

```

In [20]: from sgf_transformers import sgf_to_dataframe
import matplotlib.pyplot as plt
import matplotlib.animation as animation
from IPython.display import HTML
from collections import deque
import numpy as np
import pandas as pd

In [9]: # df = sgf_to_dataframe("./9x9_training_data/Minigo/990731.sgf")
df = sgf_to_dataframe("./9x9_training_data/Minigo/990619.sgf")

size = df.iloc[0].after.size

fig, ax = plt.subplots()
ax.set_xlim(0, size - 1)
ax.set_ylim(0, size - 1)
ax.set_aspect('equal')
ax.set_xticks(range(size))
ax.set_yticks(range(size))
ax.grid(True)
ax.invert_yaxis()
ax.set_yticklabels([8, 7, 6, 5, 4, 3, 2, 1, 0])

stone_patches = []

def update(frame_index):
    global stone_patches
    # Remove previous stones
    for patch in stone_patches:
        patch.remove()
    stone_patches.clear()

    board = df.iloc[frame_index].after

    for row in range(size):
        for col in range(size):
            color = board.get(row, col)
            if color:
                circle = plt.Circle(
                    (col, size - 1 - row), 0.4,
                    color='black' if color == 'b' else 'white',
                    ec='black'
                )
                ax.add_patch(circle)
                stone_patches.append(circle)

    ax.set_title(f"Move {frame_index + 1}")

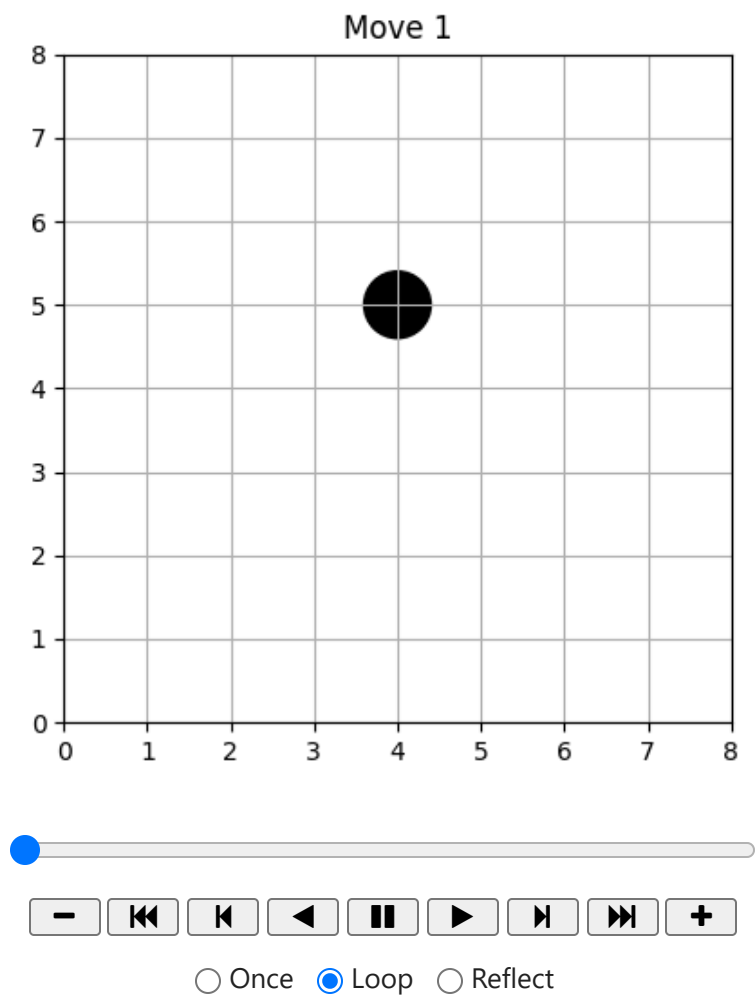
# Create animation
ani = animation.FuncAnimation(
    fig, update, frames=len(df), interval=800, repeat=True
)

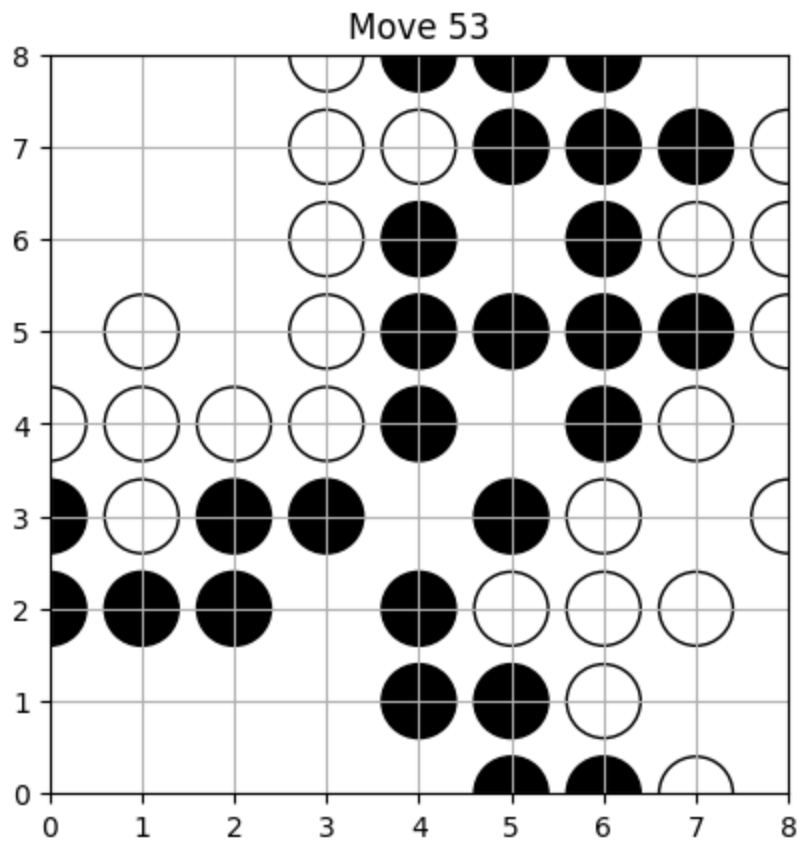
ani.save("go_game.gif", writer="pillow")

