下一步提示实现具体说明

提示交互逻辑的修改

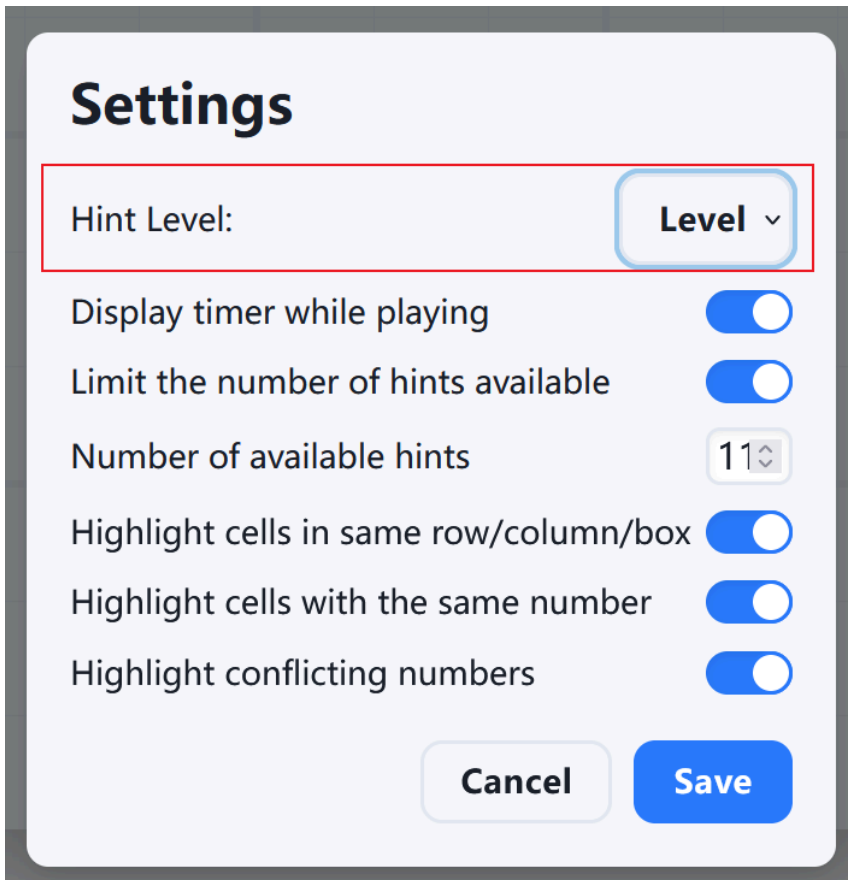
1. 设置项

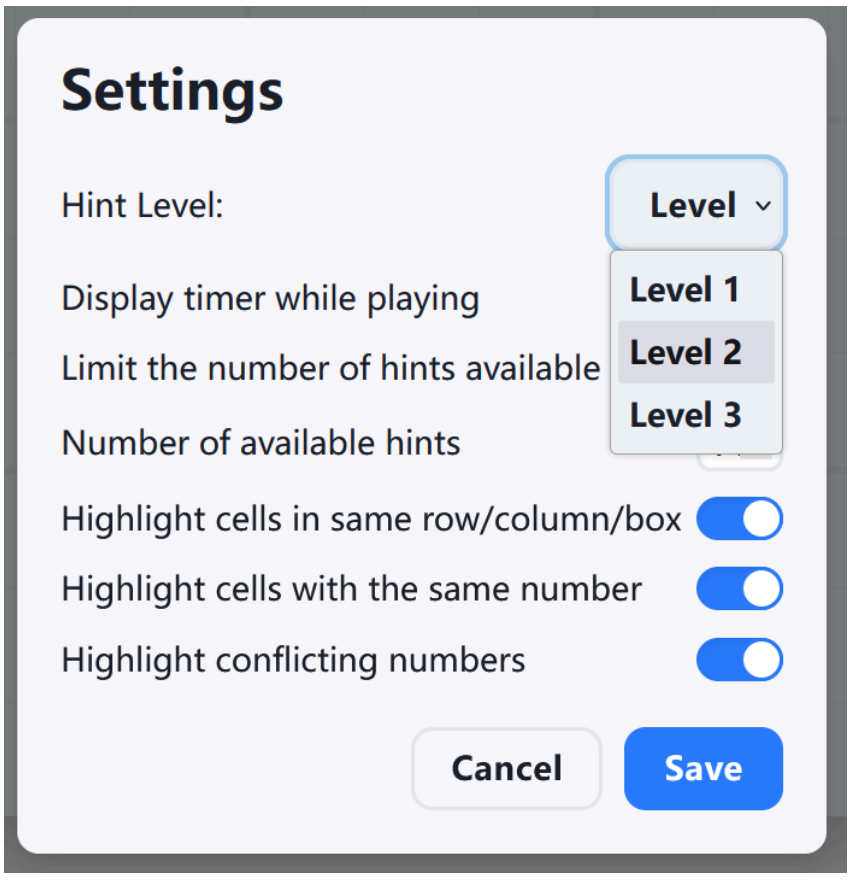
在设置中加入 `hintLevel` 选项，备选值为 {1,2,3}，通过 `hintLevel` 指明通过提示按钮获得的提示等级，`hintLevel` 值可以通过设置按钮来修改。

修改涉及以下文件：

1. src/node_modules/@sudoku/constants.js
2. src/components/Modal/Types/Settings.svelte

实现效果如下：





2. 提示的应用逻辑和显示效果

原项目的提示交互逻辑：

1. 前端展示：在操作栏中展示提示按钮，并根据提示次数的可用性控制按钮的状态。
2. 用户交互：用户点击提示按钮后，前端调用 handleHint 函数，触发提示逻辑。
3. 状态管理：hints store 管理提示次数，userGrid store 管理数独棋盘的状态。
4. 提示逻辑：调用 solveSudoku 方法求解数独，并将当前单元格的值设置为求解后的正确值。
5. 后端求解：使用 @mattflow/sudoku-solver 库进行数独求解，返回正确的数字。

