一、配置Hadoop的IDEA开发环境

一开始拿到题目还是很糊涂的，得先从实践入手摸清组件之间的关系，尤其是ide和hadoop集群之间的关系。我们知道Hadoop可以运行在三种模式下：

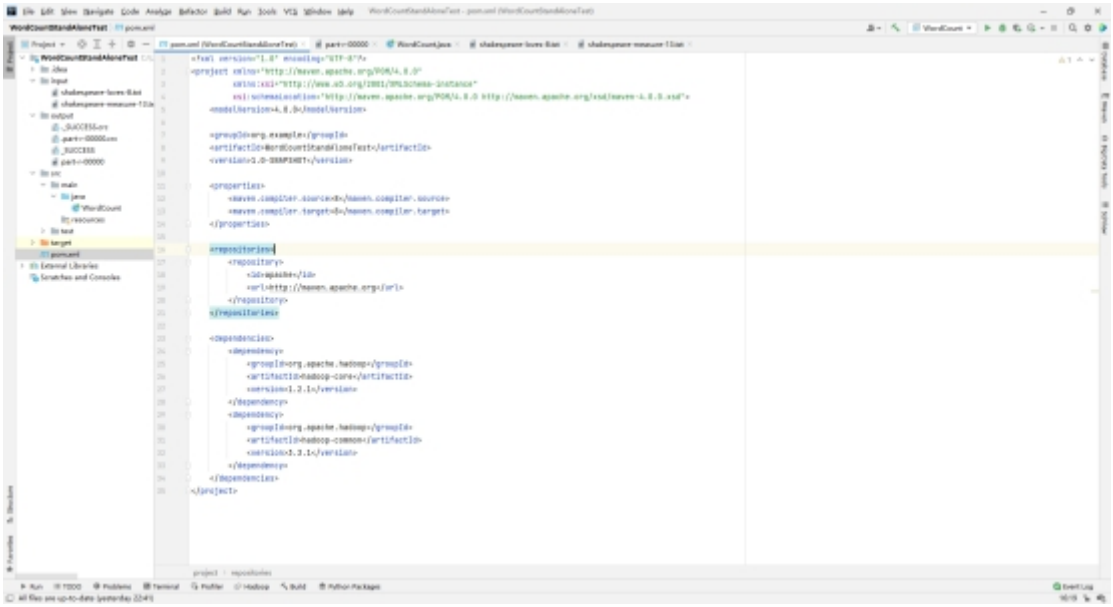
1. 单机模式
2. 伪分布模式
3. 集群模式

这篇教程Hadoop: Intellij结合Maven本地运行和调试MapReduce程序 (无需搭载Hadoop和HDFS环境) - Penguin (polarxiong.com)表示，运行和调试MapReduce程序只需要有相应的Hadoop依赖包就行，可以完全当成一个普通的JAVA程序，不过其主要不足就在于没有Hadoop的整个管理控制系统，如JobTracker面板，而只是用来运行和调试程序；而其优点就在于开发调试方便，***编写的程序通常不需要修改即可在真实的分布式*Hadoop*集群下运行***。当然有这么方便的事情肯定会想直接尝试，不过还是有一丝犹豫的，毕竟完成代码测试后就是在docker上的HADOOP集群上跑了，那我之前在WSL上搭的单机和伪分布式HADOOP就毫无价值了吗？（后面还是用上了）

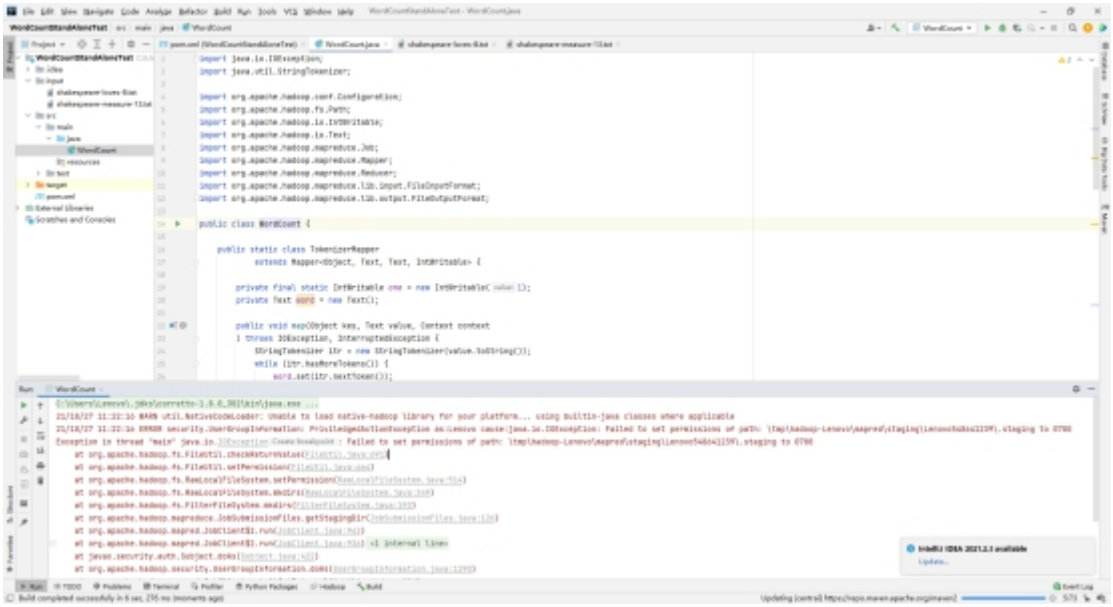
文中stop文件夹包含两个停用文件，在input同级目录下。src中，主程序是WordCount2.java，实际上就是WordCount3.0，是基于官网教程的WordCount2.0改的，就顺手没有修改文件名。MiscUtils.java和MyOutPutFormat.java分别是协助实现WordCount3.0的新写方法和重写类，剩下的WordCount.java和WordCount2_sample.java的作用主要是来存目，保留官网代码和新写的比对学习，并不参与最终运行。

1.IDEA单机模式测试WordCount1&2

之前有一定的项目基础，maven等环境是配置好的，直接复制好pom.xml和教程样例代码中的WordCount类（WordCount1.0,和ppt中main函数略有差异），先确保能跑通：

