南京大学

计算机科学与技术系

软件工程实验报告

实验名称：等价判断

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实验地点：基础实验楼乙 124

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一、代码实现

1.模块划分

(1)输入（Input)

```
class Input
{
public:
    void inputGeneration(string path);//根据文件夹路径读取标准输入文件，得到若干(输入类型＋范围)。调用generator函数，生成符合条件的输入
    string generator(int index, int left, int right);//index：输入类型，left&right：输入内容的限制
};
```

(2)输出（Output)

```
class Output
{
private:
    vector<string> op1;
    vector<string> op2;
public:
    void clearOp1(){op1.clear();}
    void clearOp2(){op2.clear();}
    void outputConversion(string filename, int index);//按行读取输出文件，导入数组
    bool outputComparison(string path);//对两数组内容进行比较，判断是否满足等价关系
};
```

(3)运行（Execute)

```
class Execute
{
public:
    void execution(string path, string filename, int index);//对目标文件运行脚本文件，引用参数op作为输出
    void shCommandGeneration(string path, string filename, int index);//根据文件名和路径生成对应脚本文件
};
```

(4)判断（Judge)

```
class Judge
{
private:
    Input input;
    Output output;
    Execute execute;
public:
    void judge(string path, string file1, string file2);//对两个目标文件进行若干次运行相同输入，比较输出，只要有一次输出不同即判断为不等价，否则等价
};
```

2.核心函数

(1)Input

```
string Input::generator(int index, int left, int right);
```

index：输入类型，包括： int,char,string
index==int： left和right是int型变量的范围，通过(rand() % (right - left + 1)) + left得到指定范围内的数值
index==char：要得到随机大小写字母，令left='A',right='z',通过(rand() % (right - left + 1)) + left得到随机大小写字母
index==string:left和right是string长度的范围，首先通过(rand() % (right - left + 1)) + left得到指定范围内的数值，再逐个字母生成随机大小写字母

(2)Output

```
bool Output::outputComparison(string path);
```

遍历Output类对象output的成员op1和op2，如果存在op1[i]!=op2[j]，判定为不等价，否则判定为等价

(3)Execute

```
void Execute::shCommandGeneration(string path, string filename);
```

需要执行的指令有

```
    string command4 ="#! /bin/bash";
    string command1 = "g++ -m64 " + filename + " -o "+path+"/a.out";//编译生成
a.out
    string command2="chmod u+x "+path+"/a.out";//修改a.out权限
    string command3 = path+"/a.out <" + path + "/input.txt" + " >" + path +
"/output.txt 2>&1";//将input.txt作为输入运行a.out，将输出或异常信息写入output.txt
```

(4)Judge

```
void Judge::judge(string path, string file1, string file2);
```

对指定程序对，进行若干次输入生成- >运行- >输出比较，一旦出现输出不等价的情况，即判断为两程序不等价，在inequal.csv中添加新条目；如果若干次测试结果都显示两程序等价，则在equal.csv中添加新条目。

3.运行示例

(1)程序对file1和file2

101036360.cpp　48762087.cpp U

home > njucs > SE_lab4 > input > test > 48762087.cpp

```cpp
#include<iostream>
using namespace std ;
int main()
{
    cout<<"HELLO" ;
}
```

101036360.cpp

home > njucs > SE_lab4 > input > 4A > 101036360.cpp > ...

```cpp
#include<iostream>
using namespace std;
int main(){
    int n;
    cin>>n;
    cout<<"Yes";
}
```

(2)生成的输入

Open　input.txt　~/SE_lab4/input/test　Save

input.txt　output.txt　shCommand.sh

```
1 84
```

(3)输出结果

```
njucs@njucs-VirtualBox:~/SE_lab4$ make
g++ -c -o outputComparison.o outputComparison.cpp
make: Circular judge.o <- judge.o dependency dropped.
make: Circular execute.o <- execute.o dependency dropped.
g++ -o main main.o inputGeneration.o outputComparison.o judge.o execute.o -g
njucs@njucs-VirtualBox:~/SE_lab4$ ./main
test
HELLO Yes njucs@njucs-VirtualBox:~/SE_lab4$
```

(4)不等价，在inequal.csv中添加条目

Open　inequal.csv　~/SE_lab4/input/test　Save

input.txt　output.txt　shCommand.sh　stdin_format.txt　inequal.csv

```
1 /home/njucs/SE_lab4/input/test/48762087.cpp,/home/njucs/SE_lab4/input/test/48762087.cpp
```

