

Nim (21 Sticks Variant)

Setup

- Start with **21 sticks** (or counters, stones, matches, etc.).
 - Two players take turns.
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Rules

1. On your turn, you must take **1, 2, or 3 sticks** from the pile.
 2. Players alternate turns.
 3. **The player forced to take the last stick loses.**
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Example Play

- Start: 21 sticks.
- Player A takes 2 → 19 left.
- Player B takes 3 → 16 left.
- Player A takes 1 → 15 left.
- ... and so on, until one player is forced to take the last stick and loses.

```
In [7]: from Game import *
```

```
In [8]: def initial_state():  
        return 21
```

```
In [9]: def show_state(state,player):  
        print("Player",player)  
        print(f"Sticks remaining: {state}")
```

```
In [10]: def valid_moves(state,player):  
        # return a list of moves that are valid  
  
        if state==1:  
            return [1]  
        elif state==2:  
            return [1,2]  
        else:  
            return [1,2,3]
```

```
In [11]: def update_state(state,player,move):  
        new_state = state - move
```

```
return new_state
```

```
In [12]: def win_status(state,player):  
    # return None if the game is not over  
    # return 'win' if player has won  
    # return 'lose' if player has lost  
    # return 'stalemate' if player has stalemate  
  
    if player==1:  
        other_player=2  
    else:  
        other_player=1  
  
    if state==0:  
        return 'lose'  
    else:  
        return None
```

Agents

```
In [13]: def human_move(state,player):  
    move = int(input("Enter your move (1, 2, or 3): "))  
    while move not in valid_moves(state,player):  
        print("Invalid move. Try again.")  
        move = int(input("Enter your move (1, 2, or 3): "))  
    return move  
  
human_agent=Agent(human_move)
```

```
In [14]: def random_move(state,player):  
    return random.choice(valid_moves(state,player))  
  
random_agent=Agent(random_move)
```

Running the Game

```
In [15]: g=Game()  
g.run(random_agent,random_agent)
```

```
====  
Game 1  
Player 1  
Sticks remaining: 21  
Player 1 moves 1  
Player 2  
Sticks remaining: 20  
Player 2 moves 2  
Player 1  
Sticks remaining: 18  
Player 1 moves 2  
Player 2  
Sticks remaining: 16  
Player 2 moves 2  
Player 1  
Sticks remaining: 14  
Player 1 moves 1  
Player 2  
Sticks remaining: 13  
Player 2 moves 1  
Player 1  
Sticks remaining: 12  
Player 1 moves 1  
Player 2  
Sticks remaining: 11  
Player 2 moves 3  
Player 1  
Sticks remaining: 8  
Player 1 moves 2  
Player 2  
Sticks remaining: 6  
Player 2 moves 1  
Player 1  
Sticks remaining: 5  
Player 1 moves 1  
Player 2  
Sticks remaining: 4  
Player 2 moves 3  
Player 1  
Sticks remaining: 1  
Player 1 moves 1  
Player 1  
Sticks remaining: 0  
Player 2 won.
```

Out[15]: [2]

In []: