

Turnpike Reconstruction

Shusen Wang

Turnpike Reconstruction Problem



Pairwise Distances

Dist =

--	--	--	--	--	--



Pairwise Distances

Dist =

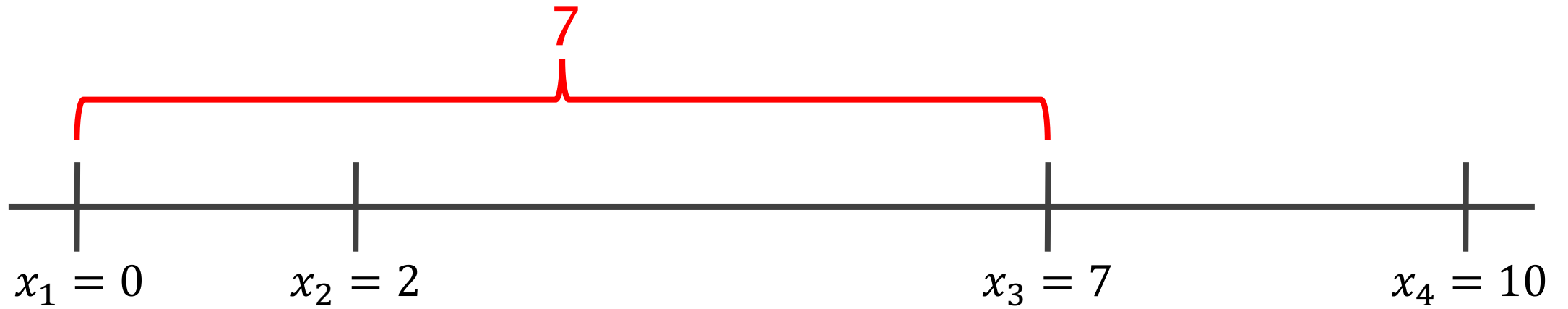
2					
---	--	--	--	--	--



Pairwise Distances

Dist =

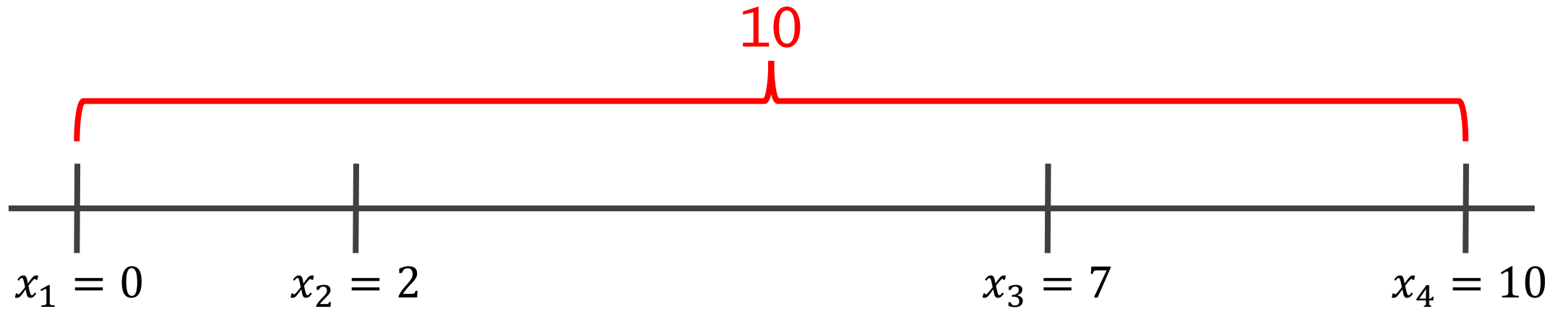
2	7				
---	---	--	--	--	--



Pairwise Distances

Dist =

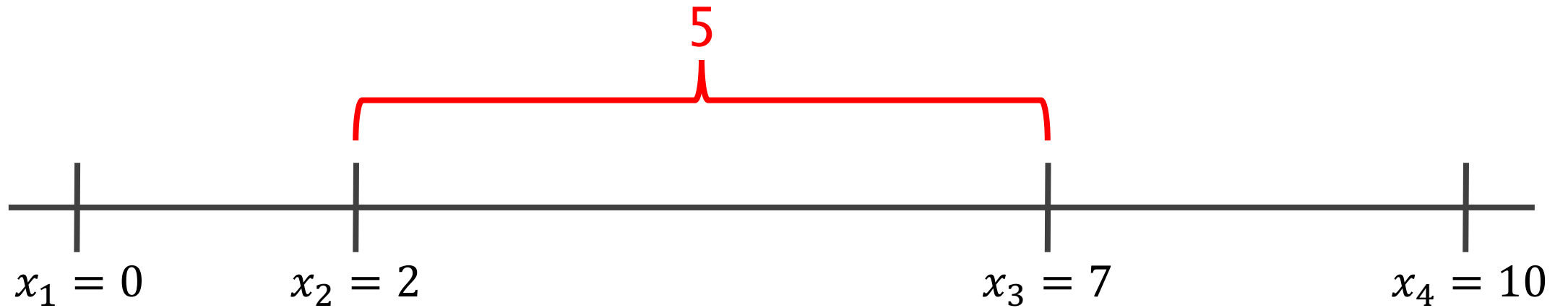
2	7	10			
---	---	----	--	--	--



Pairwise Distances

Dist =

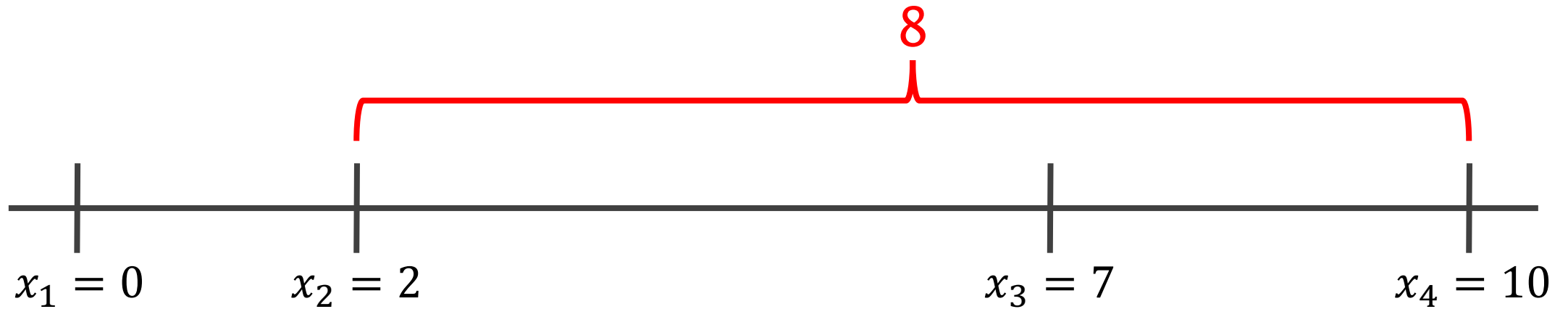
2	7	10	5		
---	---	----	---	--	--



Pairwise Distances

Dist =

2	7	10	5	8	
---	---	----	---	---	--



Pairwise Distances

Dist =

2	7	10	5	8	3
---	---	----	---	---	---



Turnpike Reconstruction Problem

$$\text{Dist} = \begin{array}{|c|c|c|c|c|c|} \hline 2 & 7 & 10 & 5 & 8 & 3 \\ \hline \end{array}$$

Turnpike reconstruction is the inverse problem: Given the distance array, find the locations of the turnpikes.



Backtracking Algorithm

Turnpike Reconstruction Problem

$$\text{Dist} = \begin{array}{|c|c|c|c|c|c|} \hline 2 & 7 & 10 & 5 & 8 & 3 \\ \hline \end{array}$$

Suppose the coordinate of the first turnpike is $x_1 = 0$.



Sort the distance array

Dist =

2	7	10	5	8	3
---	---	----	---	---	---



Backtracking Algorithm

Dist =

2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

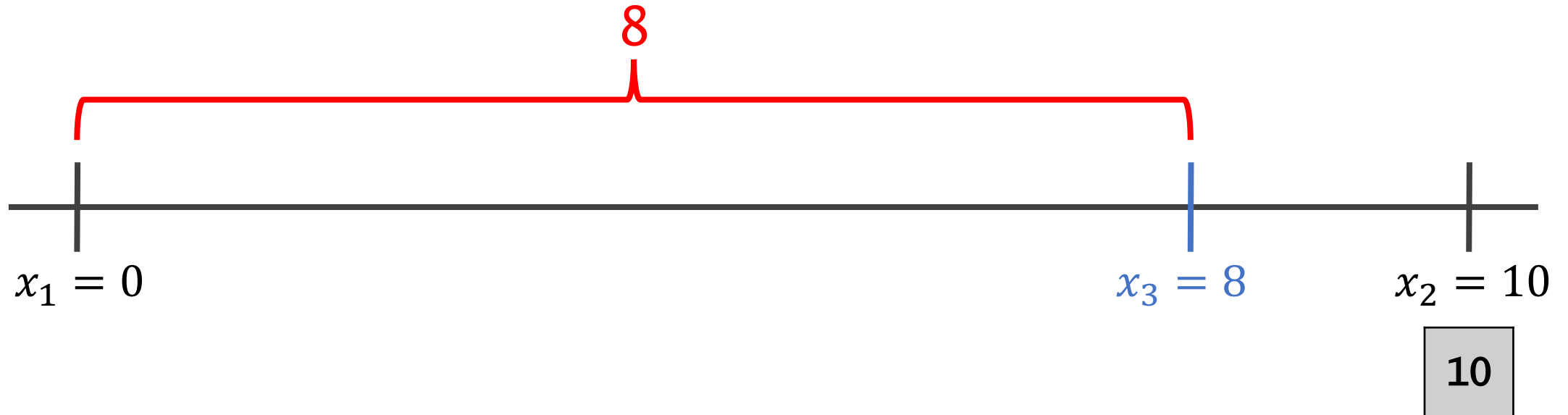
2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

