

1. Problem Description

A group of people want to cross a bridge from east to west. The bridge only allows two persons to cross at a time and they must use a flashlight. There is only one flashlight. Two people can go from east to west and then one of them returns with the flashlight from west to east. When two people are crossing the bridge, they are crossing it at the speed of the slower one. The goal of this problem is to cross the bridge as quickly as possible such that all the people in the group are on the west side of the bridge.

2. Problem Formulation

1. State representation: A tuple consisting of a list to represent the location of each member of the group, and an integer 0 or 1 to represent the available action. In the list, a 0 means that a member of the group is on the east side, and a 1 means he is on the west side. For example, $([0,1,0], 0)$, member 0 and 2 are on the west side of the bridge and 1 is on the east; moreover, the available action is to move E→W, which is represented by 0.
2. Initial State: $([0_0, 0_1, 0_2, \dots, 0_K], 1)$, where k is the number of travellers.
3. Goal State: $([1_0, 1_1, 1_2, \dots, 1_K], 0)$, where K is the number of travellers.
4. Actions: 0 for W→E, and 1 for E→W

5. Input file:

- C, number of test cases
- For each test case:
 - i. K, number of people
 - ii. A list of K numbers, showing the time required by each person to pass to the other side.

3. Experimental Results:

1. Input: K=3, Speed = 3, 2, 5

	UCS	IDS	A*
Solution	1. (0, 1) move to the west side 2. 1 returns with the flashlight 3. (1, 2) move to the west side	1. (1, 2) move to the west side 2. 1 returns with the flashlight 3. (0, 1) move to the west side	1. (1, 2) move to the west side 2. (2) returns with the flashlight 3. (2, 3) move to the west side
Solution Cost	10	10	10
Search Cost	27	9	6
Space Requirement	4	6	6

2. Input: K=4, Speed = 50, 60, 70, 100

	UCS	IDS	A*
Solution	1. (0, 1) move to the west side 2. 0 returns with the flashlight 3. (0, 2) move to the west side 4. 0 returns with the flashlight 5. (0, 3) move to the west side	1. (0, 1) move to the west side 2. 0 returns with the flashlight 3. (0, 2) move to the west side 4. 0 returns with the flashlight 5. (0, 3) move to the west side	1. (1, 2) move to the west side 2. (1) returns with the flashlight 3. (1, 3) move to the west side 4. (1) returns with the flashlight 5. (1, 4) move to the west side
Solution Cost	330	330	330
Search Cost	456	122	41
Space Requirement	8	81	45

3. Input: K=5, Speed = 120, 30, 40, 77, 20

	UCS	IDS	A*
Solution	1. (1, 4) move to the west side 2. 1 returns with the flashlight 3. (0, 3) move to the west side 4. 4 returns with the flashlight 5. (1, 4) move to the west side 6. 4 returns with the flashlight 7. (2, 4) move to the west side	1. (2, 4) move to the west side 2. 4 returns with the flashlight 3. (1, 4) move to the west side 4. 1 returns with the flashlight 5. (0, 3) move to the west side 6. 4 returns with the flashlight 7. (1, 4) move to the west side	1. (2, 5) move to the west side 2. (2) returns with the flashlight 3. (1, 4) move to the west side 4. (5) returns with the flashlight 5. (2, 5) move to the west side 6. (5) returns with the flashlight 7. (3, 5) move to the west side
Solution Cost	290	290	290
Search Cost	10780	572	270
Space Requirement	8	431	320

4. Input: K=6, Speed = 300, 200, 400, 500, 600, 222

	UCS	IDS	A*
Solution	1. (1, 5) move to the west side 2. 5 returns with the flashlight 3. (0, 2) move to the west side 4. 1 returns with the flashlight 5. (1, 5) move to the west side 6. 1 returns with the flashlight 7. (3, 4) move to the west side 8. 5 returns with the flashlight 9. (1, 5) move to the west side	1. (1, 5) move to the west side 2. 1 returns with the flashlight 3. (0, 2) move to the west side 4. 5 returns with the flashlight 5. (1, 5) move to the west side 6. 1 returns with the flashlight 7. (3, 4) move to the west side 8. 5 returns with the flashlight 9. (1, 5) move to the west side	1. (2, 6) move to the west side 2. (2) returns with the flashlight 3. (1, 2) move to the west side 4. (6) returns with the flashlight 5. (4, 5) move to the west side 6. (2) returns with the flashlight 7. (2, 6) move to the west side 8. (2) returns with the flashlight 9. (2, 3) move to the west side
Solution Cost	2510	2510	2566
Search Cost	9110	1159395	1407
Space Requirement	7122	16	1299

5. Input: K=2, Speed = 80, 60

	UCS	IDS	A*
Solution	1. (0, 1) move to the west side	1. (0, 1) move to the west side	1. (1, 2) move to the west side
Solution Cost	80	80	80
Search Cost	1	1	1
Space Requirement	1	1	1