将其修改为：

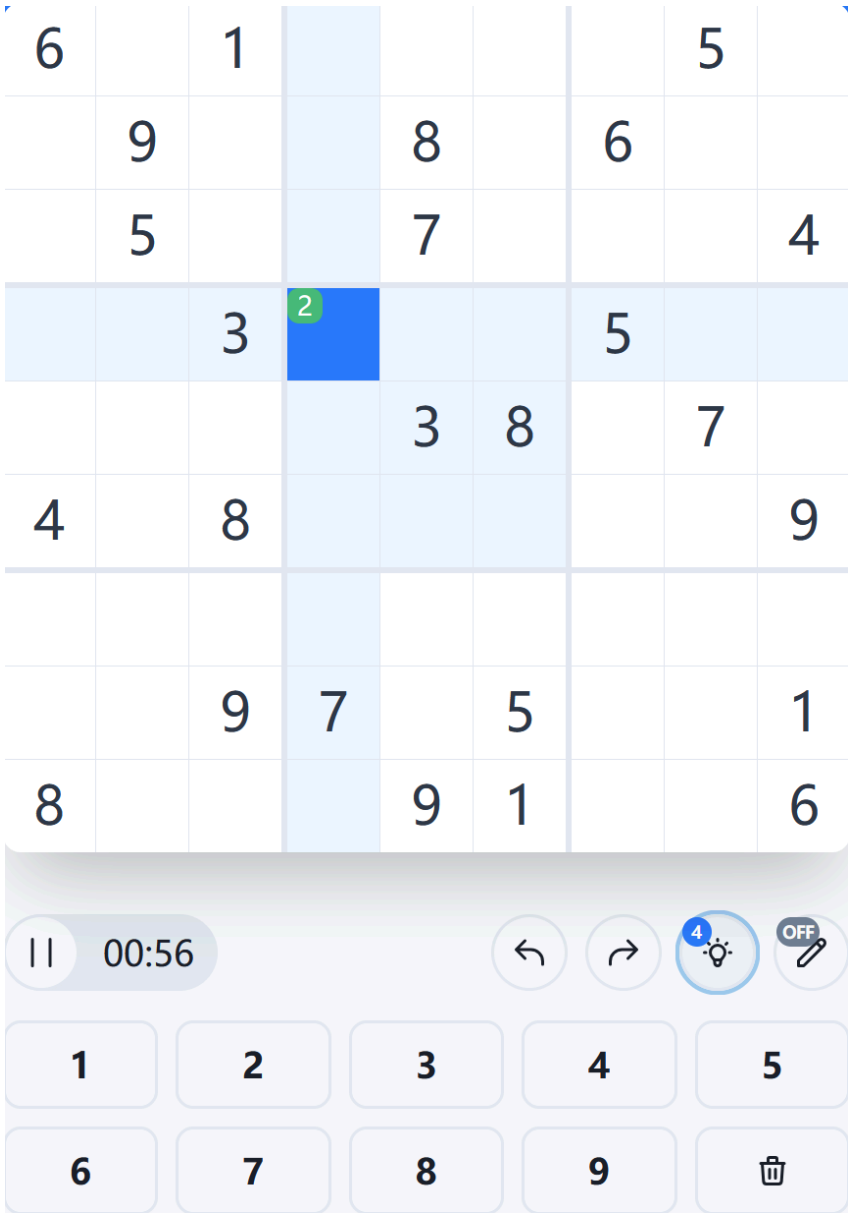
1. 用户点击提示按钮后，调用 handleHint 触发提示逻辑。
2. 求解数独，在当前单元格上显示求解后正确的值，但并不修改 userGrid 的状态。
3. 如果用户点击当前单元格，如果单元格上只有唯一候选值，则将当前单元格上的值填入 userGrid 中；如果单元格上有多个提示候选值，则不填入，由用户自己在键盘上输入数值填入。

4. 如果用户点击其他单元格，则不再显示当前单元格上的提示内容。

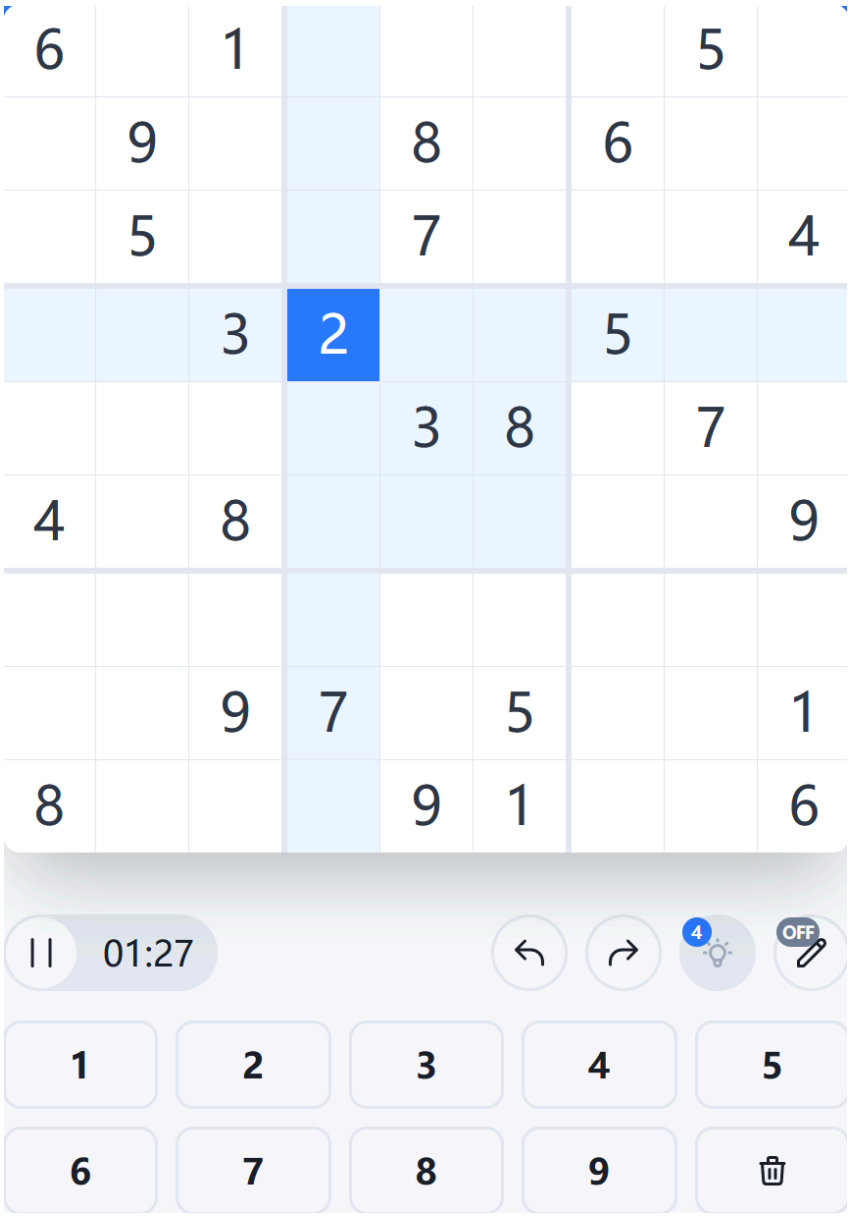
涉及修改的文件：

1. src/components/Board/Cell.svelte
2. src/components/Board/index.svelte
3. src/node_modules/@sudoku/stores/hintStore.js → 该项为新增
4. src/node_modules/@sudoku/stores/hints.js
5. src/node_modules/@sudoku/stores/grid.js