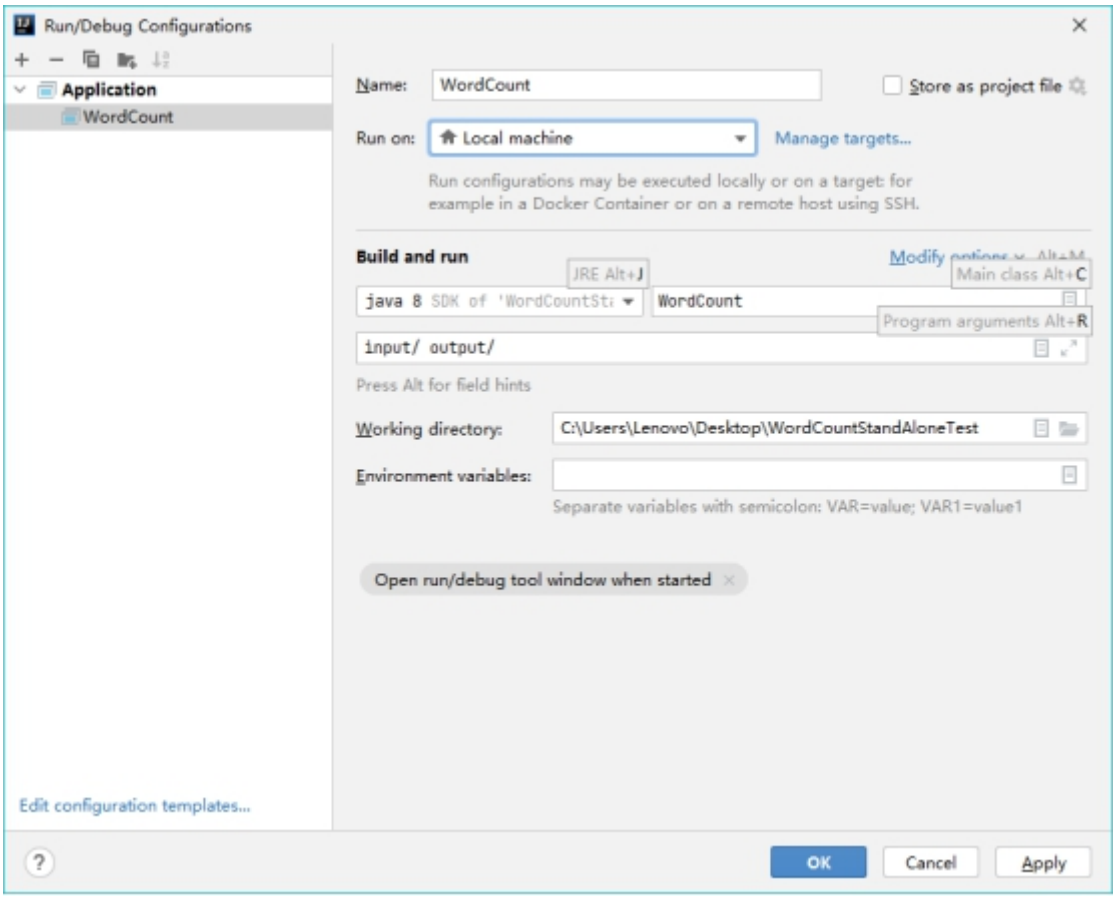


配置pom文件



复制样例代码

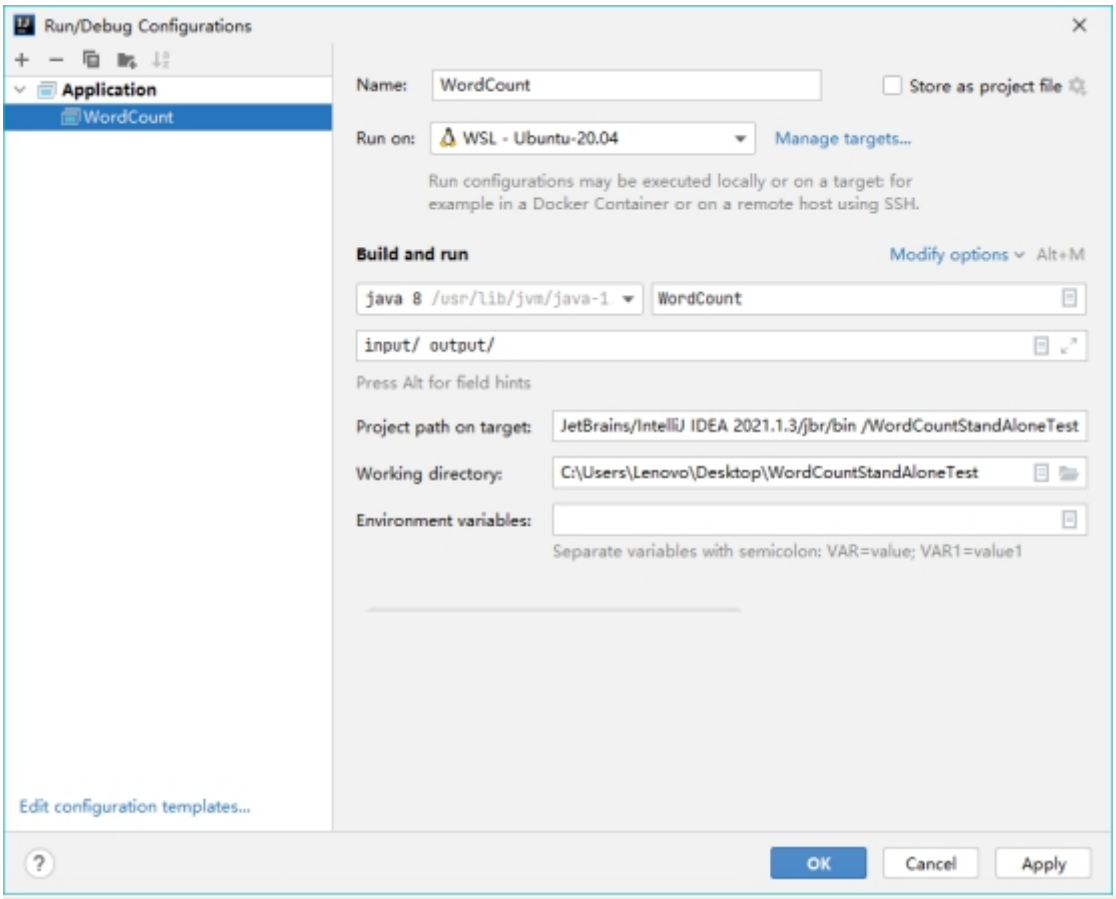
接着是准备好样例代码需要的文件。在WordCount下（src同级目录）新建一个文件夹input，复制了两个莎士比亚文集的文本文件作为示例添加到input中。然后配置运行参数。在Intellij菜单栏中选择Run->Edit Configurations，在弹出来的对话框中点击+，新建一个Application配置。配置Main class为WordCount，Program arguments为input/ output/，即输入路径为刚才创建的input文件夹，输出为output。这些内容将在main函数中 Configuration conf = new Configuration(); //取得系统的参数 这一行被读取。

