



Game Theory Project



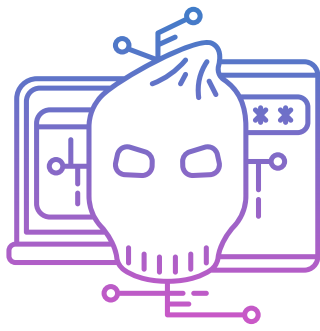
Game Theory in Cold War

Muhammad Usman Malik 19i-0402

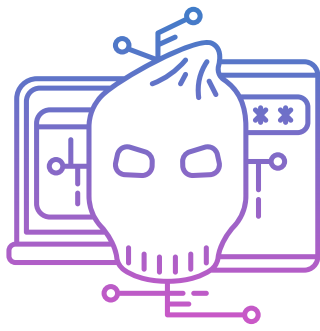
Amna Shafiq 19i-1978

Musa Ishaq 19i-0731

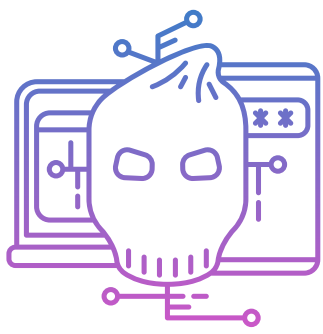
Instructor: Dr.Omer Beg



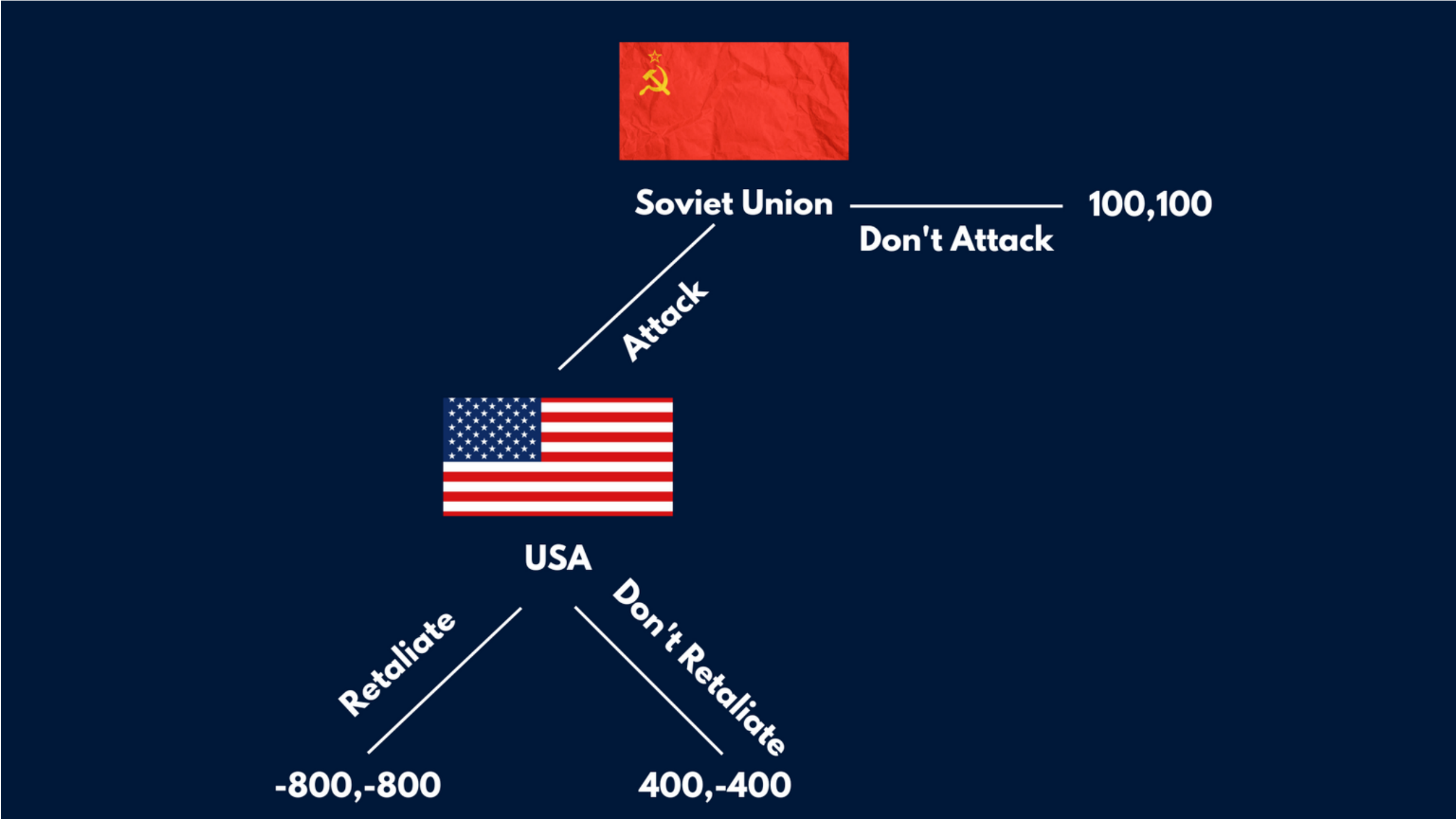
How did the Cold War Start?

