

Presenting

The Rail Guardians

in requirement of the course project for ST699 – Special Topics in Games

Presented By

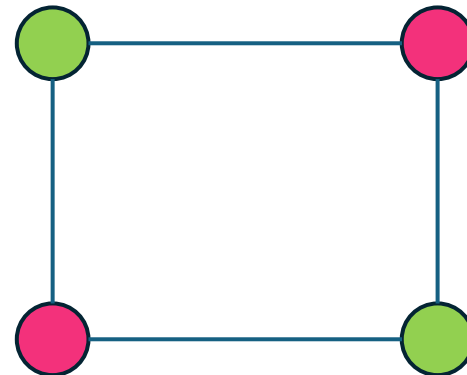
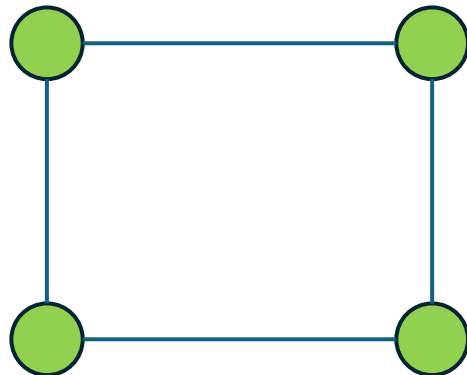
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Inspired from Eternal Vertex Cover problem, *The Rail Guardians* is a two-player game where the players alternate between defending and attacking positions in a dynamic, strategic showdown.

Minimum Vertex Cover

For a graph $G(V, E)$, a set $S \subseteq V(G)$ is said to be a vertex cover of G if for any $(u, v) \in E(G)$ either $u \in S$ or $v \in S$.

The size of the smallest vertex cover of graph G is called the minimum vertex cover of G , denoted by $\text{mvc}(G)$.



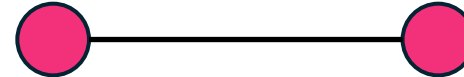
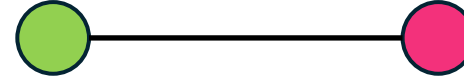
Eternal Vertex Cover

- Dynamic variant of the vertex cover problem.
- Guards are placed on some vertices of a graph.
- In every move, the attacker attacks an edge. In response, the defender moves the guards along the edges in such a manner that at least one guard moves along the attacked edge.
- If such a movement is not possible, **attacker wins**. If the defender can defend an *infinite sequence of attacks*, **defender wins**.
- The minimum number of guards with which defender has a winning strategy is called the Eternal Vertex Cover Number of the Graph G known as $evc(G)$.
- Klostermeyer and Mynhardt showed $mvc(G) \leq evc(G) \leq 2mvc(G)$

