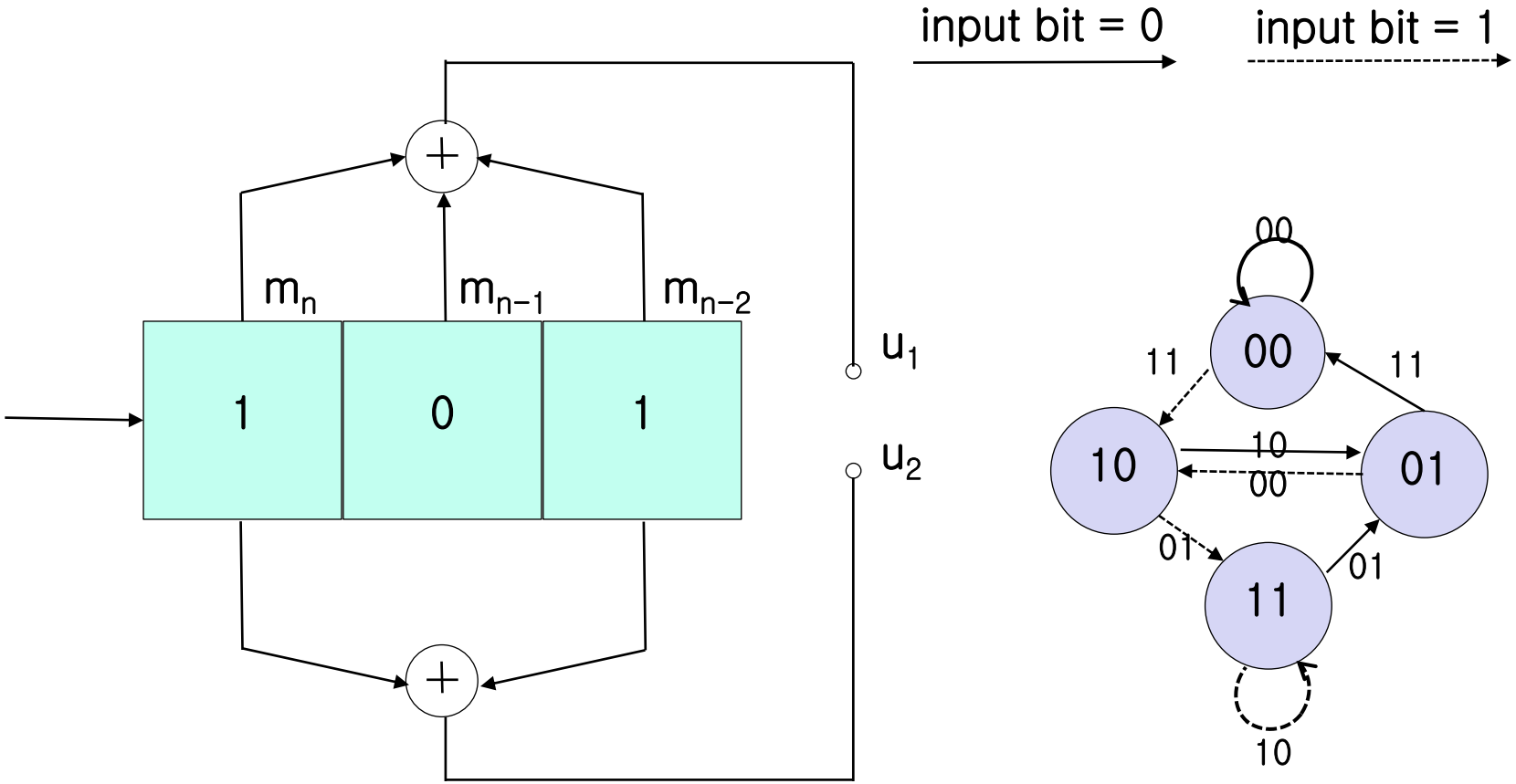




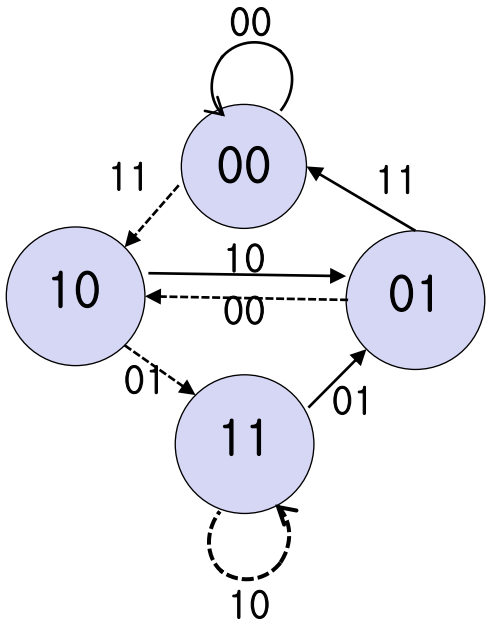
input bit = 0 input bit = 1

if input bit 0, output[u_1, u_2]=00




input bit = 0
input bit = 1
m_n
m_{n-1}
m_{n-2}
1
0
1
u_1
u_2
00
11
00
11
10
10
01
00
01
01
11
10

Trellis diagram



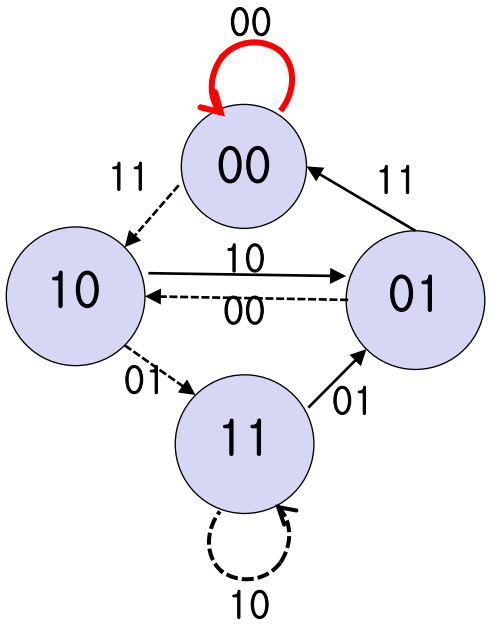
t_1

$a = 00$

$b = 10$

$c = 01$

$d = 11$

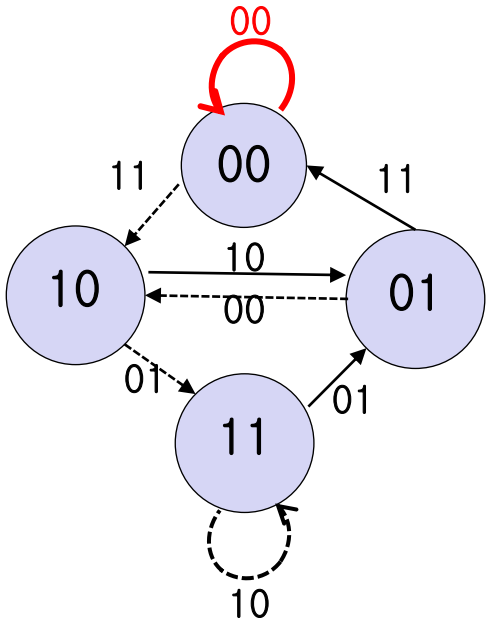


$a = 00$

$b = 10$

$c = 01$

$d = 11$

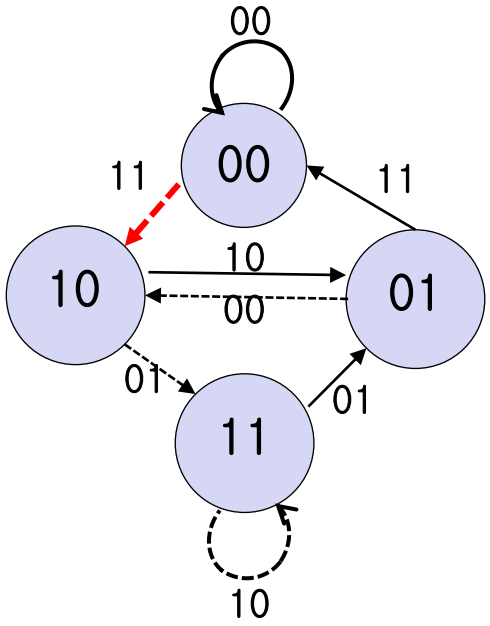


$a = 00$

$b = 10$

$c = 01$

$d = 11$

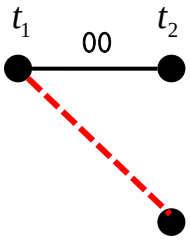


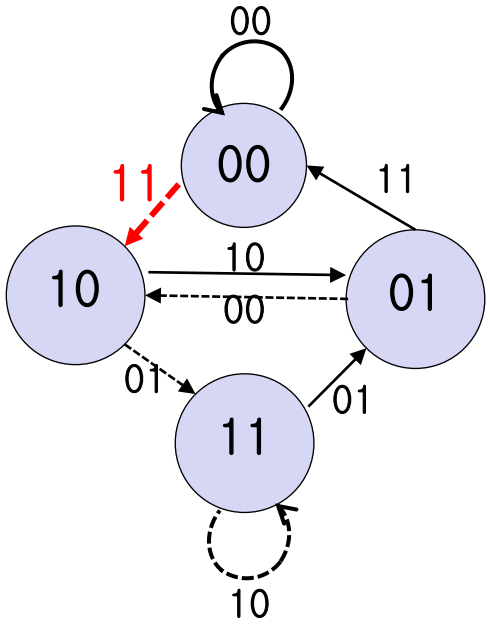
$a = 00$

$b = 10$

$c = 01$

$d = 11$



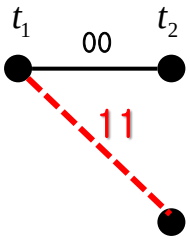


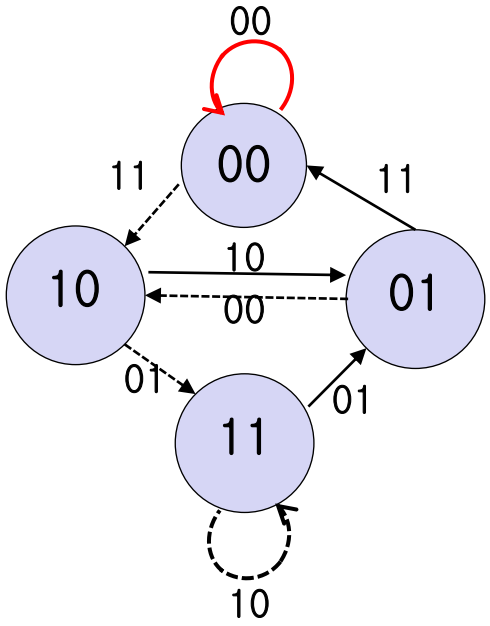
$a = 00$

$b = 10$

$c = 01$

$d = 11$



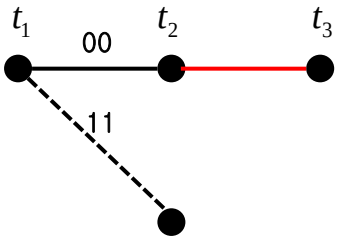


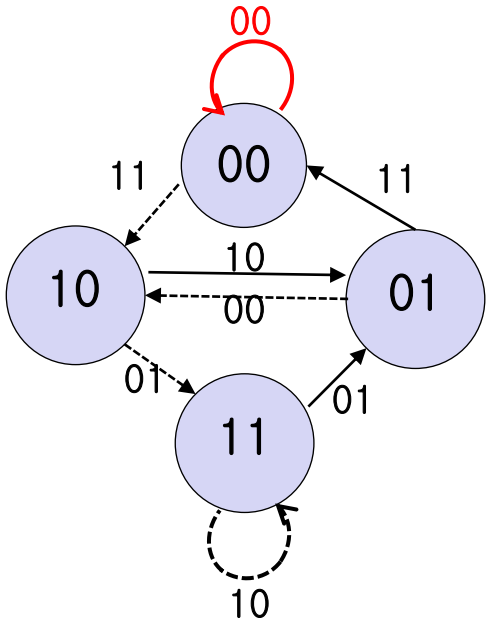
$a = 00$

$b = 10$

$c = 01$

$d = 11$



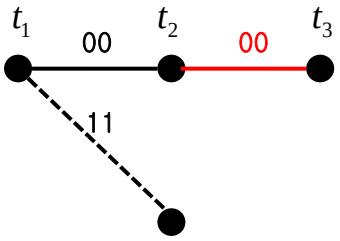


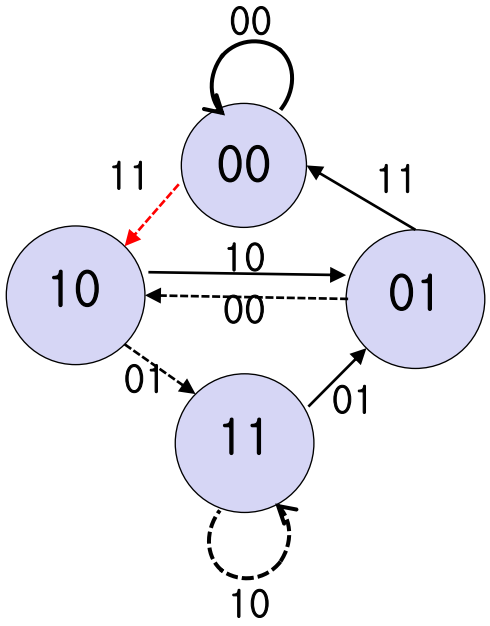
$a = 00$

$b = 10$

$c = 01$

$d = 11$



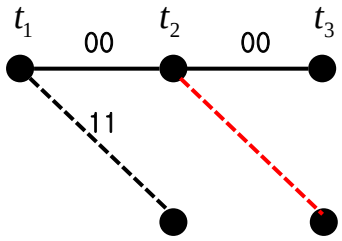


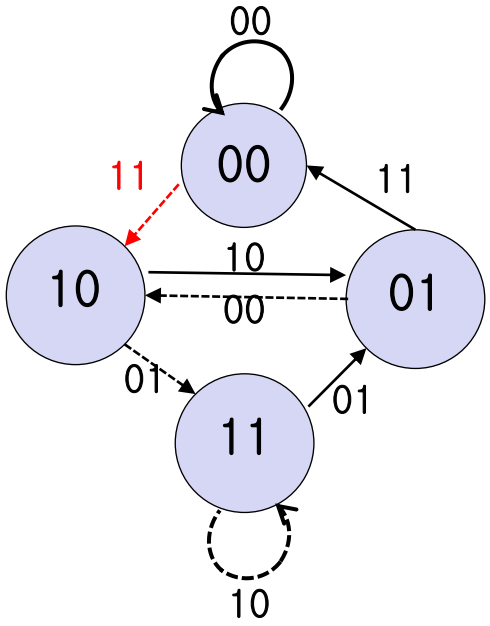
$a = 00$

$b = 10$

$c = 01$

$d = 11$





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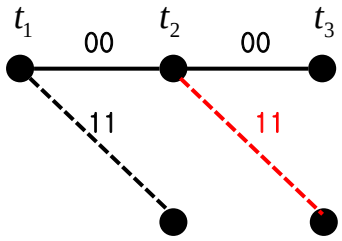

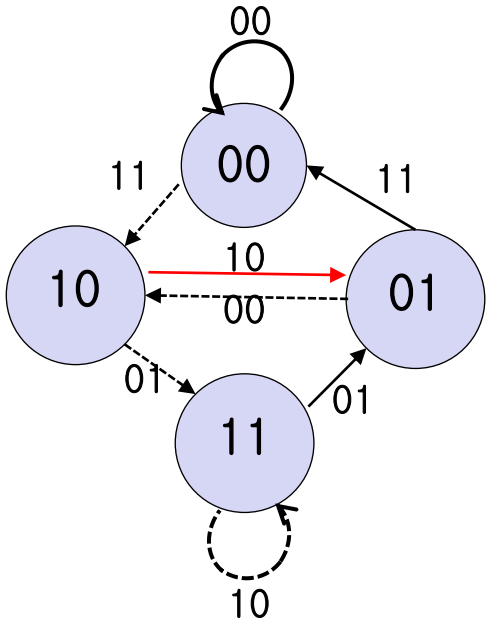
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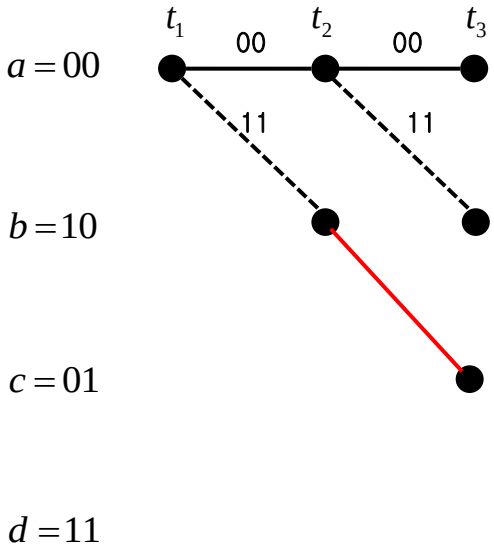
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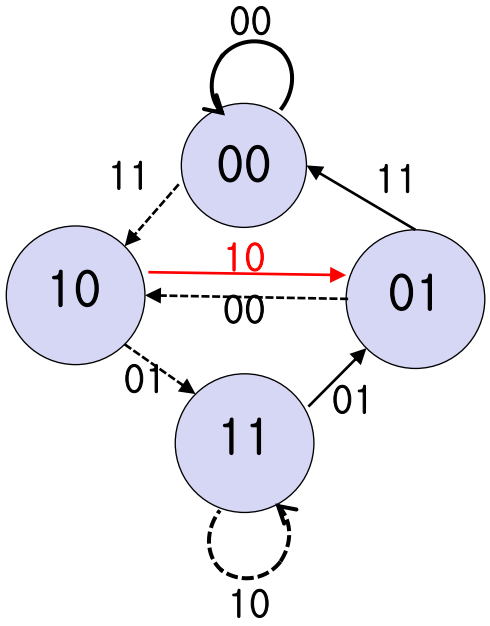

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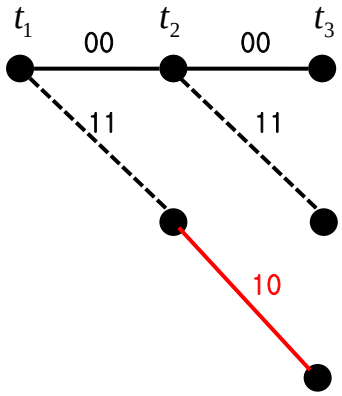

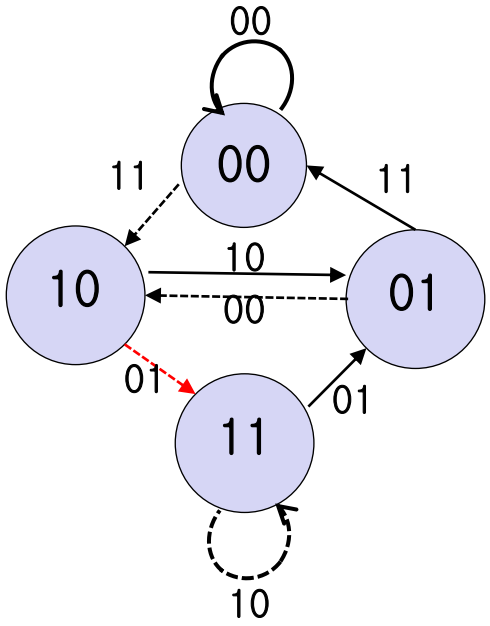
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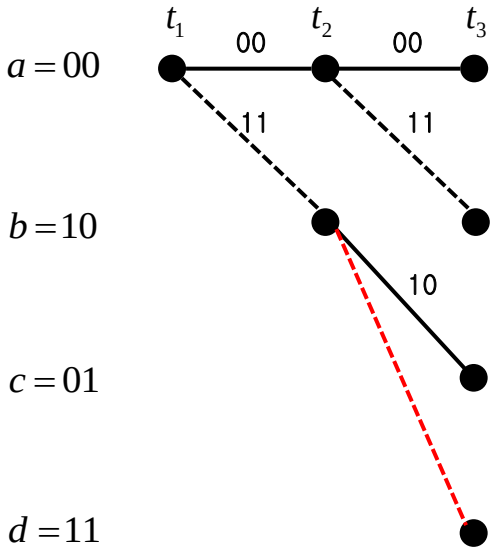
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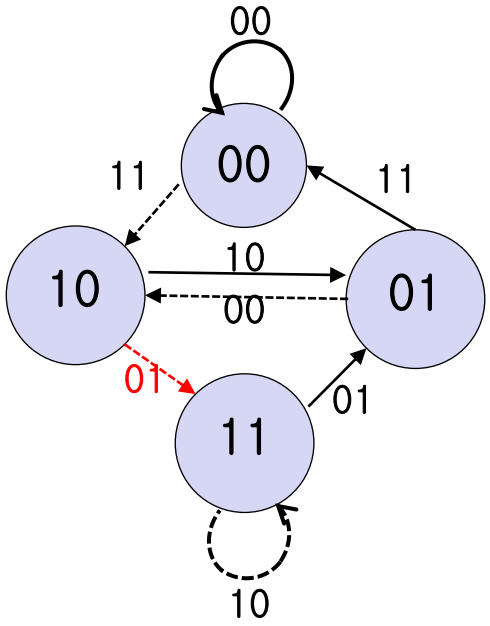
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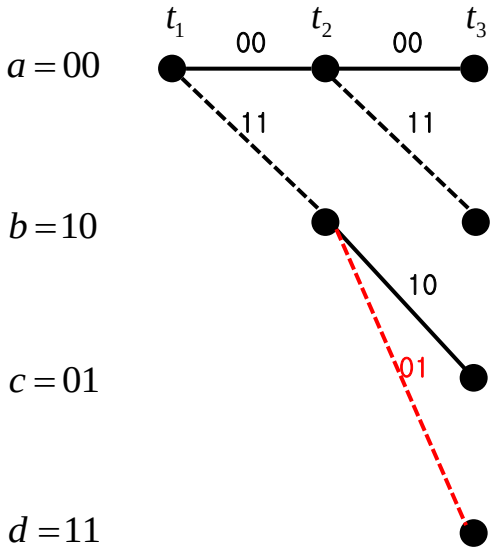
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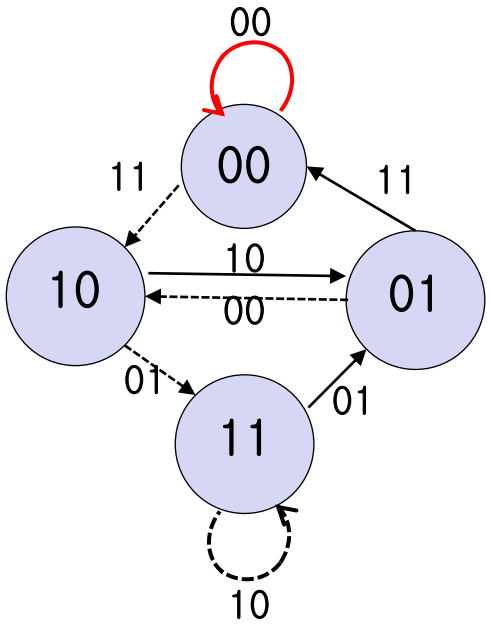
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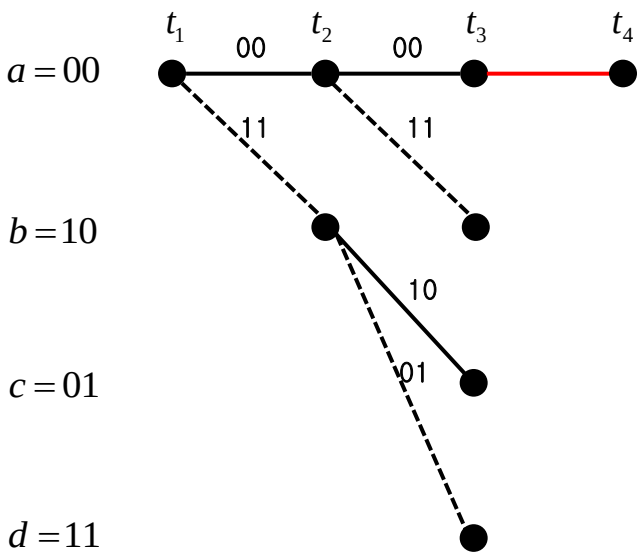
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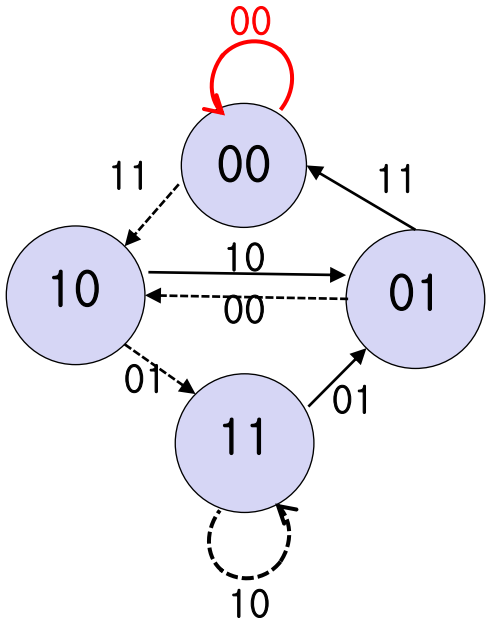
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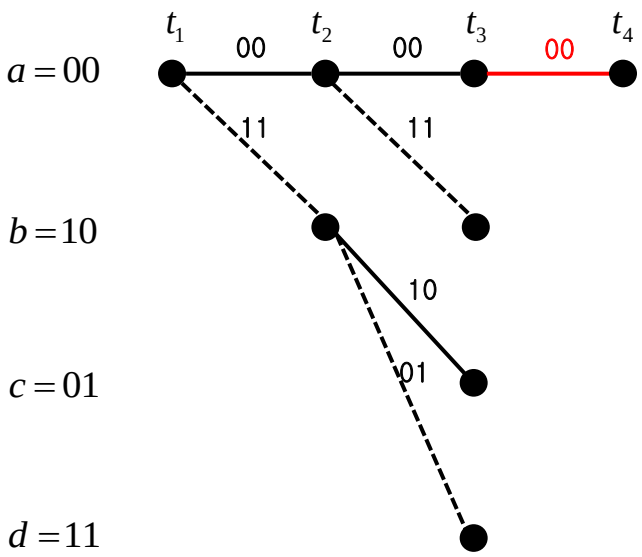
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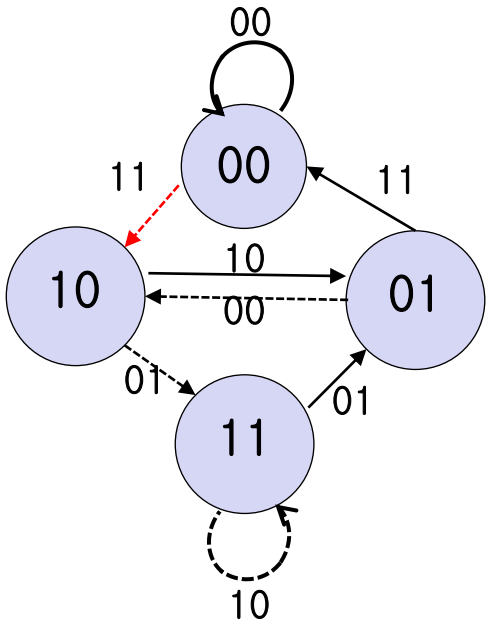
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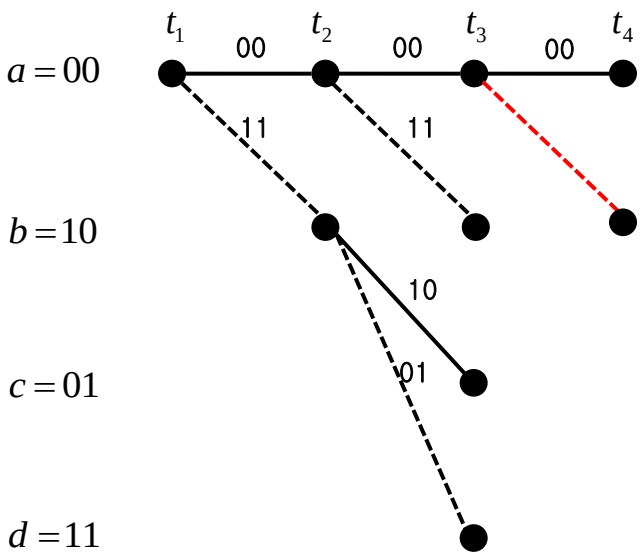
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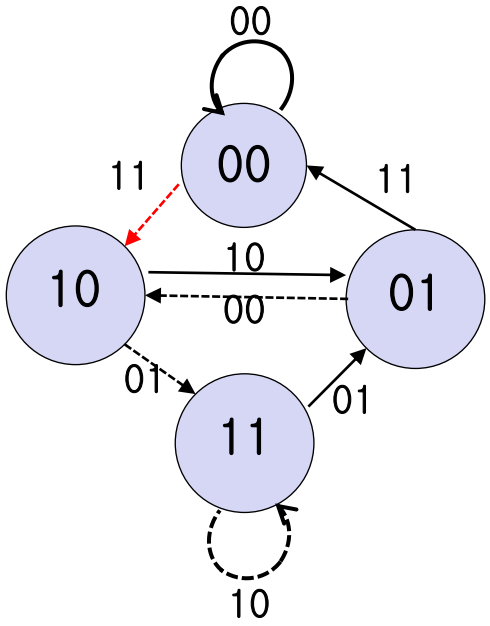
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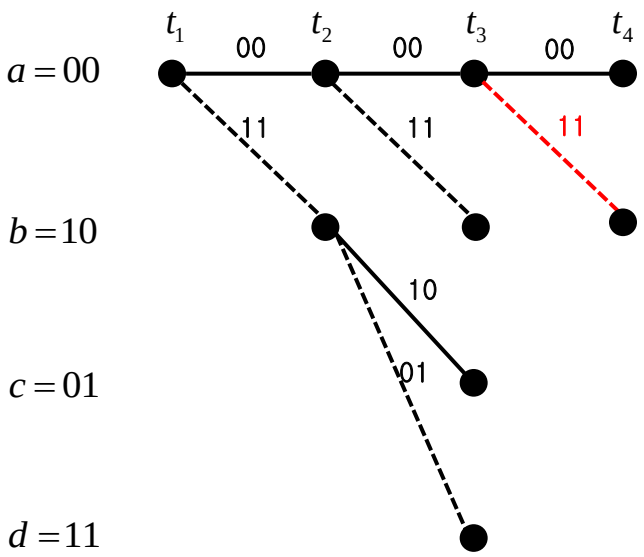
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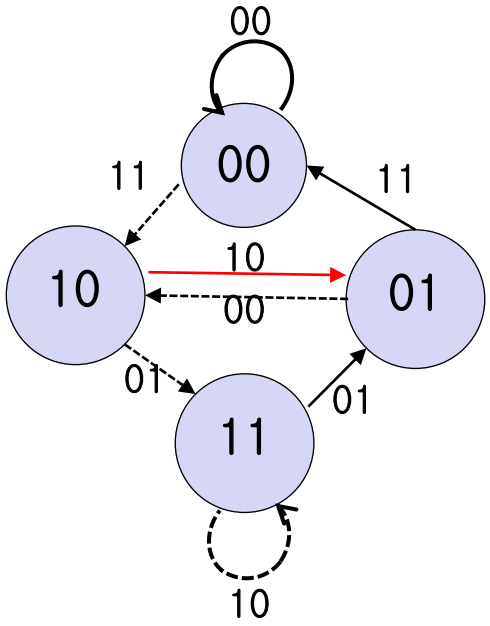
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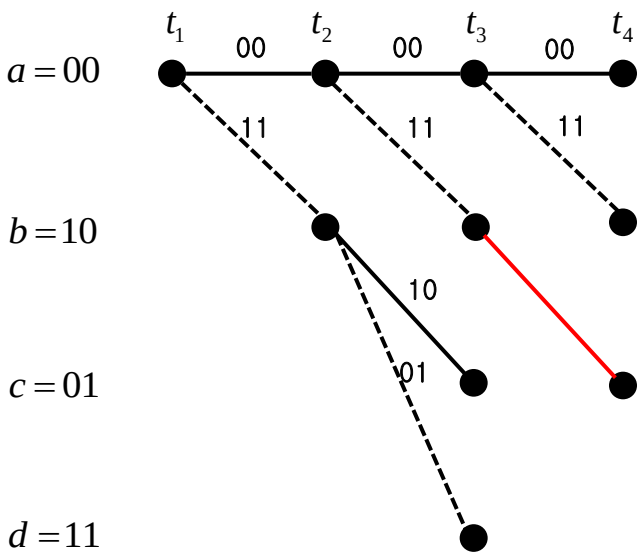
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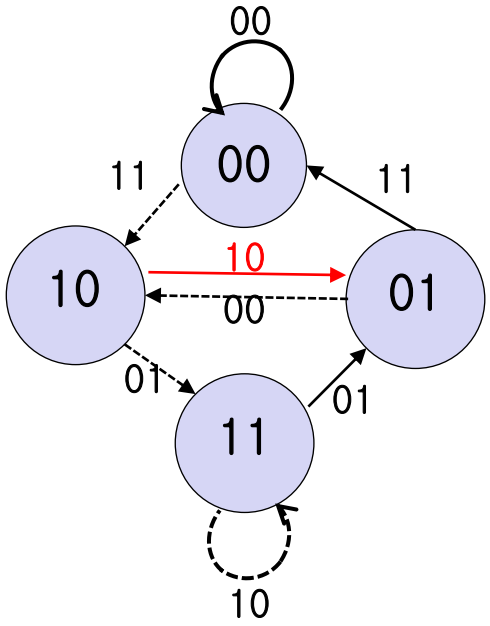
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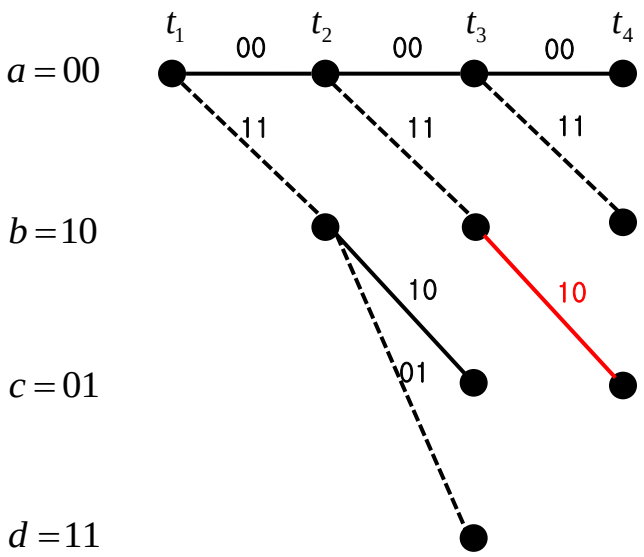
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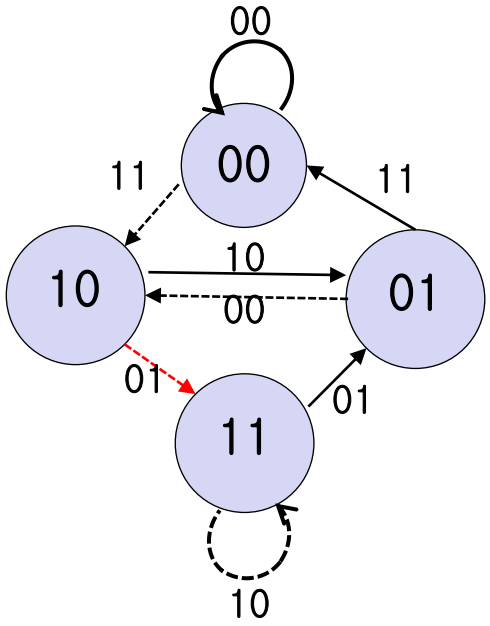
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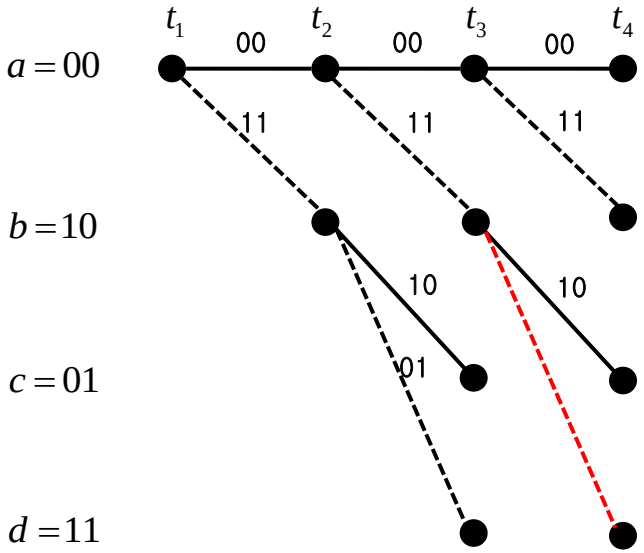
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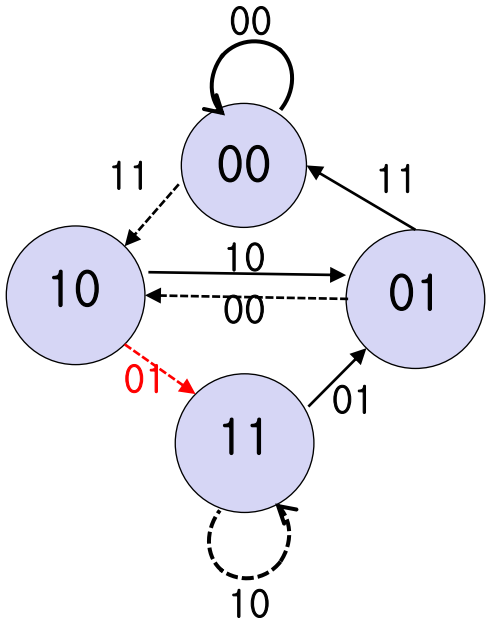
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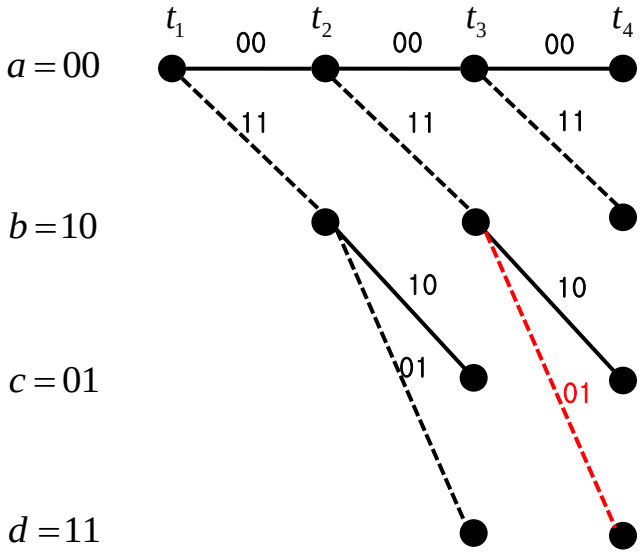
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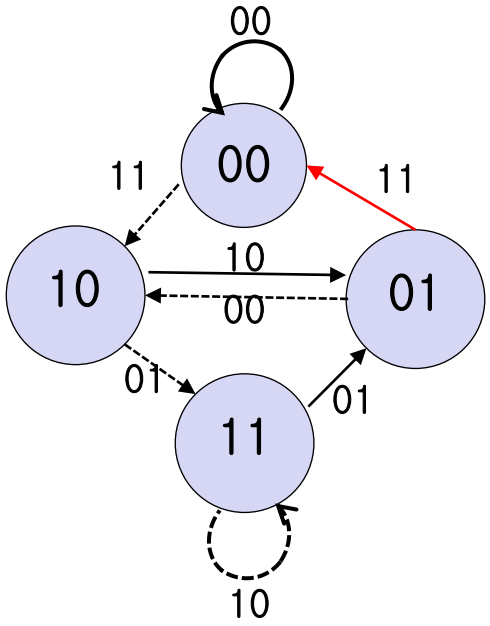
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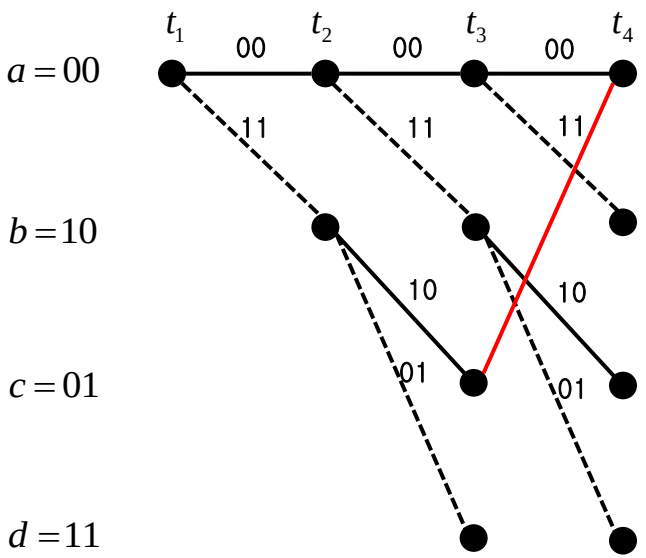
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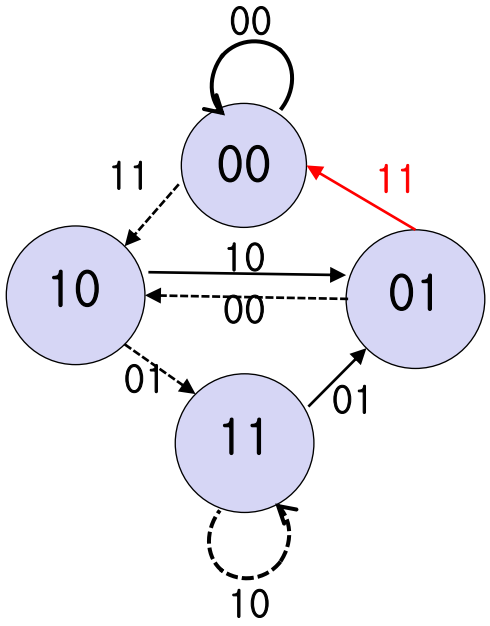
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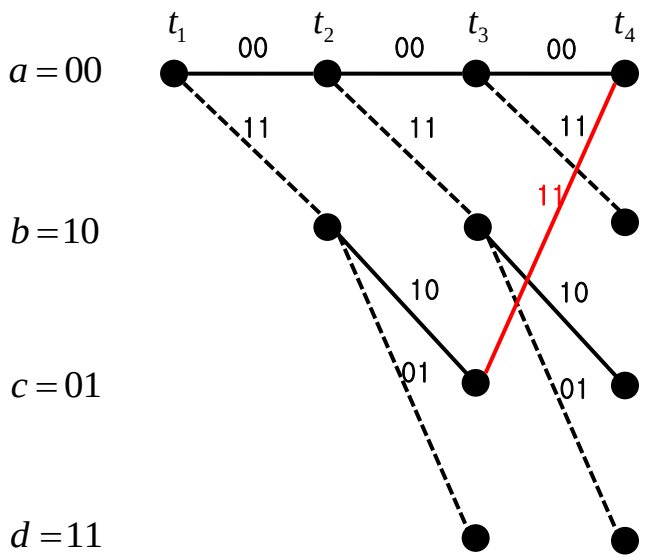
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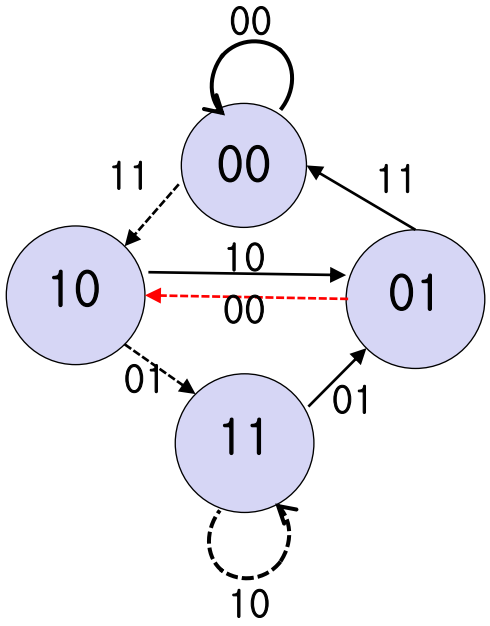
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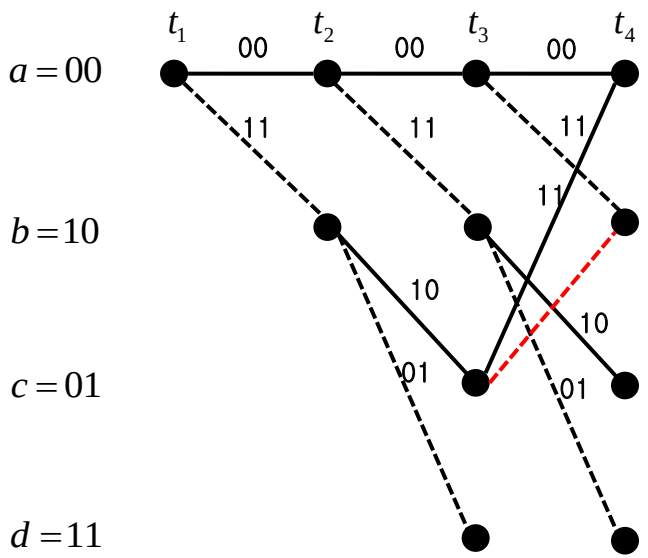
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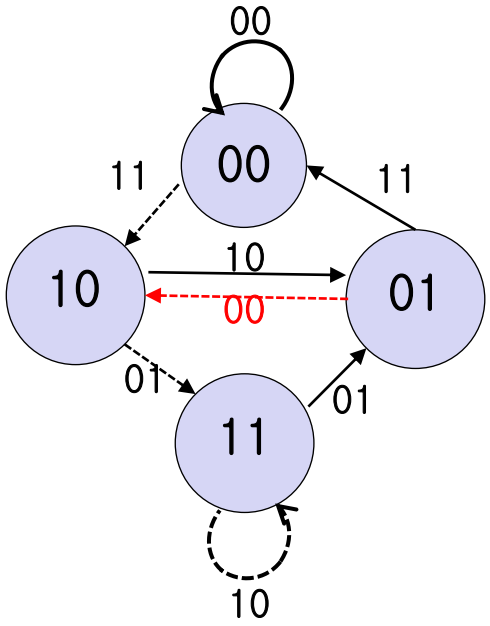
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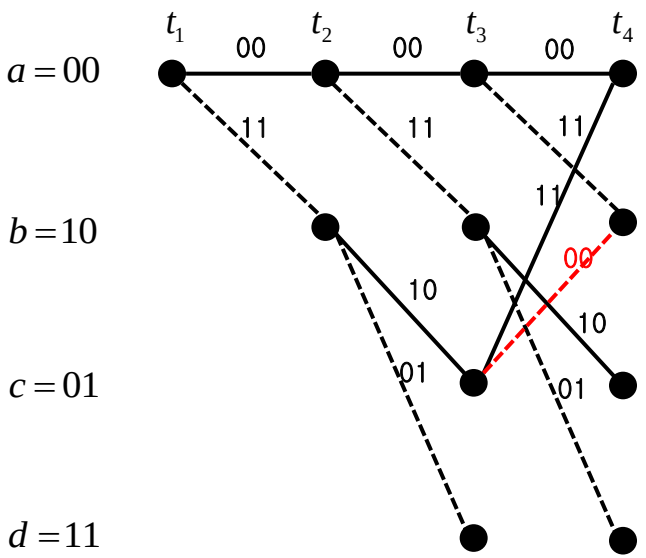
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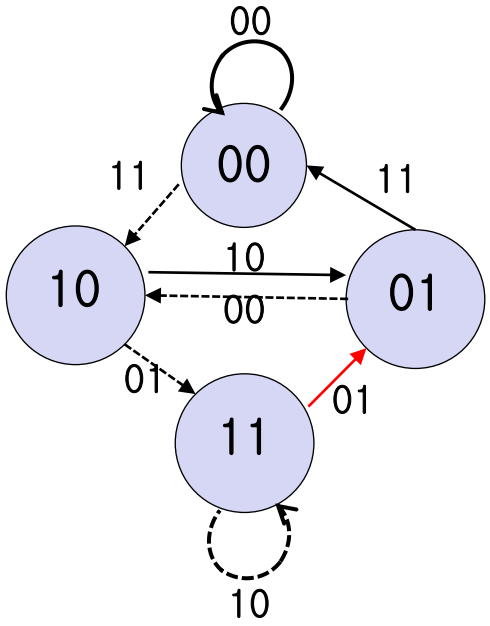
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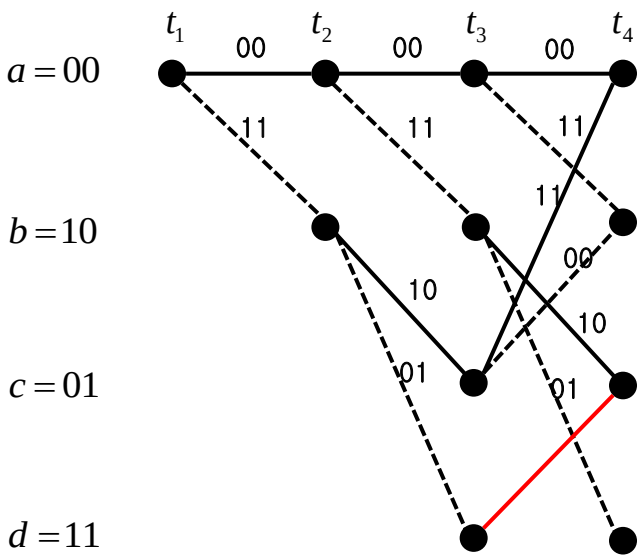
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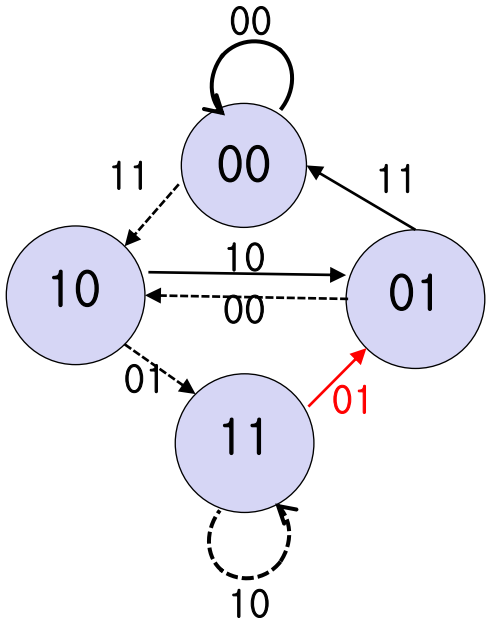
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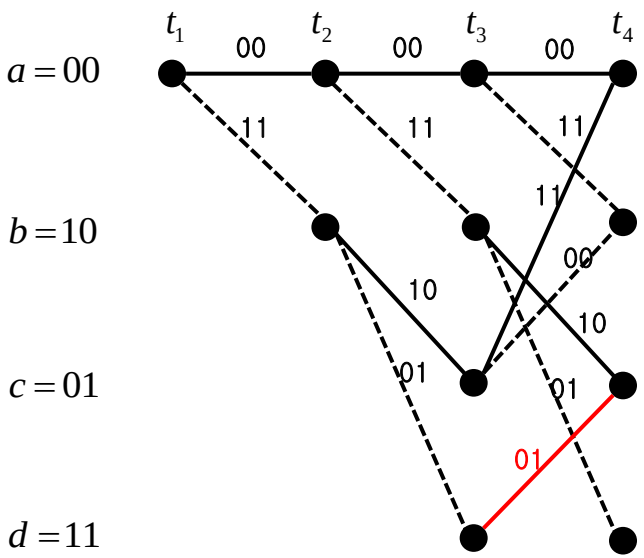
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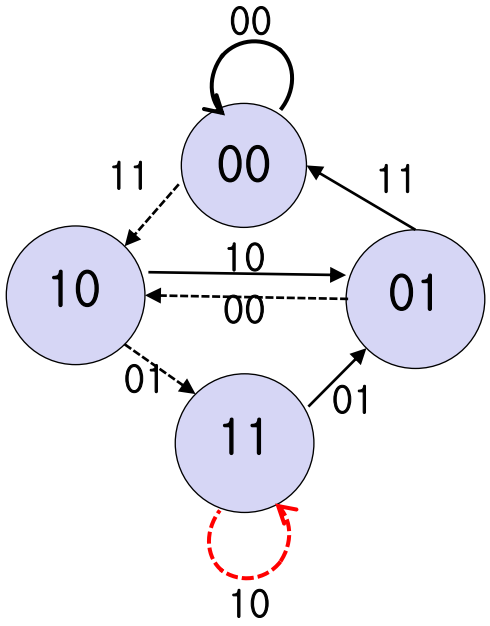
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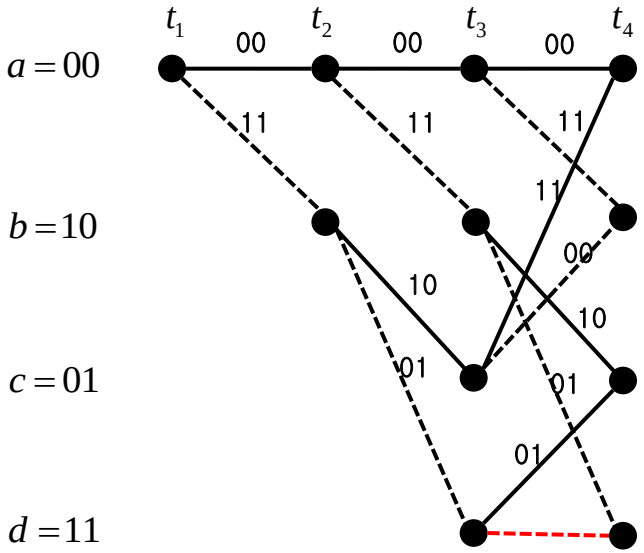
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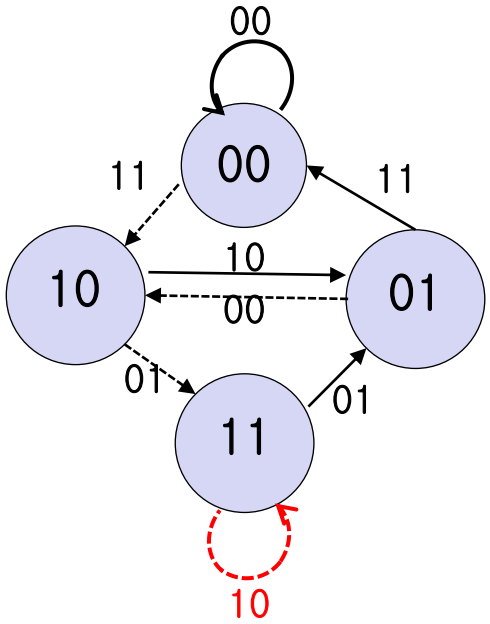
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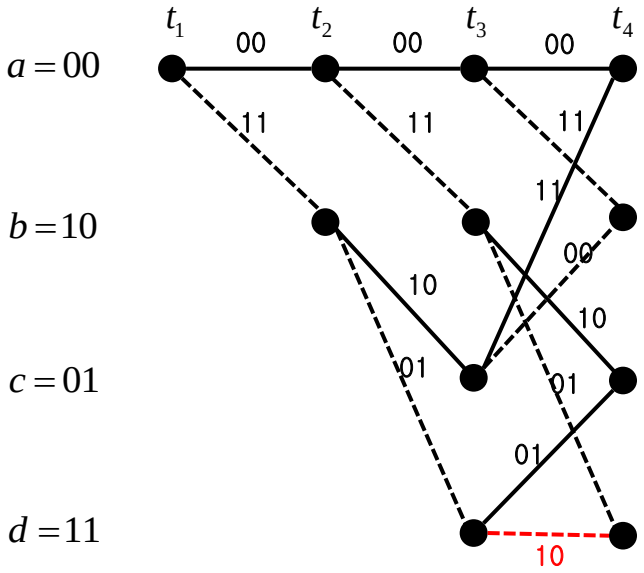
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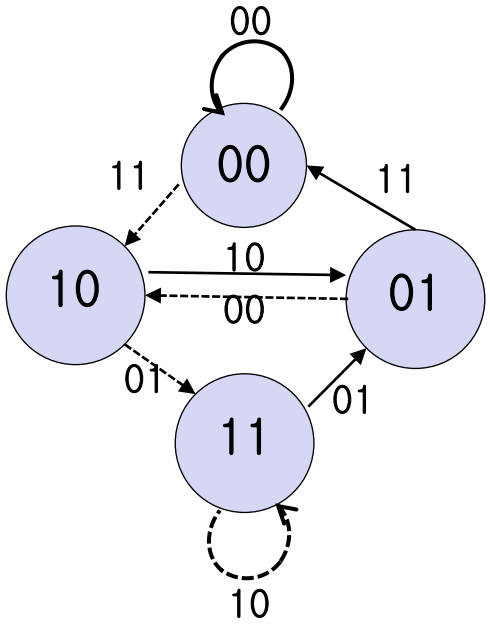
$b = 10$
00
10
10
01
01
01
$c = 01$
01
$d = 11$
10