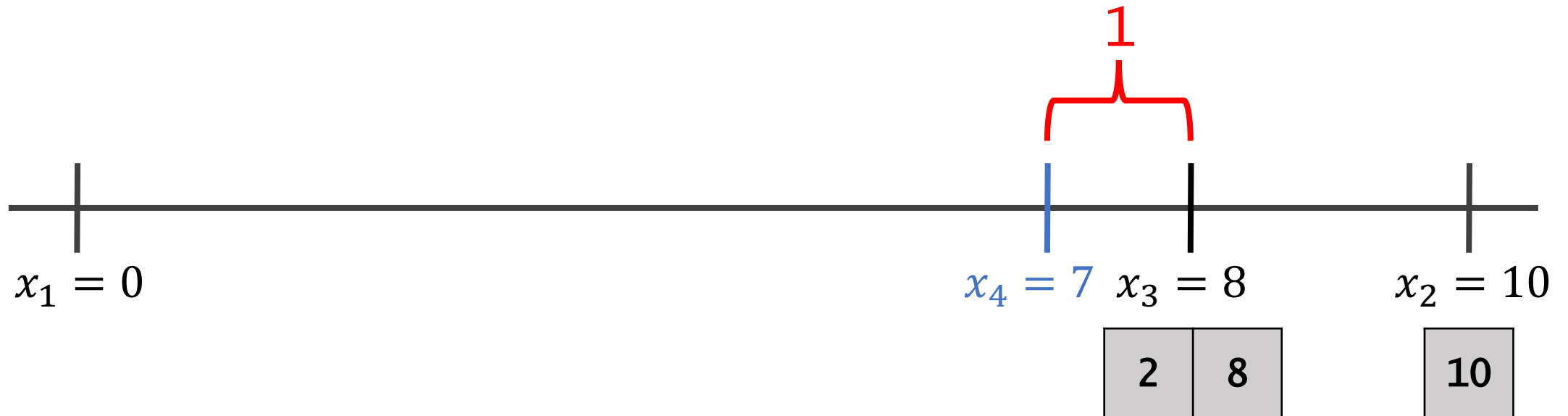
2	3	5	7	8	10
---	---	---	---	---	----



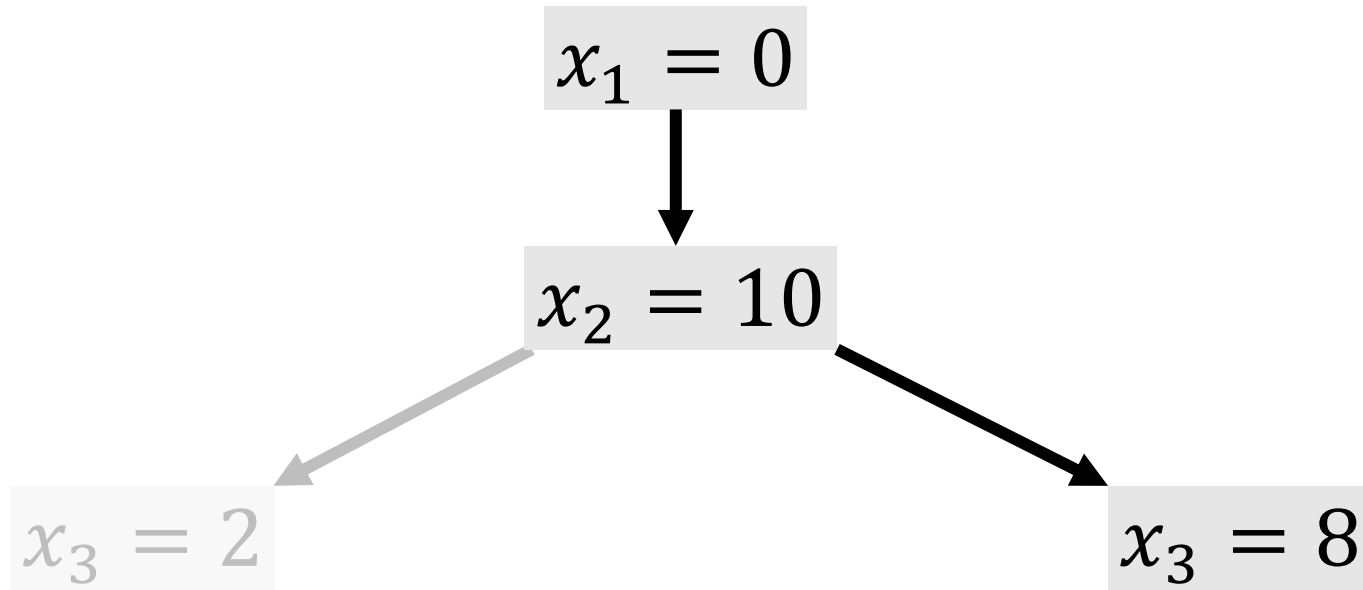
Backtracking Algorithm

Dist =

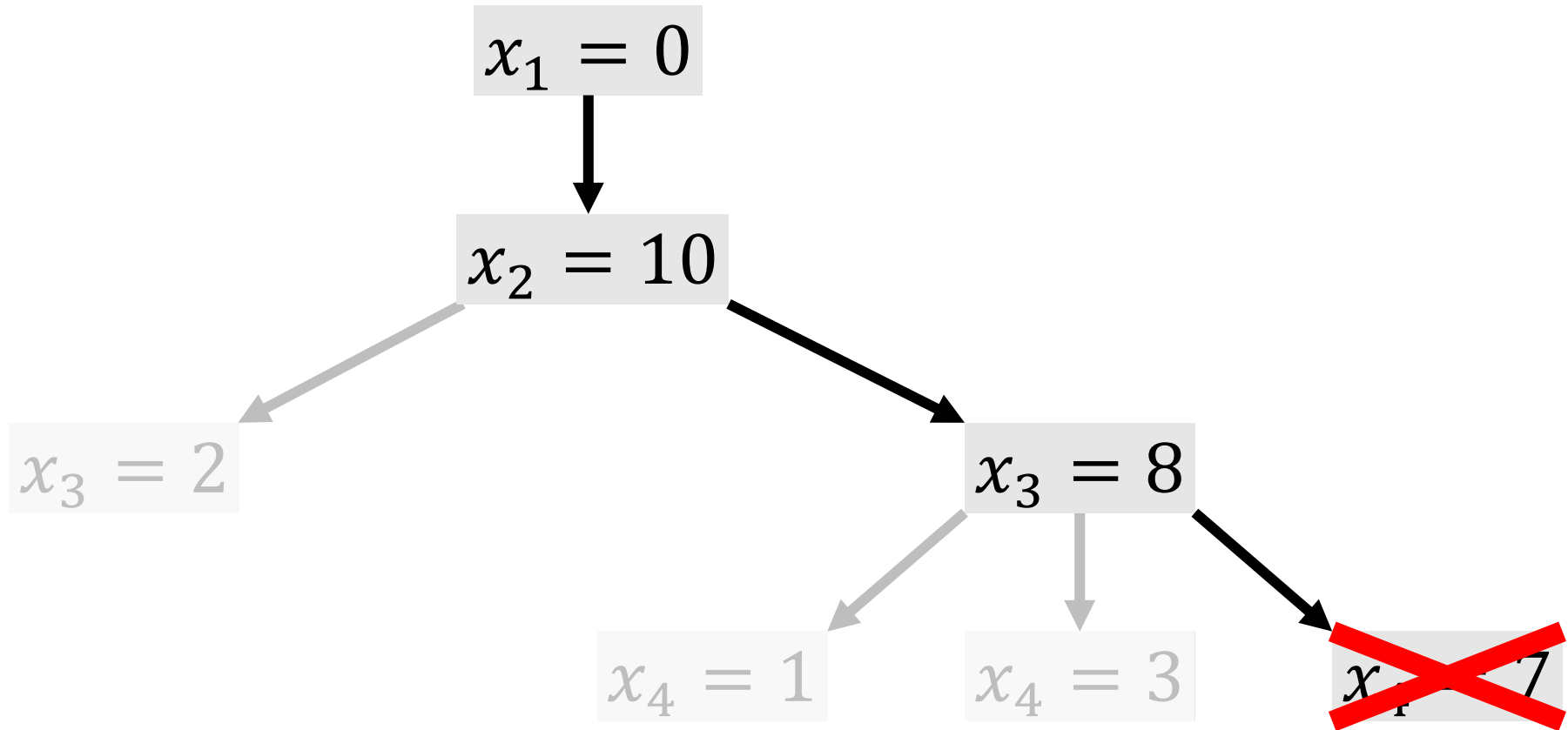
2	3	5	7	8	10
---	---	---	---	---	----



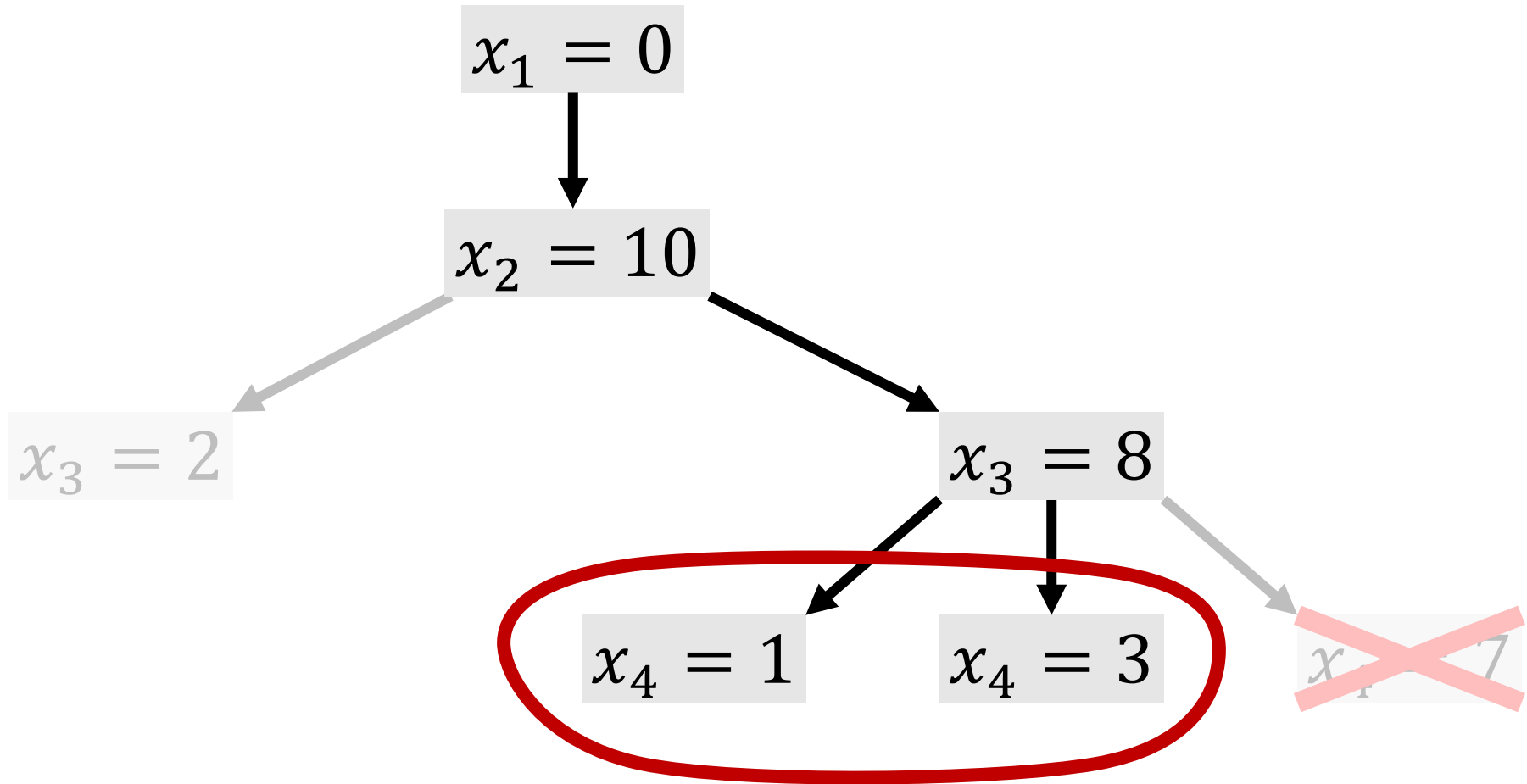
Backtracking Algorithm