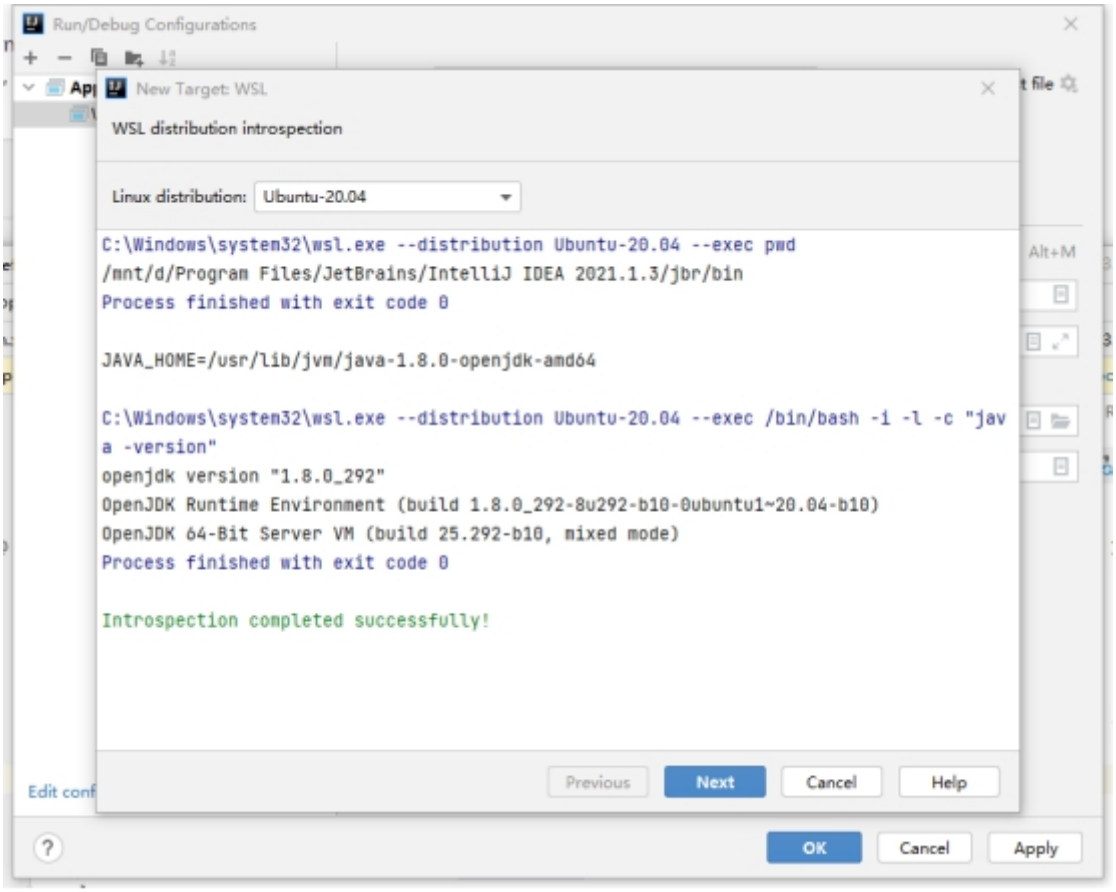


配置运行参数

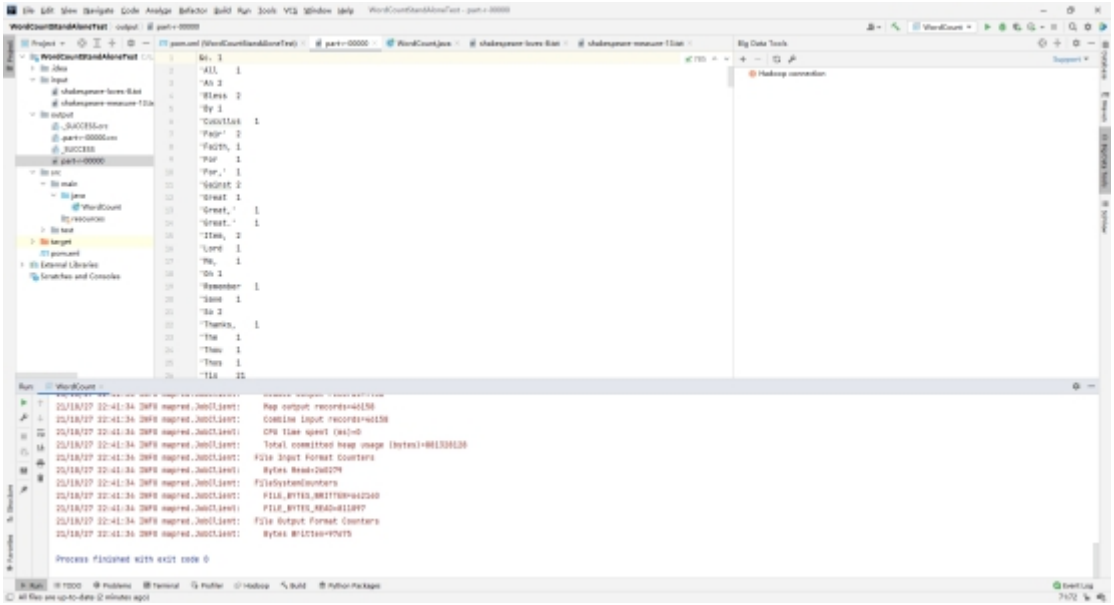
开始运行后，会看到和上面复制样例代码那张图一样的报错，failed to set permissions of path，教程中提出这是Windows下的权限问题，因为当前用户没有权限来设置路径权限（Linux无此问题）。一个解决方法是给hadoop打补丁，参考Failed to set permissions of path: tmp，因为这里使用的Maven，此方法不太适合。另一个方法是将当前用户设置为超级管理员（“计算机管理”，“本地用户和组”

中设置），或以超级管理员登录运行此程序。作者提供的两种方法我都有尝试，第一种的补丁已经年久失修找不到链接了，相应的有其他回答给出了修改jar包，改掉文件权限相关内容，重新打包替代充当补丁的作用，不过确实不是针对maven管理的，也不敢随便修改基础文件，也有建议将依赖中的hadoop-core版本改为0.20.2，但该版本并不支持Job.getInstance（后面发现hadoop-core是MRv1的产物，不应列在pom依赖中）；第二种方法则更加迷糊，不好判定到底是不是超级管理员状态。于是我在jetbrain官网https://www.jetbrains.com/help/idea/how-to-use-wsl-development-environment-in-product.html#local_project发现idea可以使用本地 JDK 在 Windows 操作系统上本地创建或打开项目，然后使用运行目标在 WSL 中运行编译代码。也就是说，得益于wsl的Linux兼容内核接口，我能够利用windows上的idea开发程序，但是在wsl的环境上运行程序，这是符合我的在单机上先跑程序测试的预期的，也回收了一些沉没成本，只需在配置运行参数中Run on选项本地运行改为在WSL上运行。





有些中间过程，都点继续就行



发现成功运行

意味着已经可以通过idea连携wsl单机运行hadoop程序了，方便了后续测试好再放到集群上运行。

在测试官网的MapReduce2.0时，我发现getCacheFiles和addCacheFile方法无论怎样import都无法resolve，经过百般尝试我把mapreduce、yarn、hadoop所有依赖都在maven里塞一遍仍然不能解决，结果发现是多写了一个hadoop-core，这是适用于MRv1的依赖，没有MRv2的方法，应该删除。

1 Answer

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0

I was able to reproduce what you have tried and did not encountered any kind of problem. I am using MRv2.

From the pom, it seems you are using MR2 (which is the latest). So remove the MR1 dependency(hadoop-core 2.6.0-mr1-cdh5.10.1). The hadoop core jar is not required for MRv2.