实现效果如下：



点击提示



点击单元格

具体交互逻辑的说明：

1. 用户点击提示按钮，触发 Hints 类的 useHint 方法，通过和策略类交互，将当前棋盘状态送入策略类，策略类返回一个两个数组：第一个数组是通过调用策略得到的棋盘候选值，可以理解为一个 9×9 的二维数组，数组的元素也是数组：表示每个位置上的候选值列表，该列表长度就是候选值的数量；第二个数组是策略类返回的提示原因，也是一个 9×9 的二维数组，数组的元素是一个说明原因的列表。
2. Hints 类通过筛选得到的候选值列表的长度，将其分组到三个列表中：长度为1（仅一个候选值）的进 level_one_list，长度为2的进 level_two_list，长度<9的进 level_three_list，得到三个列表后根据设置中的 hintLevel 选项决定将哪个列表传递到 userGrid 类。
3. userGrid 类将 Hints 类传递过来的解数组存入 hintStore 中，hintStore 通过一个 writable 的 store 存储解数组，在前端 Cell.svelte 中对 hintStore 进行订阅。
4. 点击提示后，hintStore 中的状态发生改变，Cell.svelte 的前端展示部分会把新增的提示内容显示在对应的单元格上，如果点击提示，则将提示值填入 userGrid，同时清空 hintStore 的存储状态；如果点击其他没有提示的单元格，同样清空 hintStore 的存储状态。

5. 同时 Hints 类中得到的原因数组也会通过一个 writable 的 store 进行存储，在 Cell.svelte 中导入，如果点击提示的单元格上有相应的原因，则会在棋盘左侧显示原因的文字。

3. 与策略类的对接

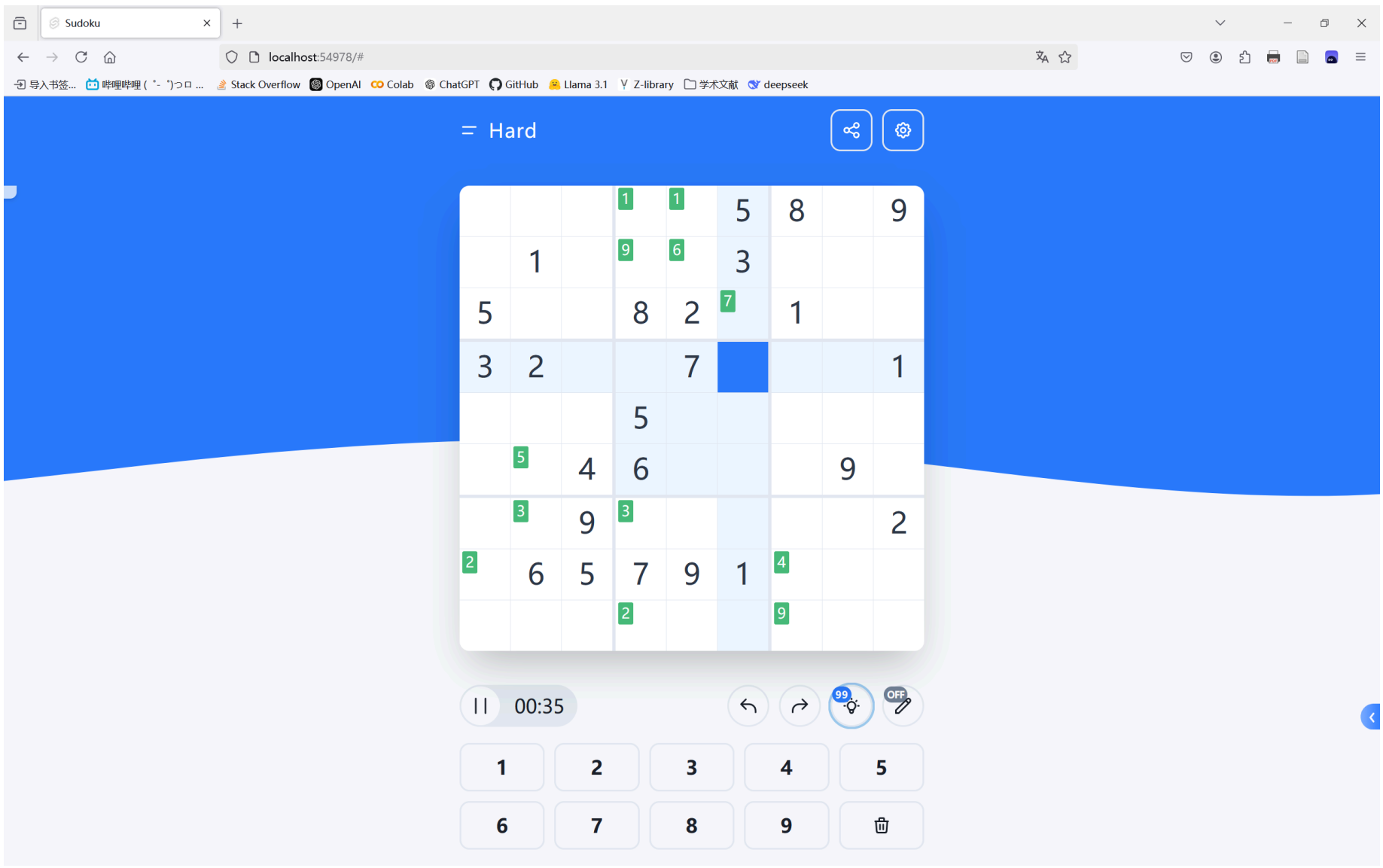
解题策略相关的内容在 sudoku-main\src\node_modules@sudoku\strategy 目录下。用法：