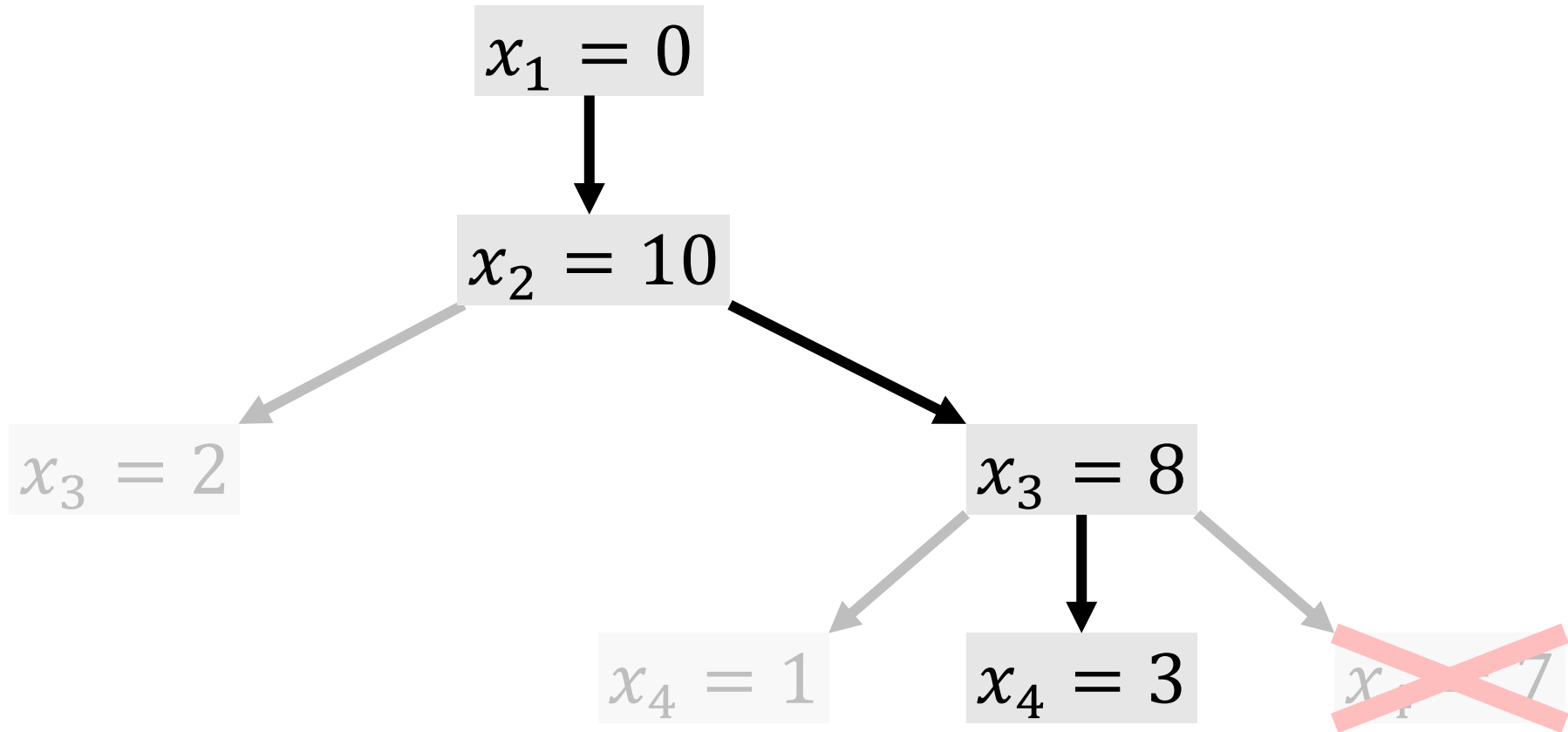
Backtracking Algorithm



Backtracking Algorithm



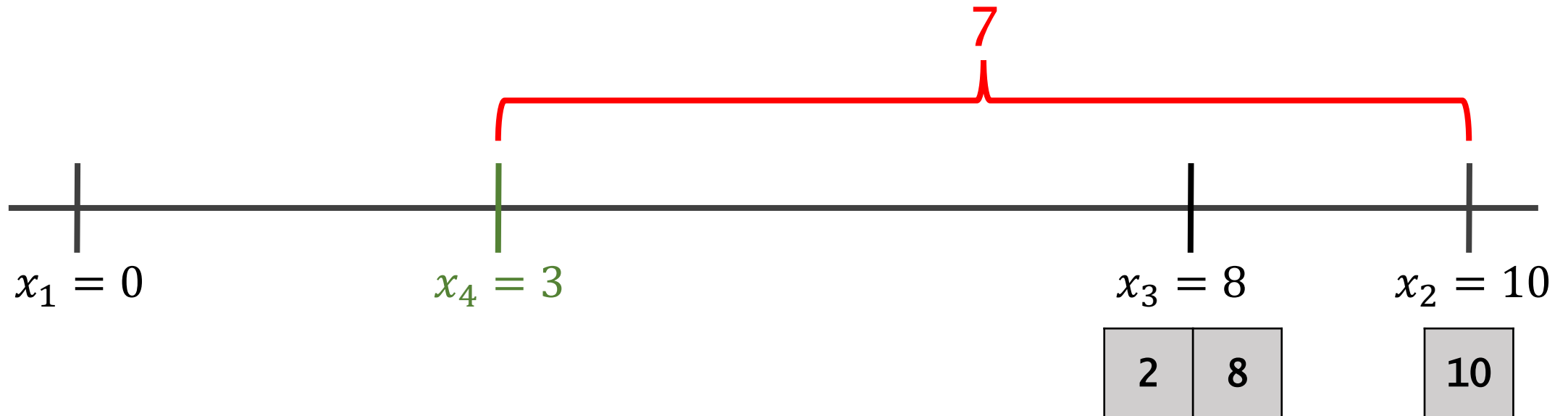
Backtracking Algorithm



Backtracking Algorithm

Dist =

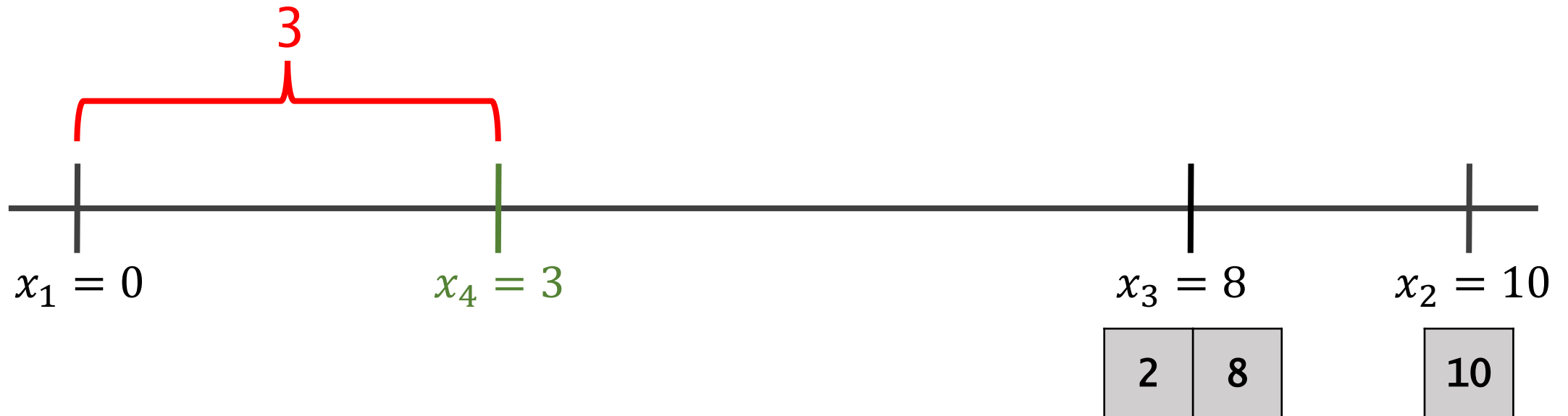
2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