The code I have used. This should work if you are using MRv2.

```
import java.io.IOException;
import java.net.URISyntaxException;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.mapreduce.Job;


public class App
{
    public static void main( String[] args ) throws IOException, InterruptedExceptio
    {
        Configuration conf = new Configuration();

        Job job = Job.getInstance(conf);

        job.addCacheFile(new Path("").toUri());
    }
}
```

But if you want to use MRv1, then we need to change the POM, then we need to use

```
    Configuration conf = new Configuration();

    DistributedCache.addFileToClassPath(new Path("<path to file>"), conf);

    Job job = new Job(conf);
```

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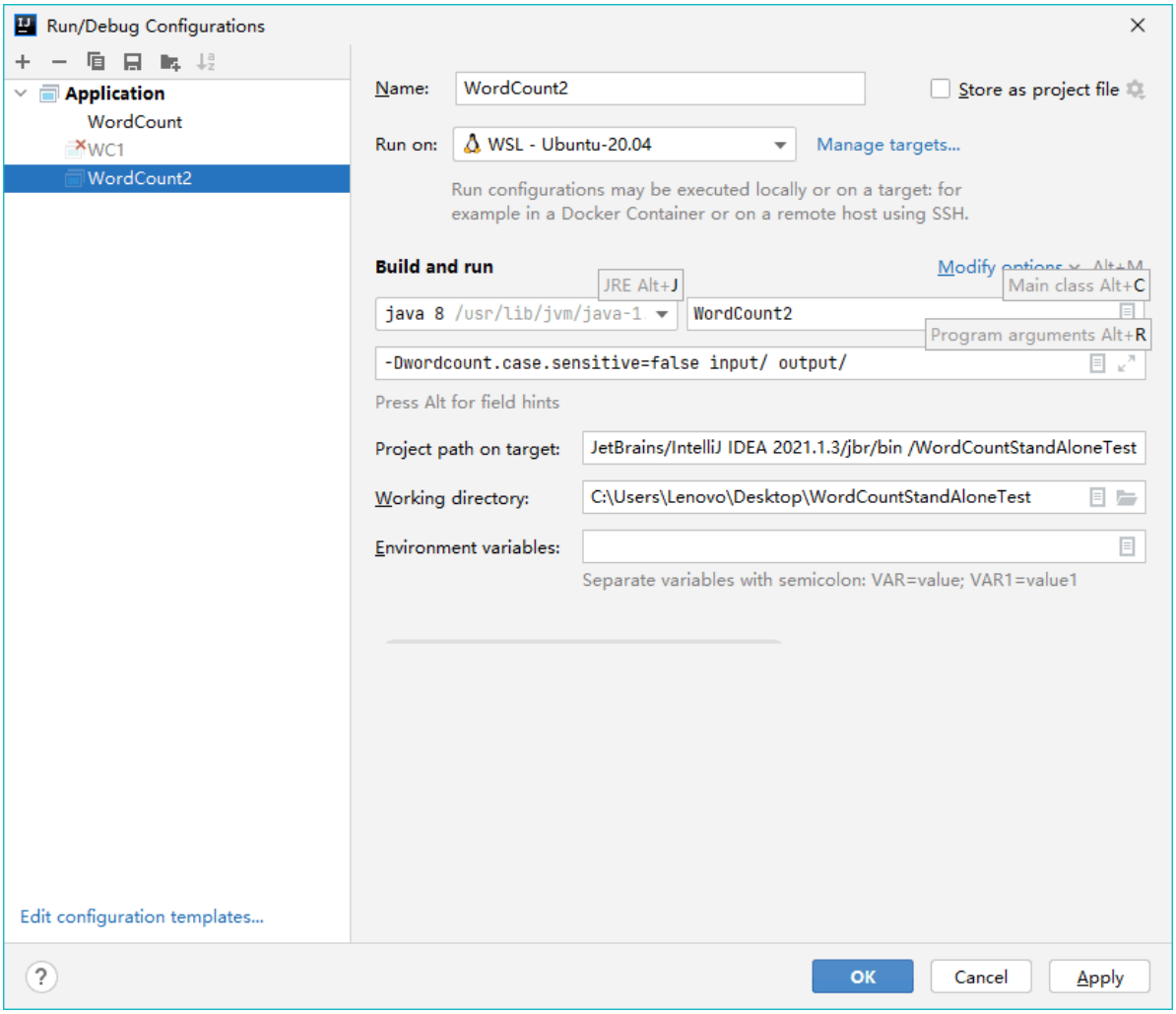
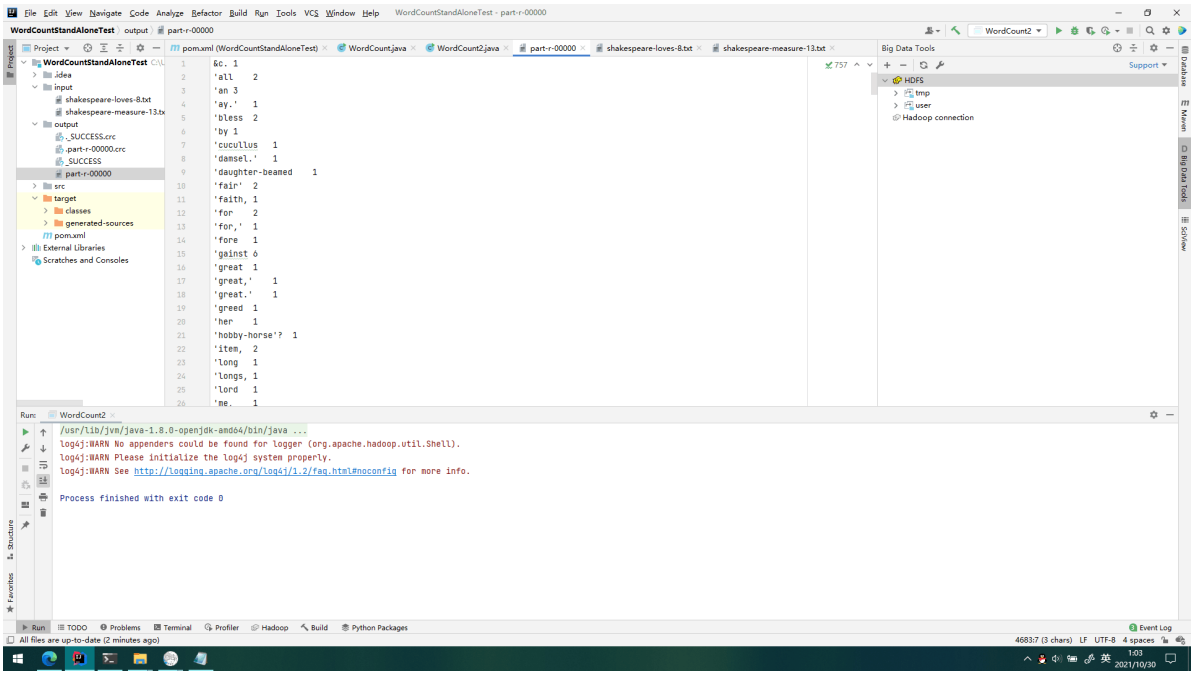
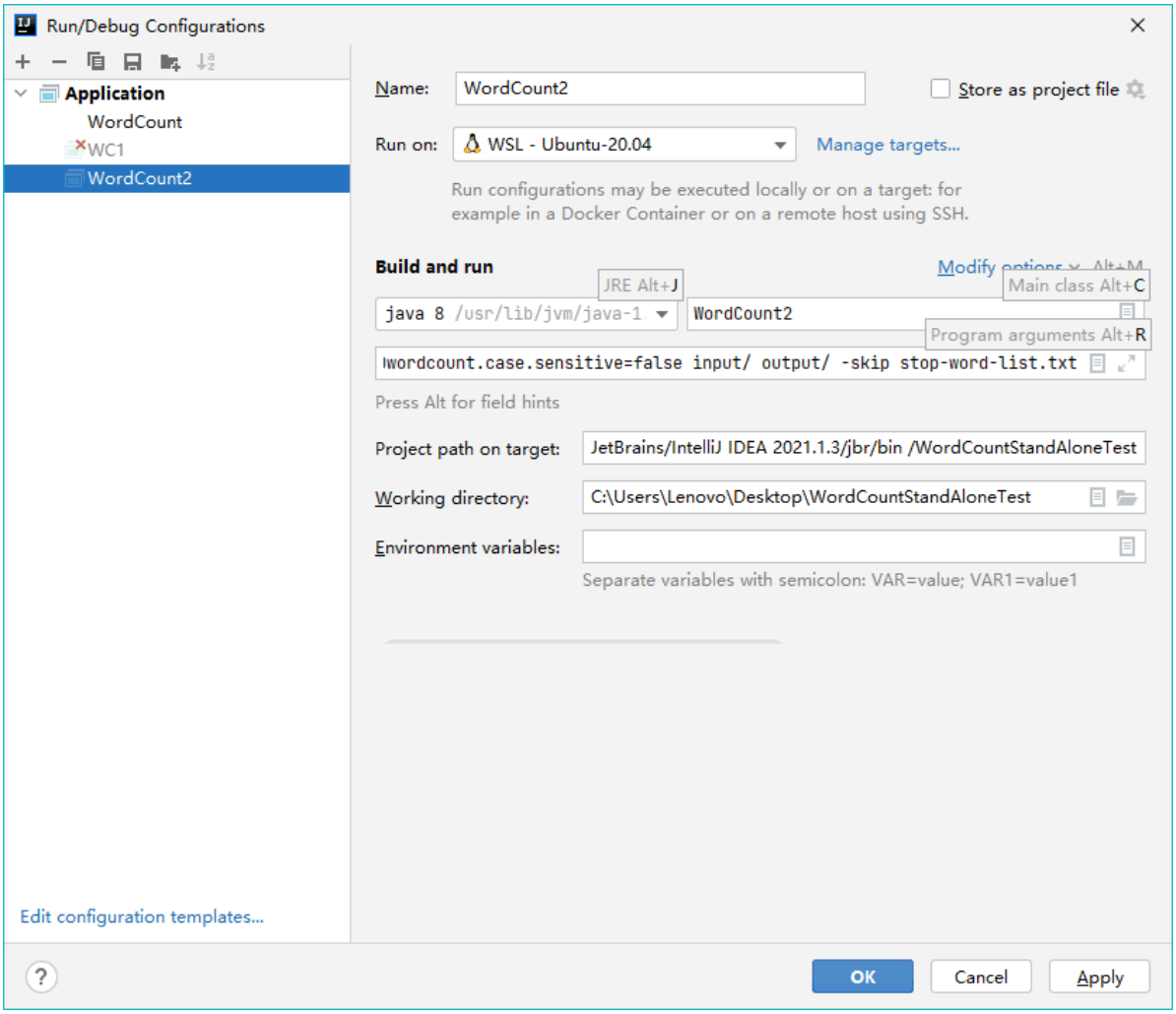
解释来源