00
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01
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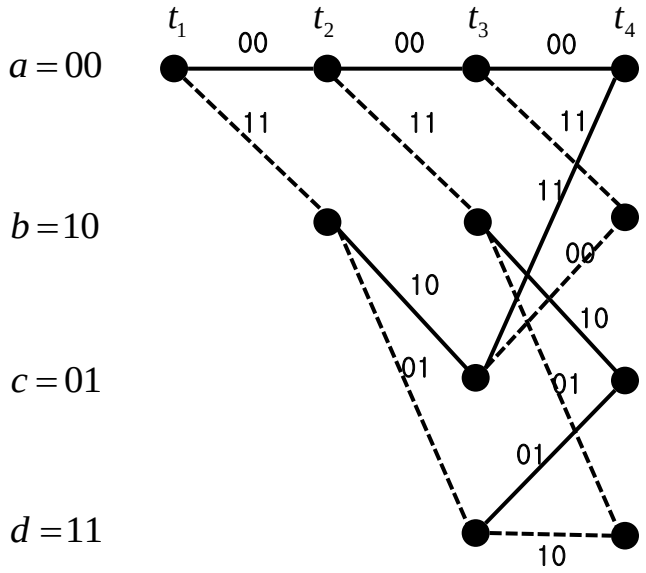
t_1
t_2
t_3
t_4
00
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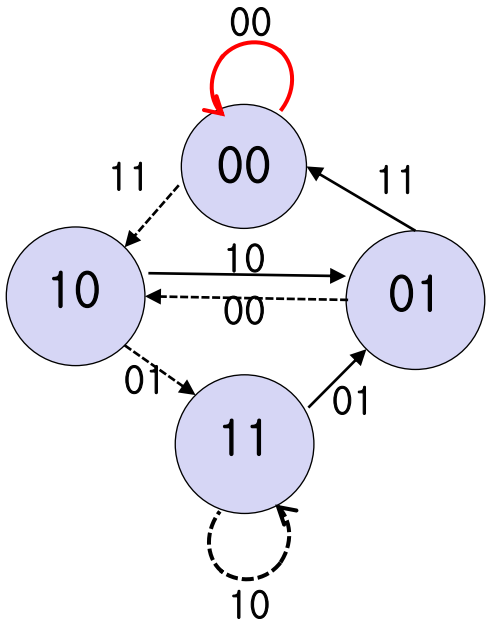
$a = 00$
11
11
11
11
$b = 10$
00
10
10
01
01
01
$c = 01$
01
$d = 11$
10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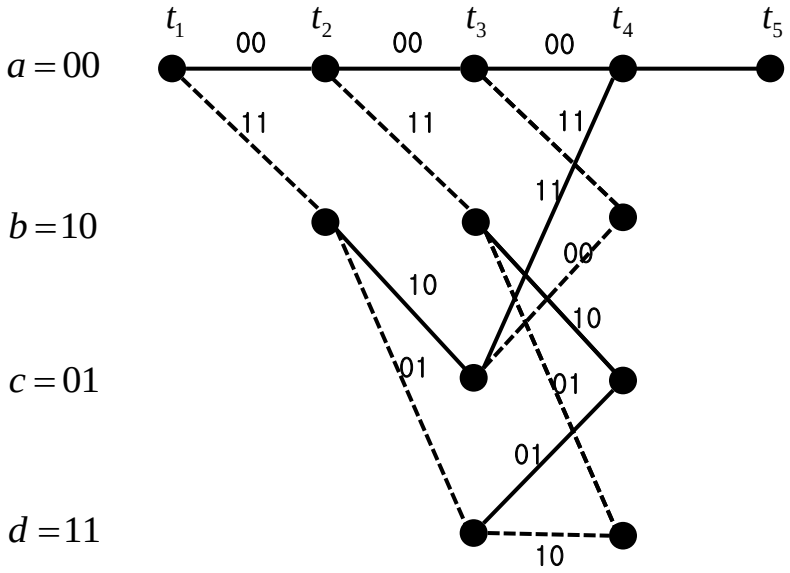
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
11
11
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11
00
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01
01
01
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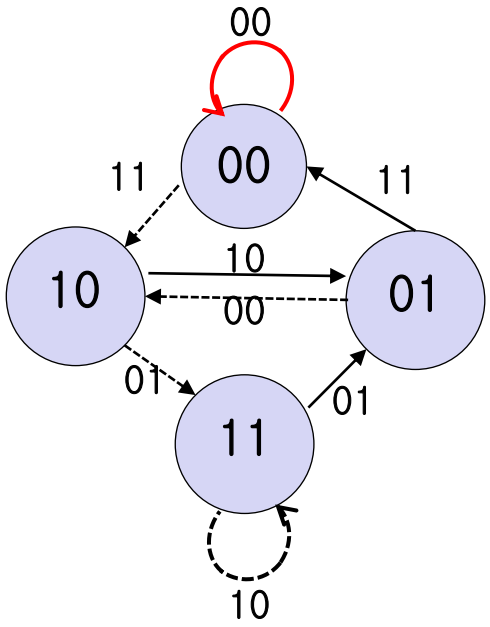
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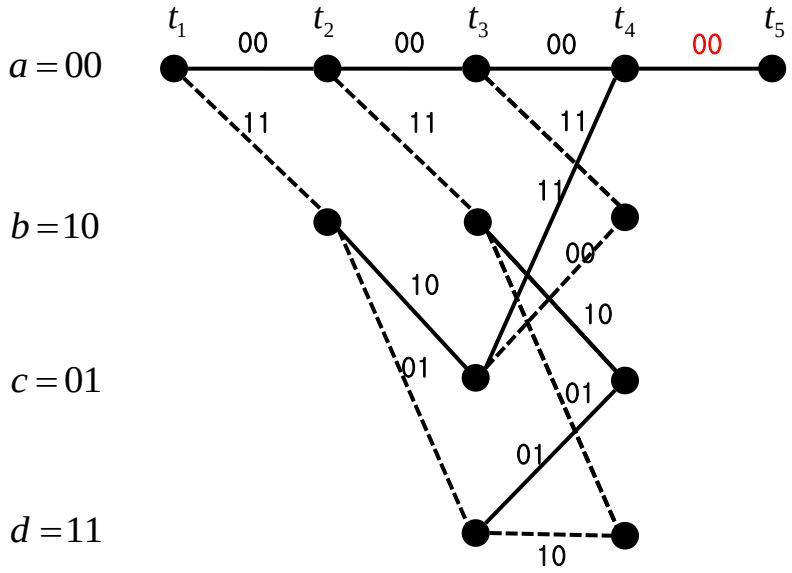
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
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11
10
00
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01
01
01
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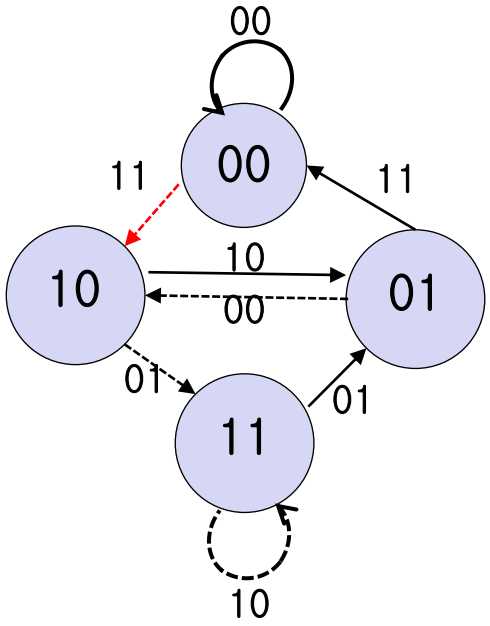
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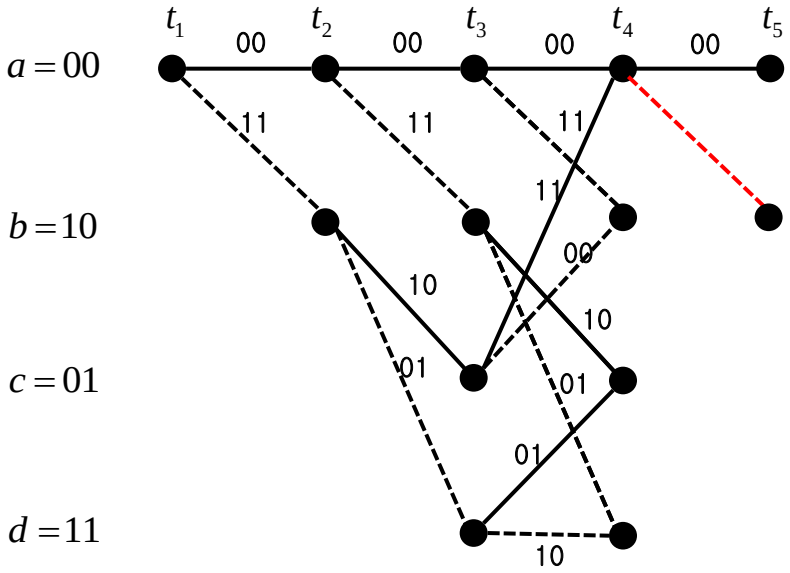
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
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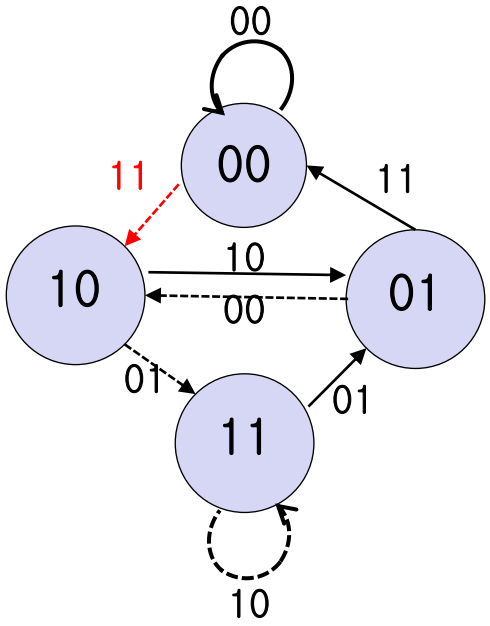
11
11
11
11
10
00
10
01
01
01
10


00
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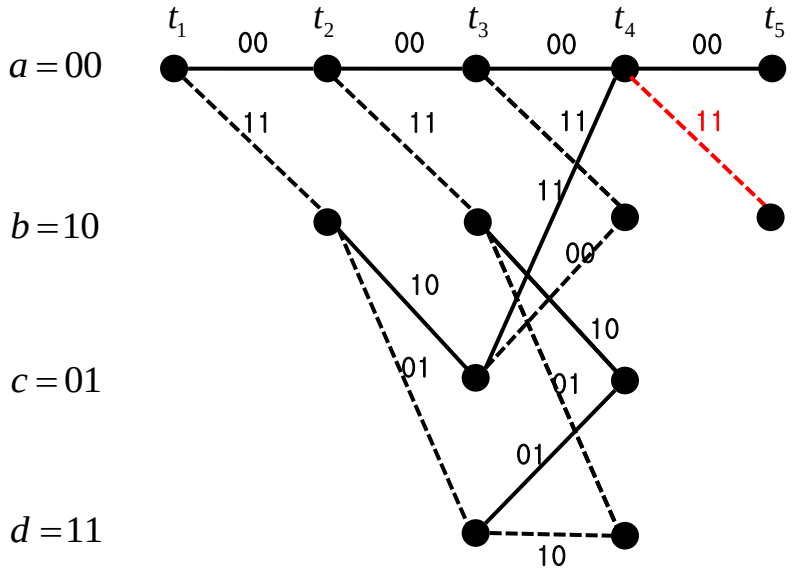
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
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11
11
11
11
11
00
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01
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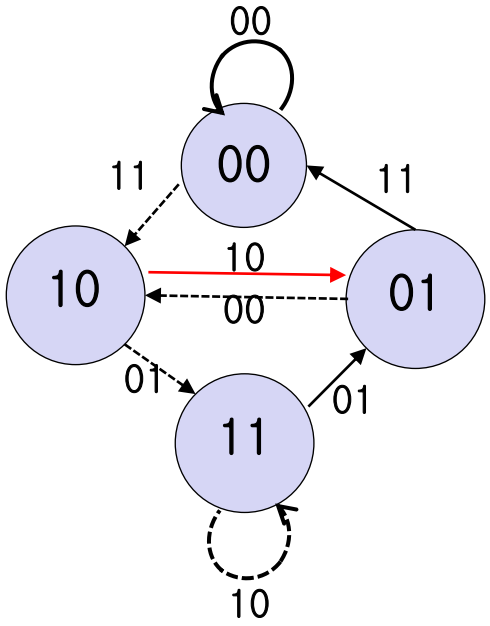
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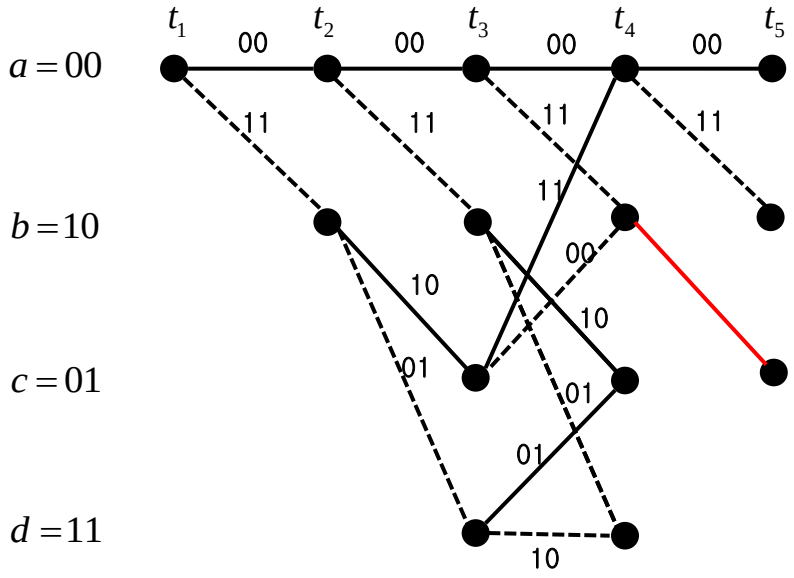
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
00
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11
11
11
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10
00
10
01
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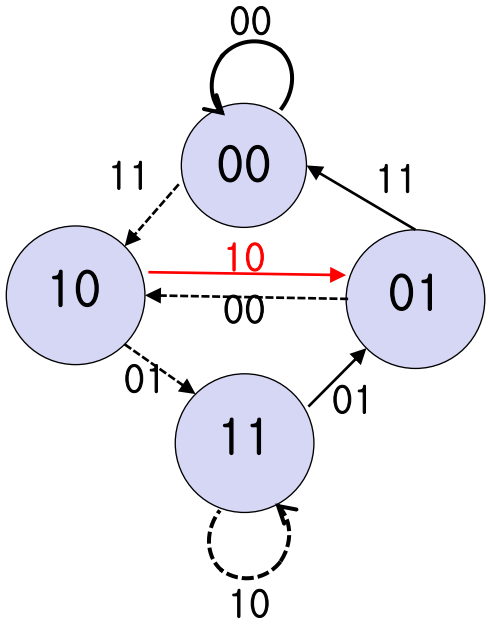
10


00
11
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10
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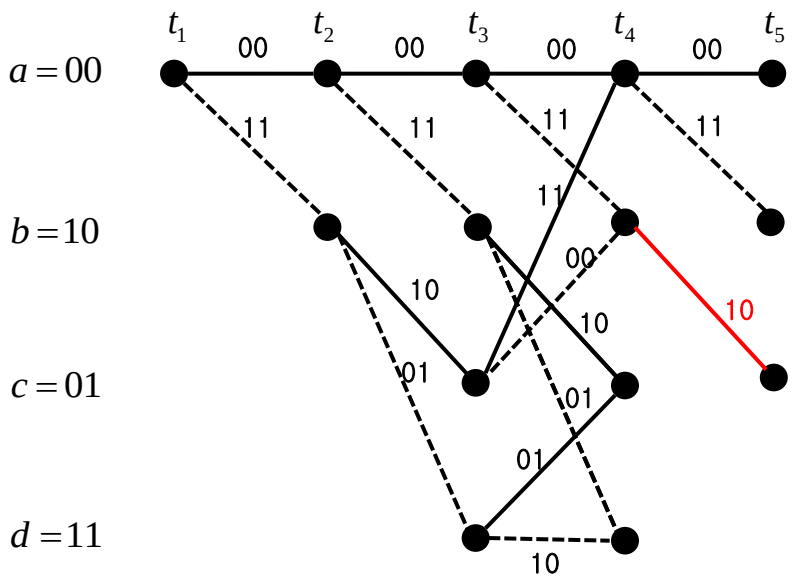
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
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11
11
11
11
11
10
00
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01
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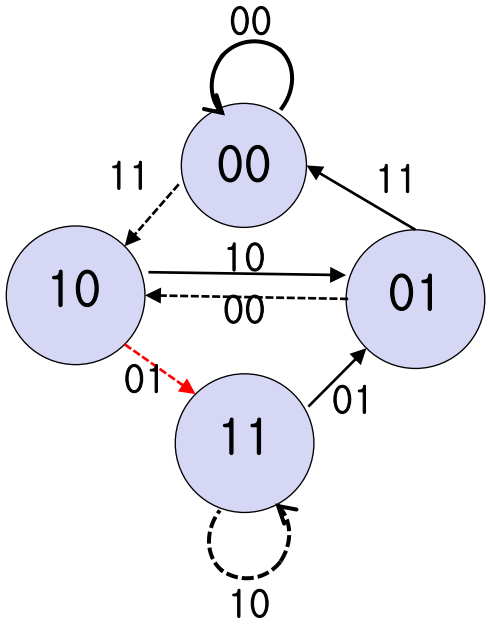
01
10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11
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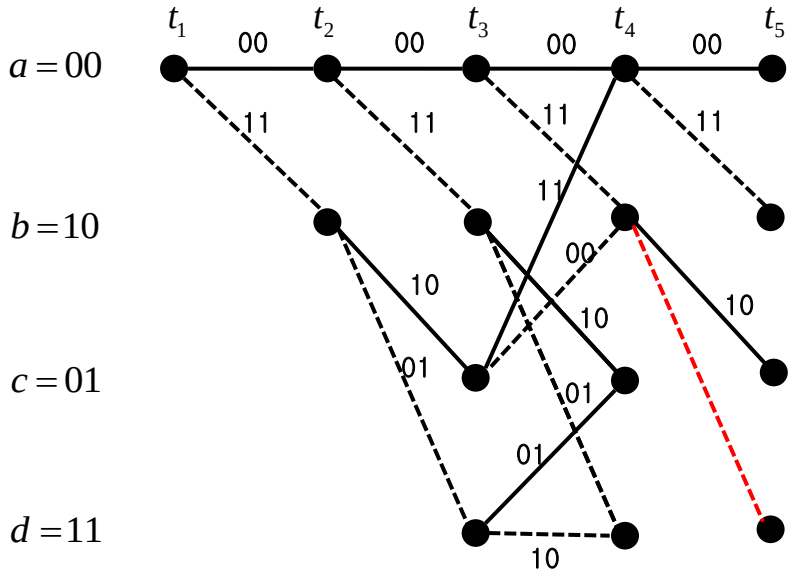
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
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00
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11
11
11
11
11
10
00
10
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01
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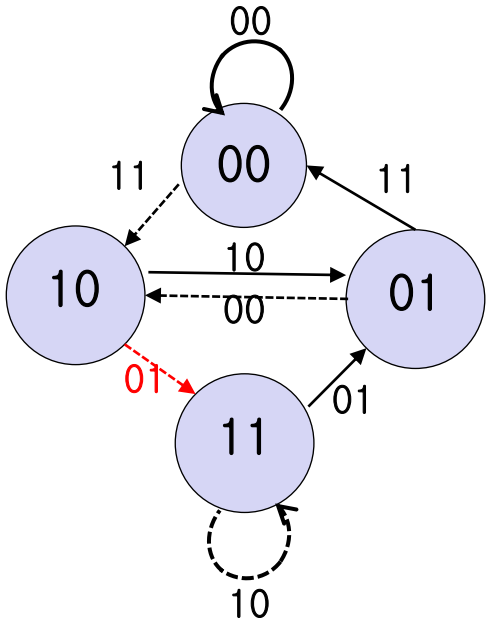
10


00
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10
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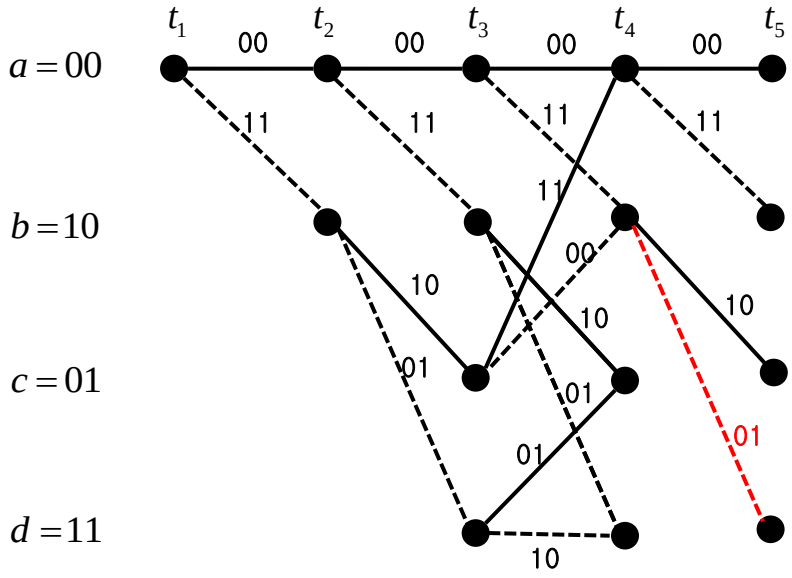
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
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11
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11
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00
10
10
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01
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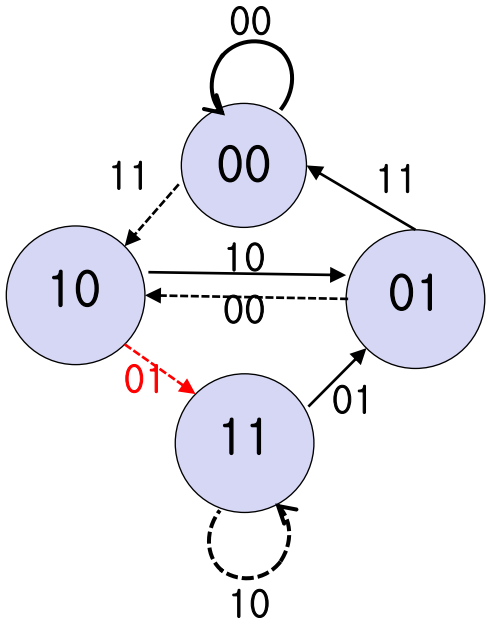
01
10


00
11
00
11
10
10
01
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11
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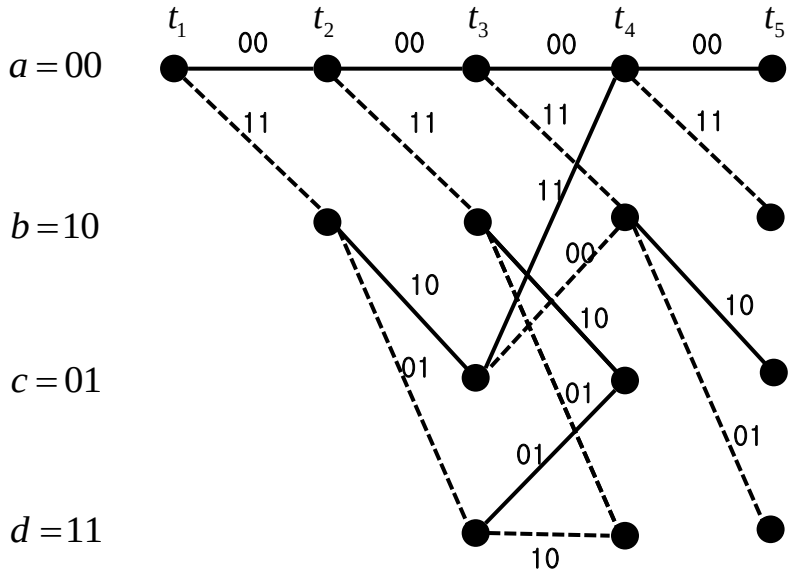
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
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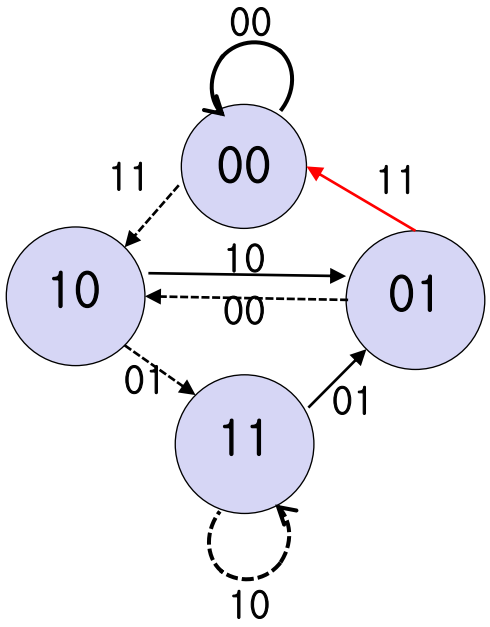
11
11
11
11
11
10
00
10
10
01
01
01
01
10


00
11
00
11
10
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01
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11
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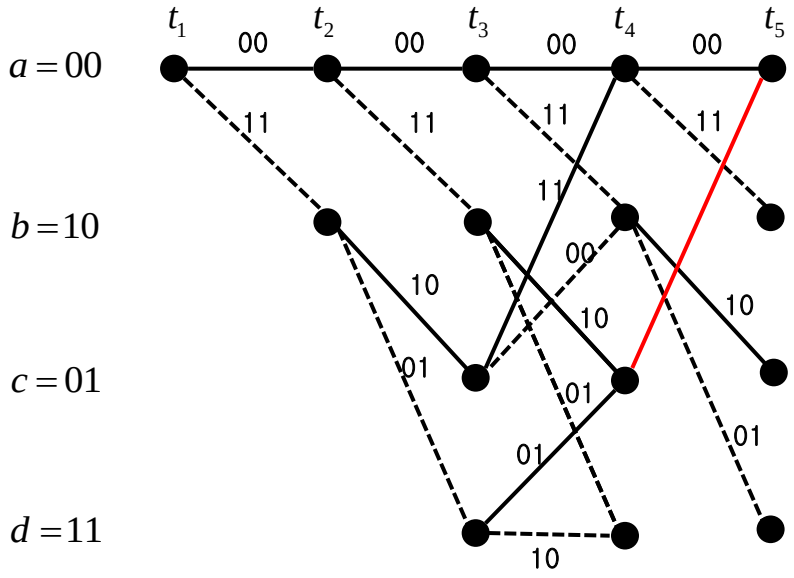
$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
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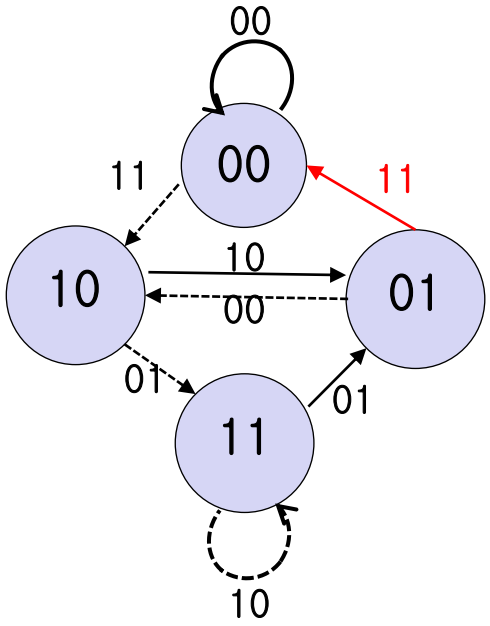
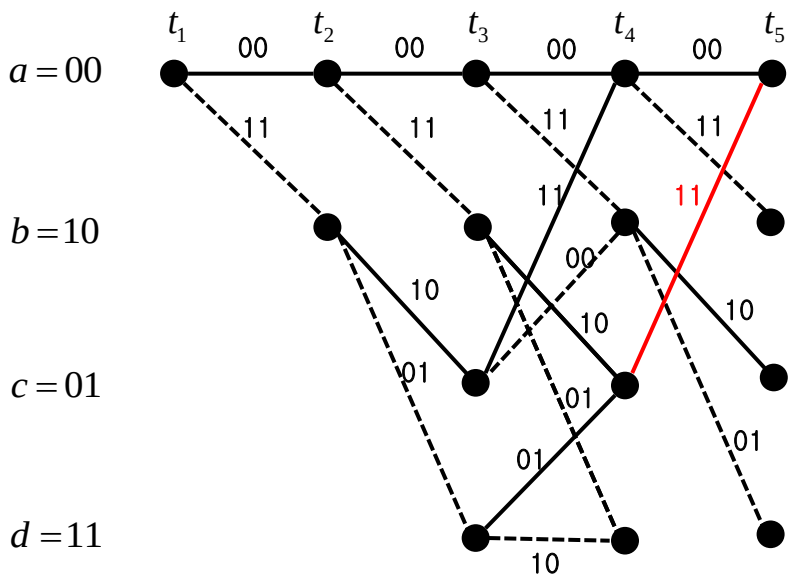
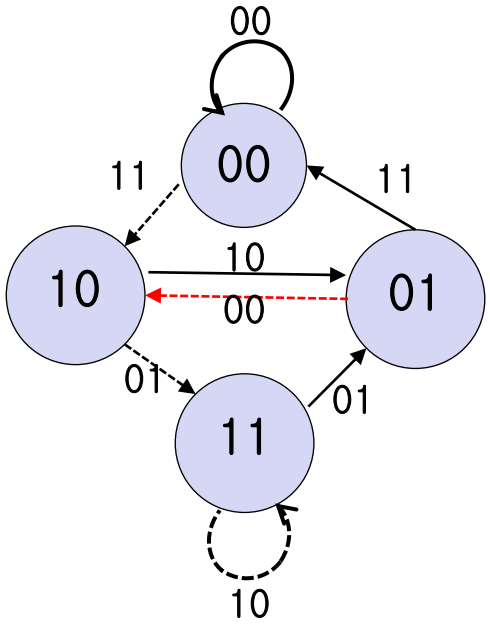
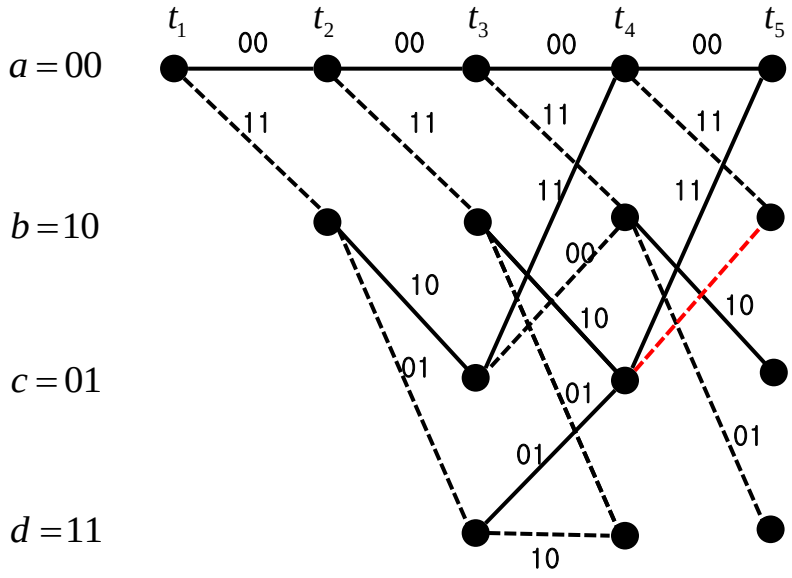
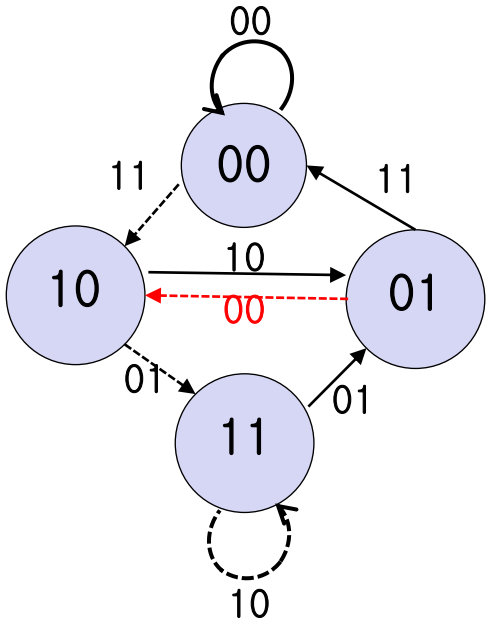
11
11
11
11
11
10
00
10
10
01
01
01
01
10

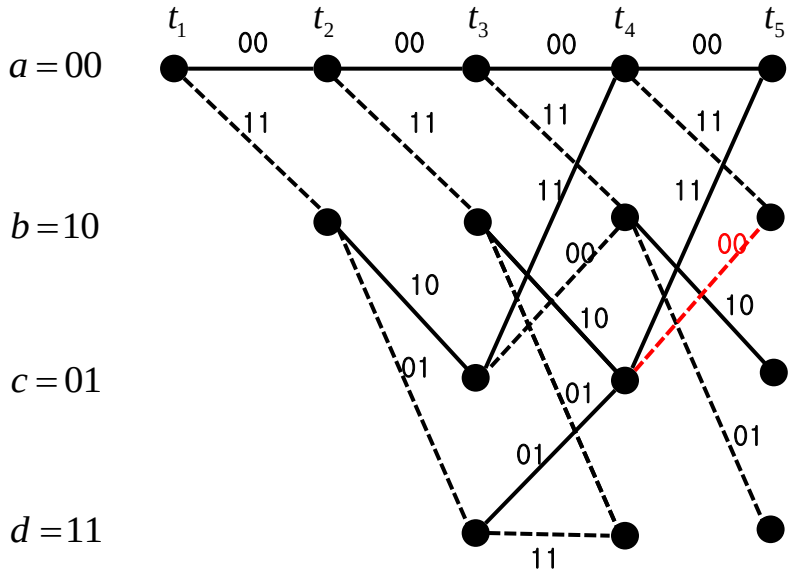

00
11
00
11
10
10
01
00
01
01
11
10

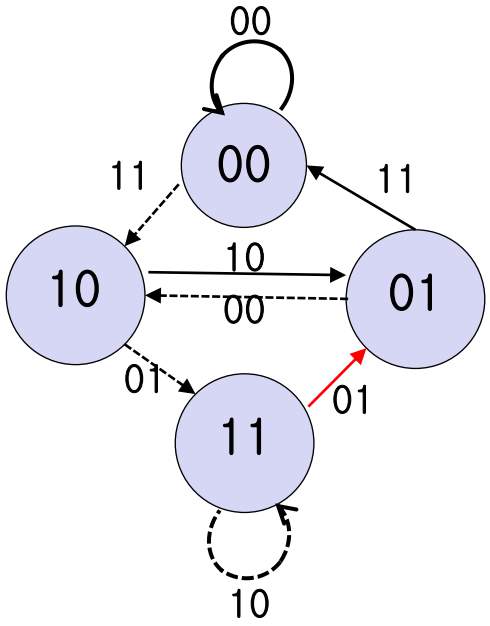

$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
00
00
00
11
11
11
11
11
11
10
10
10
10
00
01
01
01
01
01
10

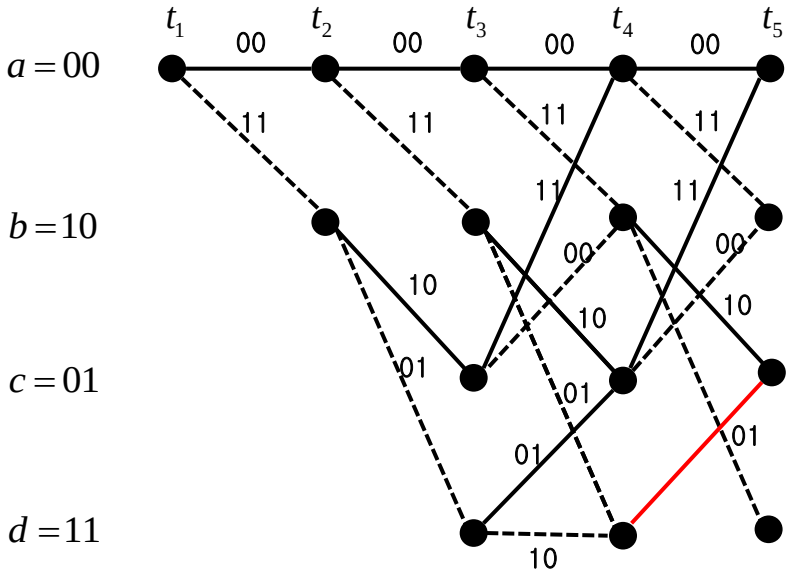

00
11
00
11
10
10
01
00
01
01
11
10

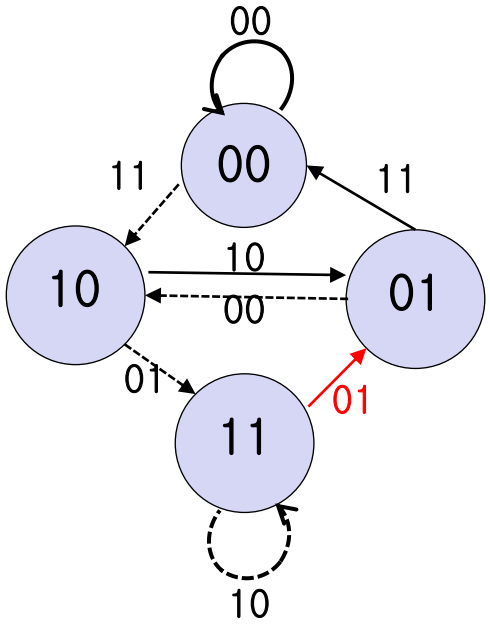

$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
11
10
01

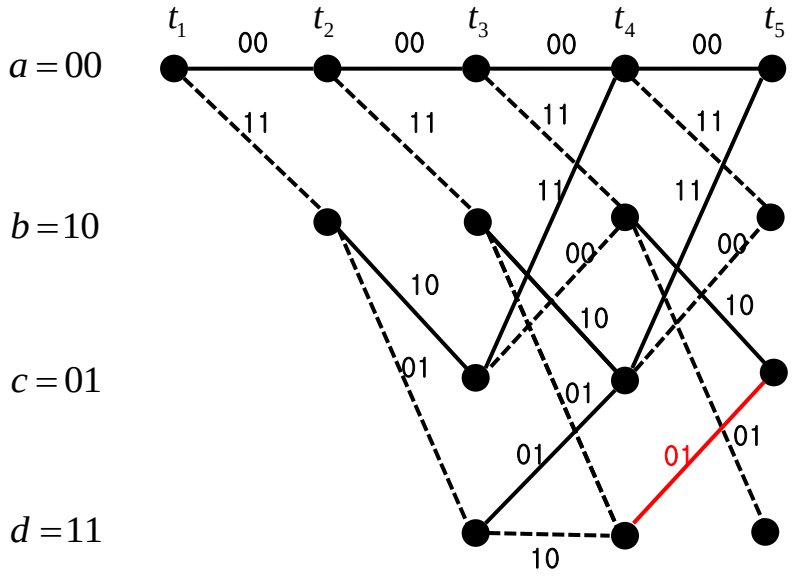

00
11
00
11
10
10
01
00
01
01
11
10

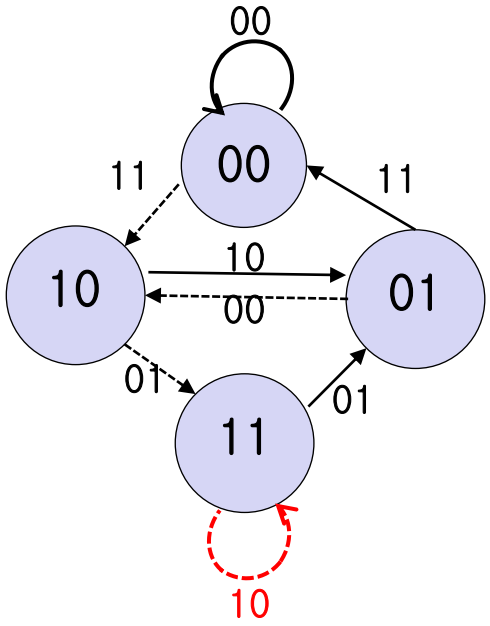

$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
11
10
01

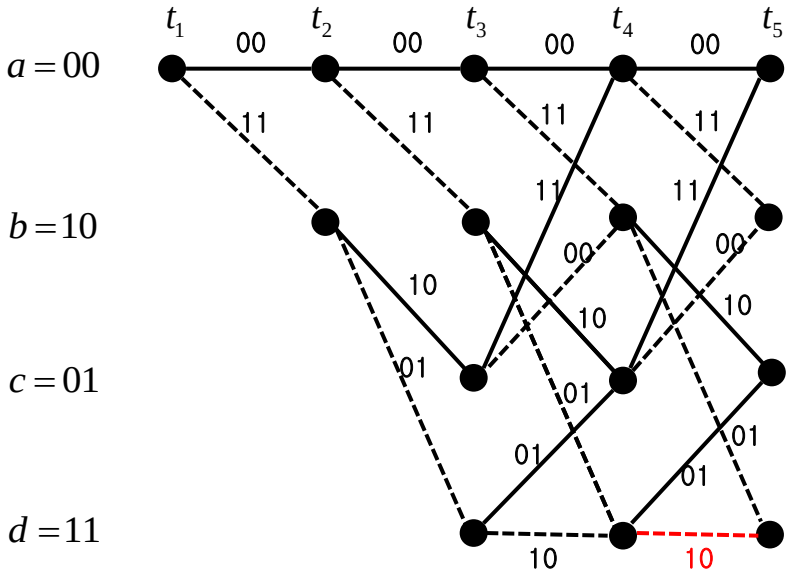

00
11
00
11
10
10
01
00
01
01
11
10

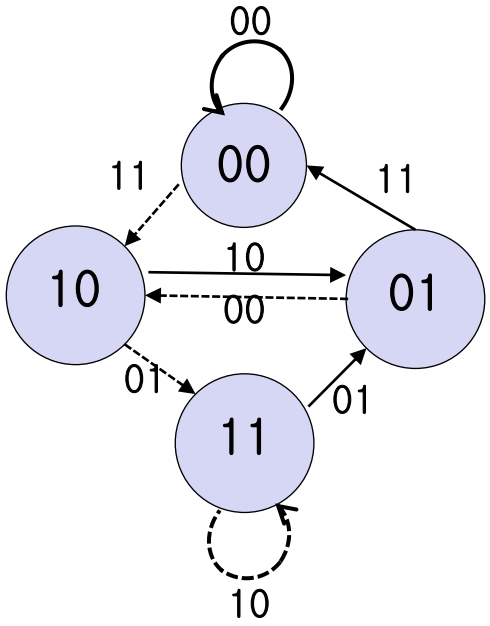

$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
11
10
01

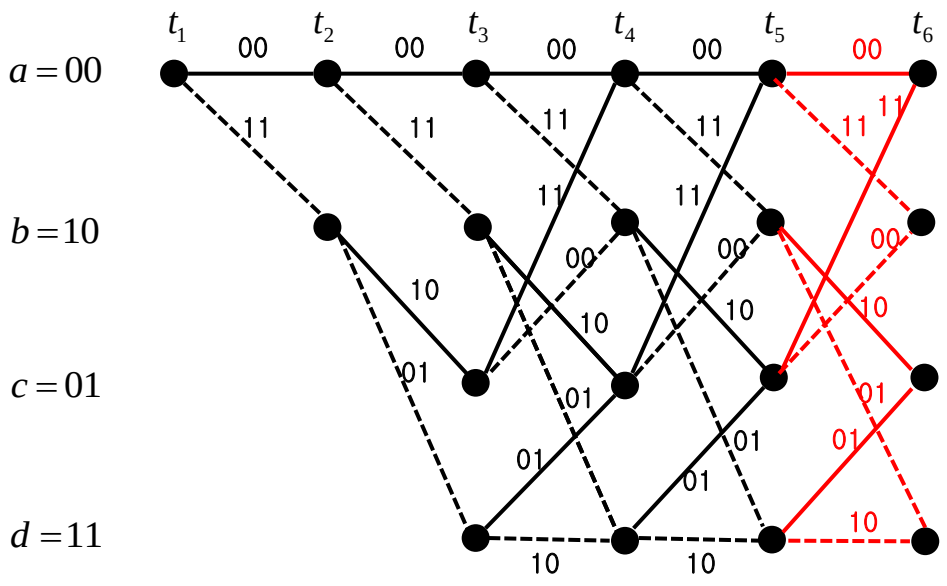

00
11
00
11
10
10
01
00
01
01
11
10


$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
11
10
01


00
00
11
11
10
01
10
00
01
01
11
10

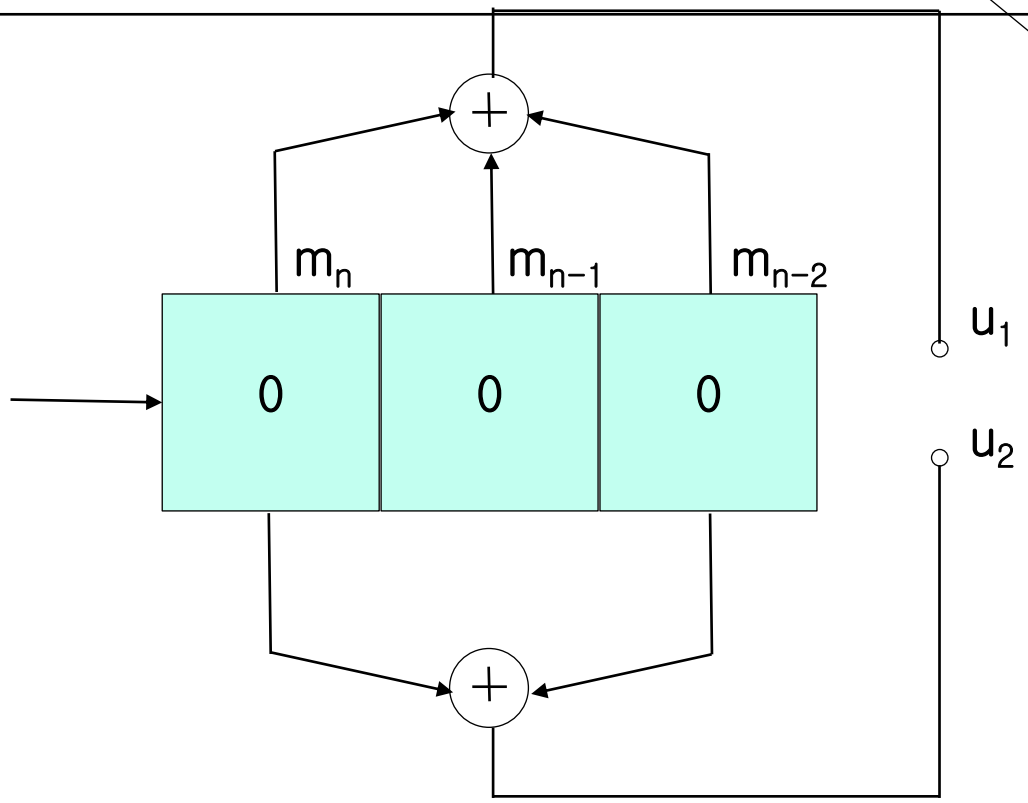

$a = 00$
$b = 10$
$c = 01$
$d = 11$
t_1
t_2
t_3
t_4
t_5
00
11
10
01


00
11
00
11
10
10
01
00
01
01
11
10

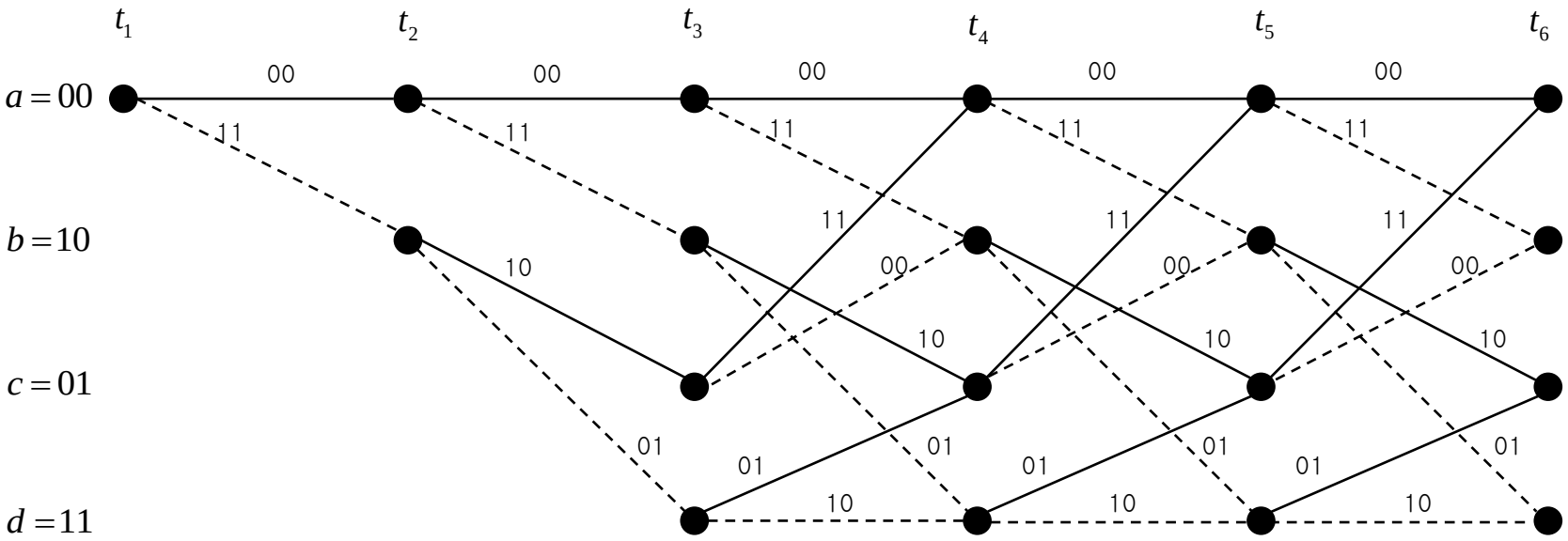

t_1
t_2
t_3
t_4
t_5
t_6
$a = 00$
$b = 10$
$c = 01$
$d = 11$
00
11
10
01

Viterbi decoding

input data sequence	m :	1	1	0	1	1	…
Transmitted codeword	U :	11	01	01	00	01	…
Received sequence	Z :	11	01	01	10	01	…

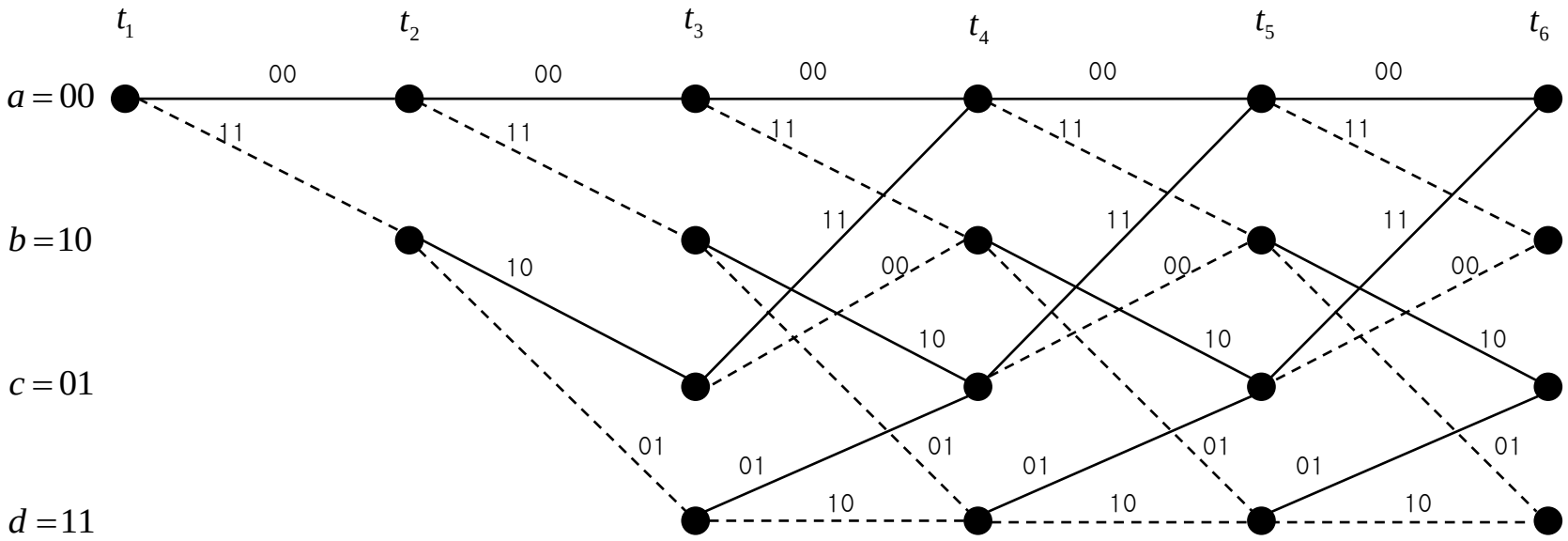


Demodulation error



Prepare the trellis diagram.