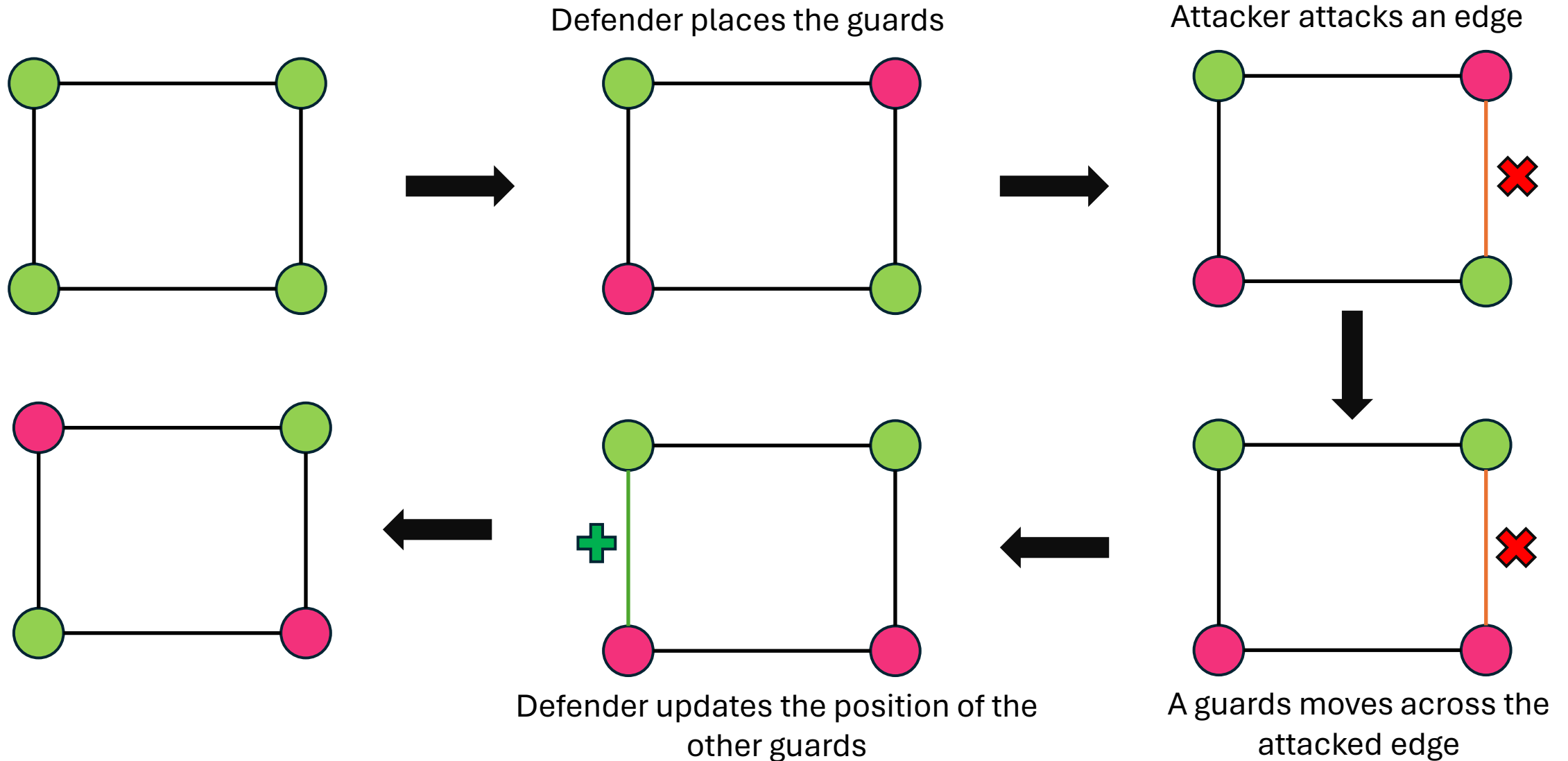
Eternal Vertex Cover – Some intuitions



Attacker Wins



Eternal Vertex Cover – A walkthrough



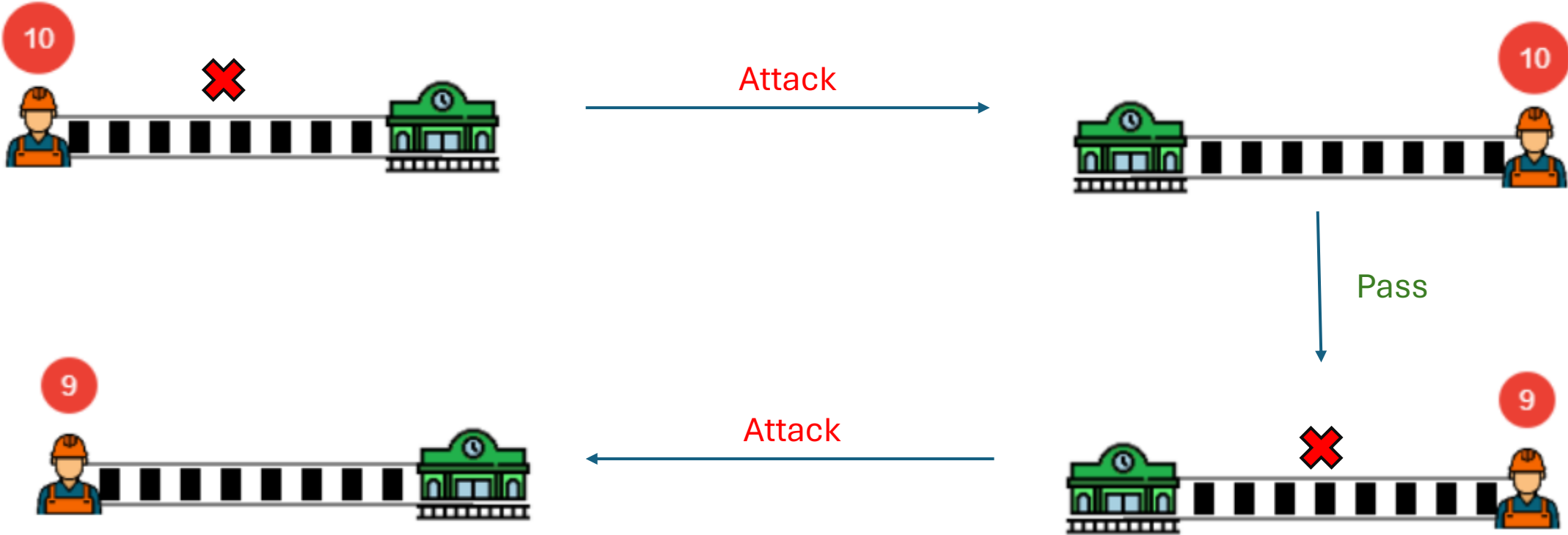
