DEVOIR MAISON

À rendre le Lundi 23 février 2026

```python
import random


def est_possible(position):
    for i in range(len(position)-1):
        if position[i] < position[i+1]:
            return False
    return True


def coups_possibles(position):
    n = max(position)
    p = len(position)
    liste = []
    for c in range(p):
        for l in range(position[c]):
            liste.append((l, c))
    return liste


def jouer_coup(position, coup):
    p = len(position)
    (l, c) = coup
    if not (c < p and l < position[c]):
        return None

    nouvelle_position = []
    for k in range(p):
        if k >= c and position[k] > l:
            nouvelle_position.append(l)
        else:
            nouvelle_position.append(position[k])
    return nouvelle_position


def positions_possibles(position):
    n = max(position)
    p = len(position)
    liste = []
    for c in range(p):
        for l in range(position[c]):
            liste.append(jouer_coup(position, (l, c)))
    return liste


def est_gagnante(position):
    if sum(position) == 0:
        return True

    liste = positions_possibles(position)
    for p in liste:
        if not est_gagnante(p):
            return True

    return False
```

```python
D = {}

def est_gagnante_memo(position):
    if tuple(position) in D:
        return D[tuple(position)]

    if sum(position) == 0:
        D[tuple(position)] = True
        return True

    liste = positions_possibles(position)
    for p in liste:
        if not est_gagnante_memo(p):
            D[tuple(position)] = True
            return True

    D[tuple(position)] = False
    return False


def coup_gagnant(position):
    liste = coups_possibles(position)
    for coup in liste:
        nouvelle_position = jouer_coup(position, coup)
        if not est_gagnante_memo(nouvelle_position):
            return coup
    return random.choice(liste)


def jeu(n, p):
    position = p * [n]

    while sum(position) > 0:
        # Coup joueur
        print(position)
        coup = input("Entrez votre coup : ")
        coup = coup.split(",")
        l = int(coup[0])
        c = int(coup[1])
        position = jouer_coup(position, (l, c))

        if sum(position) == 0:
            print("Désolé ! Tu as perdu...")
            return None

        # Coup ordi
        print(position)
        (l, c) = coup_gagnant(position)
        print(f"Je joue le coup {(l, c)}")
        position = jouer_coup(position, (l, c))

    print("Bravo ! Tu as gagné !!")
```