4.运行样例input结果展示

```
njucs@njucs-VirtualBox:~/SE_lab4$ ./main
input
/home/njucs/SE_lab4/input/4A/173077807.cpp:1:2: warning: #import is a deprecated
 GCC extension [-Wdeprecated]
    1 | #import<iostream>
      |  ^~~~~~
/home/njucs/SE_lab4/input/4A/173077807.cpp:2:11: warning: ISO C++ forbids declar
```

Open ▾ | equal.csv ~/SE_lab4/output | Save

```
1 /home/njucs/SE_lab4/input/4A/173077807.cpp,/home/njucs/SE_lab4/input/4A/84822638.cpp
2 /home/njucs/SE_lab4/input/4A/173077807.cpp,/home/njucs/SE_lab4/input/4A/84822639.cpp
3 /home/njucs/SE_lab4/input/4A/84822638.cpp,/home/njucs/SE_lab4/input/4A/84822639.cpp
4 /home/njucs/SE_lab4/input/4A/134841308.cpp,/home/njucs/SE_lab4/input/4A/127473352.cpp
5 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/21508898.cpp
6 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/164831265.cpp
7 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/33794240.cpp
8 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/21508887.cpp
9 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/31034693.cpp
10 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/29019948.cpp
11 /home/njucs/SE_lab4/input/50A/21715601.cpp,/home/njucs/SE_lab4/input/50A/36641065.cpp
12 /home/njucs/SE_lab4/input/50A/142890373.cpp,/home/njucs/SE_lab4/input/50A/138805414.cpp
13 /home/njucs/SE_lab4/input/50A/142890373.cpp,/home/njucs/SE_lab4/input/50A/30534178.cpp
14 /home/njucs/SE_lab4/input/50A/21508898.cpp,/home/njucs/SE_lab4/input/50A/164831265.cpp
15 /home/njucs/SE_lab4/input/50A/21508898.cpp,/home/njucs/SE_lab4/input/50A/33794240.cpp
16 /home/njucs/SE_lab4/input/50A/21508898.cpp,/home/njucs/SE_lab4/input/50A/21508887.cpp
17 /home/njucs/SE_lab4/input/50A/21508898.cpp,/home/njucs/SE_lab4/input/50A/31034693.cpp
```

Open ▾ | inequal.csv ~/SE_lab4/output | Save

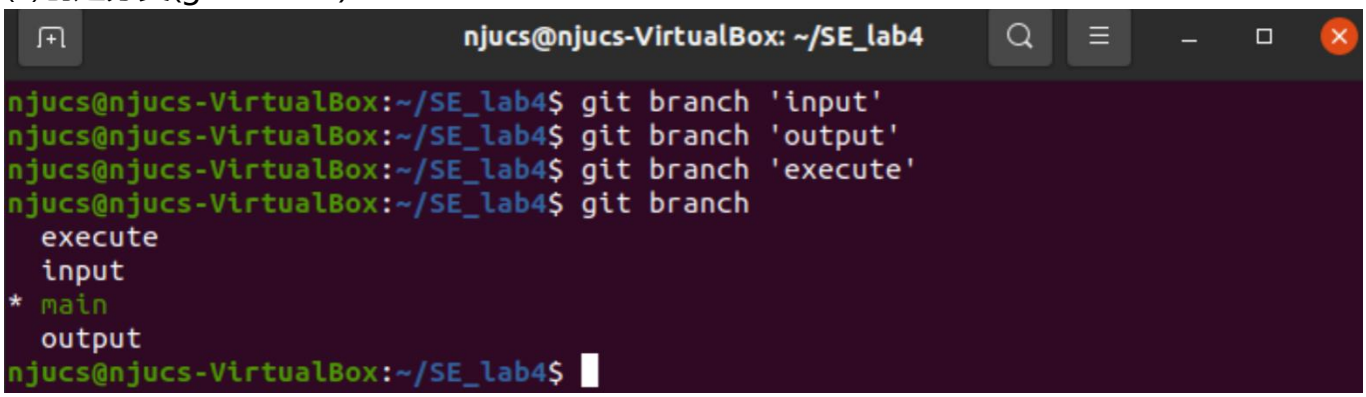
```
1 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/173077807.cpp
2 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/84822638.cpp
3 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/84822639.cpp
4 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/134841308.cpp
5 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/127473352.cpp
6 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/101036360.cpp
7 /home/njucs/SE_lab4/input/4A/48762087.cpp,/home/njucs/SE_lab4/input/4A/117364748.cpp
8 /home/njucs/SE_lab4/input/4A/173077807.cpp,/home/njucs/SE_lab4/input/4A/134841308.cpp
9 /home/njucs/SE_lab4/input/4A/173077807.cpp,/home/njucs/SE_lab4/input/4A/127473352.cpp
10 /home/njucs/SE_lab4/input/4A/173077807.cpp,/home/njucs/SE_lab4/input/4A/101036360.cpp
11 /home/njucs/SE_lab4/input/4A/173077807.cpp,/home/njucs/SE_lab4/input/4A/117364748.cpp
12 /home/njucs/SE_lab4/input/4A/84822638.cpp,/home/njucs/SE_lab4/input/4A/134841308.cpp
13 /home/njucs/SE_lab4/input/4A/84822638.cpp,/home/njucs/SE_lab4/input/4A/127473352.cpp
14 /home/njucs/SE_lab4/input/4A/84822638.cpp,/home/njucs/SE_lab4/input/4A/101036360.cpp
15 /home/njucs/SE_lab4/input/4A/84822638.cpp,/home/njucs/SE_lab4/input/4A/117364748.cpp
16 /home/njucs/SE_lab4/input/4A/84822639.cpp,/home/njucs/SE_lab4/input/4A/134841308.cpp
17 /home/njucs/SE_lab4/input/4A/84822639.cpp,/home/njucs/SE_lab4/input/4A/127473352.cpp
18 /home/njucs/SE_lab4/input/4A/84822639.cpp,/home/njucs/SE_lab4/input/4A/101036360.cpp
```