Let's get to the GAME !

Analysis of Max Score for Energy Aware Eternal Vertex Cover on Linear Graphs

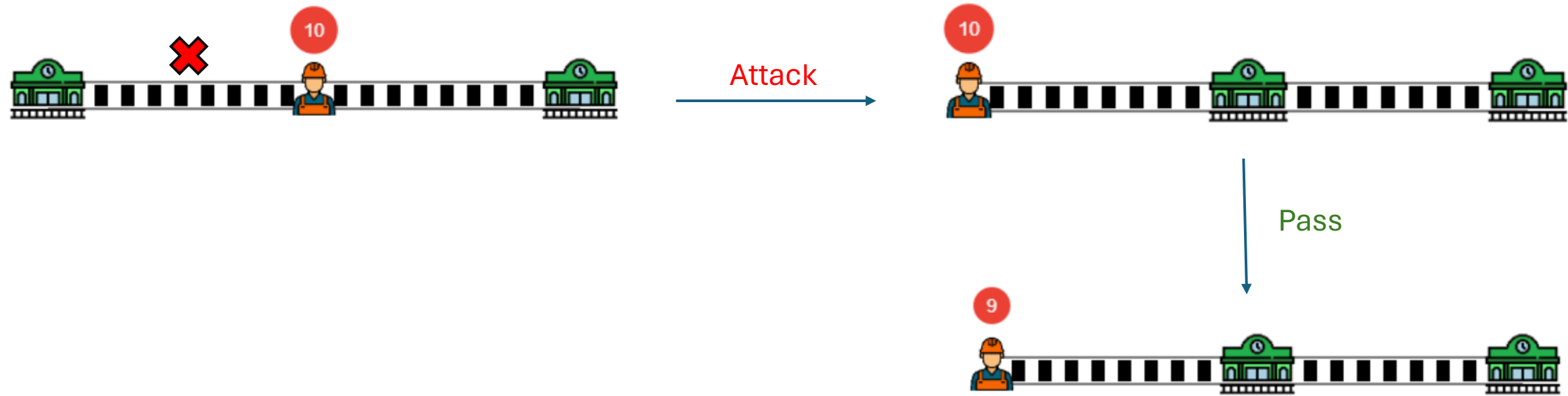
Stations	Builders	Energy	Max Score
2	1	K	?