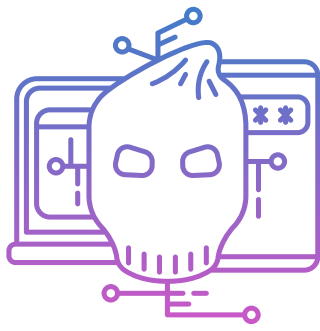


Let's Model the Cold War



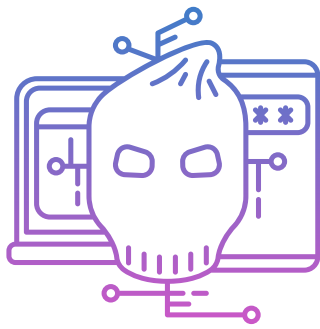
Let's Model the Game





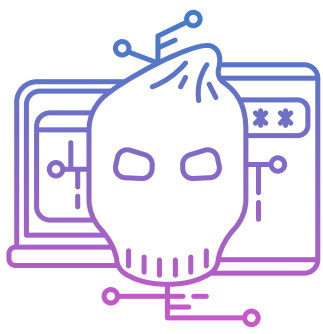
Action Space

- **Players = [“SOVIET UNION”, “USA”]**
- **Action Space SOVIET UNION = [“Attack”, “Don’t Attack”]**
- **Action Space USA = [“Retaliate”, “Don’t Retaliate”]**



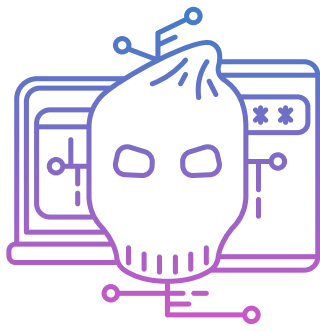
Game in Normal Form

Soviet Union	USA	
	Retaliate	Don't Retaliate
Attack	-800, -800	400, -400
Don't Attack	100, 100	100, 100