每个程序对进行20组不同输入的测试，equal.csv中有35个条目，inequal.csv中有59个条目

二、版本控制

1.本地仓库

(1)创建分支(git branch)



(2)提交代码(git add & git commit)

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch input
Switched to branch 'input'
njucs@njucs-VirtualBox:~/SE_lab4$ git add inputGeneration.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git add inputGeneration.h
njucs@njucs-VirtualBox:~/SE_lab4$ git commit -m 'input first commit'
[input 731d5ed] input first commit
 2 files changed, 99 insertions(+)
 create mode 100644 inputGeneration.cpp
 create mode 100644 inputGeneration.h
njucs@njucs-VirtualBox:~/SE_lab4$
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch output
Switched to branch 'output'
njucs@njucs-VirtualBox:~/SE_lab4$ git add outputComparison.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git add outputComparison.h
njucs@njucs-VirtualBox:~/SE_lab4$ git commit -m 'output first commit'
[output 3e8867f] output first commit
 2 files changed, 50 insertions(+)
 create mode 100644 outputComparison.cpp
 create mode 100644 outputComparison.h
njucs@njucs-VirtualBox:~/SE_lab4$
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch main
Switched to branch 'main'
Your branch is up to date with 'origin/main'.
njucs@njucs-VirtualBox:~/SE_lab4$ git add Makefile
njucs@njucs-VirtualBox:~/SE_lab4$ git commit -m 'makefile first commit'
[main d262c4c] makefile first commit
 1 file changed, 12 insertions(+)
 create mode 100644 Makefile
njucs@njucs-VirtualBox:~/SE_lab4$
njucs@njucs-VirtualBox:~/SE_lab4$ git switch execute
Switched to branch 'execute'
njucs@njucs-VirtualBox:~/SE_lab4$ git add main.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git commit -m 'execute first commit'
[execute 43cc027] execute first commit
 1 file changed, 94 insertions(+)
 create mode 100644 main.cpp
njucs@njucs-VirtualBox:~/SE_lab4$
```

(3)查看分支(git log --graph)

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch main
Switched to branch 'main'
Your branch is up to date with 'origin/main'.
njucs@njucs-VirtualBox:~/SE_lab4$ git log --graph
* commit 567eef1843834a180a6ae9b1a01be3e0889db0e7 (HEAD -> main, origin/main)
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 10:50:17 2022 +0800
|
|     use class judge
|
* commit 6cdbad4bcb769f0b9608bb4381e4ab504a887735
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 10:41:42 2022 +0800
|
|     add main
|
* commit bcdcff4af97505046fc80d2e33e53802284e433a
| Author: DingKKK <623812325@qq.com>
| Date:   Mon Nov 14 16:49:17 2022 +0800
|
|     testcase commit
|
* commit d262c4cf920b3c9e1fe2a0e921efd11a2d030f48
| Author: DingKKK <623812325@qq.com>
| Date:   Mon Nov 14 16:48:15 2022 +0800
|
|     makefile first commit
:...skipping...
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch execute
Switched to branch 'execute'
Your branch is up to date with 'origin/execute'.
njucs@njucs-VirtualBox:~/SE_lab4$ git log --graph
* commit 8880cafcec650d3e536b9893001646fdaa37047b (HEAD -> execute, origin/execute)
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 11:00:51 2022 +0800
|
|     new execute
|
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch input
Switched to branch 'input'
Your branch is up to date with 'origin/input'.
njucs@njucs-VirtualBox:~/SE_lab4$ git log --graph
* commit 17edd58f179e61b2f24835646a7a4e55256b5fdb (HEAD -> input, origin/input)
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 00:29:01 2022 +0800
|
|     add class Input
|
* commit 8a95836991d07dd36f9cece00c0b38f310273d37
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 00:26:53 2022 +0800
|
|     add class input
|
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git switch output
Switched to branch 'output'
Your branch is up to date with 'origin/output'.
njucs@njucs-VirtualBox:~/SE_lab4$ git log --graph
* commit cad04315d649e8221dd66b76cdc4ca841f3d1455 (HEAD -> output, origin/output)
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 00:32:22 2022 +0800
|
|     add class Output
|
* commit 3e8867fb32f84e2b8cd6e34e04cc12678fe8add0
| Author: DingKKK <623812325@qq.com>
| Date:   Mon Nov 14 16:45:07 2022 +0800
|
|     output first commit
|
```

(4)合并分支(git merge)

```
njucs@njucs-VirtualBox:~/SE_lab4$ git merge output
Merge made by the 'recursive' strategy.
 outputComparison.cpp | 41 ++++++++++++++++++++++++++++++++++++++++++++
 outputComparison.h   | 13 +++++++++++++
 2 files changed, 54 insertions(+)
 create mode 100644 outputComparison.cpp
 create mode 100644 outputComparison.h
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git merge judge
Merge made by the 'recursive' strategy.
 execute.cpp | 29 ++++++++++++++++++++++++++++
 execute.h   |  8 ++++++++
 judge.cpp   | 37 +++++++++++++++++++++++++++++++++++++
 judge.h     | 11 +++++++++++
 4 files changed, 85 insertions(+)
 create mode 100644 execute.cpp
 create mode 100644 execute.h
 create mode 100644 judge.cpp
 create mode 100644 judge.h
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git log --graph
* commit 6f3b4f7a3dca89db4f63f17df7dcb296642d4ac1 (HEAD -> main)
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 19:08:03 2022 +0800
|
|     modify details
|
* commit 26a33b3f31a14d66826ed28149bc23e790b5daf7
| Author: DingKKK <623812325@qq.com>
| Date:   Tue Nov 15 11:33:18 2022 +0800
|
|     add judge and execute to makefile
|
*   commit 9b0ceb4953c79a7e96e6a19422f1bf6b6fa9ddb8 (origin/main)
|\  Merge: c7e3968 c7064b8
| | Author: DingKKK <623812325@qq.com>
| | Date:   Tue Nov 15 11:29:58 2022 +0800
| |
| |     Merge branch 'judge' into main
| |
| * commit c7064b89e7fd92b6acf0171d12046fd5bbc0fa31 (origin/judge, judge)
| | Author: DingKKK <623812325@qq.com>
| | Date:   Tue Nov 15 11:15:48 2022 +0800
| |
:...skipping...
```

```
*   commit c7e39683fd6366da198182da28dd9da615eb6054
|\  Merge: 4e2edeb cad0431
| | Author: DingKKK <623812325@qq.com>
| | Date:   Tue Nov 15 11:28:20 2022 +0800
| |
| |     Merge branch 'output' into main
| |
```

```
*   commit 4e2edeb8057bbec4b4c14eb5360cd0b8debdcef4
|\  Merge: 567eef1 17edd58
| |/  Author: DingKKK <623812325@qq.com>
|/|   Date:   Tue Nov 15 11:27:47 2022 +0800
| |
| |       merge input
| |
```

(5)本地操作前后对比(git status)

