Q1: Legal Player
Hunter

Protocol: manager
Channel:
tester_team_rocket

Game: hunter
Startclock: 10
Playclock: 10

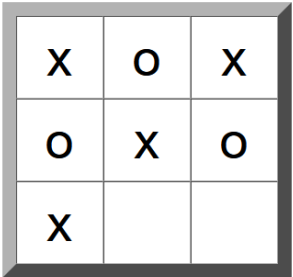|		p	p
p	p		
		p	p
	p	p	K
		p	p

Roles	robot
Players	legal_rocket
Score	11
Errors	0

Clear   Begin   Pause   Resume   End

```
message(1650148905,legal_rocket,tester_team_rocket,reply(2,move(1,1,2,3)))
message(1650148906,tester_team_rocket,legal_rocket,play(3,move(1,1,2,3)))
message(1650148907,legal_rocket,tester_team_rocket,reply(3,move(2,3,3,1)))
message(1650148909,tester_team_rocket,legal_rocket,play(4,move(2,3,3,1)))
message(1650148909,legal_rocket,tester_team_rocket,reply(4,move(3,1,4,3)))
message(1650148911,tester_team_rocket,legal_rocket,play(5,move(3,1,4,3)))
message(1650148911,legal_rocket,tester_team_rocket,reply(5,move(4,3,5,1)))
message(1650148913,tester_team_rocket,legal_rocket,play(6,move(4,3,5,1)))
message(1650148913,legal_rocket,tester_team_rocket,reply(6,move(5,1,4,3)))
message(1650148915,tester_team_rocket,legal_rocket,play(7,move(5,1,4,3)))
message(1650148915,legal_rocket,tester_team_rocket,reply(7,move(4,3,5,1)))
message(1650148917,tester_team_rocket,legal_rocket,play(8,move(4,3,5,1)))
message(1650148917,legal_rocket,tester_team_rocket,reply(8,move(5,1,4,3)))
message(1650148919,tester_team_rocket,legal_rocket,play(9,move(5,1,4,3)))
message(1650148919,legal_rocket,tester_team_rocket,reply(9,move(4,3,5,1)))
message(1650148921,tester_team_rocket,legal_rocket,play(10,move(4,3,5,1)))
```

Tic Tac Toe as O

Protocol: manager	Game: tictactoe	
Channel: tester_team_rocket	Startclock: 10	
	Playclock: 10	

X	O	X
O	X	O
X		

Game over

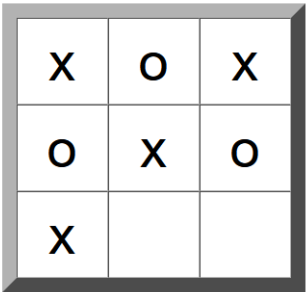| Roles	x	o
Players	legal	rocket_legal
Score	100	0
Errors	0	0

Clear Begin Pause Resume End

```
start(x)
ready
message(1650149719,tester_team_rocket,rocket_legal,start(1,o,ruleset(role(x),rol
e(o),base(cell(M,N,x)) :- index(M) & index(N),base(cell(M,N,o)) :- index(M) &
index(N),base(cell(M,N,b)) :- index(M) & index(N),base(control(R)) :-
role(R),action(mark(M,N)) :- index(M) &
index(N),index(1),index(2),index(3),init(cell(M,N,b)) :- index(M) &
index(N),init(control(x)),legal(mark(M,N)) :- cell(M,N,b),mark(M,N) ::
control(R) ==> cell(M,N,R) & ~cell(M,N,b),mark(M,N) :: control(x) ==>
~control(x) & control(o),mark(M,N) :: control(o) ==> ~control(o) &
control(x),goal(x,100) :- line(x) & ~line(o),goal(x,50) :- line(x) &
line(o),goal(x,50) :- ~line(x) & ~line(o),goal(x,0) :- ~line(x) &
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
```

Tic Tac Toe as X:

