Multiplayer Games with React Three Fiber and WebSockets

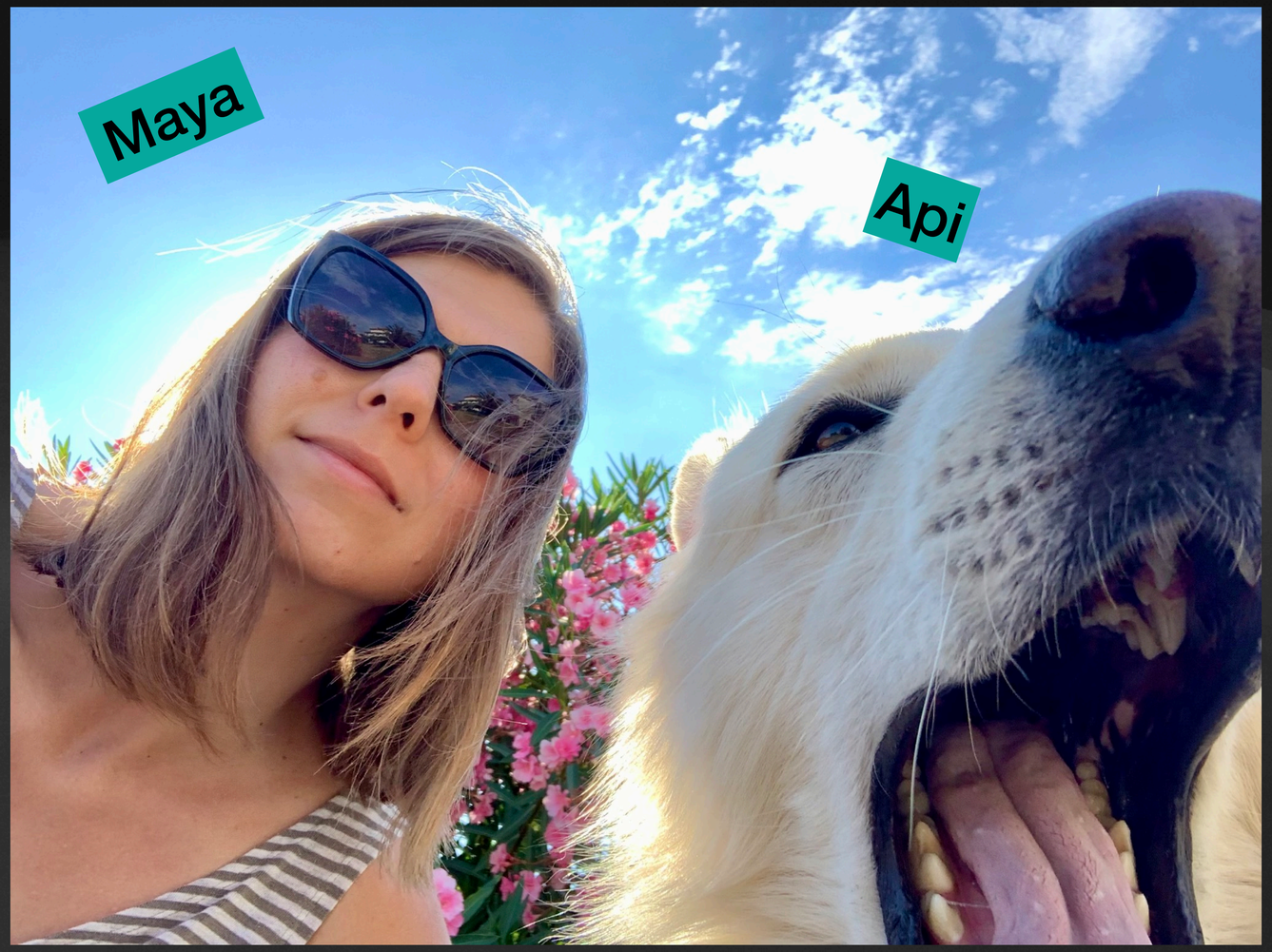
Maya Nedeljković Batić @ React Day Berlin • Dec 8, 2023

Maya Nedeljković Batić

- Art school dropout
- Software engineer at Linear
- Game development academic

@maya_ndljk

@mayacoda



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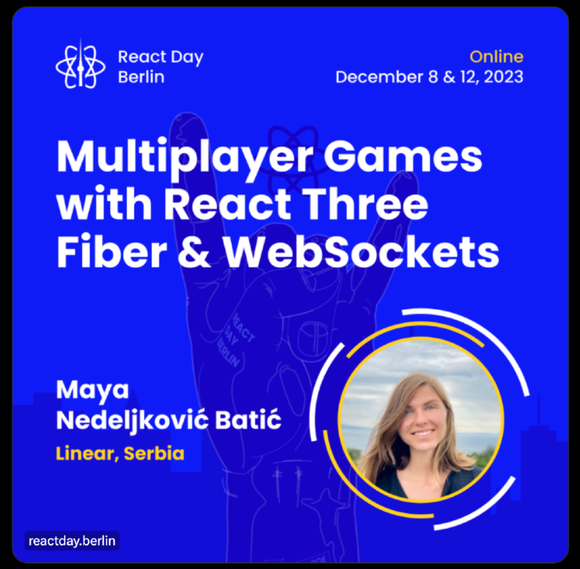
🎮Multiplayer games are the coolest! You'll learn with @maya_ndljk how to structure the game code, render an interactive 3D scene in the browser, and establish two-way communication between the client and server.



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Accessibility

Accessibility

- ✦ Accessible for you, as the developer

Accessibility

- Accessible for you, as the developer
- Accessible for your players

React Battleship

github.com/mayacoda/react-battleship

Game Plan 💪

Game Plan 💪

Game Plan 💪

Design ➡️

Game Plan 💪

Design ➡️ Prototype ➡️

Game Plan 💪

Design ➡️ Prototype ➡️ Blockout ➡️

Game Plan 💪

Design ➡️ Prototype ➡️ Blockout ➡️ Production

🎨 Design

GDD

Game title

React Battleship

Intended game systems

Web browser, specifically on mobile so targeting *iOS Safari* and *Android Chrome*

Target age of players

Adults who attend tech conferences

A summary of the game's story, focusing on gameplay

The player plays as a row boat captain in the open seas. They're surrounded by enemy boats and their goal is to defeat as many other players as possible. Players engage in 1 on 1 games of battleship with other players who are currently active. The games are shorter than usual (should be only a few minutes), allowing for a fast-paced experience.

Distinct modes of gameplay

There are two modes: exploration and battle mode. In exploration, the player controls a row boat through a 3D world in which they encounter other players. They can engage with other players in battle at which point each player is presented with a Battleship game interface.

Unique selling points

- Snappy game experience — games last only a few minutes
- No login or authentication required — low barrier to entry
- Connects conference attendees in a shared experience

https://en.wikipedia.org/wiki/Game_design_document

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🏆 must haves

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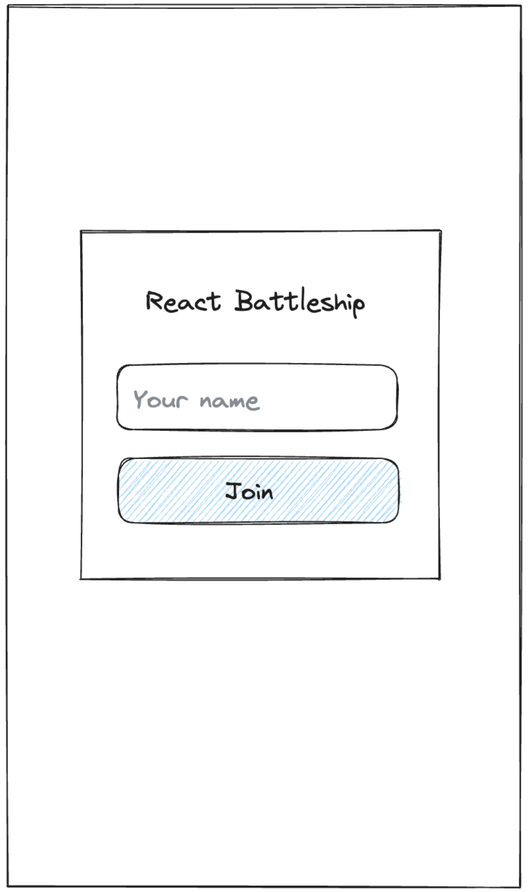
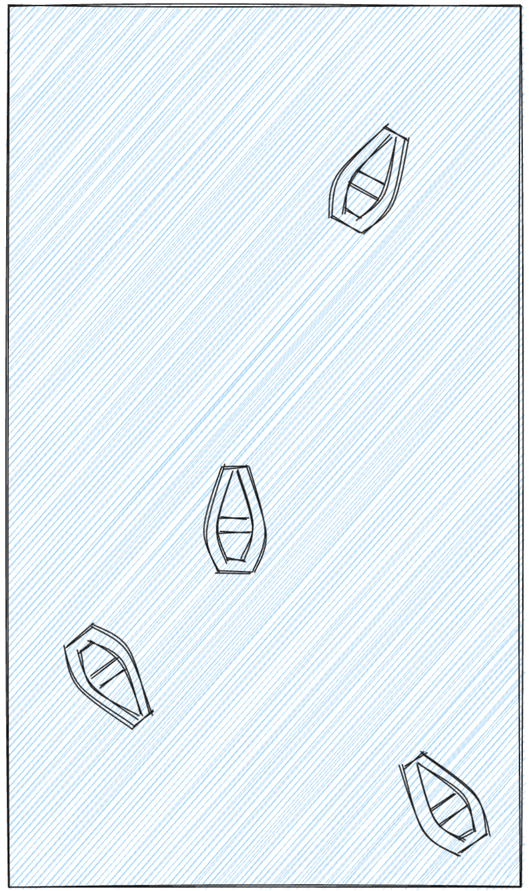
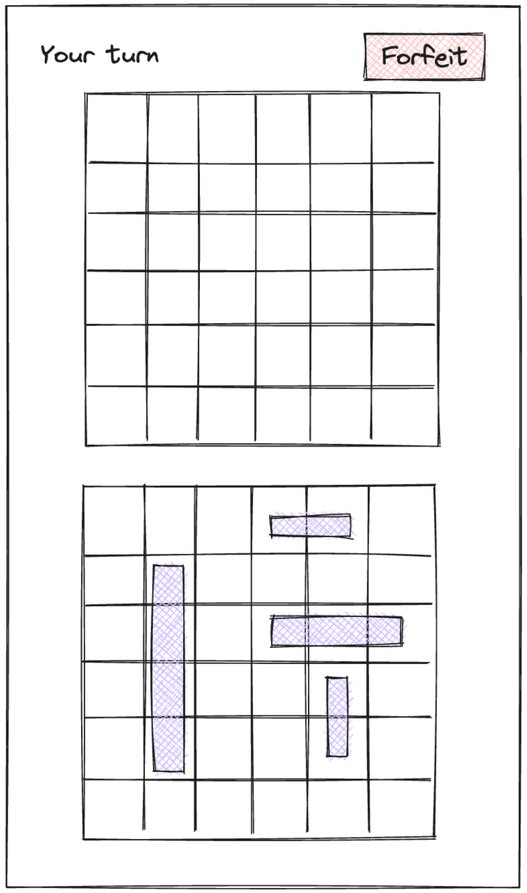
Join page



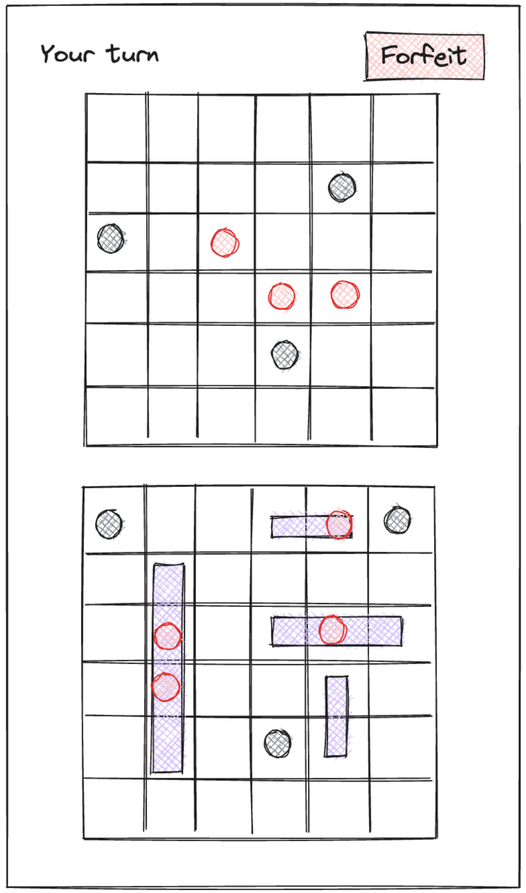
Lobby page



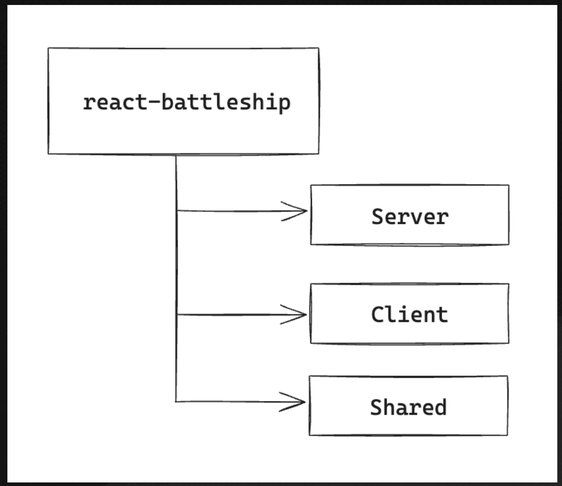
Game page

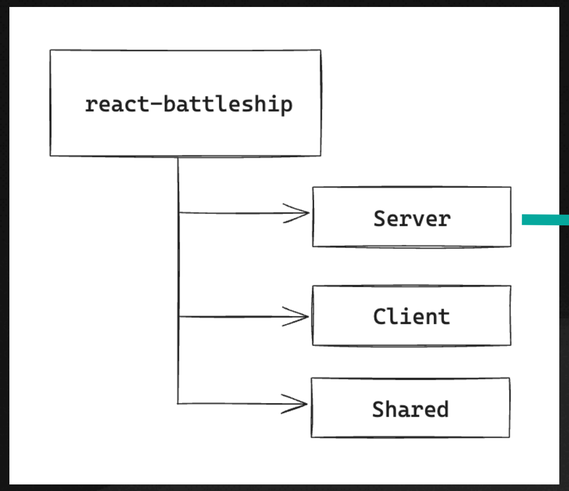


Game page



Architecture


react-battleship
Server
Client
Shared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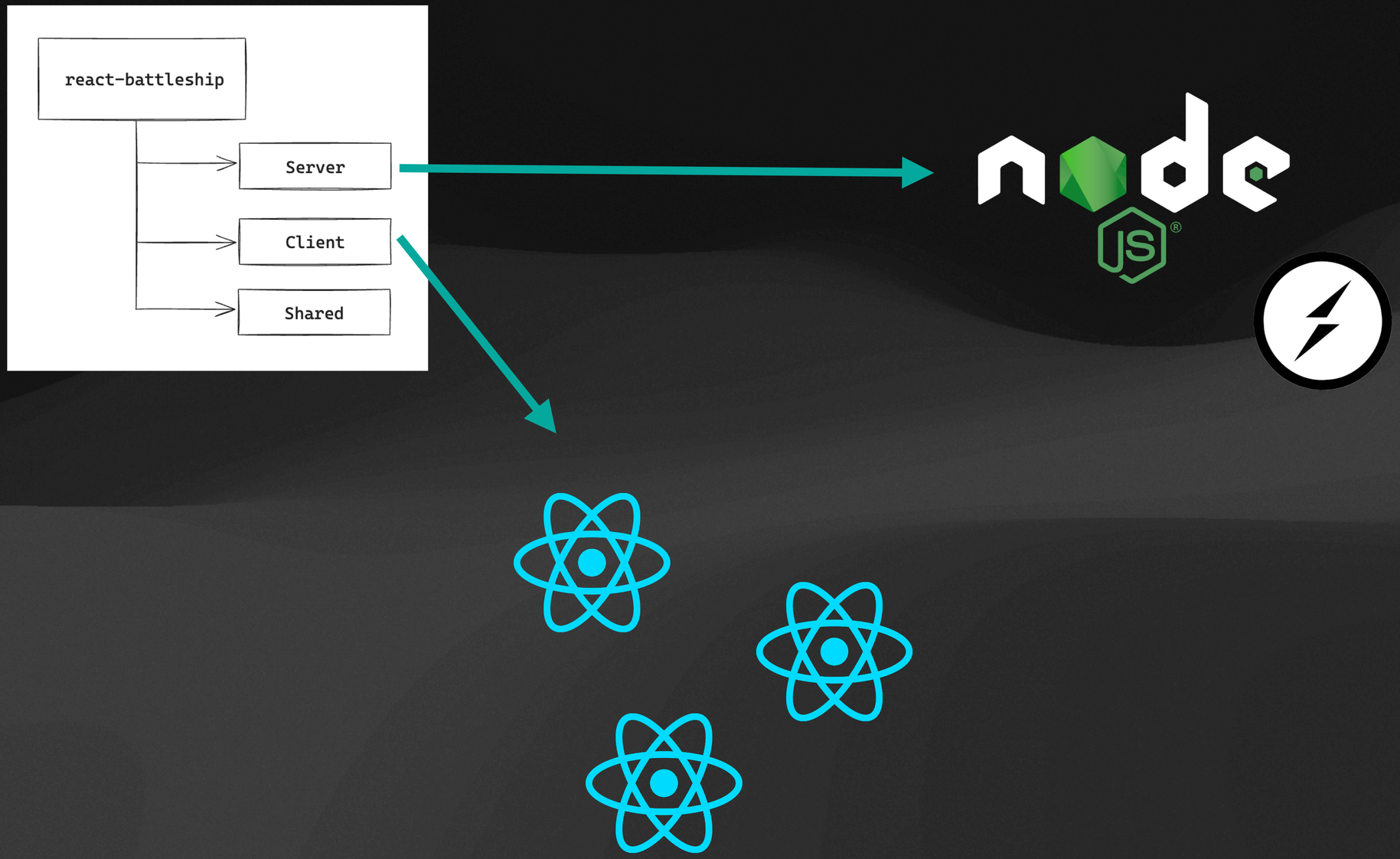
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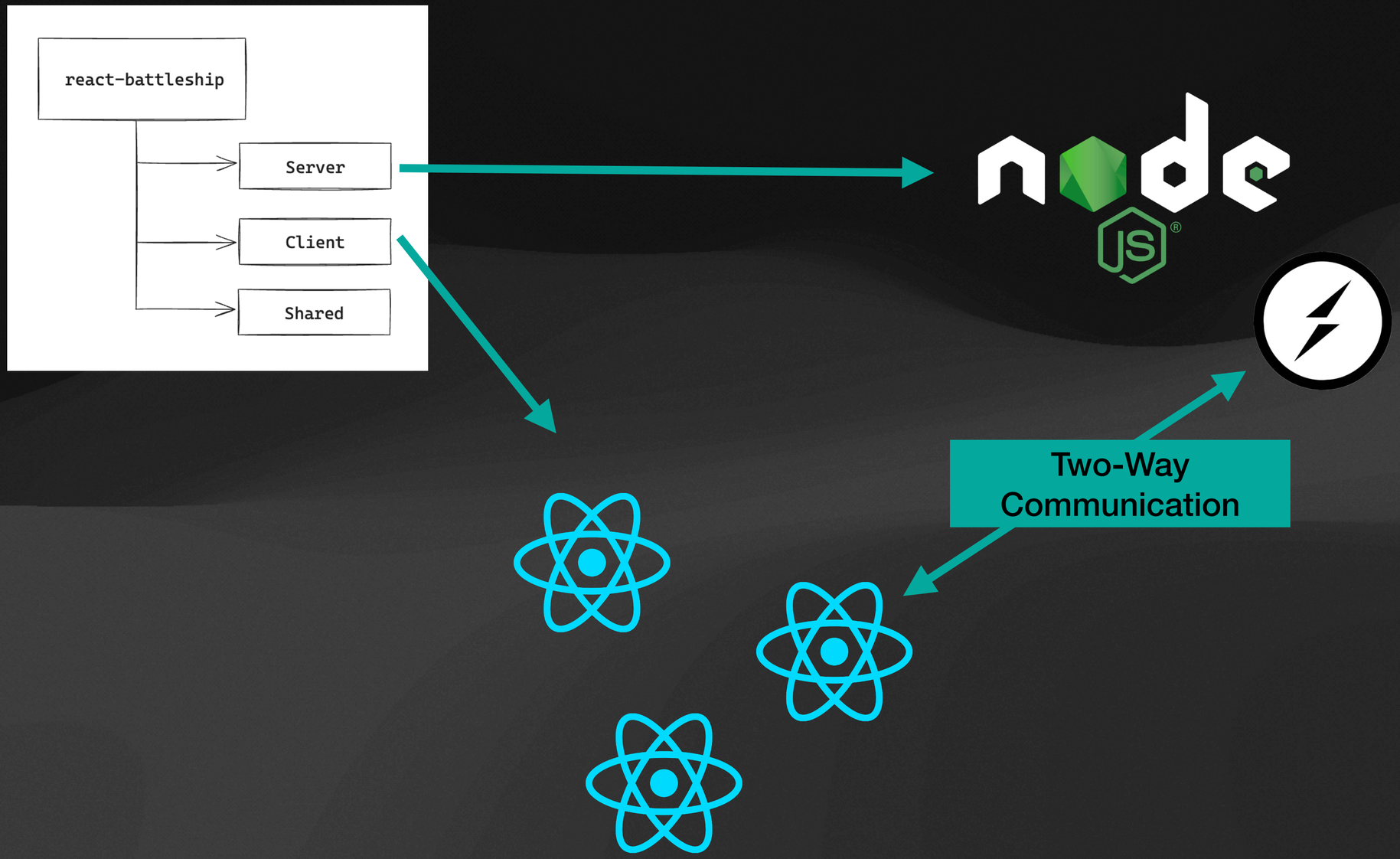
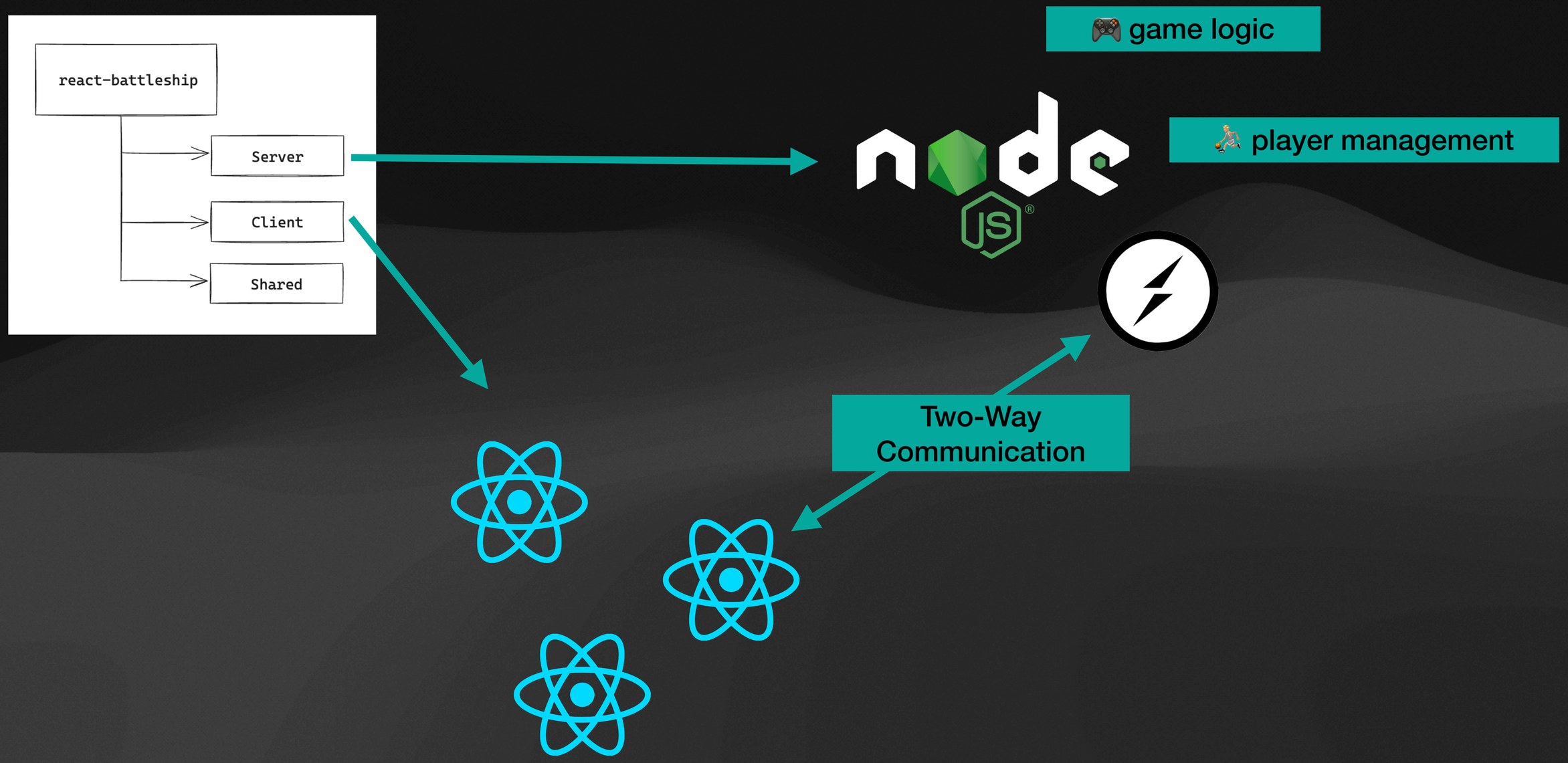
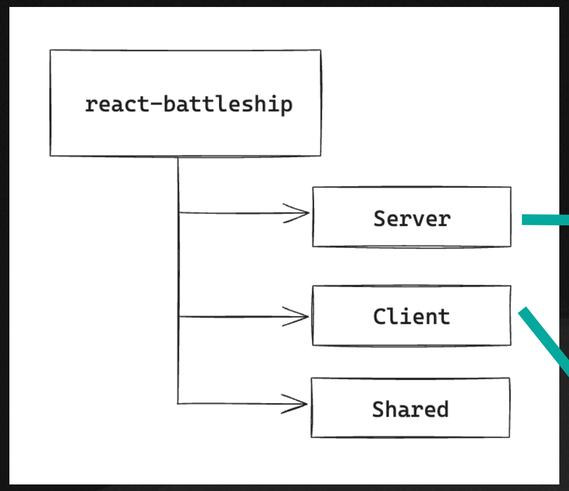

react-battleship
Server
Client
Shared
node
JS
Two-Way
Communication


react-battleship
Server
Client
Shared
🎮 game logic
🕺 player management
Two-Way
Communication



🎮 game logic

🕺 player management

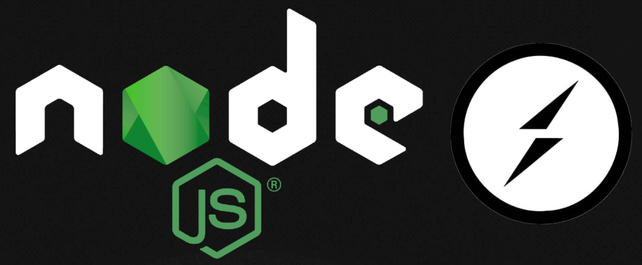
Two-Way Communication

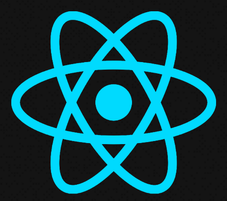
⛵ display game state

🕹️ player input

⚠️ **Disclaimer: implementation details here**
github.com/mayacoda/react-battleship

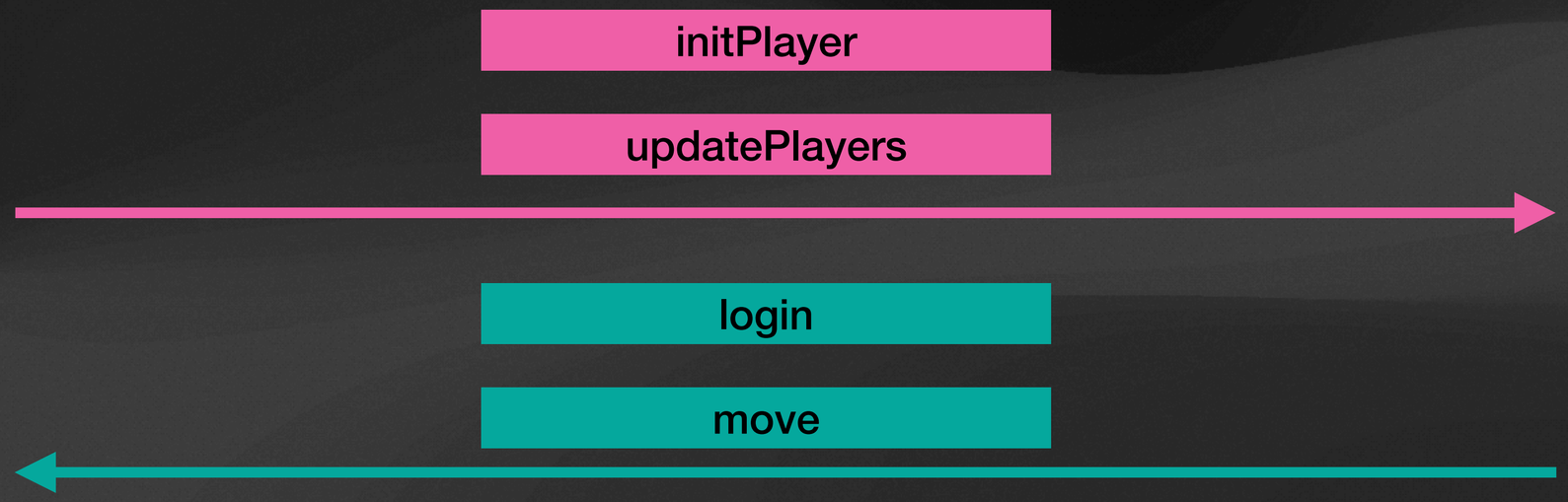
Prototype

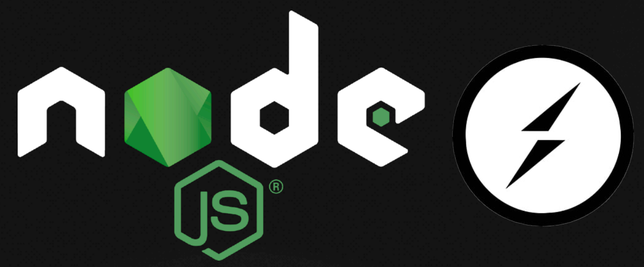

node
JS

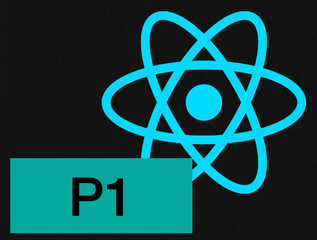


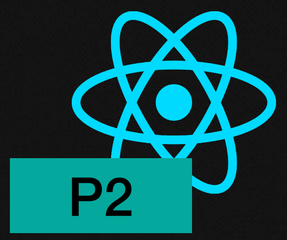
initPlayer

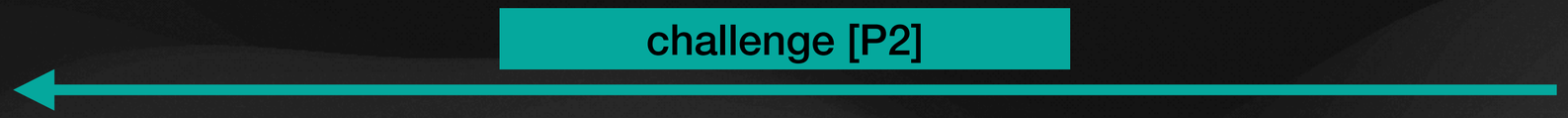
updatePlayers

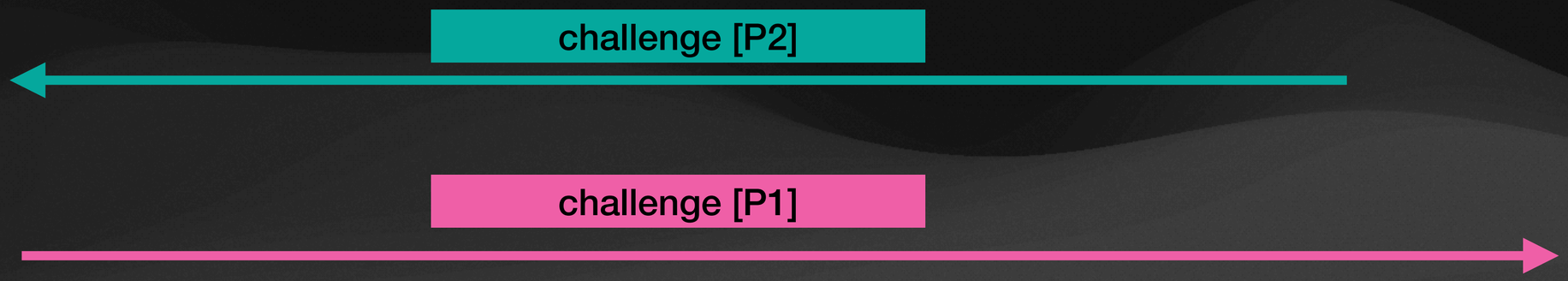

initPlayer
updatePlayers
login
move

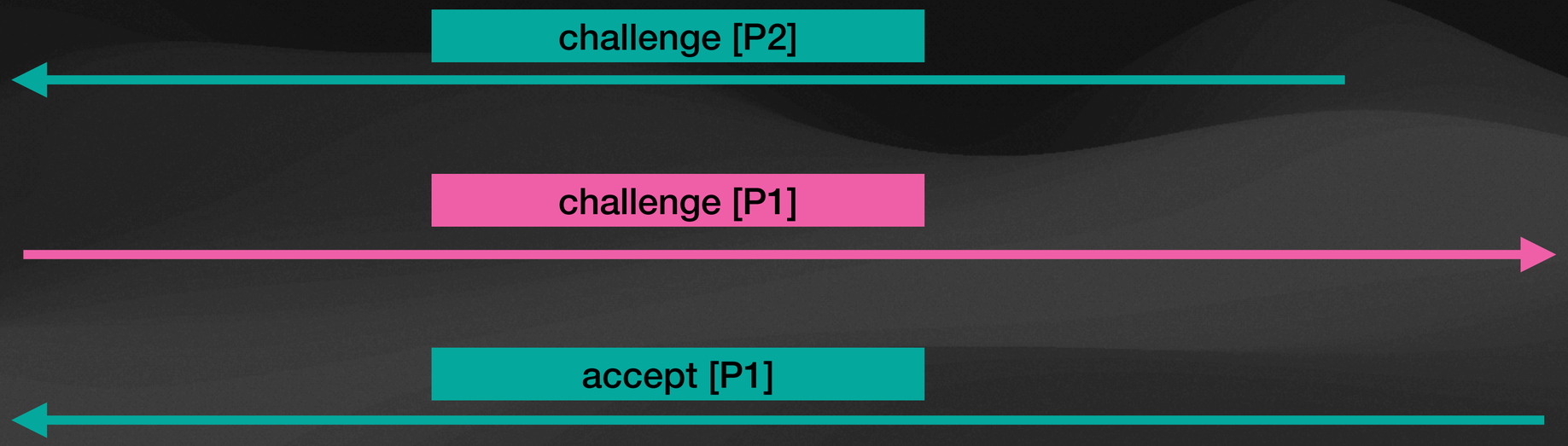

node
JS

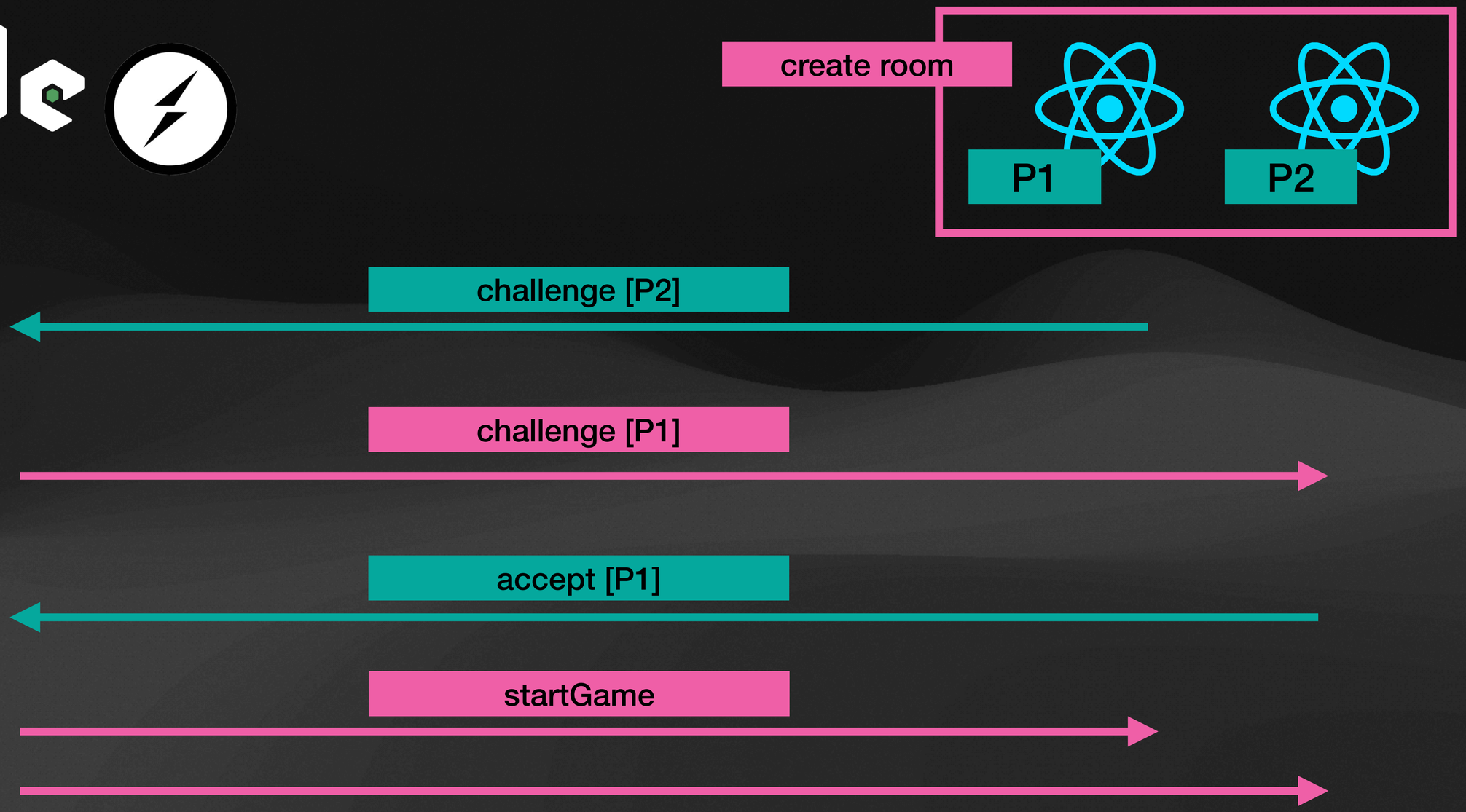

P1


P2


P1
P2
challenge [P2]


P1
P2
challenge [P2]
challenge [P1]


P1
P2
challenge [P2]
challenge [P1]
accept [P1]

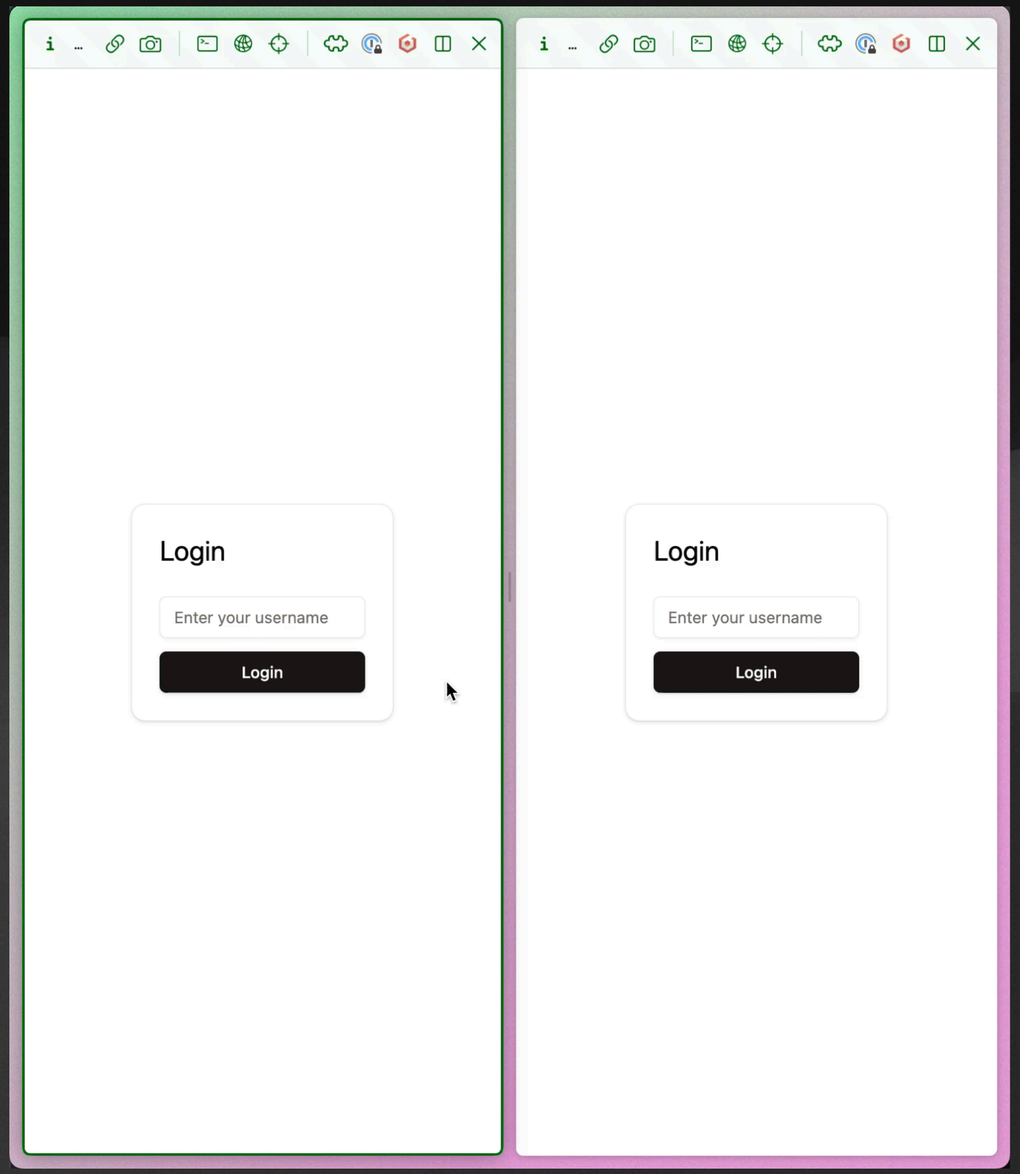

create room
P1
P2
challenge [P2]
challenge [P1]
accept [P1]
startGame

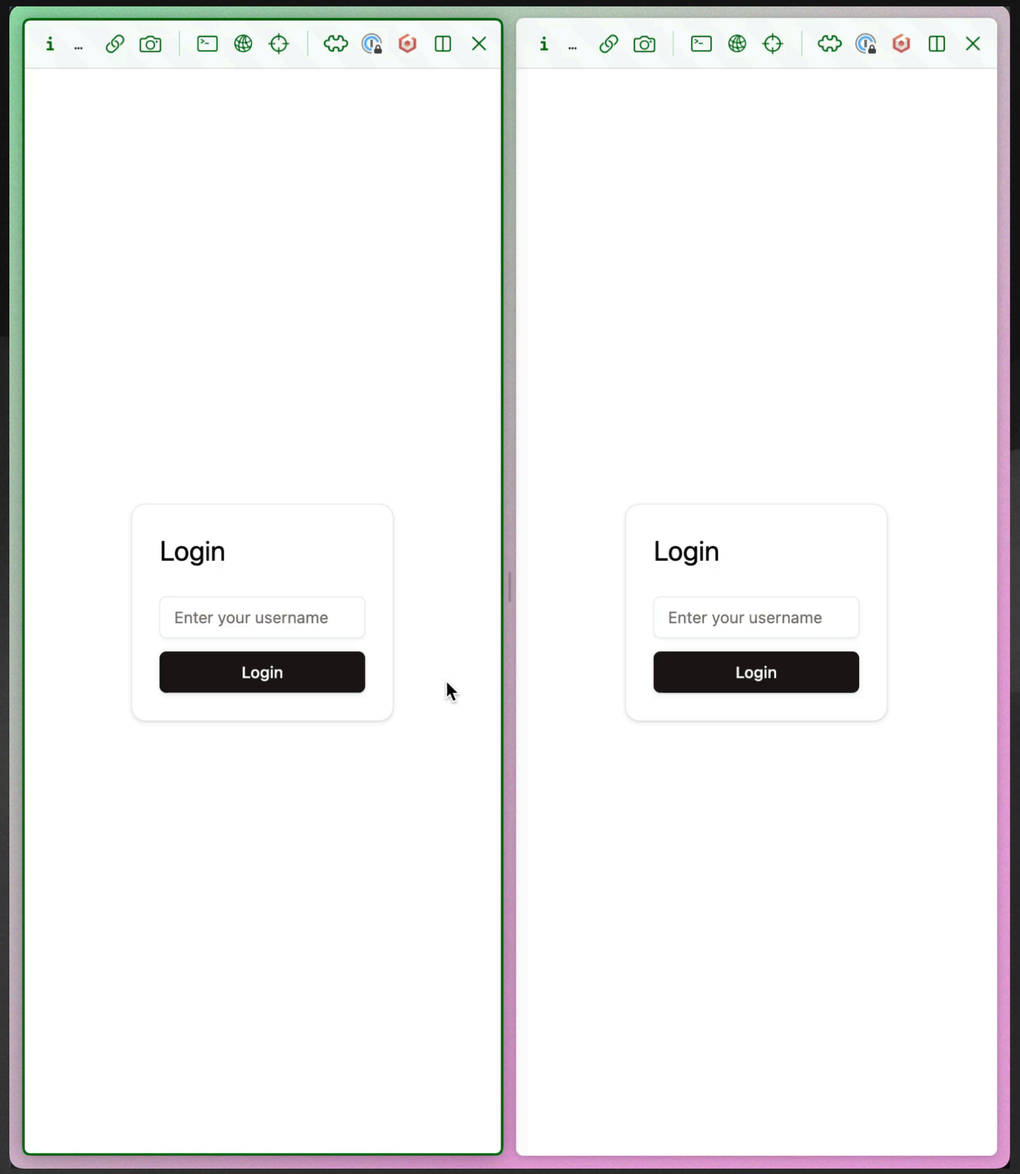
Synchronizing server state with client state with React Context

```
export const GameProvider = ({ children }: PropsWithChildren) => {
  const [players, setPlayers] = useState<Record<string, Player>>({});
  const [currentPlayer, setCurrentPlayer] = useState<Player | null>(null);
  const [challenges, setChallenges] = useState<Player[]>([]);
  const [onGameFinished, setOnGameFinished] = useState<() => void>(() => {});
  const [socket, setSocket] = useState<TypedClient | null>(null);
  const [gameState, setGameState] =
    useState<GameContextType["gameState"]>(null);
  const [previousGames, setPreviousGames] = useState<EndState[]>([]);
  const [isConnected, setIsConnected] = useState(false);
  const navigate = useNavigate();

  useEffect(() => {
    // Establish WebSocket connection when the component mounts
    const newSocket: TypedClient = io(SOCKET_URL, {
      transports: ["websocket"],
    });
    setSocket(newSocket);
    let localPlayers: Record<string, Player> = {};
    let localPlayer: Player | null = null;

    newSocket.on("disconnect", () => {
      setIsConnected(false);
      setGameState(null);
      setPlayers({});
      setCurrentPlayer(null);
      setChallenges([]);
      setPreviousGames([]);
      navigate("/");
    });
    newSocket.on("initPlayer", (p: Player) => {
      setIsConnected(true);
      localPlayer = p;
      setCurrentPlayer(localPlayer);
```