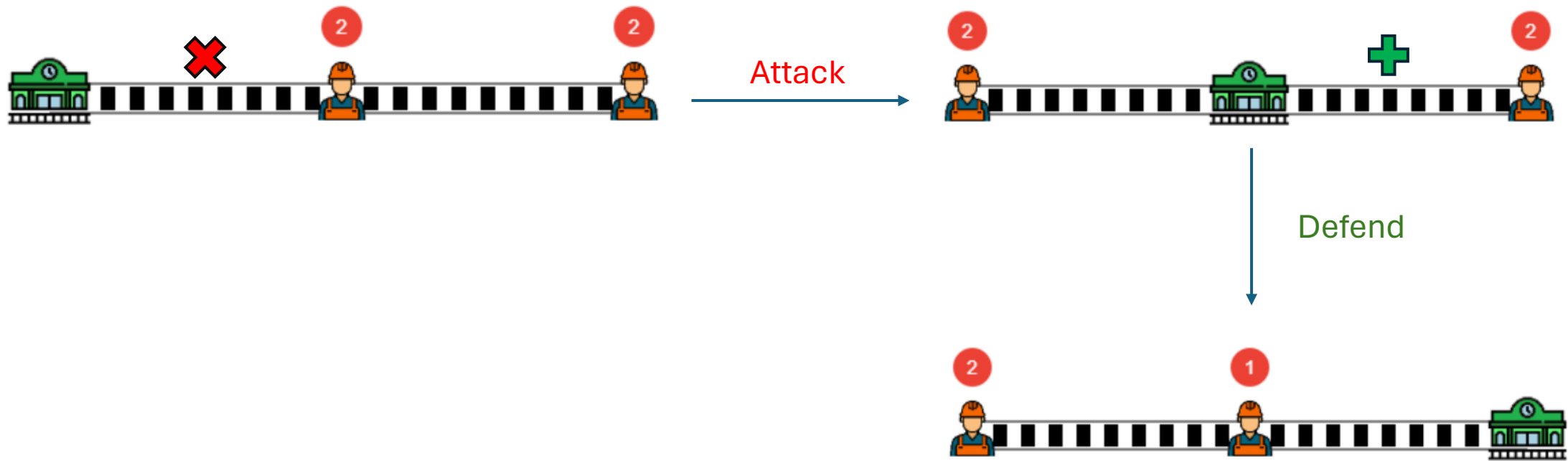
Stations	Builders	Energy	Max Score
2	1	K	K



Stations	Builders	Energy	Max Score
3	1	K	1



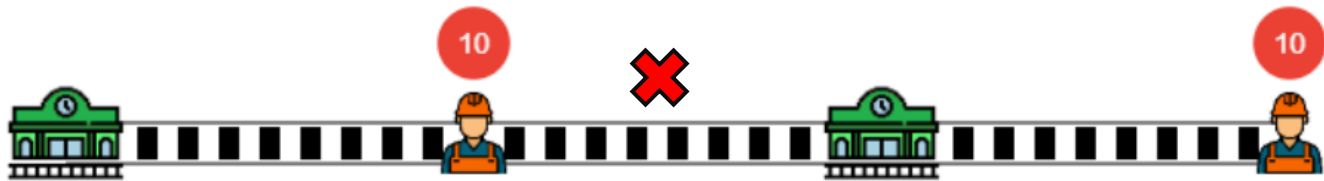
Stations	Builders	Energy	Max Score
3	2	K	2K - 1



Stations	Builders	Energy	Max Score
4	1	K	0



Stations	Builders	Energy	Max Score
4	2	K	1?