Protocol: manager
Channel:
tester_team_rocket

Game: tictactoe
Startclock: 10
Playclock: 10

X	O	X
O	X	O
X		

Game over

| Roles	x	o
Players	legal_rocket	legal
Score	100	0
Errors	0	0

Clear Begin Pause Resume End

```
message(1650149194,tester_team_rocket,legal_rocket,start(1,x,ruleset(role(x),rol
e(o),base(cell(M,N,x)) :- index(M) & index(N),base(cell(M,N,o)) :- index(M) &
index(N),base(cell(M,N,b)) :- index(M) & index(N),base(control(R)) :-
role(R),action(mark(M,N)) :- index(M) &
index(N),index(1),index(2),index(3),init(cell(M,N,b)) :- index(M) &
index(N),init(control(x)),legal(mark(M,N)) :- cell(M,N,b),mark(M,N) ::
control(R) ==> cell(M,N,R) & ~cell(M,N,b),mark(M,N) :: control(x) ==>
~control(x) & control(o),mark(M,N) :: control(o) ==> ~control(o) &
control(x),goal(x,100) :- line(x) & ~line(o),goal(x,50) :- line(x) &
line(o),goal(x,50) :- ~line(x) & ~line(o),goal(x,0) :- ~line(x) &
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
```

Q2: Random Player
Hunter

		p
	p	K
	p	
p		p
p		p
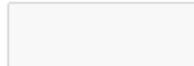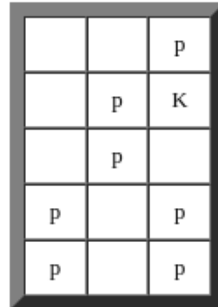
Roles	robot
Players	team_rocket_random_1
Score	29
Errors	0

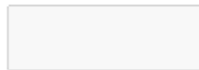Clear   Begin   Pause   Resume   End

```
add1row(M1,M2) & add2col(N1,N2),knightmove(M1,N1,M2,N2) :- add1row(M1,M2) &
add2col(N2,N1),knightmove(M1,N1,M2,N2) :- add1row(M2,M1) &
add2col(N1,N2),knightmove(M1,N1,M2,N2) :- add1row(M2,M1) &
add2col(N2,N1),knightmove(M1,N1,M2,N2) :- add2row(M1,M2) &
add1col(N1,N2),knightmove(M1,N1,M2,N2) :- add2row(M1,M2) &
add1col(N2,N1),knightmove(M1,N1,M2,N2) :- add2row(M2,M1) &
add1col(N1,N2),knightmove(M1,N1,M2,N2) :- add2row(M2,M1) &
add1col(N2,N1),succ(0,1),succ(1,2),succ(2,3),succ(3,4),succ(4,5),succ(5,6),succ(
6,7),succ(7,8),succ(8,9),succ(9,10),succ(10,11),succ(11,12),succ(12,13),succ(13,
14),succ(14,15),succ(15,16),add1row(1,2),add1row(2,3),add1row(3,4),add1row(4,5),
add2row(1,3),add2row(2,4),add2row(3,5),add1col(1,2),add1col(2,3),add2col(1,3),sc
oremap(0,0),scoremap(1,1),scoremap(2,3),scoremap(3,7),scoremap(4,11),scoremap(5,
16),scoremap(6,22),scoremap(7,29),scoremap(8,37),scoremap(9,45),scoremap(10,54),
scoremap(11,64),scoremap(12,75),scoremap(13,87),scoremap(14,100)),10,10))
message(1650149730,rocket_legal,tester_team_rocket,reply(8,mark(3,1)))
message(1650432655,team_rocket_random_1,tester_team_rocket,reply(1,ready))
message(1650432657,tester_team_rocket,team_rocket_random_1,play(2,[]))
message(1650432657,team_rocket_random_1,tester_team_rocket,reply(2,move(1,1,2,3)
))
message(1650432659,tester_team_rocket,team_rocket_random_1,play(3,move(1,1,2,3))
)
message(1650432660,team_rocket_random_1,tester_team_rocket,reply(3,move(2,3,4,2)
))
message(1650432662,tester_team_rocket,team_rocket_random_1,play(4,move(2,3,4,2))
)
message(1650432663,team_rocket_random_1,tester_team_rocket,reply(4,move(4,2,2,1)
))
message(1650432665,tester_team_rocket,team_rocket_random_1,play(5,move(4,2,2,1))
)
message(1650432665,team_rocket_random_1,tester_team_rocket,reply(5,move(2,1,3,3)
```

Tic Tac Toe as X:
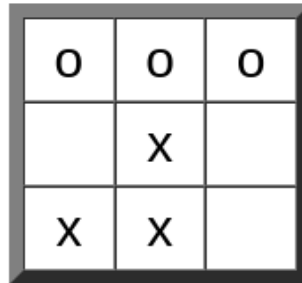
Game over

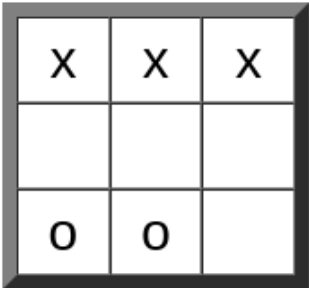| Roles	x	o
Players	team_rocket_random_1	legal
Score	0	100
Errors	0	0