Login
Enter your username
Login
Login
Enter your username
Login


Login
Enter your username
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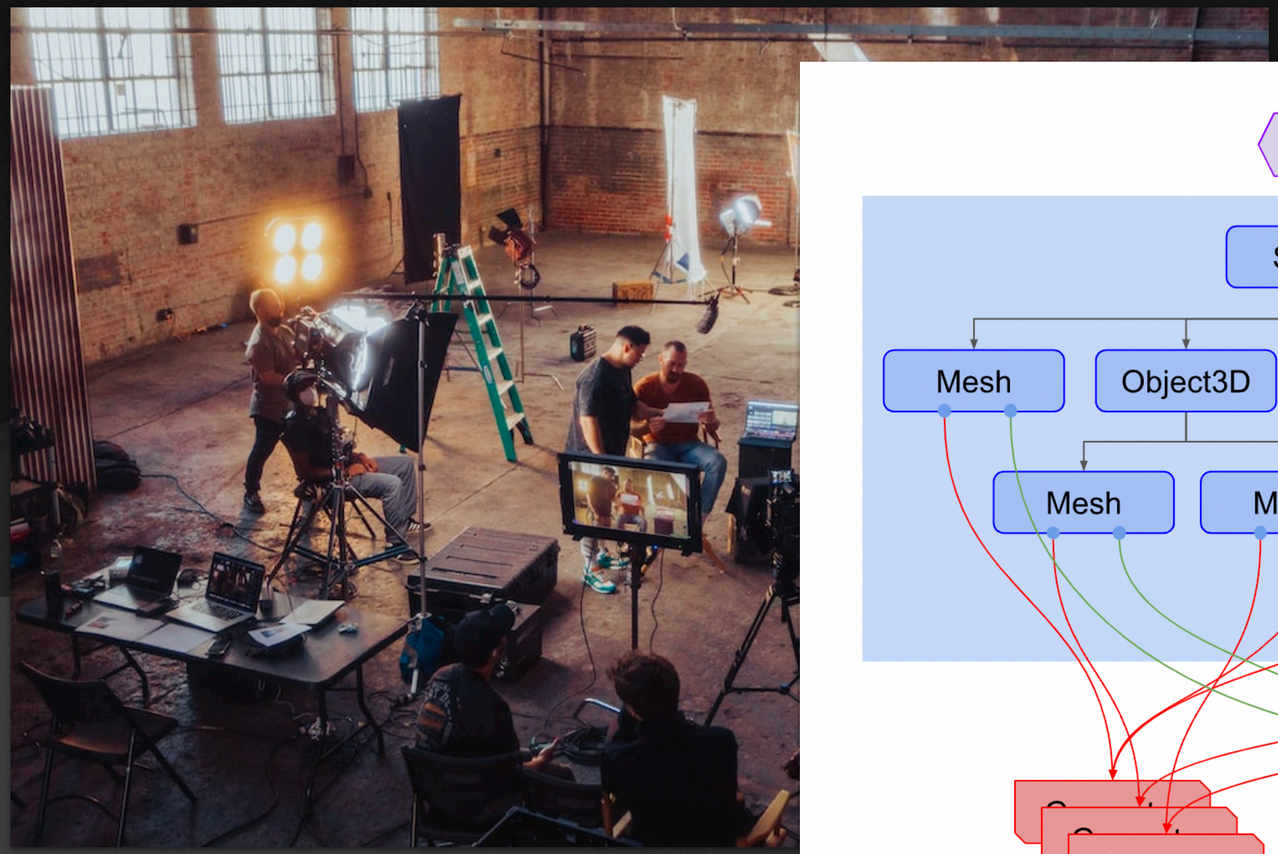
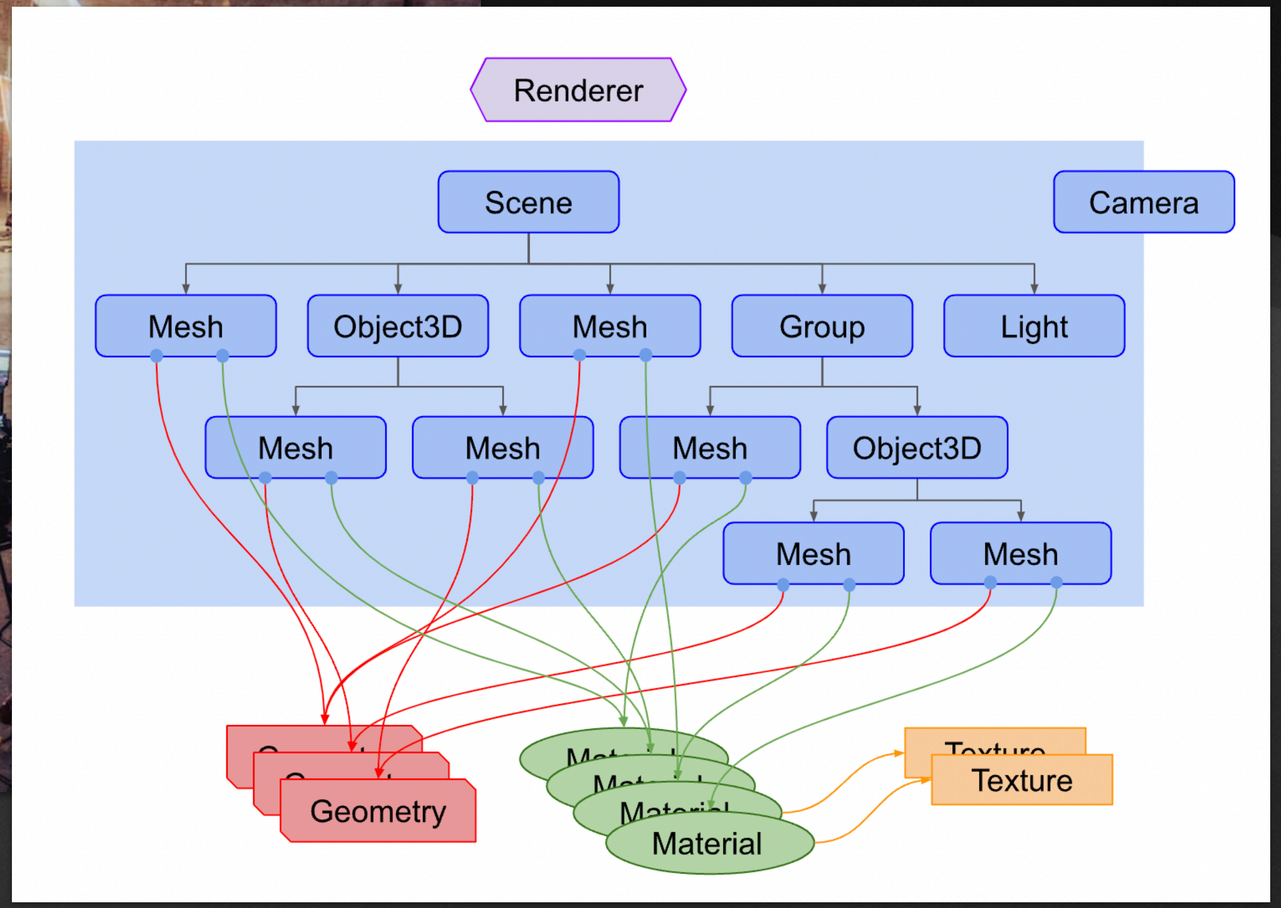
Login
Enter your username
Login

📦 Blockout

https://threejs.org/manual/#en/fundamentals





https://threejs.org/manual/#en/fundamentals

Three.js

```
const scene = new THREE.Scene()
const camera = new THREE.PerspectiveCamera(75, width / height, 0.1, 1000)

const renderer = new THREE.WebGLRenderer()
renderer.setSize(width, height)
document.querySelector('#canvas-container').appendChild(renderer.domElement)

const mesh = new THREE.Mesh()
mesh.geometry = new THREE.BoxGeometry()
mesh.material = new THREE.MeshStandardMaterial()

scene.add(mesh)

function animate() {
  requestAnimationFrame(animate)
  renderer.render(scene, camera)
}

animate()
```

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animate()
```

R3F.jsx

```
function App() {
  return (
    <div id="canvas-container">
      <Canvas>
        <mesh>
          <boxGeometry />
          <meshStandardMaterial />
        </mesh>
      </Canvas>
    </div>
  )
}
```

ReactLobby.jsx

```jsx
<div className="flex flex-col h-screen">
  <Table>
    <TableHeader>
      <TableRow>
        <TableHead>Name</TableHead>
        <TableHead>Status</TableHead>
      </TableRow>
    </TableHeader>
    <TableBody>
      {players.map((player) => (
        <TableRow key={player.id}>
          <TableCell>{player.name}</TableCell>
          <TableCell>
            {player.isPlaying ? (
              <Badge>Playing</Badge>
            ) : player.id !== game.currentPlayer?.id ? (
              <Button size="sm" onClick={() => onChallenge(player.id)}>
                Challenge
              </Button>
            ) : null}
          </TableCell>
        </TableRow>
      ))}
    </TableBody>
  </Table>
</div>
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              </Button>
            ) : null}
          </TableCell>
        </TableRow>
      ))}
    </TableBody>
  </Table>
</div>
```
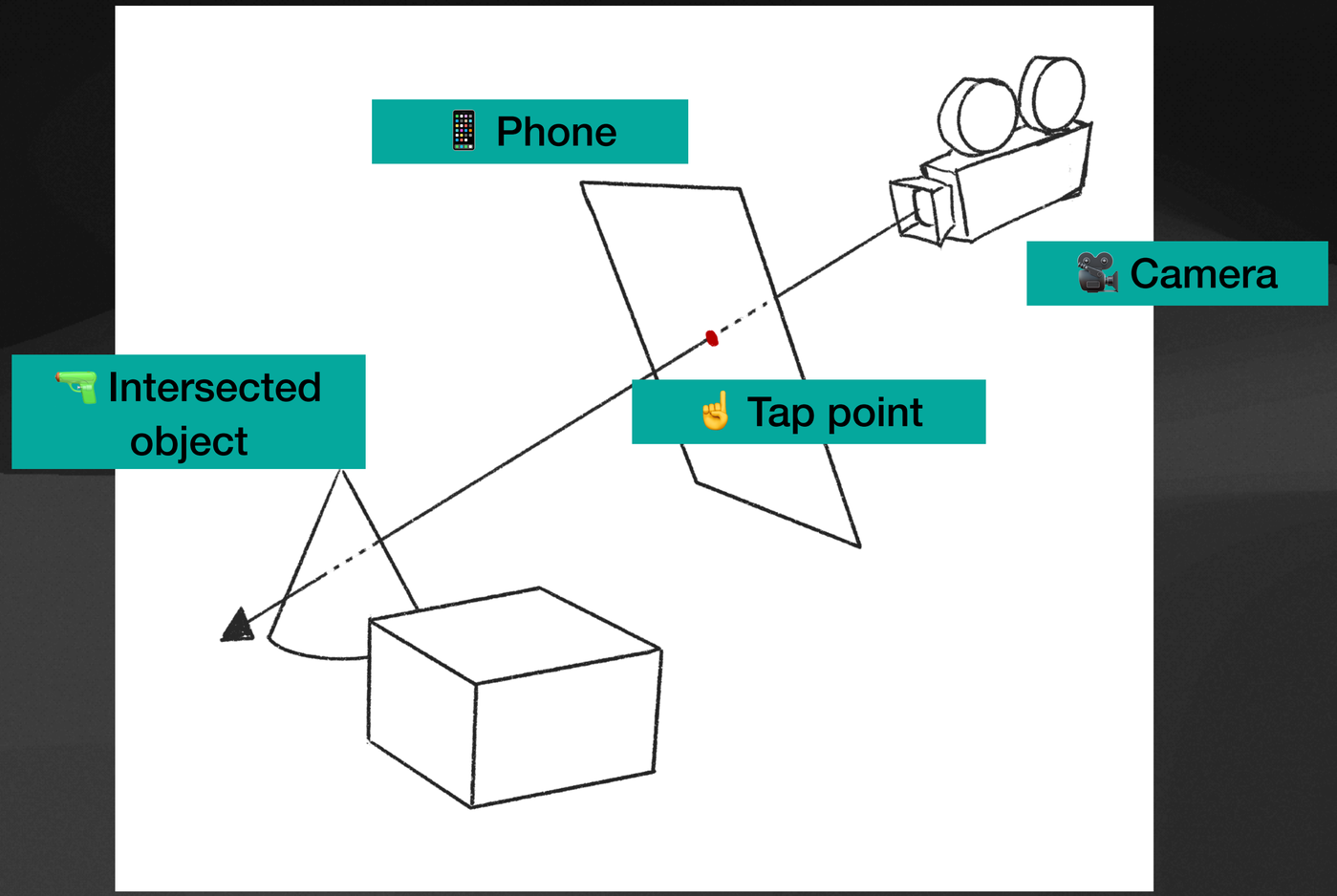

R3fLobby.jsx