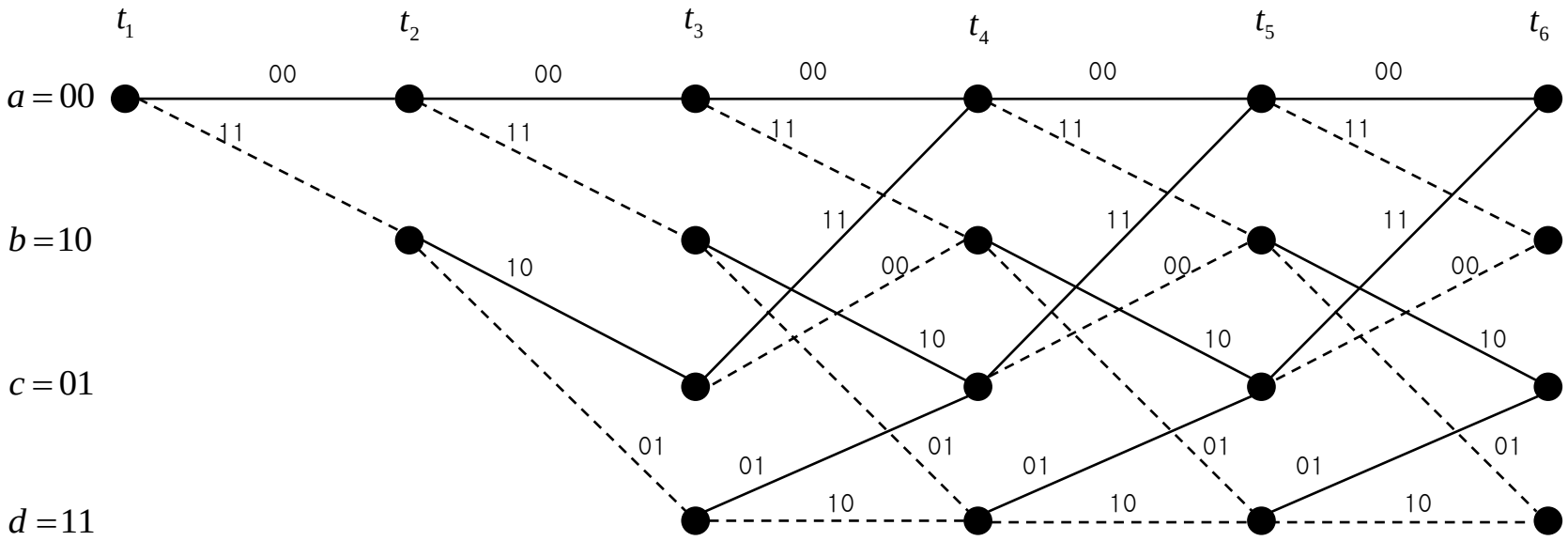
And prepare the table for
the accumulated path metrics and the corresponding encoder input(decoder output)



	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

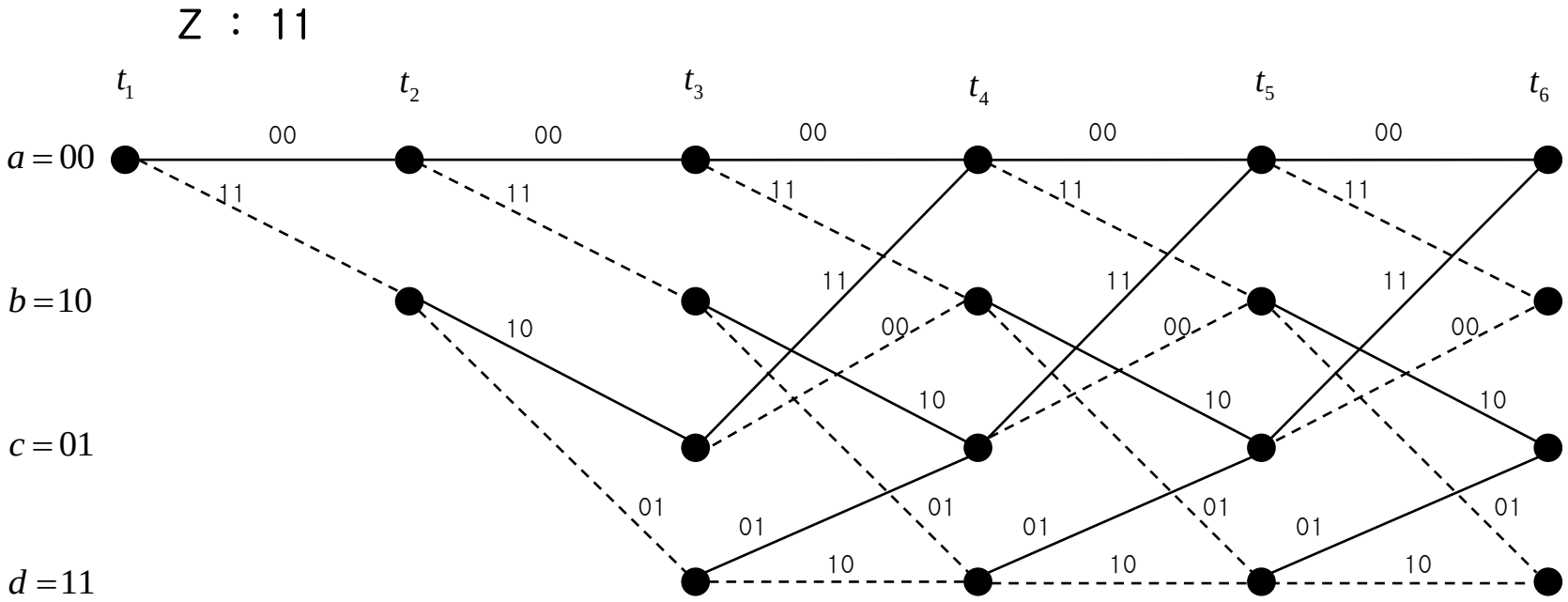
Z= decoder input, received (demodulated) sequence.

Z :



	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

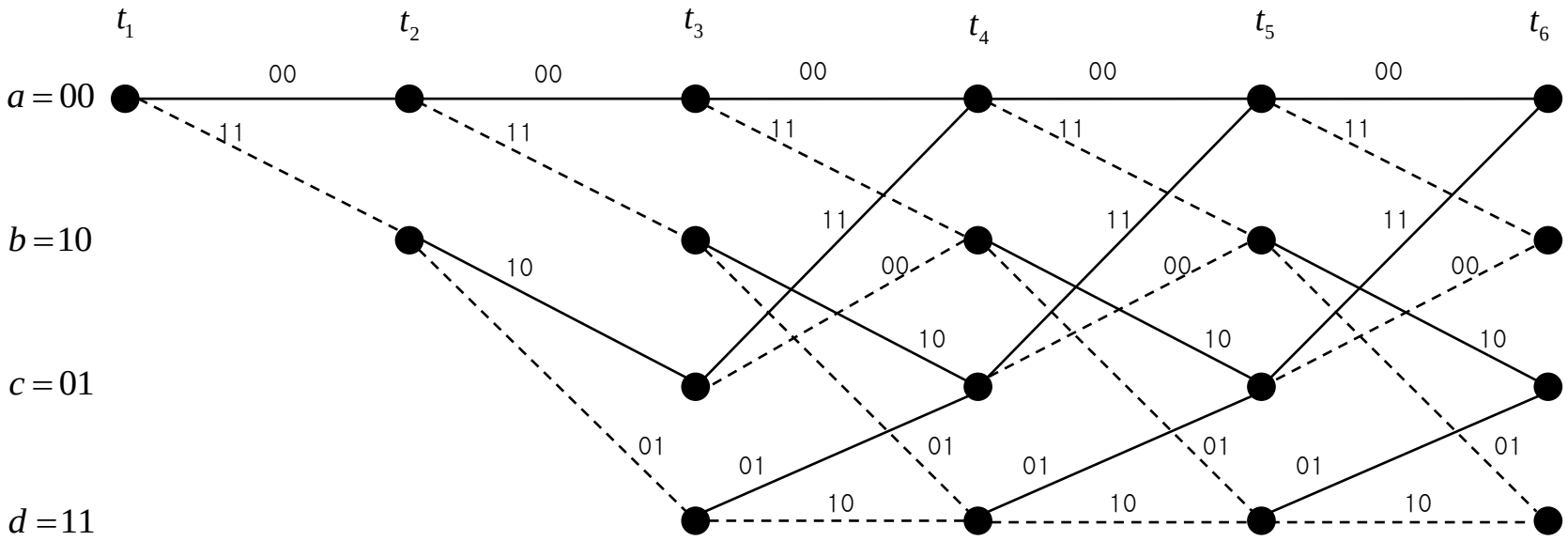
Z= decoder input, received (demodulated) sequence.



	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

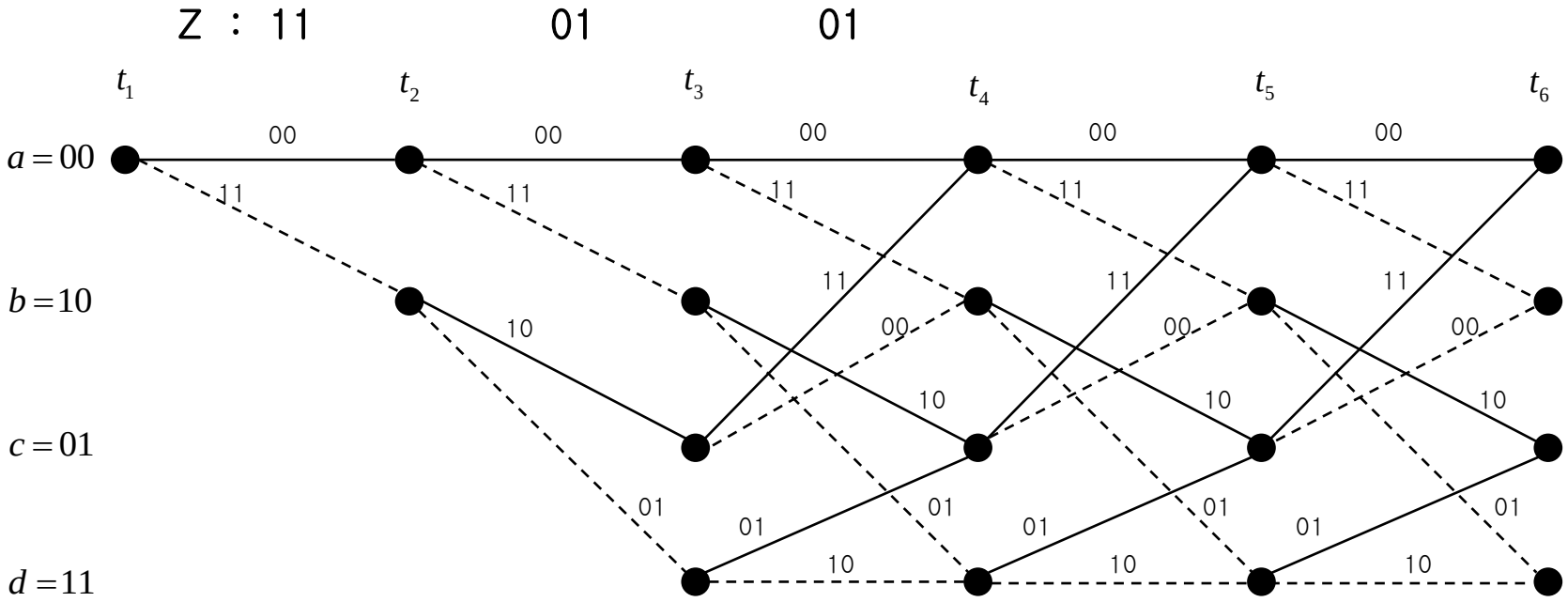
Z= decoder input, received (demodulated) sequence.

Z : 11 01



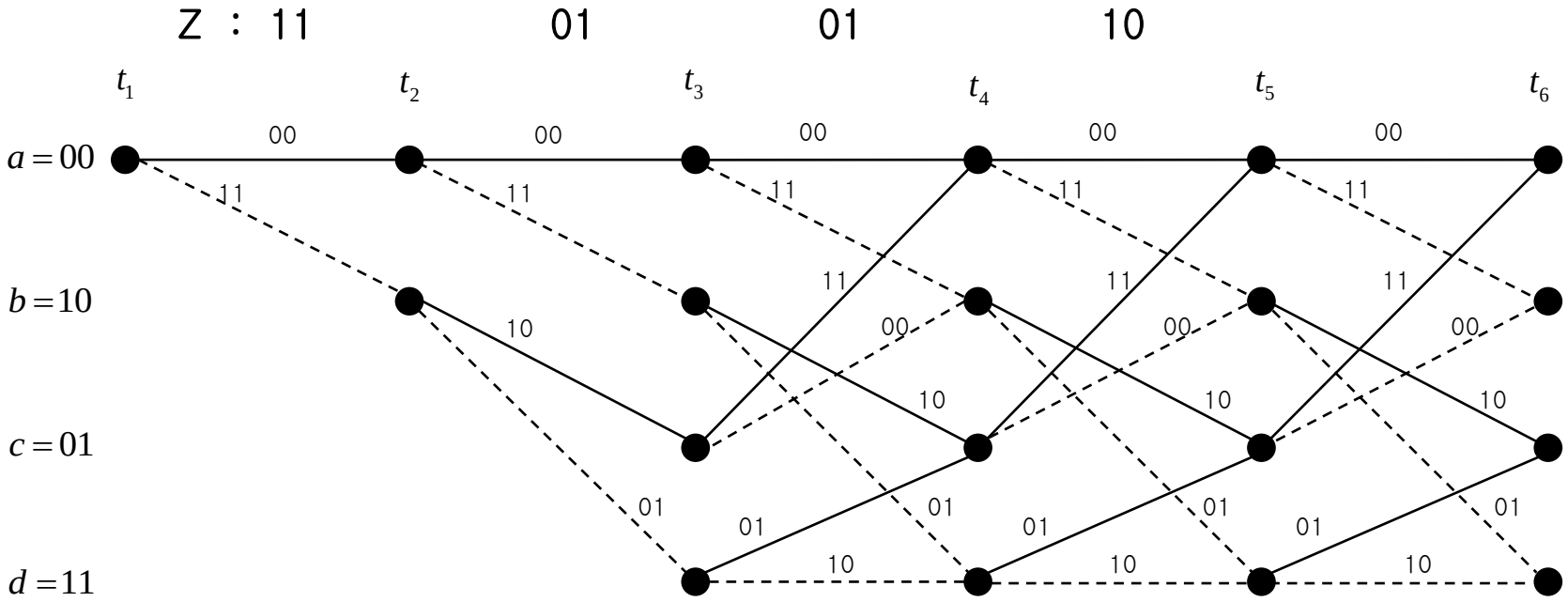
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



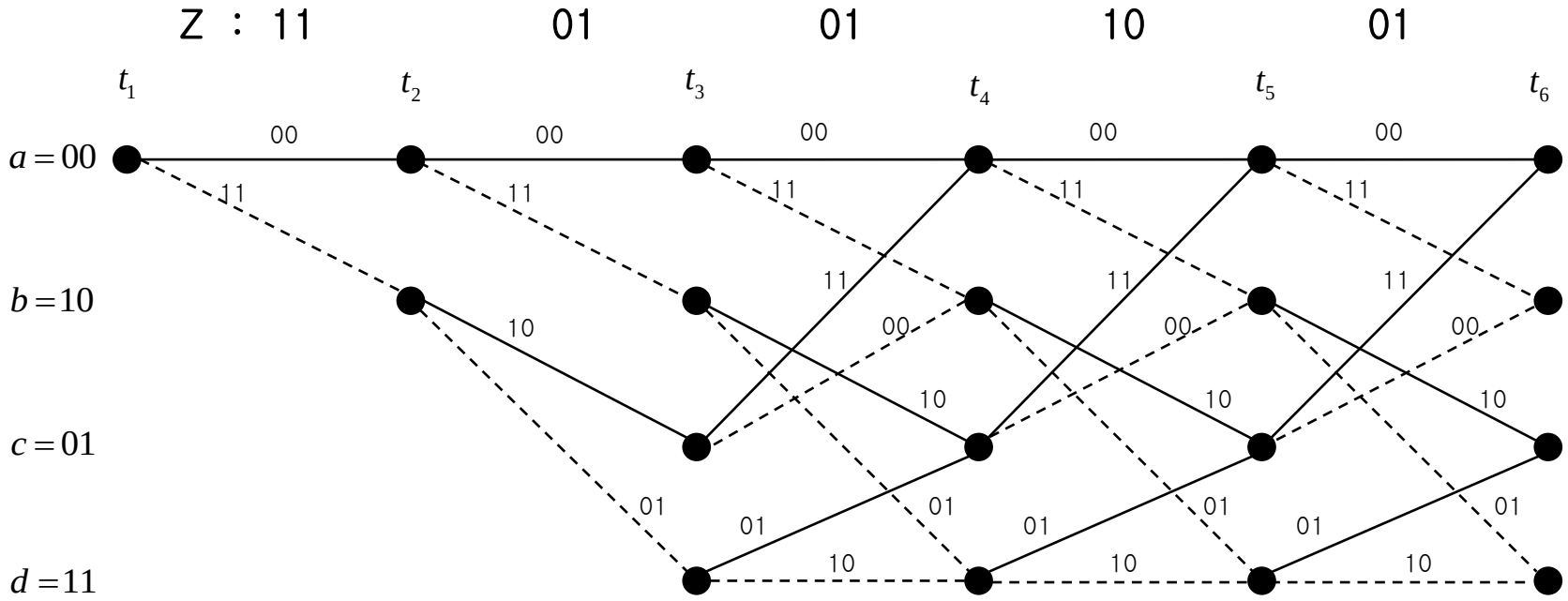
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



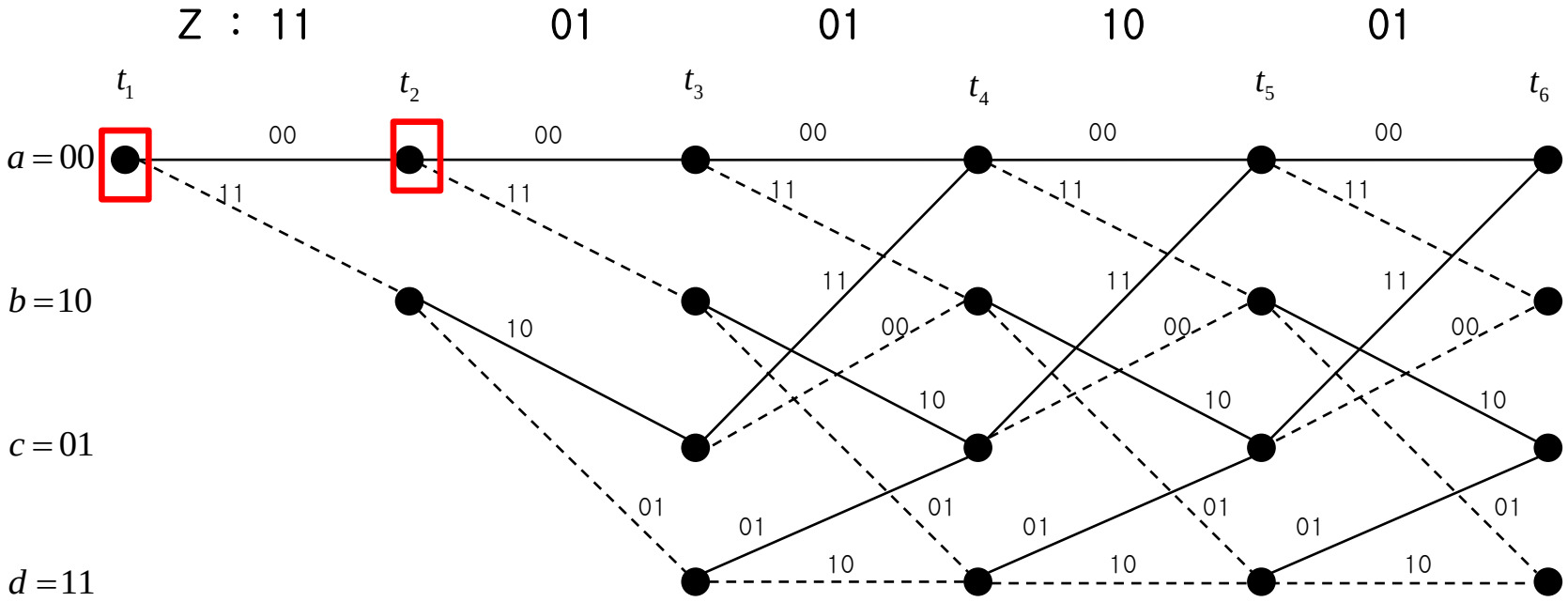
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



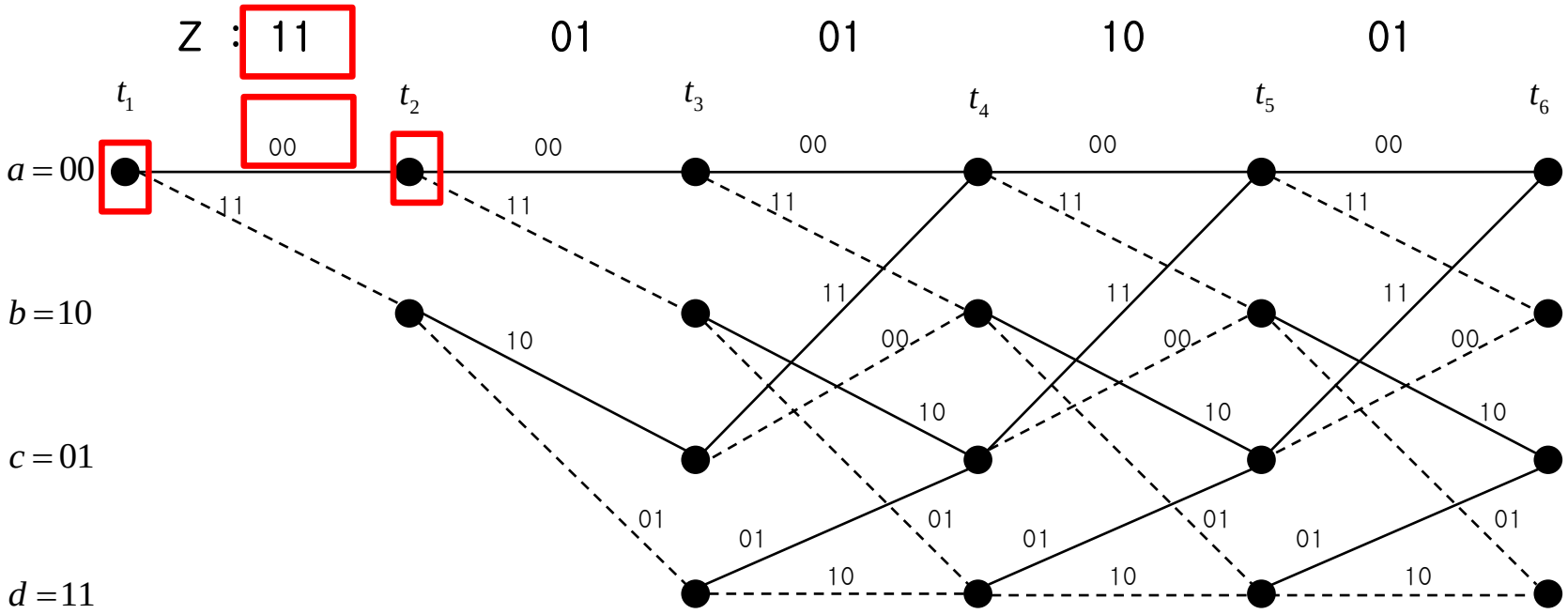
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



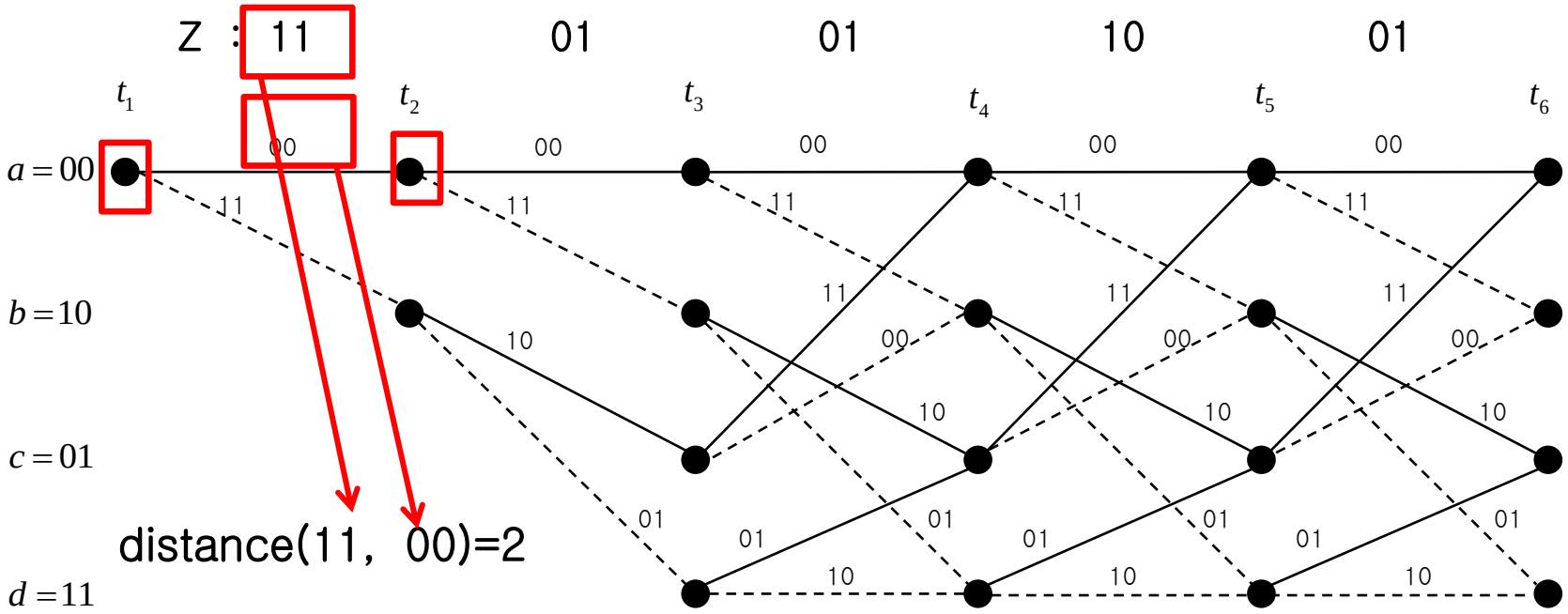
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



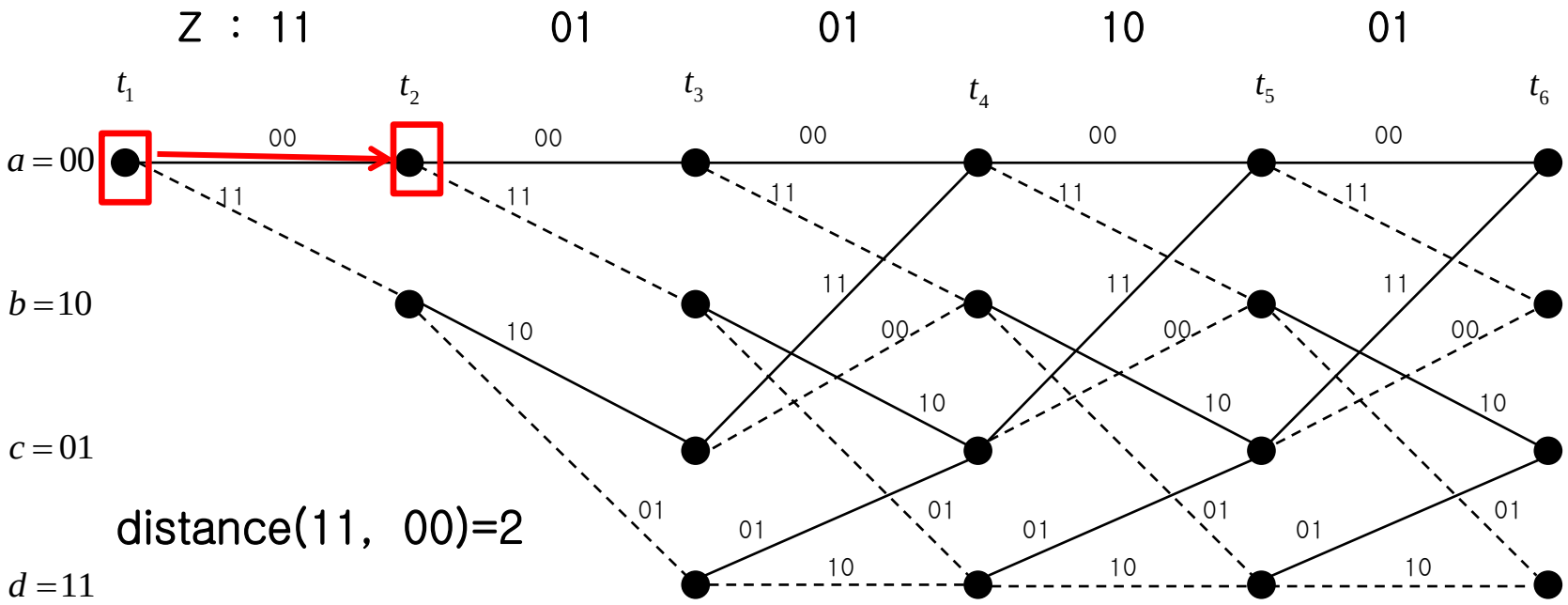
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



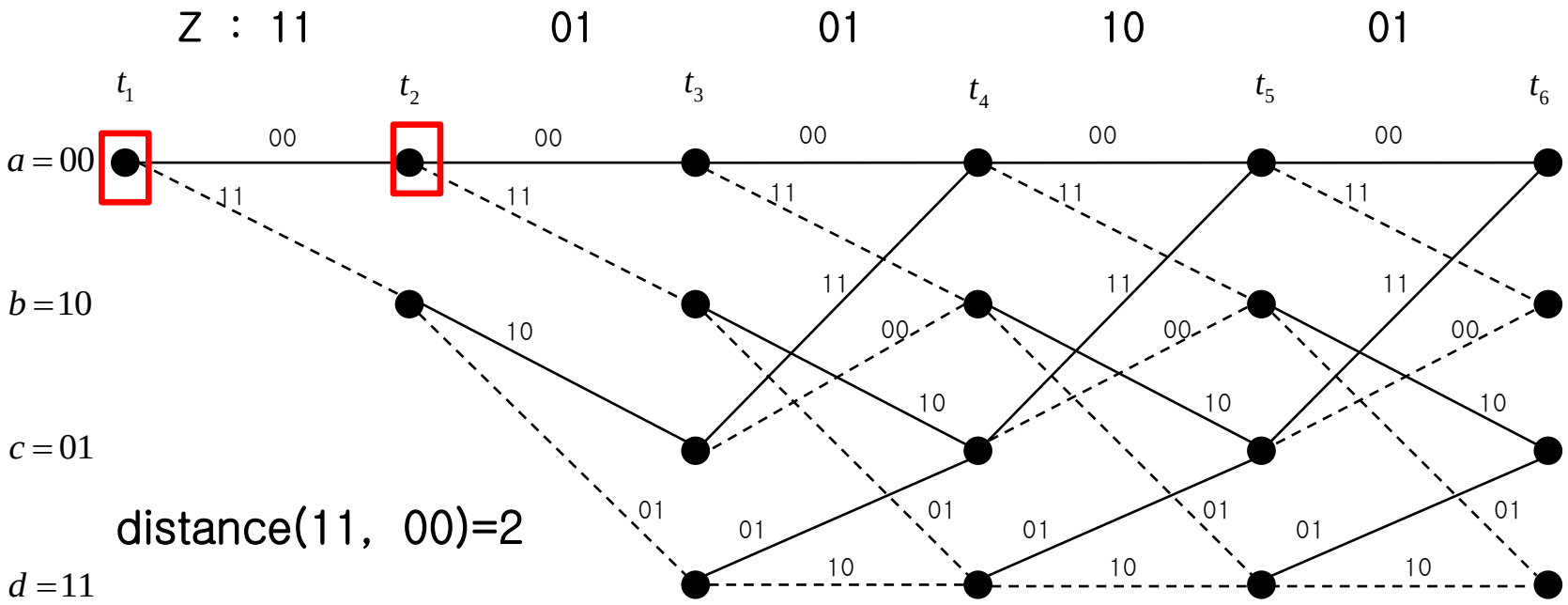
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



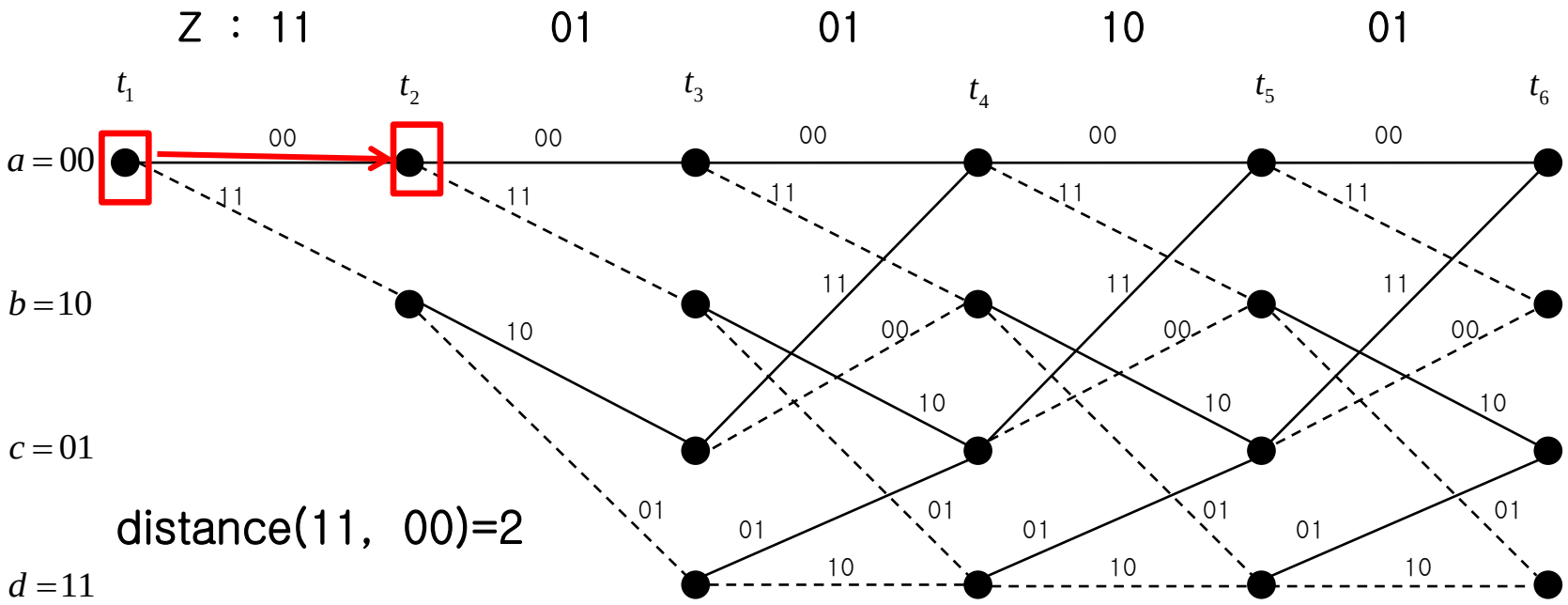
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



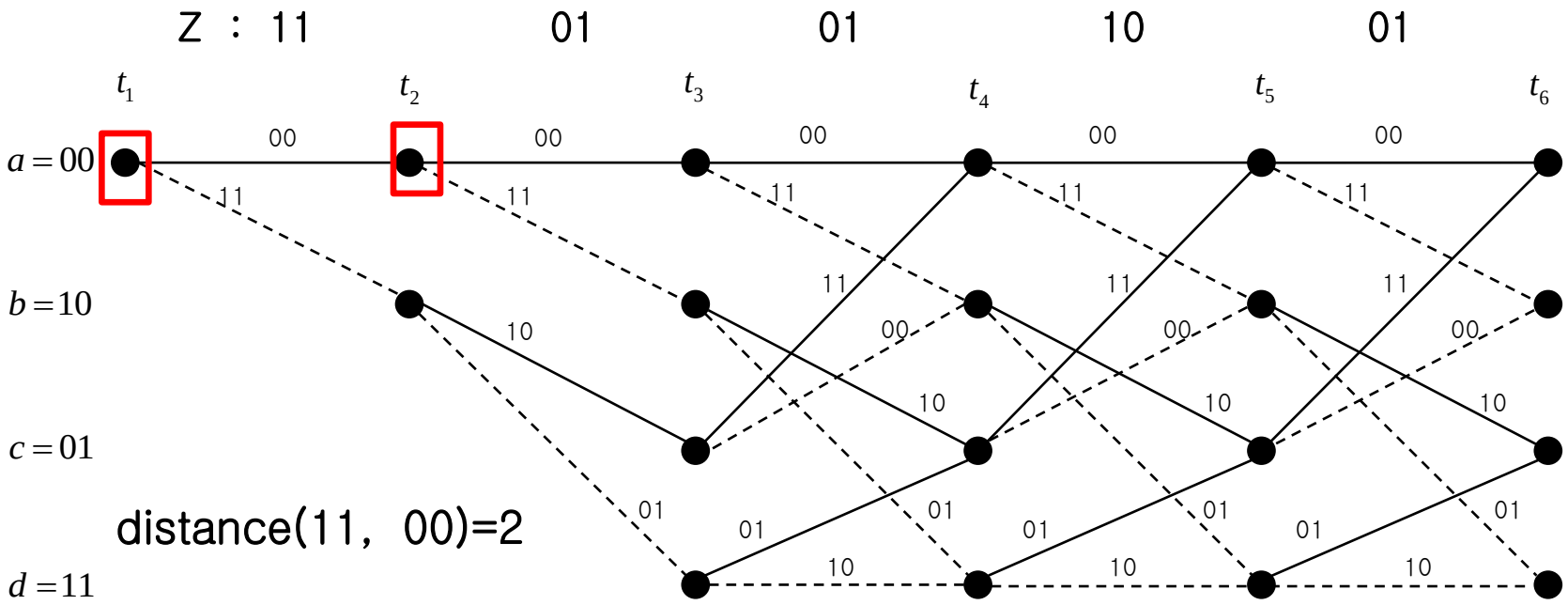
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



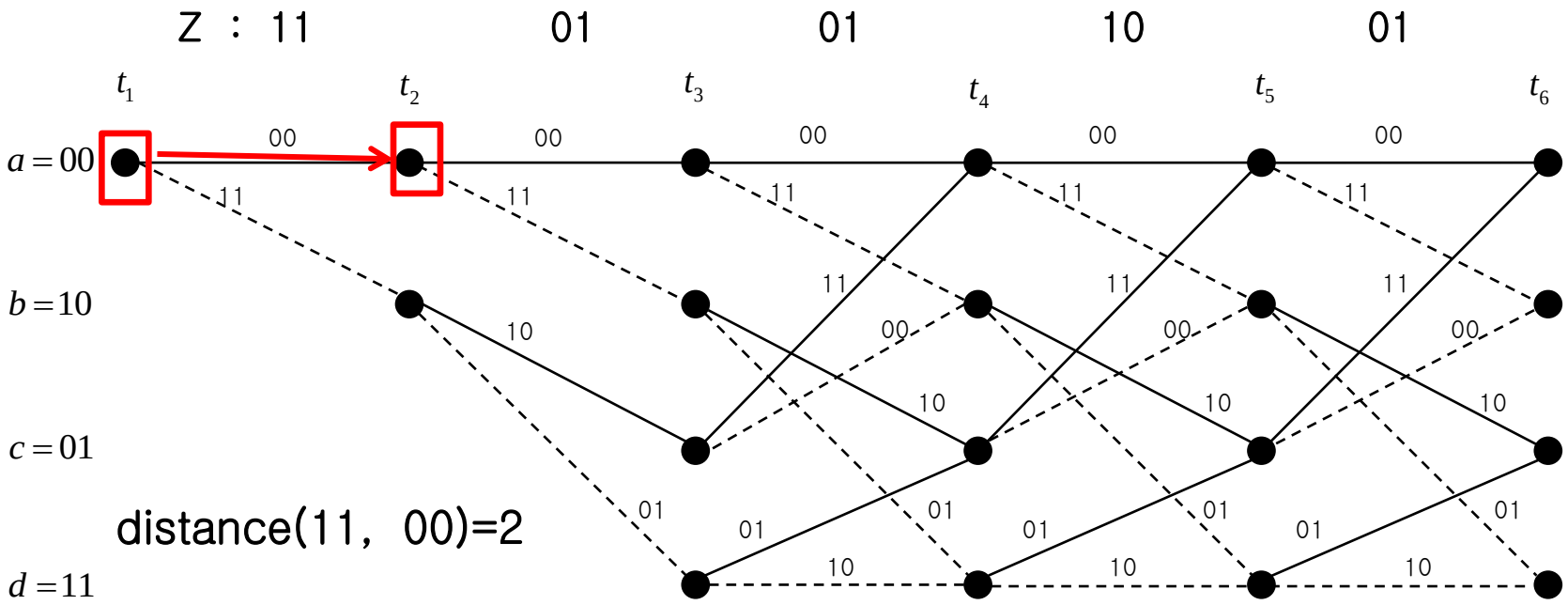
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



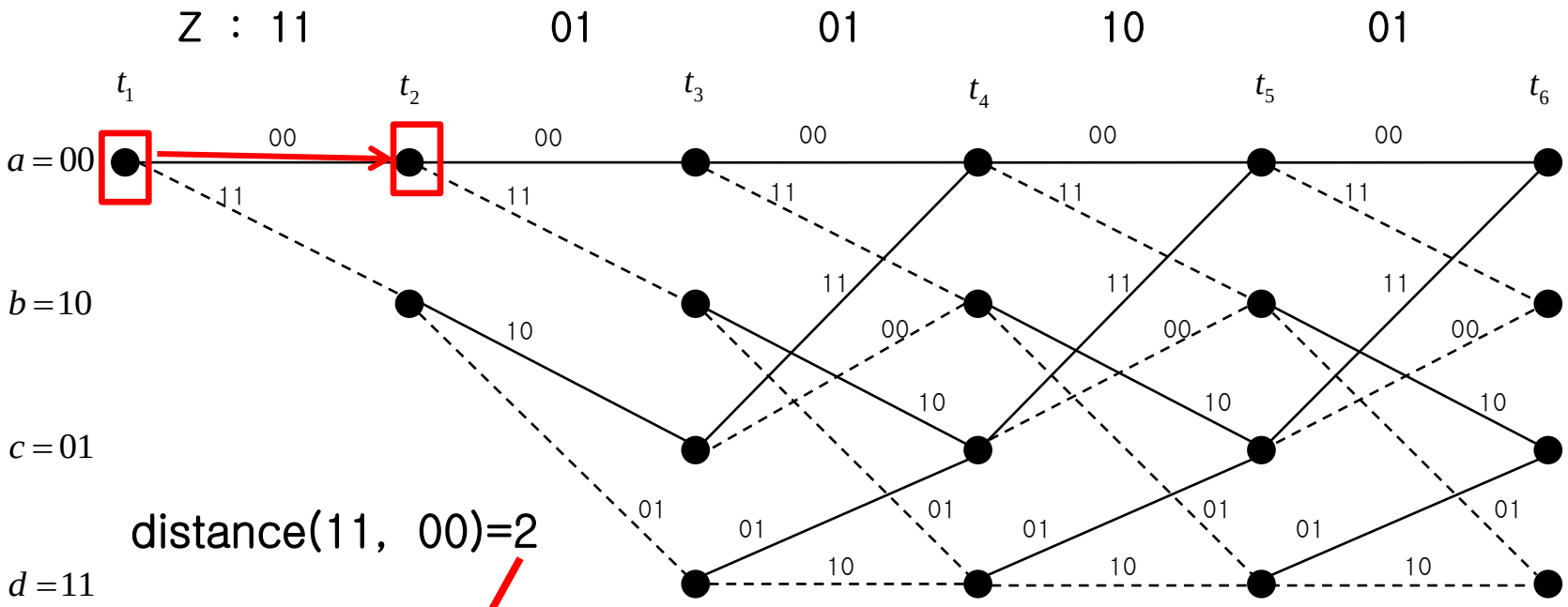
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



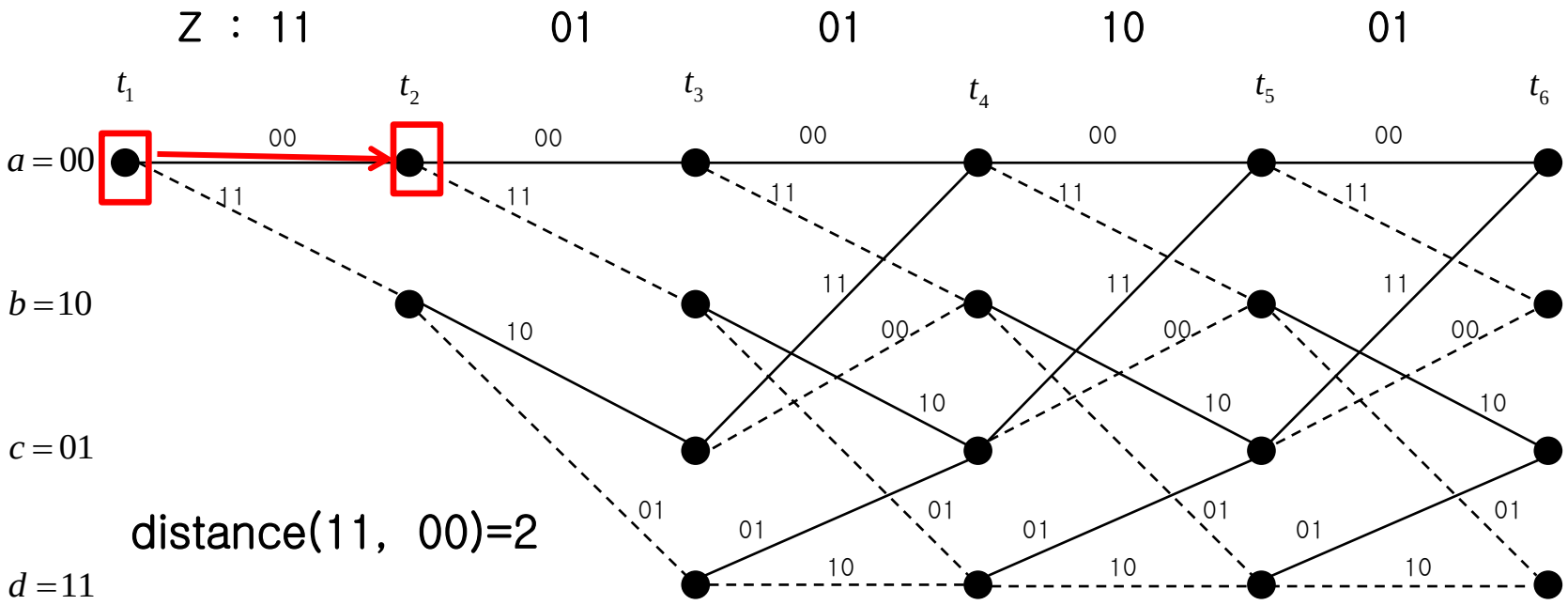
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0					
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