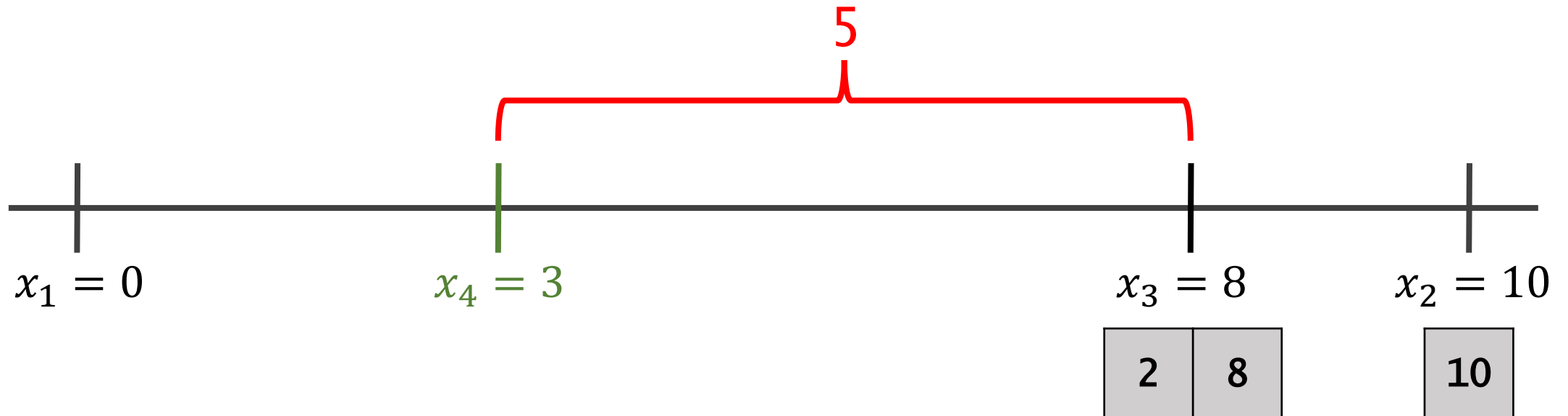
2	3	5	7	8	10
---	---	---	---	---	----



Backtracking Algorithm

Dist =

2	3	5	7	8	10
---	---	---	---	---	----



End of Procedure

Dist =

2	3	5	7	8	10
---	---	---	---	---	----

Output:



End of Procedure

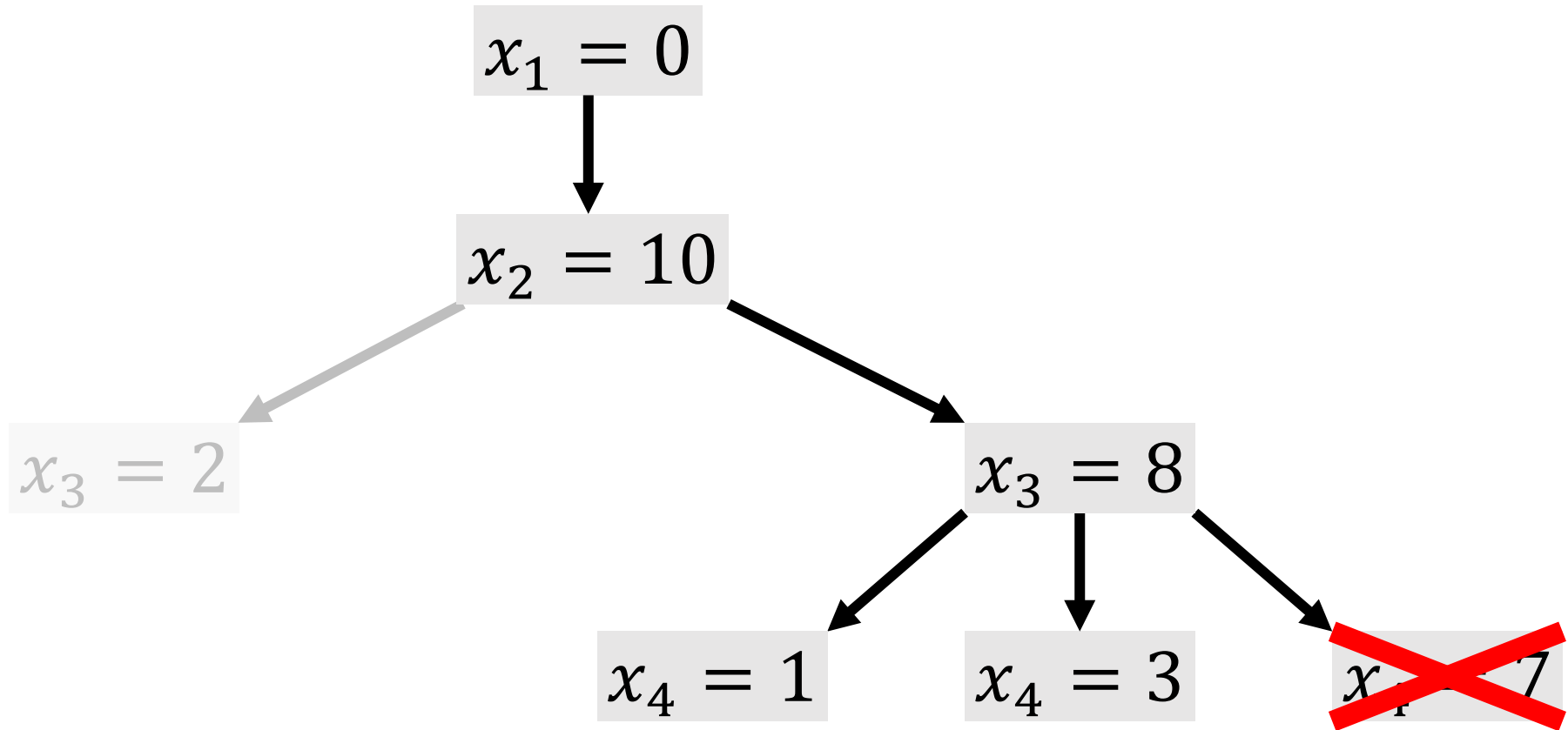
Actual turnpikes:



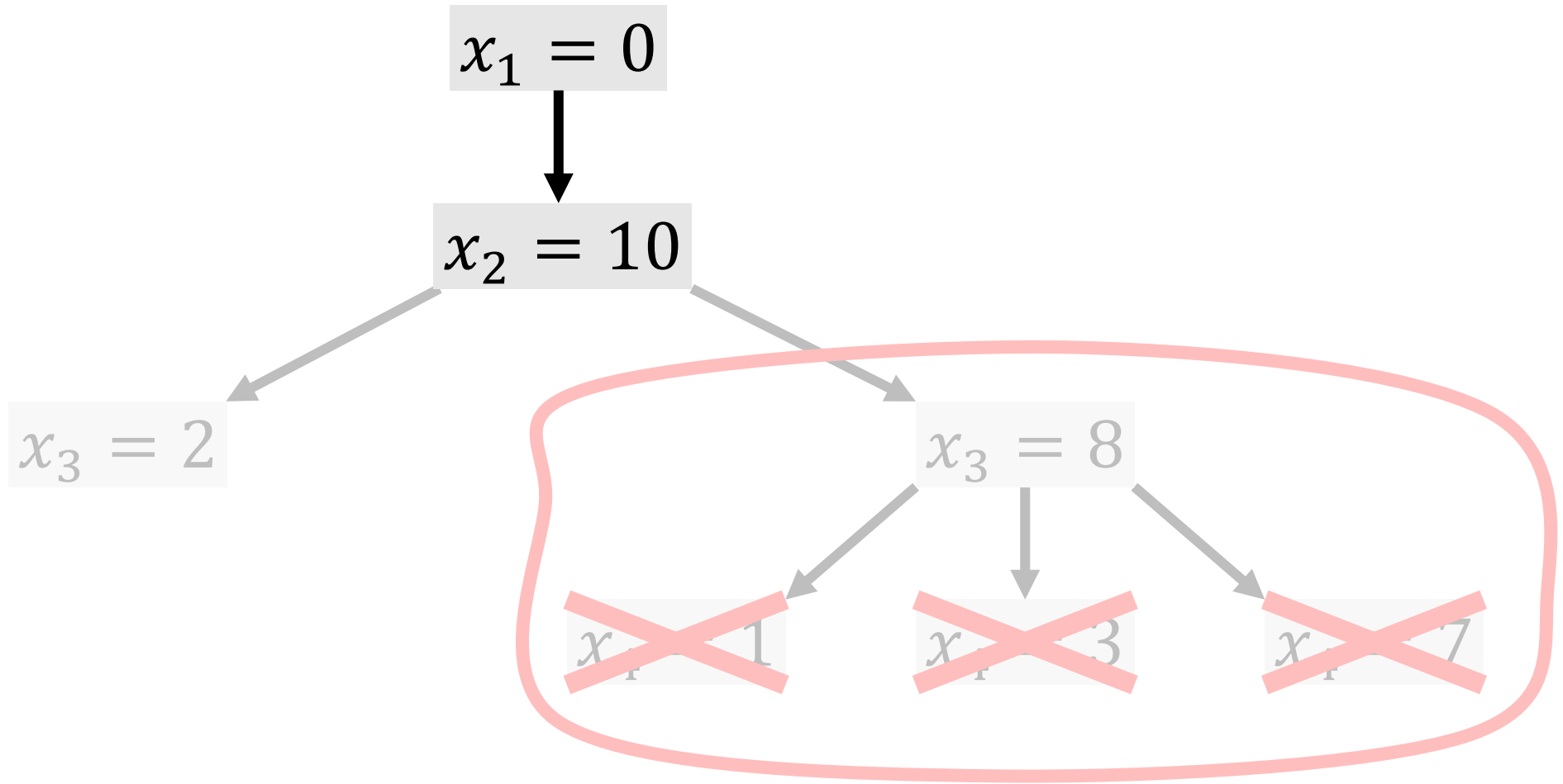
Output:



Backtracking Algorithm



Backtracking Algorithm



Another Example

Turnpike Reconstruction Problem

Dist =

1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

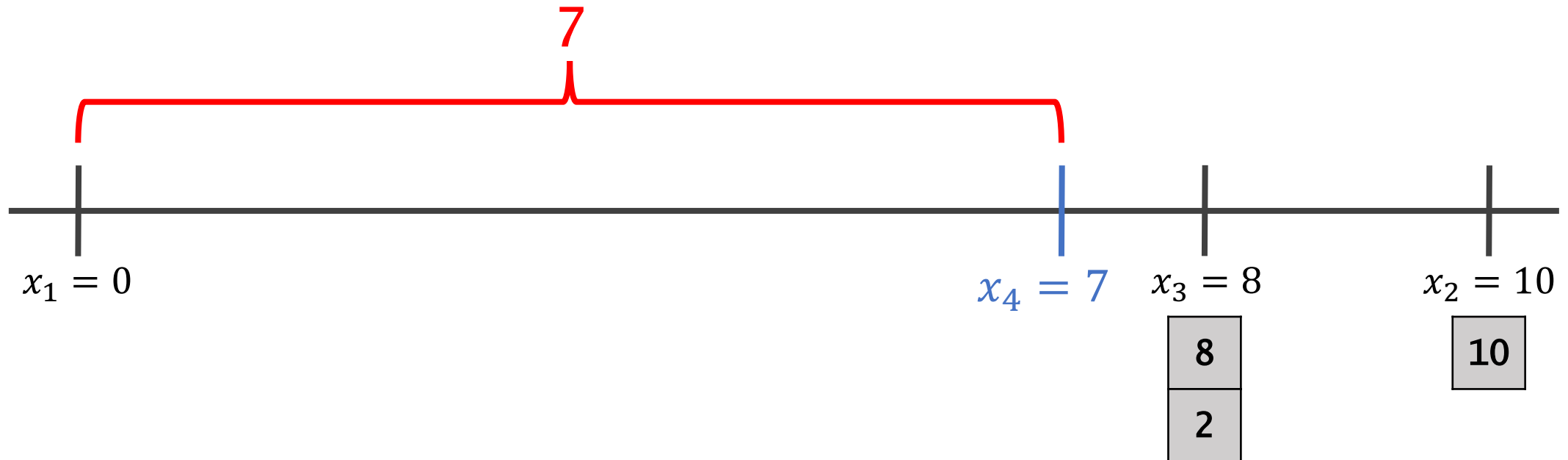
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

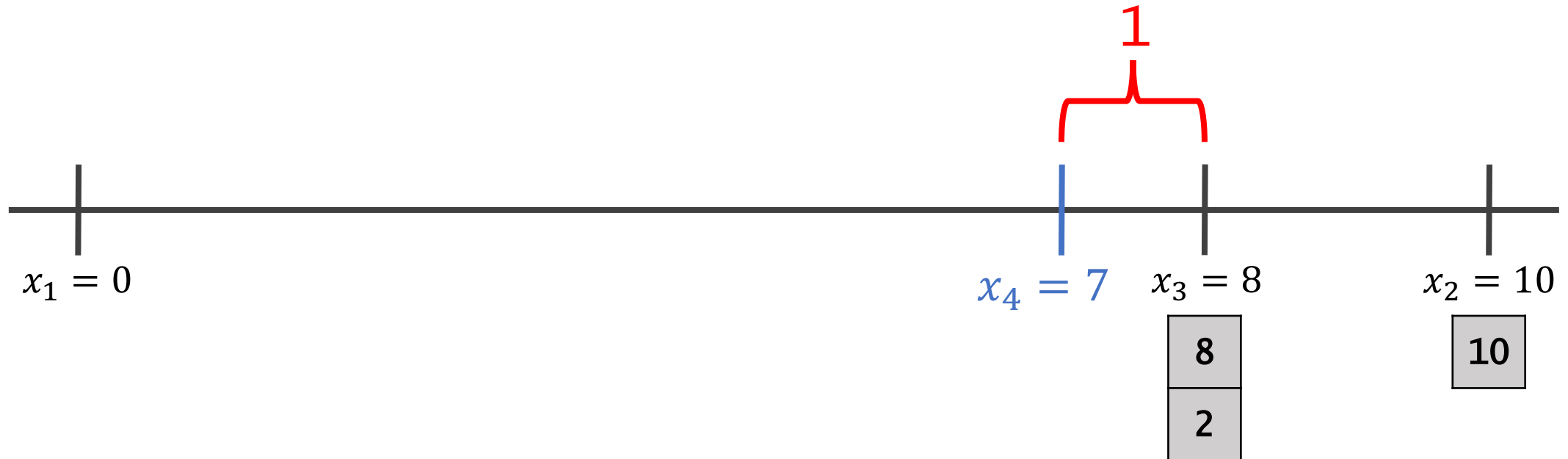
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

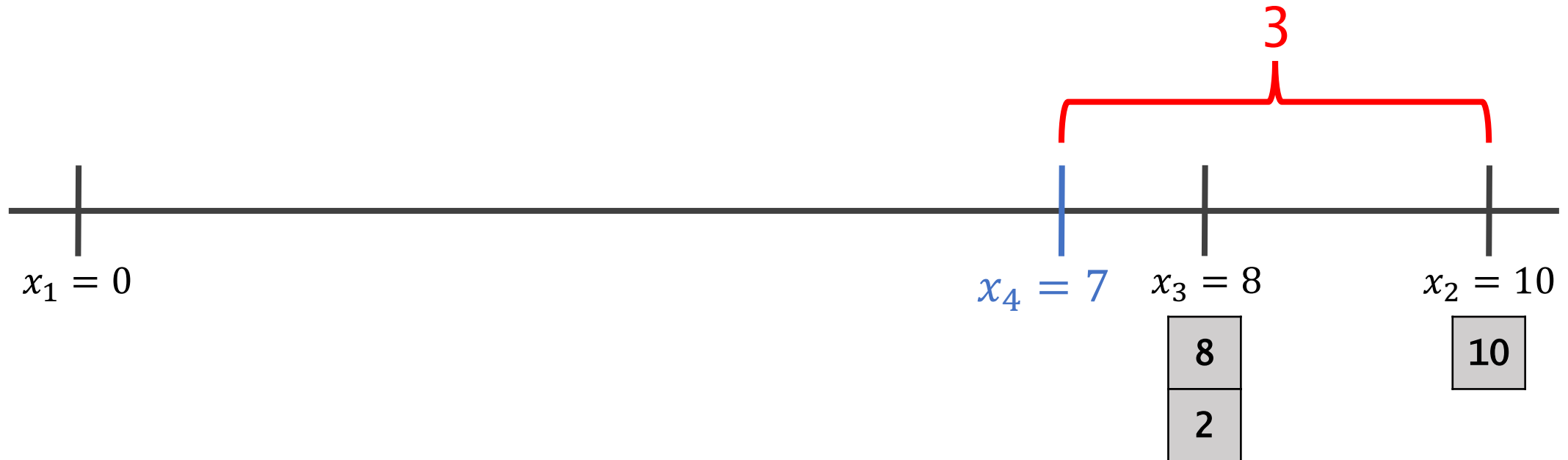
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