- strategyManager.js 是策略的管理类。
- 具体的导出类实例、注册策略：

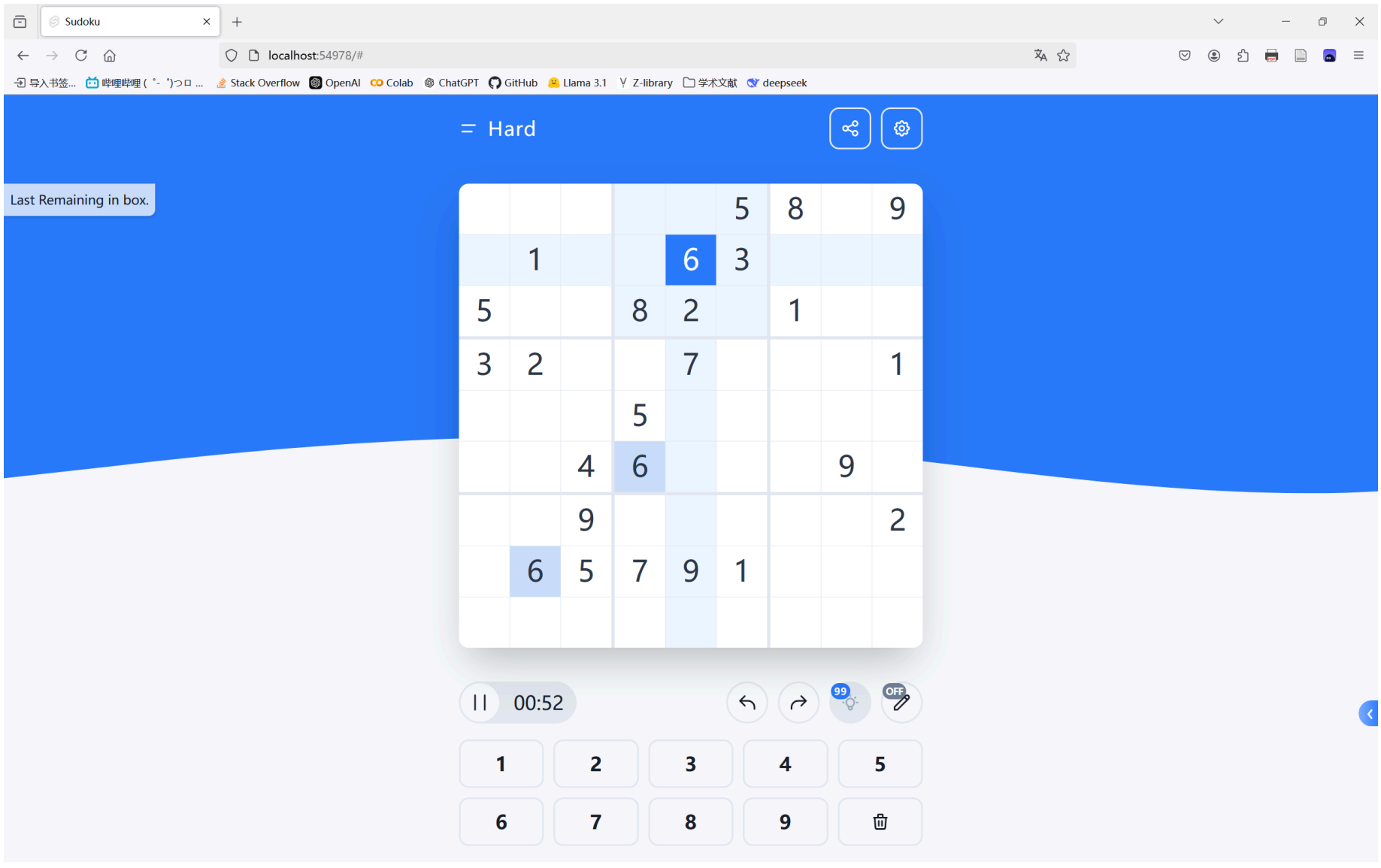
```javascript
export const strategymanager = new StrategyManager();

// 注册策略
strategymanager.register(lastRemianStrategy)
strategymanager.register(nakePairStrategy);
strategymanager.register(hiddenPairStrategy);
```