前:

```
njucs@njucs-VirtualBox:~/SE_lab4$ git status
On branch main
Your branch is ahead of 'origin/main' by 1 commit.
  (use "git push" to publish your local commits)

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   execute.cpp
        modified:   execute.h
        modified:   input/4A/equal.csv
        modified:   input/4A/inequal.csv
        modified:   input/4A/shCommand.sh
        modified:   inputGeneration.cpp
        modified:   judge.cpp
        modified:   judge.h
        modified:   main.cpp
        modified:   outputComparison.cpp
```

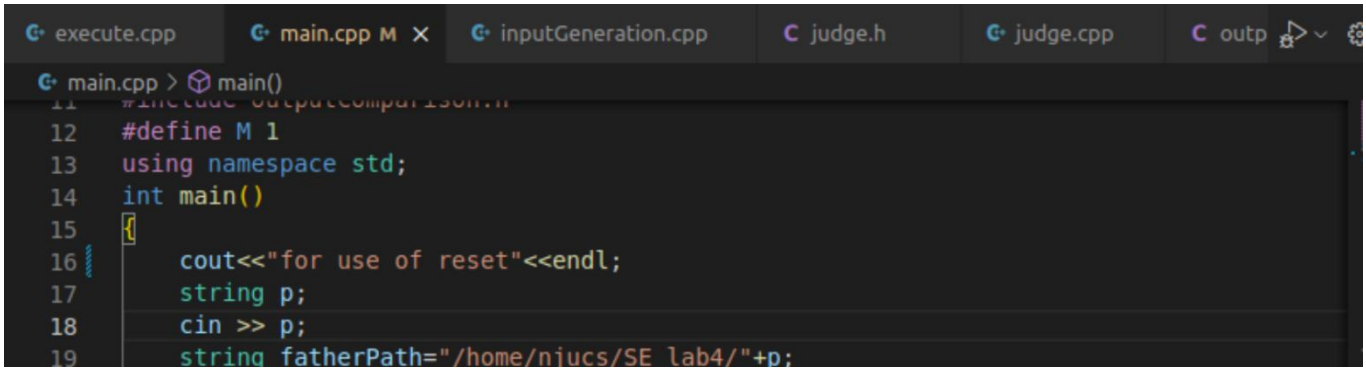
后:

```
njucs@njucs-VirtualBox:~/SE_lab4$ git add execute.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git add execute.h
njucs@njucs-VirtualBox:~/SE_lab4$ git add input
njucs@njucs-VirtualBox:~/SE_lab4$ git add inputGeneration.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git add judge.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git add judge.h
njucs@njucs-VirtualBox:~/SE_lab4$ git add main.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git add outputComparison.cpp
njucs@njucs-VirtualBox:~/SE_lab4$ git commit -m 'modify details'
[main 6f3b4f7] modify details
 18 files changed, 107 insertions(+), 24 deletions(-)
 create mode 100644 input/test/101036360.cpp
 create mode 100644 input/test/48762087.cpp
 create mode 100755 input/test/a.out
 create mode 100644 input/test/inequal.csv
 create mode 100644 input/test/input.txt
 create mode 100644 input/test/output.txt
 create mode 100755 input/test/shCommand.sh
 create mode 100644 input/test/stdin_format.txt
njucs@njucs-VirtualBox:~/SE_lab4$
```

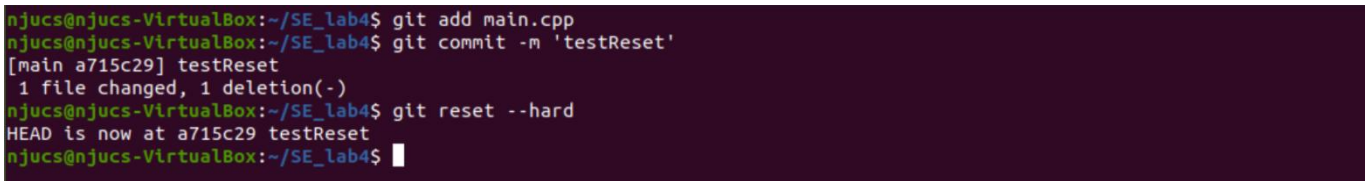
```
njucs@njucs-VirtualBox:~/SE_lab4$ git status
On branch main
Your branch is ahead of 'origin/main' by 2 commits.
  (use "git push" to publish your local commits)
```

(6) 版本回退(git reset)