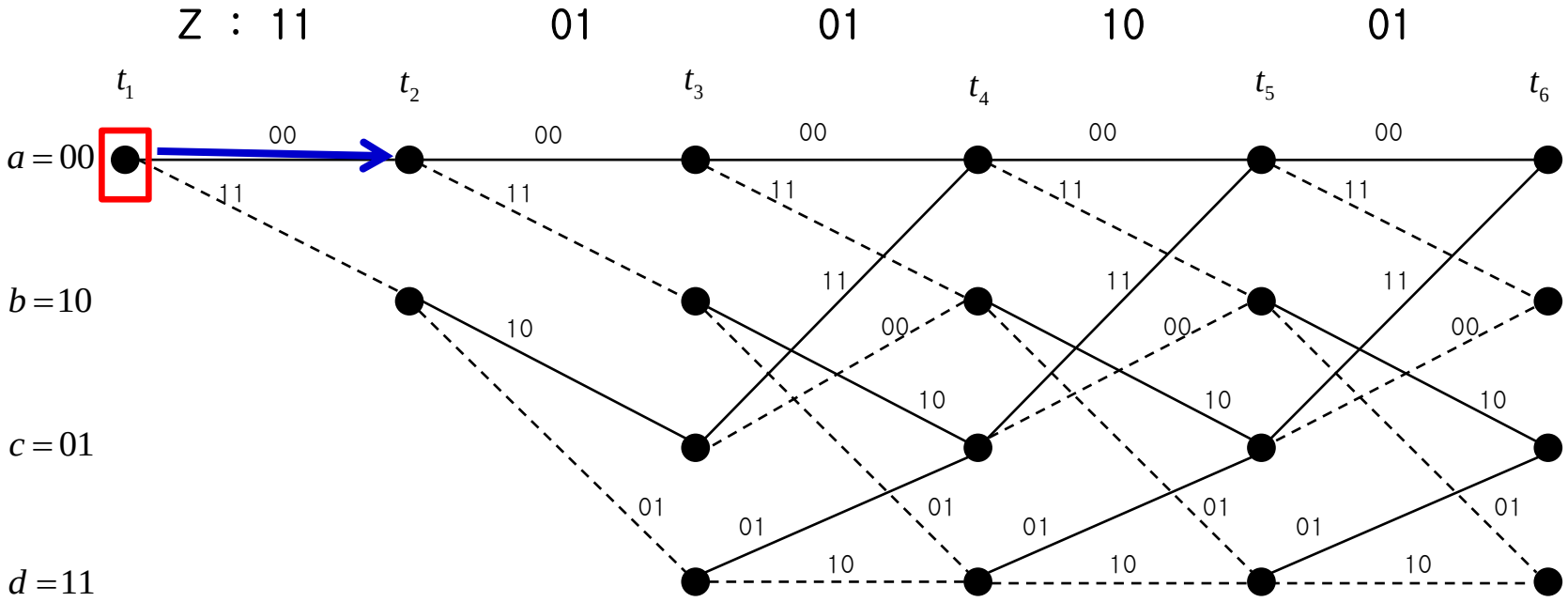
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	0+2=2				
d2	0					
d3	0					
d4	0					
output1	None					
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



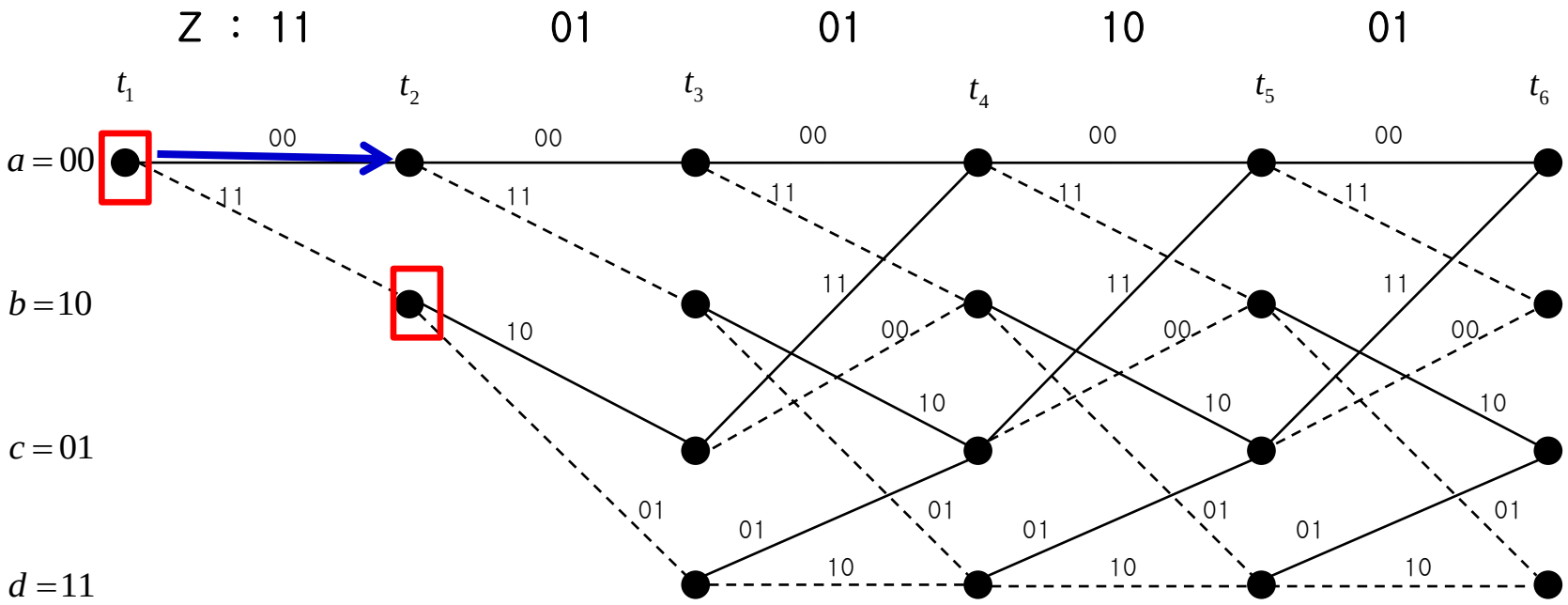
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None →	**0** (Solid line =0)				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



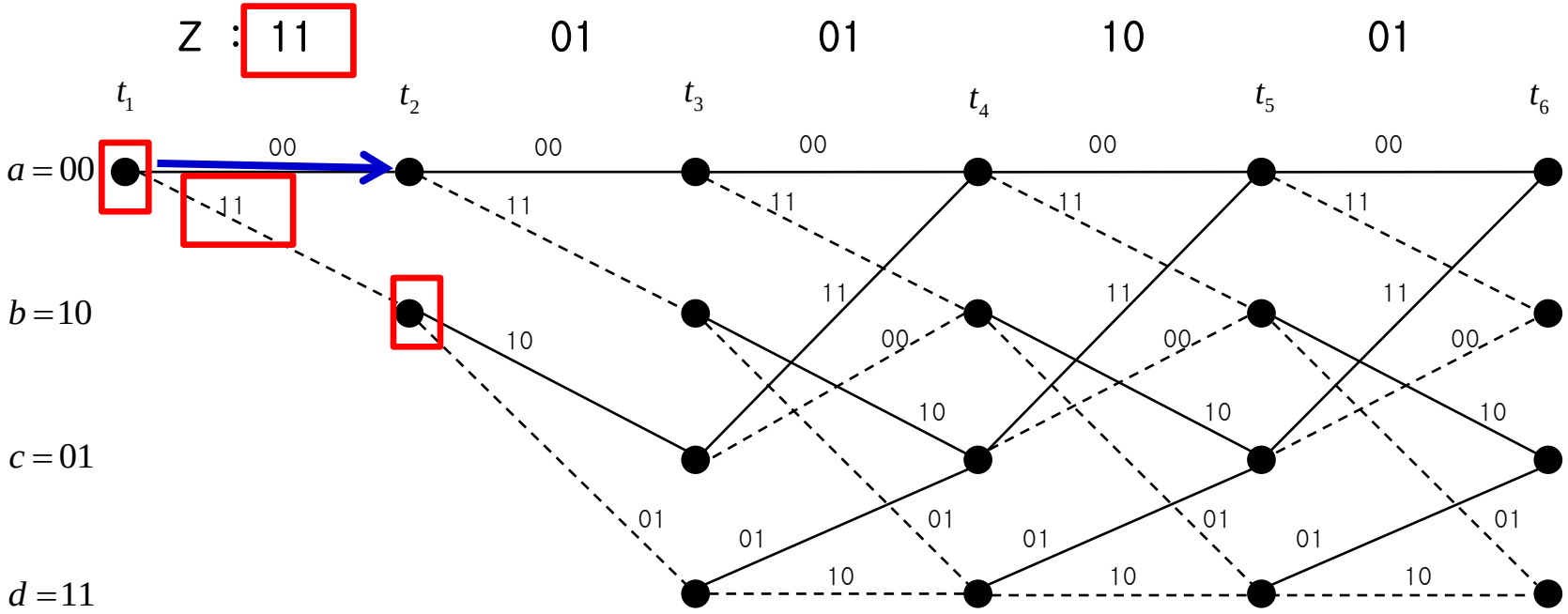
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



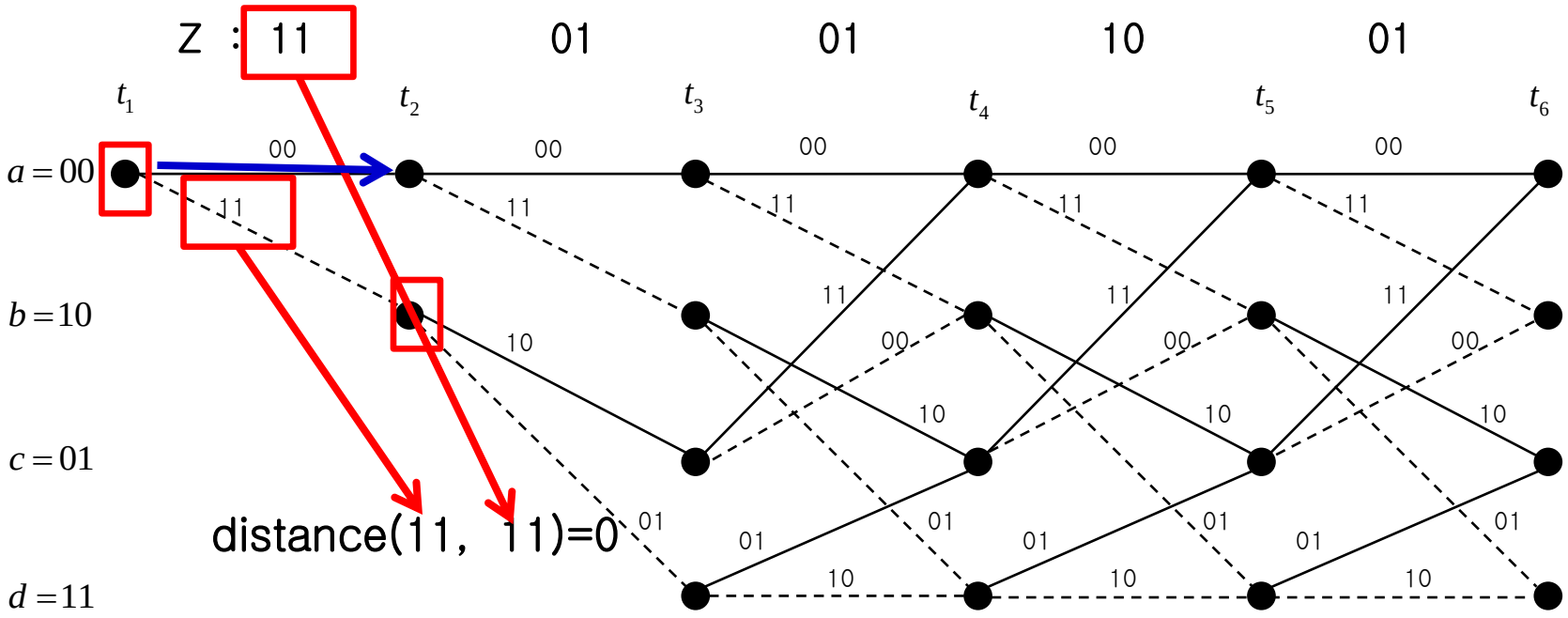
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



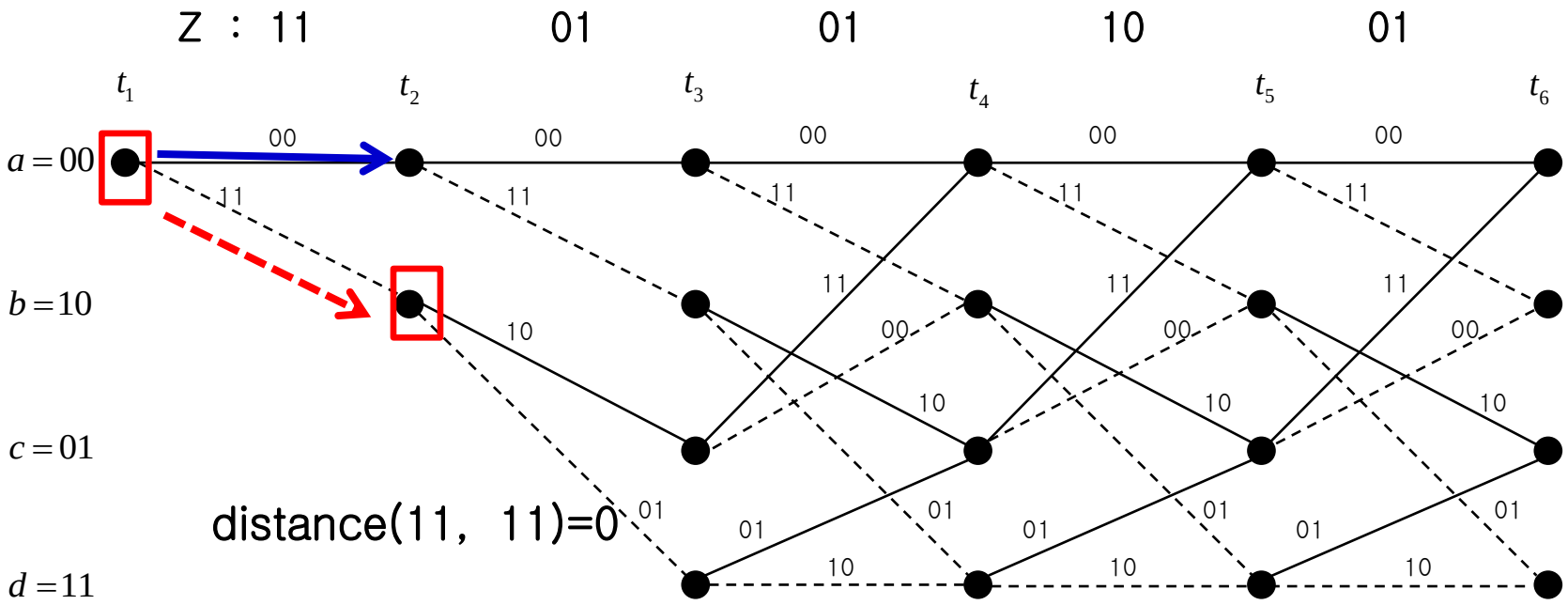
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



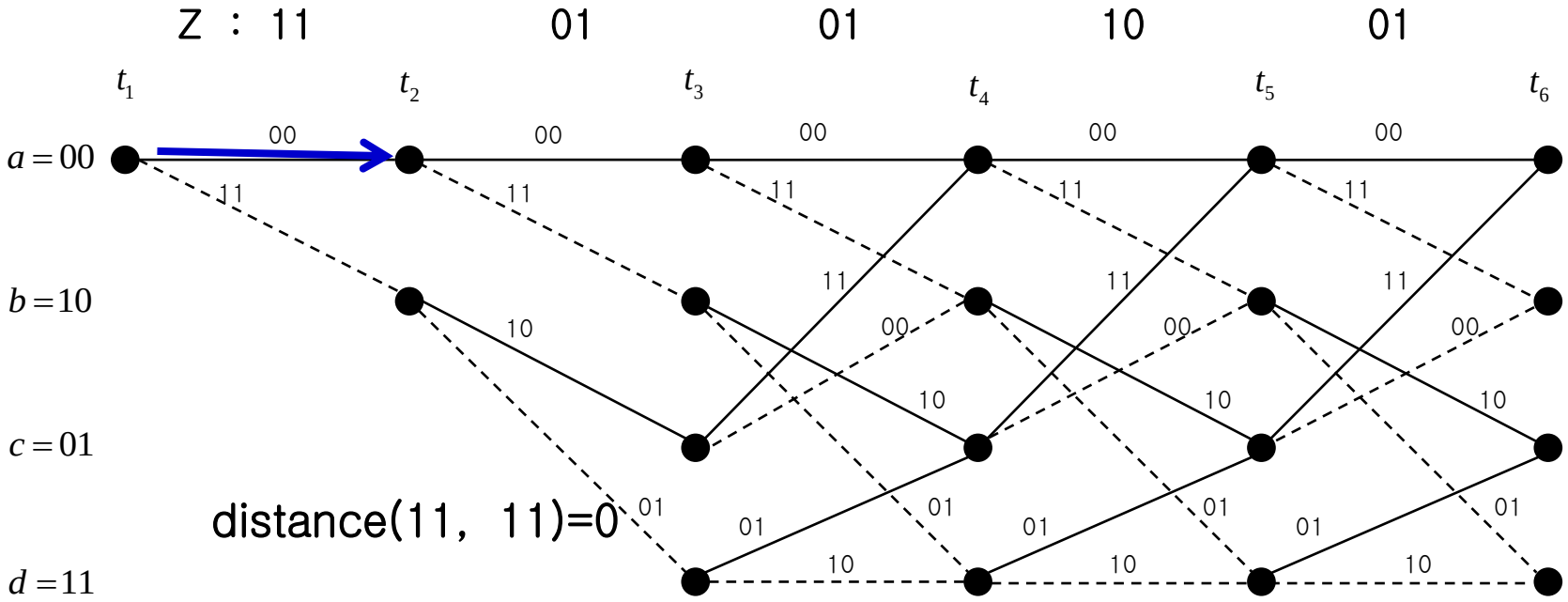
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



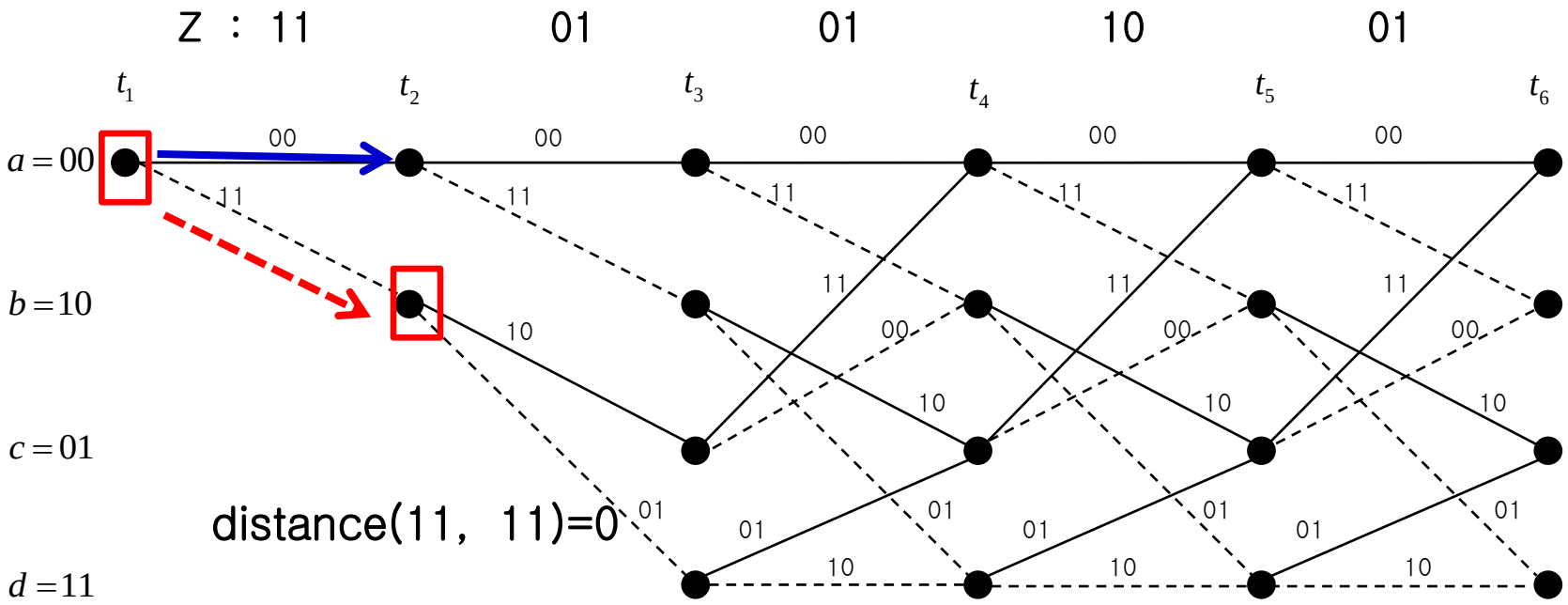
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



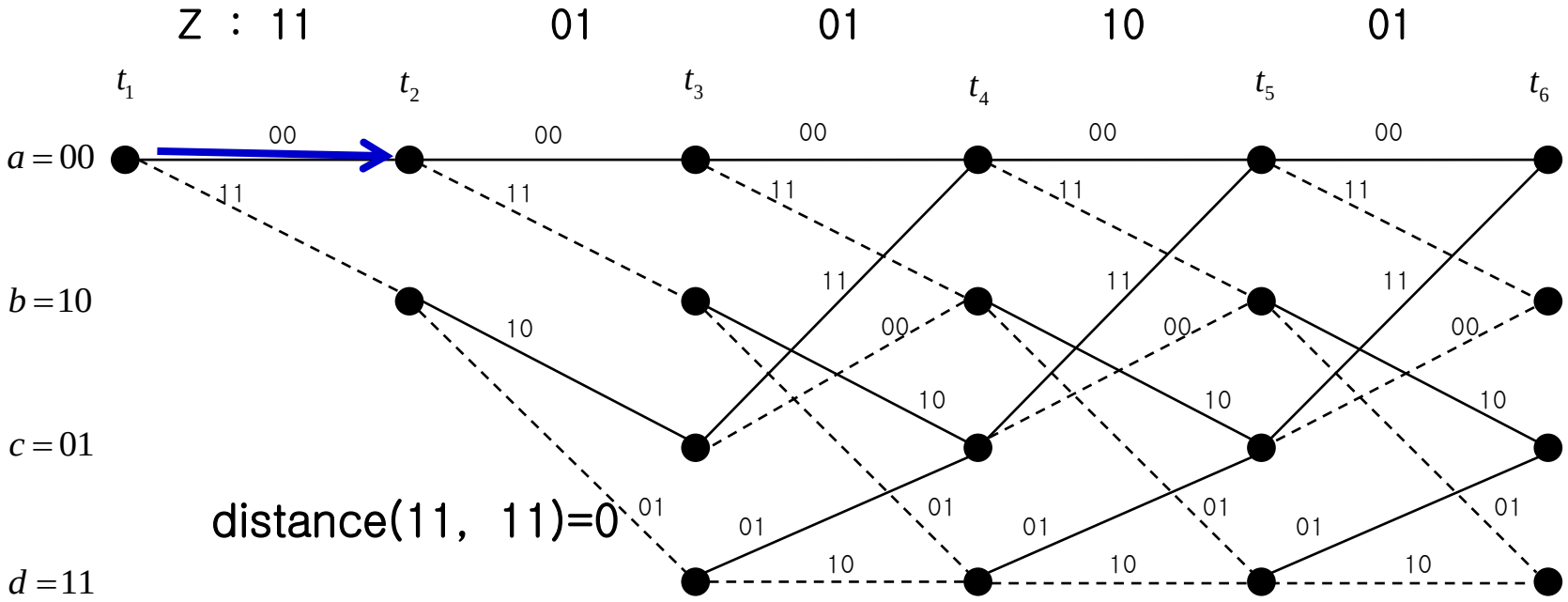
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



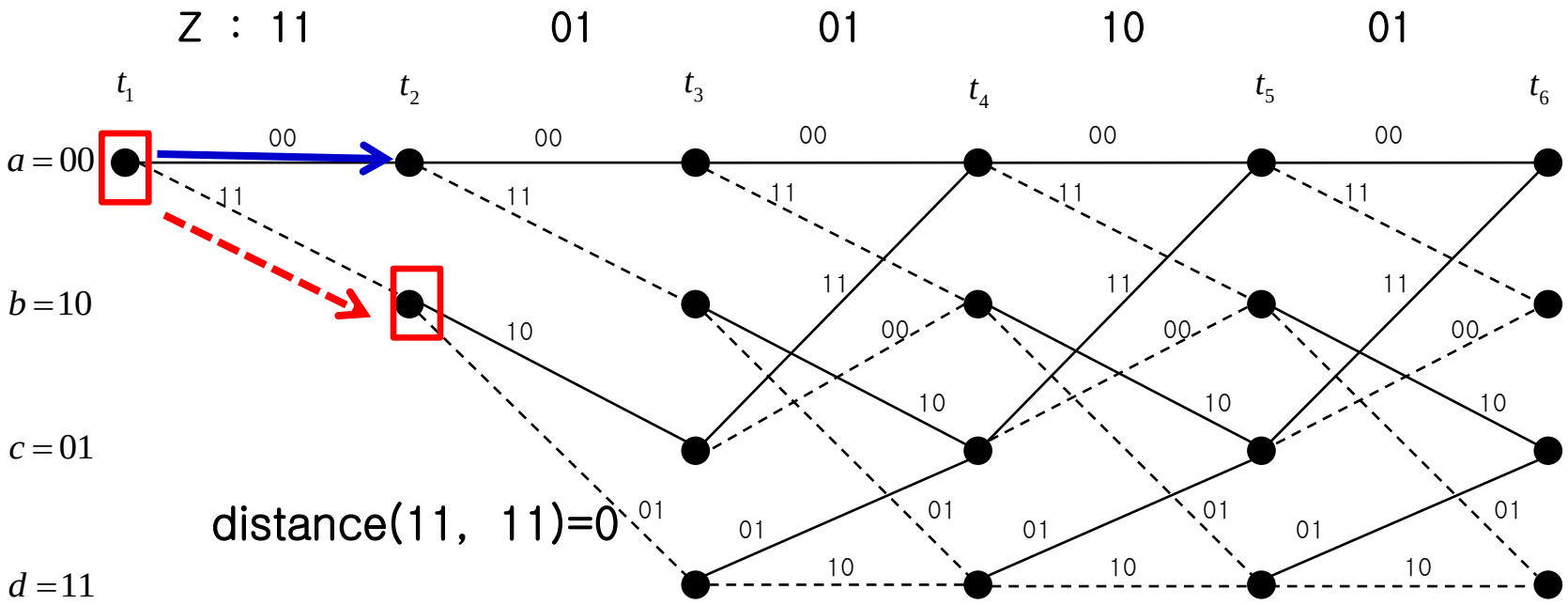
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



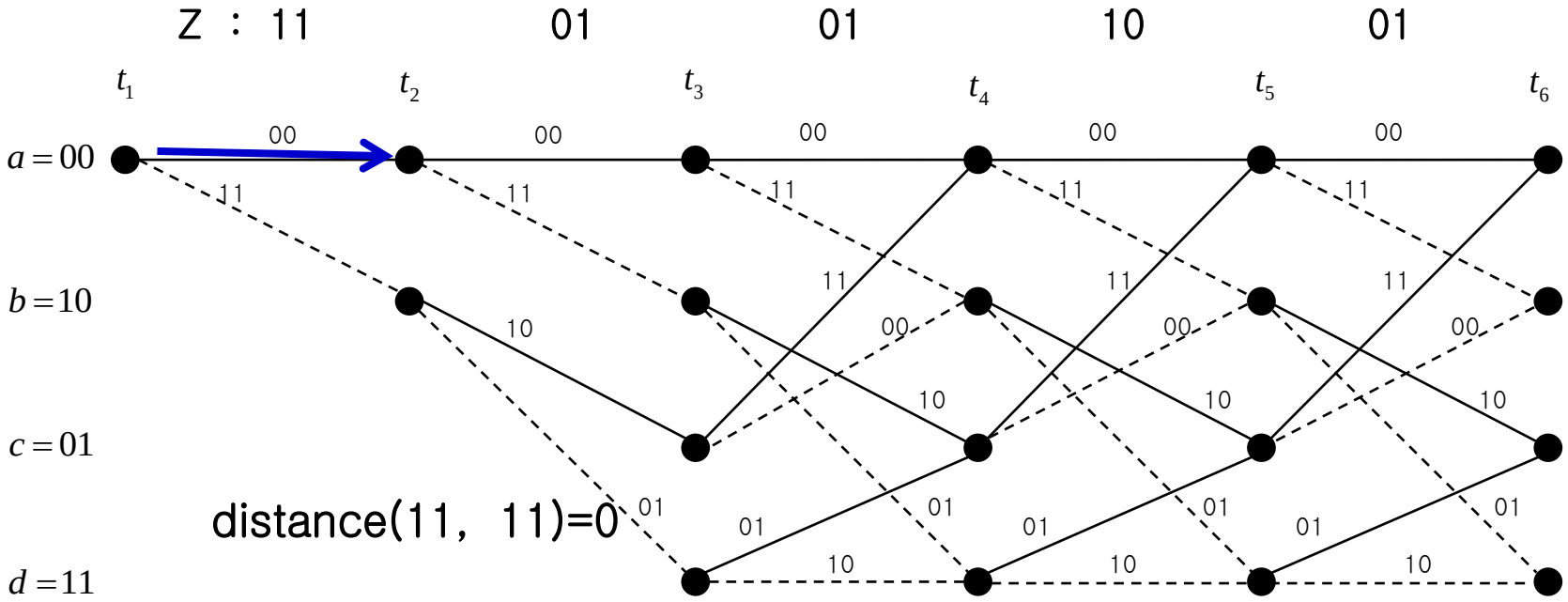
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



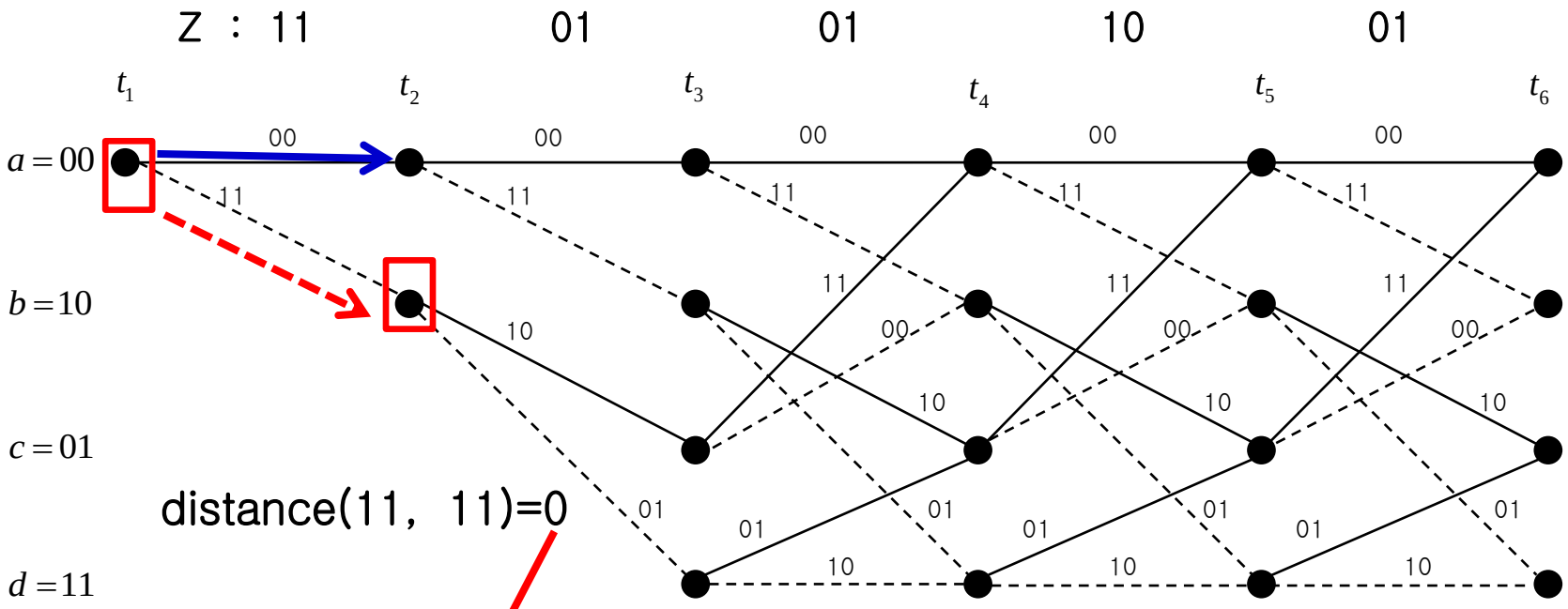
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



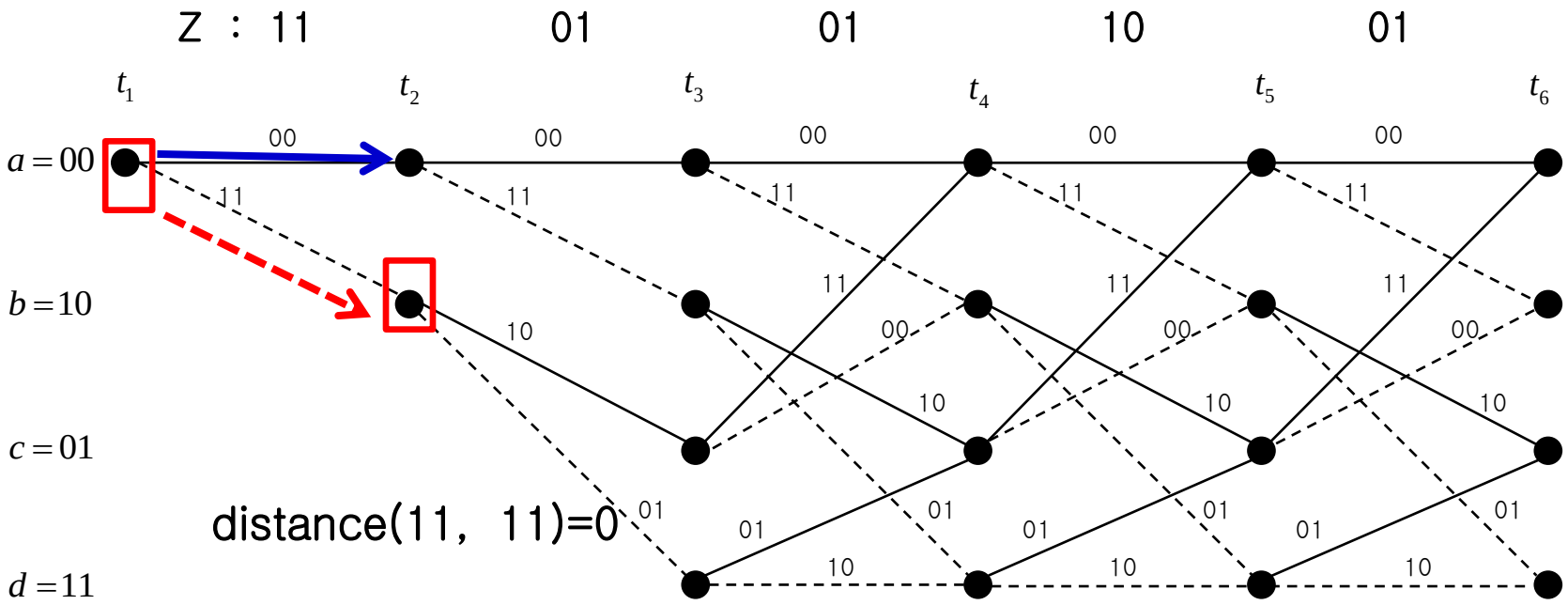
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0					
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



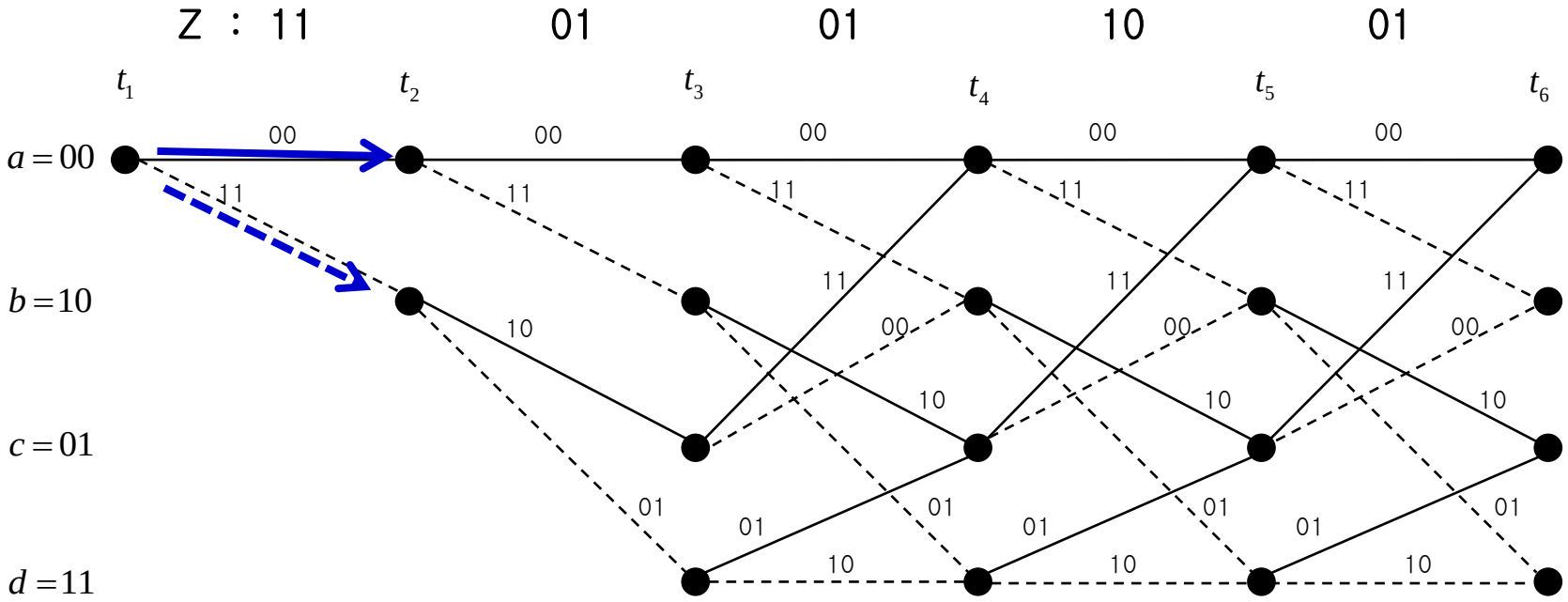
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0+0=0				
d3	0					
d4	0					
output1	None	0				
output2	None					
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



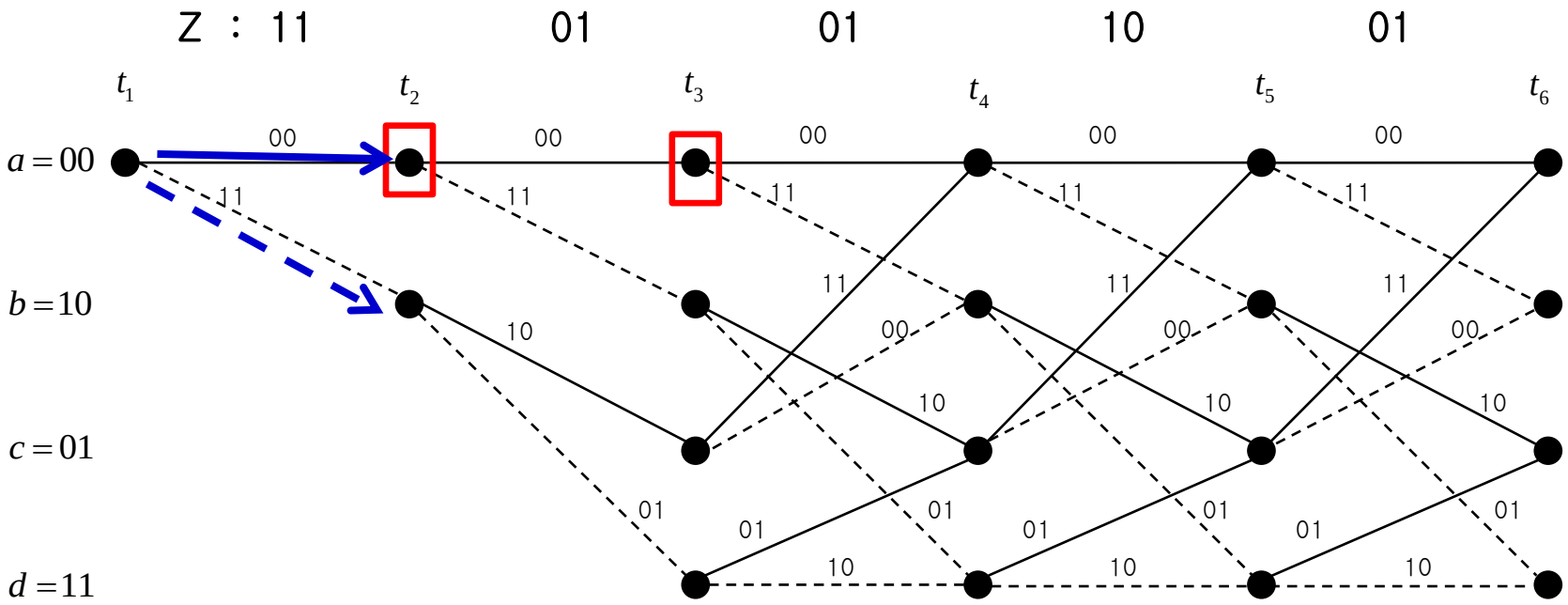
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1 (Dashed line =1)				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



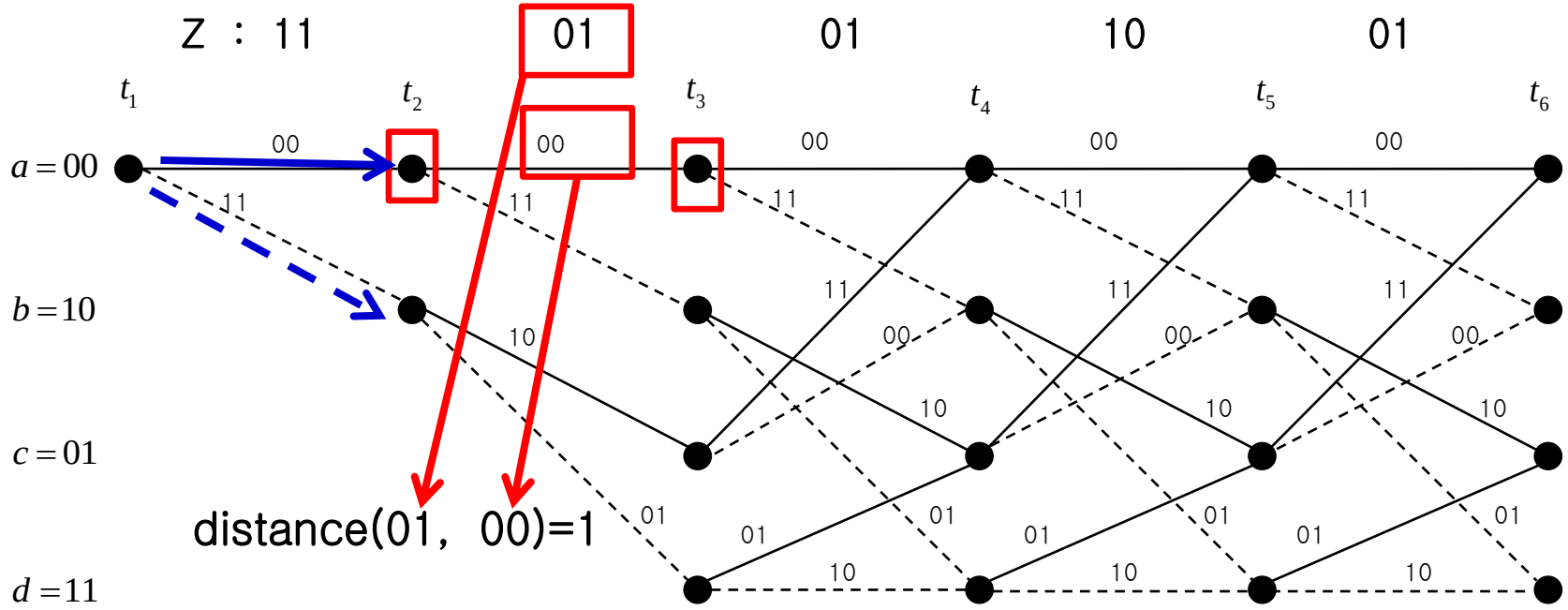
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



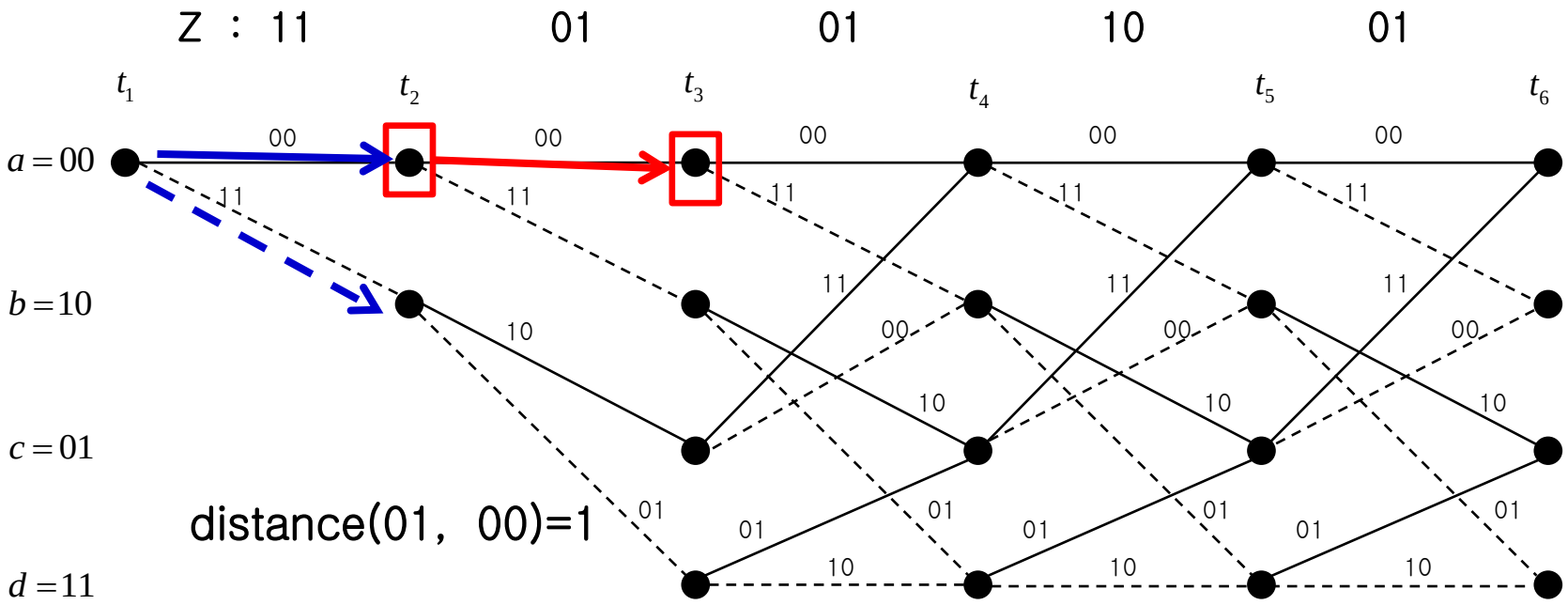
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



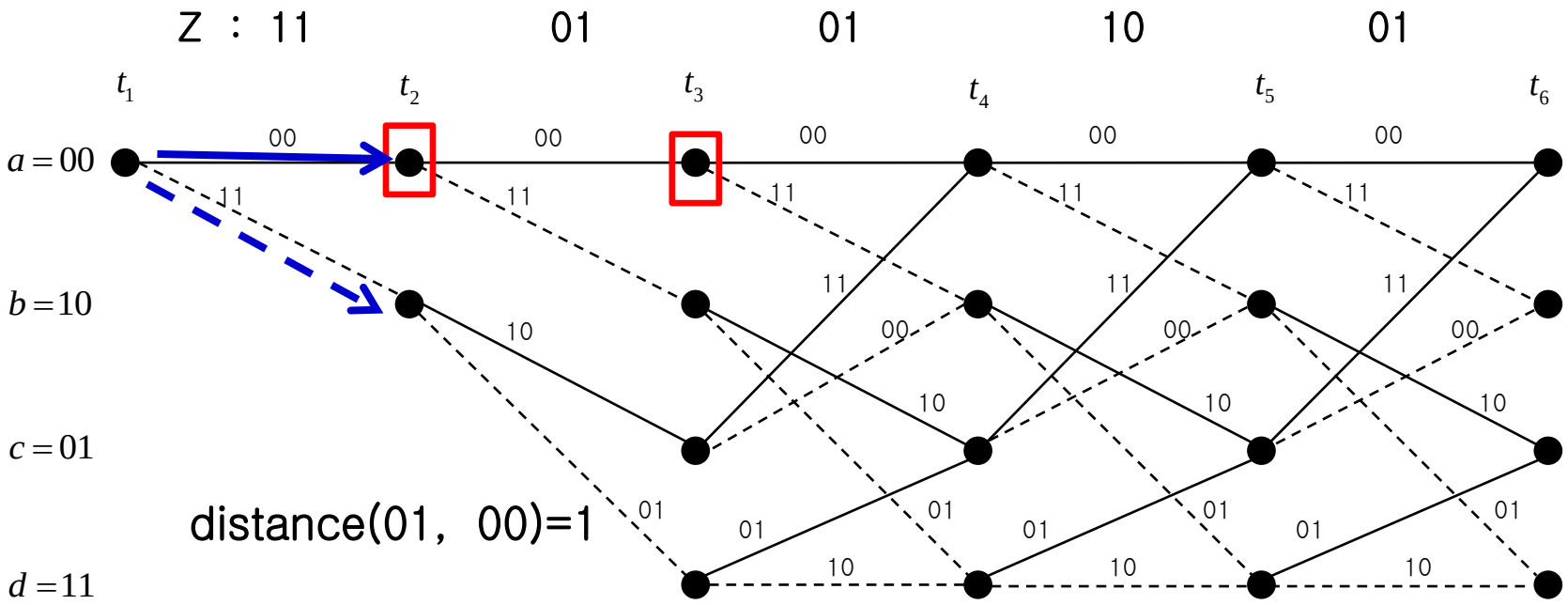
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



