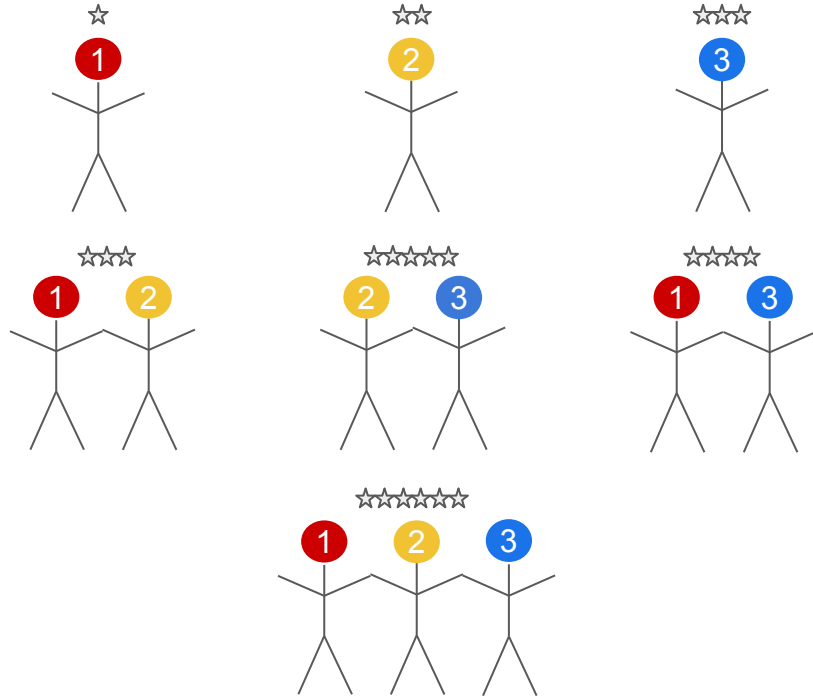
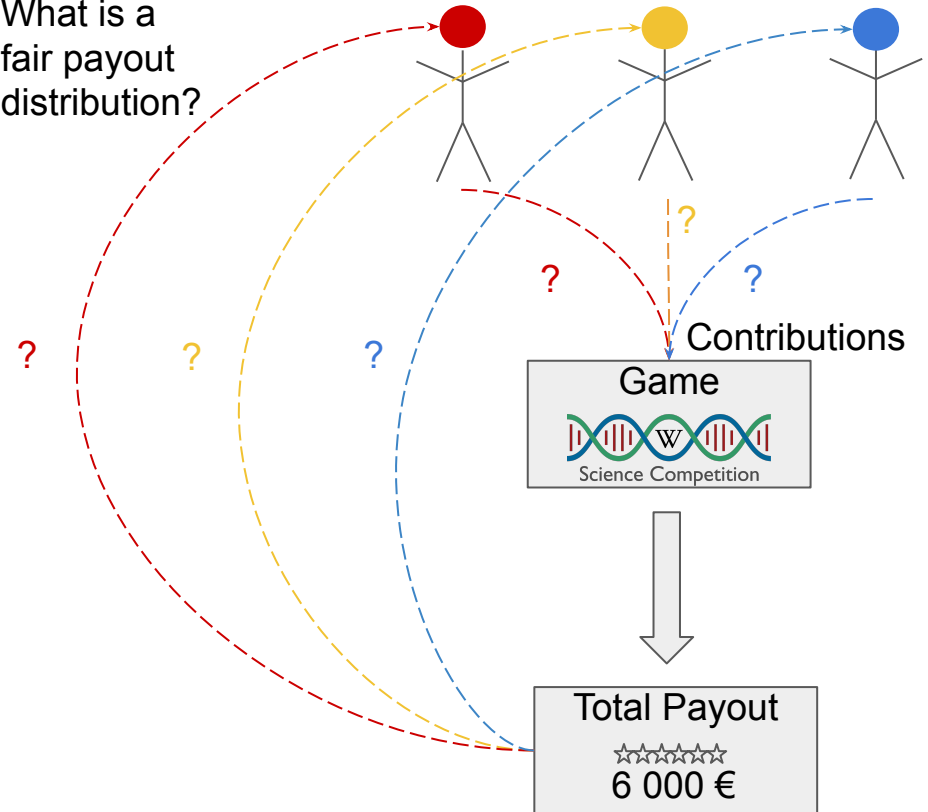


Players do not interact  
(payouts ☆ add up in each coalition)

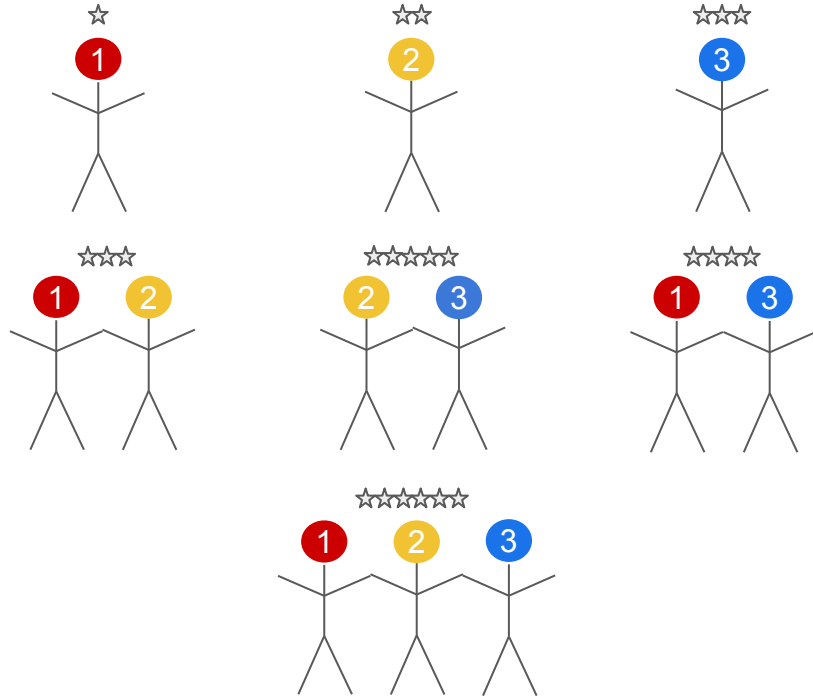


What is a  
fair payout  
distribution?

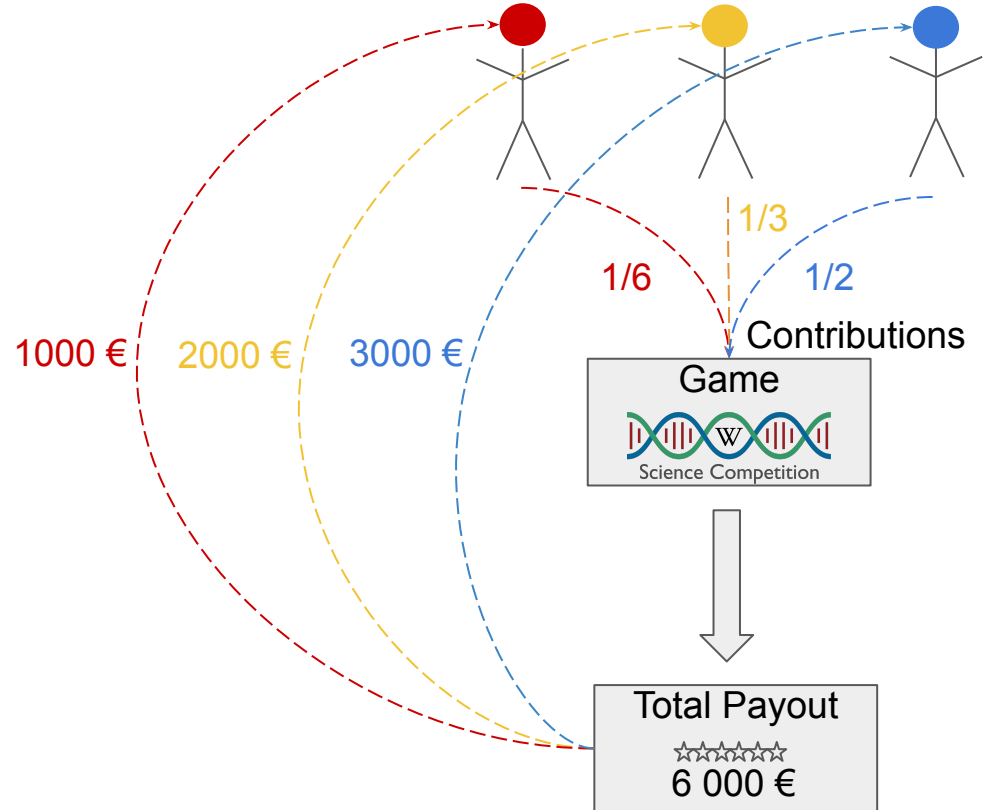
Players do not interact



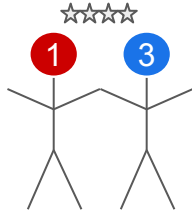
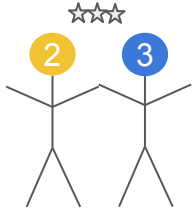
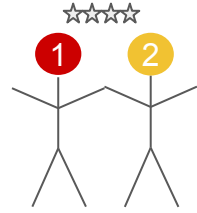
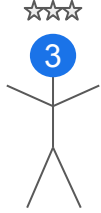
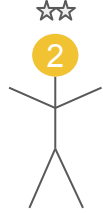
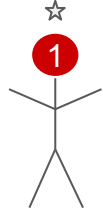
Players do not interact  
(payouts ☆ add up in each coalition)