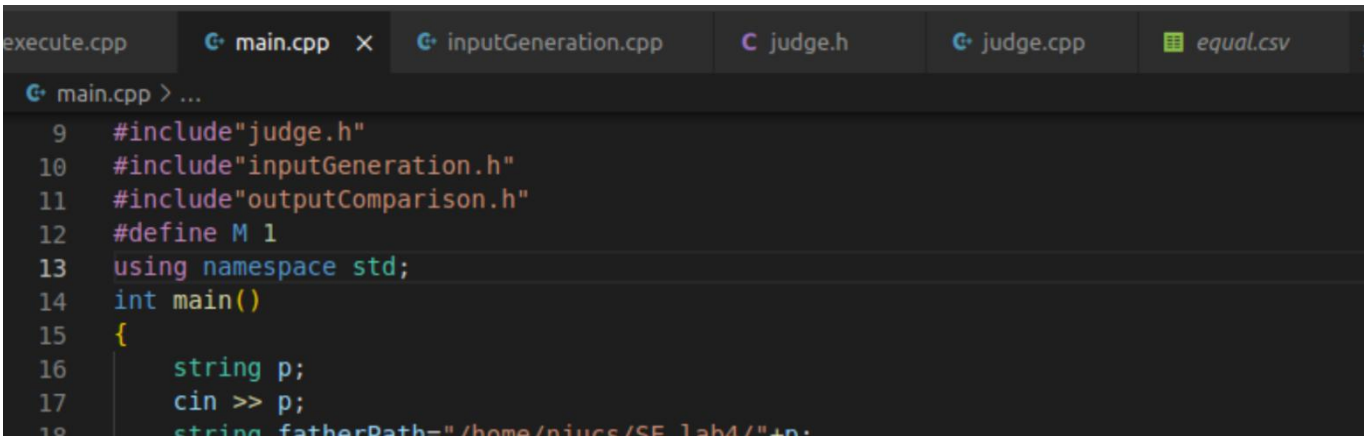
修改：line16



git reset:

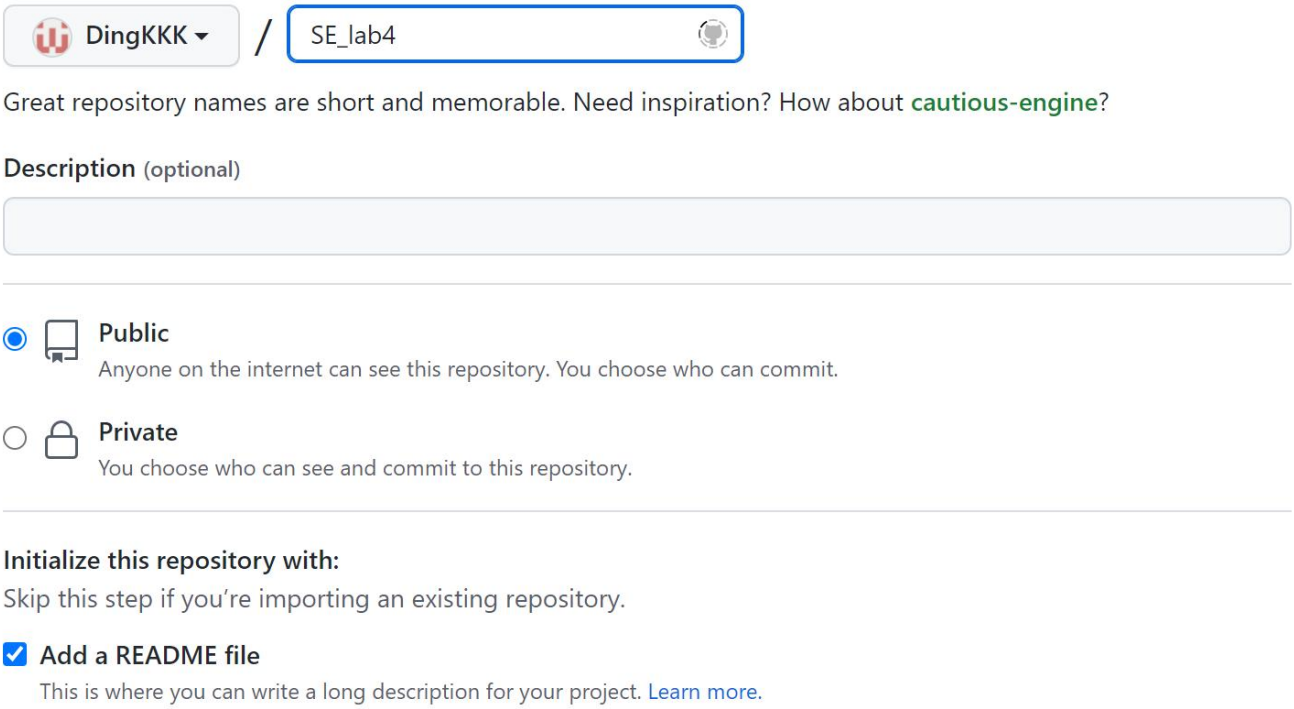


回退后的文件内容：



2.远程仓库

(1)仓库创建



(2)仓库内容更新(git push)