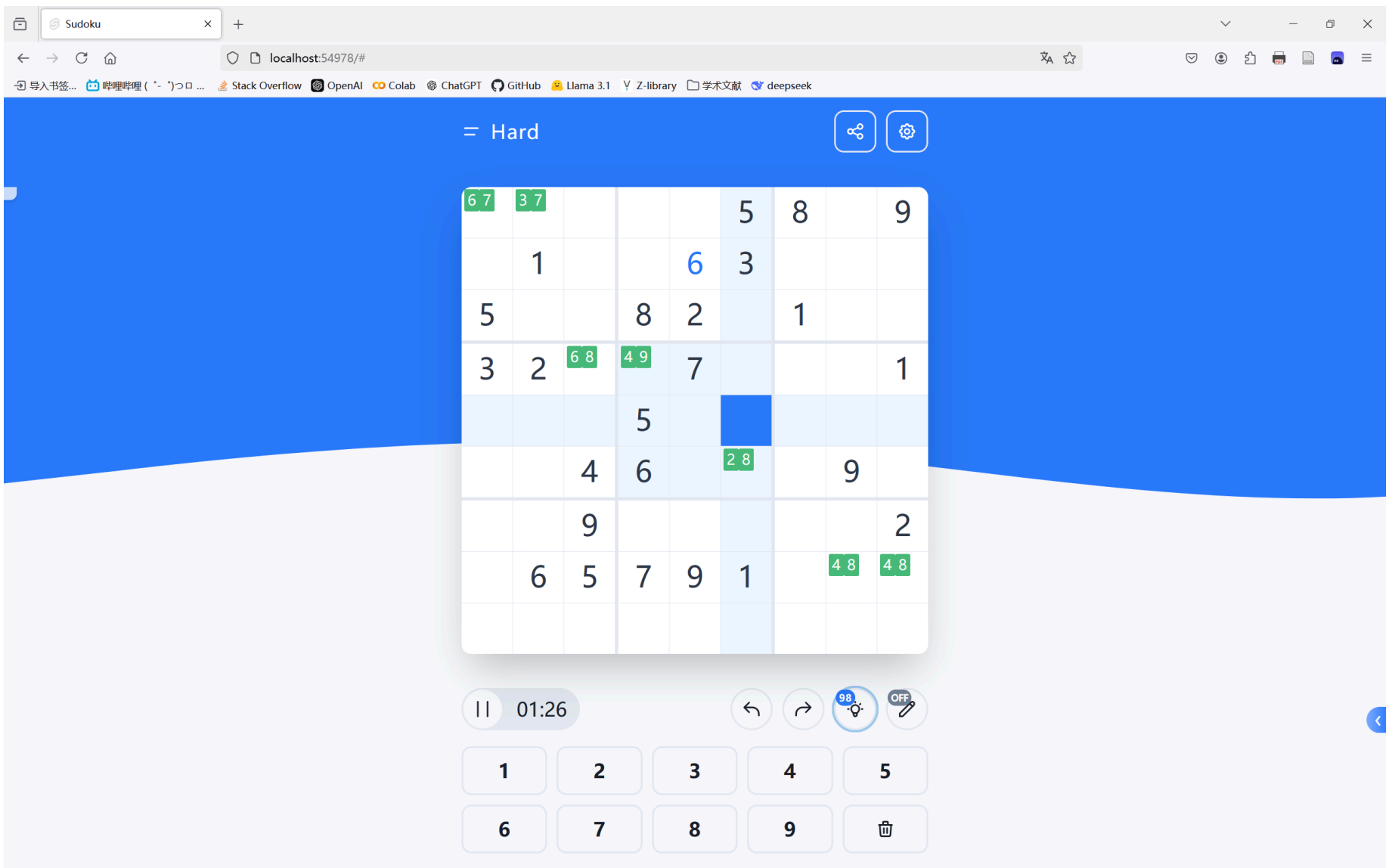
实现效果如下：



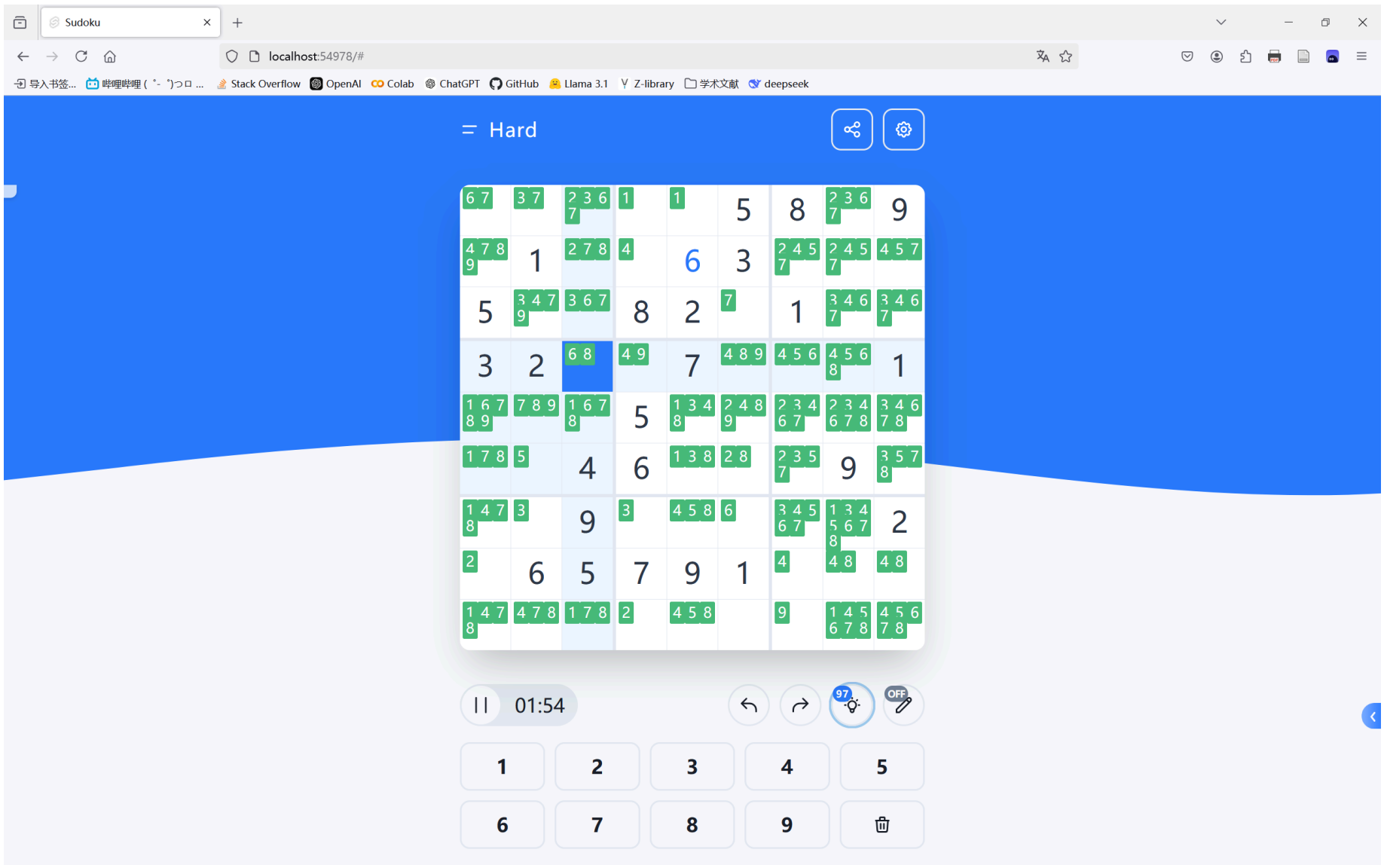
一级提示



提示后弹出原因



二级提示



三级提示

其他说明

1. 代码中的 console.log 均为调试语句，可以删除。
2. 如果提示只有一个候选值，点击单元格会填入提示值；如果提示有多个候选值，点击单元格则提示内容消失，单元格的值由用户自行填入。

