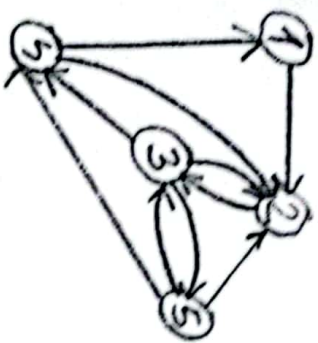


alt 2: shortest path between s and t by using backward breadth-first search



dict-in-dictionary

key	value
1	[4]
2	[1, 3, 4, 5]
3	[2, 5]
4	[3, 5]
5	[3]

$S=1, t=5$	x	y	queue	visited	dict - dictionary	next - dictionary																				
initialization			$[5]$	$\{5\}$	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td></td><td></td><td>0</td></tr></table>	1	2	3	4	5					0	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table>	1	2	3	4	5					
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				0																						
1	2	3	4	5																						
iteration 1		5																								
iteration 1.1	3		$[3]$	$\{3, 5\}$	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td>1</td><td></td><td>0</td></tr></table>	1	2	3	4	5			1		0	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td>5</td><td></td><td></td></tr></table>	1	2	3	4	5			5		
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		1		0																						
1	2	3	4	5																						
		5																								
iteration 2		3																								
iteration 2.1	2		$[2]$	$\{2, 3, 5\}$	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td>2</td><td>1</td><td></td><td>0</td></tr></table>	1	2	3	4	5		2	1		0	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td>3</td><td>5</td><td></td><td></td></tr></table>	1	2	3	4	5		3	5		
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iteration 3		2																								
iteration 3.1	1		$[1]$	$\{1, 2, 3, 5\}$	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>3</td><td>2</td><td>1</td><td></td><td>0</td></tr></table>	1	2	3	4	5	3	2	1		0	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>2</td><td>3</td><td>5</td><td></td><td></td></tr></table>	1	2	3	4	5	2	3	5		
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iteration 3.2	3																									
iteration 3.3	4		$[1, 4]$	$\{1, 2, 3, 4, 5\}$	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>3</td><td>2</td><td>1</td><td>3</td><td>0</td></tr></table>	1	2	3	4	5	3	2	1	3	0	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>2</td><td>3</td><td>5</td><td>2</td><td></td></tr></table>	1	2	3	4	5	2	3	5	2	
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iteration 4.1	4																									
iteration 5		4																								
iteration 5.1	3																									
iteration 5.2	5																									

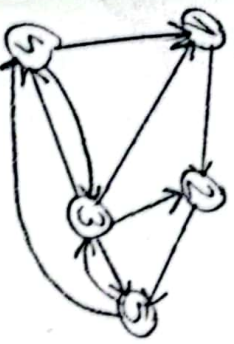
len(queue) == 0 \Rightarrow stop

The path is built from next

1	2	3	4	5
2	3	5	2	

 beginning with $n=1$.

$n=1$, next[1] = 2, next[2] = 3, next[3] = 5 = t
 path = [1, 2, 3, 5], length = dist[5] = dist[1] = 3



dict in dictionary

key	value
1	[3, 4]
2	[1, 3]
3	[4, 5]
4	[3, 5]
5	[2, 3]

$n=4, t=5$		x	y	queue	visited	dict - dictionary	meet - dictionary																																			
initialization				[5]	{5}	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td></td><td></td><td>5</td></tr></table>	1	2	3	4	5					5	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table>	1	2	3	4	5																				
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iteration 2.1		1		[3, 1]	{1, 2, 3, 5}	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td>1</td><td></td><td></td><td>5</td></tr><tr><td></td><td>1</td><td>2</td><td>3</td><td>5</td></tr><tr><td></td><td></td><td>1</td><td></td><td>0</td></tr></table>	1	2	3	4	5		1			5		1	2	3	5			1		0	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td>5</td><td></td><td></td><td></td></tr><tr><td></td><td>5</td><td></td><td></td><td></td></tr></table>	1	2	3	4	5		5					5			
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iteration 2.2		3																																								
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iteration 4.2		4																																								
iteration 5			4																																							
iteration 5.1		3																																								
iteration 5.2		3																																								

len(queue) == 0 \Rightarrow stop

The path is built from meet beginning with $S=4$

1	2	3	4	5
2	5	5	3	

$S=4$, meet[4] = 3, meet[3] = 5 = t
 path = [4, 3, 5], length = dist[5] = dist[4] = 2