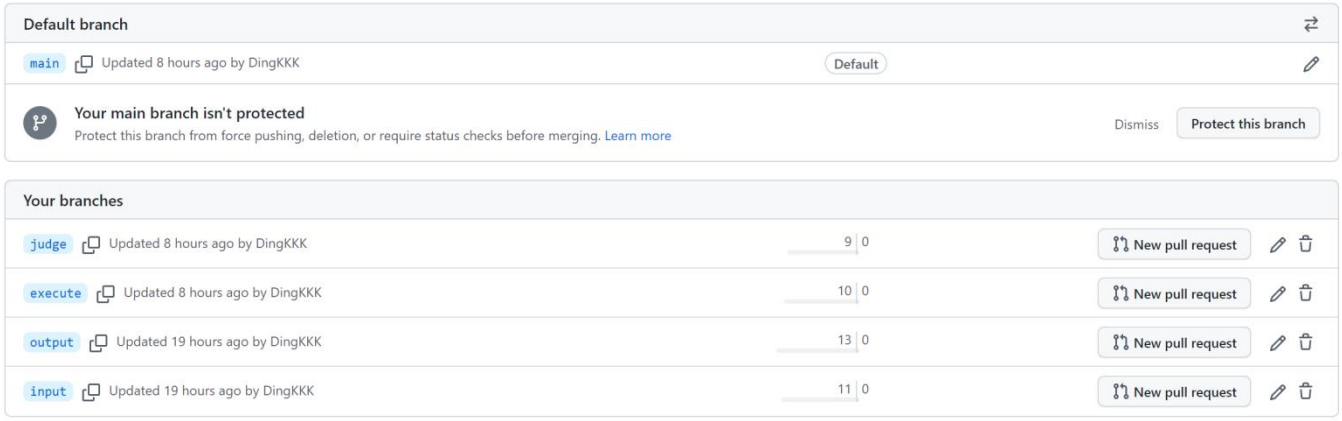
本地git push：

```
njucs@njucs-VirtualBox:~/SE_lab4$ git push --set-upstream origin input
Username for 'https://github.com': DingKKK
Password for 'https://DingKKK@github.com':
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 4 threads
Compressing objects: 100% (4/4), done.
Writing objects: 100% (4/4), 1.07 KiB | 1.07 MiB/s, done.
Total 4 (delta 0), reused 0 (delta 0)
remote:
remote: Create a pull request for 'input' on GitHub by visiting:
remote:      https://github.com/DingKKK/SE_lab4/pull/new/input
remote:
To https://github.com/DingKKK/SE_lab4.git
 * [new branch]      input -> input
Branch 'input' set up to track remote branch 'input' from 'origin'.
```