具体修改的代码（整个粘贴）

src/node_modules/@sudoku/constants.js

SVELTE

```
export const BASE_URL = 'https://sudoku.jonasgeiler.com/';

export const DIFFICULTY_CUSTOM = 'custom';
export const DIFFICULTIES = {
    veryeasy: 'Very Easy',
    easy:     'Easy',
    medium:   'Medium',
    hard:     'Hard',
};

export const DEFAULT_SETTINGS = {
    darkTheme:            false,
    displayTimer:         true,
    hintsLimited:         true,
    hints:                5,
    highlightCells:       true,
    highlightSame:        true,
    highlightConflicting: true,
```

```
    hintLevel:            1, // 新增 hintLevel，默认值为 1
};
export const MAX_HINTS = 99999;

export const SUDOKU_SIZE = 9;
export const BOX_SIZE = 3;
export const GRID_LENGTH = SUDOKU_SIZE * SUDOKU_SIZE;
export const GRID_COORDS = [[0,0],[0,1],[0,2],[0,3],[0,4],[0,5],[0,6],[0,7],[0,8],[1,0],[1,1],[1,2],
[1,3],[1,4],[1,5],[1,6],[1,7],[1,8],[2,0],[2,1],[2,2],[2,3],[2,4],[2,5],[2,6],[2,7],[2,8],[3,0],
[3,1],[3,2],[3,3],[3,4],[3,5],[3,6],[3,7],[3,8],[4,0],[4,1],[4,2],[4,3],[4,4],[4,5],[4,6],[4,7],
[4,8],[5,0],[5,1],[5,2],[5,3],[5,4],[5,5],[5,6],[5,7],[5,8],[6,0],[6,1],[6,2],[6,3],[6,4],[6,5],
[6,6],[6,7],[6,8],[7,0],[7,1],[7,2],[7,3],[7,4],[7,5],[7,6],[7,7],[7,8],[8,0],[8,1],[8,2],[8,3],
[8,4],[8,5],[8,6],[8,7],[8,8]];
export const CANDIDATE_COORDS = [[1, 1],[1, 2],[1, 3],[2, 1],[2, 2],[2, 3],[3, 1],[3, 2],[3, 3]];

export const SENCODE_SEPARATOR = '-';
export const SENCODE_SEPARATOR_REVERSE = '_';
export    const    SENCODE_REGEX    =    new    RegExp('^[a-zA-Z0-9]+['    +    SENCODE_SEPARATOR    +
SENCODE_SEPARATOR_REVERSE + '][a-zA-Z0-9]+$');

export const BASE62_CHARSET = '0123456789abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ';

export const MODAL_NONE = 'none'; // Modal type when hidden
export const MODAL_DURATION = 400;

export const DROPDOWN_DURATION = MODAL_DURATION;

export const GAME_OVER_CELEBRATIONS = [
    'Excellent!',
    'Wow!',
    'Congratulations!',
    'Oh yeah!',
    'Impressive!',
    'Good work!',
    'You did great!',
    'Applause!',
    'Great!'
]
```

src/components/Modal/Types/Settings.svelte

JAVASCRIPT

```
<script>
    import { slide } from 'svelte/transition';
    import Switch from '../../Utils/Switch.svelte';
    import { settings as settingsStore } from '@sudoku/stores/settings';
    import { MAX_HINTS } from '@sudoku/constants';

    export let data = {};
    export let hideModal;

    let settings = { ...$settingsStore };

    let hintsLimited = settings.hintsLimited;

    function handleSave() {
        settings.hintsLimited = hintsLimited;

```

```
        if (settings.hints < 0) settings.hints = 0;
        if (settings.hints > MAX_HINTS) settings.hints = MAX_HINTS;

        settingsStore.set(settings);
        hideModal();
    }
</script>

<h1 class="text-3xl font-semibold mb-6 leading-none">Settings</h1>

<!--

- Display Timer while playing
- Highlight cells in same Row/Column/Box
- Highlight matching digits
- Highlight conflicting digits
-

-->

<div class="flex flex-col mb-6 space-y-3">
    <!--<Switch bind:checked={settings.darkTheme} text="Enable dark theme" id="dark-theme" />-->

    <!-- 新增 hintLevel 选项 -->
    <div class="inline-flex items-center">
        <label for="hintLevel" class="flex-grow text-lg">Hint Level:</label>
        <select id="hintLevel" class="btn btn-small w-24" bind:value={settings.hintLevel}>
            <option value={1}>Level 1</option>
            <option value={2}>Level 2</option>
            <option value={3}>Level 3</option>
        </select>
    </div>

    <!-- 其他设置项 -->
     <Switch bind:checked={settings.displayTimer} text="Display timer while playing" id="display-timer" />

    <Switch bind:checked={hintsLimited} text="Limit the number of hints available" id="hints-limited" />
    {#if hintsLimited}
        <div transition:slide class="inline-flex items-center">
            <label for="hints" class="flex-grow text-lg">Number of available hints</label>

                <input bind:value={settings.hints} class="number-input" id="hints" name="hints" type="number" min="0" max="81" />
        </div>
    {/if}

     <Switch bind:checked={settings.highlightCells} text="Highlight cells in same row/column/box" id="highlight-cells" />
     <Switch bind:checked={settings.highlightSame} text="Highlight cells with the same number" id="highlight-matching" />
      <Switch bind:checked={settings.highlightConflicting} text="Highlight conflicting numbers" id="highlight-conflicting" />
</div>

<div class="flex justify-end">
    <button class="btn btn-small mr-3" on:click={hideModal}>Cancel</button>
    <button class="btn btn-small btn-primary" on:click={handleSave}>Save</button>
</div>

```

```
<style>
    .number-input {
        @apply w-12 h-8 px-1 border-2 rounded-lg shadow-inner text-xl text-center leading-none;
    }

    .number-input:focus {
        @apply outline-none shadow-outline;
    }
</style>
```