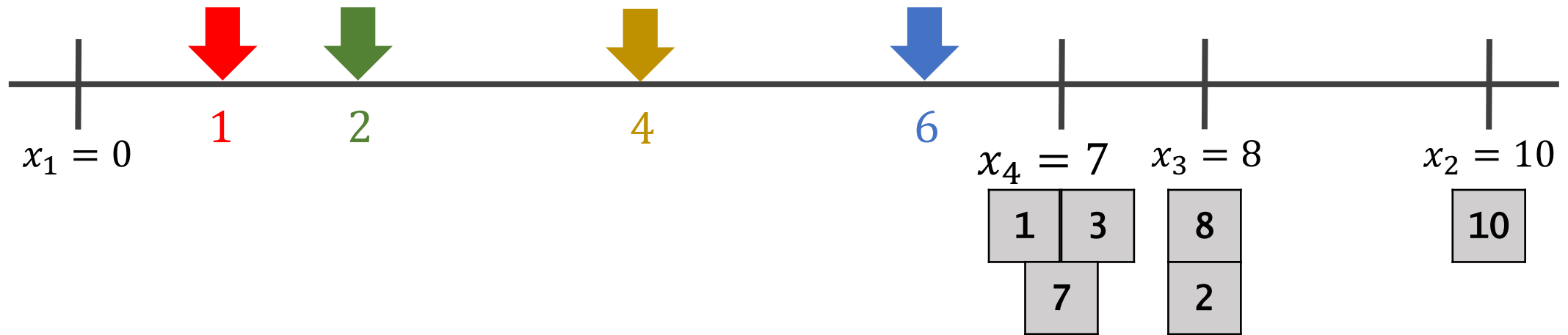
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



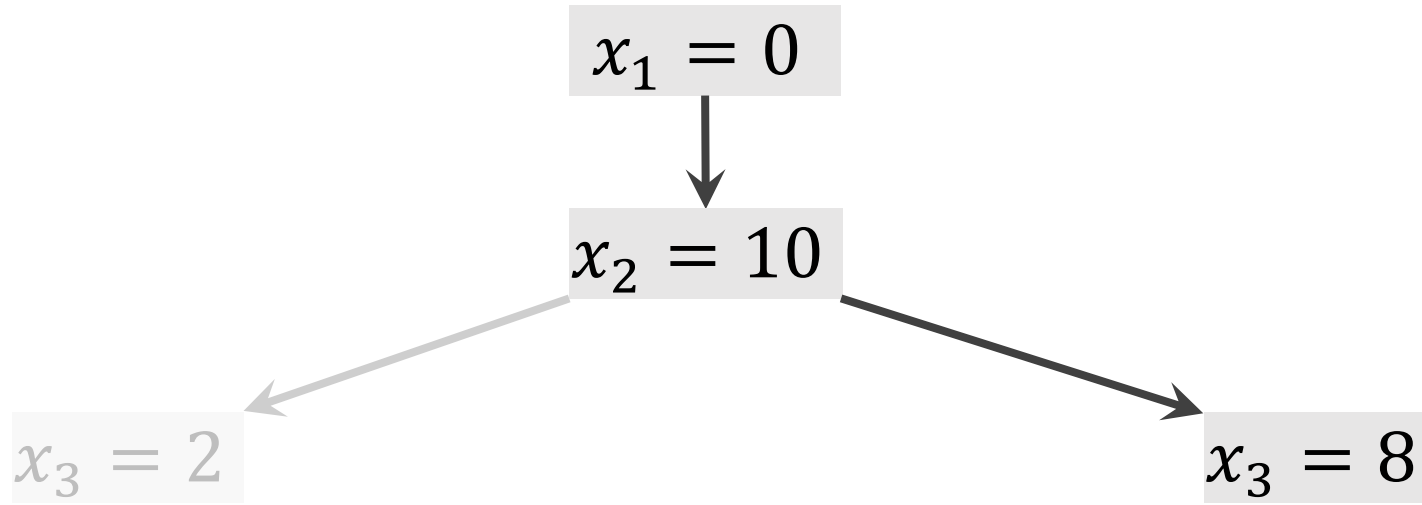
Turnpike Reconstruction Problem

Dist =

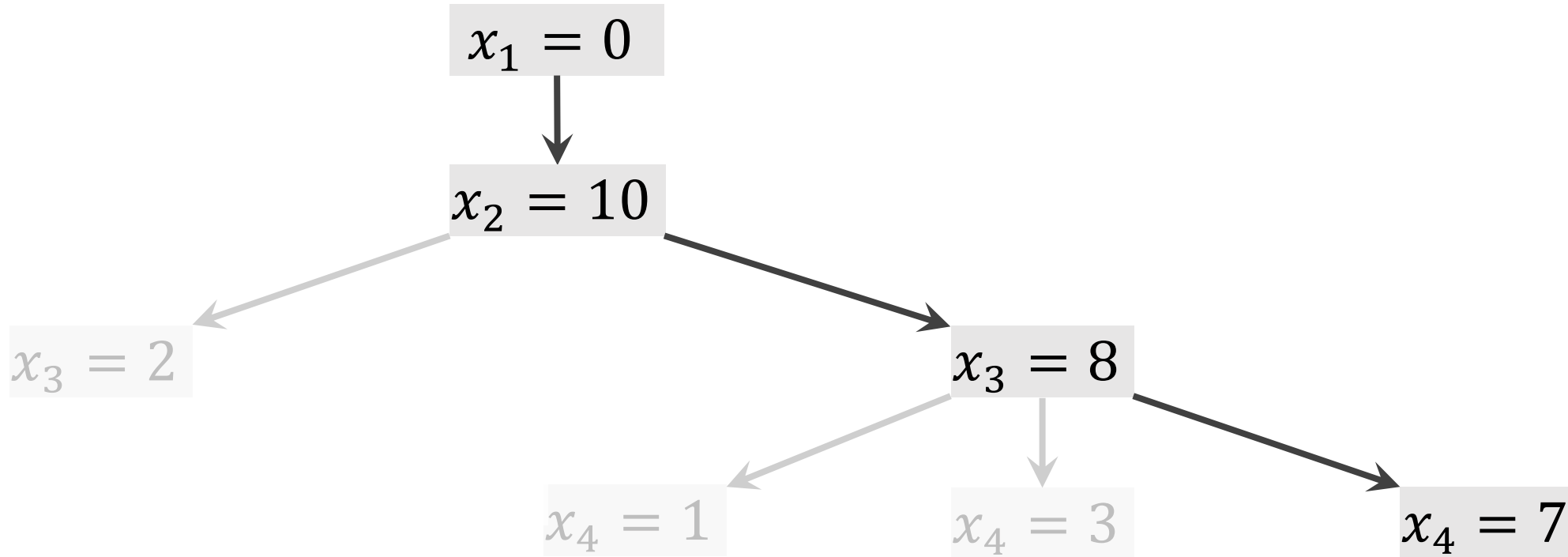
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