```jsx
<>
  <ambientLight intensity={1} />
  <directionalLight position={[10, 10, 10]} intensity={3.5} castShadow />
  <OrbitControls />
  <WaterPlane
    ref={planeRef}
    size={100}
    rotation={[-Math.PI / 2, 0, 0]}
    position={[0, -0.1, 0]}
    onClick={handlePlaneClick}
  />
  <ControlledPlayer player={currentPlayer!} ref={playerRef} />
  {players.map((player) => (
    <OtherPlayer
      key={player.id}
      player={player}
      onChallenge={onChallenge}
    />
  ))}
</>
```

Raycasting or Clicking?



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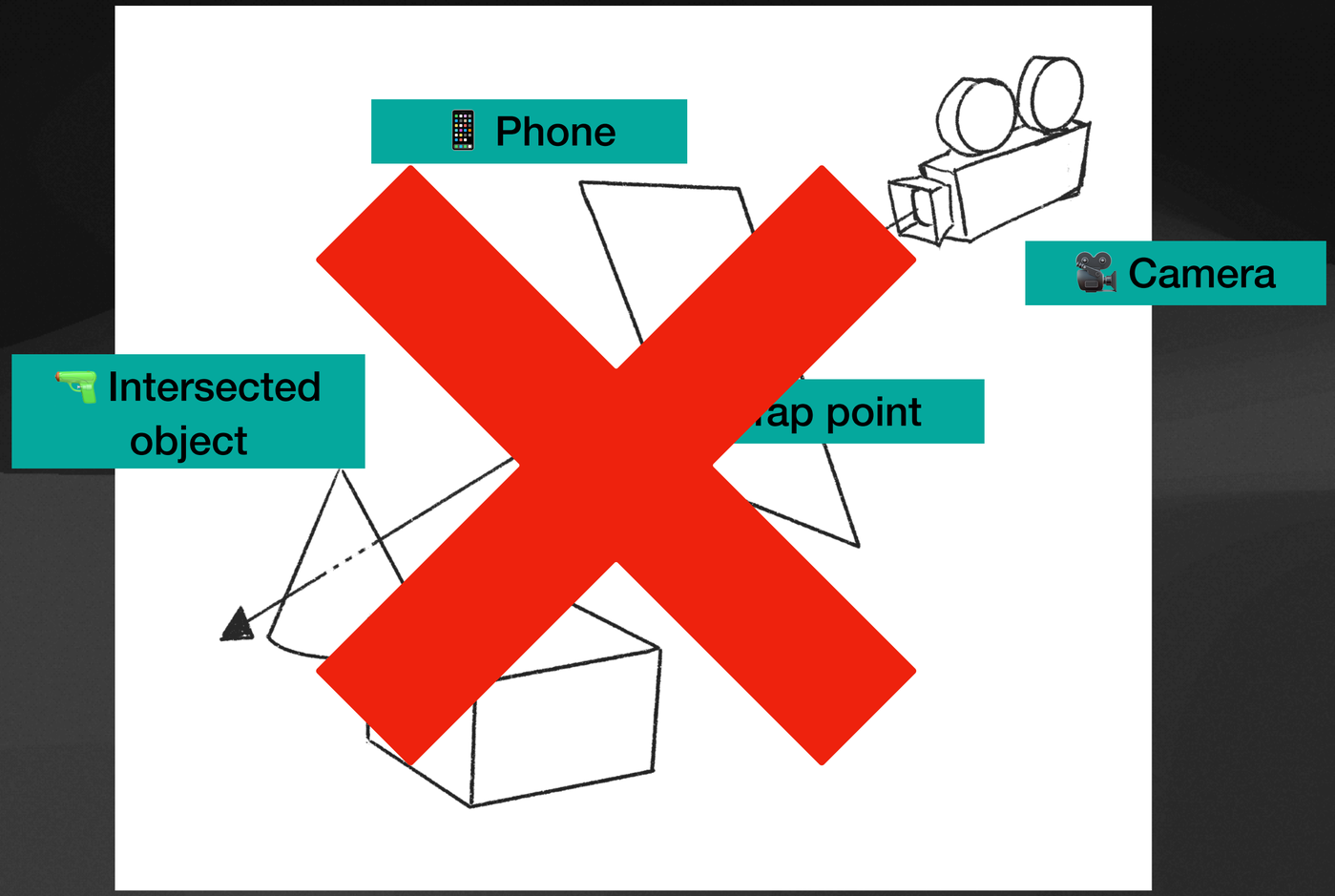

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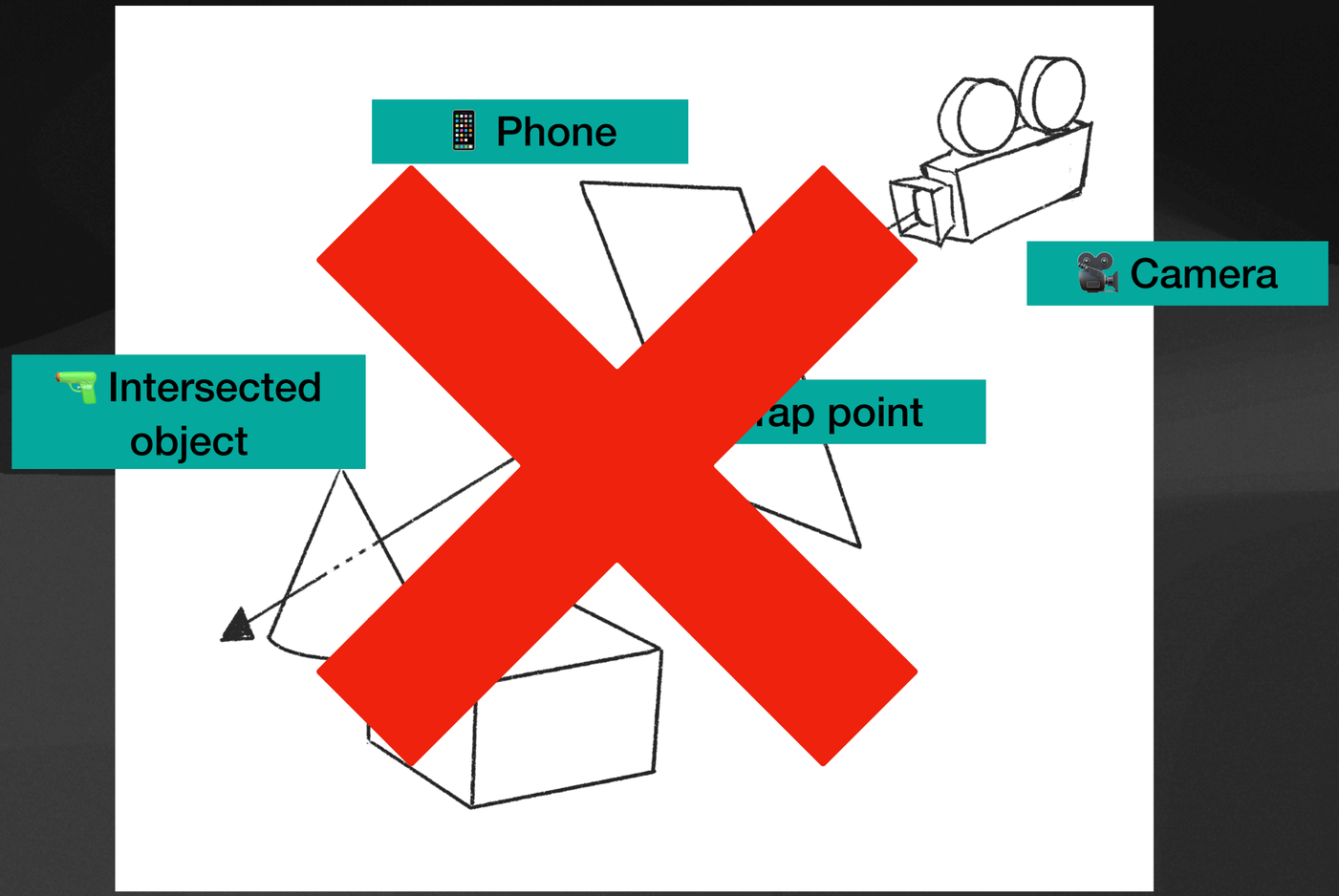
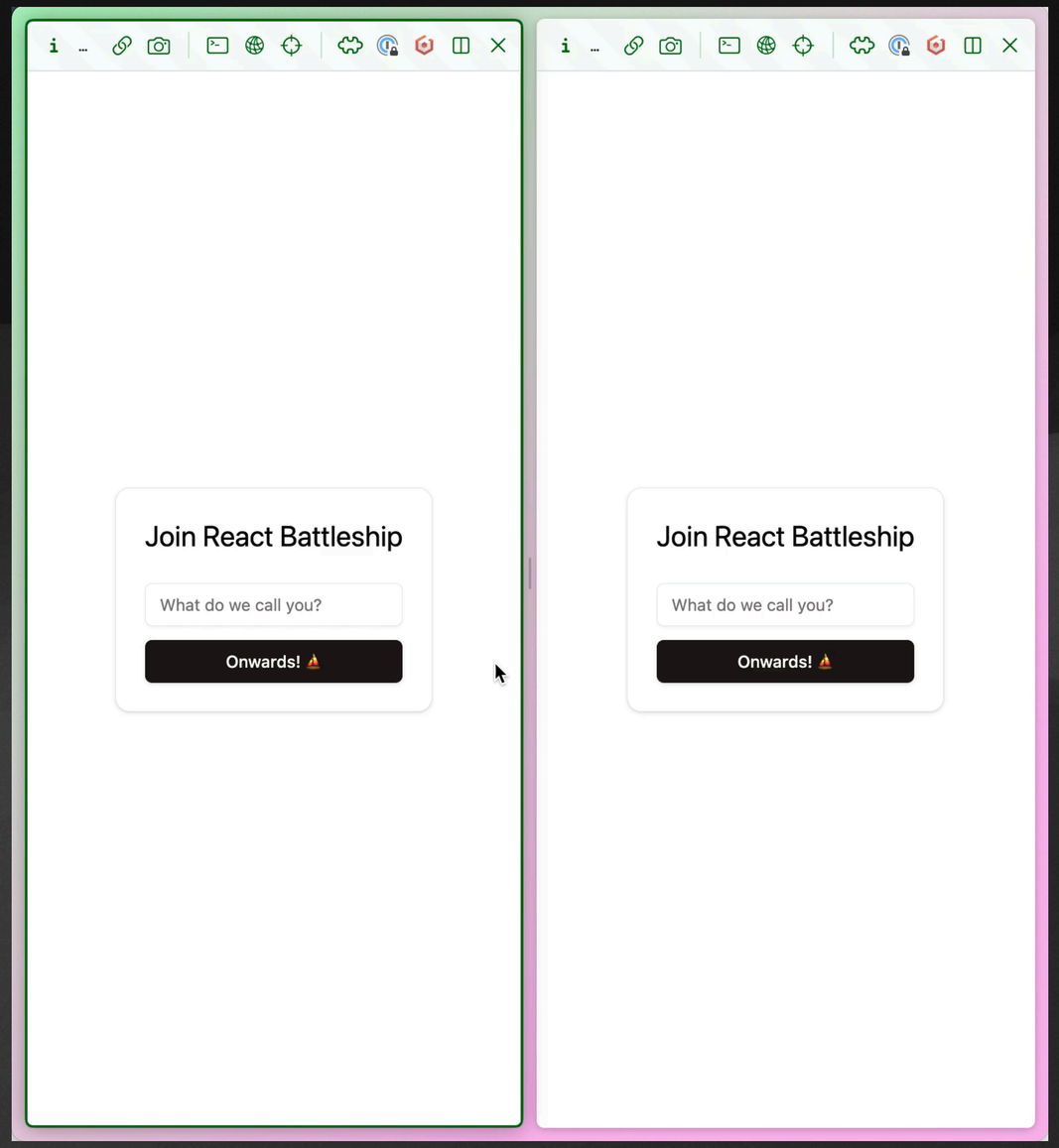


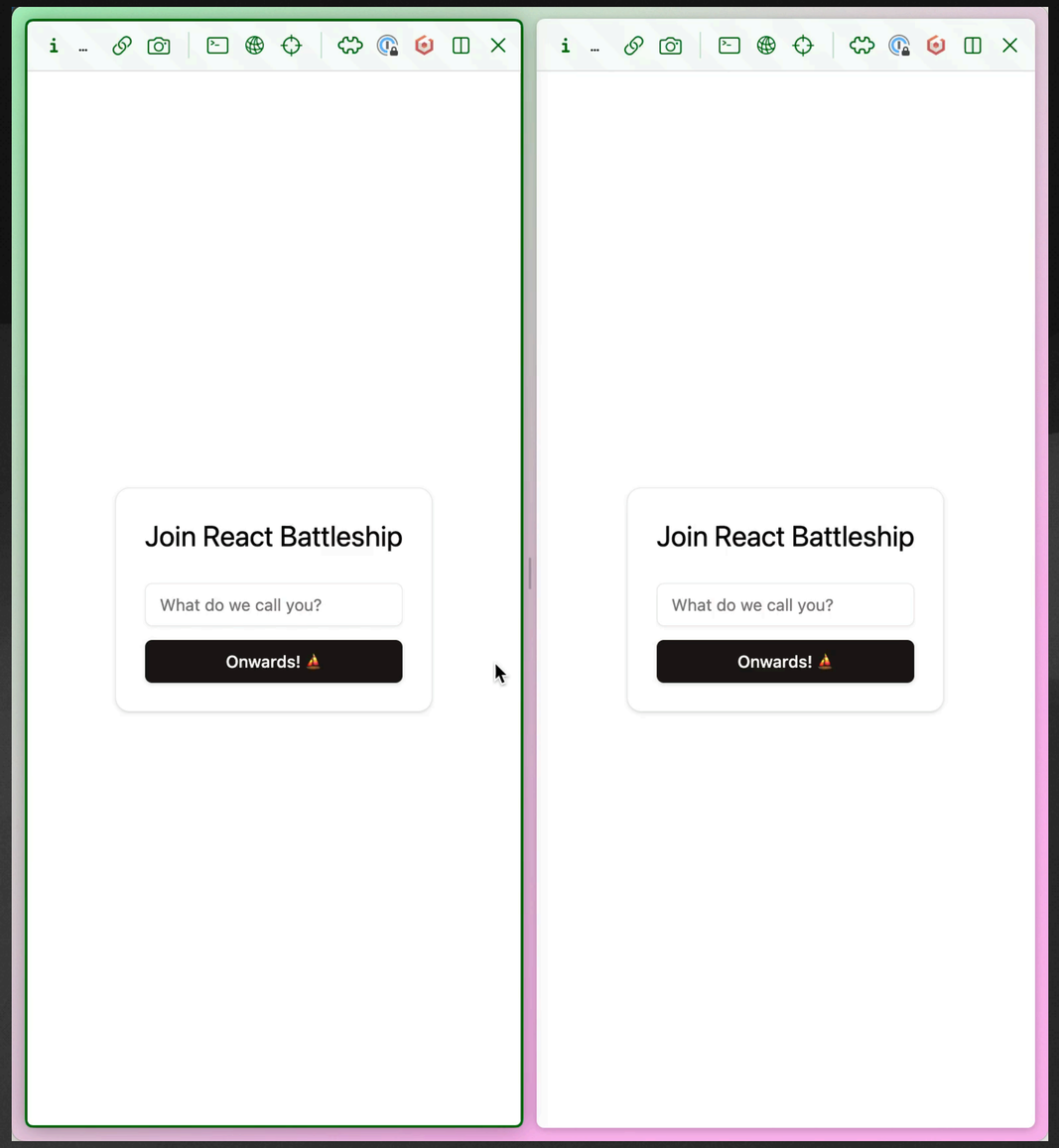
ReactLobby.jsx