Players do not interact

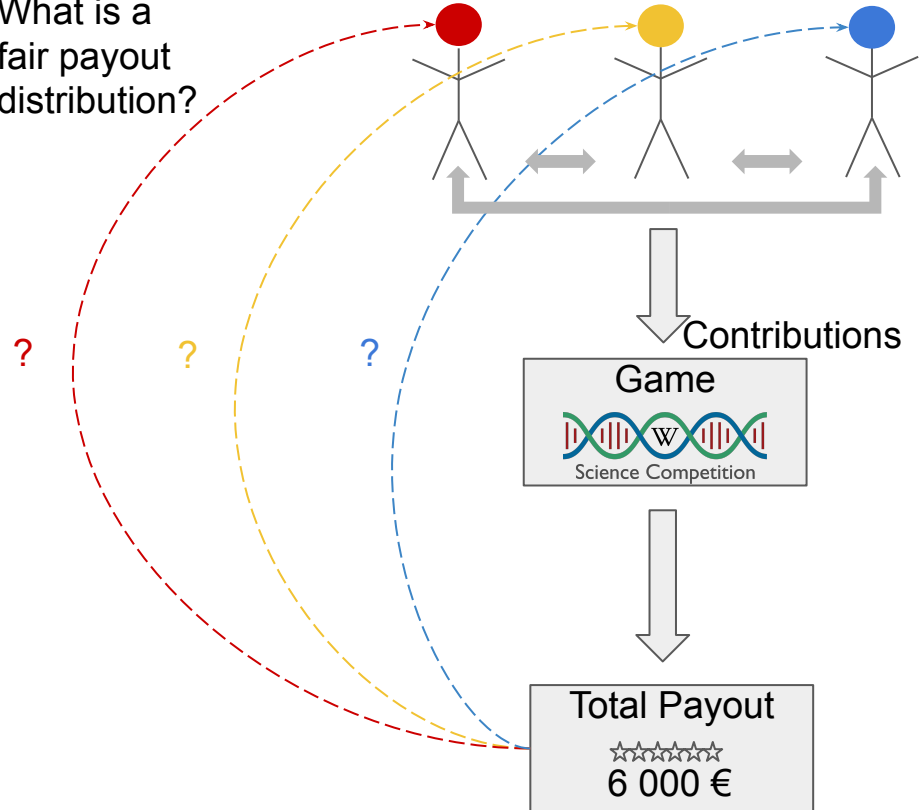


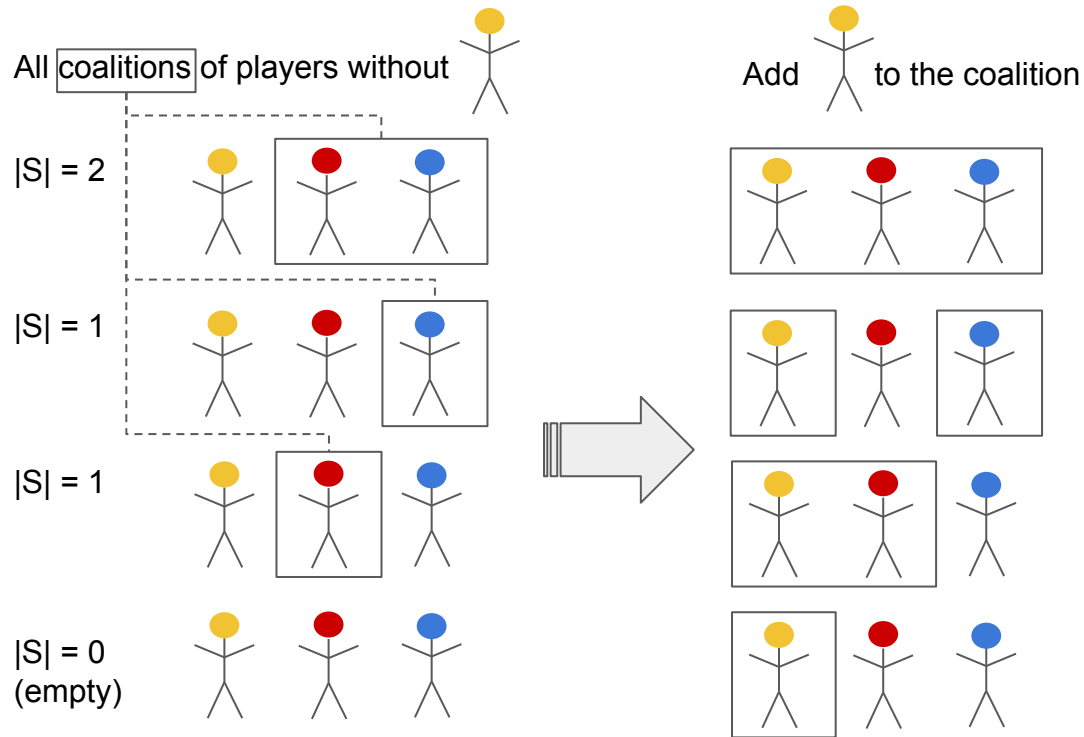
Players interact  
(payouts ☆ do not add up)




What is a  
fair payout  
distribution?

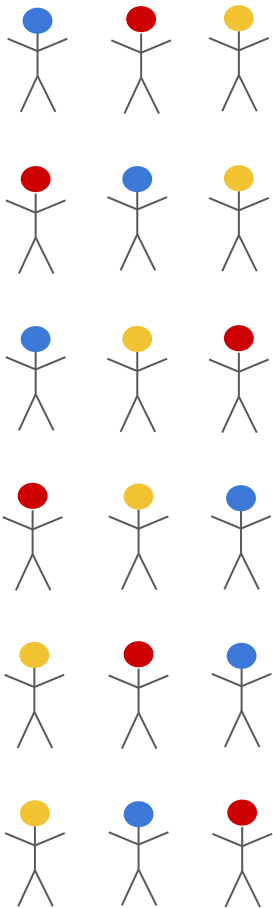
Players interact



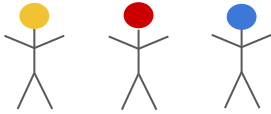
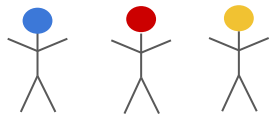


- Compute total payout of each coalition
- Compute difference in total payout for each coalition with and without player 
- Sum up weighted differences in total payout

$|P|! = 6 \text{ orders}$



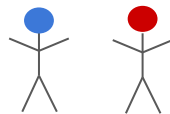
$|P| = 6$  orders



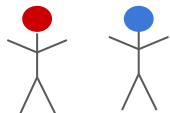
via orders

(predecessor sets = players before "yellow")

$|S| = 2$   
weight =  $1/6$



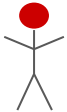
$|S| = 2$   
weight =  $1/6$



$|S| = 1$   
weight =  $1/6$



$|S| = 1$   
weight =  $1/6$



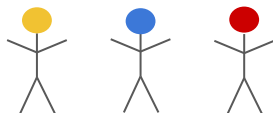
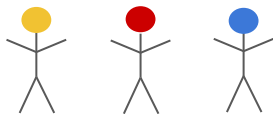
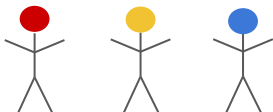
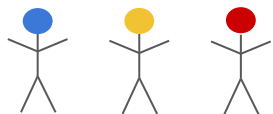
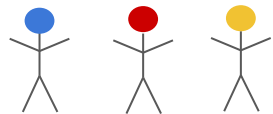
$|S| = 0$   
weight =  $1/6$



$|S| = 0$   
weight =  $1/6$



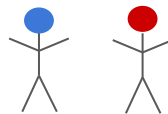
$|P| = 6$  orders



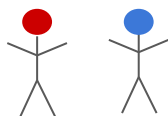
via orders

(predecessor sets = players before "yellow")