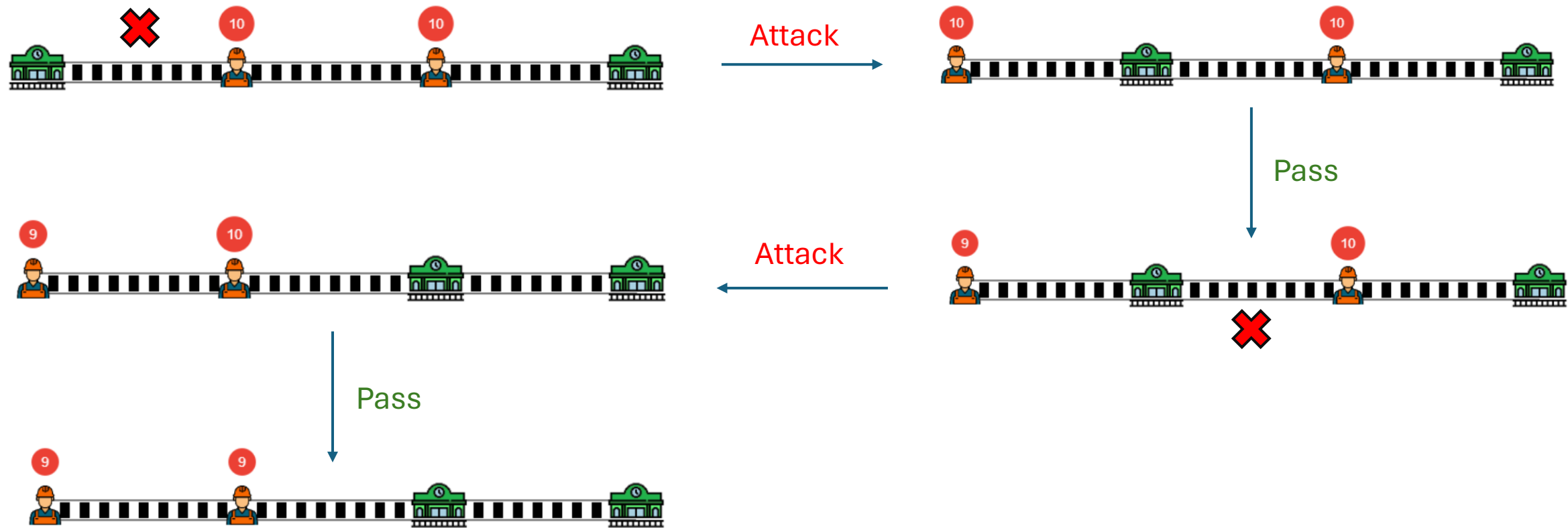
Attack



Pass



Stations	Builders	Energy	Max Score
4	2	K	2



Stations	Builders	Energy	Max Score
4	3	K	3K - 2



Attack



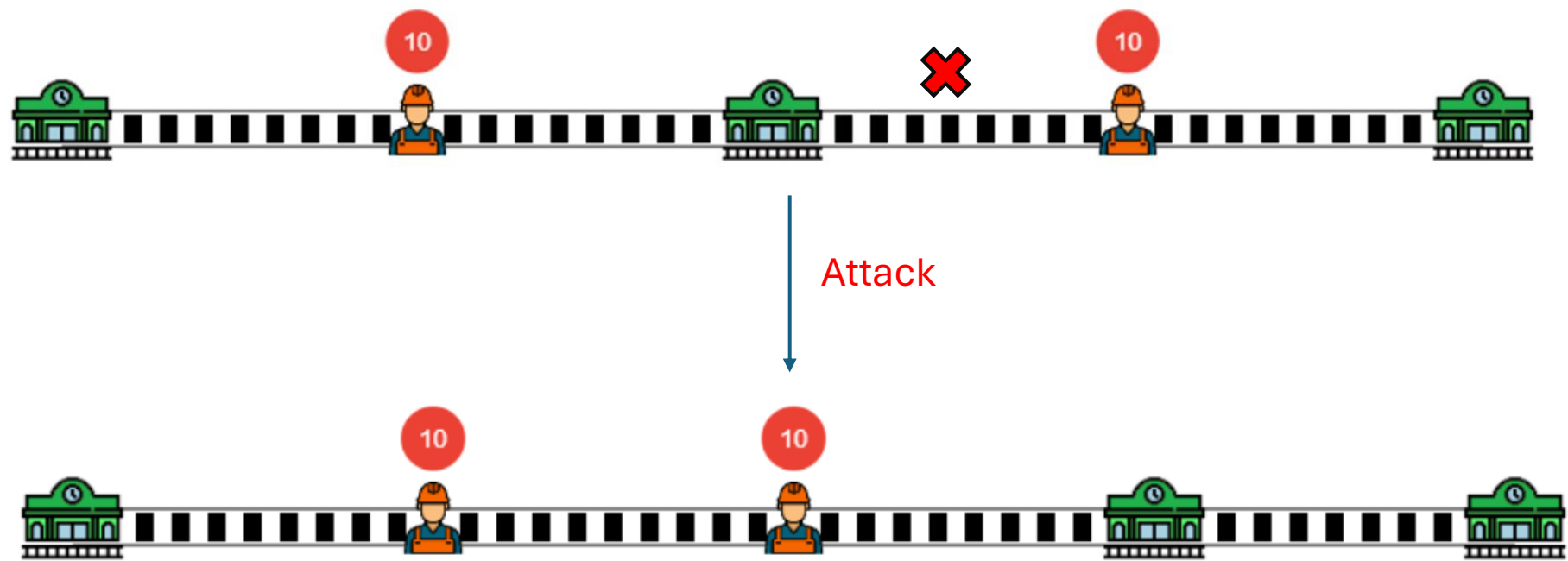