Clear Begin Pause Resume End

```
message(1650432755,tester_team_rocket,team_rocket_random_1,start(1,x,ruleset(rol
e(x),role(o),base(cell(M,N,x)) :- index(M) & index(N),base(cell(M,N,o)) :-
index(M) & index(N),base(cell(M,N,b)) :- index(M) & index(N),base(control(R)) :-
role(R),action(mark(M,N)) :- index(M) &
index(N),index(1),index(2),index(3),init(cell(M,N,b)) :- index(M) &
index(N),init(control(x)),legal(mark(M,N)) :- cell(M,N,b),mark(M,N) ::
control(R) ==> cell(M,N,R) & ~cell(M,N,b),mark(M,N) :: control(x) ==>
~control(x) & control(o),mark(M,N) :: control(o) ==> ~control(o) &
control(x),goal(x,100) :- line(x) & ~line(o),goal(x,50) :- line(x) &
line(o),goal(x,50) :- ~line(x) & ~line(o),goal(x,0) :- ~line(x) &
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,10))
start(o)
ready
message(1650432755,team_rocket_random_1,tester_team_rocket,reply(1,ready))
message(1650432757,tester_team_rocket,team_rocket_random_1,play(2,[]))
update([])
message(1650432757,team_rocket_random_1,tester_team_rocket,reply(2,mark(3,1)))
message(1650432759,tester_team_rocket,team_rocket_random_1,play(3,mark(3,1)))
update(mark(3,1))
submit(mark(1,1))
message(1650432760,tester_team_rocket,team_rocket_random_1,play(4,mark(1,1)))
update(mark(1,1))
message(1650432759,team_rocket_random_1,tester_team_rocket,reply(3,mark(2,1)))
message(1650432761,team_rocket_random_1,tester_team_rocket,reply(4,mark(2,2)))
```
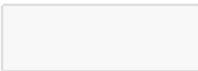
Tic Tac Toe as O:

Protocol: manager   Game: tictactoe
Identifier: tester_team_rocket   Startclock: 10
    Playclock: 10

X	X	X
O	O	

Game over

Roles	x	o
Players	legal	team_rocket_random_1
Score	100	0
Errors	0	0

Clear   Begin   Pause   Resume   End

```
line(o),goal(x,50) :- ~line(x) & ~line(o),goal(x,0) :- ~line(x) &
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,10))
message(1650432767,team_rocket_random_1,tester_team_rocket,reply(7,mark(2,3)))
message(1650432862,team_rocket_random_1,tester_team_rocket,reply(1,ready))
update([])
message(1650432864,tester_team_rocket,team_rocket_random_1,play(2,[]))
submit(mark(1,1))
update(mark(1,1))
message(1650432865,tester_team_rocket,team_rocket_random_1,play(3,mark(1,1)))
message(1650432864,team_rocket_random_1,tester_team_rocket,reply(2,mark(2,1)))
message(1650432866,team_rocket_random_1,tester_team_rocket,reply(3,mark(3,2)))
update(mark(3,2))
message(1650432868,tester_team_rocket,team_rocket_random_1,play(4,mark(3,2)))
submit(mark(1,2))
update(mark(1,2))
message(1650432869,tester_team_rocket,team_rocket_random_1,play(5,mark(1,2)))
message(1650432868,team_rocket_random_1,tester_team_rocket,reply(4,mark(2,3)))
message(1650432870,team_rocket_random_1,tester_team_rocket,reply(5,mark(3,1)))
update(mark(3,1))
message(1650432872,tester_team_rocket,team_rocket_random_1,play(6,mark(3,1)))
submit(mark(1,3))
stop(x)
message(1650432872,tester_team_rocket,team_rocket_random_1,stop(x))
```

Q3: Minimax One player
Buttons and Lights

Protocol: manager   Game: buttonsandlights
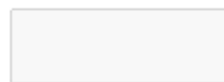Identifier: tester_team_rocket Startclock: 10
             Playclock: 10

Step: 7

Game over

Roles	robot
Players	team_rocket_minimax
Score	100
Errors	0

Clear Begin Pause Resume End

```
message(1650434823,tester_team_rocket,team_rocket_minimax,start(1,robot,ruleset(ro
le(robot),base(p),base(q),base(r),base(step(1)),base(step(2)),base(step(3)),base(s
tep(4)),base(step(5)),base(step(6)),base(step(7)),action(a),action(b),action(c),in
it(step(1)),init(control(robot)),legal(a),legal(b),legal(c),a :: ~p ==> p,a :: p
==> ~p,a :: step(M) & successor(M,N) ==> ~step(M) & step(N),b :: q ==> p,b :: ~q
==> ~p,b :: p ==> q,b :: ~p ==> ~q,b :: step(M) & successor(M,N) ==> ~step(M) &
step(N),c :: q ==> r,c :: ~q ==> ~r,c :: r ==> q,c :: ~r ==> ~q,c :: step(M) &
successor(M,N) ==> ~step(M) & step(N),goal(robot,100) :- p & q & r,goal(robot,50)
:- p & q & ~r,goal(robot,50) :- p & ~q & r,goal(robot,50) :- ~p & q &
r,goal(robot,25) :- p & ~q & ~r,goal(robot,25) :- ~p & q & ~r,goal(robot,25) :- p
& ~q & ~r,goal(robot,0) :- ~p & ~q & ~r,terminal :- p & q & r,terminal :-
step(7),successor(1,2),successor(2,3),successor(3,4),successor(4,5),successor(5,6)
,successor(6,7)),10,10))
message(1650434823,team_rocket_minimax,tester_team_rocket,reply(1,ready))
message(1650434825,tester_team_rocket,team_rocket_minimax,play(2,[]))
message(1650434825,team_rocket_minimax,tester_team_rocket,reply(2,a))
message(1650434827,tester_team_rocket,team_rocket_minimax,play(3,a))
message(1650434827,team_rocket_minimax,tester_team_rocket,reply(3,b))
message(1650434830,tester_team_rocket,team_rocket_minimax,play(4,b))
message(1650434831,team_rocket_minimax,tester_team_rocket,reply(4,a))
message(1650434835,tester_team_rocket,team_rocket_minimax,play(5,a))
message(1650434835,team_rocket_minimax,tester_team_rocket,reply(5,c))
message(1650434839,tester_team_rocket,team_rocket_minimax,play(6,c))
message(1650434840,team_rocket_minimax,tester_team_rocket,reply(6,b))
message(1650434842,tester_team_rocket,team_rocket_minimax,play(7,b))
message(1650434844,team_rocket_minimax,tester_team_rocket,reply(7,a))
message(1650434846,tester_team_rocket,team_rocket_minimax,stop(8,a))
```

Three Puzzle:

Roles	robot
Players	team_rocket_minimax
Score	100
Errors	0

Clear   Begin   Pause   Resume   End
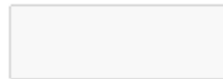
```
board(X,b,Y,Z),legal(left) :- board(X,Y,Z,b),legal(right) :-
board(b,X,Y,Z),legal(right) :- board(X,Y,b,Z),up :: board(X,Y,b,Z) ==>
~board(X,Y,b,Z) & board(b,Y,X,Z),up :: board(X,Y,Z,b) ==> ~board(X,Y,Z,b) &
board(X,b,Z,Y),down :: board(b,X,Y,Z) ==> ~board(b,X,Y,Z) & board(Y,X,b,Z),down
:: board(X,b,Y,Z) ==> ~board(X,b,Y,Z) & board(X,Z,Y,b),left :: board(X,b,Y,Z)
==> ~board(X,b,Y,Z) & board(b,X,Y,Z),left :: board(X,Y,Z,b) ==> ~board(X,Y,Z,b)
& board(X,Y,b,Z),right :: board(b,X,Y,Z) ==> ~board(b,X,Y,Z) &
board(X,b,Y,Z),right :: board(X,Y,b,Z) ==> ~board(X,Y,b,Z) & board(X,Y,Z,b),up
:: step(M) & successor(M,N) ==> ~step(M) & step(N),down :: step(M) &
successor(M,N) ==> ~step(M) & step(N),left :: step(M) & successor(M,N) ==>
~step(M) & step(N),right :: step(M) & successor(M,N) ==> ~step(M) &
step(N),goal(robot,100) :- board(1,2,3,b),goal(robot,0) :-
~board(1,2,3,b),terminal :-
step(7),successor(1,2),successor(2,3),successor(3,4),successor(4,5),successor(5,
6),successor(6,7)),10,10))
message(1650434920,team_rocket_minimax,tester_team_rocket,reply(1,ready))
message(1650434921,tester_team_rocket,team_rocket_minimax,play(2,[]))
message(1650434922,team_rocket_minimax,tester_team_rocket,reply(2,right))
message(1650434924,tester_team_rocket,team_rocket_minimax,play(3,right))
message(1650434926,team_rocket_minimax,tester_team_rocket,reply(3,down))
message(1650434927,tester_team_rocket,team_rocket_minimax,play(4,down))
message(1650434928,team_rocket_minimax,tester_team_rocket,reply(4,left))
message(1650434929,tester_team_rocket,team_rocket_minimax,play(5,left))
message(1650434930,team_rocket_minimax,tester_team_rocket,reply(5,up))
message(1650434931,tester_team_rocket,team_rocket_minimax,play(6,up))
message(1650434932,team_rocket_minimax,tester_team_rocket,reply(6,right))
message(1650434933,tester_team_rocket,team_rocket_minimax,play(7,right))
message(1650434934,team_rocket_minimax,tester_team_rocket,reply(7,down))
message(1650434934,tester_team_rocket,team_rocket_minimax,stop(8,down))
```