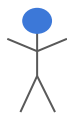
$|S| = 2$   
weight =  $1/6$



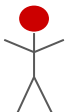
$|S| = 2$   
weight =  $1/6$



$|S| = 1$   
weight =  $1/6$



$|S| = 1$   
weight =  $1/6$



$|S| = 0$   
weight =  $1/6$

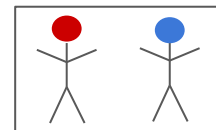


$|S| = 0$   
weight =  $1/6$



via sets

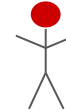
$|S| = 2$   
weight =  $2/6$



$|S| = 1$   
weight =  $1/6$

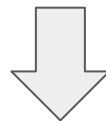
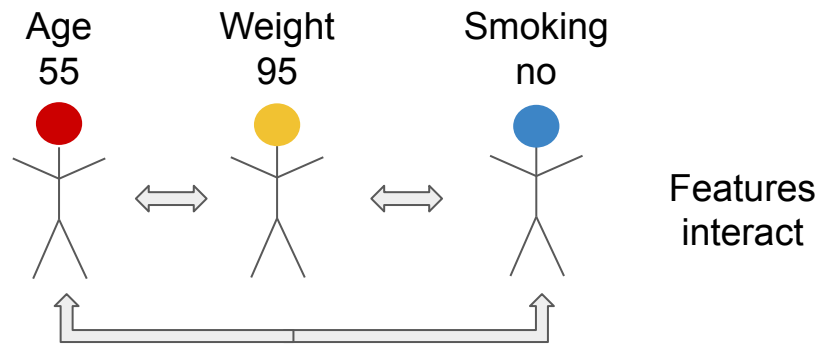


$|S| = 1$   
weight =  $1/6$



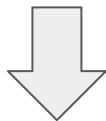
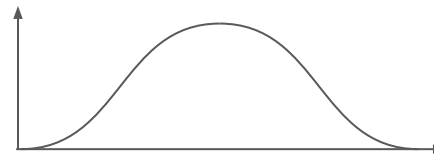
$|S| = 0$   
weight =  $2/6$





Contributions

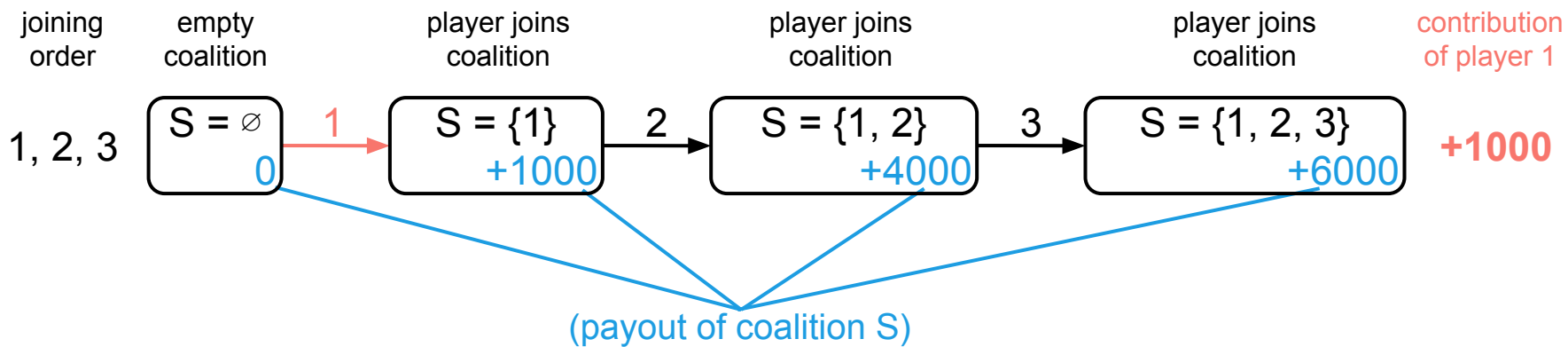
Predictive  
model



Predicted target, e.g.,  
disease risk

10%





joining order	empty coalition	player joins coalition	player joins coalition	player joins coalition	contribution of player 1
1, 2, 3	$S = \emptyset$ 0	$S = \{1\}$ +1000	$S = \{1, 2\}$ +4000	$S = \{1, 2, 3\}$ +6000	+1000
1, 3, 2	$S = \emptyset$ 0	$S = \{1\}$ +1000	$S = \{1, 3\}$ +4000	$S = \{1, 2, 3\}$ +6000	+1000
2, 1, 3	$S = \emptyset$ 0	$S = \{2\}$ +2000	$S = \{1, 2\}$ +4000	$S = \{1, 2, 3\}$ +6000	+2000
2, 3, 1	$S = \emptyset$ 0	$S = \{2\}$ +2000	$S = \{2, 3\}$ +3000	$S = \{1, 2, 3\}$ +6000	+3000
3, 1, 2	$S = \emptyset$ 0	$S = \{3\}$ +3000	$S = \{1, 3\}$ +4000	$S = \{1, 2, 3\}$ +6000	+1000
3, 2, 1	$S = \emptyset$ 0	$S = \{3\}$ +3000	$S = \{2, 3\}$ +3000	$S = \{1, 2, 3\}$ +6000	+3000

Shapley value of player 1  : +1833.33

joining order	empty coalition	player joins coalition	player joins coalition	player joins coalition	contribution of player 2
1, 2, 3	$S = \emptyset$ 0	1 → $S = \{1\}$ +1000	2 → $S = \{1, 2\}$ +4000	3 → $S = \{1, 2, 3\}$ +6000	+3000
1, 3, 2	$S = \emptyset$ 0	1 → $S = \{1\}$ +1000	3 → $S = \{1, 3\}$ +4000	2 → $S = \{1, 2, 3\}$ +6000	+2000
2, 1, 3	$S = \emptyset$ 0	2 → $S = \{2\}$ +2000	1 → $S = \{1, 2\}$ +4000	3 → $S = \{1, 2, 3\}$ +6000	+2000
2, 3, 1	$S = \emptyset$ 0	2 → $S = \{2\}$ +2000	3 → $S = \{2, 3\}$ +3000	1 → $S = \{1, 2, 3\}$ +6000	+2000
3, 1, 2	$S = \emptyset$ 0	3 → $S = \{3\}$ +3000	1 → $S = \{1, 3\}$ +4000	2 → $S = \{1, 2, 3\}$ +6000	+2000
3, 2, 1	$S = \emptyset$ 0	3 → $S = \{3\}$ +3000	2 → $S = \{2, 3\}$ +3000	1 → $S = \{1, 2, 3\}$ +6000	+0