Pass



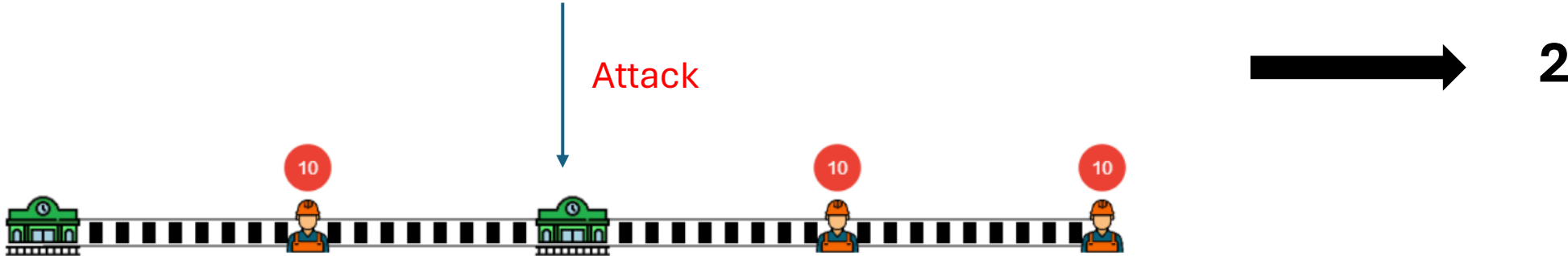
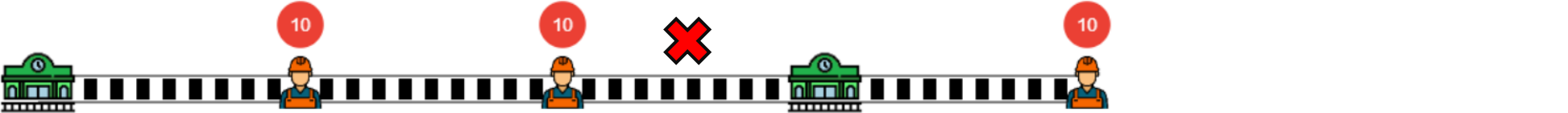
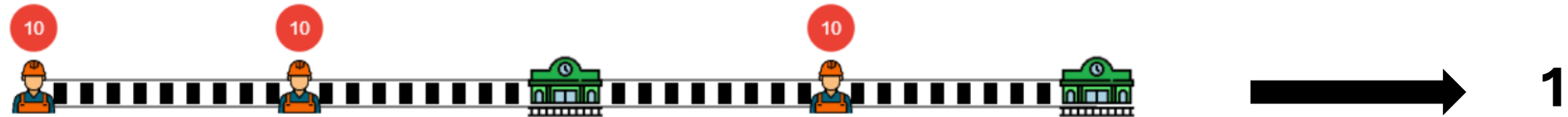
Stations	Builders	Energy	Max Score
5	1	K	0