src/components/Board/Cell.svelte

SVELTE

```
<script>
    import Candidates from './Candidates.svelte';
    import { fade } from 'svelte/transition';
    import { SUDOKU_SIZE } from '@sudoku/constants';
    import { cursor } from '@sudoku/stores/cursor';
    import { hintStore } from '@sudoku/stores/hintStore'; // 导入 hintStore
    import { userGrid } from '@sudoku/stores/grid'

    import { hintText } from '@sudoku/stores/hints'; // 导入 hintText
    import { reasons_list } from '@sudoku/stores/hints'; // 导入 reasons_list
    import { get } from 'svelte/store'; //导入 svelte 的 get 方法

    export let value;
    export let cellX;
    export let cellY;
    export let candidates;

    export let disabled;
    export let conflictingNumber;
    export let userNumber;
    export let selected;
    export let sameArea;
    export let sameNumber;

    const borderRight = (cellX !== SUDOKU_SIZE && cellX % 3 !== 0);
    const borderRightBold = (cellX !== SUDOKU_SIZE && cellX % 3 === 0);
    const borderBottom = (cellY !== SUDOKU_SIZE && cellY % 3 !== 0);
    const borderBottomBold = (cellY !== SUDOKU_SIZE && cellY % 3 === 0);

    // 用于存储所有提示内容
    let allHints = [];

    // 订阅 hintStore，获取所有提示数据
    hintStore.subscribe(hints => {
        allHints = hints; // 保存整个 hintStore 列表
    });

    function handleCellClick() {
        cursor.set(cellX - 1, cellY - 1);
        // 查找是否有提示与当前单元格匹配
        const matchingHint = allHints.find(hint => hint.x === cellX - 1 && hint.y === cellY - 1);
        let hintval = 0;
        if (matchingHint) {
            // 如果找到匹配的提示，将提示的值填入 userGrid 对应位置
            if (matchingHint.value.length === 1) {
```

```
                hintval = matchingHint.value[0];
                userGrid.set({ x: cellX - 1, y: cellY - 1 }, hintval);
            }

            // 如果找到匹配的提示，才设置显示提示的原因
            let reasons = get(reasons_list); // 提取 writable 的当前值
            console.log("reasons:",reasons);
            const matchingReason = reasons[cellY-1][cellX-1];
            console.log("cellX-1:",cellX-1,"cellY-1:",cellY-1,"matchingReason:",matchingReason);
            if (matchingReason && matchingReason.length) {
                hintText.set(matchingReason[0]);
                console.log(matchingReason[0]);
            }

        } else {
            hintText.set("");
        }

        // 清空 hintStore 的内容
        hintStore.clear();
    }

</script>

<div class="cell row-start-{cellY} col-start-{cellX}"
     class:border-r={borderRight}
     class:border-r-4={borderRightBold}
     class:border-b={borderBottom}
     class:border-b-4={borderBottomBold}>

    {#if !disabled}
        <div class="cell-inner"
             class:user-number={userNumber}
             class:selected={selected}
             class:same-area={sameArea}
             class:same-number={sameNumber}
             class:conflicting-number={conflictingNumber}>

            <button class="cell-btn" on:click={handleCellClick}>
                {#if candidates}
                    <Candidates {candidates} />
                {:else}
                    <span class="cell-text">{value || ''}</span>
                {/if}

                {#each allHints as hint}
                    {#if hint.x === cellX-1  && hint.y === cellY-1 }
                         <div class="hint-grid grid grid-cols-3 grid-rows-3 gap-0.5 p-0.5 absolute
inset-0">
                           {#each hint.value as val}
                               <div class="hint-value">
                                   {val}
                               </div>
                           {/each}
                       </div>
                    {/if}
                {/each}
            </button>


        </div>
```

```
    {/if}
</div>

<style>
    .cell {
        @apply h-full w-full row-end-auto col-end-auto;
    }

    .cell-btn {
        @apply absolute inset-0 h-full w-full;
    }

    .hint-grid {
        width: 90%;
        height: 90%;
        top: 5%;
        left: 5%;
    }

    .hint-value {
        @apply flex items-center justify-center text-white bg-green-500 rounded-sm text-xs;
        aspect-ratio: 1 / 1; /* 确保每个小提示格是正方形 */
    }


    /*.hint-values {*/
    /*  @apply absolute inset-0 flex flex-wrap items-center justify-center gap-1 p-1;*/
    /*}*/

    /*.hint-value {*/
    /*  @apply flex items-center justify-center text-white bg-green-500 rounded-lg text-sm w-6 h-
6;*/
    /*}*/

    .cell-inner {
        @apply relative h-full w-full text-gray-800;
    }



    .cell-btn:focus {
        @apply outline-none;
    }

    .cell-text {
        @apply leading-full text-base;
    }

    @media (min-width: 300px) {
        .cell-text {
            @apply text-lg;
        }
        .hint-value {
            @apply text-lg;
        }
    }

    @media (min-width: 350px) {
        .cell-text {
            @apply text-xl;
        }
```

```
    }

    @media (min-width: 400px) {
        .cell-text {
            @apply text-2xl;
        }
    }

    @media (min-width: 500px) {
        .cell-text {
            @apply text-3xl;
        }
    }

    @media (min-width: 600px) {
        .cell-text {
            @apply text-4xl;
        }
    }

    .user-number {
        @apply text-primary;
    }

    .selected {
        @apply bg-primary text-white;
    }

    .same-area {
        @apply bg-primary-lighter;
    }

    .same-number {
        @apply bg-primary-light;
    }

    .conflicting-number {
        @apply text-red-600;
    }
</style>


```

src/components/Board/index.svelte

SVELTE

```svelte
<script>
    import { BOX_SIZE } from '@sudoku/constants';
    import { gamePaused } from '@sudoku/stores/game';
    import { grid, userGrid, invalidCells } from '@sudoku/stores/grid';
    import { settings } from '@sudoku/stores/settings';
    import { cursor } from '@sudoku/stores/cursor';
    import { candidates } from '@sudoku/stores/candidates';
    import Cell from './Cell.svelte';
    import { hintText } from '@sudoku/stores/hints'; // 导入提示文字状态

    function isSelected(cursorStore, x, y) {
        return cursorStore.x === x && cursorStore.y === y;
```

```
    }

    function isSameArea(cursorStore, x, y) {
        if (cursorStore.x === null && cursorStore.y === null) return false;
        if (cursorStore.x === x || cursorStore.y === y) return true;

        const cursorBoxX = Math.floor(cursorStore.x / BOX_SIZE);
        const cursorBoxY = Math.floor(cursorStore.y / BOX_SIZE);
        const cellBoxX = Math.floor(x / BOX_SIZE);
        const cellBoxY = Math.floor(y / BOX_SIZE);
        return (cursorBoxX === cellBoxX && cursorBoxY === cellBoxY);
    }

    function getValueAtCursor(gridStore, cursorStore) {
        if (cursorStore.x === null && cursorStore.y === null) return null;

        return gridStore[cursorStore.y][cursorStore.x];
    }
</script>

<div class="board-padding relative z-10">

    <!-- 新增：提示文字显示区域 -->
    <div class="hint-text absolute top-0 left-0 p-2 bg-white bg-opacity-75 rounded-br-lg shadow-lg z-20">
        {$hintText}
    </div>

    <div class="max-w-xl relative">
        <div class="w-full" style="padding-top: 100%"></div>
    </div>
    <div class="board-padding absolute inset-0 flex justify-center">

         <div  class="bg-white  shadow-2xl  rounded-xl  overflow-hidden  w-full  h-full  max-w-xl  grid" class:bg-gray-200={$gamePaused}>

            {#each $userGrid as row, y}
                {#each row as value, x}
                    <Cell {value}
                          cellY={y + 1}
                          cellX={x + 1}
                          candidates={$candidates[x + ',' + y]}
                          disabled={$gamePaused}
                          selected={isSelected($cursor, x, y)}
                          userNumber={$grid[y][x] === 0}
                               sameArea={$settings.highlightCells  &&  !isSelected($cursor,  x,  y)  &&  isSameArea($cursor, x, y)}
                           sameNumber={$settings.highlightSame && value && !isSelected($cursor, x, y) && getValueAtCursor($userGrid, $cursor) === value}
                           conflictingNumber={$settings.highlightConflicting && $grid[y][x] === 0 && $invalidCells.includes(x + ',' + y)} />
                {/each}
            {/each}

        </div>

    </div>
</div>

<style>
    .board-padding {
```

```
        @apply px-4 pb-4;
    }

    .hint-text {
        position: absolute;
        top: 0;
        left: 0;
        padding: 8px;
        /*background-color: rgba(255, 255, 255, 0.75); !* 半透明背景 *!*/
        /*border-radius: 0 0 8px 0; !* 右下角圆角 *!*/
        box-shadow: 0 2px 4px rgba(0, 0, 0, 0.1); /* 阴影 */
        z-index: 20; /* 确保提示文字在棋盘之上 */
    }

</style>
```