```

```
HTML(ani.to_jshtml())
```

Out[9]:





In [10]: df

Out[10]:

	player	move	before	after	lost_stones_before	black_capt
0	b	(5, 4)	<sgfmill.boards.Board object at 0x0000020AFF78...	<sgfmill.boards.Board object at 0x0000020AFF78...		[]
1	w	(3, 4)	<sgfmill.boards.Board object at 0x0000020A800A...	<sgfmill.boards.Board object at 0x0000020A800A...		[]
2	b	(4, 6)	<sgfmill.boards.Board object at 0x0000020AFF78...	<sgfmill.boards.Board object at 0x0000020AFF78...		[]
3	w	(4, 2)	<sgfmill.boards.Board object at 0x0000020AFF78...	<sgfmill.boards.Board object at 0x0000020AFF78...		[]
4	b	(2, 2)	<sgfmill.boards.Board object at 0x0000020AFF78...	<sgfmill.boards.Board object at 0x0000020AFF84...		[]
5	w	(3, 6)	<sgfmill.boards.Board object at 0x0000020AFF84...	<sgfmill.boards.Board object at 0x0000020A800A...		[]
6	b	(3, 7)	<sgfmill.boards.Board object at 0x0000020AFF9A...	<sgfmill.boards.Board object at 0x0000020AFF84...		[]
7	w	(4, 5)	<sgfmill.boards.Board object at 0x0000020AFF5C...	<sgfmill.boards.Board object at 0x0000020AFF80...		[]
8	b	(5, 5)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
9	w	(4, 7)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
10	b	(5, 6)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
11	w	(2, 7)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
12	b	(3, 3)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
13	w	(6, 3)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]

	player	move	before	after	lost_stones_before	black_capt
14	b	(2, 4)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
15	w	(2, 5)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
16	b	(4, 4)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
17	w	(7, 4)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
18	b	(3, 5)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
19	w	(2, 6)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...	[(3, 4), (4, 5)]	
20	b	(5, 7)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
21	w	(3, 8)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
22	b	(7, 5)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...	[(3, 7)]	
23	w	(8, 5)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
24	b	(7, 6)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
25	w	(3, 1)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
26	b	(1, 5)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
27	w	(1, 6)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020A800C...		[]

	player	move	before	after	lost_stones_before	black_capt
28	b	(2, 1)	<sgfmill.boards.Board object at 0x0000020A800C...	<sgfmill.boards.Board object at 0x0000020AFF79...		[]
29	w	(5, 1)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
30	b	(8, 6)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
31	w	(5, 3)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
32	b	(8, 4)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
33	w	(8, 3)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[(8, 5)]
34	b	(6, 4)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
35	w	(7, 3)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
36	b	(3, 0)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
37	w	(4, 0)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
38	b	(2, 0)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
39	w	(5, 8)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
40	b	(1, 4)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
41	w	(6, 7)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]