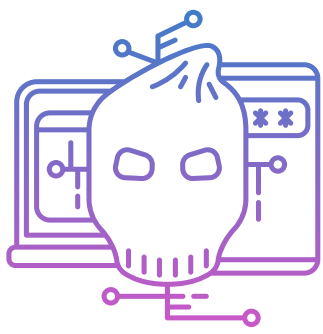


Let's Solve the Game

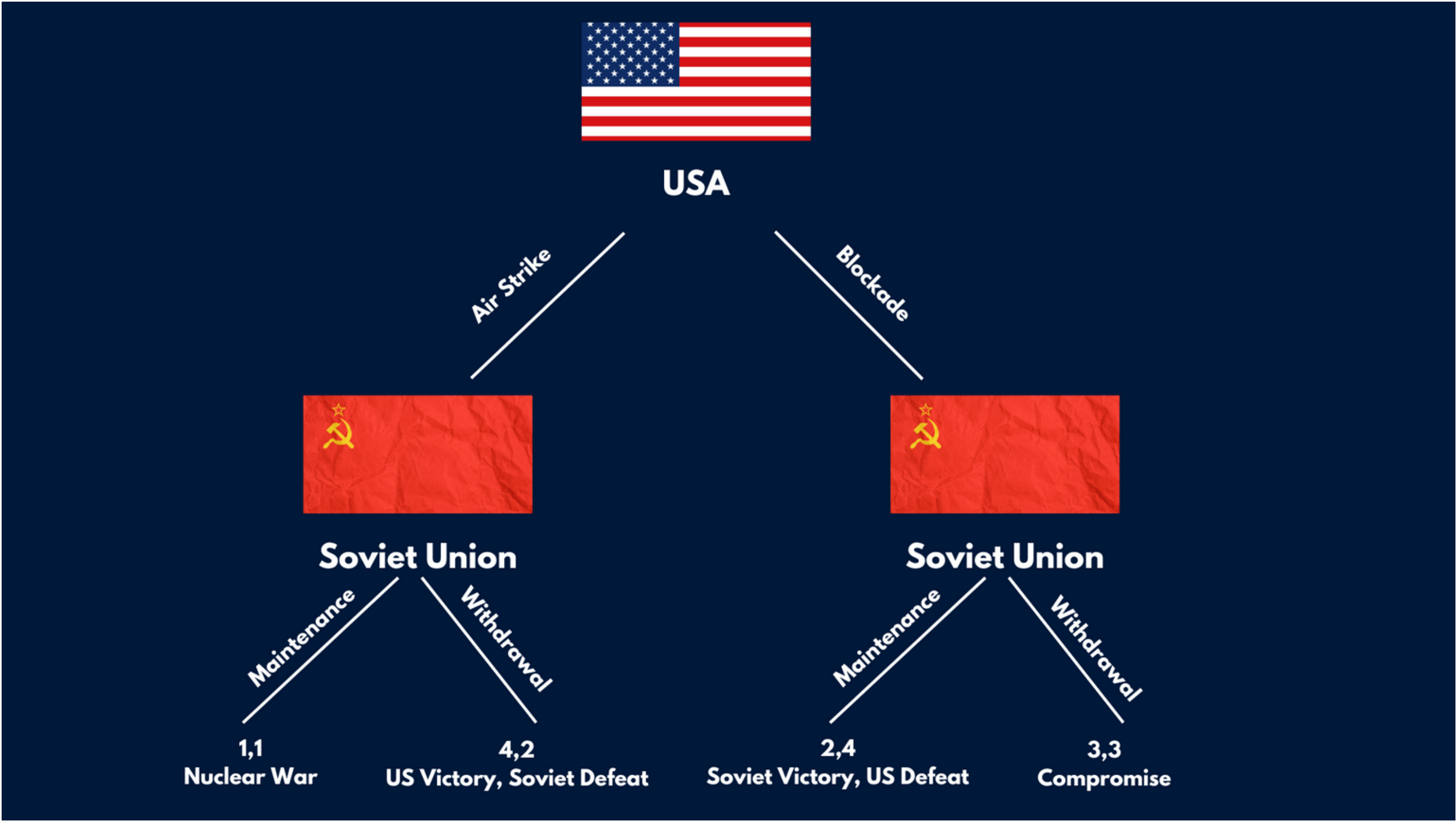
- **SU = Don't Attack --> Payoff = 100**
- **SU = Attack --> Payoff = 400 or -800**
- **US = Don't Retaliate --> Payoff = -400**
- **US = Retaliate --> Payoff = -800**
- **So US = Don't Retaliate**
- **SU = Attack**