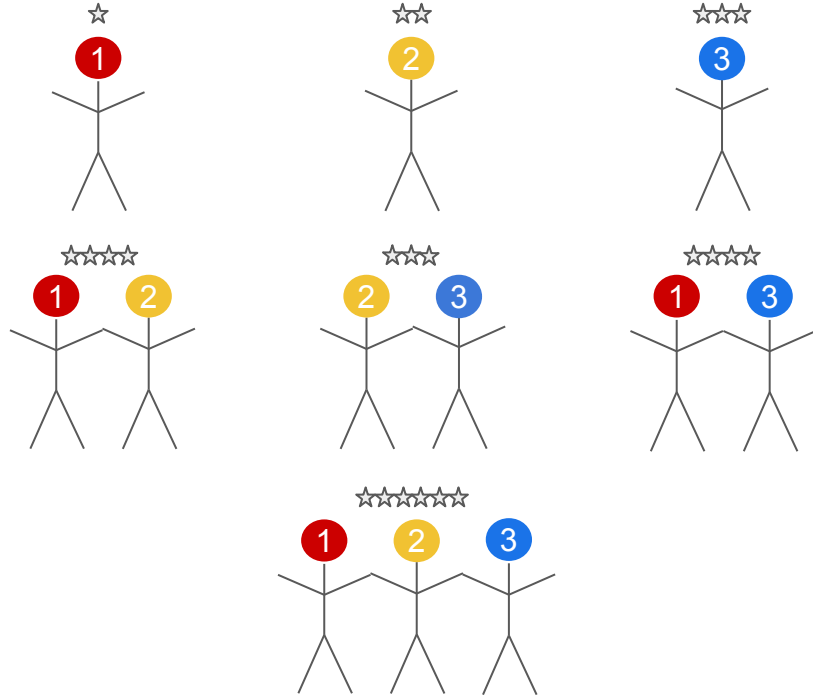
Shapley value of player 2  : +1833.33

joining order	empty coalition	player joins coalition	player joins coalition	player joins coalition	contribution of player 3
1, 2, 3	$S = \emptyset$ 0	1 → $S = \{1\}$ +1000	2 → $S = \{1, 2\}$ +4000	3 → $S = \{1, 2, 3\}$ +6000	+2000
1, 3, 2	$S = \emptyset$ 0	1 → $S = \{1\}$ +1000	3 → $S = \{1, 3\}$ +4000	2 → $S = \{1, 2, 3\}$ +6000	+3000
2, 1, 3	$S = \emptyset$ 0	2 → $S = \{2\}$ +2000	1 → $S = \{1, 2\}$ +4000	3 → $S = \{1, 2, 3\}$ +6000	+2000
2, 3, 1	$S = \emptyset$ 0	2 → $S = \{2\}$ +2000	3 → $S = \{2, 3\}$ +3000	1 → $S = \{1, 2, 3\}$ +6000	+1000
3, 1, 2	$S = \emptyset$ 0	3 → $S = \{3\}$ +3000	1 → $S = \{1, 3\}$ +4000	2 → $S = \{1, 2, 3\}$ +6000	+3000
3, 2, 1	$S = \emptyset$ 0	3 → $S = \{3\}$ +3000	2 → $S = \{2, 3\}$ +3000	1 → $S = \{1, 2, 3\}$ +6000	+3000

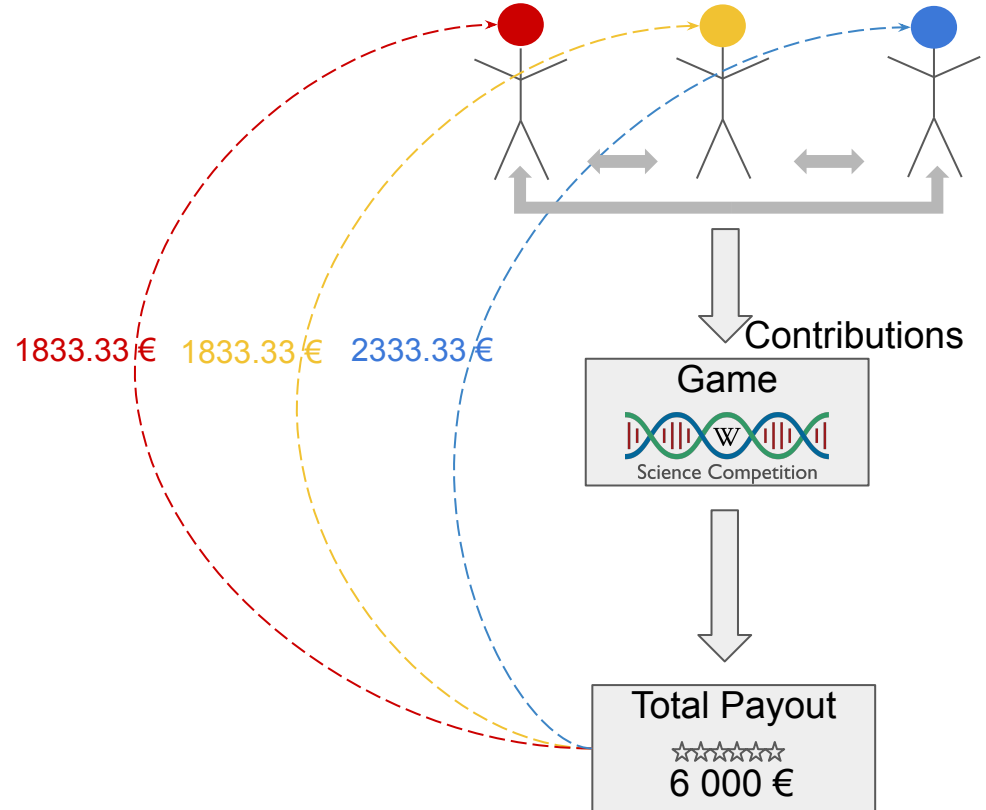
Shapley value of player 3  : +2333.33

## Players interact

(payouts ☆ do not add up)