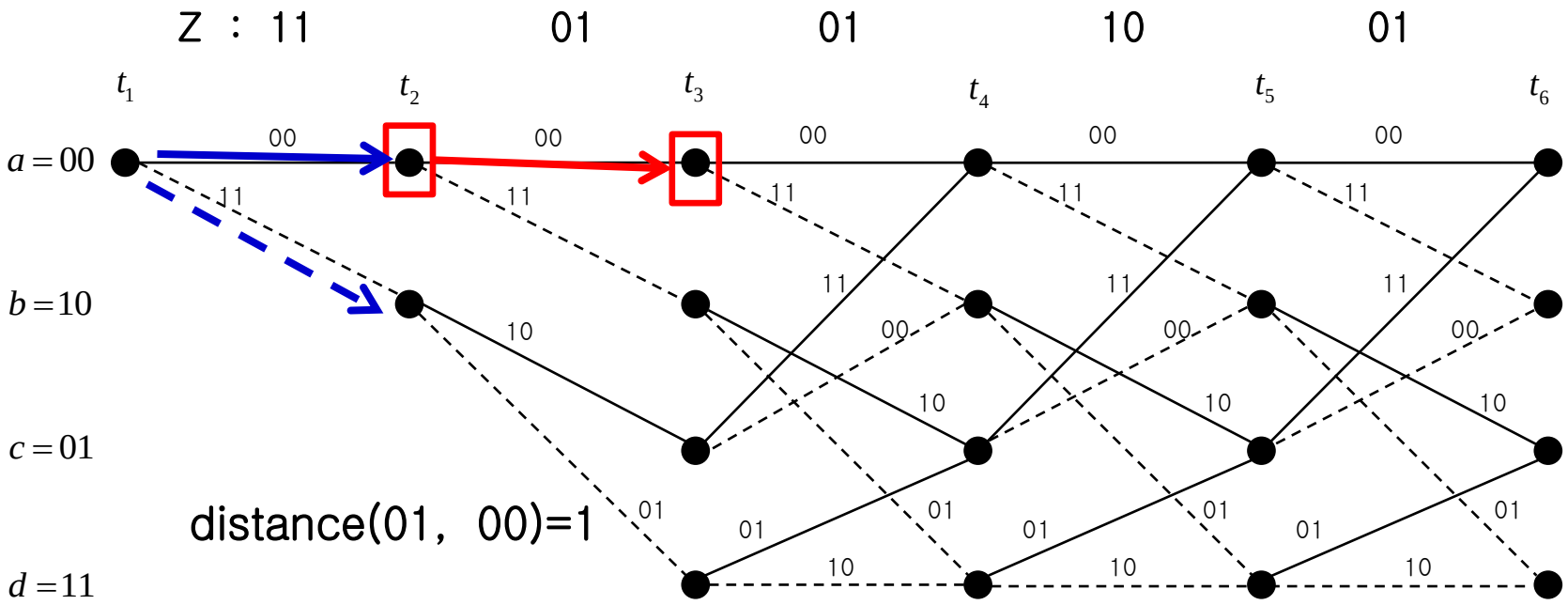
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



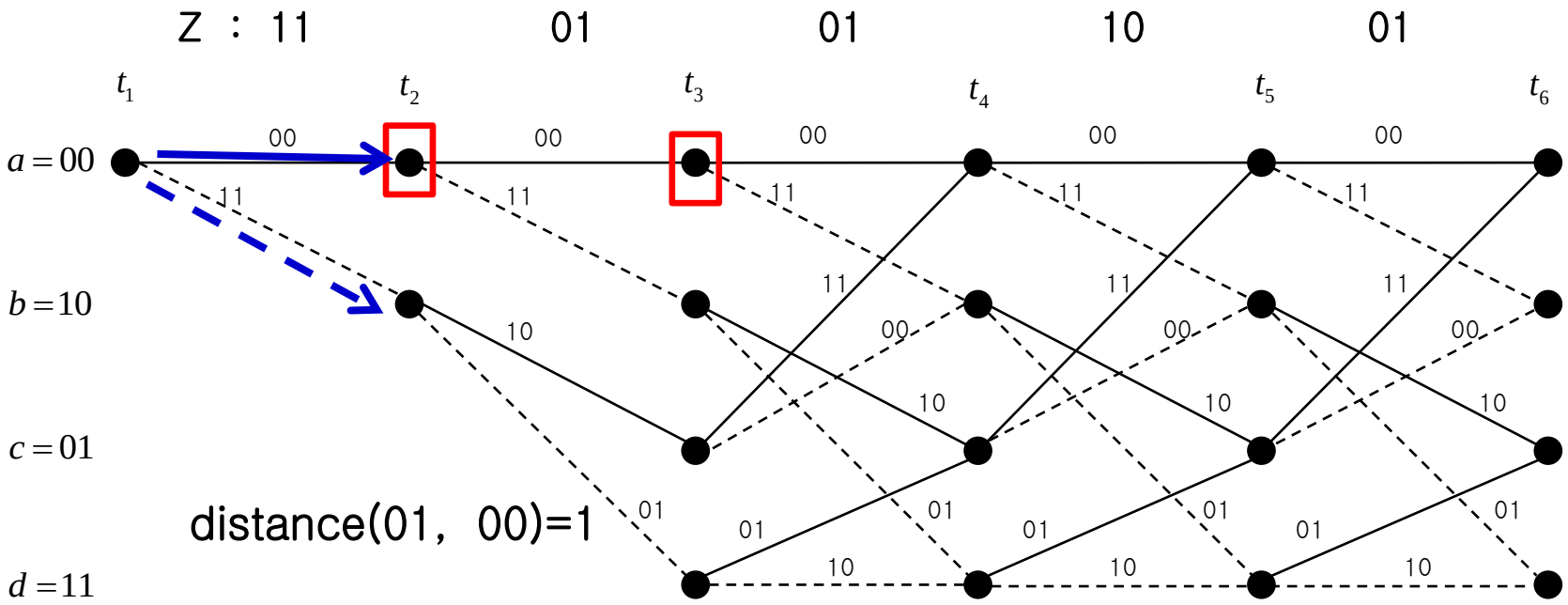
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



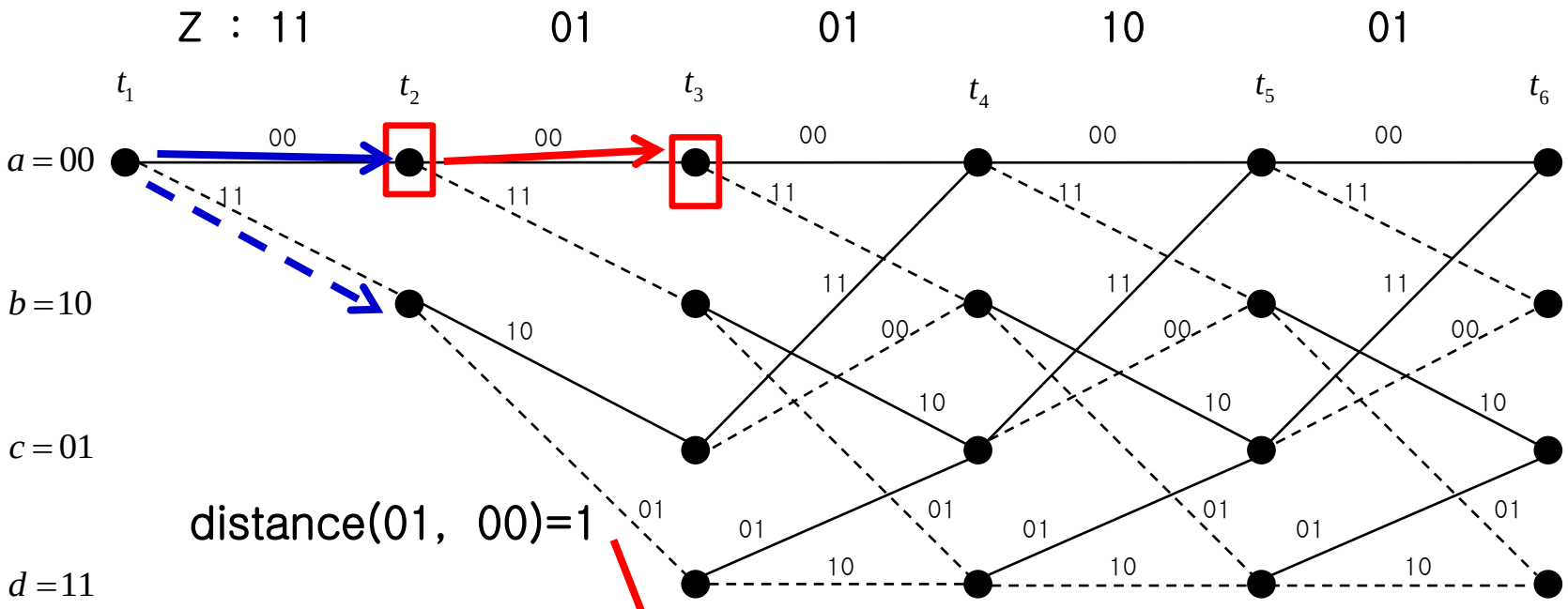
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



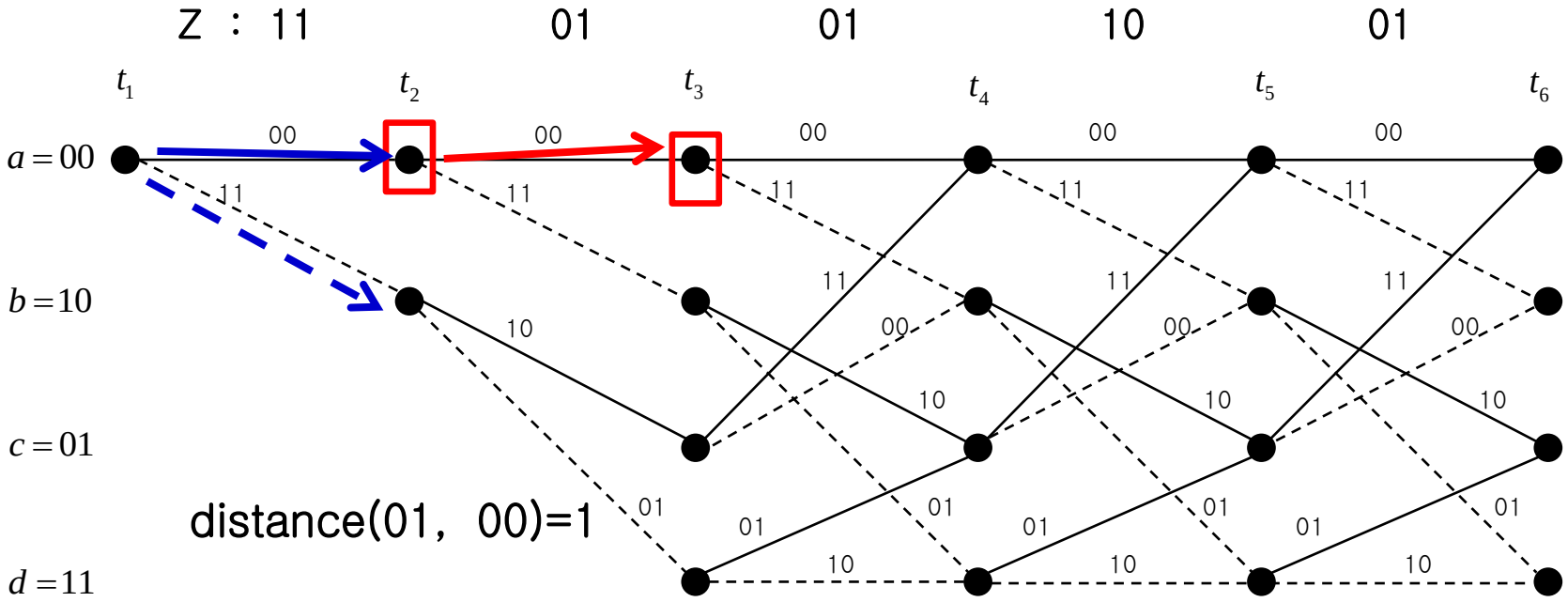
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2				
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



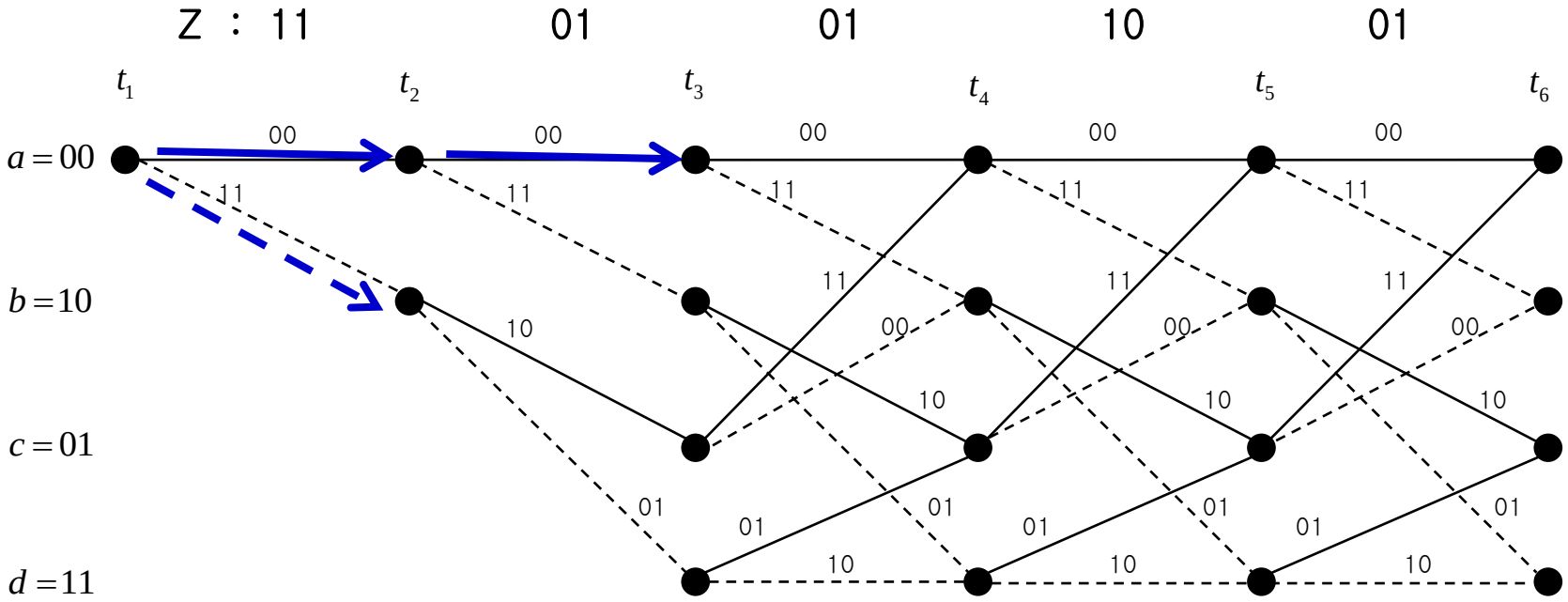
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	2+1=3			
d2	0	0				
d3	0					
d4	0					
output1	None	0				
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



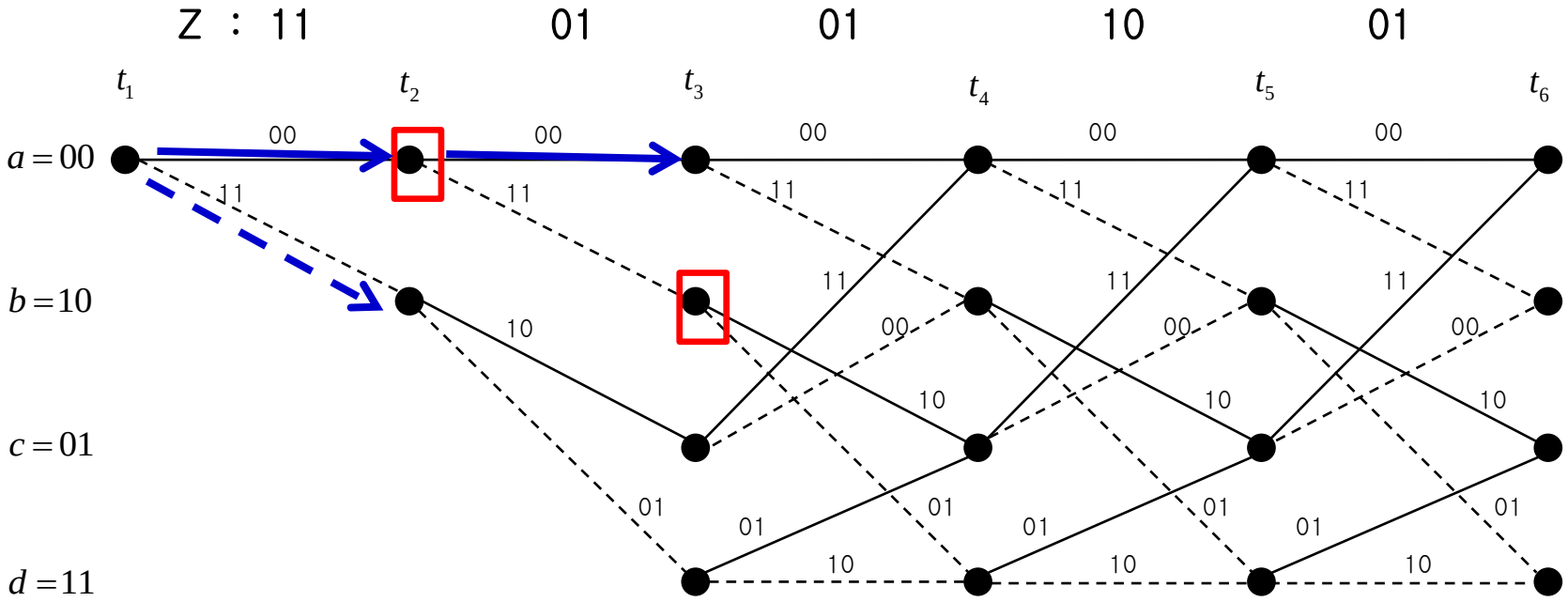
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	→ 00 (Solid line =0)			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



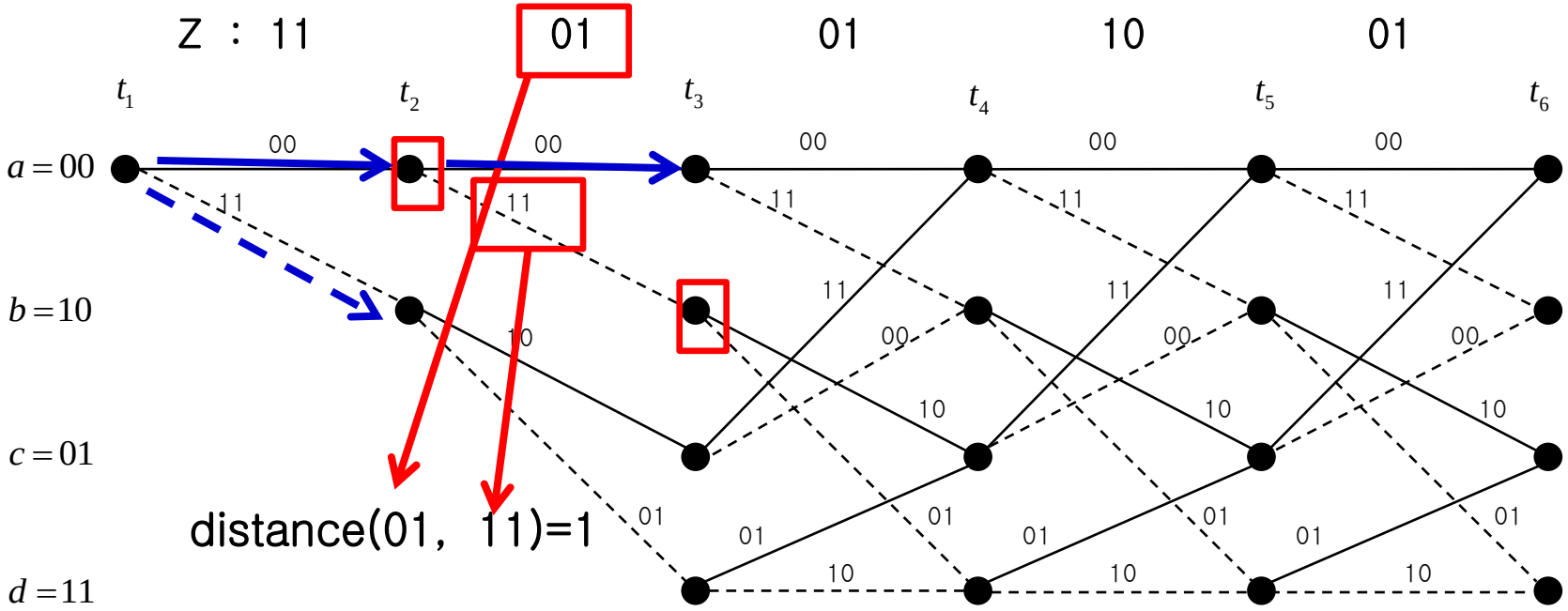
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



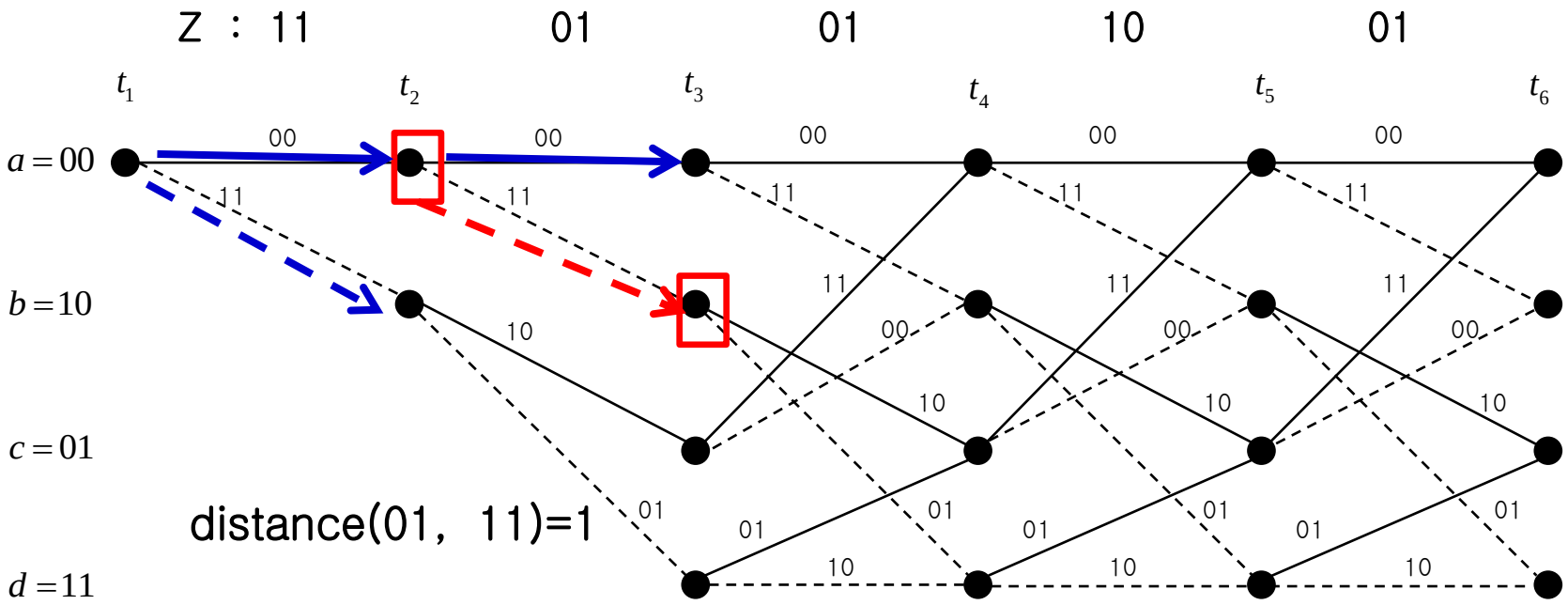
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



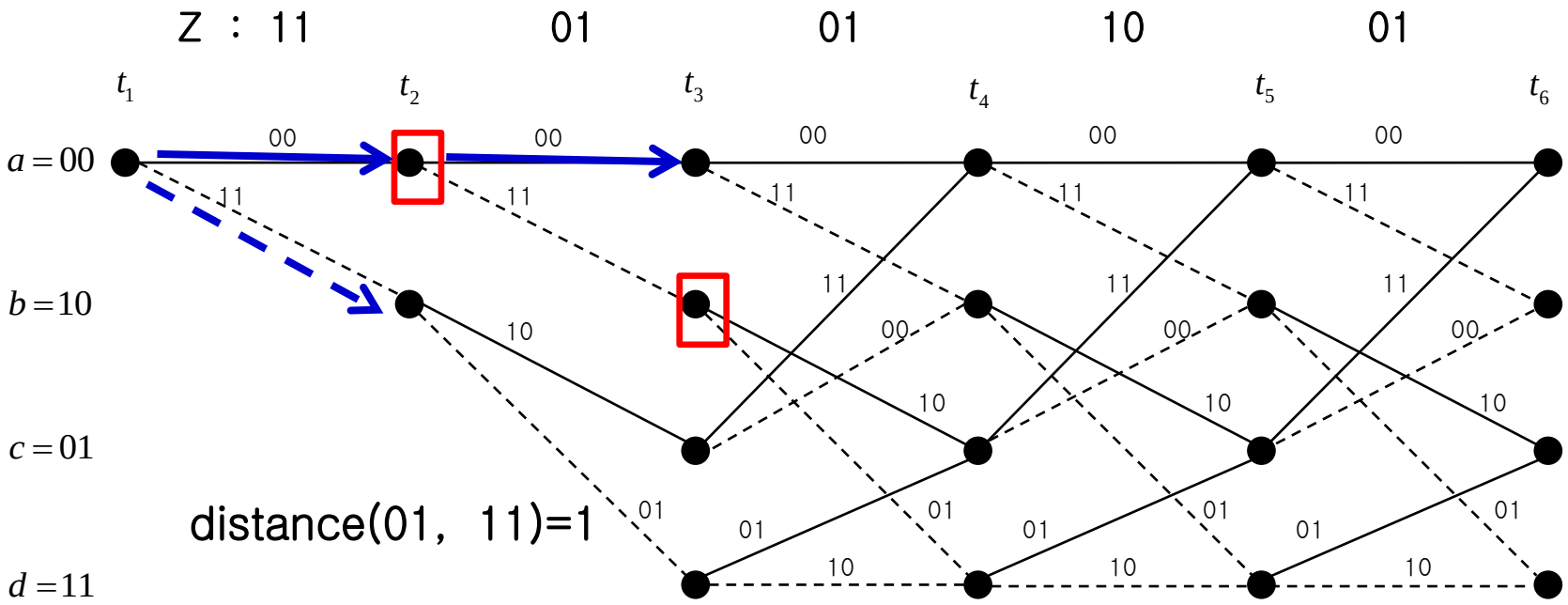
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



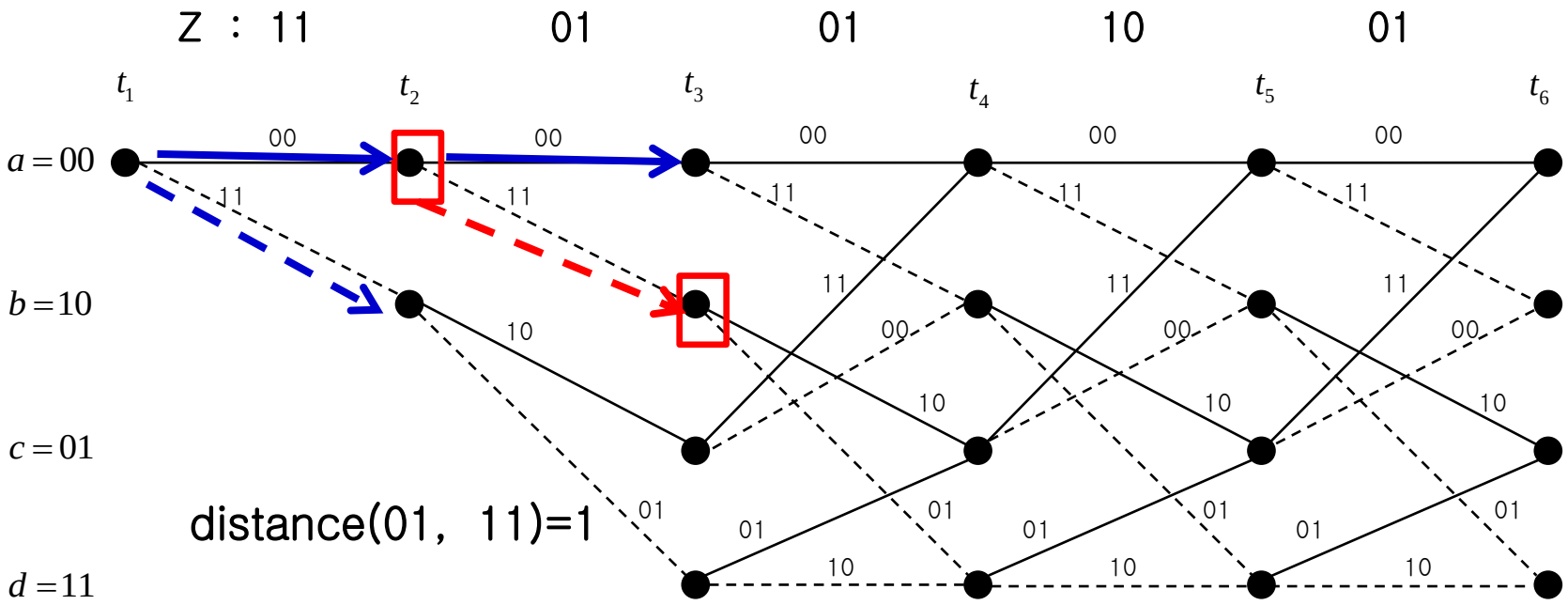
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



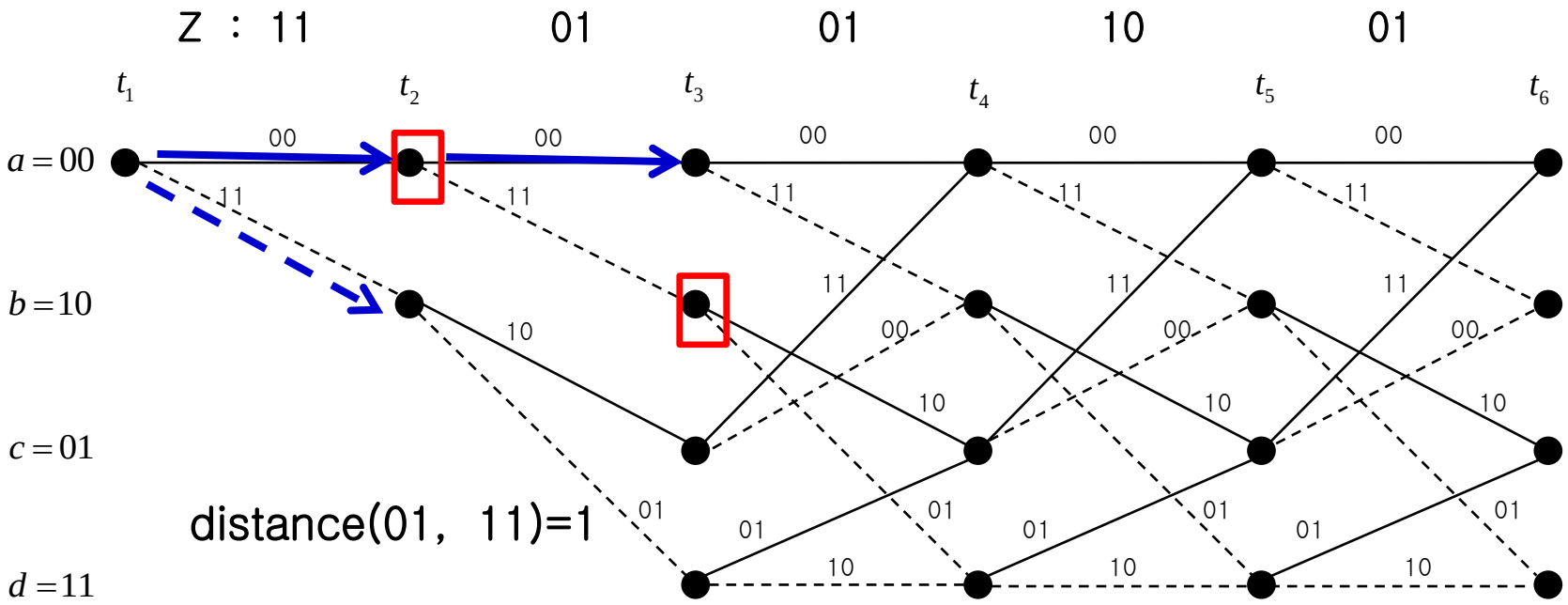
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



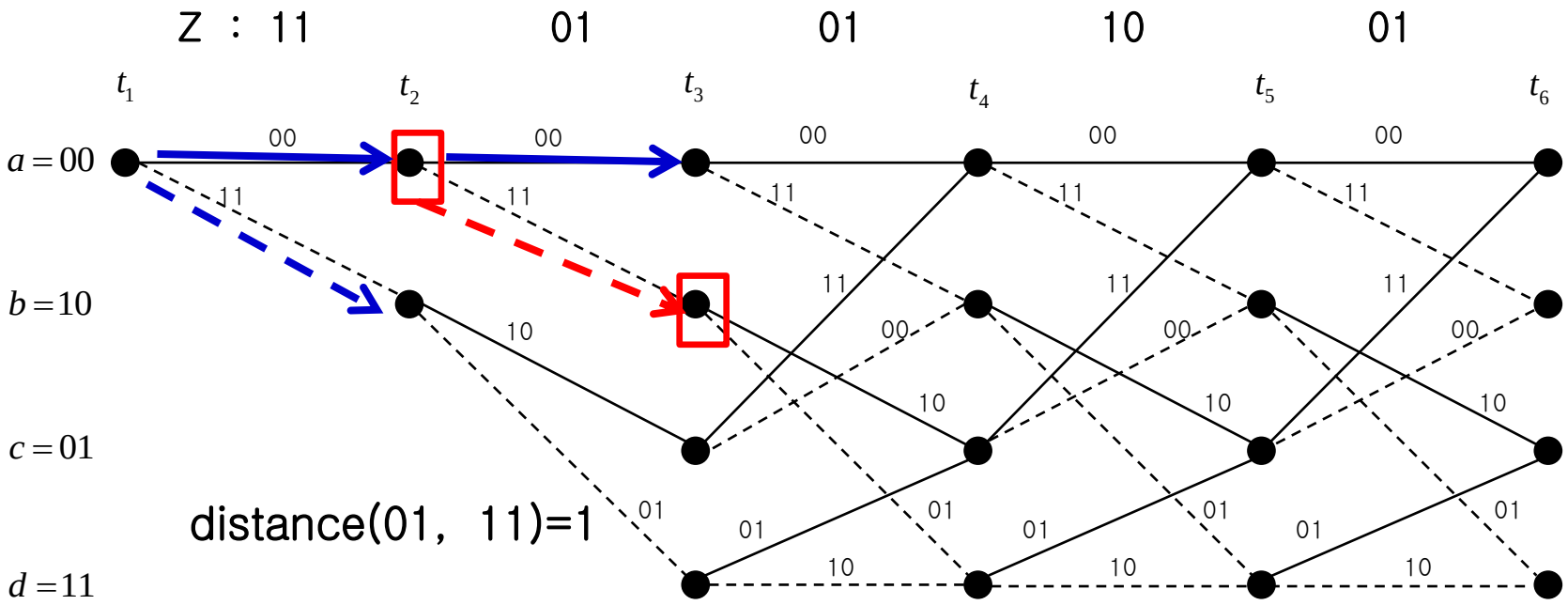
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



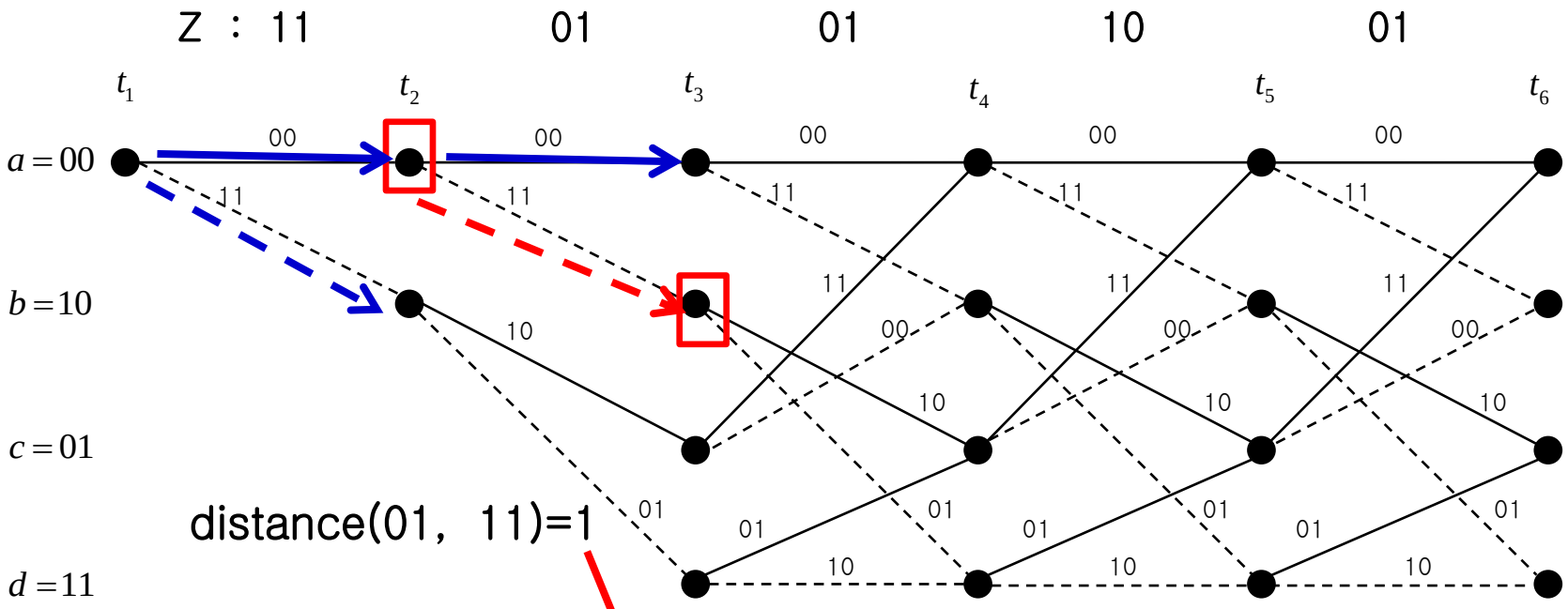
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



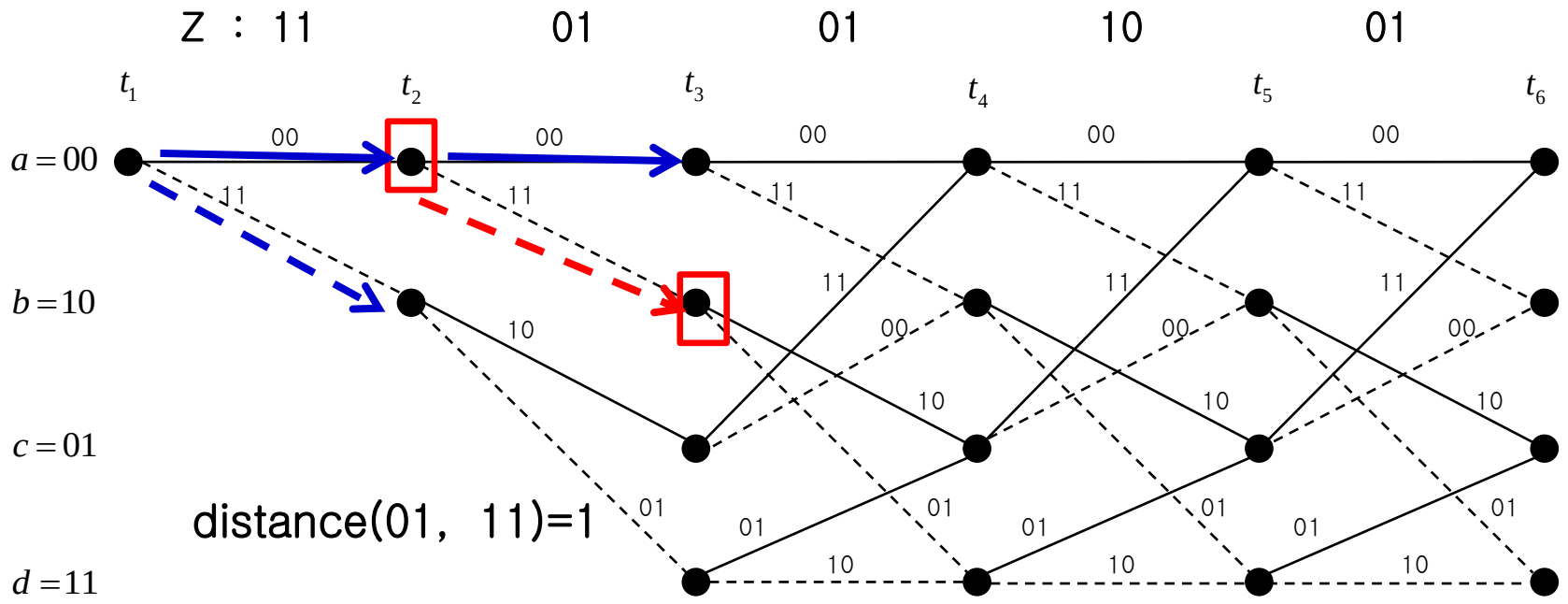
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0				
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



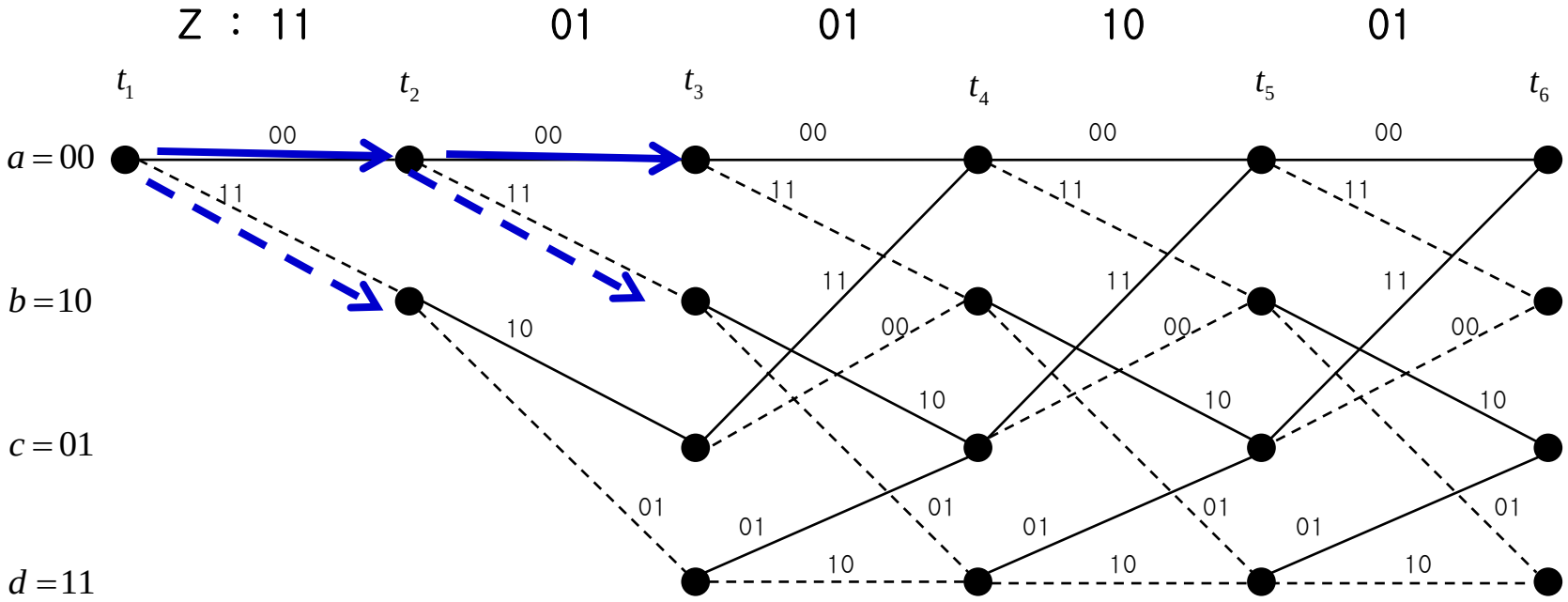
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	2+1=3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1				
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



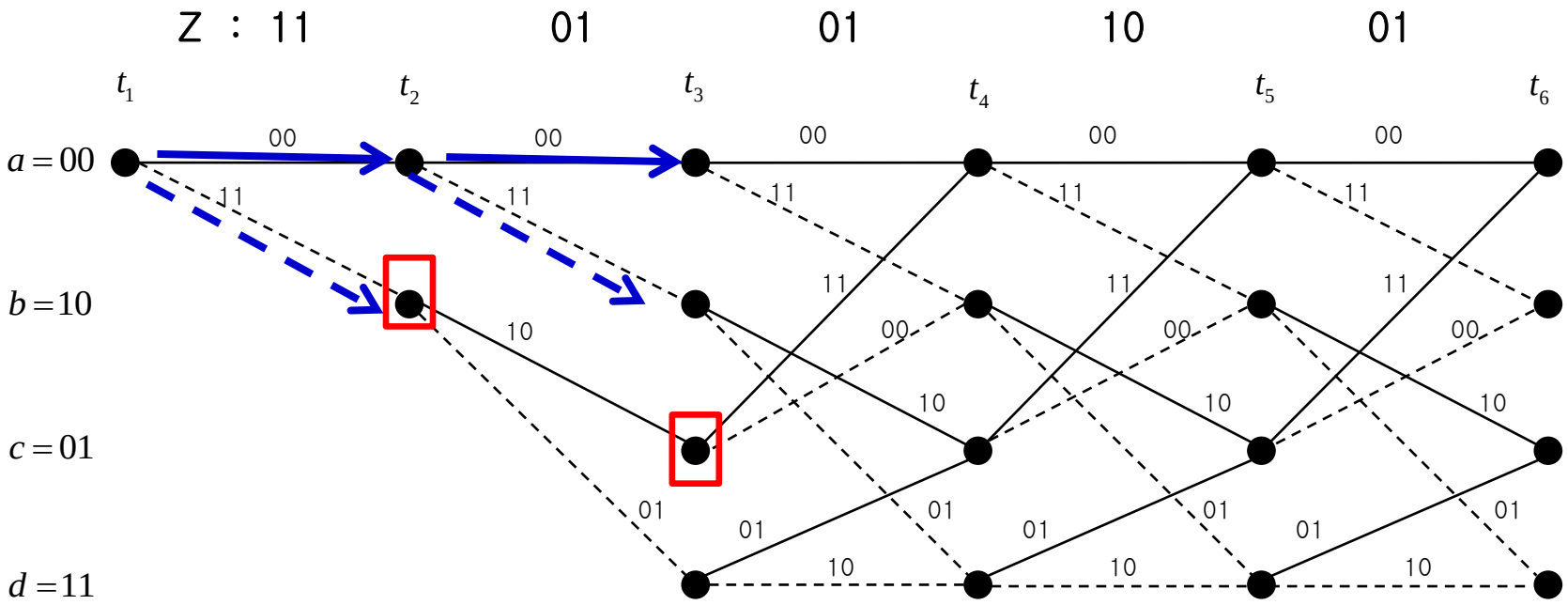
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01 (Dashed line =1)			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



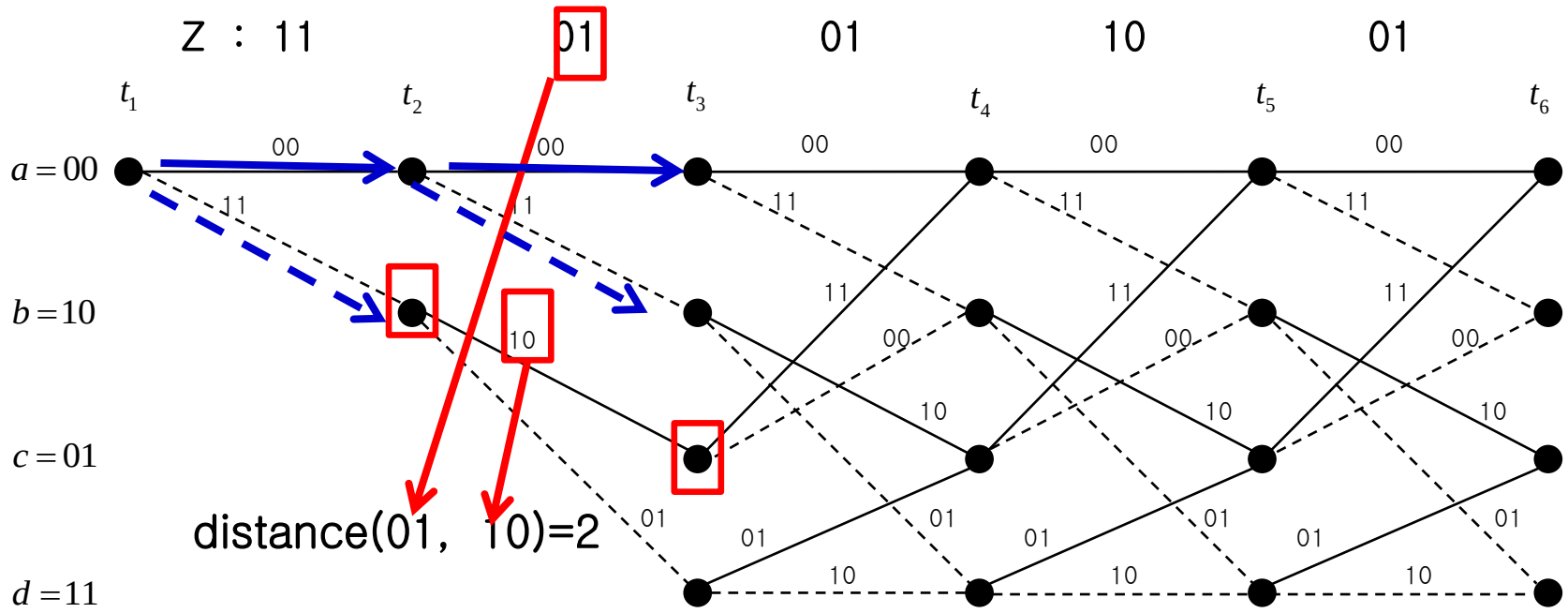
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



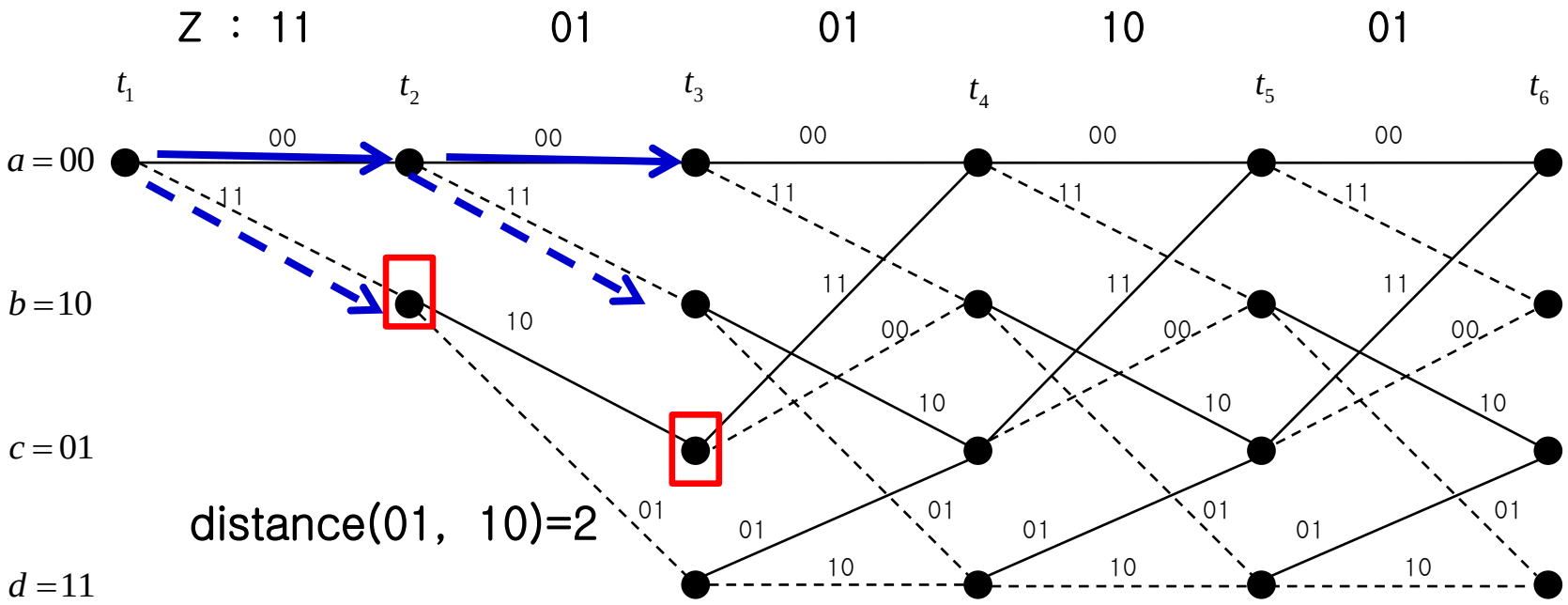
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