store/hints.js

JAVASCRIPT

```
import { writable } from 'svelte/store';
import { settings } from './settings';
import { solveSudoku } from '@sudoku/sudoku';

export const usedHints = writable(0);

// 新增：用于存储提示文字的状态
export const hintText = writable('');

class Hints {
    #hints;
    #defaultHints;
    #hintLevel;

    constructor() {
        this.#defaultHints = Infinity;
        this.#hints = writable(Infinity);

        settings.subscribe(($settings) => {
            this.#hintLevel = $settings.hintLevel;
            if ($settings.hintsLimited) {
                this.#defaultHints = $settings.hints;
                this.#hints.update(($hints) => {
                    if ($hints > $settings.hints) return $settings.hints;
                    return $hints;
                });
            } else {
                this.#defaultHints = Infinity;
                this.#hints.set(Infinity);
            }
        });
    }

    subscribe(callback) {
        return this.#hints.subscribe(callback);
    }

    /**
     * 使用提示功能，返回提示内容。
```

```
     * @param {Array<Array<number>>} currentGrid 当前用户数独网格
     * @param {Object} pos 提示的坐标 { x, y }
     * @returns {number|null} 提示的值，若无可用提示则返回 null
     */
    useHint(currentGrid, pos) {
        let hintValue = [];
        this.#hints.update(($hints) => {
            if ($hints > 0) {
                usedHints.update(($usedHints) => $usedHints + 1);

                if (this.#hintLevel === 1) { //一级提示：提示所有仅剩一个候选值的单元格
                    const solvedSudoku = solveSudoku(currentGrid);
                    if (solvedSudoku && solvedSudoku[pos.x] !== undefined) {
                        hintValue.push(solvedSudoku[pos.x][pos.y]);
                    }
                    hintText.set('Level 1 Hint: 测试');
                } else if (this.#hintLevel === 2) { //二级提示：提示所有剩两个候选值的单元格
                    const solvedSudoku = solveSudoku(currentGrid);
                    if (solvedSudoku && solvedSudoku[pos.x] !== undefined) {
                        hintValue.push(solvedSudoku[pos.x][pos.y]);
                    }
                    hintText.set('Level 2 Hint: 测试');
                } else { //三级提示：提示所有候选值 < 9 的单元格
                    const solvedSudoku = solveSudoku(currentGrid);
                    if (solvedSudoku && solvedSudoku[pos.x] !== undefined) {
                        hintValue.push(solvedSudoku[pos.x][pos.y]);
                    }
                    hintText.set('Level 3 Hint: 测试');
                }

                return $hints - 1;
            }
            return $hints; // 提示次数为 0，不进行更新
        });

        return hintValue;
    }

    reset() {
        this.#hints.set(this.#defaultHints);
        usedHints.set(0);
    }
}

export const hints = new Hints();
```

store/grid.js

JAVASCRIPT

```
import { BOX_SIZE, SUDOKU_SIZE } from '@sudoku/constants';
import { decodeSencode, encodeSudoku } from '@sudoku/sencode';
import { generateSudoku } from '@sudoku/sudoku';
import { derived, writable } from 'svelte/store';
import { hintStore } from '@sudoku/stores/hintStore';
import { hints } from './hints';
import { get } from 'svelte/store';

```

```
class Grid {
    #grid;

    constructor() {
        this.#grid = writable(
            Array(SUDOKU_SIZE).fill().map(() => Array(SUDOKU_SIZE).fill(0))
        );
    }

    subscribe(callback) {
        return this.#grid.subscribe(callback);
    }

    generate(difficulty) {
        this.#grid.set(generateSudoku(difficulty));
    }

    decodeSencode(sencode) {
        this.#grid.set(decodeSencode(sencode));
    }

    get(gridStore, x, y) {
        return gridStore[y][x];
    }

    getSencode(gridStore) {
        return encodeSudoku(gridStore);
    }
}

export const grid = new Grid();

class UserGrid {
    #userGrid;

    constructor(gridInstance) {
        this.#userGrid = writable(
            Array(SUDOKU_SIZE).fill().map(() => Array(SUDOKU_SIZE).fill(0))
        );

        gridInstance.subscribe($grid => {
            const newGrid = $grid.map(row => [...row]);
            this.#userGrid.set(newGrid);
        });
    }

    subscribe(callback) {
        return this.#userGrid.subscribe(callback);
    }

    set(pos, value) {
        this.#userGrid.update($userGrid => {
            $userGrid[pos.y][pos.x] = value;
            return $userGrid;
        });
    }

    /**
     * 与 hints.js 交互，获取提示值并保存到 hintStore 中。
     * @param {Object} pos 提示的坐标 { x, y }
```

```
     */
    applyHint(pos) {

        const currentUserGrid = get(this.#userGrid);

        let solve = hints.useHint(currentUserGrid);
        console.log("Solve:",solve);

        if (solve instanceof Array) {
            hintStore.hint_array_set(solve);
        }

    }
}

export const userGrid = new UserGrid(grid);

export const invalidCells = derived(userGrid, $userGrid => {
    const _invalidCells = [];

    const addInvalid = (x, y) => {
        const xy = `${x},${y}`;
        if (!_invalidCells.includes(xy)) _invalidCells.push(xy);
    };

    for (let y = 0; y < SUDOKU_SIZE; y++) {
        for (let x = 0; x < SUDOKU_SIZE; x++) {
            const value = $userGrid[y][x];

            if (value) {
                for (let i = 0; i < SUDOKU_SIZE; i++) {
                    // Check the row
                    if (i !== x && $userGrid[y][i] === value) {
                        addInvalid(x, y);
                    }

                    // Check the column
                    if (i !== y && $userGrid[i][x] === value) {
                        addInvalid(x, i);
                    }
                }

                // Check the box
                const startY = Math.floor(y / BOX_SIZE) * BOX_SIZE;
                const endY = startY + BOX_SIZE;
                const startX = Math.floor(x / BOX_SIZE) * BOX_SIZE;
                const endX = startX + BOX_SIZE;
                for (let row = startY; row < endY; row++) {
                    for (let col = startX; col < endX; col++) {
                        if (row !== y && col !== x && $userGrid[row][col] === value) {
                            addInvalid(col, row);
                        }
                    }
                }
            }
        }
    }

    return _invalidCells;
}, []);
```