

Game Theory in Cold War

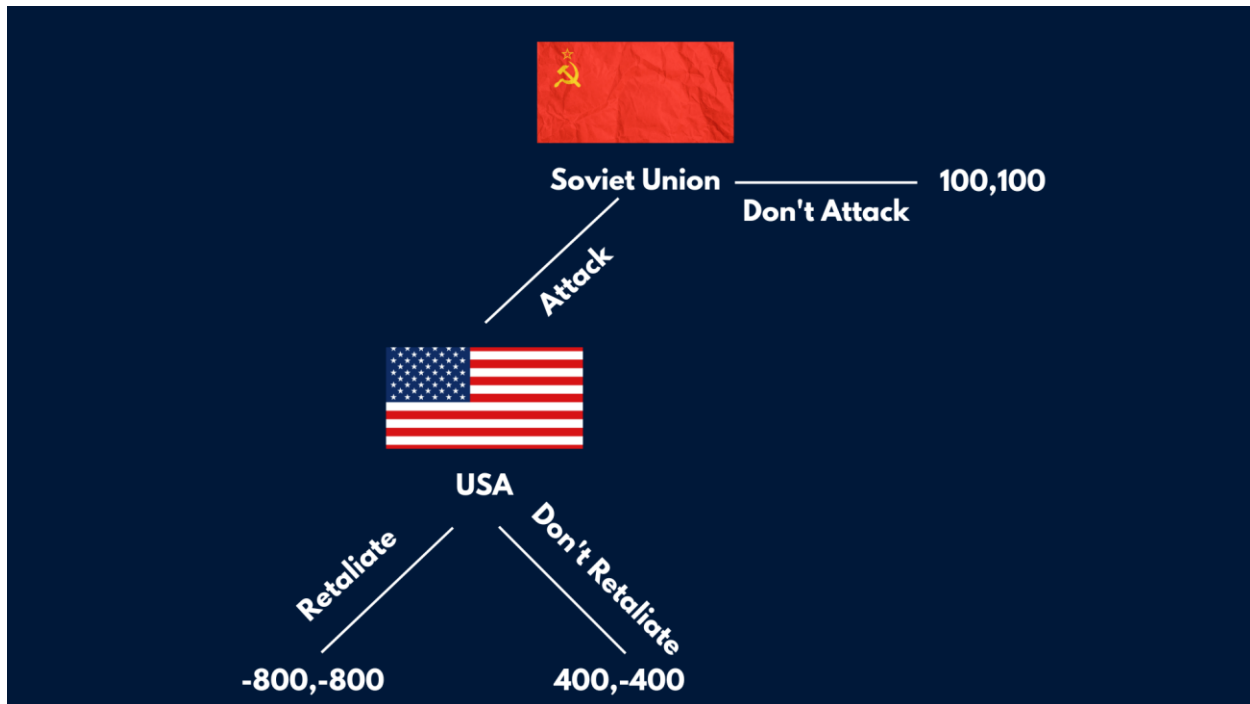
1945 marked the beginning of a time period filled with proxy wars, spycraft, espionage, and the struggle toward world dominance between two superpowers. The United States of America (USA) and the Soviet Union (USSR). The three major players on the allies' front during WW2 met in Postdam in 1945 to agree on terms to conclude WW2 and decide on post-war Europe. Britain, USA, and USSR met in Postdam in 1945 which kickstarted the cold war. Within 18 months of this meeting, the cold war officially began lasting almost four decades finally coming to an end in 1991 with the fall of the Soviet Union.

But how did it begin in Postdam? During the meeting, US President Harry Truman took Joseph Stalin, the leader of the Soviets, aside and told him about the recent development of the nuclear arsenal of the US capable of destroying cities with just one blow. This little piece of information kickstarted the race to arms and the cold war itself. Soon after this, the US used two bombs in Japan totally destroying the two cities of Hiroshima and Nagasaki.

This showed the world that the US was the superpower dominating the world. USSR didn't like the US getting the upper hand and started to build its own arsenal of weapons of mass destruction. The cold war was filled with espionage, spycraft, proxy wars all over the globe, and the race to dominate the world. The major highlight of the cold war era is the Cuban missile crisis in 1962 when the world almost saw a full-out nuclear war between the US and the USSR.