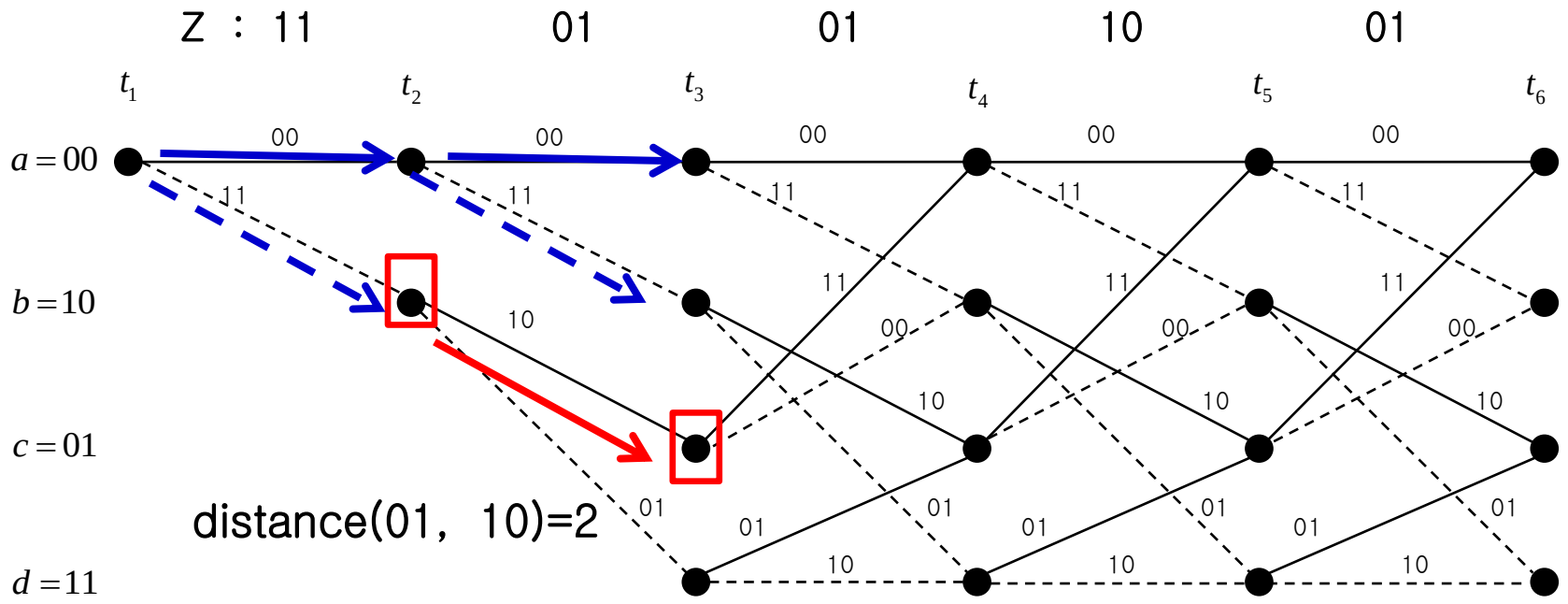
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



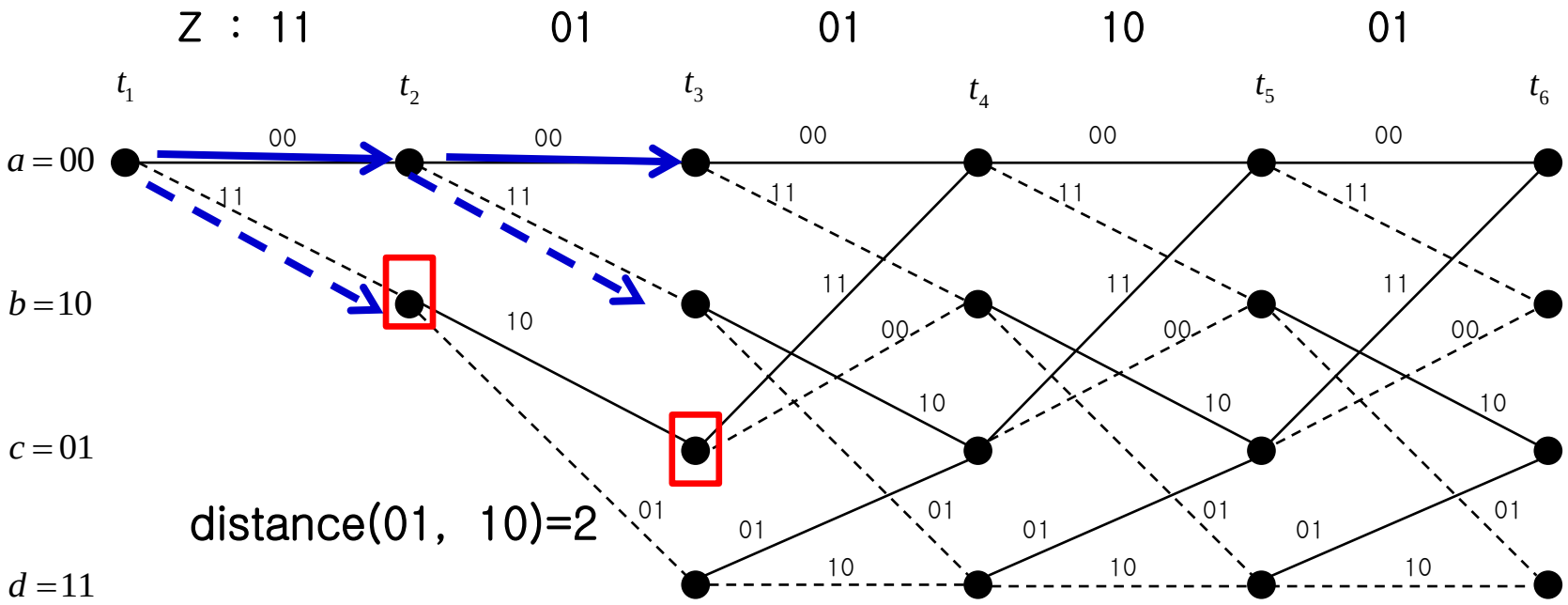
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



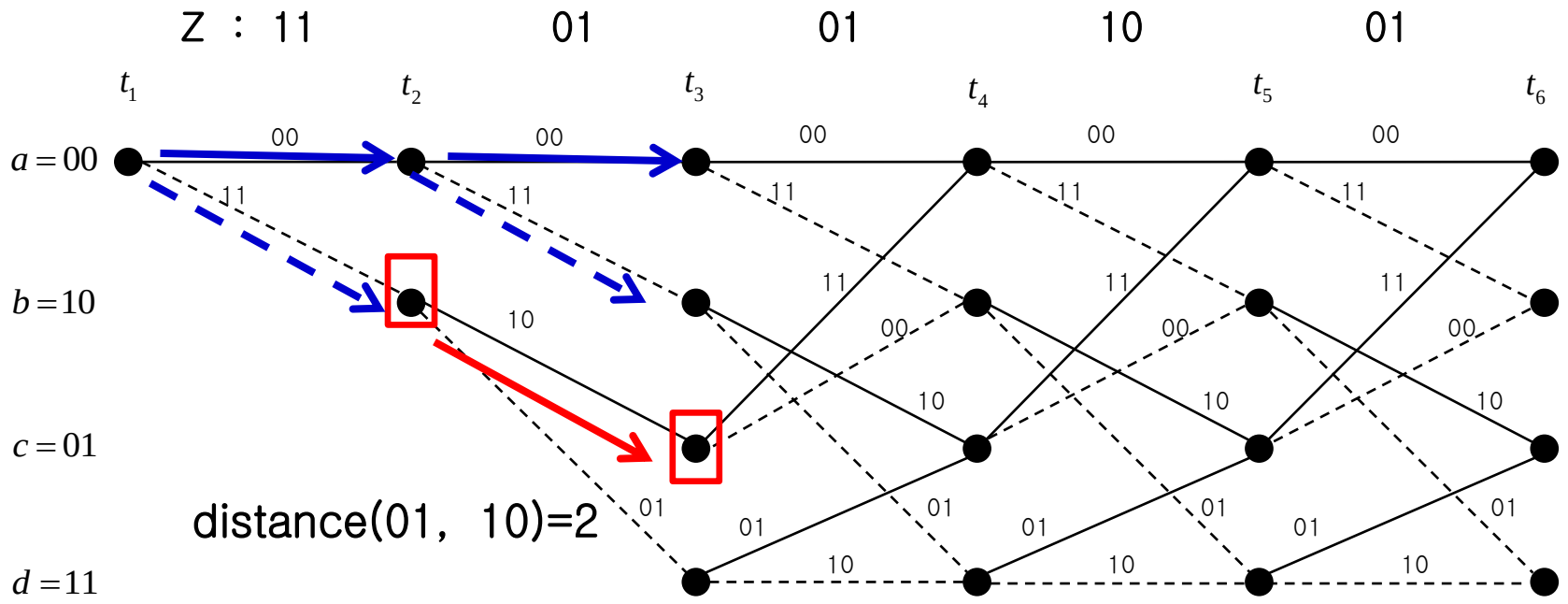
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



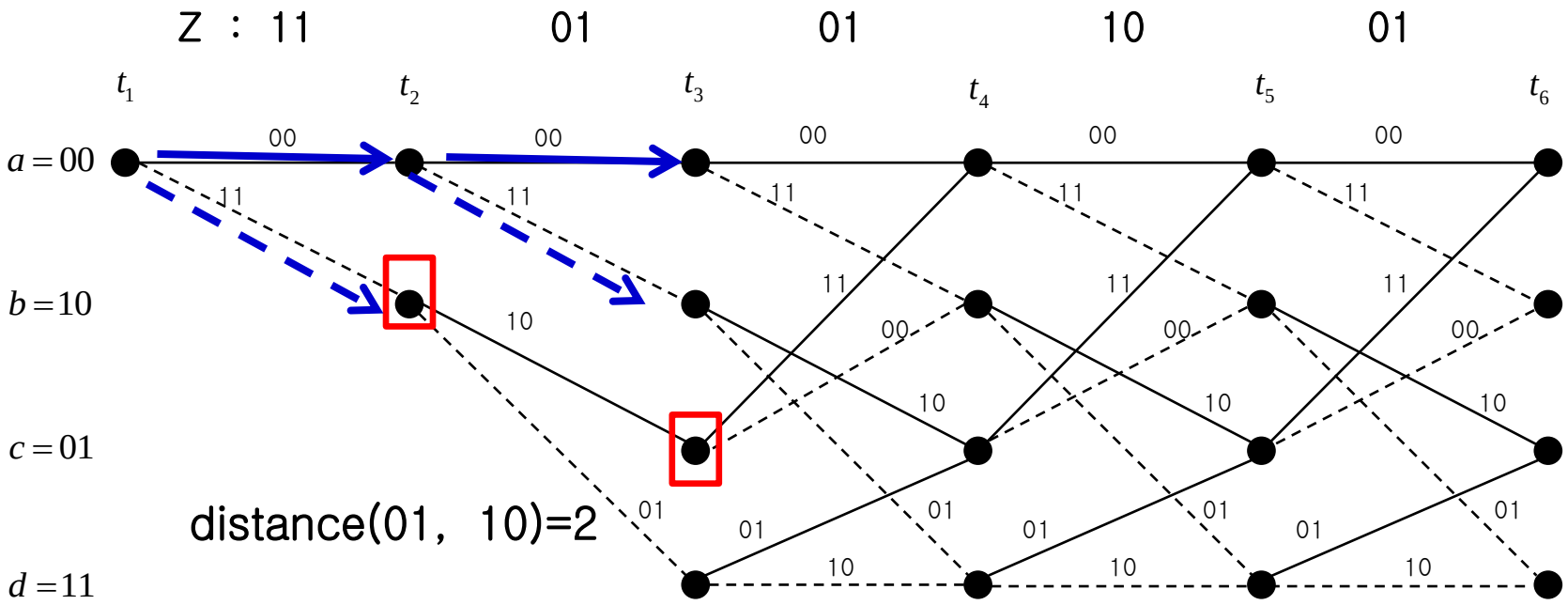
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



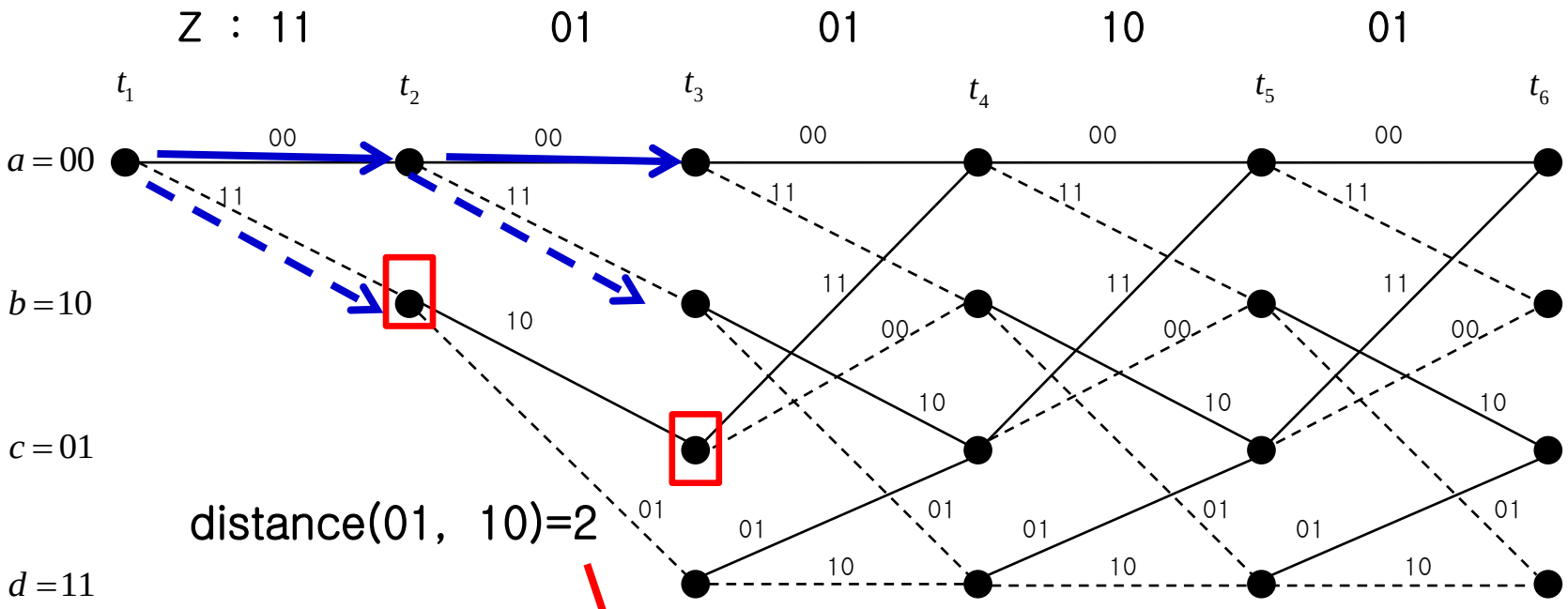
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



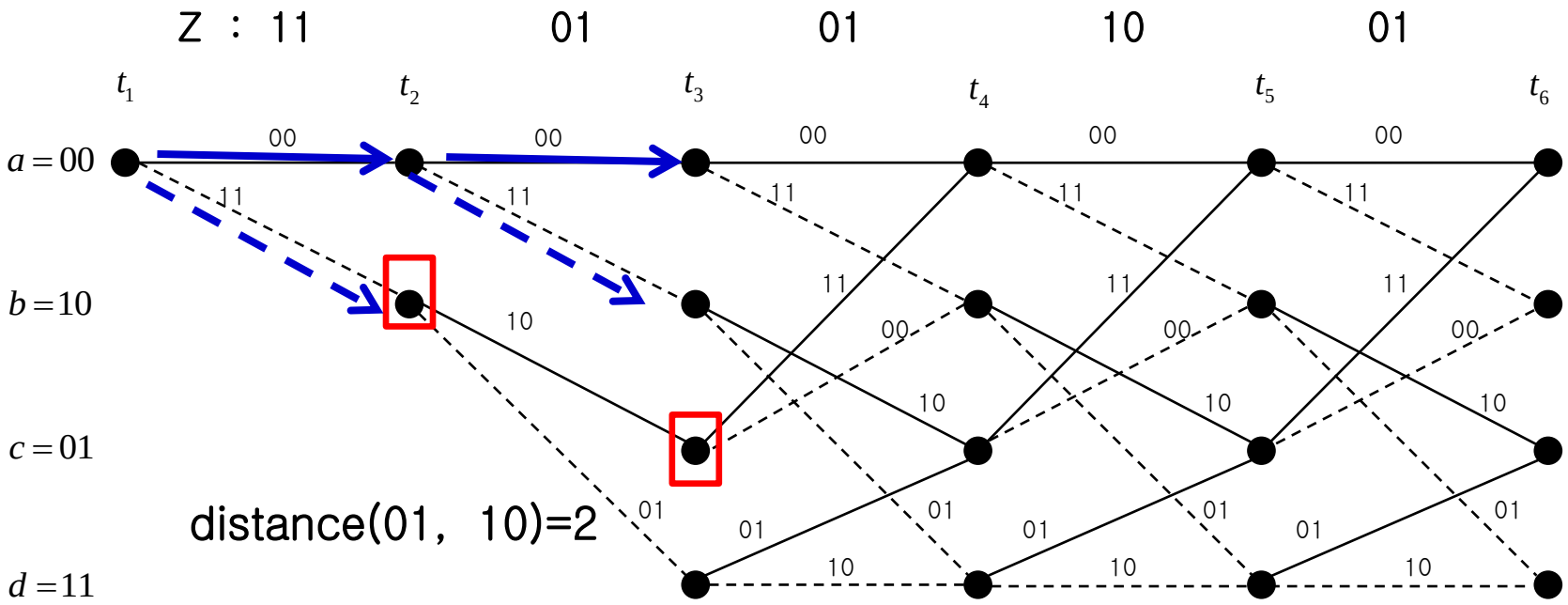
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0					
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



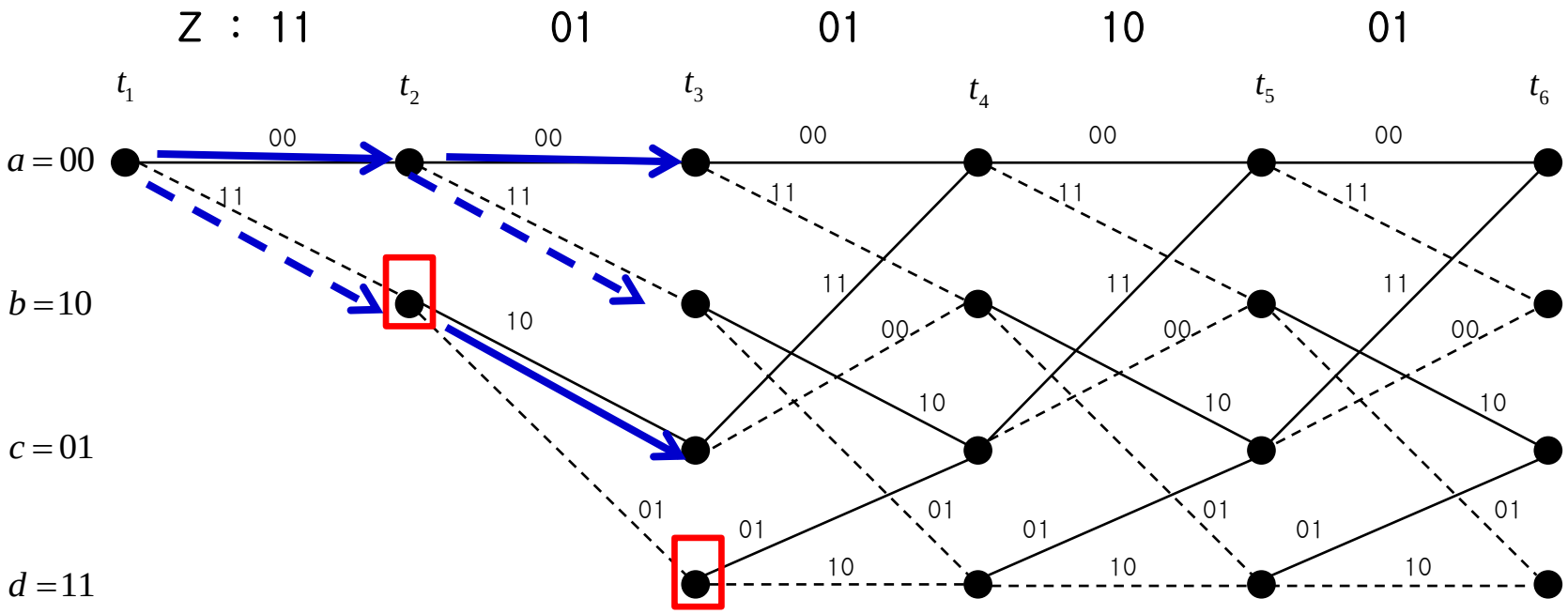
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		0+2=2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None					
output4	None					

Z= decoder input, received (demodulated) sequence.



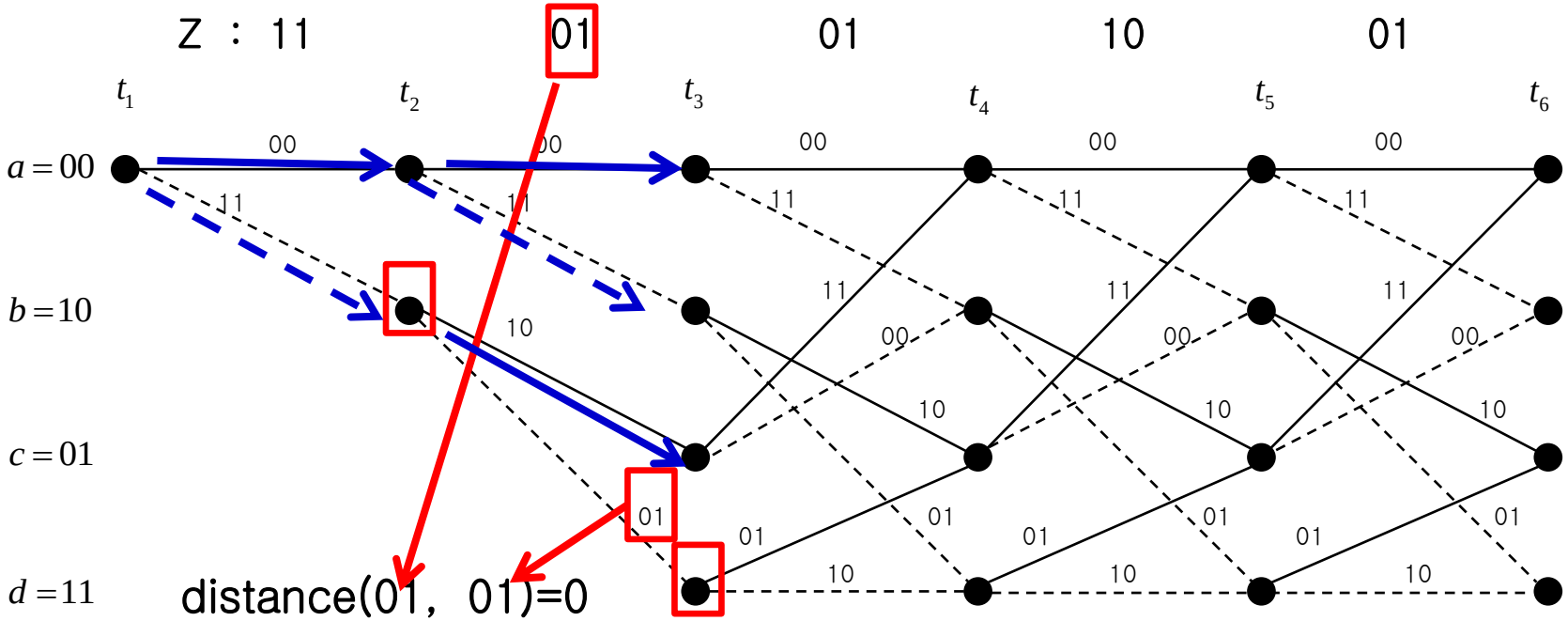
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		**10** (Solid line =0)			
output4	None					

Z= decoder input, received (demodulated) sequence.



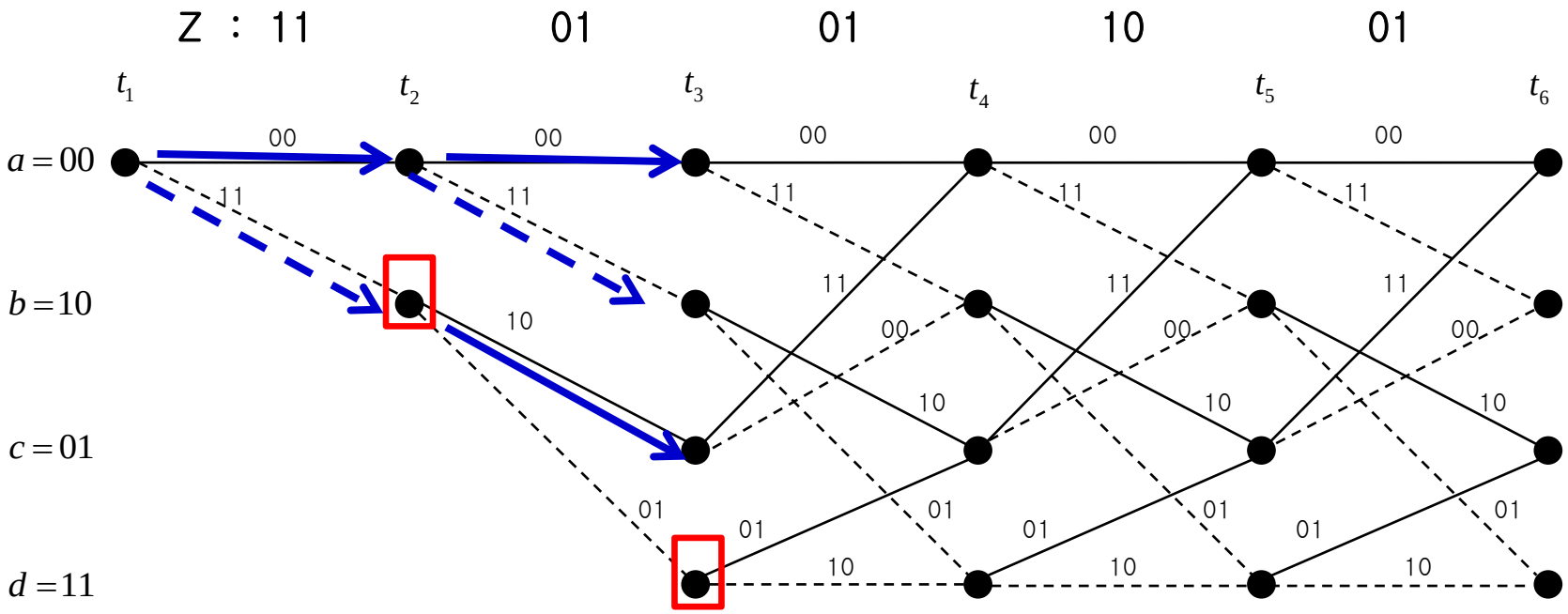
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



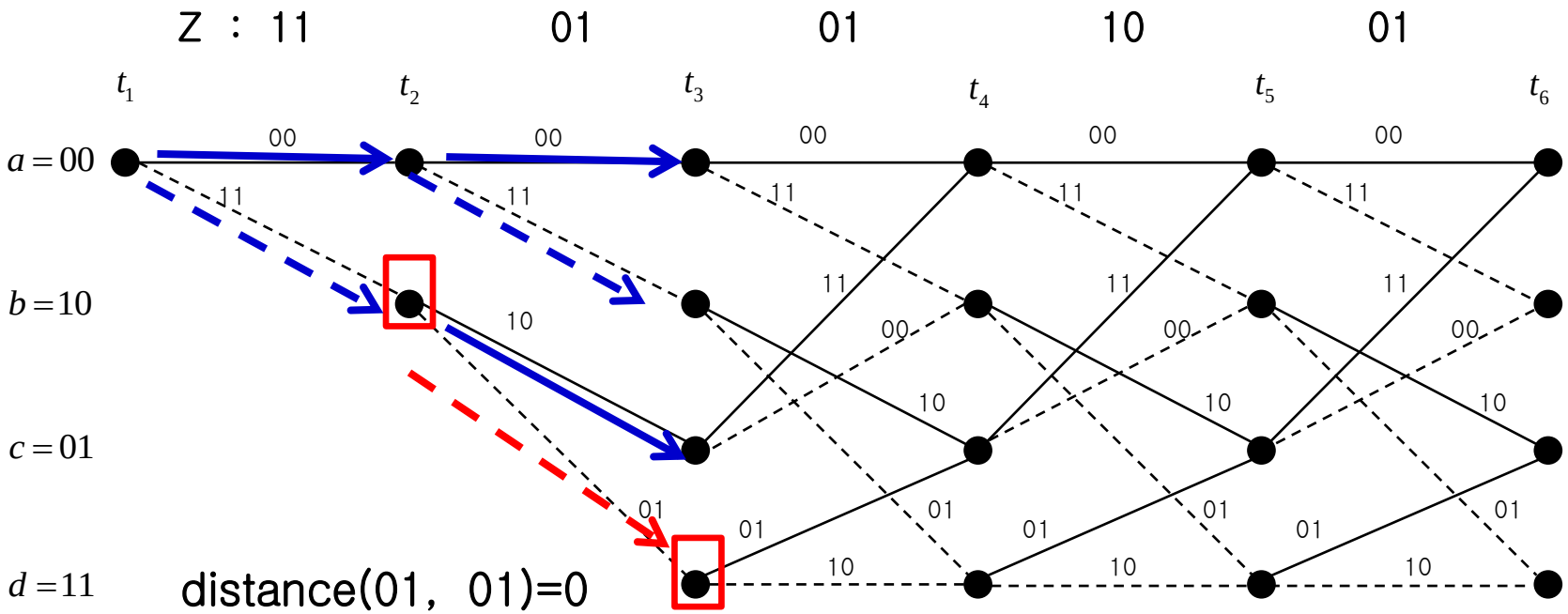
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



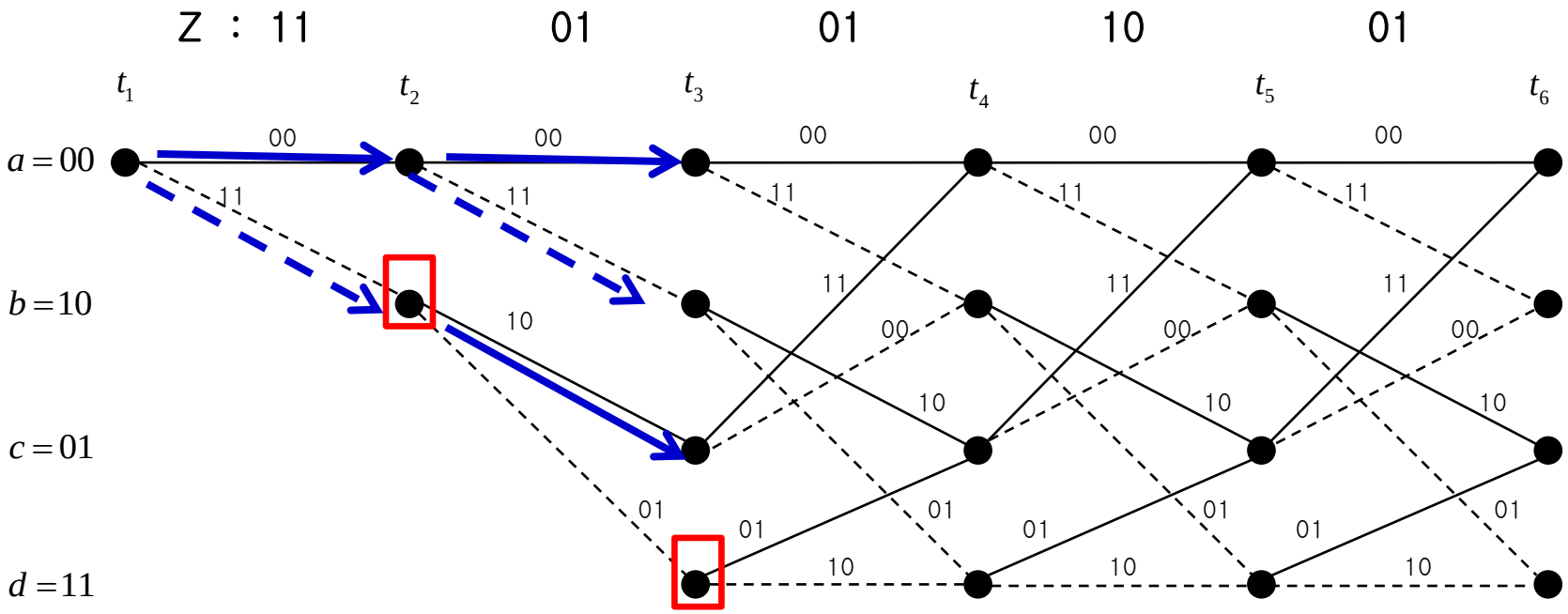
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



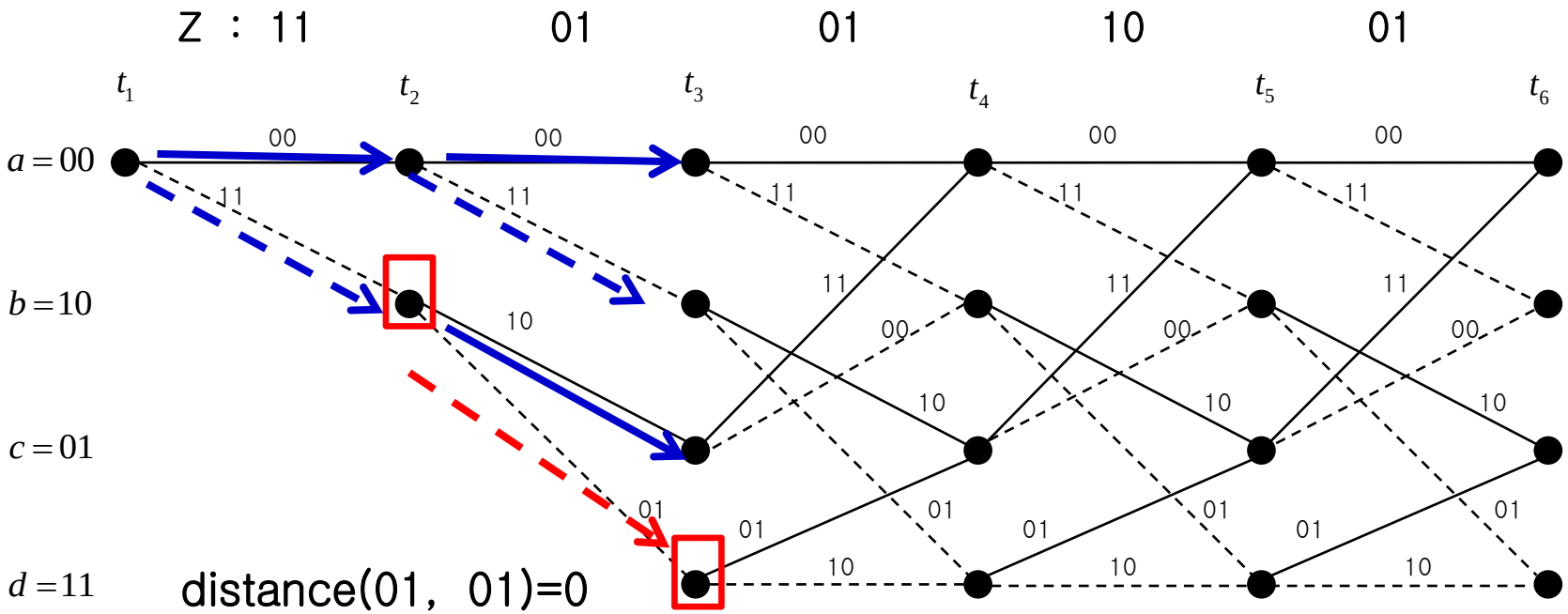
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



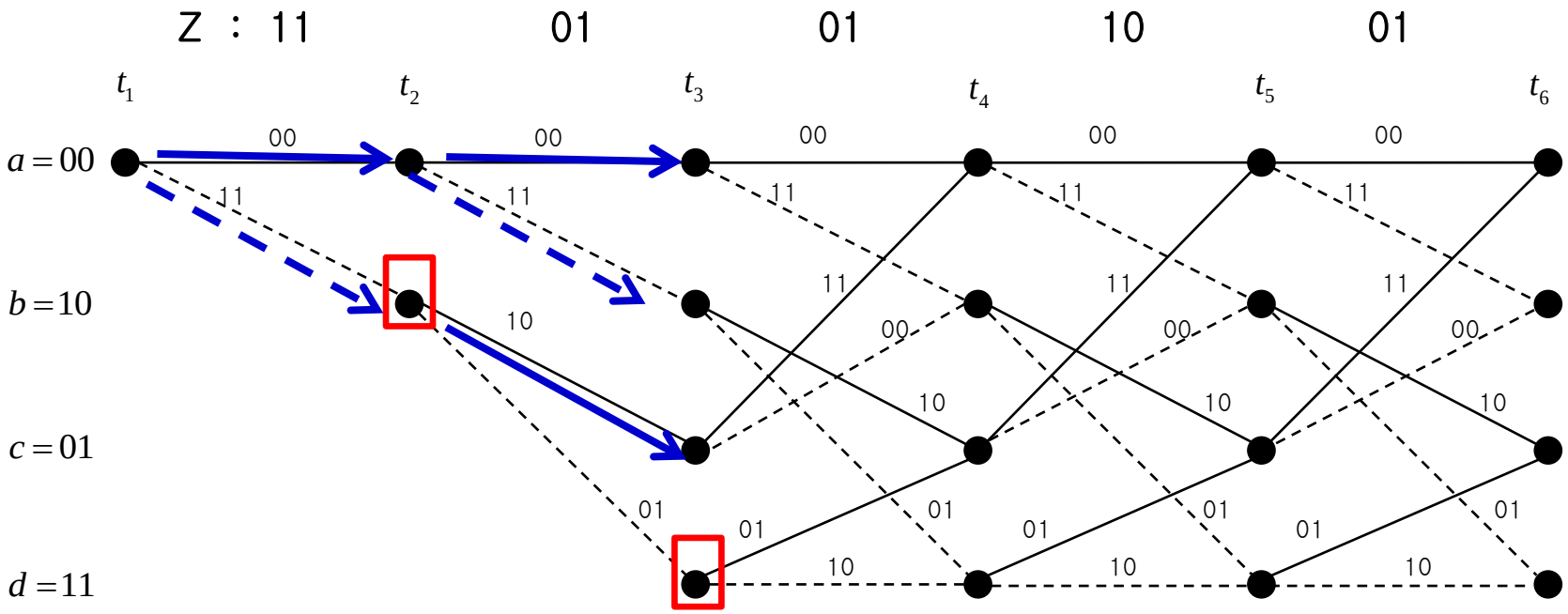
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



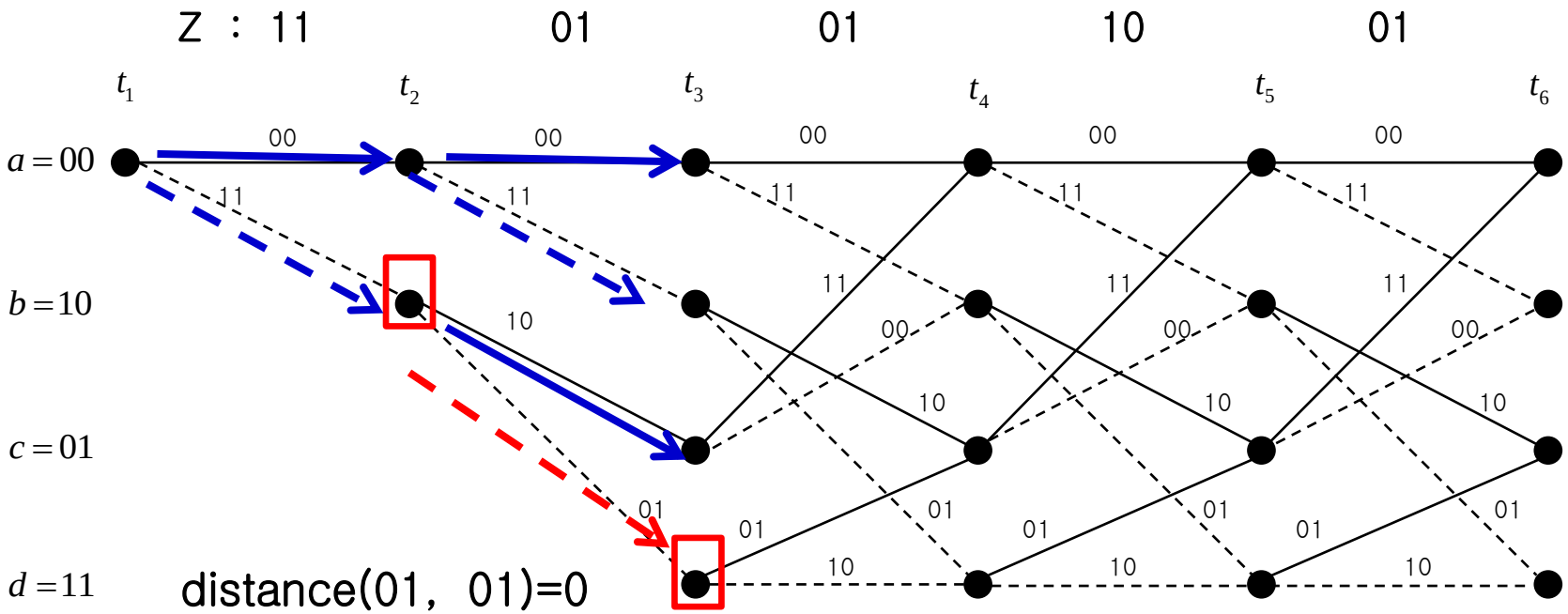
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



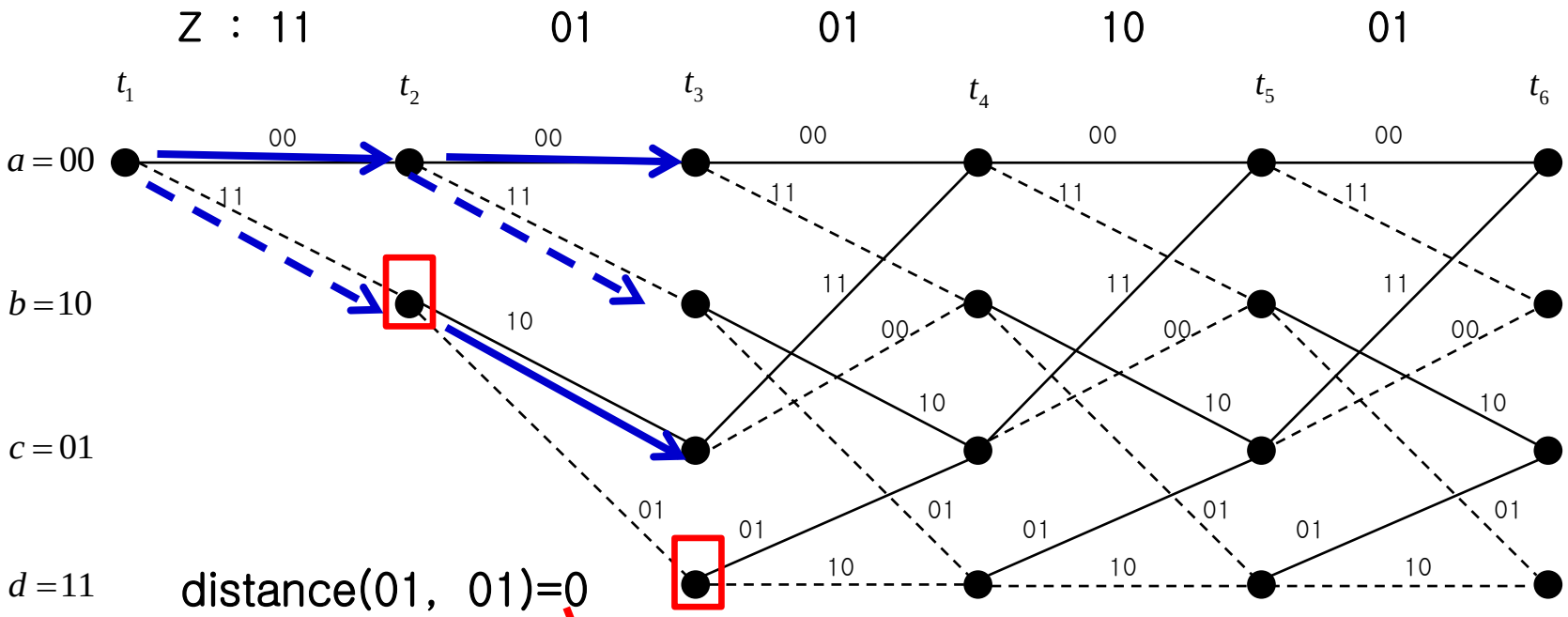
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



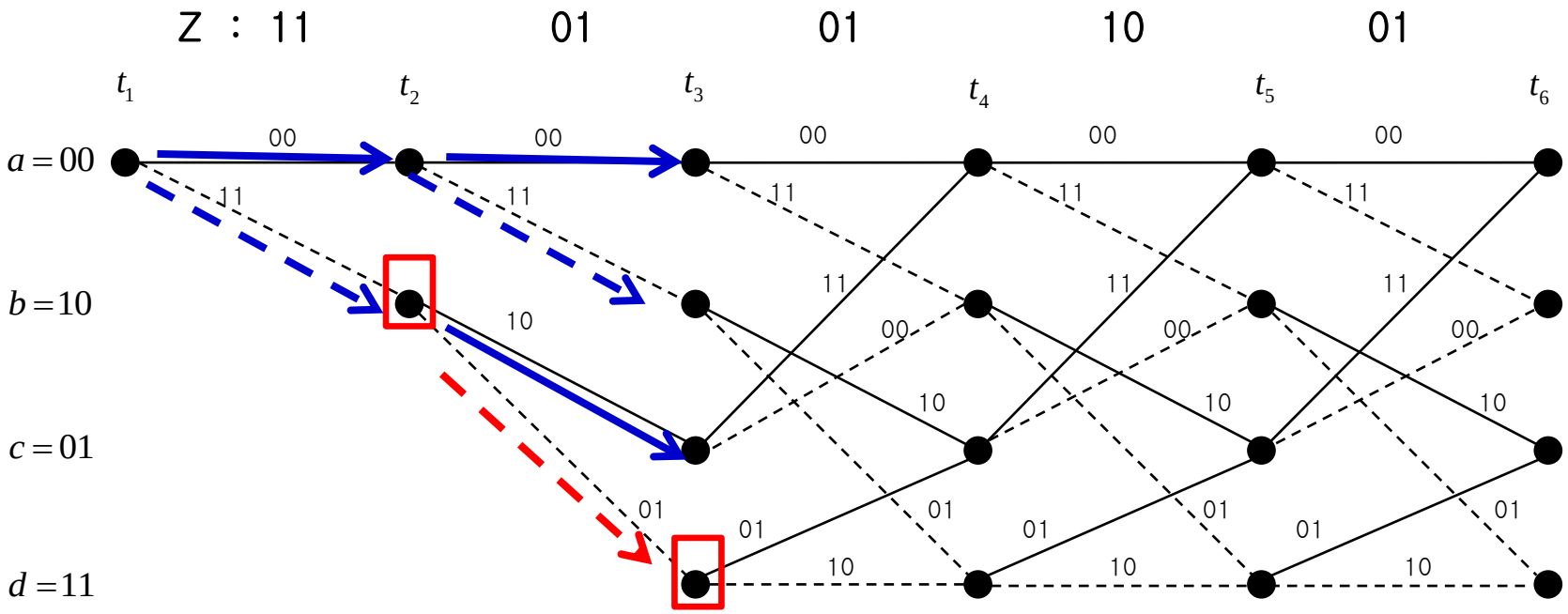
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0					
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



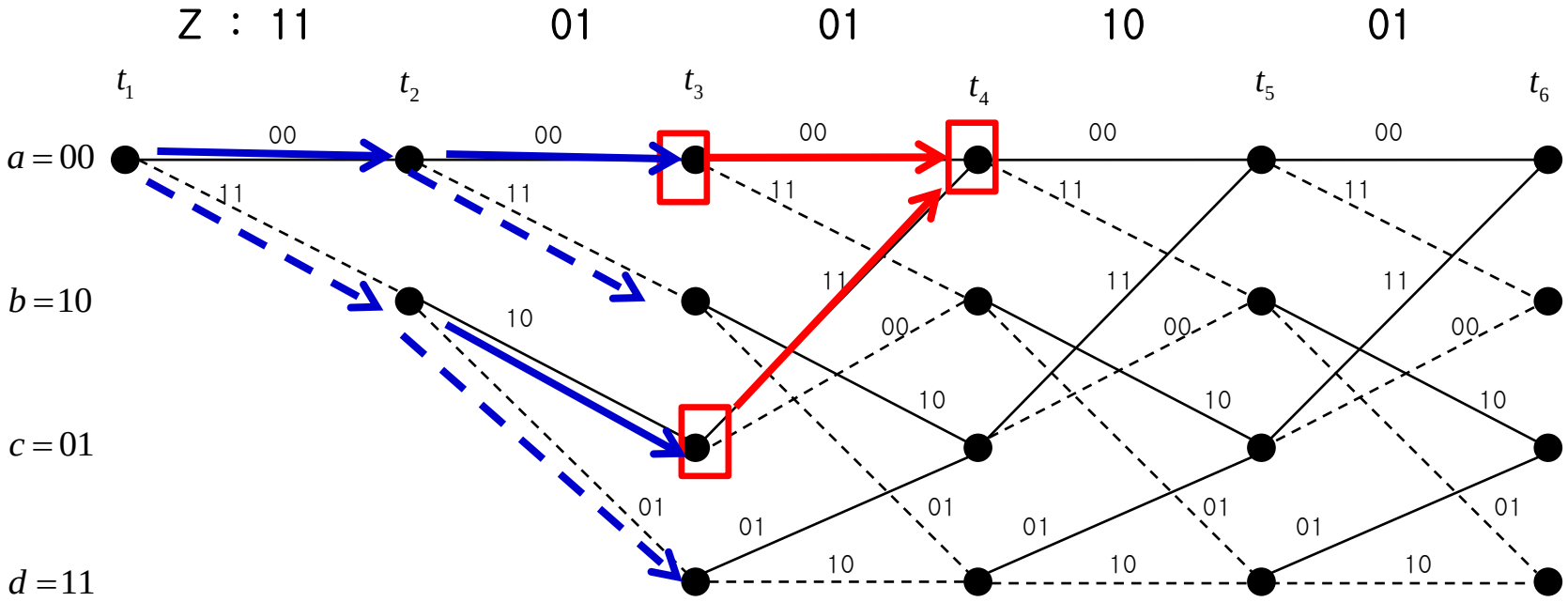
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0+0=0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None					

Z= decoder input, received (demodulated) sequence.