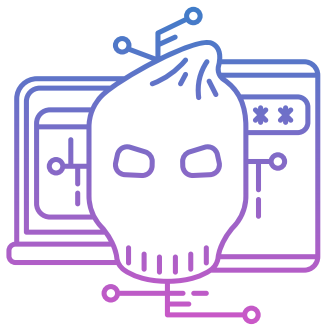


Let's Model the Cuban Missile Crisis



Let's Model the Game

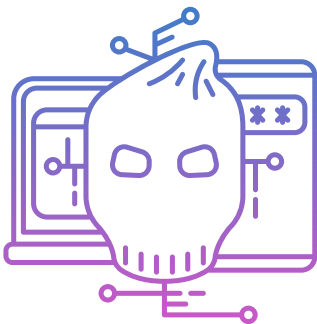




Action Space



- **Players = [“SOVIET UNION”, “USA”]**
- **Action Space SOVIET UNION = [“Withdrawal”, ”Maintenance”]**
- **Action Space USA = [“Air Strike”, “Blockade”]**



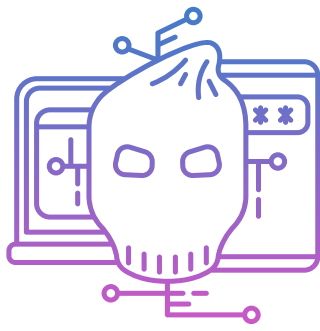
Game in Normal Form

Soviet Union	USA	
	Blockade	Air Strike
Withdrawal	(3,3) Compromise	(4,2) US Victory, Soviet Defeat
Maintenance	(2,4) Soviet Victory, US Defeat	(1,1) Nuclear War

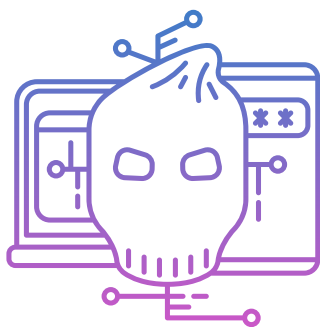


Let's Solve the Game

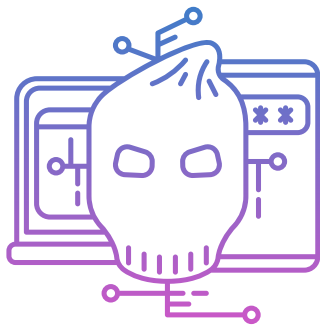
- **SU will pick Withdrawal if the US picks Air Strike**
- **SU will pick Maintenance if the US picks Blockade**
- **The US will pick Air Strike and SU will pick Withdrawal**
- **But this didn't happen in real life**