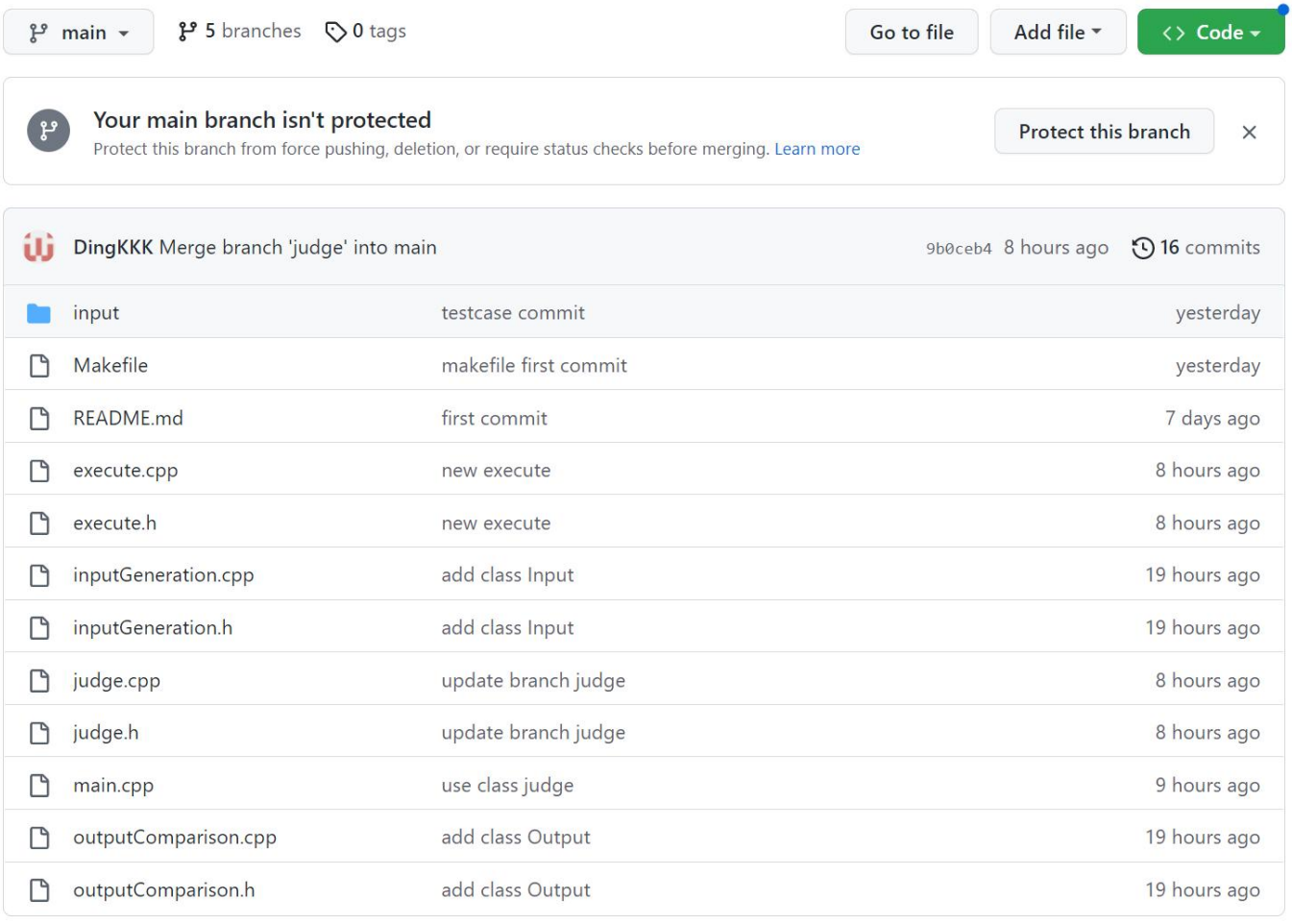
```
njucs@njucs-VirtualBox:~/SE_lab4$ git push --set-upstream origin output
Username for 'https://github.com': DingKKK
Password for 'https://DingKKK@github.com':
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 4 threads
Compressing objects: 100% (4/4), done.
Writing objects: 100% (4/4), 853 bytes | 284.00 KiB/s, done.
Total 4 (delta 0), reused 0 (delta 0)
remote:
remote: Create a pull request for 'output' on GitHub by visiting:
remote:      https://github.com/DingKKK/SE_lab4/pull/new/output
remote:
To https://github.com/DingKKK/SE_lab4.git
 * [new branch]      output -> output
Branch 'output' set up to track remote branch 'output' from 'origin'.
```

```
njucs@njucs-VirtualBox:~/SE_lab4$ git push --set-upstream origin execute
Username for 'https://github.com': DingKKK
Password for 'https://DingKKK@github.com':
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 4 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 1.13 KiB | 580.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0)
remote:
remote: Create a pull request for 'execute' on GitHub by visiting:
remote:      https://github.com/DingKKK/SE_lab4/pull/new/execute
remote:
To https://github.com/DingKKK/SE_lab4.git
 * [new branch]      execute -> execute
Branch 'execute' set up to track remote branch 'execute' from 'origin'.
```

远程仓库内容：



分支合并后：



Commits on Nov 15, 2022

Merge branch 'judge' into main DingKKK committed 8 hours ago	9b0ceb4
Merge branch 'output' into main DingKKK committed 8 hours ago	c7e3968
merge input DingKKK committed 8 hours ago	4e2edeb