```
<mesh
  rotation={[-Math.PI / 2, 0, 0]}
  position={[0, -0.1, 0]}
  ref={planeRef}
  onClick={(event: ThreeEvent<MouseEvent>) => {
    if (!planeRef.current || !currentPlayer) return;

    const {x, y, z} = currentPlayer.position;
    const direction = new Vector3().subVectors(
      event.point,
      new Vector3(x, y, z),
    );
    const distance = direction.length();
    direction.normalize();
    direction.multiplyScalar(Math.min(distance, 3));

    setTarget(direction.add(new Vector3(x, y, z)));
  }}
>
  <planeGeometry args={[100, 100]} />
  <meshStandardMaterial color="lightblue" />
</mesh>
```


Join React Battleship
What do we call you?
Onwards!
Join React Battleship
What do we call you?
Onwards!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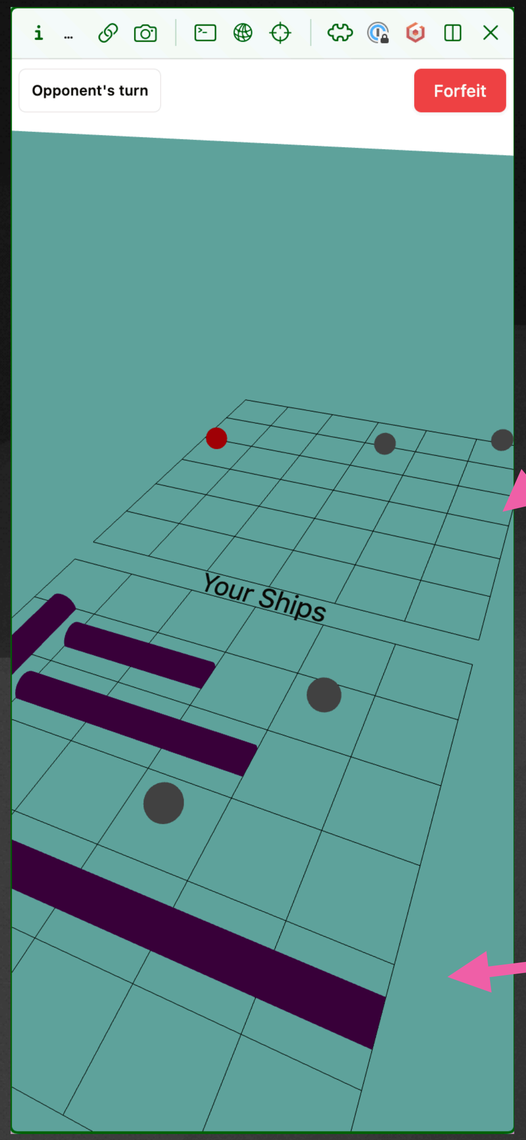


GridHelper

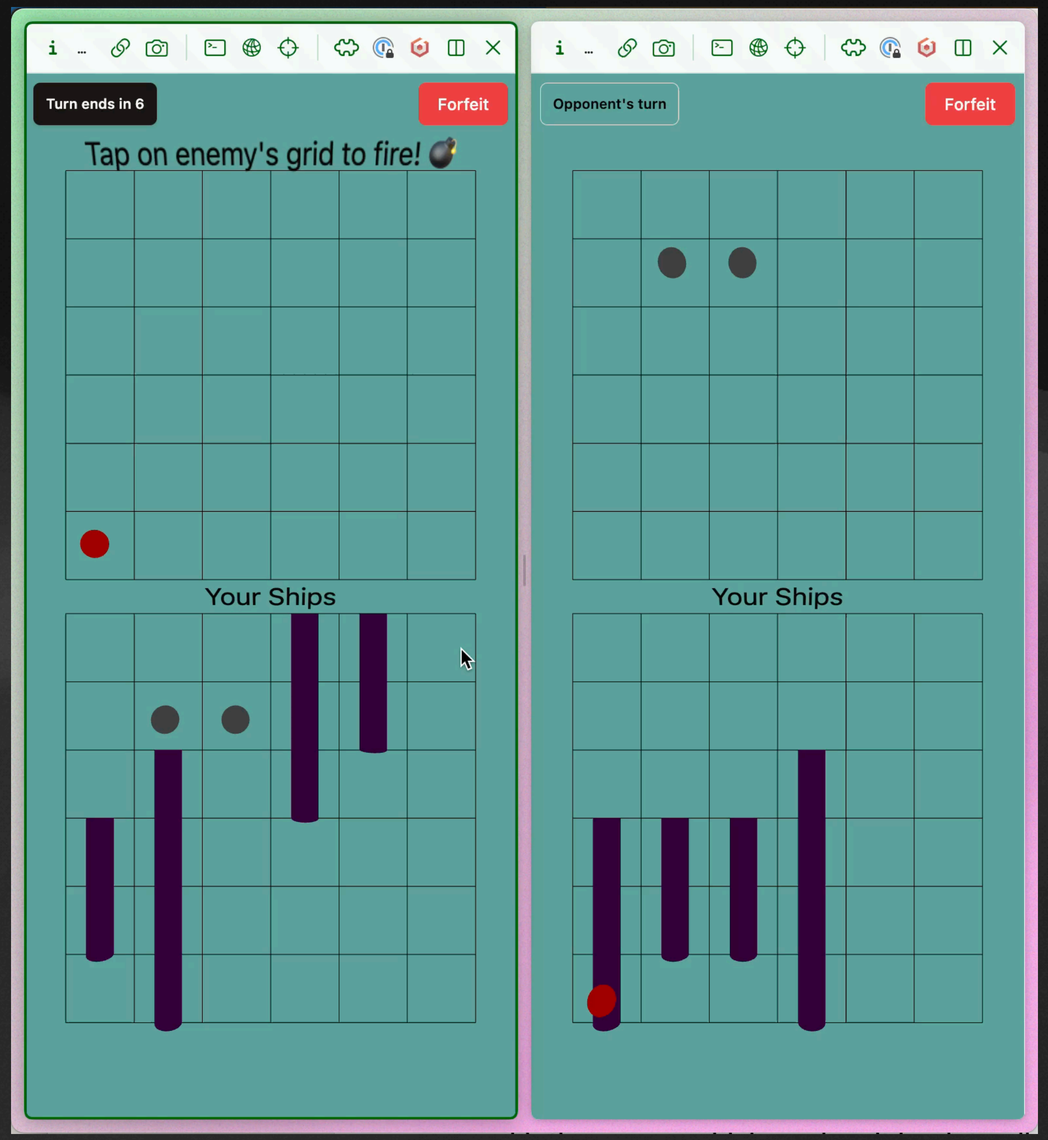
WaterBackground

Game.jsx

```
<WaterBackground
  onClick={(e: ThreeEvent<MouseEvent>) => {
    const x = e.point.x;
    const z = e.point.z + 3.25;
    const isInOpponentGrid =
      x >= -GRID_WIDTH / 2 &&
      x <= GRID_WIDTH / 2 &&
      z >= -GRID_WIDTH / 2 &&
      z <= GRID_WIDTH / 2;

    if (!isInOpponentGrid || !gameState?.yourTurn || showCannon) {
      return;
    }

    const col = Math.floor((x + GRID_WIDTH / 2) / CELL_SIZE);
    const row = Math.floor((z + GRID_WIDTH / 2) / CELL_SIZE);

    setShowCannon(true);
    setCannonEnd(e.point.clone());

    setTimeout(() => {
      setShowCannon(false);
      onCannonFired(row, col);
      onFired();
    }, cannonDuration + 200);
  }}
/>
```

Game.jsx

```jsx
<Grid grid={gameState.yourGrid} position={[0, 0, 3.25]}>
  {gameState.yourShipPositions.map((ship) => {
    const rotationY = ship.direction === "vertical" ? 0 : -Math.PI / 2;

    let positionZ = -GRID_SIZE / 2;
    let positionX = -GRID_SIZE / 2;

    // offset based on size of ship
    positionZ +=
      ship.direction === "horizontal"
        ? (SHIP_SIZE[ship.type] * CELL_SIZE) / 2
        : 0;
    positionX +=
      ship.direction === "vertical"
        ? (SHIP_SIZE[ship.type] * CELL_SIZE) / 2
        : 0;

    // offset based on start position
    positionZ += ship.start.x * CELL_SIZE;
    positionX += ship.start.y * CELL_SIZE;

    // offset to center of cell based on direction
    positionZ += ship.direction === "vertical" ? CELL_SIZE / 2 : 0;
    positionX += ship.direction === "horizontal" ? CELL_SIZE / 2 : 0;

