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1. applyModuleIds

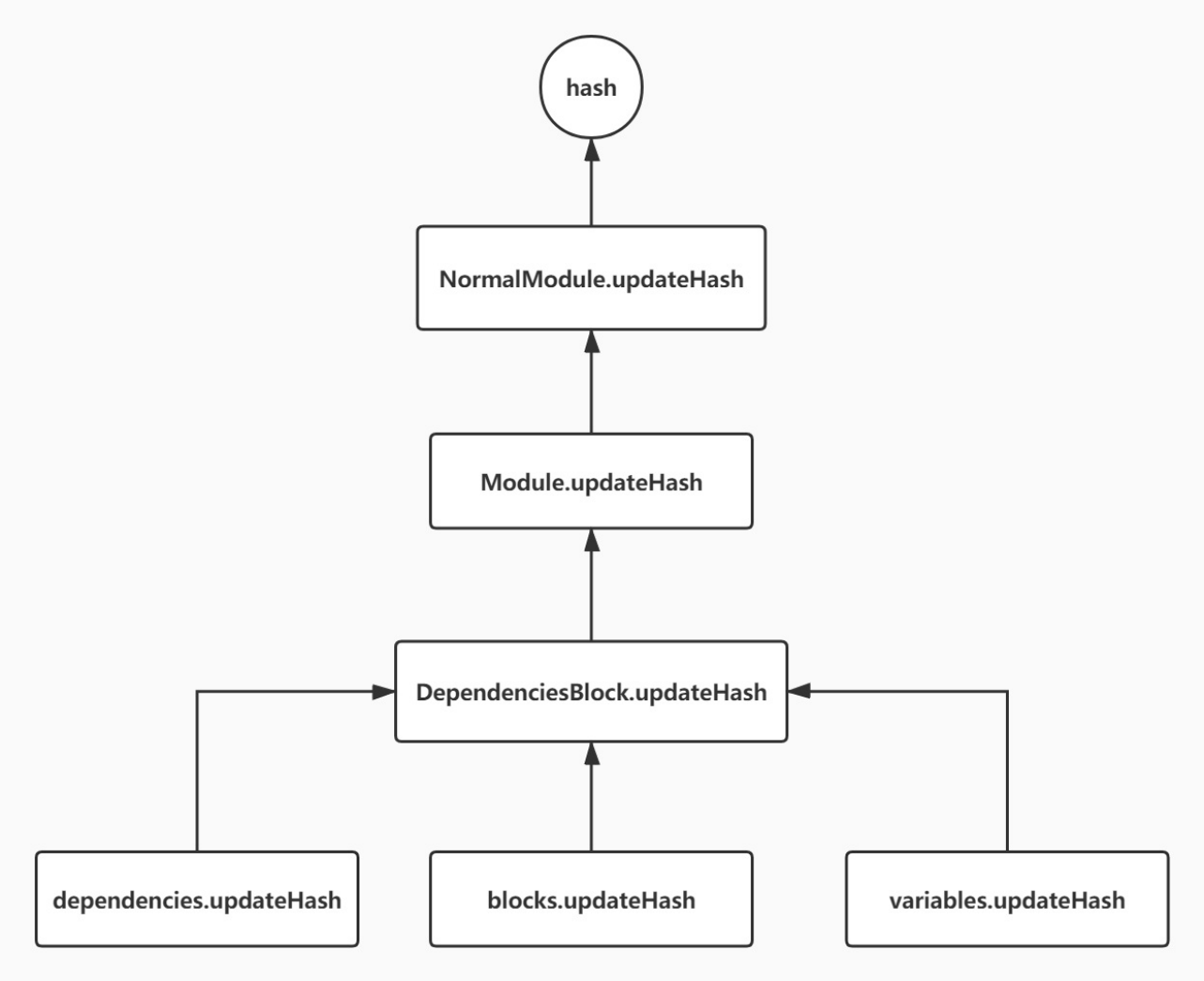
```
    applyModuleIds() {
        const unusedIds = [];
        let nextFreeModuleId = 0;
        const usedIds = new Set();
        if (this.usedModuleIds) {
            for (const id of this.usedModuleIds) {
                usedIds.add(id);
            }
        }

        const modules1 = this.modules;
        for (let indexModule1 = 0; indexModule1 < modules1.length; indexModule1++) {
            const module1 = modules1[indexModule1];
            if (module1.id !== null) {
                usedIds.add(module1.id);
            }
        }

        if (usedIds.size > 0) {
            let usedIdMax = -1;
            for (const usedIdKey of usedIds) {
                if (typeof usedIdKey !== "number") {
                    continue;
                }

                usedIdMax = Math.max(usedIdMax, usedIdKey);
            }

            let lengthFreeModules = (nextFreeModuleId = usedIdMax + 1);

            while (lengthFreeModules--) {
                if (!usedIds.has(lengthFreeModules)) {
                    unusedIds.push(lengthFreeModules);
                }
            }
        }

        const modules2 = this.modules;
        for (let indexModule2 = 0; indexModule2 < modules2.length; indexModule2++) {
            const module2 = modules2[indexModule2];
            if (module2.id === null) {
                if (unusedIds.length > 0) {
                    module2.id = unusedIds.pop();
                } else {
                    module2.id = nextFreeModuleId++;
                }
            }
        }
    }
```