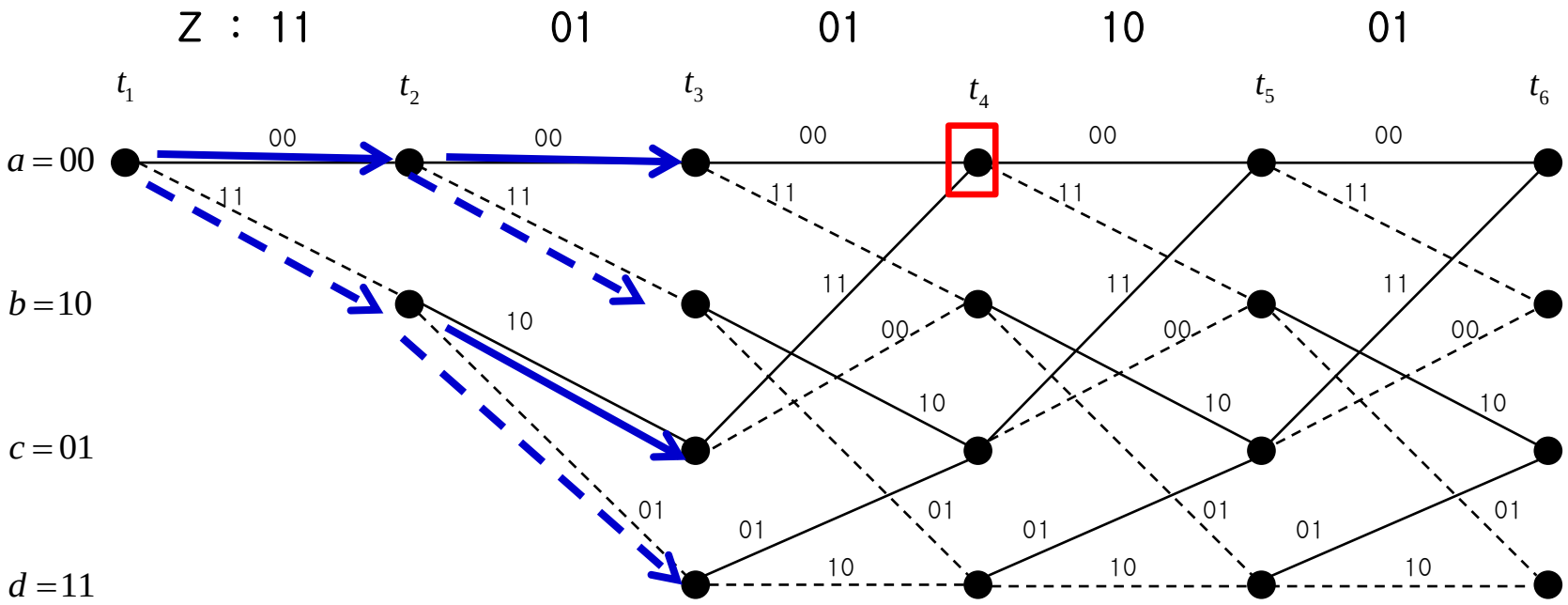
	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



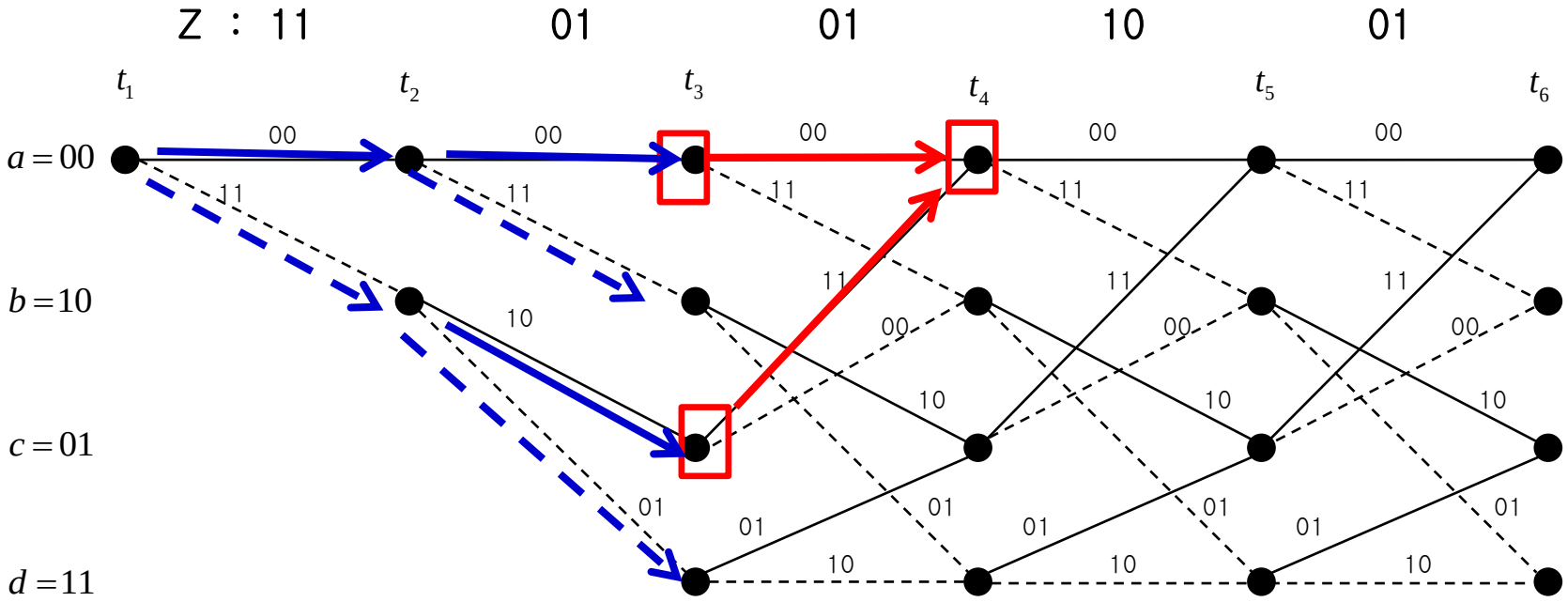
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



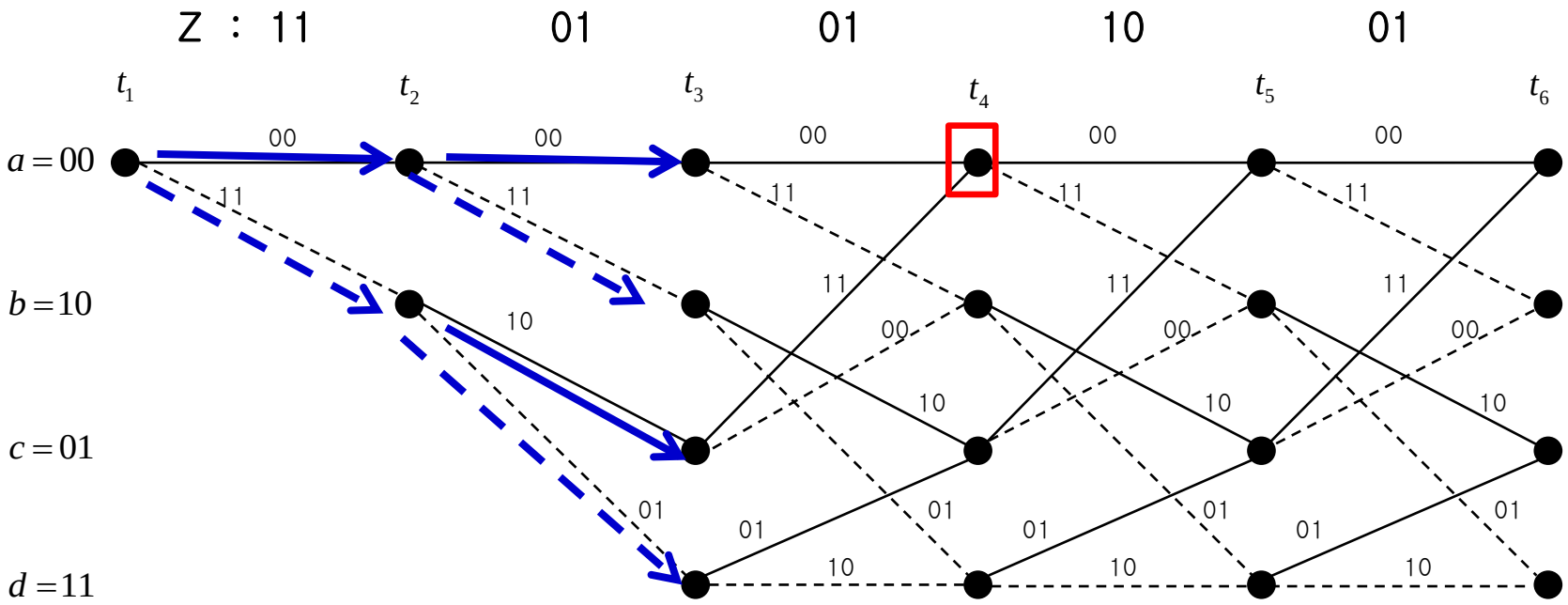
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



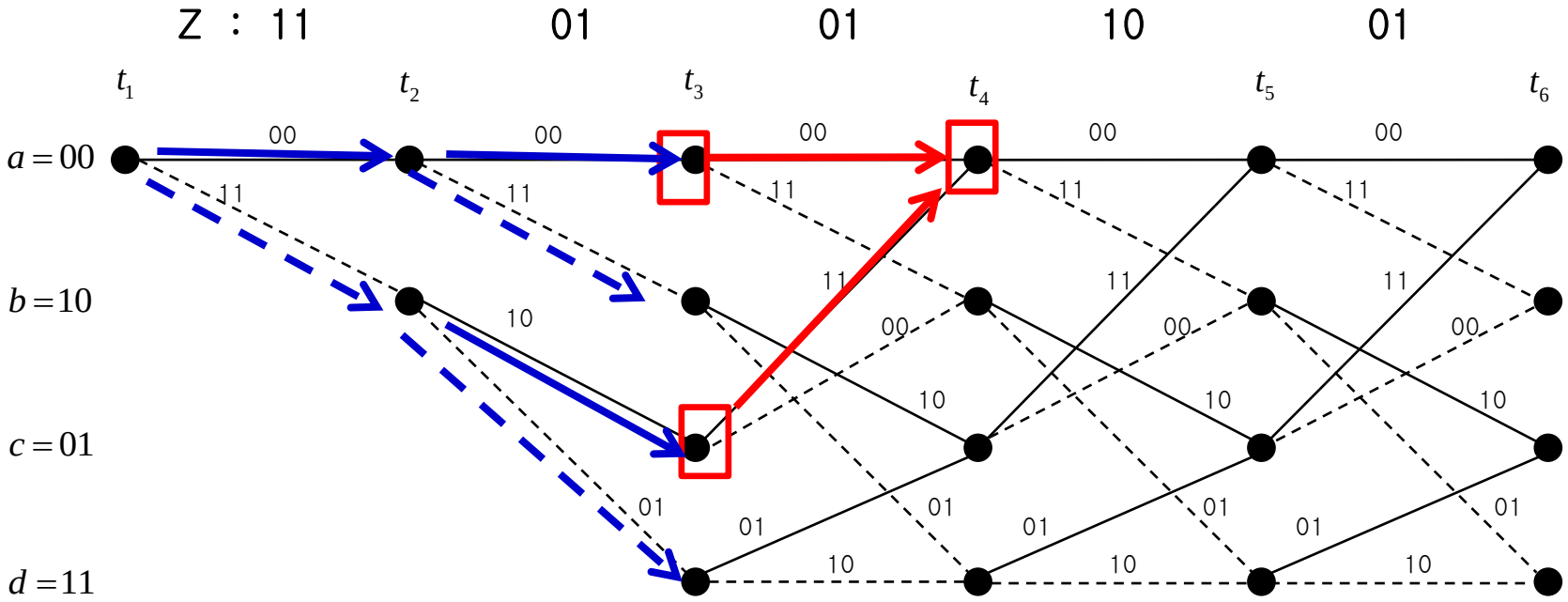
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



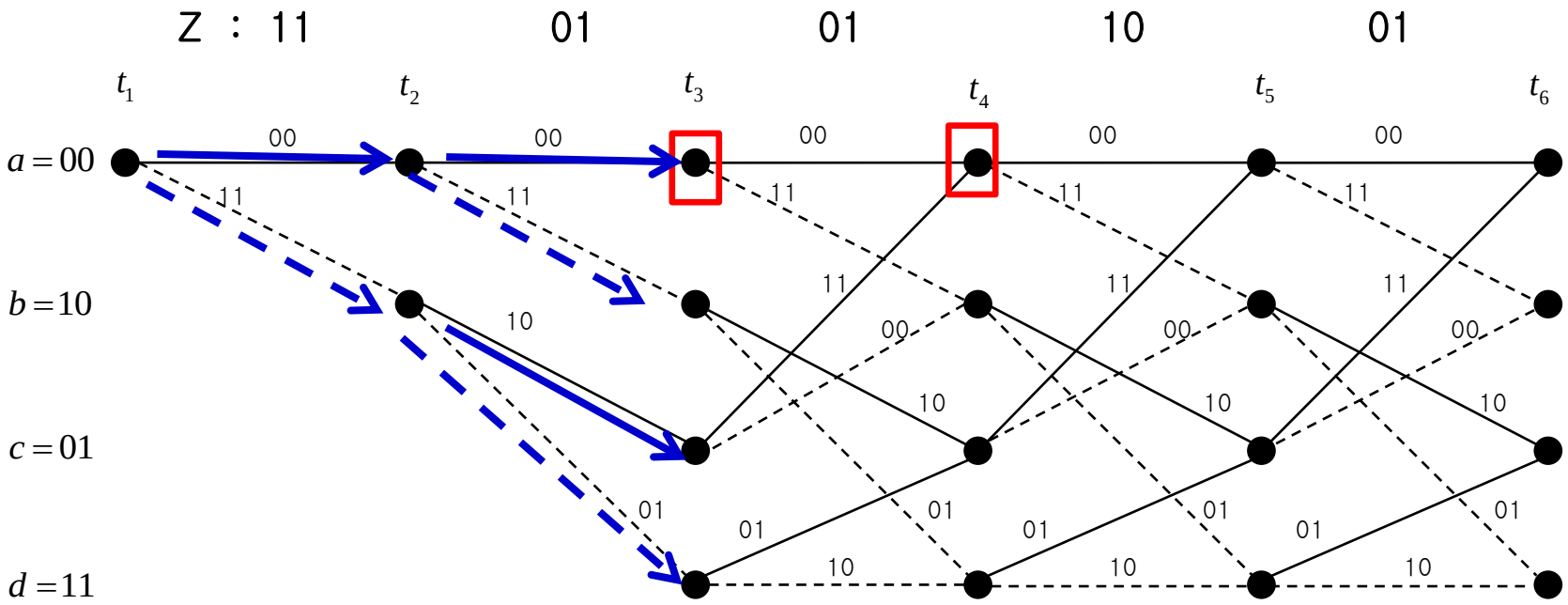
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



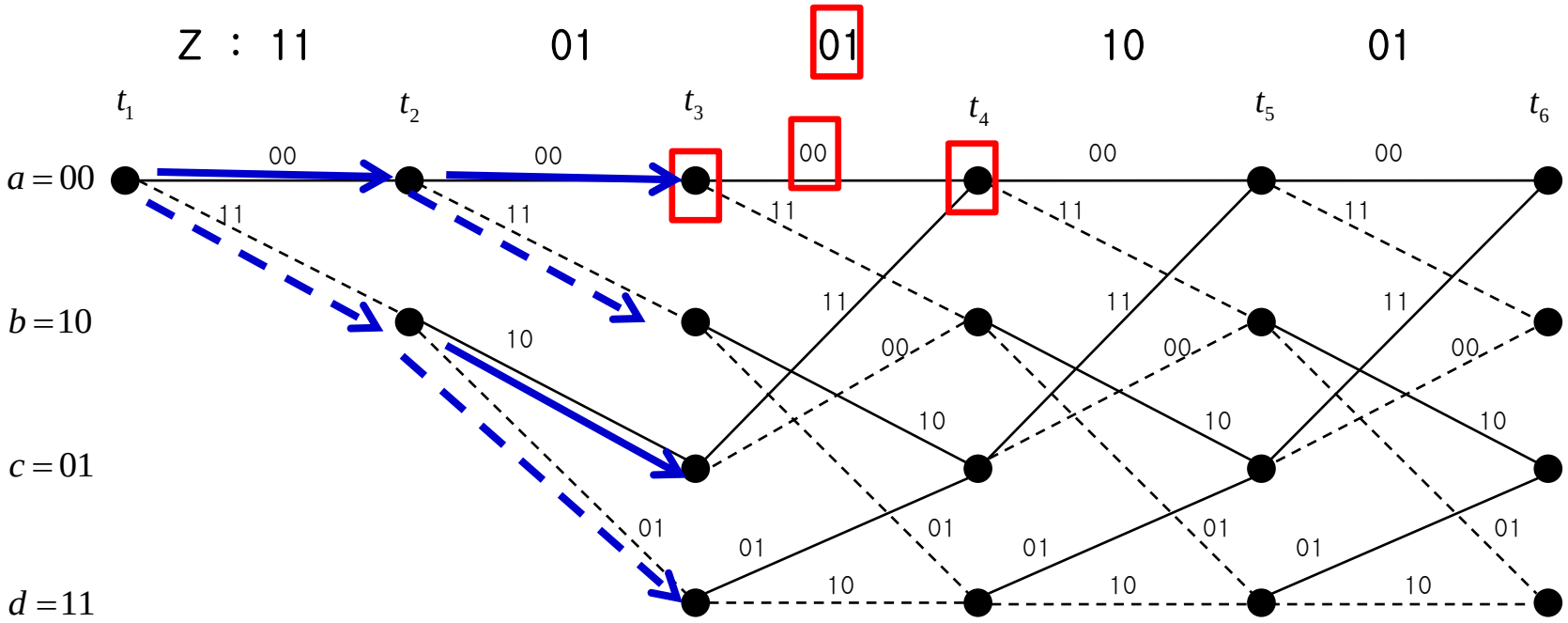
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



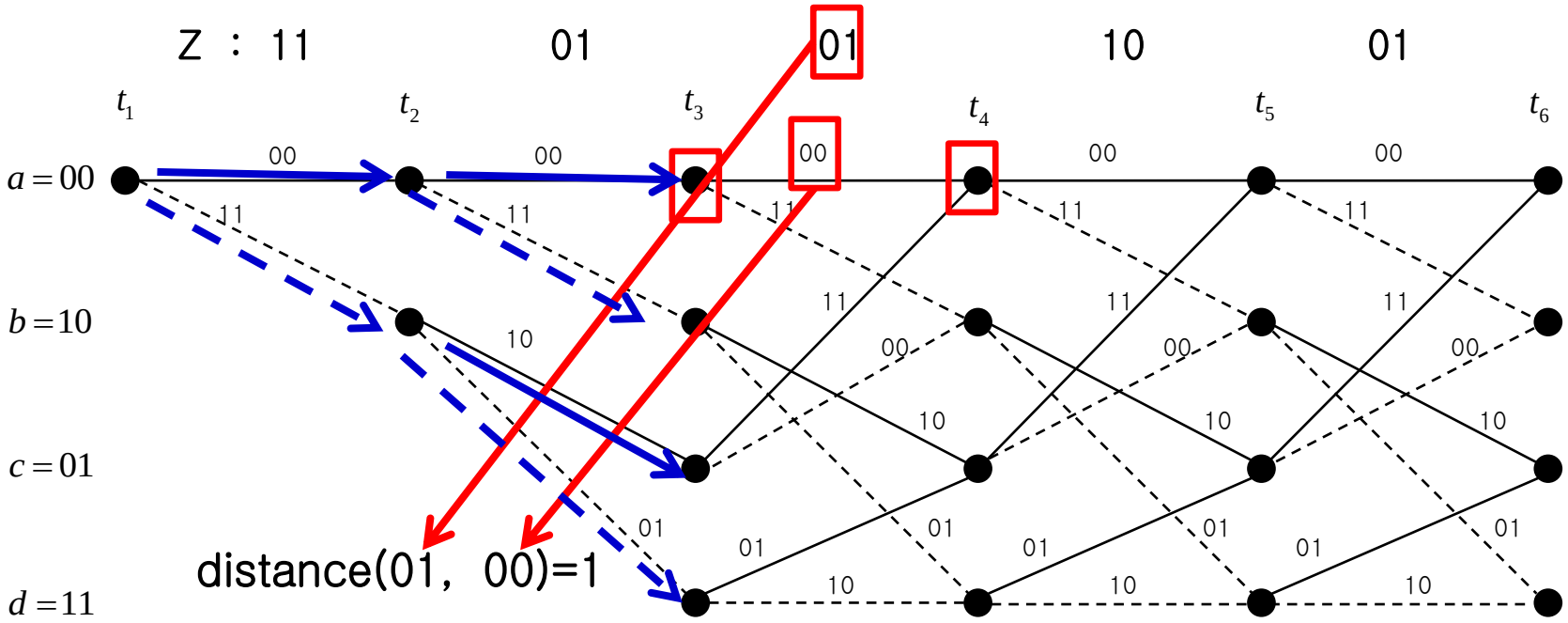
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



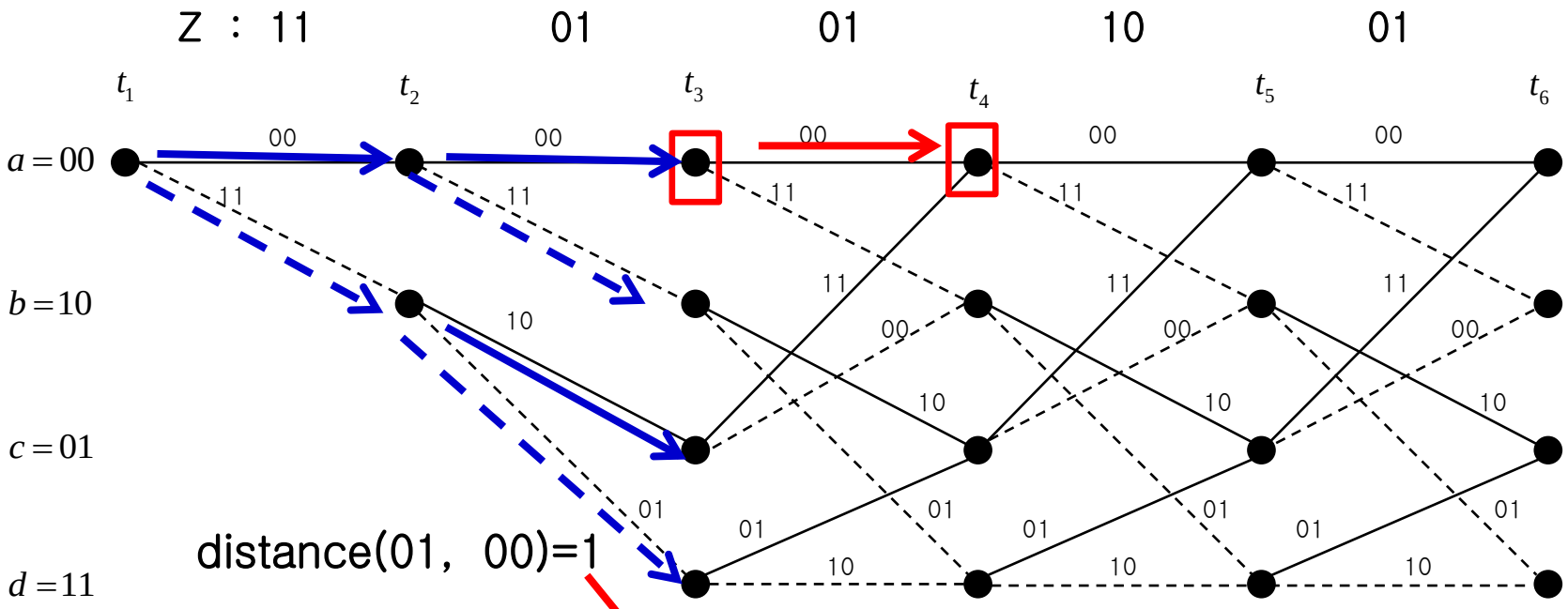
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



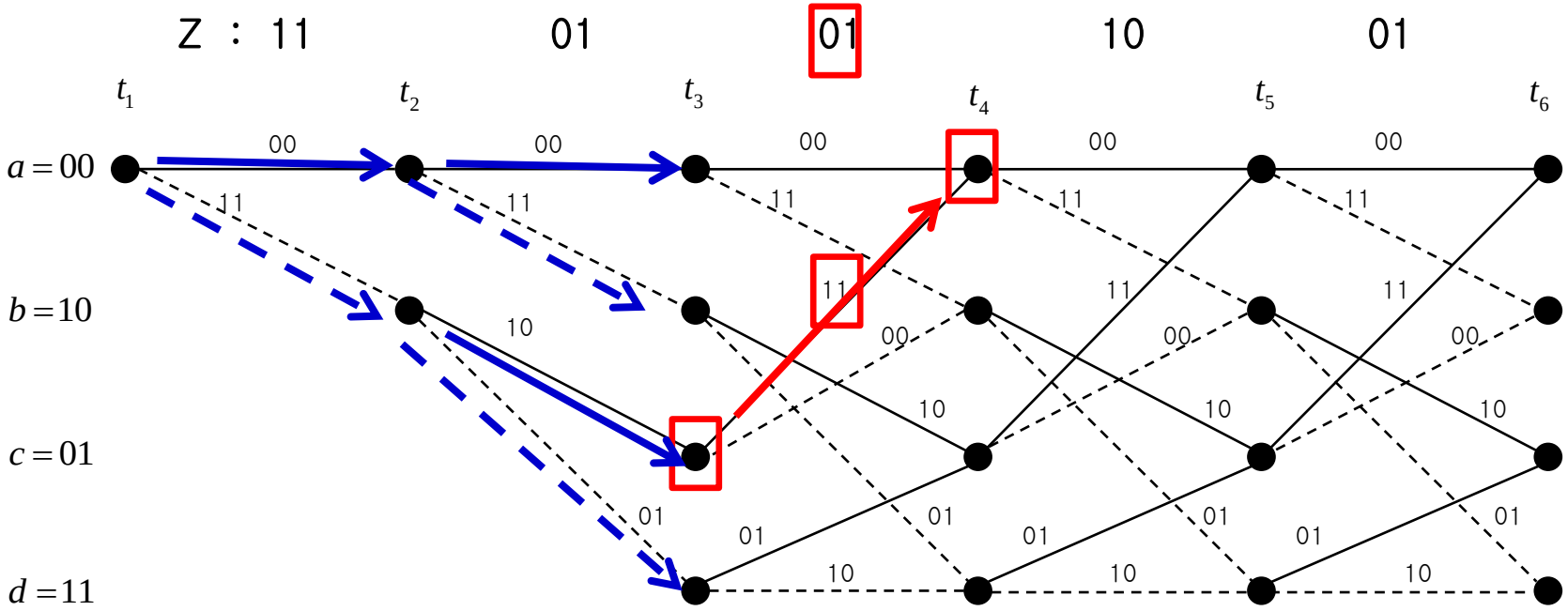
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3			
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



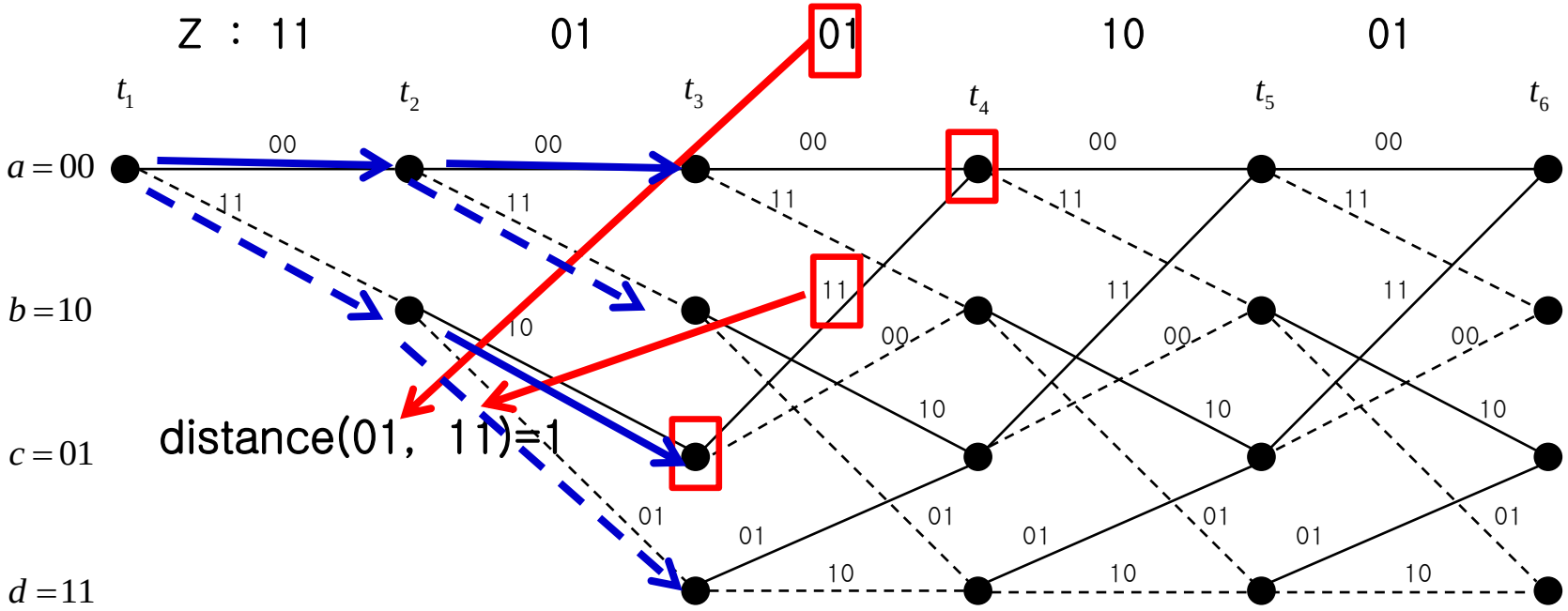
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3+1	4		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



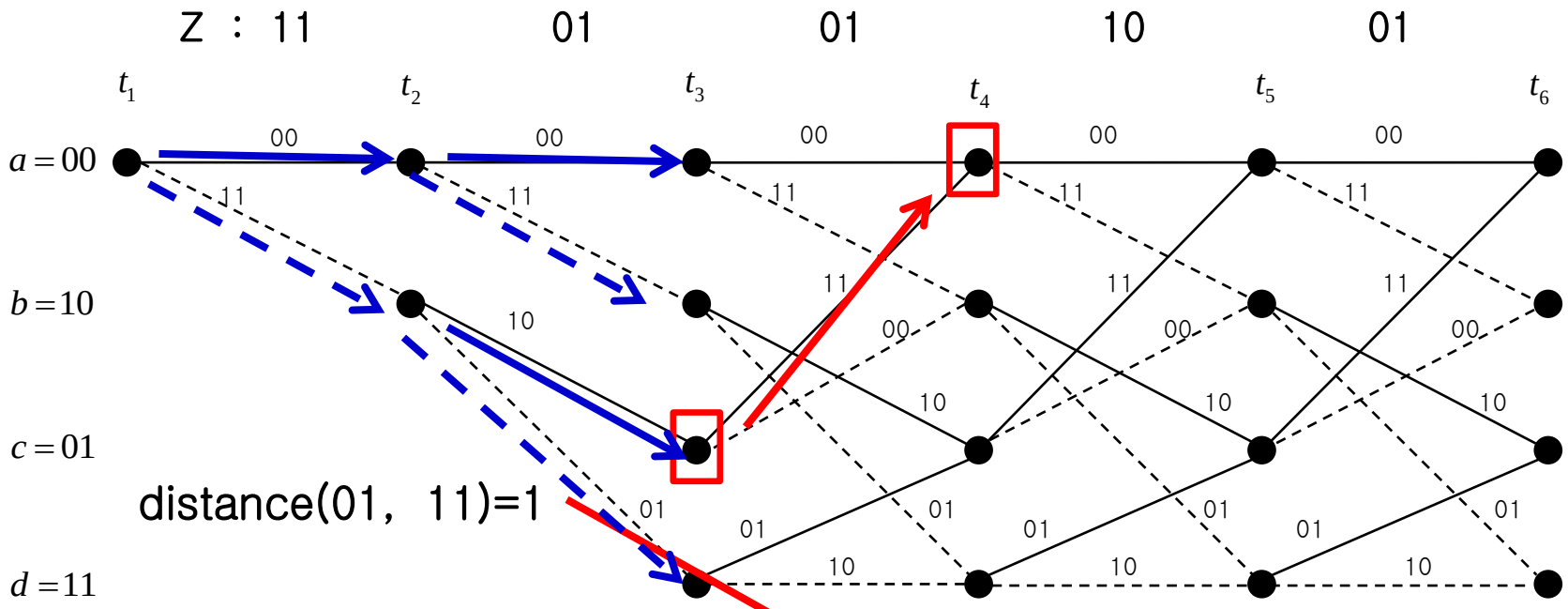
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	4		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



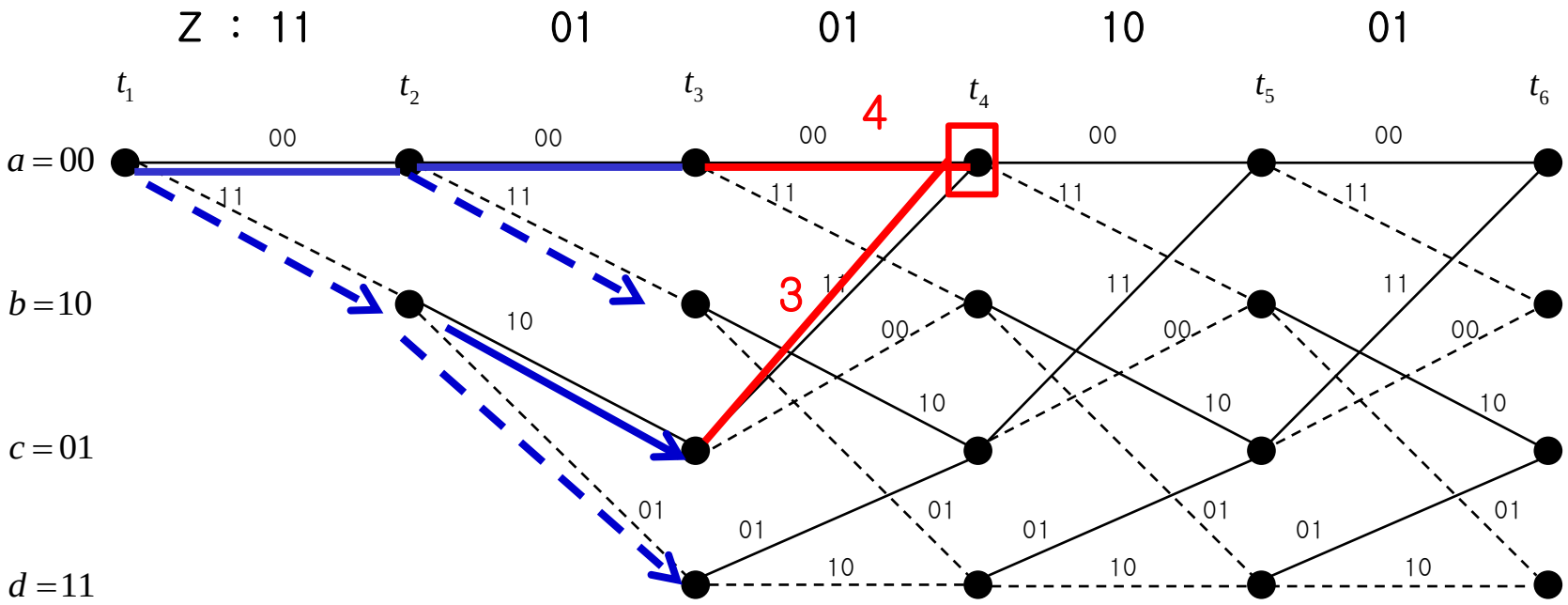
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	4		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



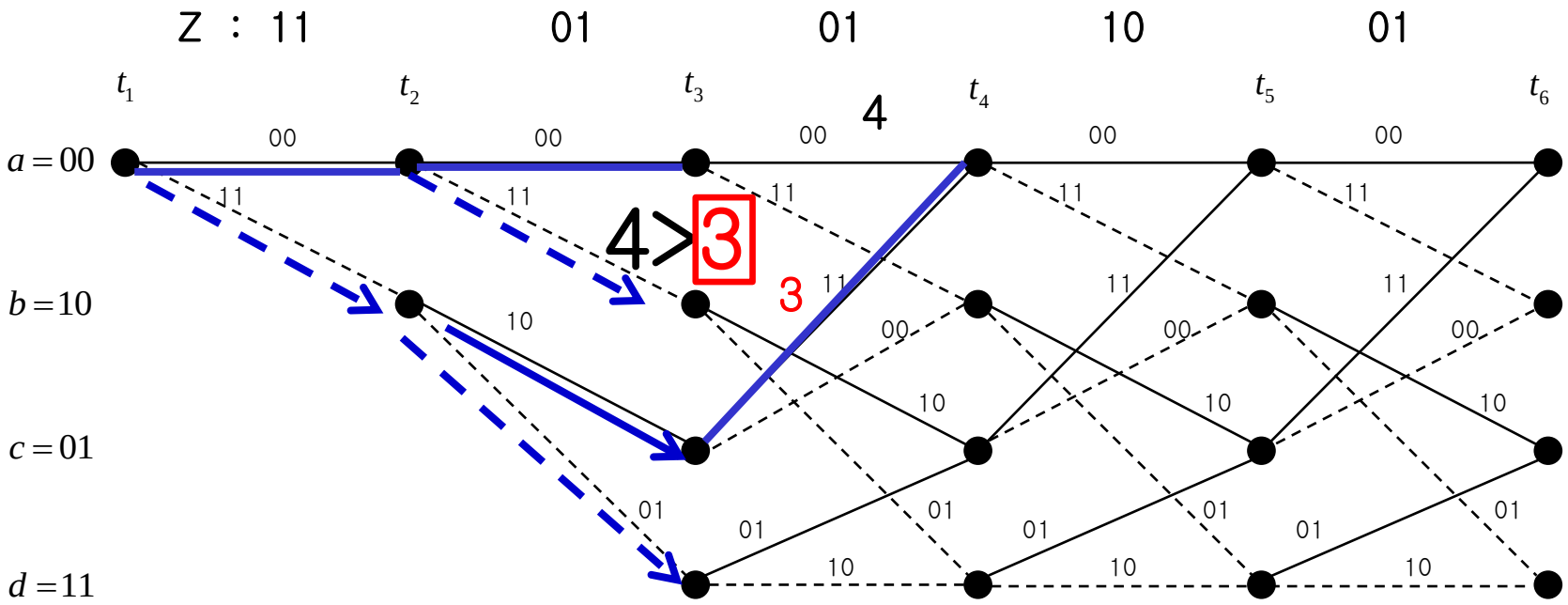
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	(4, 2+1=3)		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



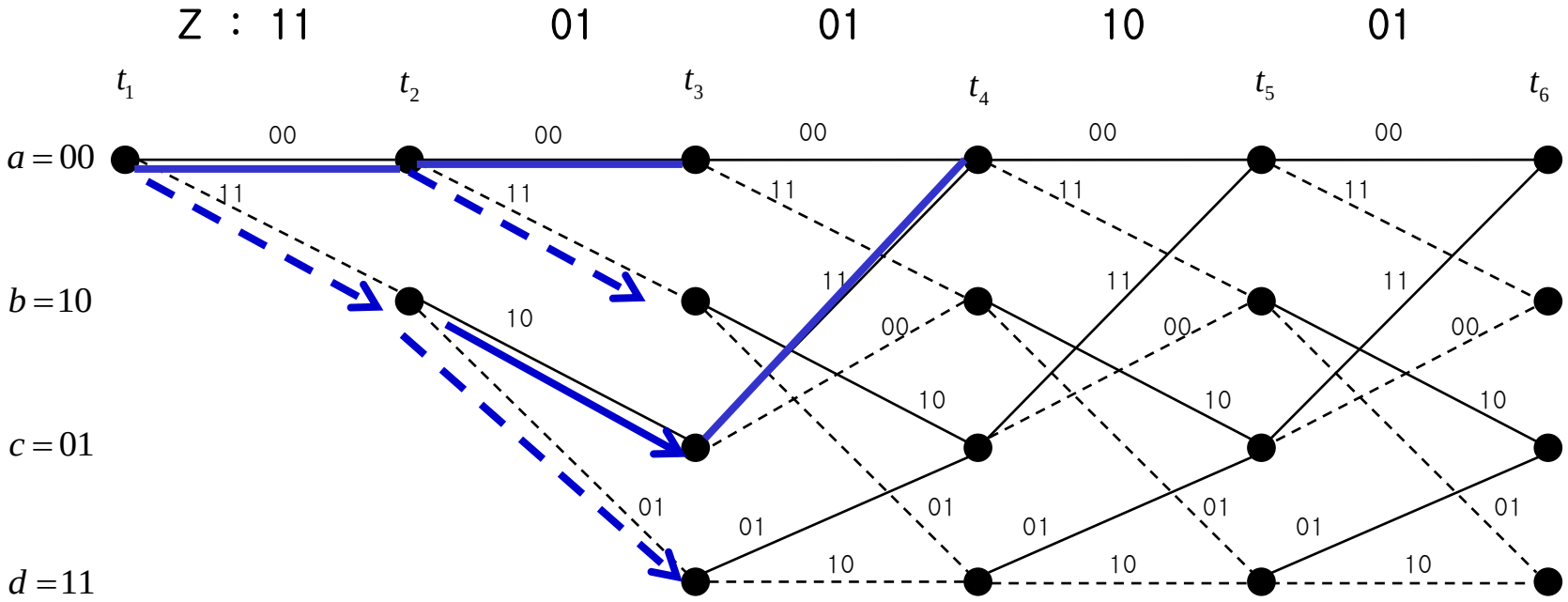
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	(**4**, **3**)		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



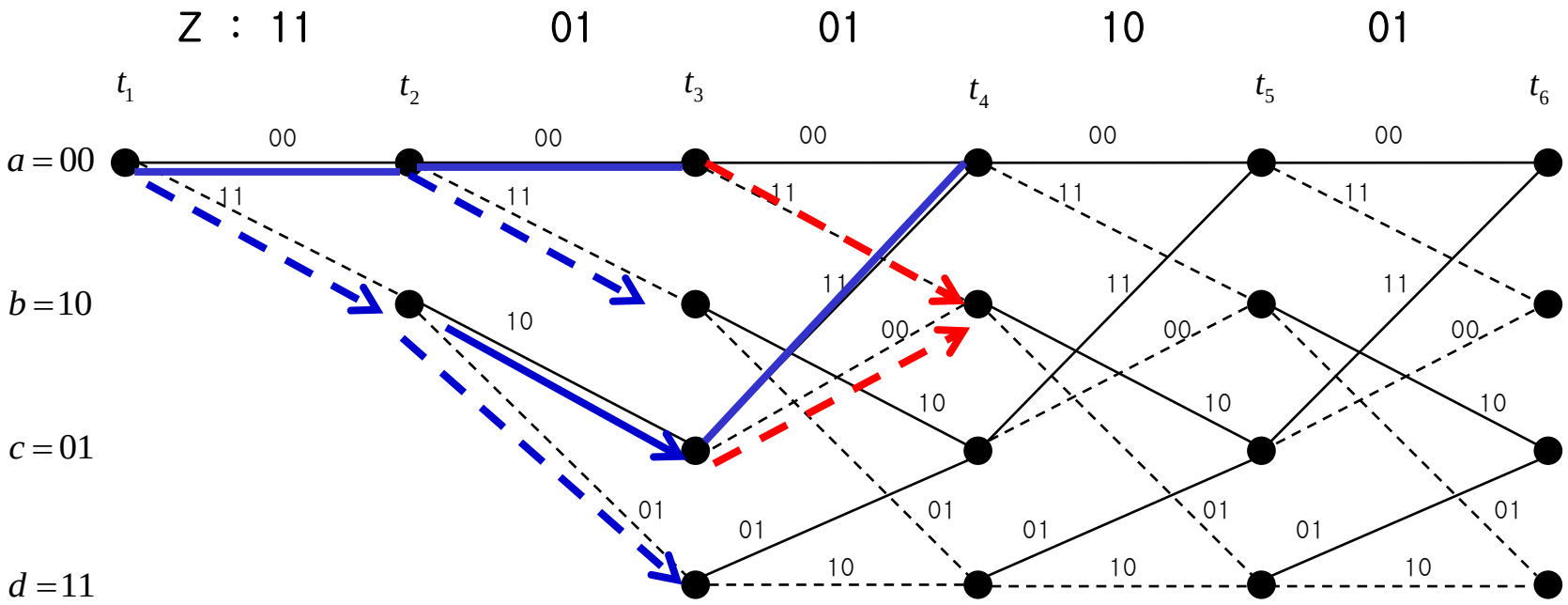
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	**3**		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00			
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



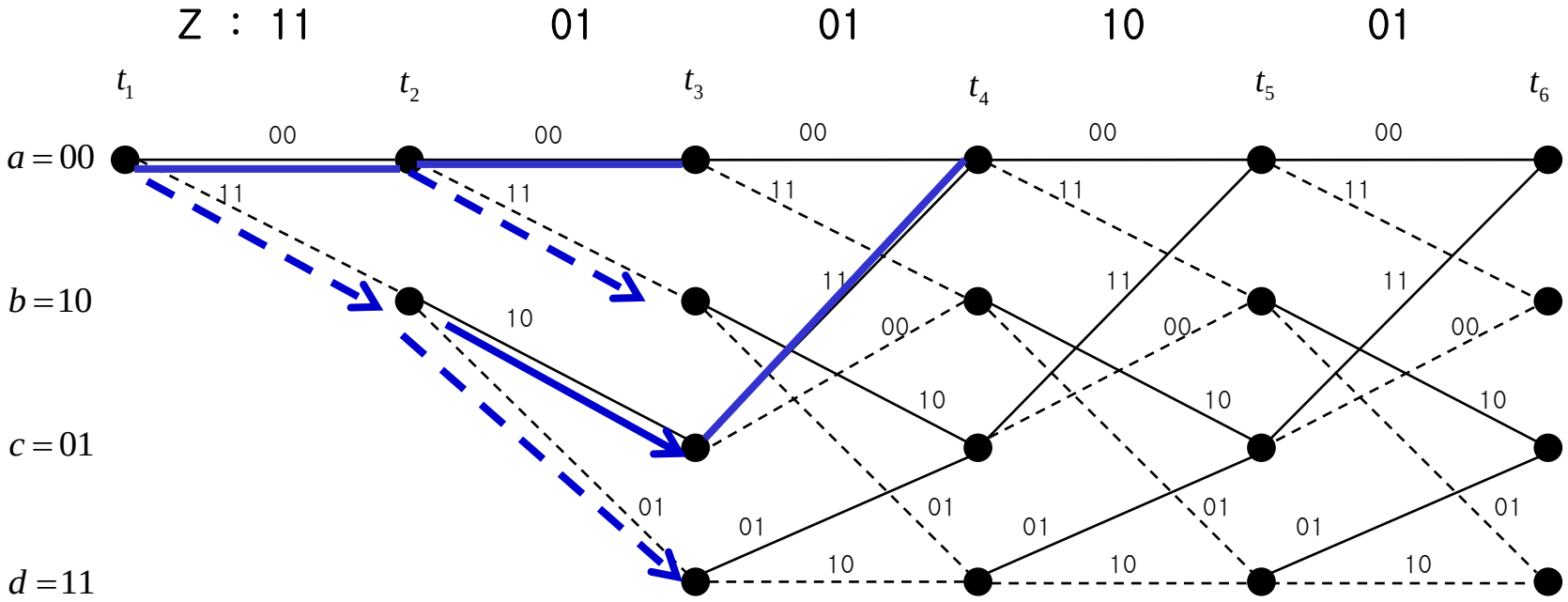
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



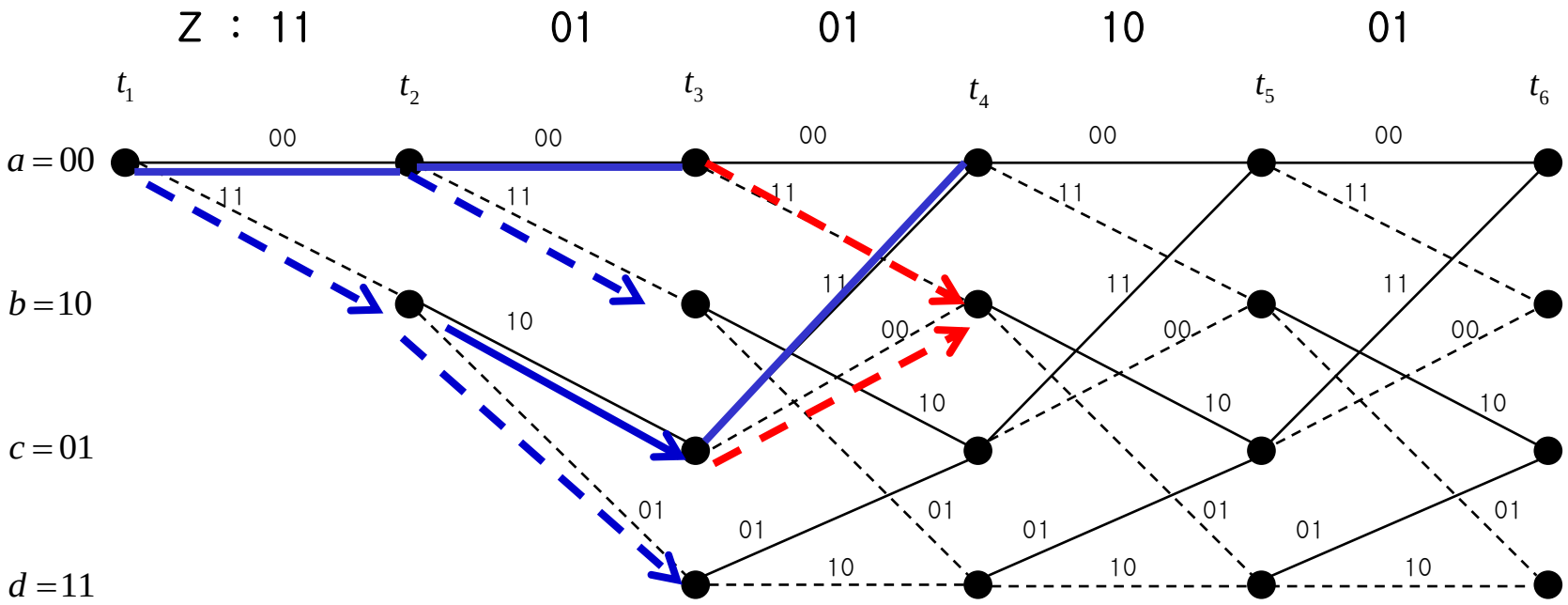
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