It started with the USSR installing weapons of mass destruction in communist Cuba just 90 miles south of Florida. US president John F. Kennedy warned USSR to dismantle the weapons and withdraw. If the US was attacked then a nuclear strike on USSR would be the immediate response from the US. Eventually, after a tense standoff and negotiations, USSR agreed to dismantle and withdraw the weapons from Cuba. The US agreed to not invade Cuba and to dismantle its nuclear weapons in Turkey. This was the closest the world came to a nuclear war between the two superpowers at the time.

Game Model



In this game, the Soviet Union makes the first move (doesn't matter who goes first). Now the Soviet Union has two options:

1. *Attack*
2. *Don't Attack*

If the Soviet Union chooses *Don't Attack* then the game ends in a stalemate where no nuclear weapons are used. If the Soviet Union chooses *Attack* then the US gets two options:

1. *Retaliate*
2. *Don't Retaliate*

Players = [*“SOVIET UNION”*, *“USA”*]

Action Space SOVIET UNION = [*“Attack”*, *“Don't Attack”*]

Action Space USA = [*“Retaliate”*, *“Don't Retaliate”*]

The game is represented in a Normal Form below.

Soviet Union	USA	
	<i>Retaliate</i>	<i>Don't Retaliate</i>
<i>Attack</i>	-800, -800	400, -400
<i>Don't Attack</i>	100, 100	100, 100

The payoffs are as below:

- If the Soviet Union chooses to ***Don't Attack*** the game ends in a stalemate and both players get a payoff of 100.
- If the Soviet Union chooses to ***Attack*** and the US chooses to ***Don't Retaliate*** then the Soviet Union gets a payoff of 400 whereas the US gets a payoff of -400.
- If the Soviet Union chooses to ***Attack*** and the US chooses to ***Retaliate*** then the game results in a nuclear war destroying everything with both the nation getting a payoff of -800.

Solving the Game

The Soviet Union begins the game. It has the option to choose ***Don't Attack*** and get a payoff of **100** or choose ***Attack*** and get a payoff of ***X*** as it needs to know what will the US pick so it can get a payoff of **400** or **-800** depending on what the US chooses.

Now for the turn of the US, it can choose to ***Retaliate*** and get a payoff of **-800** or choose ***Don't Retaliate*** and get a payoff of **-400**. Since **-400** is better than **-800** it will choose to ***Don't Retaliate*** if the Soviet Union chooses to ***Attack*** the US.

So the solution here is; the Soviet Union will choose to ***Attack*** since the US will choose ***Don't Retaliate*** meaning the Soviet Union will get a payoff of **400** and since **400** is better than **100** it will choose ***Attack***. So the final solution of the game is the Soviet Union attacking the USA and the USA choosing to not retaliate.

But this solution doesn't really make sense. What if the US can make the Soviets believe that if the Soviets attack the US then the US will choose to **Retaliate**? No rational player will pick **-800** over **-400** but if the US can make the Soviets believe that it is using the madman strategy or the doomsday device then the game changes totally.

Now the Soviets believe the US will choose to **Retaliate** if the Soviets choose to **Attack**. If this is the scenario then the Soviets will receive a payoff of **-800**. It can now choose to **Attack** and get a payoff of **-800** or it can choose to **Don't Attack** and get a payoff of **100**. Since **100** is better than **-800**, it will choose to **Don't Attack**. The game will end in a stalemate with both players getting a payoff of **100**.

Implementation Results

The game has been modeled in python. The Soviet Union gets to make the first move. The US is given a turn to choose if the Soviet Union chooses to **Attack**. The game lets the players know about the results, the payoffs, and the consequences of their choices. The game also outputs the nash equilibrium for the game which is:

1. **100,100 (Don't Attack)**
2. **400, -400 (Attack, Don't Retaliate)**

Notes

[Link to the Drive with a 40-sec demo of the results and screenshots of the code and the results](#)