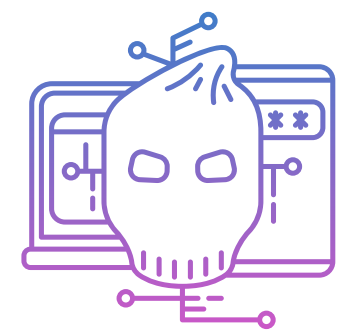
Limitations of Game Theory



What if we take Nuclear Weapons out of the equation

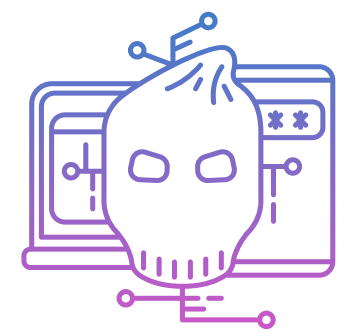


Implementation



Code

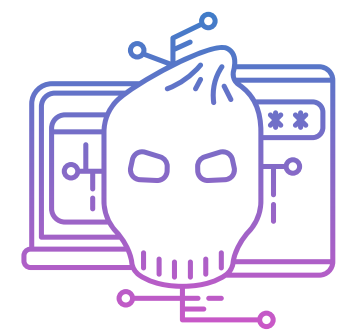
```
1
2 SOVIET_UNION = [[-800,400],[100,100]]
3 USA = [[-800,-400],[100,100]]
4
5 print("\nThe Game represented in a Normal Game Form below\n")
6 print(f"_____ \n\n{SOVIET_UNION[0][0]},{USA[0][0]} || {SOVIET_UNION[0][1]},{USA[0][1]}"
7 print(f"_____ \n\n{SOVIET_UNION[1][0]},{USA[1][0]} || {SOVIET_UNION[1][1]},{USA[1][1]}\n_____ \n")
8
9 print(f"\nThe Nash Equilibriums are: ({SOVIET_UNION[0][1]},{USA[0][1]}) and ({SOVIET_UNION[1][1]},{USA[1][1]})\n")
10
11
12 action_space_usa = ['Retaliate','Not Retaliate']
13 action_space_soviet_union = ['Attack','Not Attack']
14
15 move_USA = ''
16 move_SOVIET_UNION = ''
17
18 SOVIET_UNION_turn = True
19 USA_turn = False
20 is_game_over = False
21
22 if(SOVIET_UNION_turn and USA_turn==False and is_game_over==False):
23     print(f'\nSoviet Union please pick your move\n\nType A or B to pick from the options below\nA - {action_space_soviet_union[0]}\nB - {action_space_soviet_union[1]}\n')
24     option=input()
25     if option == 'A' or option == 'a':
26         move_SOVIET_UNION = action_space_soviet_union[0]
27     elif option == 'B' or option == 'b':
28         move_SOVIET_UNION = action_space_soviet_union[1]
29     else:
30         print("Invalid Input")
31
32     SOVIET_UNION_turn = False
33     USA_turn = True
34     print ("SOVIET UNION YOU CHOSE TO",move_SOVIET_UNION)
35
36 if(move_SOVIET_UNION==action_space_soviet_union[1]):
37     is_game_over=True
```

Code



```
36 if(move_SOVIET_UNION==action_space_soviet_union[1]):
37     is_game_over=True
38
39 if(SOVIET_UNION_turn == False and USA_turn and is_game_over == False):
40     print(f'\nUSA please pick your move   SOVIET UNION CHOSE TO {move_SOVIET_UNION} you\n\nType A or B to pick from the options below\nA - {action_space_usa[0]}\nB - {action_s
41     option=input()
42     if option == 'A' or option == 'a':
43         move_USA = action_space_usa[0]
44     elif option == 'B' or option == 'b':
45         move_USA = action_space_usa[1]
46     else:
47         print("Invalid Input")
48     USA_turn = False
49     is_game_over = True
50     print ("USA YOU CHOSE TO",move_USA)
51
52 if(is_game_over):
53     if (move_SOVIET_UNION==action_space_soviet_union[1]):
54         print("\nSOVIET UNION CHOSE NOT TO ATTACK USA HENCE THE GAME IS OVER\nPAYOFFS OF EACH NATION IS LISTED BELOW\n")
55         print("SOVIET UNION",SOVIET_UNION[1][1])
56         print("USA",USA[1][1])
57         print("THE GAME IS OVER! BOTH USA AND SOVIET UNION WON AS THEY DIDNOT ATTACK EACH OTHER\nIT IS A NASH EQUIBLIRIA\n")
58
59     if (move_SOVIET_UNION==action_space_soviet_union[0] and move_USA==action_space_usa[0]):
60         print("\nCONGRATULATIONS, YOU TWO JUST STARTED A NUCLEAR WAR DESTROYING EVERYTHING\n\nPAYOFFS OF EACH NATION IS LISTED BELOW\n")
61         print("SOVIET UNION",SOVIET_UNION[0][0])
62         print("USA",USA[0][0])
63         print("\nTHE GAME IS OVER! BOTH USA AND SOVIET UNION LOST AS BOTH NATIONS DESTROYED EVERYTHING\n")
64
65     if (move_SOVIET_UNION==action_space_soviet_union[0] and move_USA==action_space_usa[1]):
66         print("\nSOVIET UNION ATTACKED USA BUT USA CONCEDED\n\nPAYOFFS OF EACH NATION IS LISTED BELOW\n")
67         print("SOVIET UNION",SOVIET_UNION[0][1])
68         print("USA",USA[0][1])
69         print("\nTHE GAME IS OVER! SOVIET UNION WON BUT USA LOST\nIT IS A NASH EQAUILIBRIA\n")
70
71
72
```