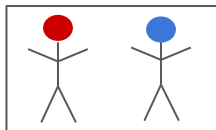
## Players interact



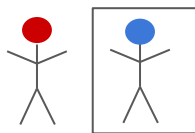


## via sets

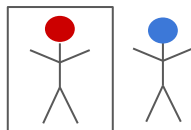
$|S| = 2$   
weight =  $2/6$



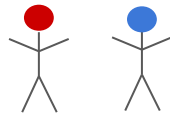
$|S| = 1$   
weight =  $1/6$



$|S| = 1$   
weight =  $1/6$

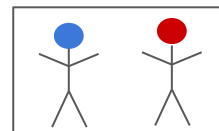


$|S| = 0$   
weight =  $2/6$

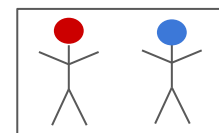


## via orders

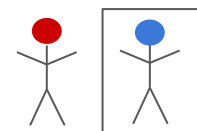
$|S| = 2$   
weight =  $1/6$



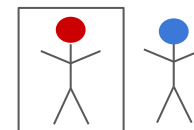
$|S| = 2$   
weight =  $1/6$



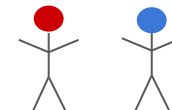
$|S| = 1$   
weight =  $1/6$



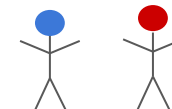
$|S| = 1$   
weight =  $1/6$



$|S| = 0$   
weight =  $1/6$

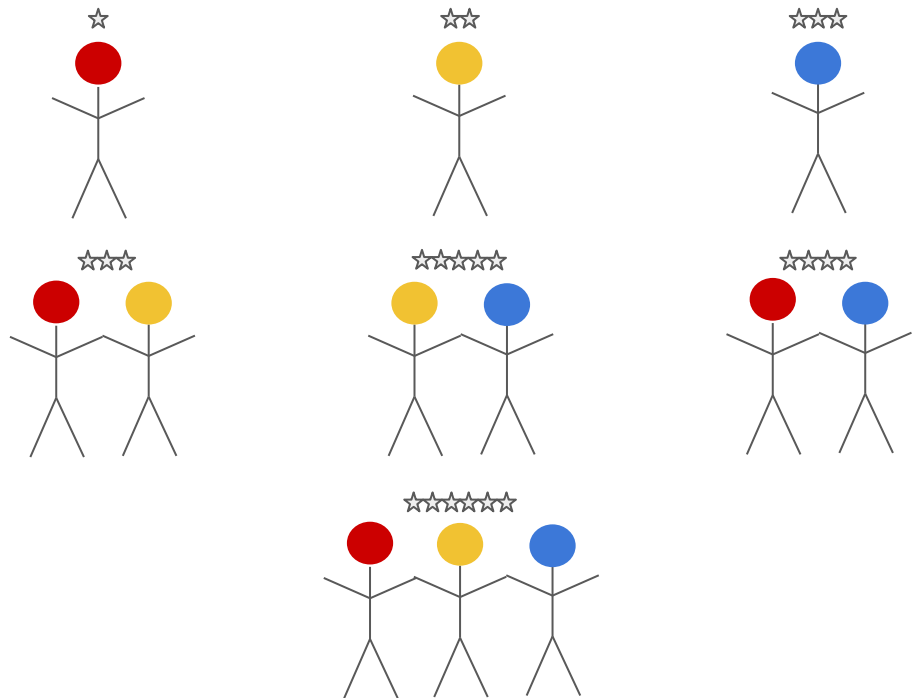


$|S| = 0$   
weight =  $1/6$

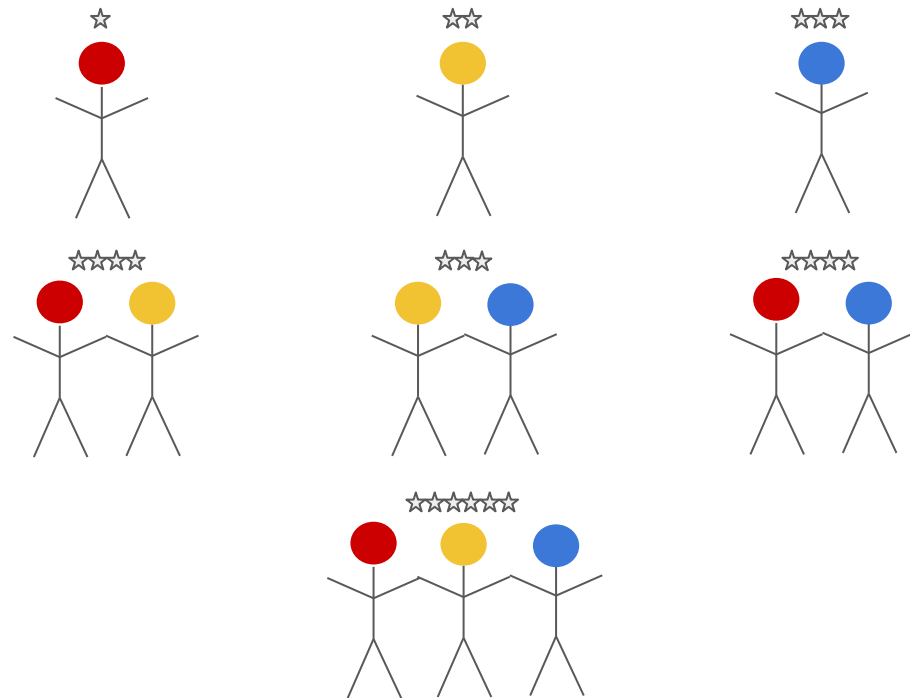


## Players do not interact

(payouts ☆ add up in each coalition)