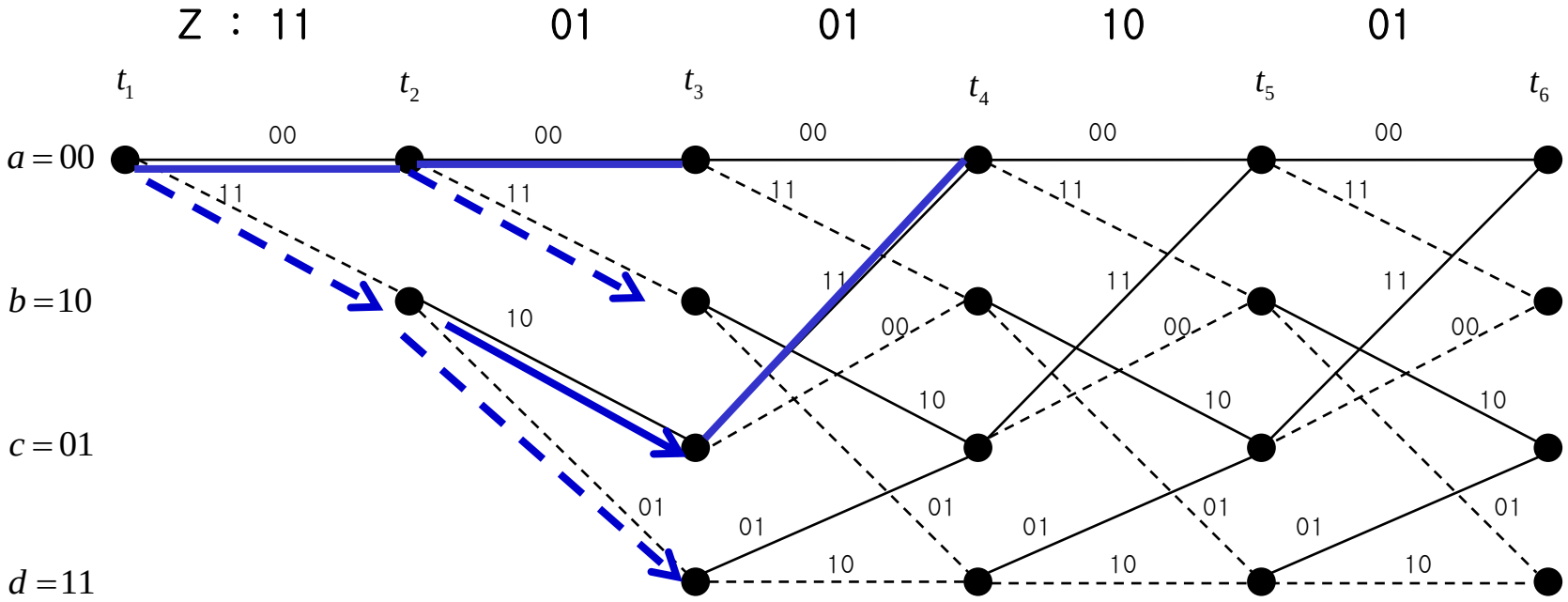
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



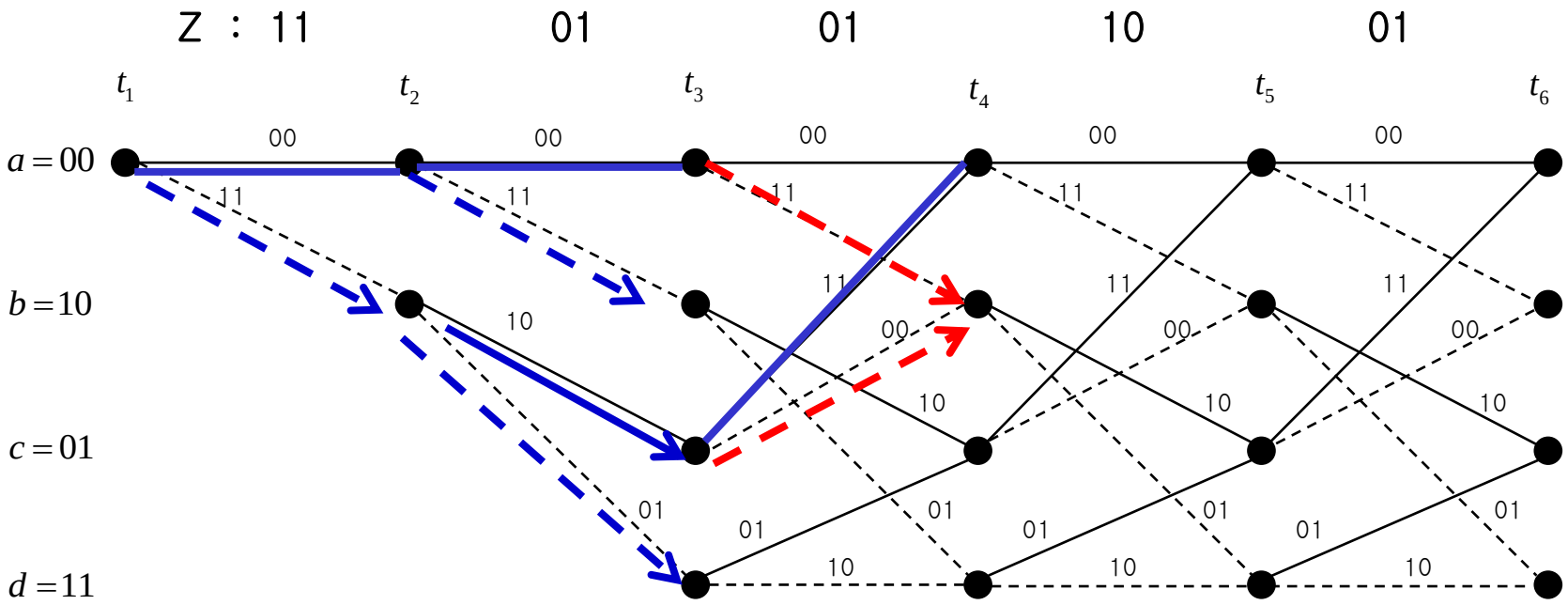
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



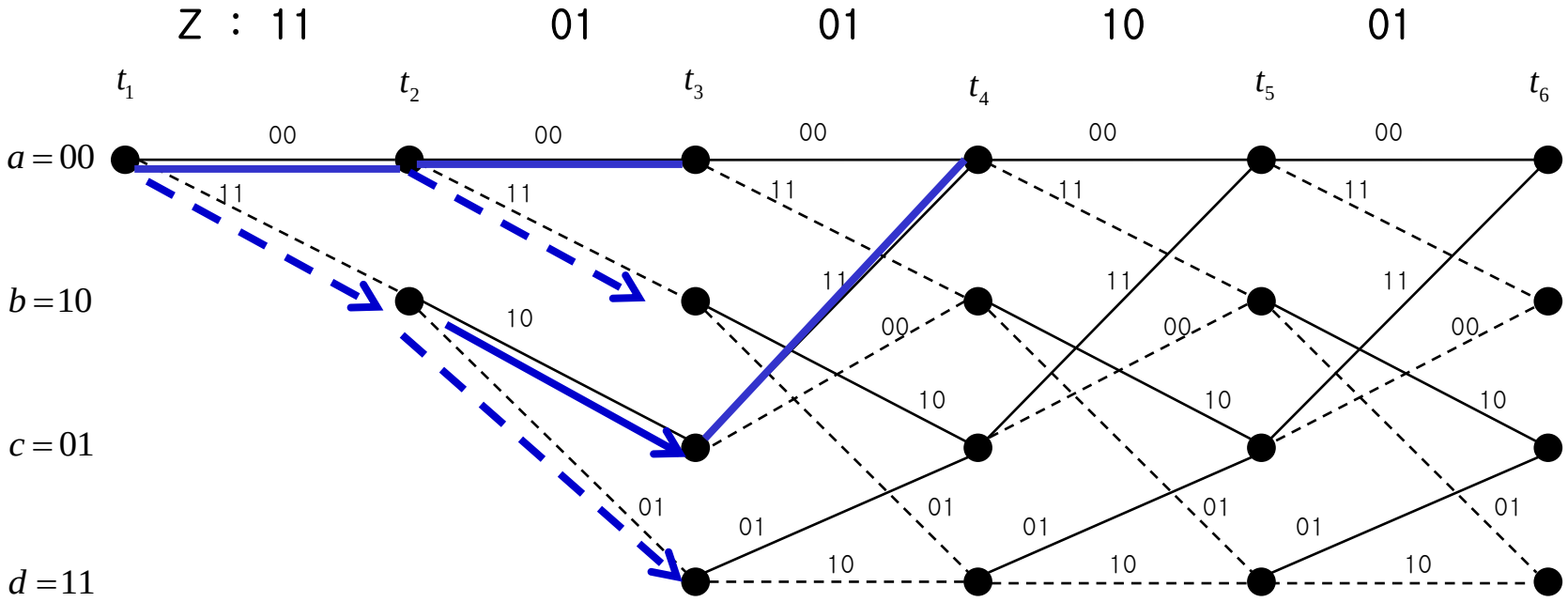
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



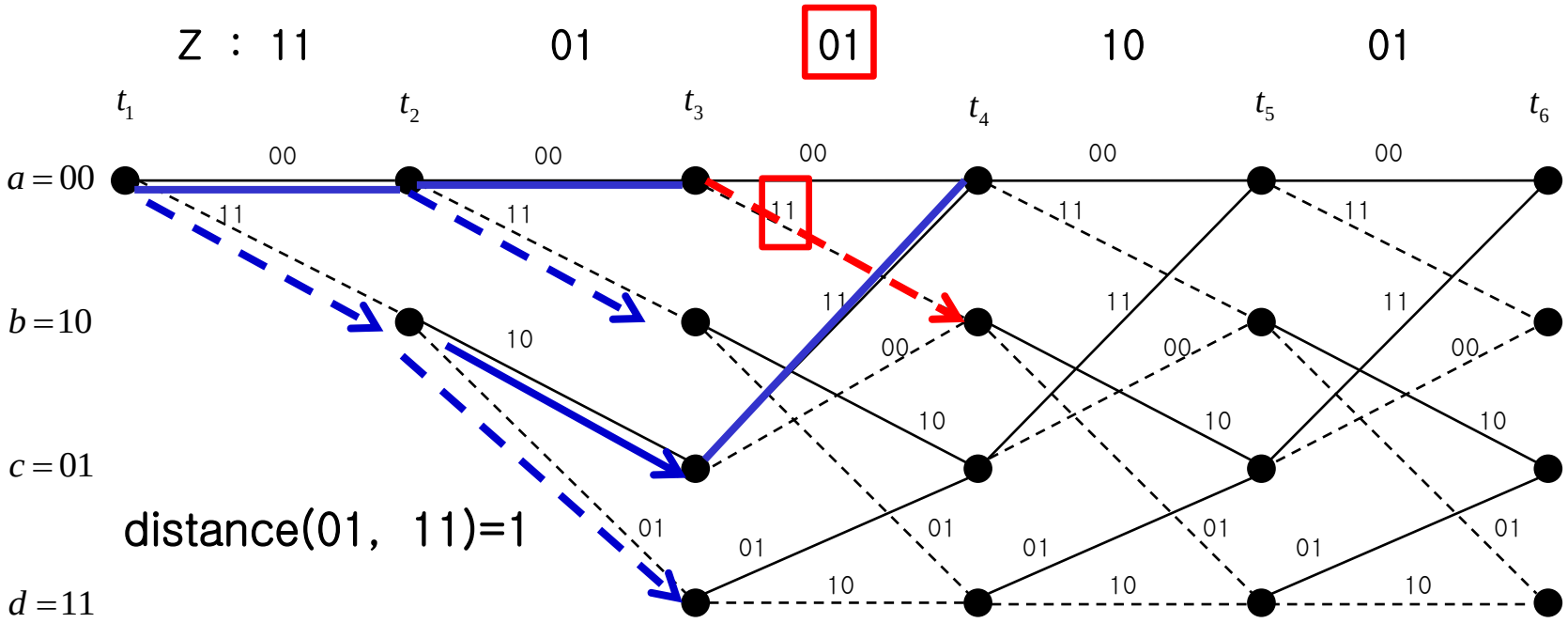
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



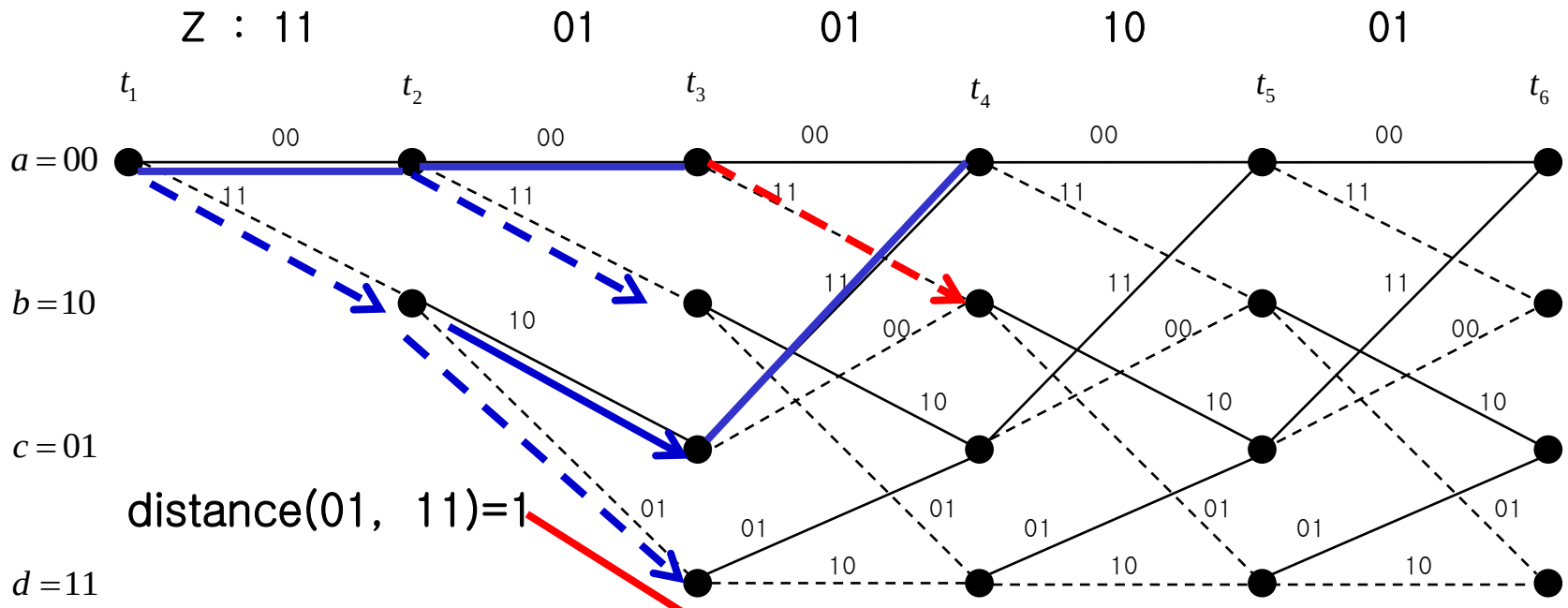
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



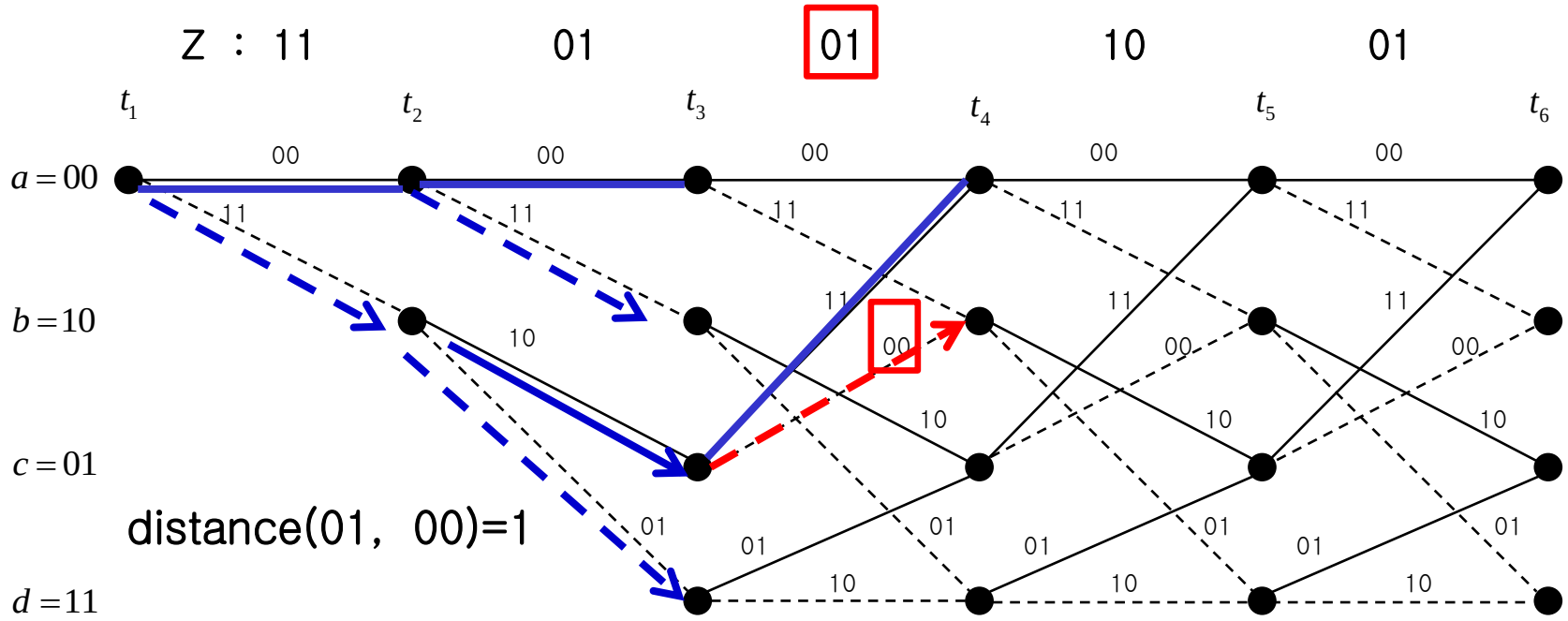
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3			
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



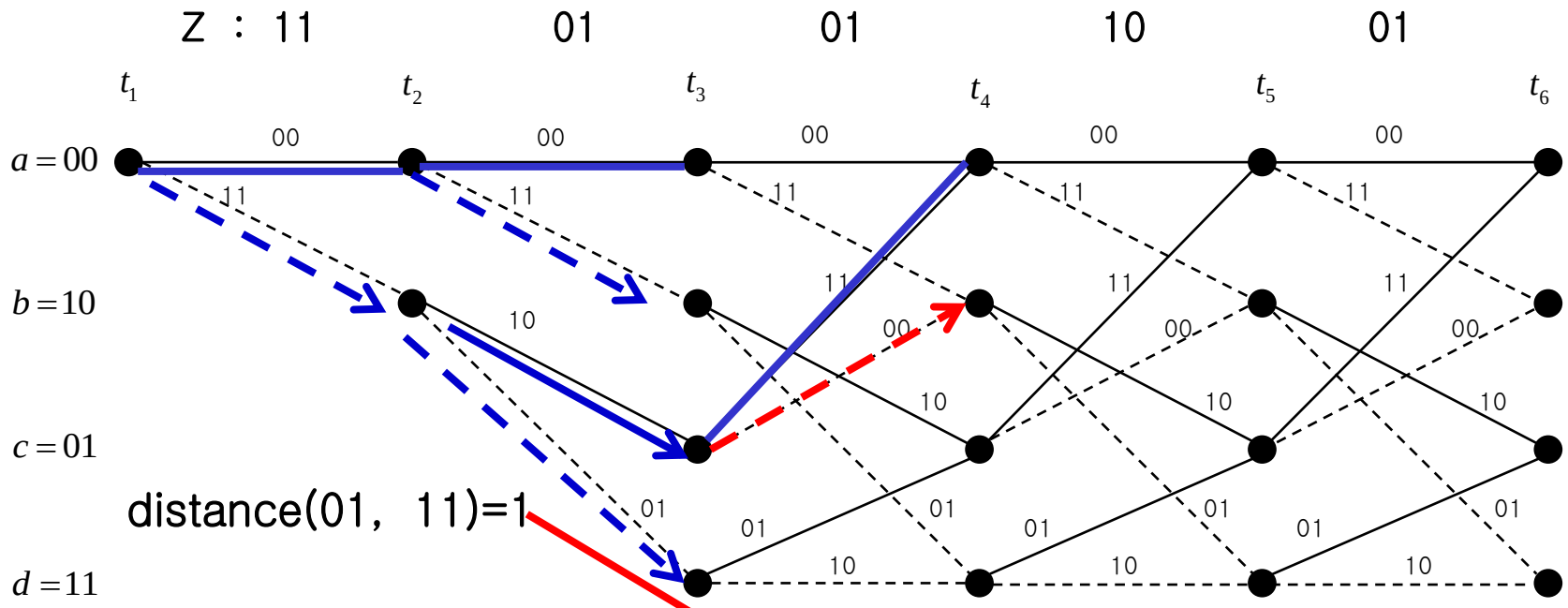
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	3+1=4		
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



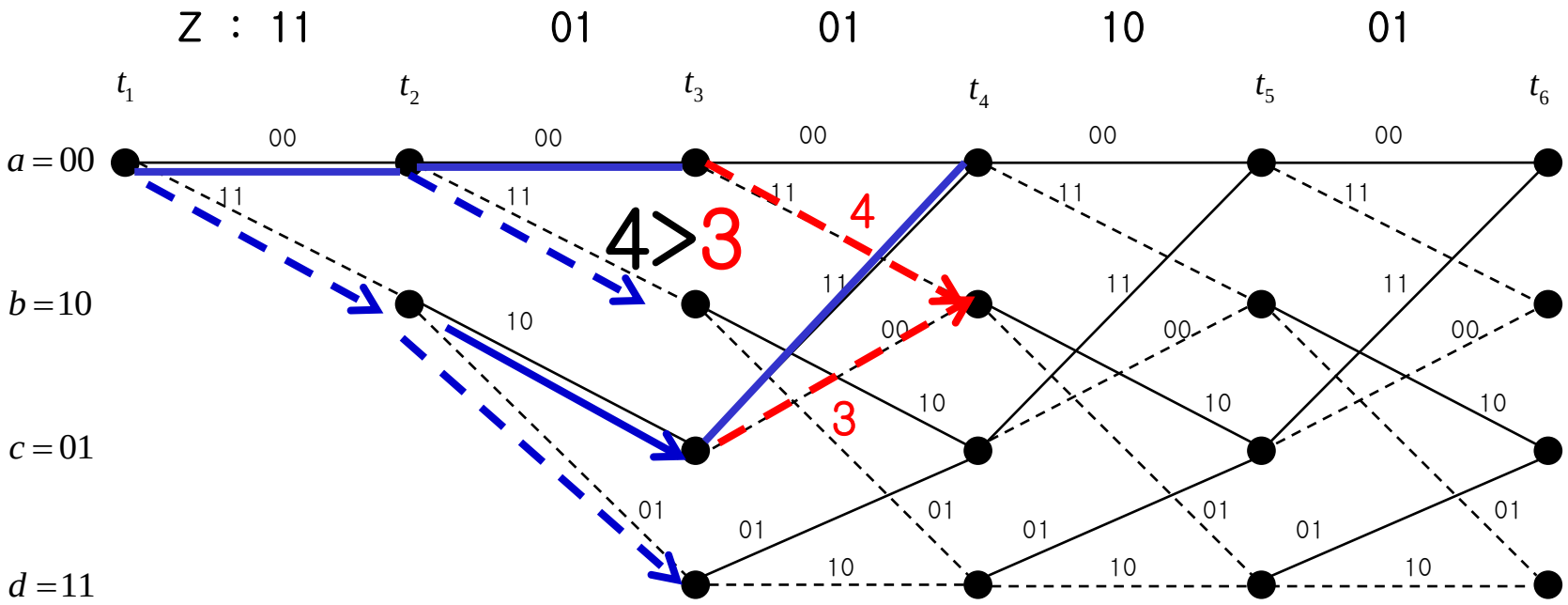
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	(4,		
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



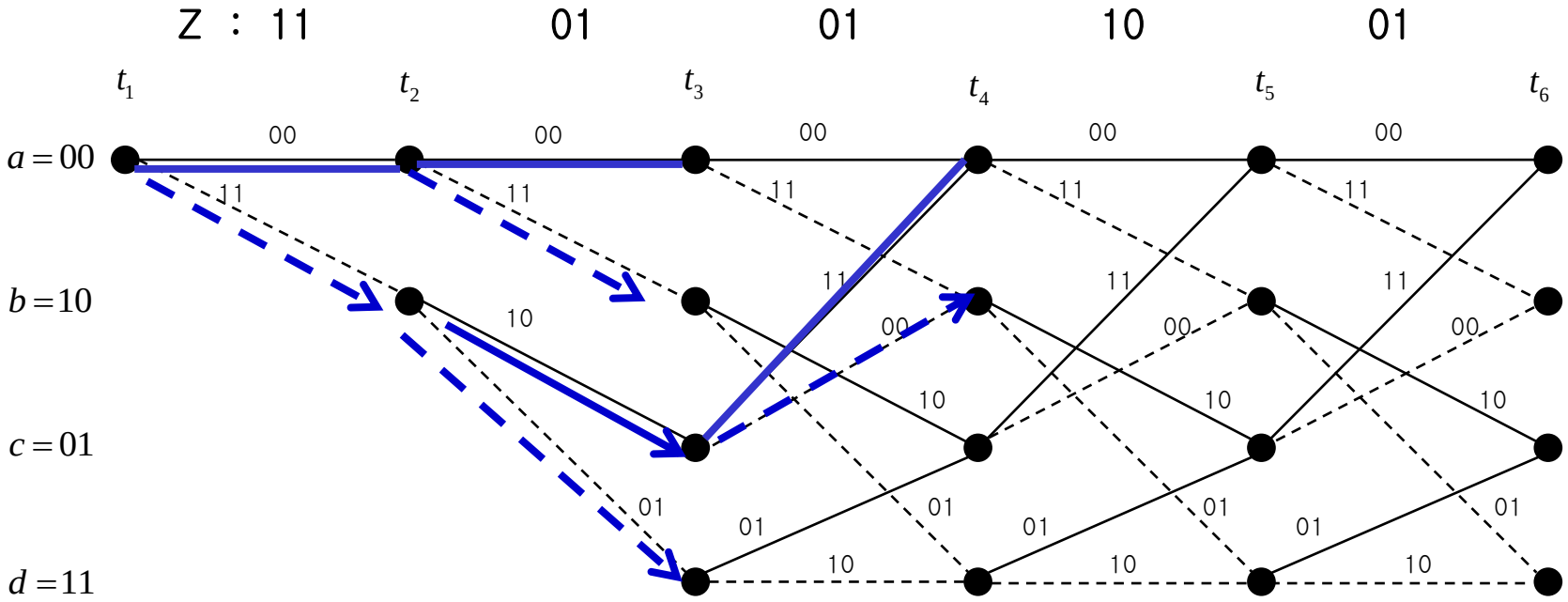
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	(4, 2+1=3)		
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



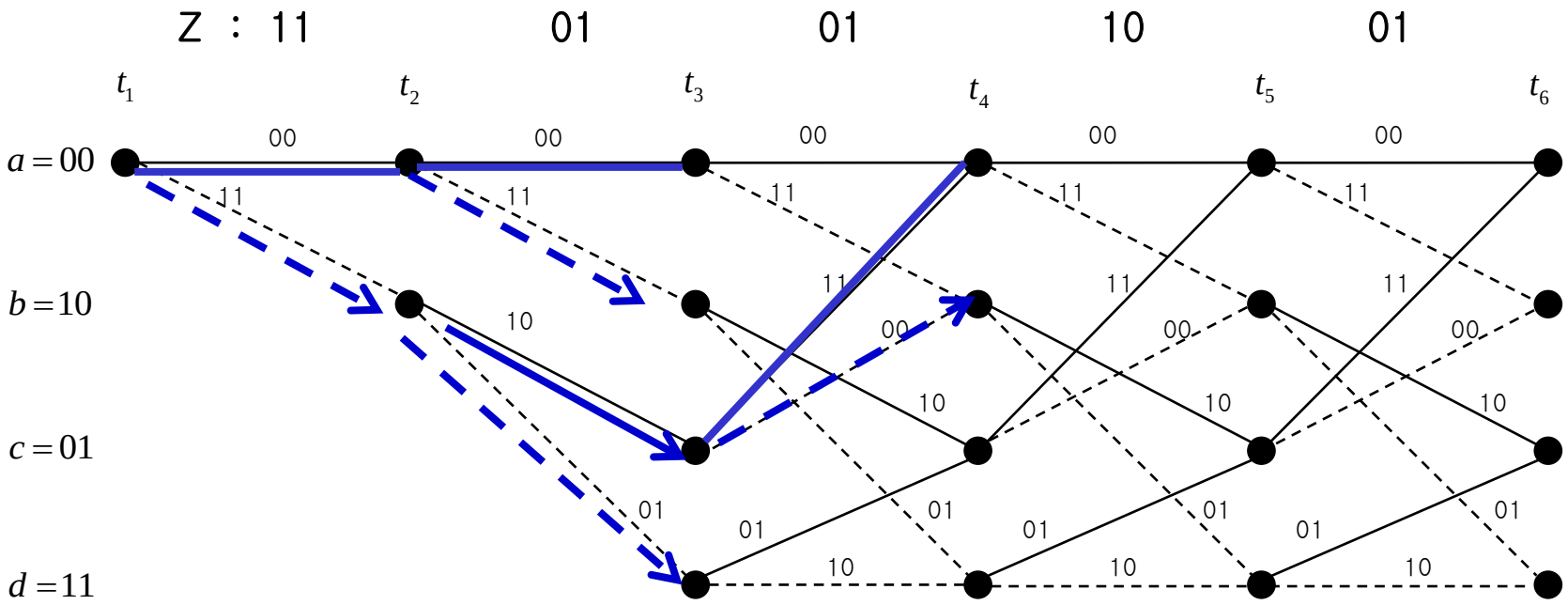
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	**(4,3)**		
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



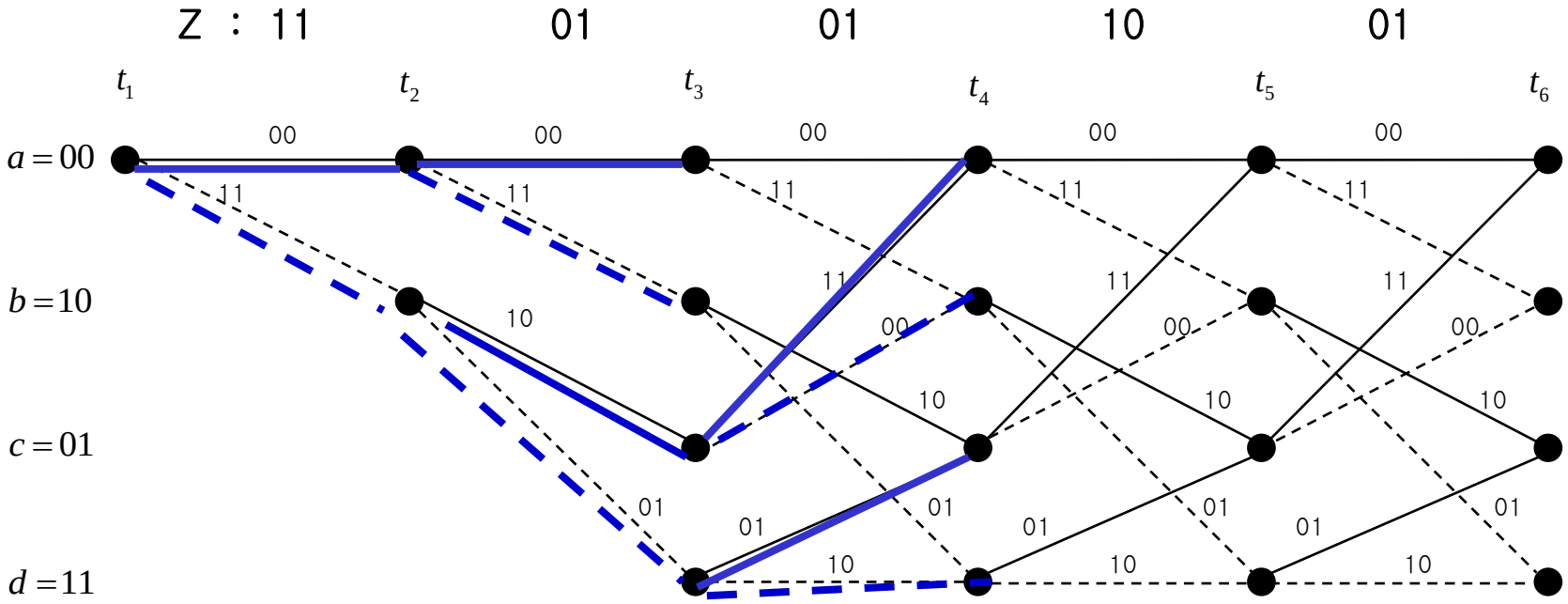
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	3		
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01			
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



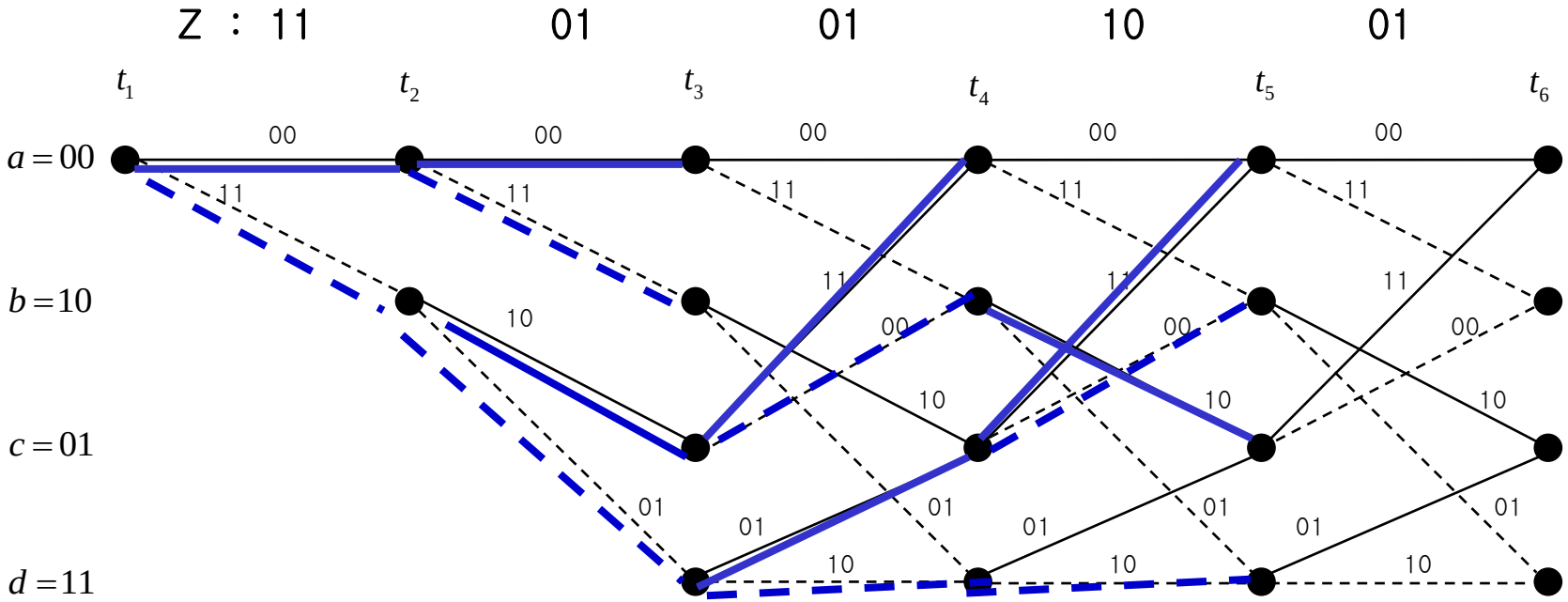
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	3		
d3	0		2			
d4	0		0			
output1	None	0	00	100		
output2	None	1	01	101		
output3	None		10			
output4	None		11			

Z= decoder input, received (demodulated) sequence.



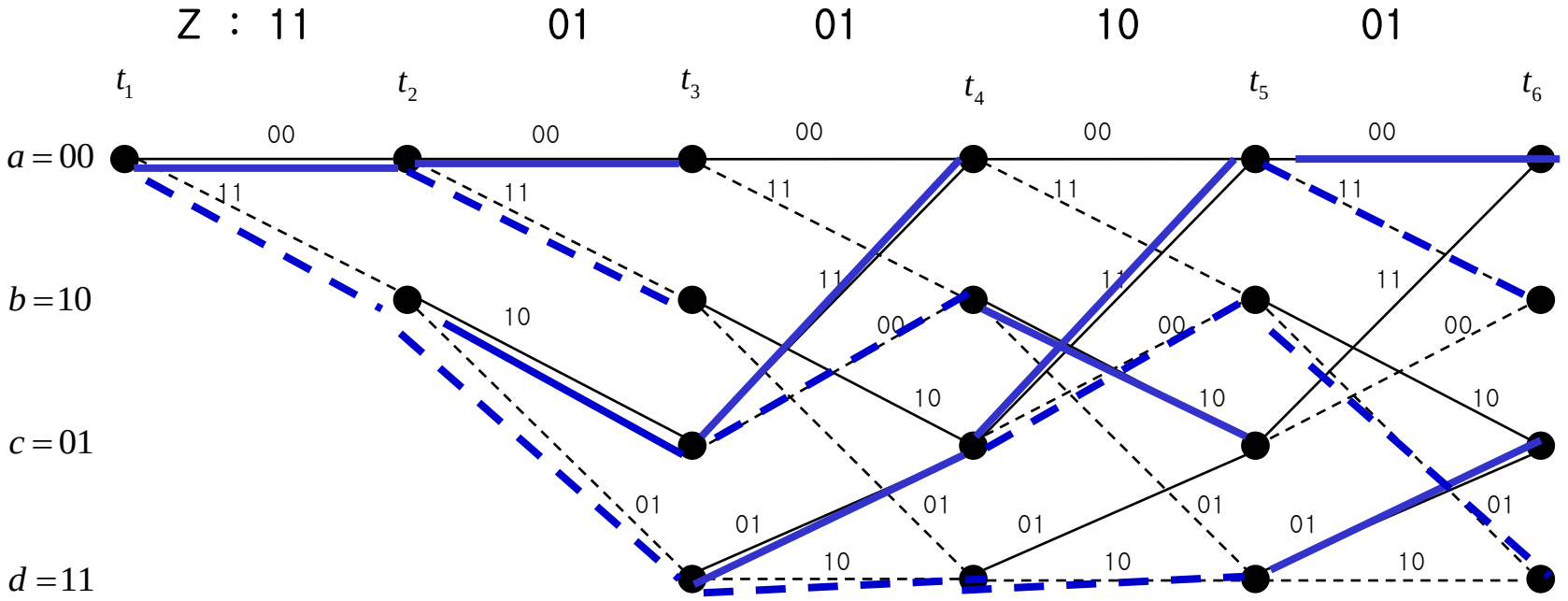
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3		
d2	0	0	3	3		
d3	0		2	0		
d4	0		0	2		
output1	None	0	00	100		
output2	None	1	01	101		
output3	None		10	110		
output4	None		11	111		

Z= decoder input, received (demodulated) sequence.



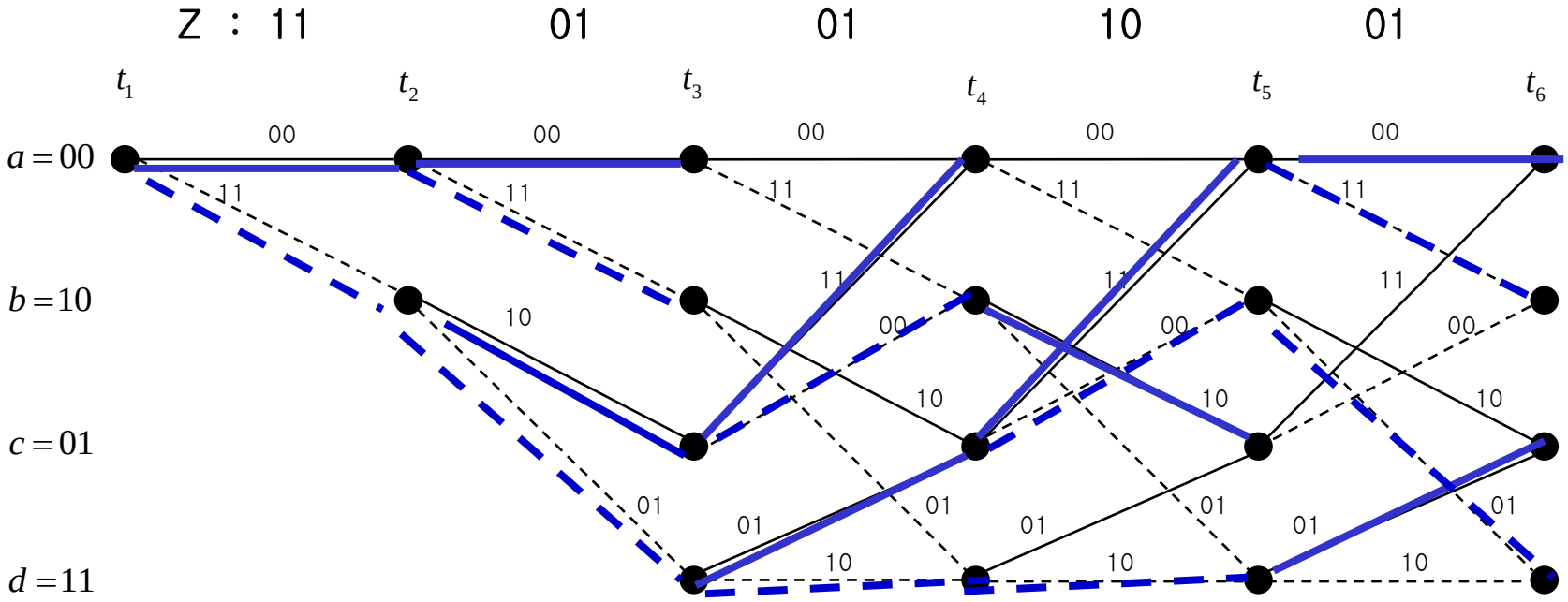
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3	1	
d2	0	0	3	3	1	
d3	0		2	0	3	
d4	0		0	2	2	
output1	None	0	00	100	1100	
output2	None	1	01	101	1101	
output3	None		10	110	1010	
output4	None		11	111	1111	

Z= decoder input, received (demodulated) sequence.



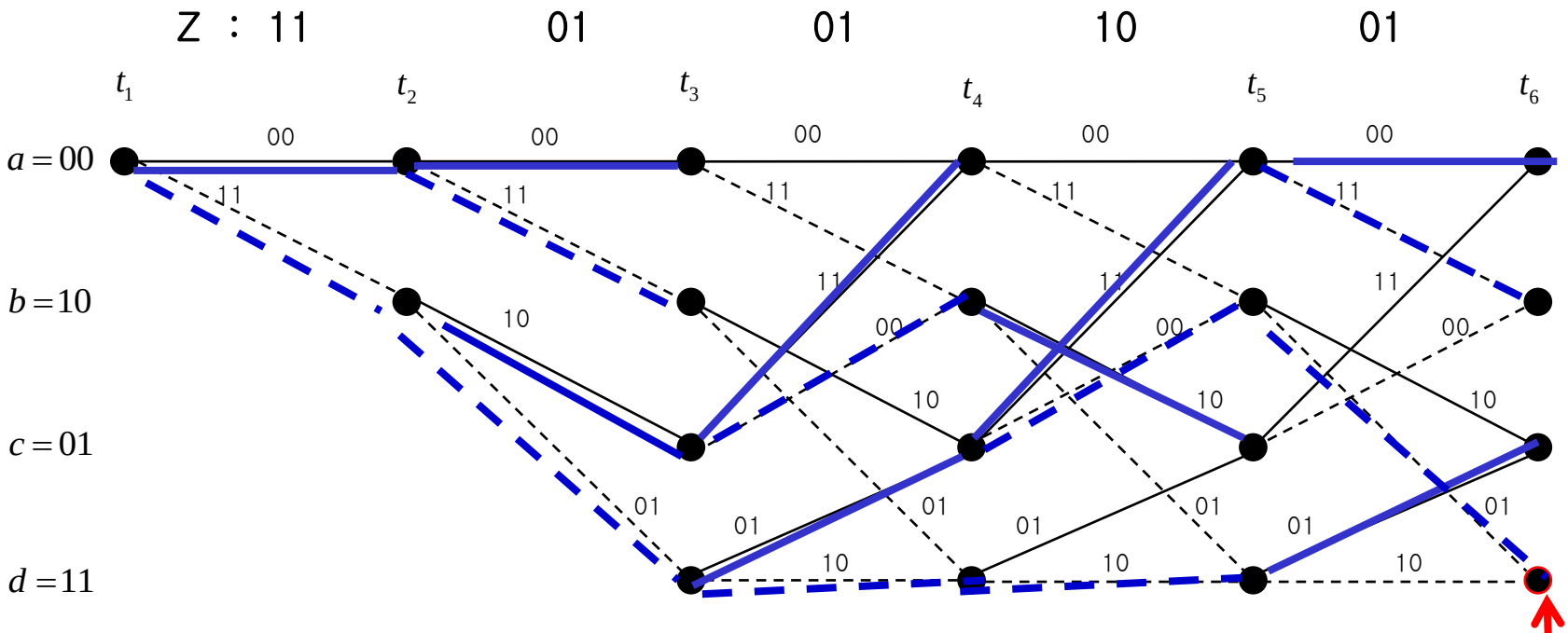
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3	1	2
d2	0	0	3	3	1	2
d3	0		2	0	3	2
d4	0		0	2	2	1
output1	None	0	00	100	1100	11000
output2	None	1	01	101	1101	11001
output3	None		10	110	1010	11110
output4	None		11	111	1111	11011

Z= decoder input, received (demodulated) sequence.



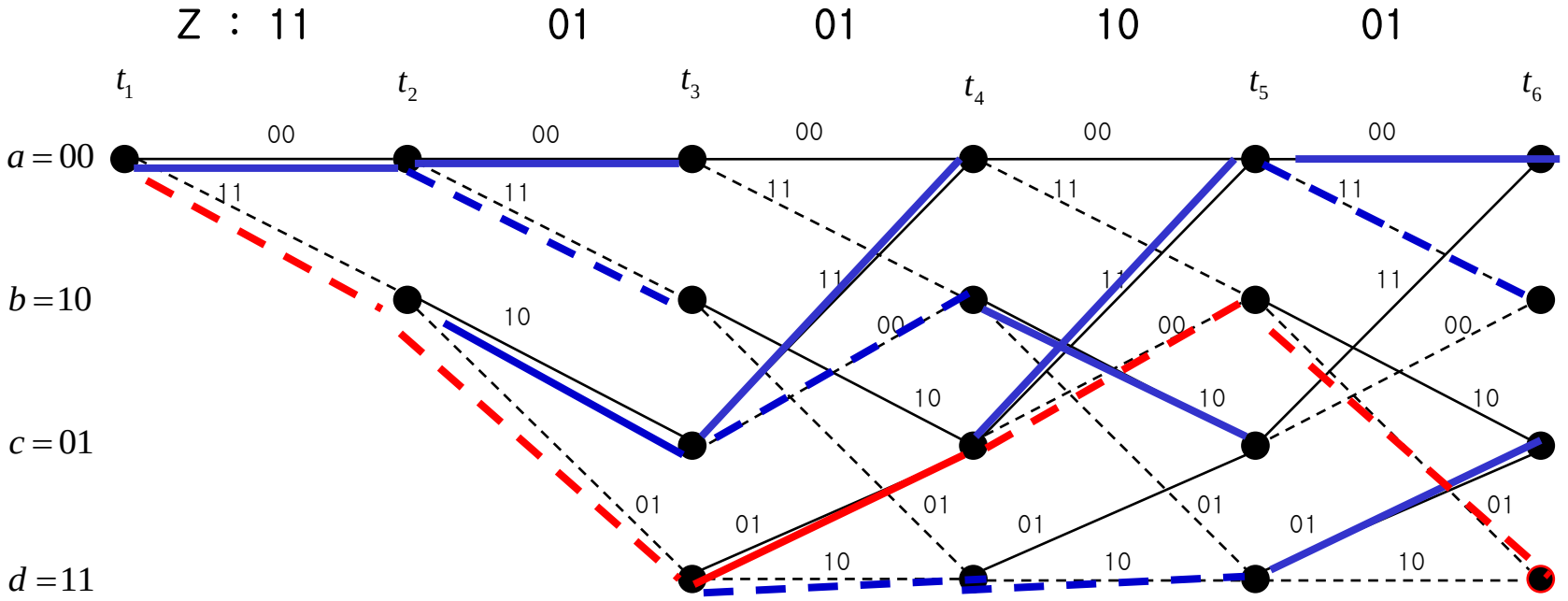
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3	1	2
d2	0	0	3	3	1	2
d3	0		2	0	3	2
d4	0		0	2	2	**1 (Minimum)**
output1	None	0	00	100	1100	11000
output2	None	1	01	101	1101	11001
output3	None		10	110	1010	11110
output4	None		11	111	1111	11011

Z= decoder input, received (demodulated) sequence.



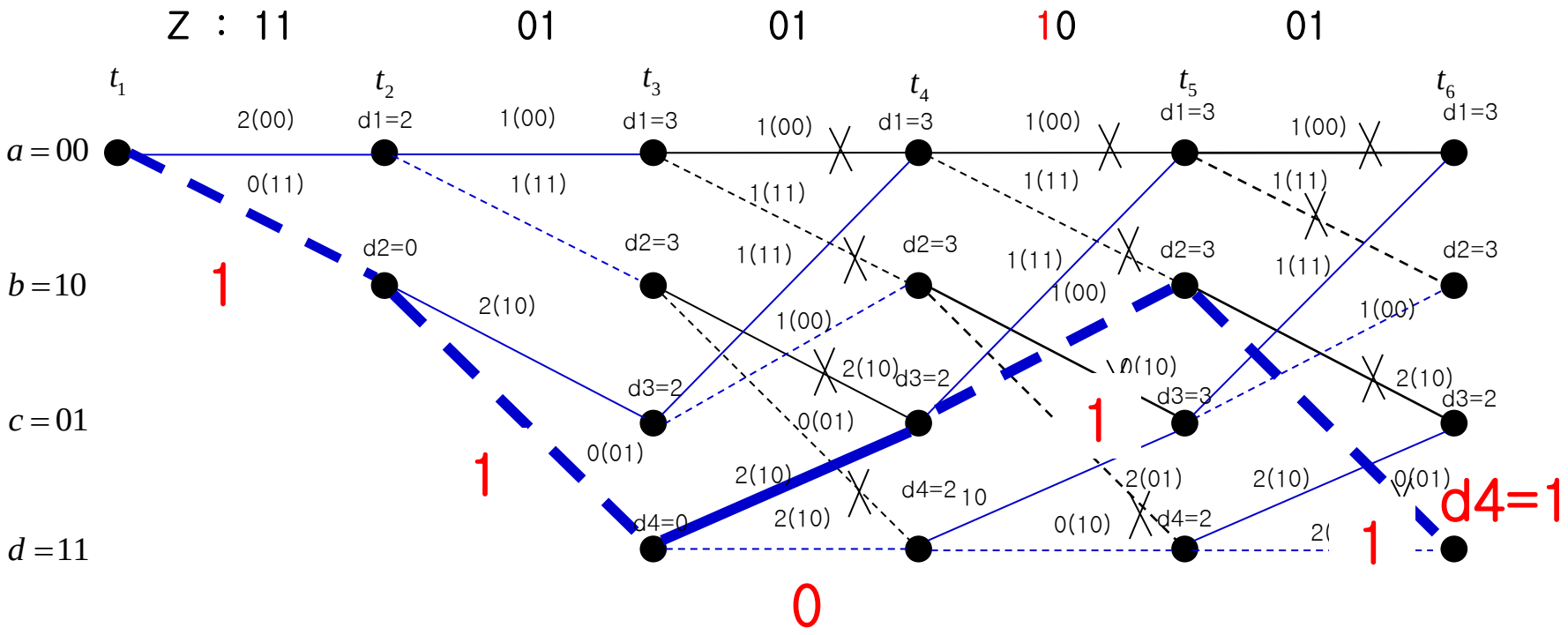
`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3	1	2
d2	0	0	3	3	1	2
d3	0		2	0	3	2
d4	0		0	2	2	**1 (Minimum)**
output1	None	0	00	100	1100	11000
output2	None	1	01	101	1101	11001
output3	None		10	110	1010	11110
output4	None		11	111	1111	11011

Z= decoder input, received (demodulated) sequence.



`	t_1=0	t_1->t_2	t_2->t_3	t_3->t_4	t_4->t_5	t_5->t_6
d1	0	2	3	3	1	2
d2	0	0	3	3	1	2
d3	0		2	0	3	2
d4	0		0	2	2	**1 (Minimum)**
output1	None	0	00	100	1100	11000
output2	None	1	01	101	1101	11001
output3	None		10	110	1010	11110
output4	None		11	111		

Decoding result = **11011**



m :	1	1	0	1	1
decoder output :	1	1	0	1	1

Decoder output is equal to the message m despite 1 channel bit(z(7)) error.