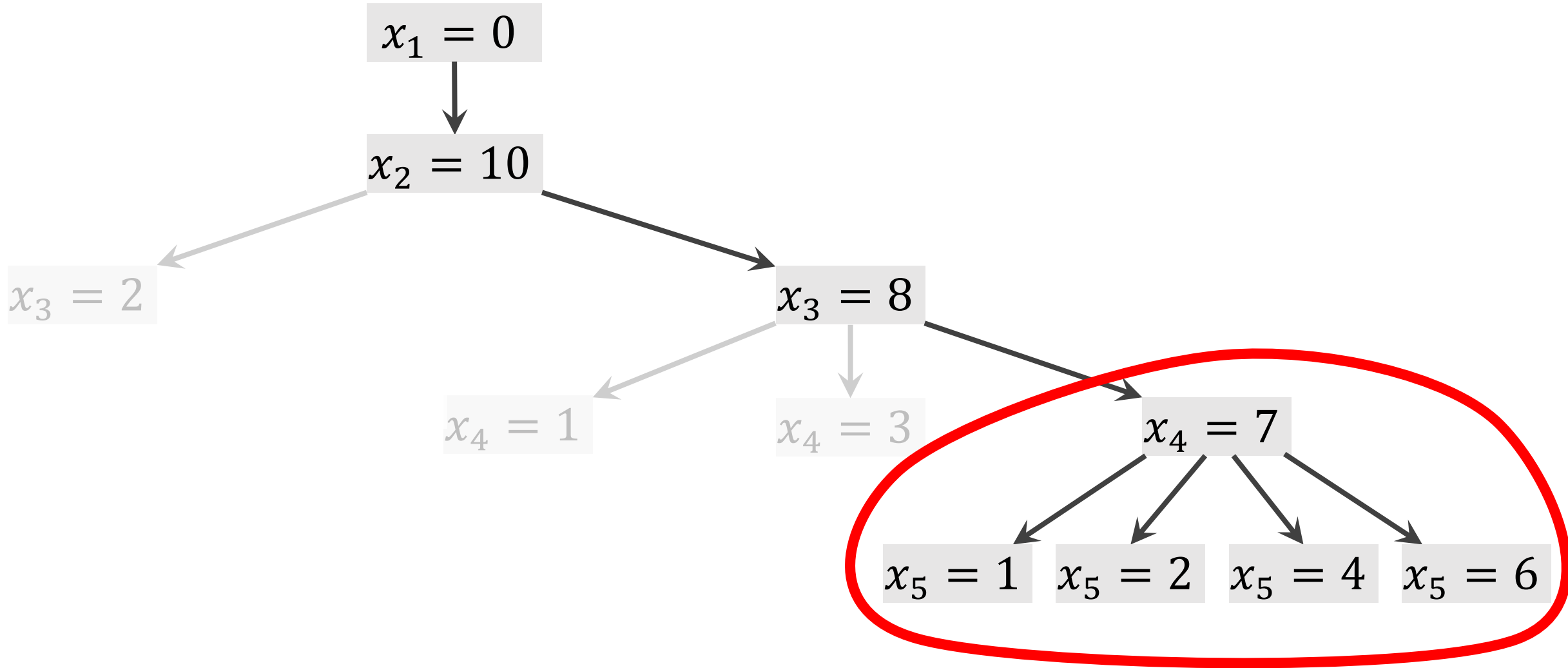
Backtracking Algorithm



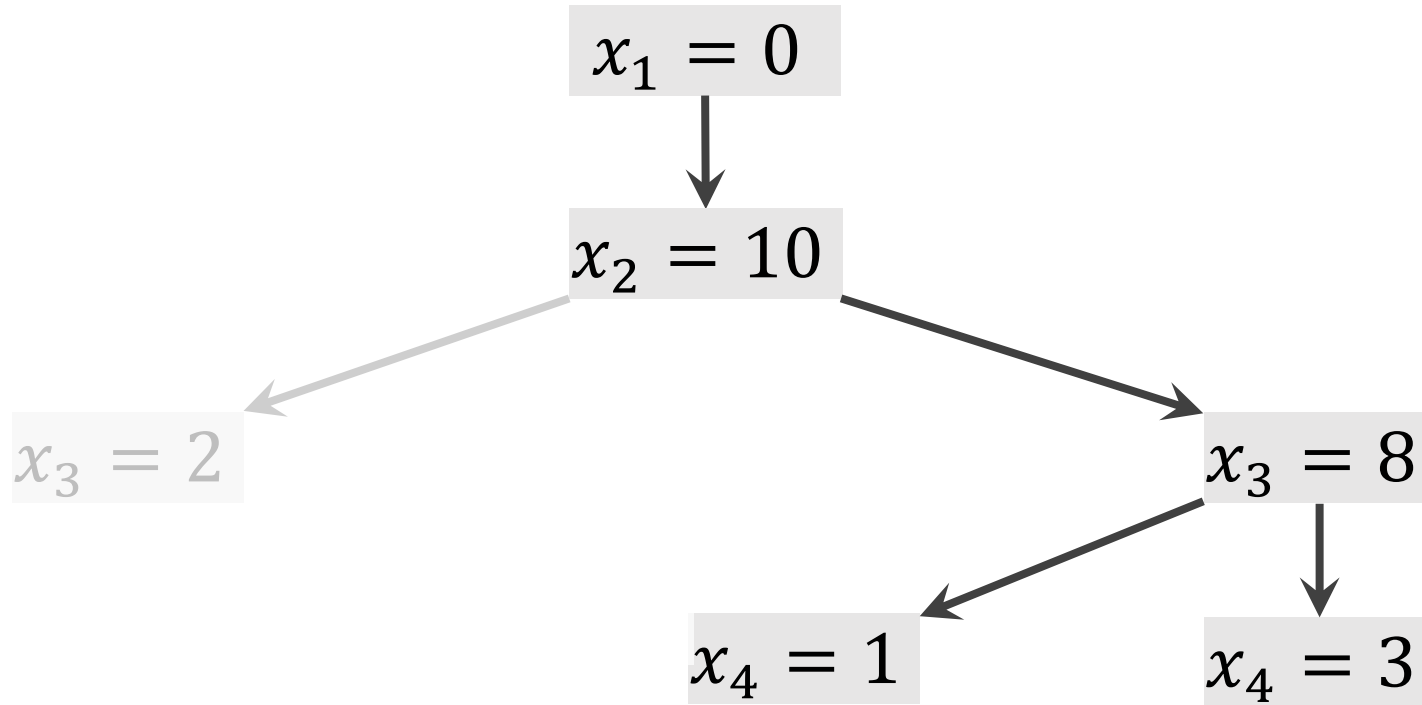
Backtracking Algorithm



Backtracking Algorithm



Backtracking Algorithm



Turnpike Reconstruction Problem

Dist =

1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

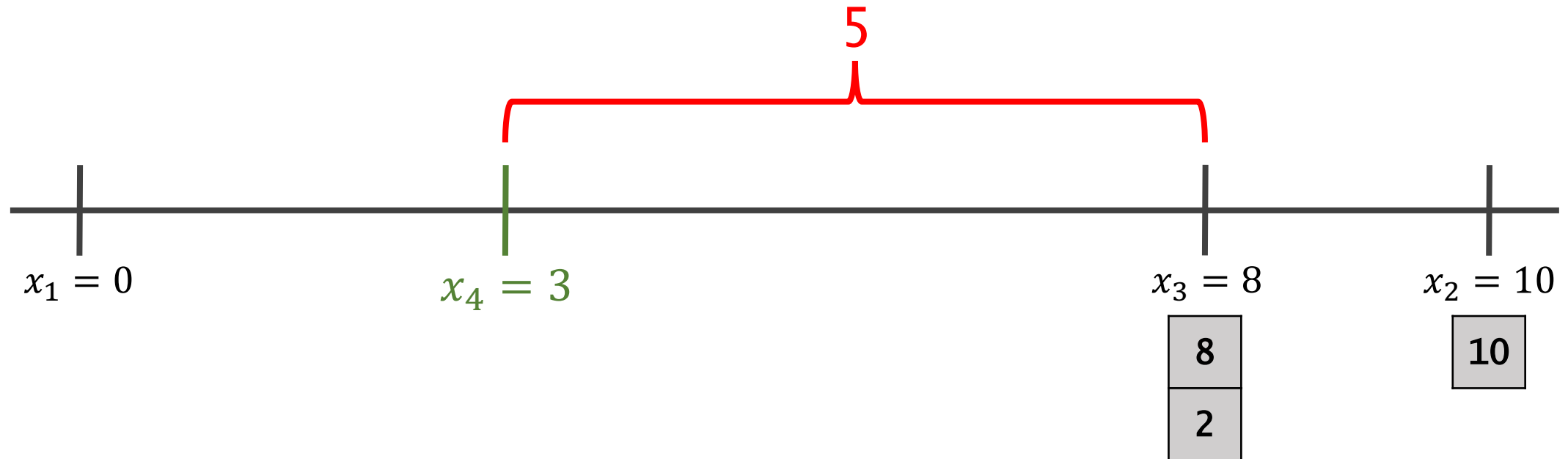
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

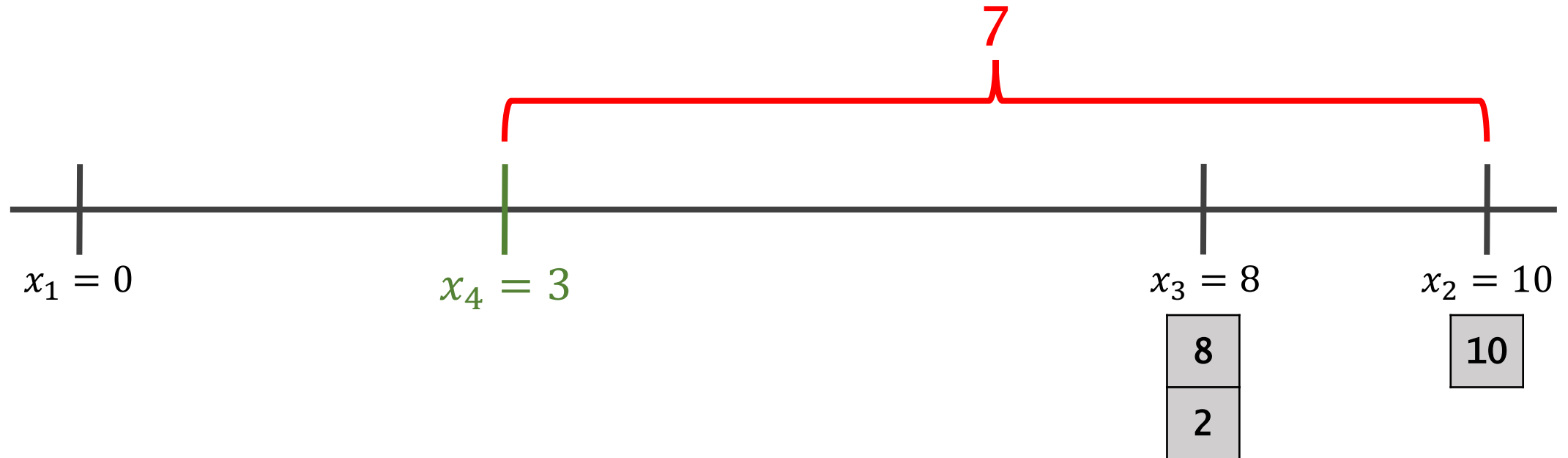
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

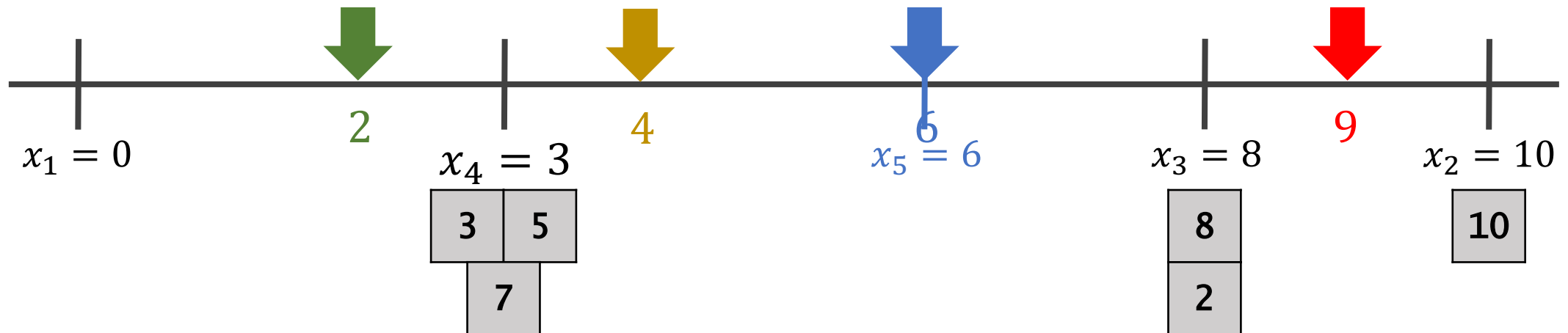
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