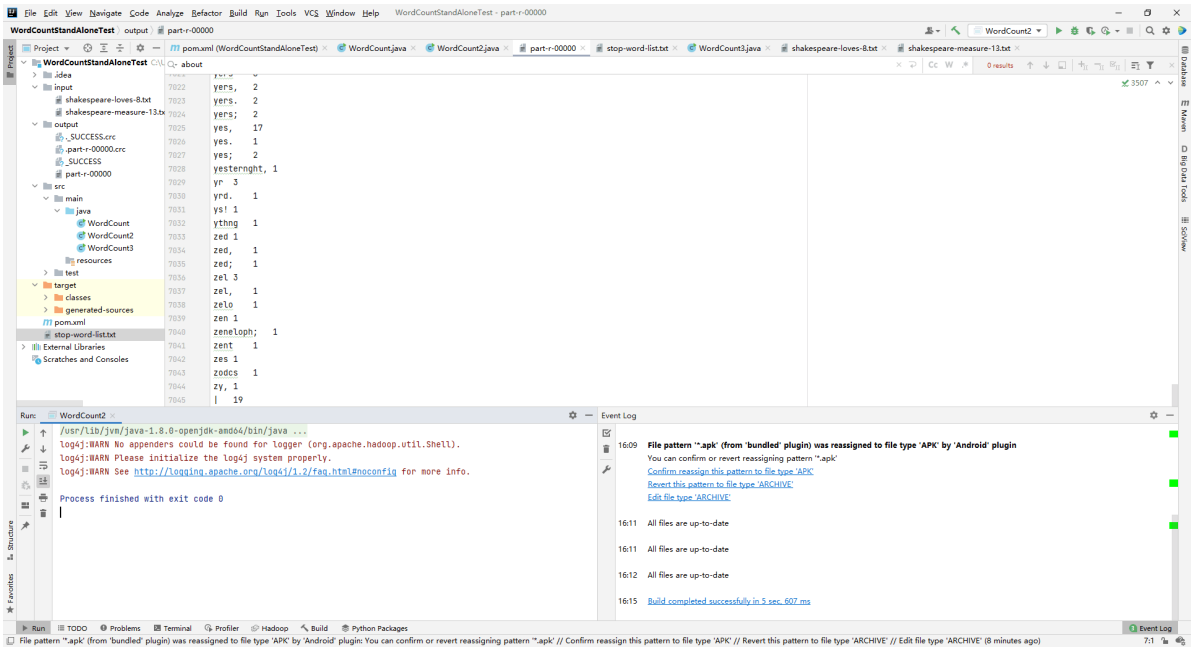
针对WordCount2.0增加了大小写敏感的传参



调整参数后成功运行MapReduce2.0，过程中也提醒了我利用已经实现的传参可能减少不少代码量

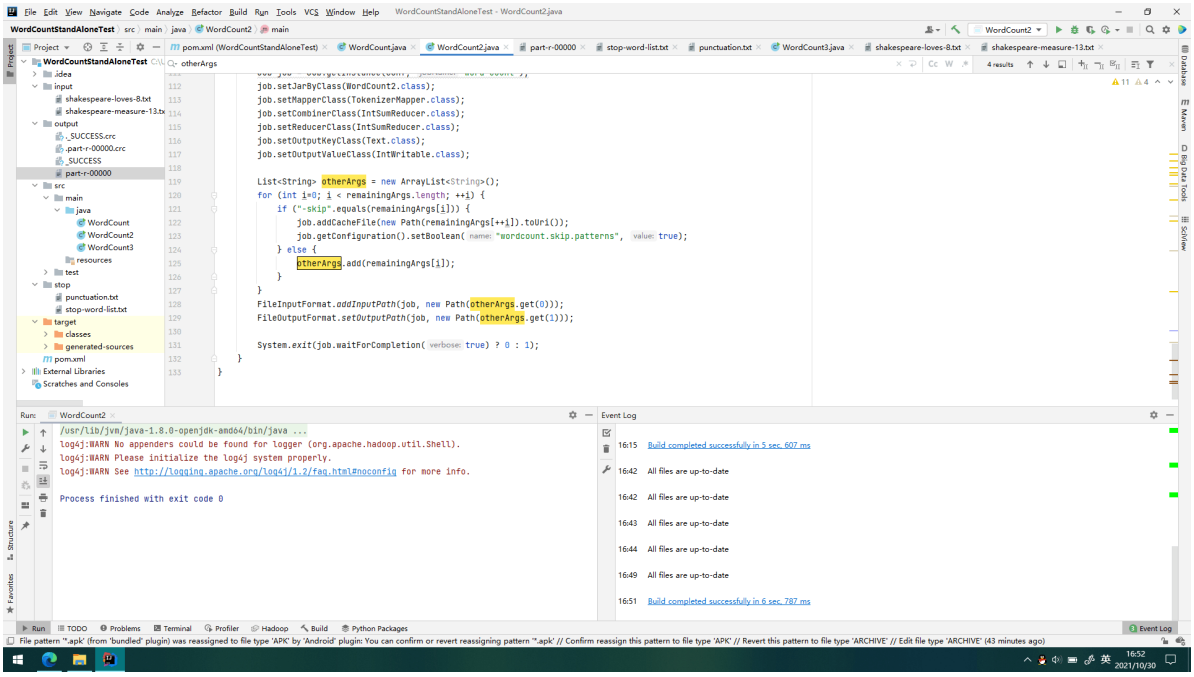


比如停用词就可以通过传参-skip解决

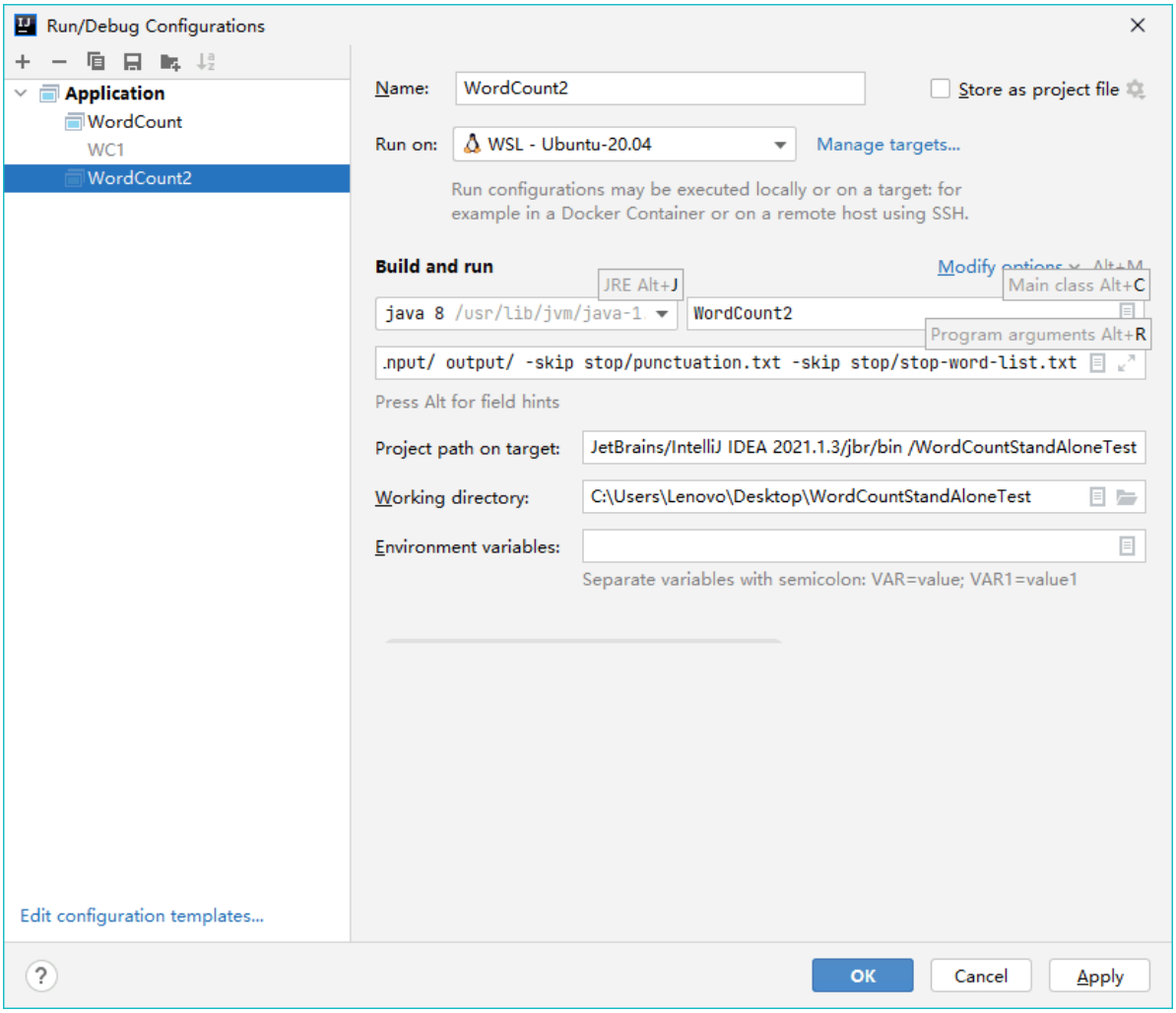


中间因为是电脑重新启动，导致了依赖出现了前后不一致的情况：Exception in thread "main" java.lang.NoSuchMethodError: org.apache.hadoop.security.proto.SecurityProtos.getDescriptor()Lcom/google/protobuf/Descriptors$FileDescriptor;清理一下缓存invalid cache重新刷新后恢复，可以发现确实起效跳过了停用词。目前就已经解决不少问题了。