Results



The Game represented in a Normal Game Form below

-800,-800 || 400,-400

100,100 || 100,100

The Nash Equilibriums are: (400,-400) and (100,100)

Soviet Union please pick your move

Type A or B to pick from the options below

A - Attack

B - Not Attack

B

SOVIET UNION YOU CHOSE TO Not Attack

SOVIET UNION CHOSE NOT TO ATTACK USA HENCE THE GAME IS OVER

PAYOFFS OF EACH NATION IS LISTED BELOW

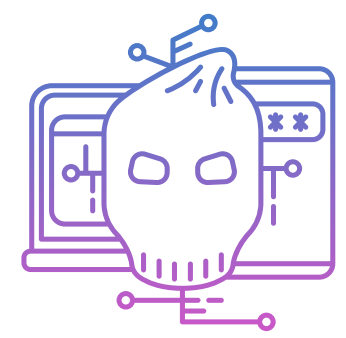
SOVIET UNION 100

USA 100

THE GAME IS OVER! BOTH USA AND SOVIET UNION WON AS THEY DIDNOT ATTACK EACH OTHER

IT IS A NASH EQUIBLIRIA

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The Game represented in a Normal Game Form below

-800,-800 || 400,-400

100,100 || 100,100

The Nash Equilbiriums are: (400,-400) and (100,100)

Soviet Union please pick your move

Type A or B to pick from the options below

A - Attack

B - Not Attack

A

SOVIET UNION YOU CHOSE TO Attack

USA please pick your move SOVIET UNION CHOSE TO Attack you

Type A or B to pick from the options below

A - Retaliate

B - Not Retaliate

B

USA YOU CHOSE TO Not Retaliate

SOVIET UNION ATTACKED USA BUT USA CONCEDED

PAYOFFS OF EACH NATION IS LISTED BELOW

SOVIET UNION 400

USA -400

THE GAME IS OVER! SOVIET UNION WON BUT USA LOST
IT IS A NASH EQUILIBRIA

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The Game represented in a Normal Game Form below

-800,-800 || 400,-400

100,100 || 100,100

The Nash Equilbiriums are: (400,-400) and (100,100)

Soviet Union please pick your move

Type A or B to pick from the options below

A - Attack

B - Not Attack

A

SOVIET UNION YOU CHOSE TO Attack

USA please pick your move SOVIET UNION CHOSE TO Attack you

Type A or B to pick from the options below

A - Retaliate

B - Not Retaliate

A

USA YOU CHOSE TO Retaliate

CONGRATULATIONS, YOU TWO JUST STARTED A NUCLEAR WAR DESTROYING EVERYTHING

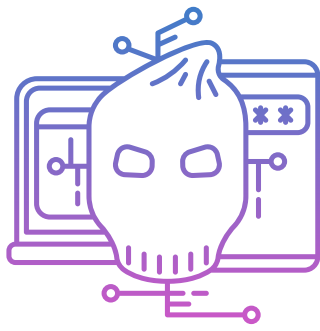
PAYOFFS OF EACH NATION IS LISTED BELOW

SOVIET UNION -800

USA -800

THE GAME IS OVER! BOTH USA AND SOVIET UNION LOST AS BOTH NATIONS DESTROYED EVERYTHING

PS C:\Users\usman> █



THANK YOU