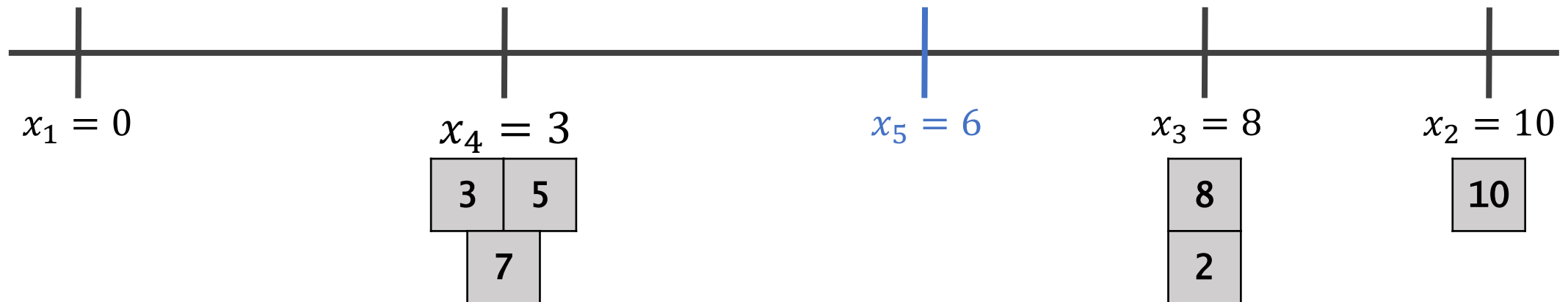
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

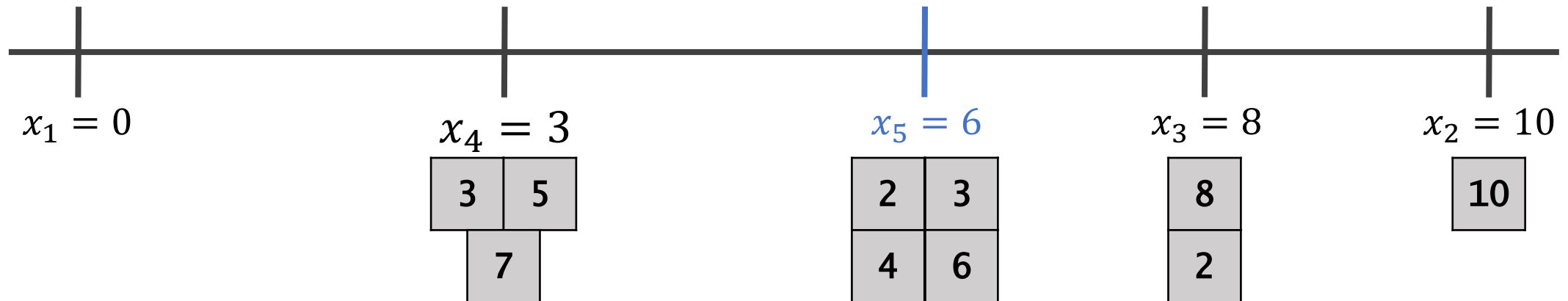
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



Turnpike Reconstruction Problem

Dist =

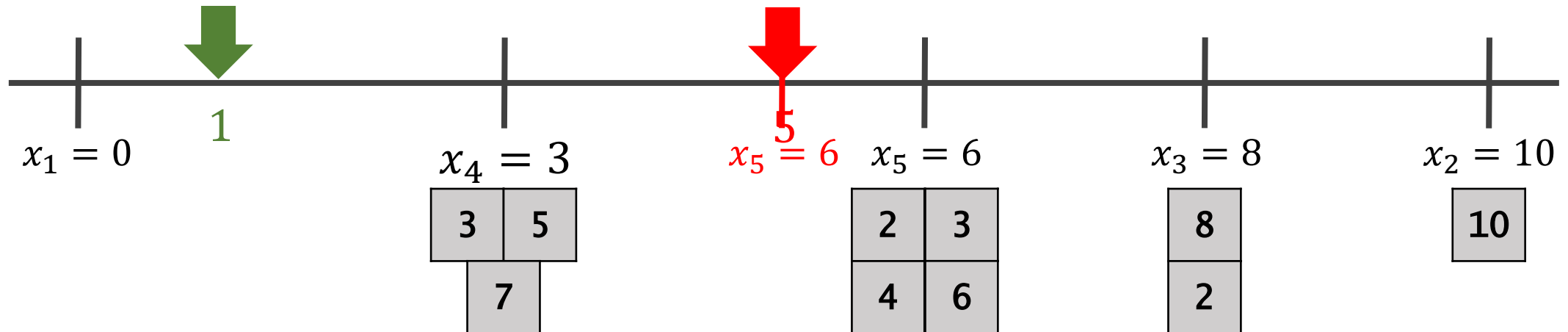
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



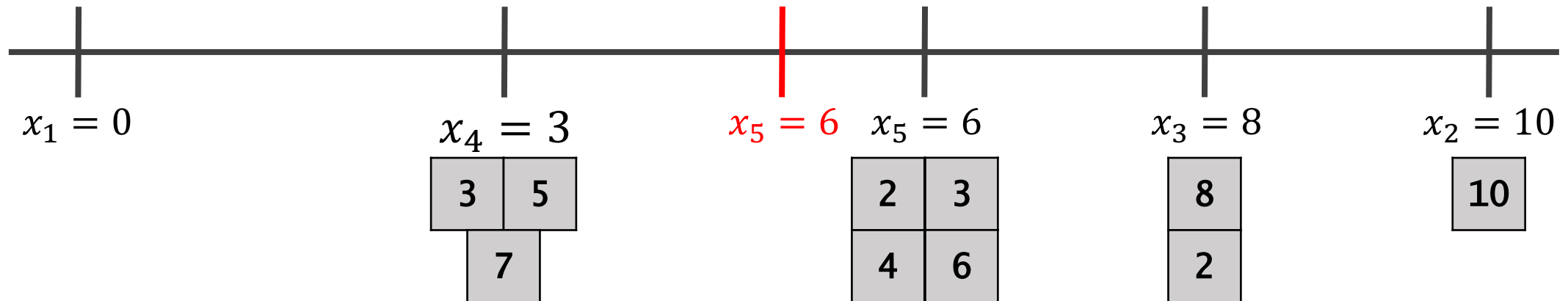
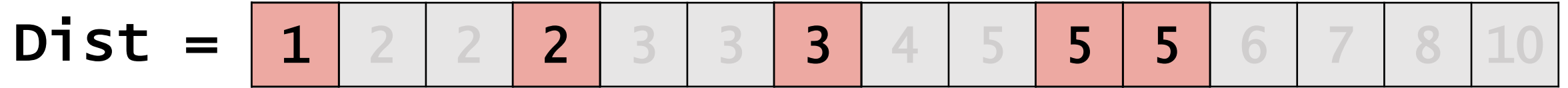
Turnpike Reconstruction Problem

Dist =

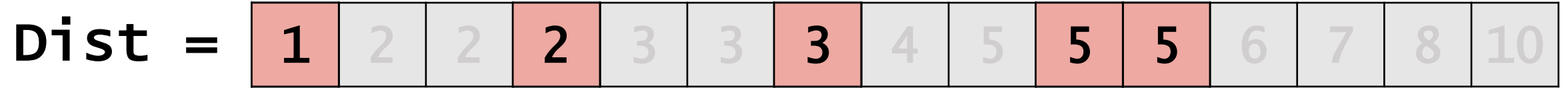
1	2	2	2	3	3	3	4	5	5	5	6	7	8	10
---	---	---	---	---	---	---	---	---	---	---	---	---	---	----



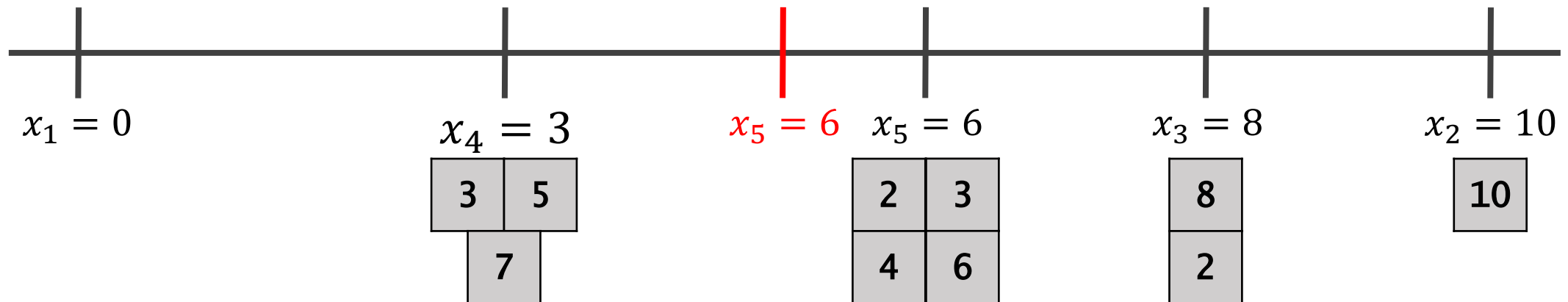
Turnpike Reconstruction Problem



Turnpike Reconstruction Problem



Output:



Thank You!