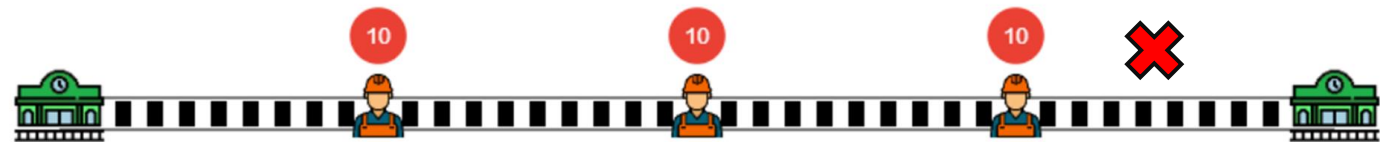
Stations	Builders	Energy	Max Score
5	2	K	1



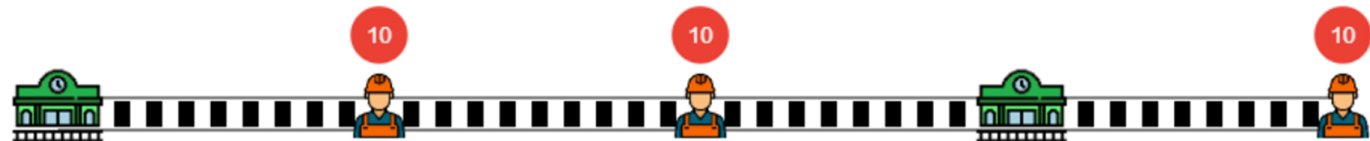
Stations	Builders	Energy	Max Score
5	3	K	?



Stations	Builders	Energy	Max Score
5	3	K	3



Attack



3



2, 3

Stations	Builders	Energy	Max Score
5	4	K	4K - 3



Observation Summary

Stations	Builders	Energy	Max Score
2	1	K	K
3	1	K	1
3	2	K	2K – 1
4	1	K	0
4	2	K	2
4	3	K	3K – 2
5	1	K	0
5	2	K	1
5	3	K	3
5	4	K	4K – 3

References

1. Babu, J., Misra, N. and Nanoti, S.G., 2022, June. Eternal vertex cover on bipartite graphs. In International Computer Science Symposium in Russia (pp. 64-76). Cham: Springer International Publishing.
2. Paul, K. and Pandey, A., 2023, March. Some algorithmic results for eternal vertex cover problem in graphs. In International Conference and Workshops on Algorithms and Computation (pp. 242-253). Cham: Springer Nature Switzerland.
3. Fujito, T. and Nakamura, T., 2020. Eternal connected vertex cover problem. In *Theory and Applications of Models of Computation: 16th International Conference, TAMC 2020, Changsha, China, October 18–20, 2020, Proceedings 16* (pp. 181-192). Springer International Publishing.

Thank You

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