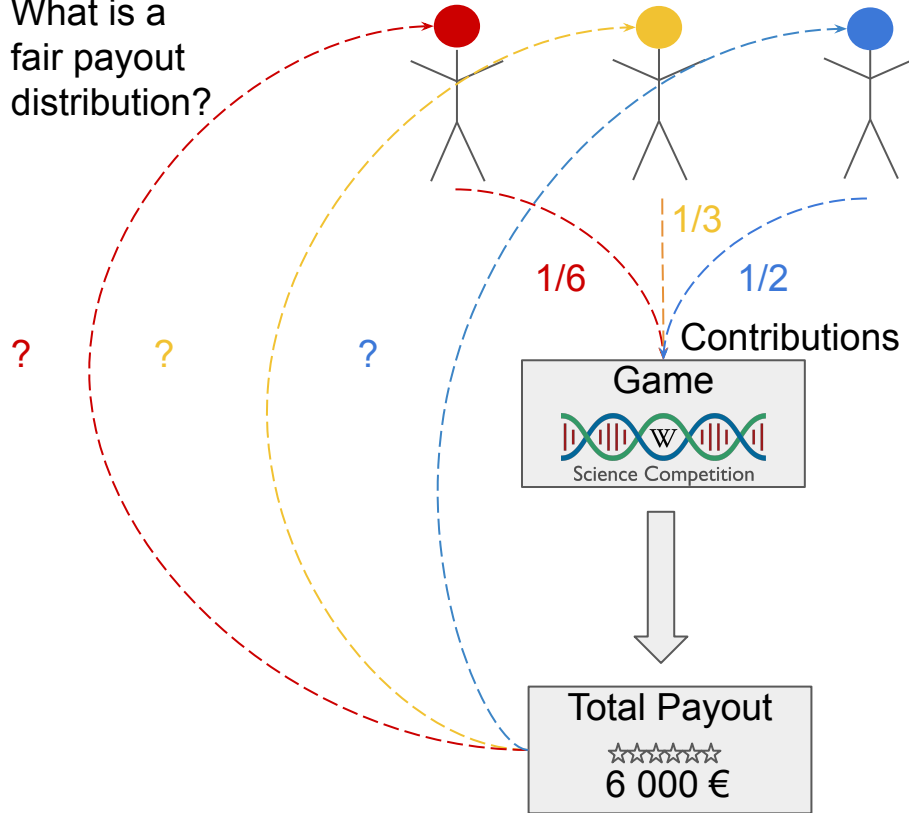
## Players interact



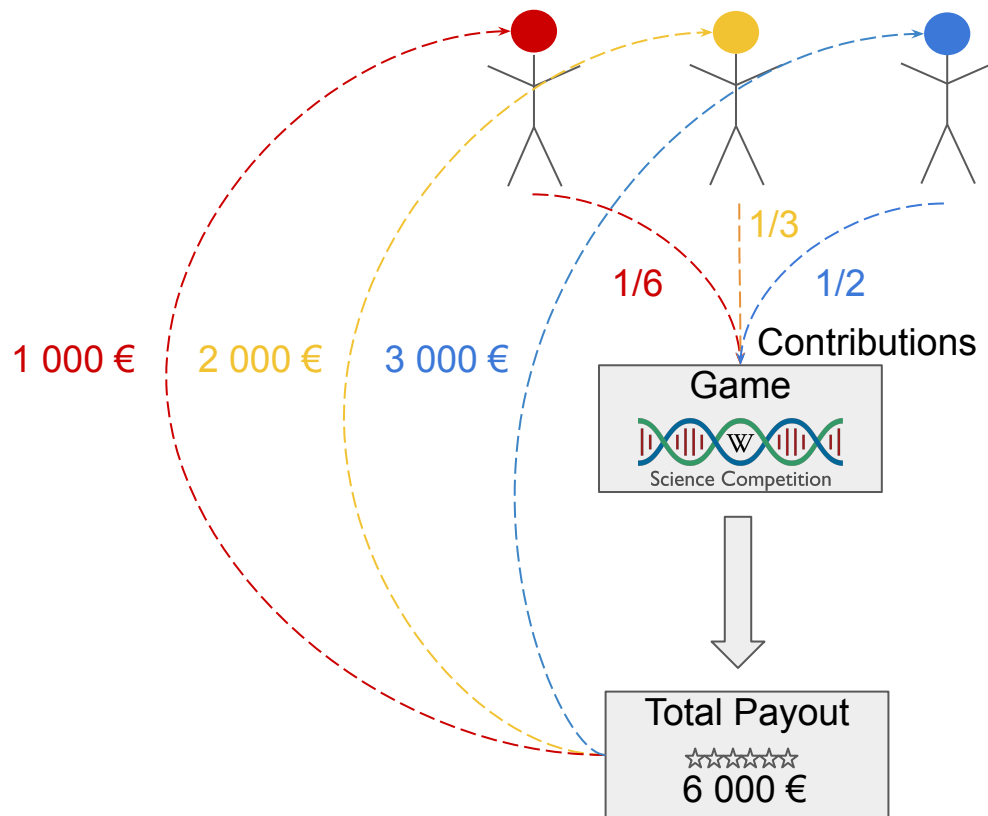


Players do not interact

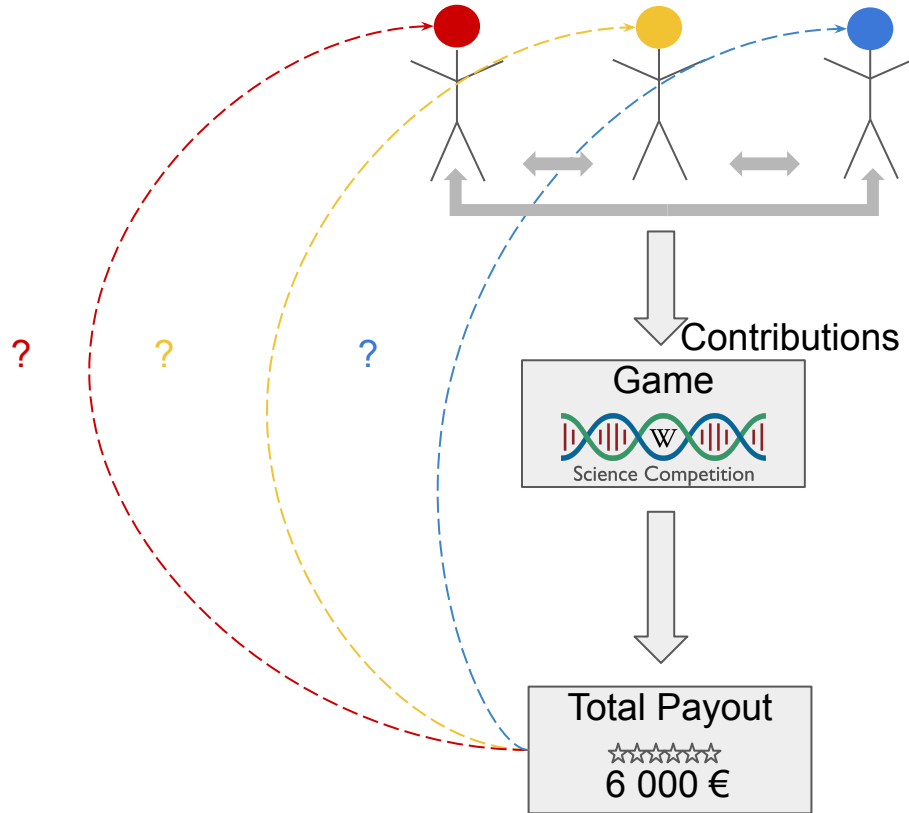
What is a  
fair payout  
distribution?



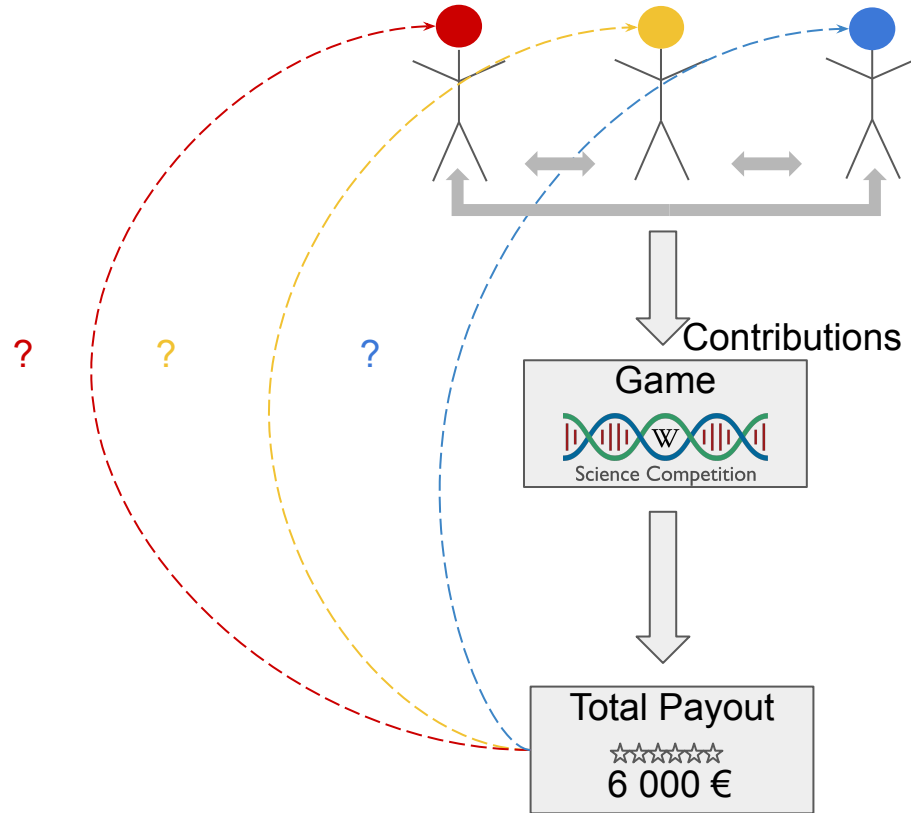
Players do not interact



Players interact



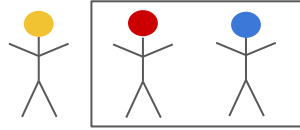
Players interact



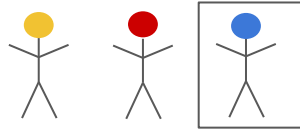
All coalitions of players without



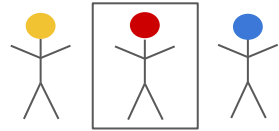
$|S| = 2$   
weight =  $2/6$



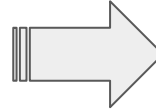
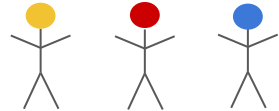
$|S| = 1$   
weight =  $1/6$



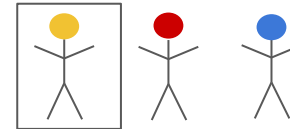
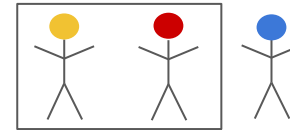
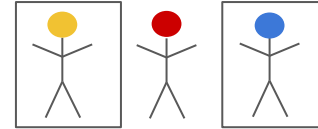
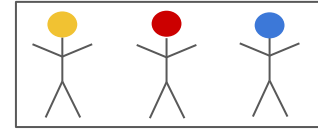
$|S| = 1$   
weight =  $1/6$




$|S| = 0$   
weight =  $2/6$   
(empty coalition)



Add to the coalition



- Compute total payout of each coalition
- Compute difference in total payout for each coalition with and without player 
- Sum up weighted differences in total payout