	player	move	before	after	lost_stones_before	black_capt
42	b	(7, 7)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
43	w	(7, 8)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
44	b	(3, 2)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
45	w	(4, 1)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
46	b	(6, 6)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
47	w	(6, 8)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
48	b	(0, 6)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A8011...		[]
49	w	(0, 7)	<sgfmill.boards.Board object at 0x0000020A8011...	<sgfmill.boards.Board object at 0x0000020A800C...		[]
50	b	(0, 5)	<sgfmill.boards.Board object at 0x0000020A8015...	<sgfmill.boards.Board object at 0x0000020A8015...		[]
51	w	(4, 3)	<sgfmill.boards.Board object at 0x0000020A8015...	<sgfmill.boards.Board object at 0x0000020A8015...		[]
52	b	(8, 5)	<sgfmill.boards.Board object at 0x0000020A8015...	<sgfmill.boards.Board object at 0x0000020A8015...		[]

```
In [17]: def color_state(board):
    """Convert board state to two arrays that represent black and white respectively
    white_board = np.zeros((size, size), dtype=int)
    black_board = np.zeros((size, size), dtype=int)

    for colour, point in board.list_occupied_points():
        row, col = point
        if colour == 'b':
            black_board[row, col] = 1
        elif colour == 'w':
            white_board[row, col] = 1
```

```
return black_board, white_board
```

```
In [18]: black_history = deque([np.zeros((9, 9), dtype=np.int8) for _ in range(3)], maxlen=3)
white_history = deque([np.zeros((9, 9), dtype=np.int8) for _ in range(3)], maxlen=3)

processed_states = []
processed_actions = []

for index, row in df.iterrows():
    player = 0 if row['player'] == 'b' else 1
    move = row['move']
    x, y = move
    move = x * 9 + y

    black_board, white_board = color_state(row['before'])

    black_history.append(black_board)
    white_history.append(white_board)

    state = np.stack([
        black_history[-1],
        black_history[-2],
        black_history[-3],
        white_history[-1],
        white_history[-2],
        white_history[-3],
        np.full((9, 9), player, dtype=np.int8)
    ], axis=-1)

    processed_states.append(state)
    processed_actions.append(move)
```

```
In [22]: df_frame = pd.DataFrame({
    'state': processed_states,
    'action': processed_actions
})
df_frame.head()
```

```
Out[22]:
```

	state	action
0	[[[0, 0, 0, 0, 0, 0, 0], [0, 0, 0, 0, 0, 0, 0]]...	49
1	[[[0, 0, 0, 0, 0, 0, 1], [0, 0, 0, 0, 0, 0, 1]]...	31
2	[[[0, 0, 0, 0, 0, 0, 0], [0, 0, 0, 0, 0, 0, 0]]...	42
3	[[[0, 0, 0, 0, 0, 0, 1], [0, 0, 0, 0, 0, 0, 1]]...	38
4	[[[0, 0, 0, 0, 0, 0, 0], [0, 0, 0, 0, 0, 0, 0]]...	20

```
In [28]: print(divmod(processed_actions[16], 9))
print(processed_states[16])
```


(4, 4)

```

[[[0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]]]

```

```

[[[0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]]]

```

```

[[[0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [1 1 1 0 0 0 0]
  [0 0 0 0 0 0 0]
  [1 1 0 0 0 0 0]
  [0 0 0 1 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 1 1 1 0]
  [0 0 0 0 0 0 0]]]

```

```

[[[0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [1 1 1 0 0 0 0]
  [0 0 0 1 1 1 0]
  [0 0 0 0 0 0 0]
  [0 0 0 1 1 1 0]
  [1 1 1 0 0 0 0]
  [0 0 0 0 0 0 0]]]

```

```

[[[0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 1 1 1 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 1 1 1 0]
  [1 1 1 0 0 0 0]
  [0 0 0 1 1 1 0]
  [0 0 0 0 0 0 0]]]

```

```

[[[0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [0 0 0 0 0 0 0]
  [1 1 1 0 0 0 0]]]

```

```
[1 1 1 0 0 0 0]
[1 1 1 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]]
```

```
[[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 1 1 1 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]]
```

```
[[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]]
```

```
[[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]
[0 0 0 0 0 0 0]]]
```