二.完善WordCount3.0



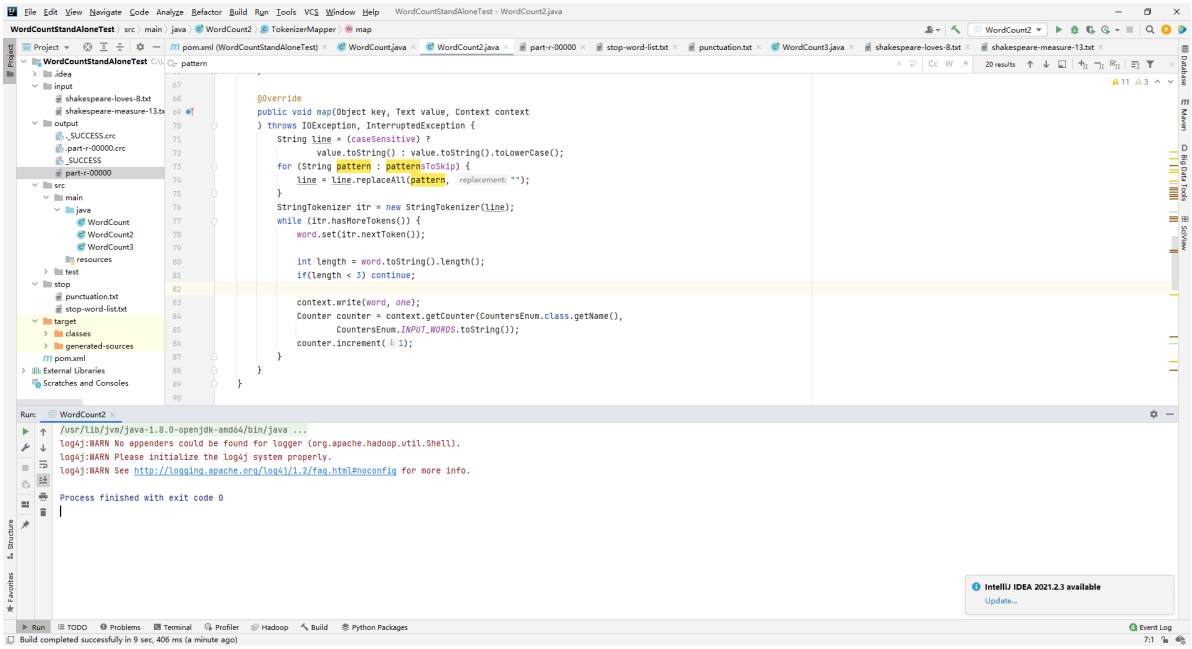
修改代码



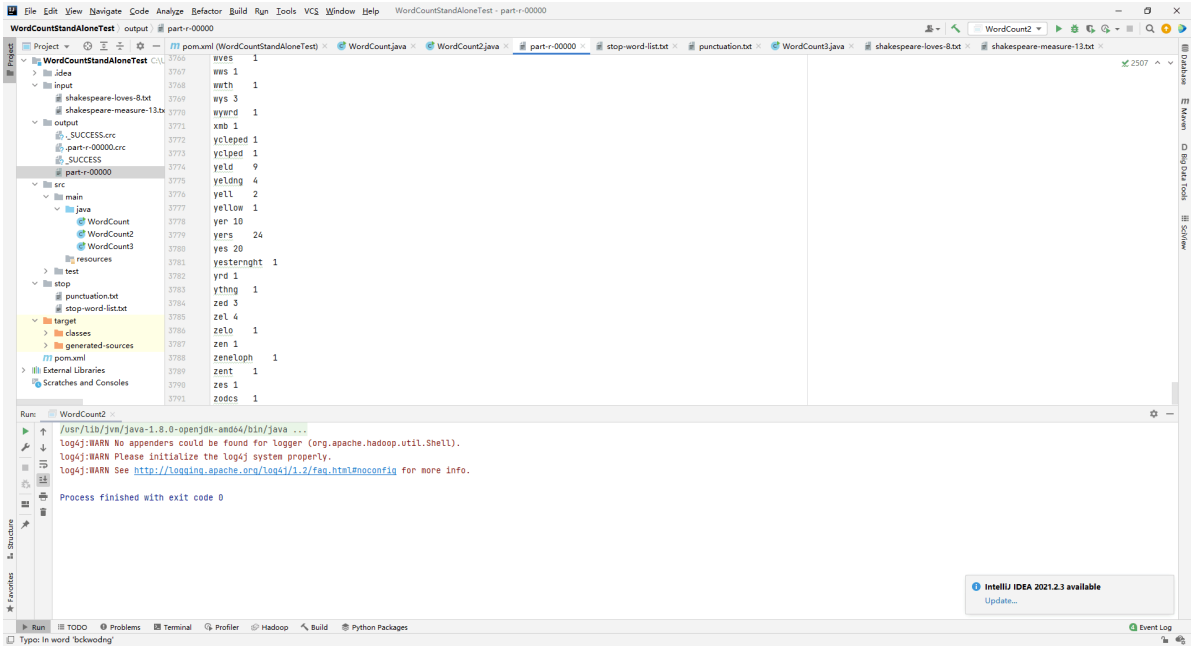
修改命令行和读取命令行参数，使得能够同时读取两个stop-word-list和punctuation停用文件样板