Sukoshi:

3	1	2
2	3	1
1	2	3

Roles	robot
Players	team_rocket_minimax
Score	100
Errors	0

Clear   Begin   Pause   Resume   End
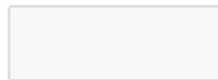
```
message(1650434970,tester_team_rocket,team_rocket_minimax,start(1,robot,ruleset(ro
le(robot),base(cell(M,N,X)) :- index(M) & index(N) & filler(X),action(mark(M,N,X))
:- index(M) & index(N) & index(X),filler(X) :-
index(X),filler(b),index(1),index(2),index(3),init(cell(1,1,b)),init(cell(1,2,1)),
init(cell(1,3,b)),init(cell(2,1,2)),init(cell(2,2,b)),init(cell(2,3,b)),init(cell(
3,1,b)),init(cell(3,2,b)),init(cell(3,3,b)),init(control(robot)),legal(mark(M,N,X)
) :- cell(M,N,b) & index(X) & ~row(M,X) & ~col(N,X),row(M,X) :-
cell(M,1,X),row(M,X) :- cell(M,2,X),row(M,X) :- cell(M,3,X),col(N,X) :-
cell(1,N,X),col(N,X) :- cell(2,N,X),col(N,X) :- cell(3,N,X),mark(M,N,X) ::
~cell(M,N,b) & cell(M,N,X),goal(robot,100) :- ~open,open :- cell(M,N,b),terminal
:- ~playable,playable :- legal(mark(M,N,X))),10,10))
message(1650434972,team_rocket_minimax,tester_team_rocket,reply(1,ready))
message(1650434973,tester_team_rocket,team_rocket_minimax,play(2,[]))
message(1650434974,team_rocket_minimax,tester_team_rocket,reply(2,mark(1,3,2)))
message(1650434975,tester_team_rocket,team_rocket_minimax,play(3,mark(1,3,2)))
message(1650434974,legal_team_rocket,tester_team_rocket,reply(1,ready))
message(1650434976,team_rocket_minimax,tester_team_rocket,reply(3,mark(3,3,3)))
message(1650434977,tester_team_rocket,team_rocket_minimax,play(4,mark(3,3,3)))
message(1650434978,team_rocket_minimax,tester_team_rocket,reply(4,mark(1,1,3)))
message(1650434979,tester_team_rocket,team_rocket_minimax,play(5,mark(1,1,3)))
message(1650434980,team_rocket_minimax,tester_team_rocket,reply(5,mark(3,1,1)))
message(1650434981,tester_team_rocket,team_rocket_minimax,play(6,mark(3,1,1)))
message(1650434982,team_rocket_minimax,tester_team_rocket,reply(6,mark(2,2,3)))
message(1650434983,tester_team_rocket,team_rocket_minimax,play(7,mark(2,2,3)))
message(1650434984,team_rocket_minimax,tester_team_rocket,reply(7,mark(3,2,2)))
message(1650434985,tester_team_rocket,team_rocket_minimax,play(8,mark(3,2,2)))
message(1650434986,team_rocket_minimax,tester_team_rocket,reply(8,mark(2,3,1)))
message(1650434986,tester_team_rocket,team_rocket_minimax,stop(9,mark(2,3,1)))
```
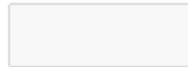
Q4: Minimax for Multiplayer game:
Tic Tac Toe 5:

Protocol: manager	Game: tictactoe5
Identifier: tester_team_rocket	Startclock: 10
	Playclock: 20

X	X	O
O	O	X
X	O	X

Game over

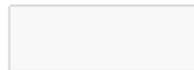| Roles	x	o
Players	team_rocket_minimax	onestep
Score	50	50
Errors	0	0

Clear Begin Pause Resume End

```
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,20))
start(o)
ready
message(1650435040,team_rocket_minimax,tester_team_rocket,reply(1,ready))
message(1650435041,tester_team_rocket,team_rocket_minimax,play(2,[]))
update([])
message(1650435042,team_rocket_minimax,tester_team_rocket,reply(2,mark(1,2)))
message(1650435043,tester_team_rocket,team_rocket_minimax,play(3,mark(1,2)))
update(mark(1,2))
submit(mark(1,3))
message(1650435044,tester_team_rocket,team_rocket_minimax,play(4,mark(1,3)))
update(mark(1,3))
message(1650435043,team_rocket_minimax,tester_team_rocket,reply(3,mark(2,1)))
message(1650435046,team_rocket_minimax,tester_team_rocket,reply(4,mark(3,1)))
message(1650435047,tester_team_rocket,team_rocket_minimax,play(5,mark(3,1)))
update(mark(3,1))
submit(mark(2,1))
message(1650435048,tester_team_rocket,team_rocket_minimax,play(6,mark(2,1)))
update(mark(2,1))
message(1650435047,team_rocket_minimax,tester_team_rocket,reply(5,mark(2,3)))
message(1650435049,team_rocket_minimax,tester_team_rocket,reply(6,mark(2,3)))
message(1650435050,tester_team_rocket,team_rocket_minimax,stop(7,mark(2,3)))
stop(o)
```

Tic Tac Toe 7:

X	X	X
O	O	

Game over

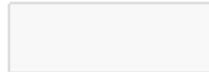| Roles	x	o
Players	team_rocket_minimax	onestep
Score	100	0
Errors	0	0

Clear | Begin | Pause | Resume | End

```
index(N),index(1),index(2),index(3),init(cell(1,1,x)),init(cell(1,2,b)),init(cel
l(1,3,b)),init(cell(2,1,b)),init(cell(2,2,o)),init(cell(2,3,b)),init(cell(3,1,b)
),init(cell(3,2,b)),init(cell(3,3,b)),init(control(x)),legal(mark(X,Y)) :-
cell(X,Y,b),mark(M,N) :: control(R) ==> cell(M,N,R) & ~cell(M,N,b),mark(M,N) ::
control(x) ==> ~control(x) & control(o),mark(M,N) :: control(o) ==> ~control(o)
& control(x),goal(x,100) :- line(x) & ~line(o),goal(x,50) :- line(x) &
line(o),goal(x,50) :- ~line(x) & ~line(o),goal(x,0) :- ~line(x) &
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,10))
start(o)
ready
message(1650435086,legal_team_rocket,tester_team_rocket,reply(6,mark(2,2)))
message(1650435098,tester_team_rocket,team_rocket_minimax,play(2,[]))
update([])
message(1650435100,team_rocket_minimax,tester_team_rocket,reply(2,mark(1,2)))
message(1650435102,tester_team_rocket,team_rocket_minimax,play(3,mark(1,2)))
update(mark(1,2))
submit(mark(2,1))
message(1650435103,tester_team_rocket,team_rocket_minimax,play(4,mark(2,1)))
update(mark(2,1))
message(1650435104,team_rocket_minimax,tester_team_rocket,reply(3,mark(3,2)))
message(1650435104,team_rocket_minimax,tester_team_rocket,reply(4,mark(1,3)))
message(1650435104,tester_team_rocket,team_rocket_minimax,stop(5,mark(1,3)))
stop(o)
```

Tic Tac Toe:

O | X |
O | X | X
O | |

Game over

Roles	x	o
Players	team_rocket_minimax	onestep
Score	0	100
Errors	2	0

Clear   Begin   Pause   Resume   End

```
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,10))
start(o)
ready
message(1650435282,team_rocket_minimax,tester_team_rocket,reply(1,ready))
message(1650435289,team_rocket_minimax,tester_team_rocket,reply(2,mark(1,2)))
message(1650435289,team_rocket_minimax,tester_team_rocket,reply(3,mark(1,2)))
message(1650435290,team_rocket_minimax,tester_team_rocket,reply(4,mark(1,1)))
message(1650435290,team_rocket_minimax,tester_team_rocket,reply(5,mark(3,1)))
message(1650435290,team_rocket_minimax,tester_team_rocket,reply(6,mark(3,1)))
message(1650435290,team_rocket_minimax,tester_team_rocket,reply(7,mark(1,1)))
message(1650435290,team_rocket_minimax,tester_team_rocket,reply(8,mark(1,2)))
message(1650435290,team_rocket_minimax,tester_team_rocket,reply(9,mark(3,3)))
message(1650435329,tester_team_rocket,team_rocket_minimax,play(2,[]))
update([])
message(1650435329,team_rocket_minimax,tester_team_rocket,reply(1,undefined()))
message(1650435329,team_rocket_minimax,tester_team_rocket,reply(1,ready))
message(1650435337,team_rocket_minimax,tester_team_rocket,reply(2,mark(1,2)))
message(1650435338,tester_team_rocket,team_rocket_minimax,play(3,mark(1,2)))
update(mark(1,2))
submit(mark(3,1))
message(1650435339,tester_team_rocket,team_rocket_minimax,play(4,mark(3,1)))
update(mark(3,1))
message(1650435350,tester_team_rocket,team_rocket_minimax,play(5,mark(2,3)))
update(mark(2,3))
submit(mark(2,1))
message(1650435351,tester_team_rocket,team_rocket_minimax,play(6,mark(2,1)))
update(mark(2,1))
message(1650435362,tester_team_rocket,team_rocket_minimax,play(7,mark(2,2)))
```
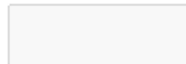
Q5: Alphabeta player:
Tic Tac Toe 5:

X	X	X
X	O	O
O	O	X

Game over

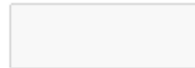| Roles	x	o
Players	team_rocket_alphabeta	onestep
Score	100	0
Errors	0	0

Clear   Begin   Pause   Resume   End

```
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,20))
start(o)
ready
message(1650444524,team_rocket_alphabeta,tester_team_rocket,reply(1,ready))
message(1650444526,tester_team_rocket,team_rocket_alphabeta,play(2,[]))
update([])
message(1650444526,team_rocket_alphabeta,tester_team_rocket,reply(2,mark(1,2)))
message(1650444528,tester_team_rocket,team_rocket_alphabeta,play(3,mark(1,2)))
update(mark(1,2))
submit(mark(2,3))
message(1650444529,tester_team_rocket,team_rocket_alphabeta,play(4,mark(2,3)))
update(mark(2,3))
message(1650444528,team_rocket_alphabeta,tester_team_rocket,reply(3,mark(3,1)))
message(1650444531,team_rocket_alphabeta,tester_team_rocket,reply(4,mark(2,1)))
message(1650444532,tester_team_rocket,team_rocket_alphabeta,play(5,mark(2,1)))
update(mark(2,1))
submit(mark(3,1))
message(1650444533,tester_team_rocket,team_rocket_alphabeta,play(6,mark(3,1)))
update(mark(3,1))
message(1650444533,team_rocket_alphabeta,tester_team_rocket,reply(5,mark(1,3)))
message(1650444535,team_rocket_alphabeta,tester_team_rocket,reply(6,mark(1,3)))
message(1650444535,tester_team_rocket,team_rocket_alphabeta,stop(7,mark(1,3)))
stop(o)
```

Tic Tac Toe 7:

Game over

Roles	x	o
Players	team_rocket_alphabeta	onestep
Score	100	0
Errors	0	0

Clear Begin Pause Resume End

```
index(N),index(1),index(2),index(3),init(cell(1,1,x)),init(cell(1,2,b)),init(cel
l(1,3,b)),init(cell(2,1,b)),init(cell(2,2,o)),init(cell(2,3,b)),init(cell(3,1,b)
),init(cell(3,2,b)),init(cell(3,3,b)),init(control(x)),legal(mark(X,Y)) :-
cell(X,Y,b),mark(M,N) :: control(R) ==> cell(M,N,R) & ~cell(M,N,b),mark(M,N) ::
control(x) ==> ~control(x) & control(o),mark(M,N) :: control(o) ==> ~control(o)
& control(x),goal(x,100) :- line(x) & ~line(o),goal(x,50) :- line(x) &
line(o),goal(x,50) :- ~line(x) & ~line(o),goal(x,0) :- ~line(x) &
line(o),goal(o,100) :- ~line(x) & line(o),goal(o,50) :- line(x) &
line(o),goal(o,50) :- ~line(x) & ~line(o),goal(o,0) :- line(x) &
~line(o),row(M,X) :- cell(M,1,X) & cell(M,2,X) & cell(M,3,X),col(N,X) :-
cell(1,N,X) & cell(2,N,X) & cell(3,N,X),diag(X) :- cell(1,1,X) & cell(2,2,X) &
cell(3,3,X),diag(X) :- cell(1,3,X) & cell(2,2,X) & cell(3,1,X),line(X) :-
row(M,X),line(X) :- col(N,X),line(X) :- diag(X),terminal :- line(x),terminal :-
line(o),terminal :- ~open,open :- cell(M,N,b)),10,10))
start(o)
ready
message(1650444478,team_rocket_alphabeta,tester_team_rocket,reply(1,ready))
message(1650444480,tester_team_rocket,team_rocket_alphabeta,play(2,[]))
update([])
message(1650444481,team_rocket_alphabeta,tester_team_rocket,reply(2,mark(2,1)))
message(1650444482,tester_team_rocket,team_rocket_alphabeta,play(3,mark(2,1)))
update(mark(2,1))
submit(mark(1,3))
message(1650444483,tester_team_rocket,team_rocket_alphabeta,play(4,mark(1,3)))
update(mark(1,3))
message(1650444482,team_rocket_alphabeta,tester_team_rocket,reply(3,mark(3,3)))
message(1650444484,team_rocket_alphabeta,tester_team_rocket,reply(4,mark(3,1)))
message(1650444485,tester_team_rocket,team_rocket_alphabeta,stop(5,mark(3,1)))
stop(o)
```
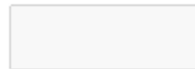
Tic Tac Toe:

<table>
<tr><td>Protocol: manager</td><td>Game: tictactoe</td></tr>
<tr><td>Identifier: tester_team_rocket</td><td>Startclock: 10</td></tr>
<tr><td></td><td>Playclock: 10</td></tr>
</table>

O		
X	X	X
O	O	X

Game over

Roles	x	o
Players	team_rocket_alphabeta	onestep
Score	100	0
Errors	0	0

Clear　Begin　Pause　Resume　End

```
ready
message(1650444262,team_rocket_alphabeta,tester_team_rocket,reply(1,ready))
message(1650444266,tester_team_rocket,team_rocket_alphabeta,play(2,[]))
update([])
message(1650444266,team_rocket_alphabeta,tester_team_rocket,reply(1,ready))
message(1650444271,team_rocket_alphabeta,tester_team_rocket,reply(2,mark(2,1)))
message(1650444272,tester_team_rocket,team_rocket_alphabeta,play(3,mark(2,1)))
update(mark(2,1))
submit(mark(3,2))
message(1650444273,tester_team_rocket,team_rocket_alphabeta,play(4,mark(3,2)))
update(mark(3,2))
message(1650444272,team_rocket_alphabeta,tester_team_rocket,reply(3,mark(1,2)))
message(1650444275,team_rocket_alphabeta,tester_team_rocket,reply(4,mark(2,2)))
message(1650444276,tester_team_rocket,team_rocket_alphabeta,play(5,mark(2,2)))
update(mark(2,2))
submit(mark(3,1))
message(1650444277,tester_team_rocket,team_rocket_alphabeta,play(6,mark(3,1)))
update(mark(3,1))
message(1650444278,team_rocket_alphabeta,tester_team_rocket,reply(5,mark(1,3)))
message(1650444278,team_rocket_alphabeta,tester_team_rocket,reply(6,mark(3,3)))
message(1650444279,tester_team_rocket,team_rocket_alphabeta,play(7,mark(3,3)))
update(mark(3,3))
submit(mark(1,1))
message(1650444280,tester_team_rocket,team_rocket_alphabeta,play(8,mark(1,1)))
update(mark(1,1))
message(1650444280,team_rocket_alphabeta,tester_team_rocket,reply(7,mark(1,2)))
message(1650444282,team_rocket_alphabeta,tester_team_rocket,reply(8,mark(2,3)))
message(1650444282,tester_team_rocket,team_rocket_alphabeta,stop(9,mark(2,3)))
stop(o)
```