2. applyChunkIds

```
applyChunkIds() {

    const usedIds = new Set();

    if (this.usedChunkIds) {
        for (const id of this.usedChunkIds) {
            if (typeof id !== "number") {
                continue;
            }

            usedIds.add(id);
        }
    }

    const chunks = this.chunks;
    for (let indexChunk = 0; indexChunk < chunks.length; indexChunk++) {
        const chunk = chunks[indexChunk];
        const usedIdValue = chunk.id;

        if (typeof usedIdValue !== "number") {
            continue;
        }

        usedIds.add(usedIdValue);
    }

    let nextFreeChunkId = -1;
    for (const id of usedIds) {
        nextFreeChunkId = Math.max(nextFreeChunkId, id);
    }
    nextFreeChunkId++;

    const unusedIds = [];
    if (nextFreeChunkId > 0) {
        let index = nextFreeChunkId;
        while (index--) {
            if (!usedIds.has(index)) {
                unusedIds.push(index);
            }
        }
    }

    for (let indexChunk = 0; indexChunk < chunks.length; indexChunk++) {
        const chunk = chunks[indexChunk];
        if (chunk.id === null) {
            if (unusedIds.length > 0) {
                chunk.id = unusedIds.pop();
            } else {
                chunk.id = nextFreeChunkId++;
            }
        }
        if (!chunk.ids) {
            chunk.ids = [chunk.id];
        }
    }
}
```

3. hash

3.1 module hash



Module.js

```
updateHash(hash) {
    hash.update(`${this.id}`);
    hash.update(JSON.stringify(this.usedExports));
    super.updateHash(hash);
}
```

3.2 chunk hash

Chunk.js

```
updateHash(hash) {
    hash.update(`${this.id} `);
    hash.update(this.ids ? this.ids.join(",") : "");
    hash.update(`${this.name || ""} `);
    for (const m of this._modules) {
        hash.update(m.hash);
    }
}
```

4. createChunkAssets

- JavascriptModulesPlugin (JavascriptModulesPlugin)
- MainTemplate.js (MainTemplate.js)
- JsonpMainTemplatePlugin.js (JsonpMainTemplatePlugin.js)
- hash 值生成之后，会调用 `createChunkAssets` 方法来决定最终输出到每个 chunk 当中对应的文本内容
- 获取对应的渲染模板
- 然后通过 getRenderManifest 获取到 render 需要的内容
- 执行 `render()` 得到最终的代码
- 获取文件路径，保存到 `assets` 中

4.hash

- hash 每次编译会生成一个hash,代表这次编译 代码:https://github.com/webpack/webpack/blob/c9d4ff7b054fc581c96ce0e53432d44f9dd8ca72/lib/Compilation.js#L1985 (https://github.com/webpack/webpack/blob/c9d4ff7b054fc581c96ce0e53432d44f9dd8ca72/lib/Compilation.js#L1985)
- chunkhash 每个chunk代码块对应的哈希值，各个chunk之间独立 代码:https://github.com/webpack/webpack/blob/c9d4ff7b054fc581c96ce0e53432d44f9dd8ca72/lib/Compilation.js#L1976 (https://github.com/webpack/webpack/blob/c9d4ff7b054fc581c96ce0e53432d44f9dd8ca72/lib/Compilation.js#L1976)
- contenthash 文件内容级别的哈希值,文件内容变了，那么hash值才改变 代码:https://github.com/webpack/webpack/blob/c9d4ff7b054fc581c96ce0e53432d44f9dd8ca72/lib/Compilation.js#L1979 (https://github.com/webpack/webpack/blob/c9d4ff7b054fc581c96ce0e53432d44f9dd8ca72/lib/Compilation.js#L1979)