    const position = new Vector3(positionX, 0, positionZ);
    return (
      <mesh
        position={position}
        rotation={[0, rotationY, -Math.PI / 2]}
        key={ship.type}
      >
        <cylinderGeometry args={[0.2, 0.2, SHIP_SIZE[ship.type], 32]} />
        <meshStandardMaterial color="purple" />
      </mesh>
    );
  })}
</Grid>
```



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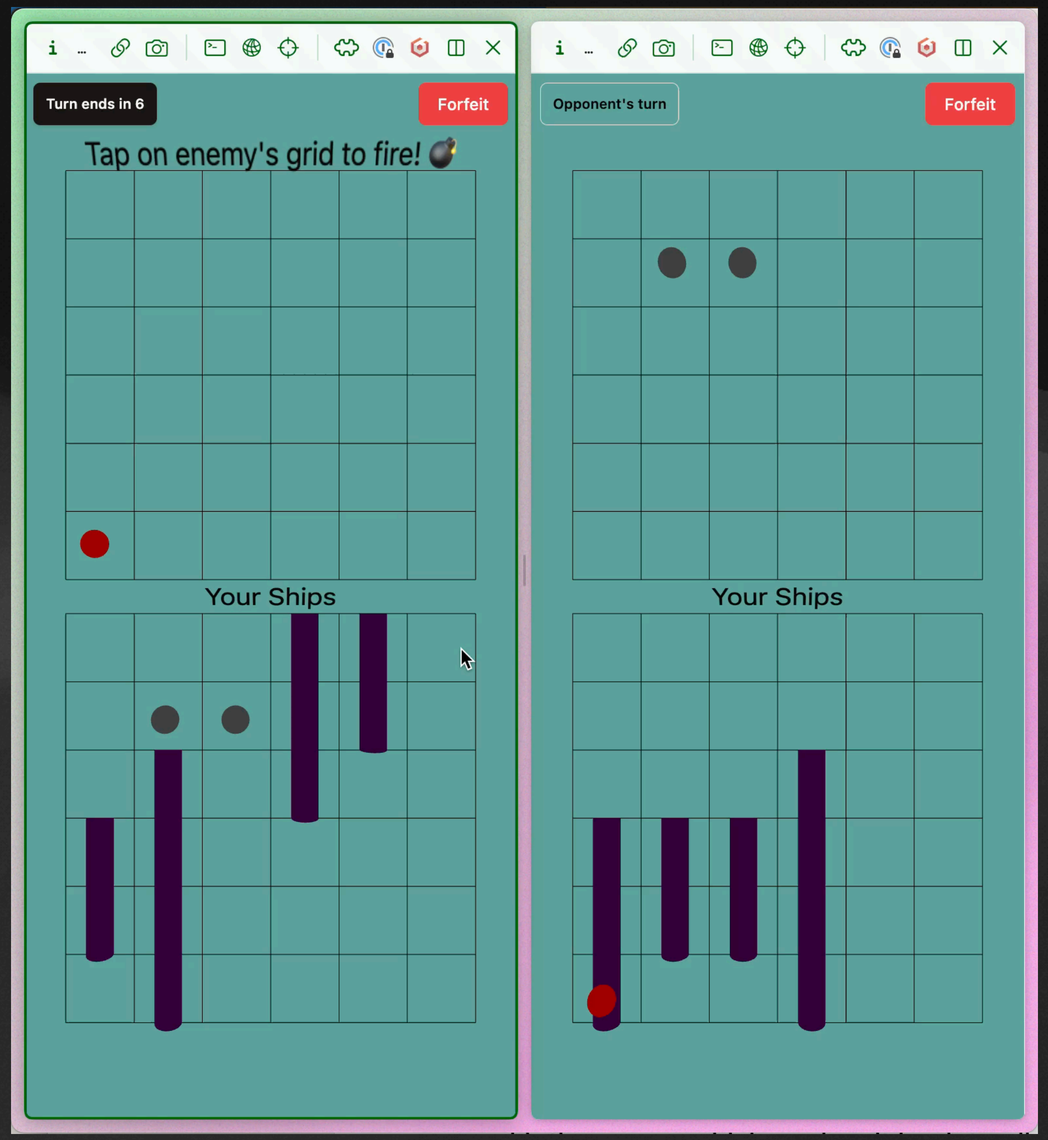
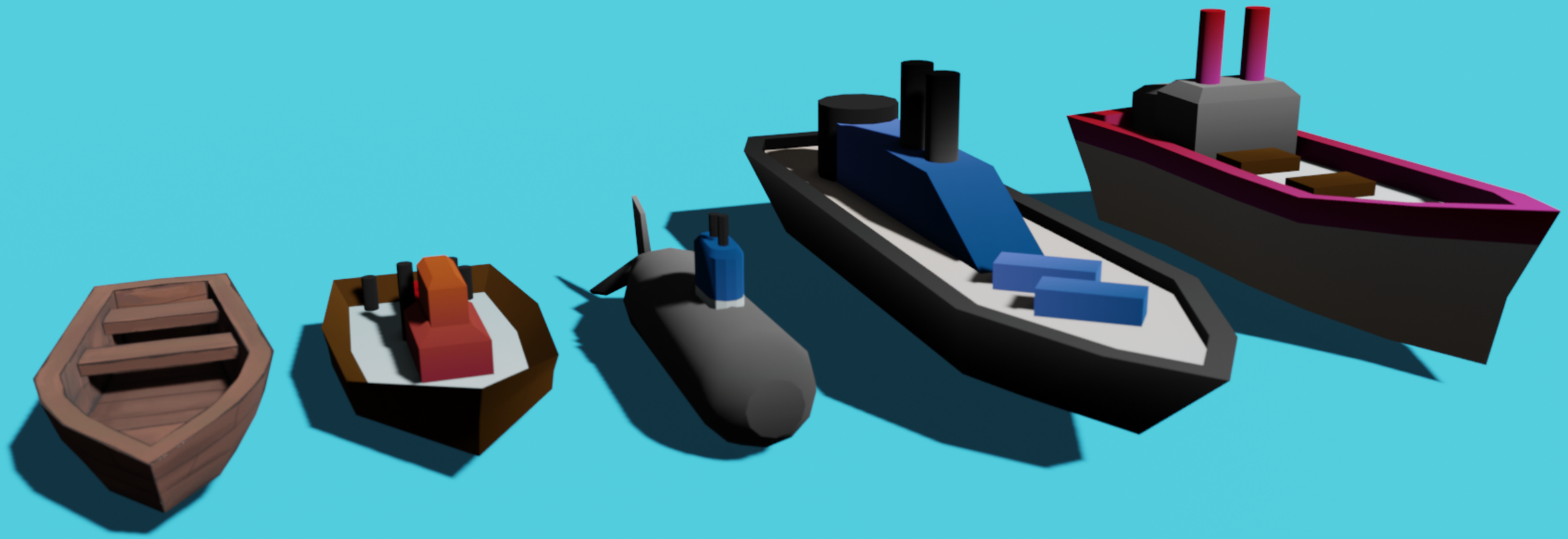


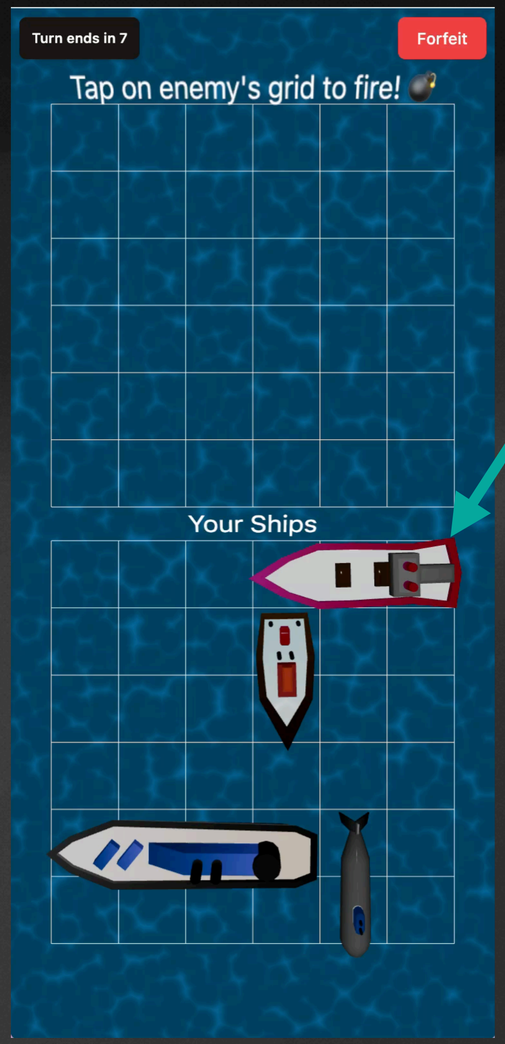
✨ Production

Models



Models in game

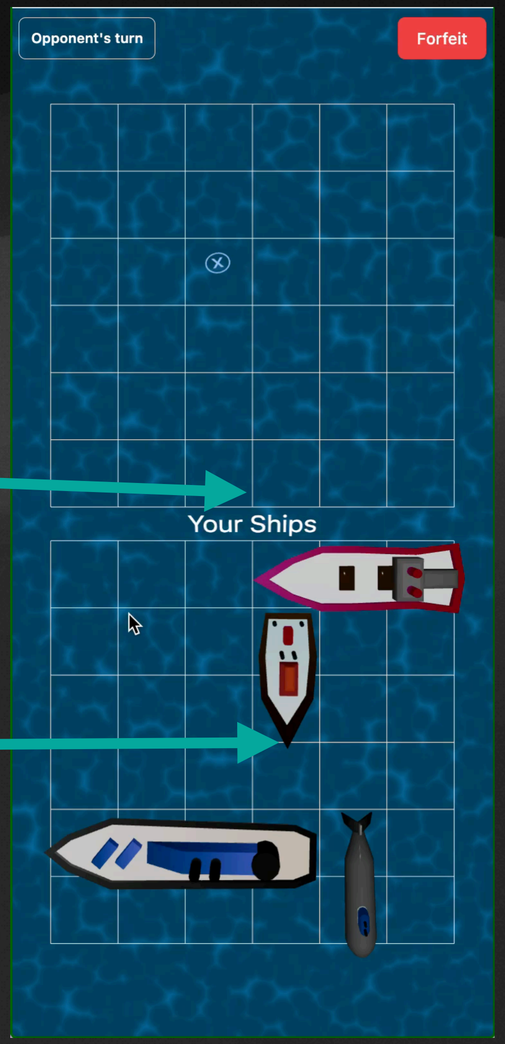
Animations



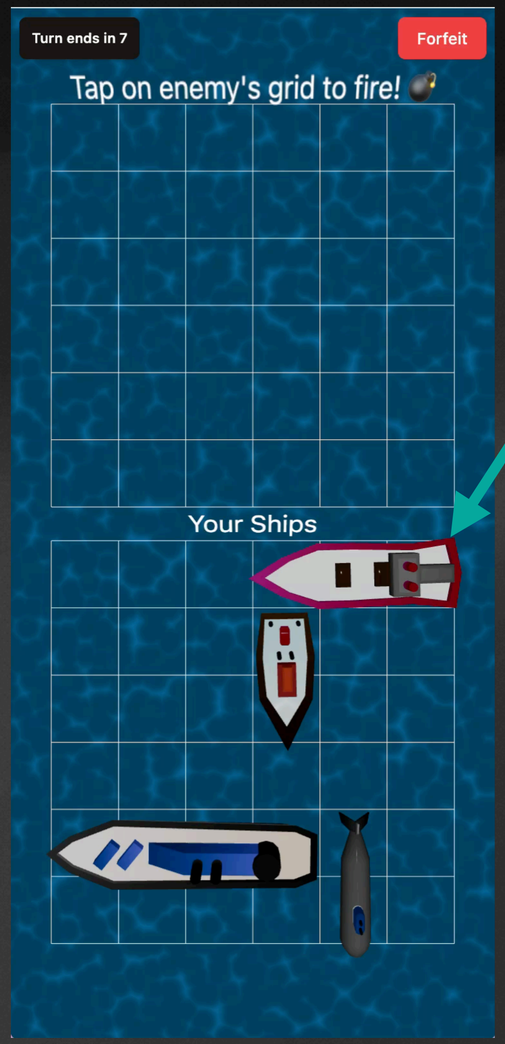
<Float>

useSpring

model animations



Animations



<Float>

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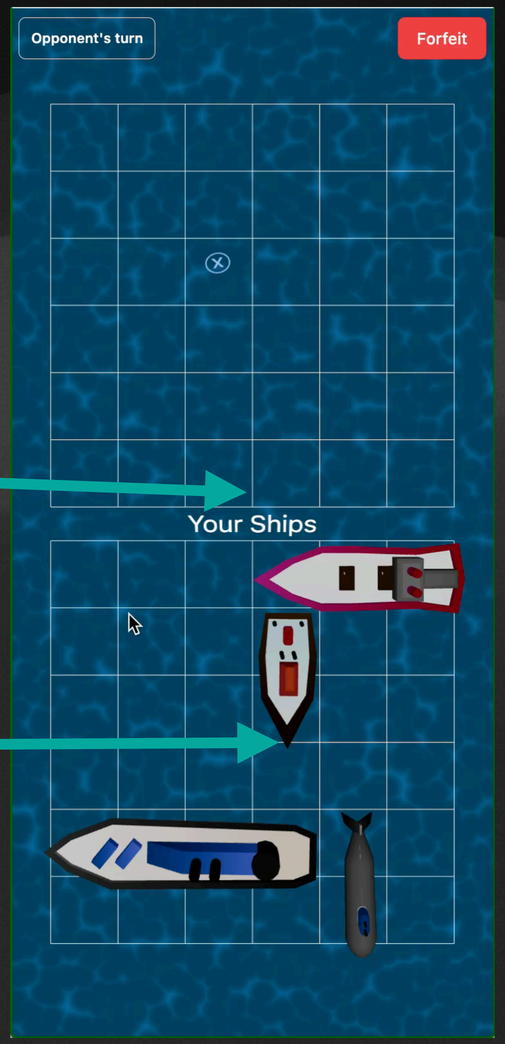
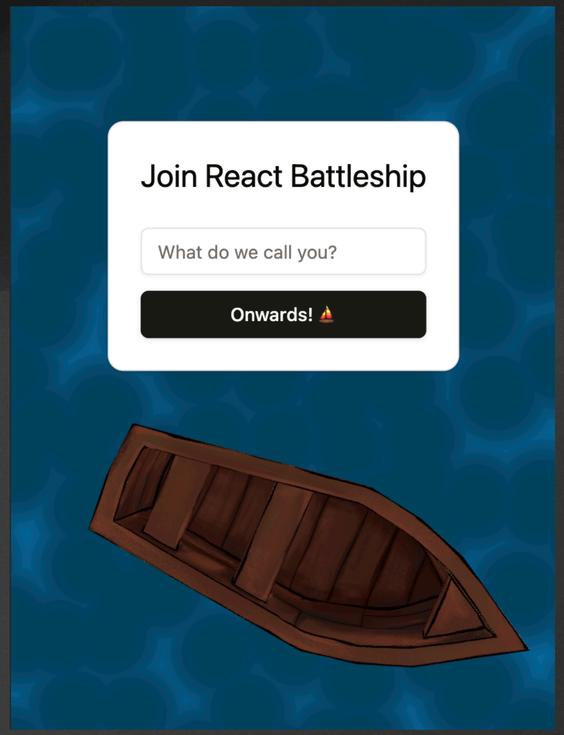


UI Improvements



⛵ Demo

bit.ly/react-battleship

Resources

- Wawa Sensei's React Three Fiber Ultimate Guide
- Bruno Simon's Three.js Journey
- WebGameDev Community (newsletter, discord server)

Thank you ✨

@maya_ndljk

@mayacoda