WordCount3.0需要skip两个停用词文件，这就需要重新调整对参数的数量限制和读取方式，体现在java代码上。

针对单词长度的过滤，不外乎两种，一种是map时过滤，一种是reduce时不输出，显然前者减少了传输开销和reducer的负担，更划算。

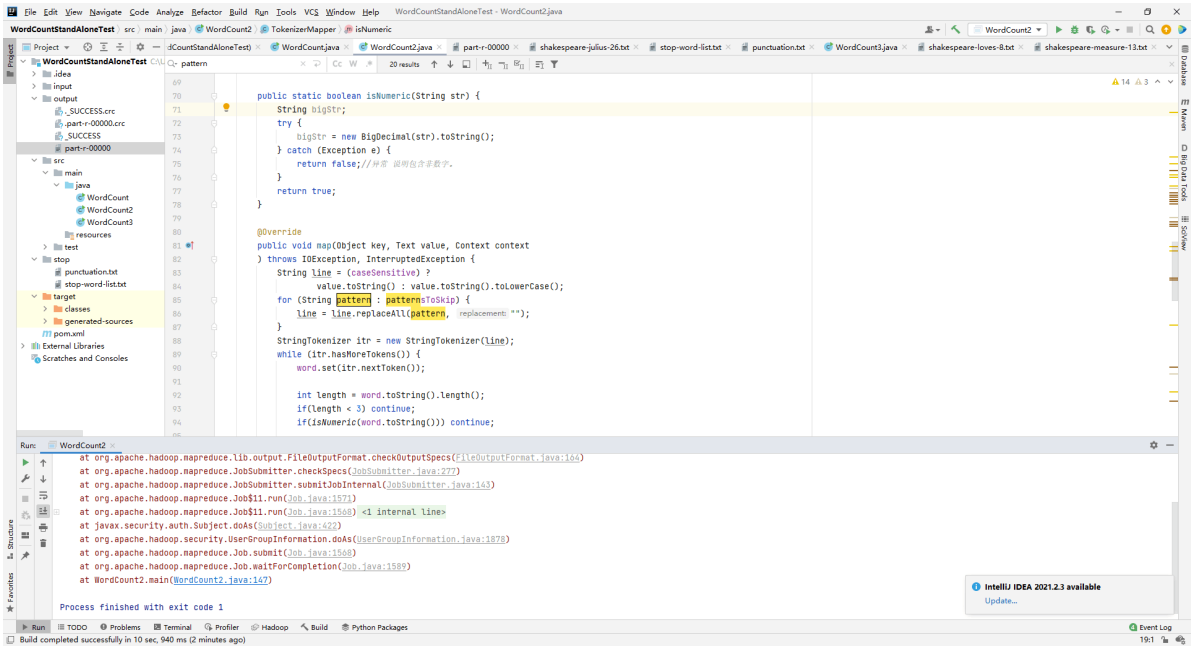


修改map提前过滤掉短单词

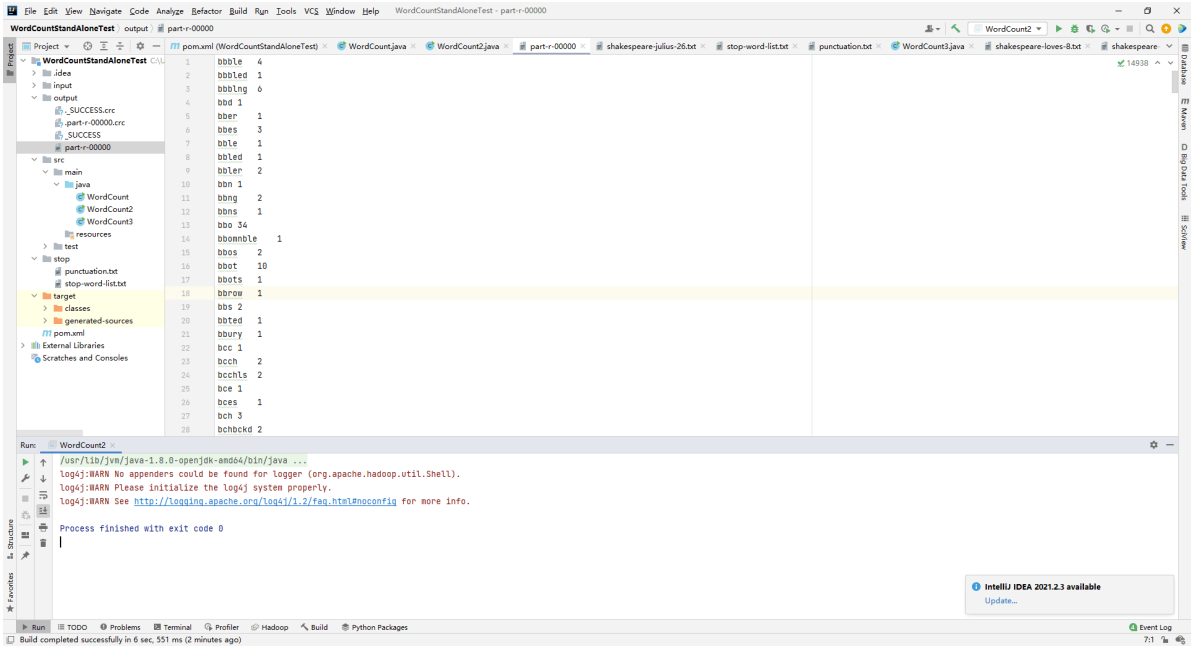


效果拔群

数字也是如此。之前为了方便只用了两个文本试跑，对所有文本的跑一遍，发现大概只有1609这样的单独数字，没有和英文混杂的。一方面我们使用正则表达式，确保正负数整数小数都能被筛到，-?[0-9]+(\.[0-9]+)?即可；或者更粗暴。



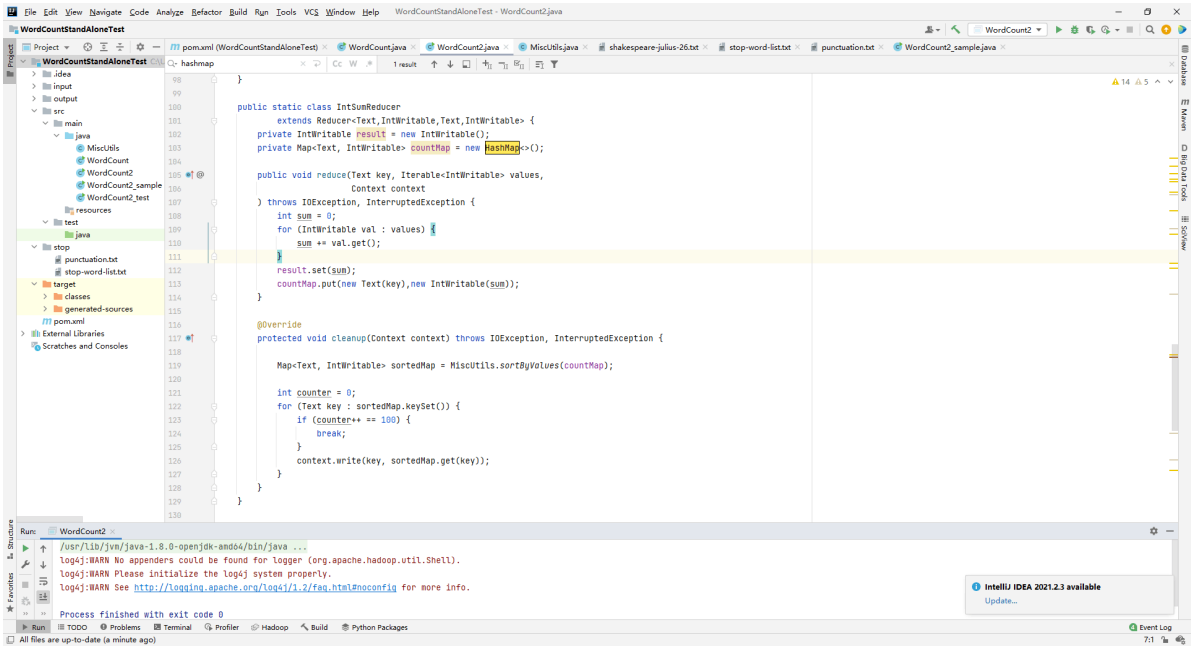
直接尝试能不能换成BigDecimal类型



奏效

对数字处理的想法参考了https://blog.csdn.net/u013066244/article/details/53197756。

接下来是输出数量的过滤，只要Top100。MapReduce的核心过程并不能解决输出数量的问题，让数据交给reducer，不急着写入文件，通过重写reducer下的cleanup方法，先写入hashmap，再排序筛选写入文件。这里的排序正常来说也可以通过串接第二个mapreduce程序来完成，这里省事直接另写一个类对作为中间存储的HashMap进行排序http://andreaiacono.blogspot.com/2014/03/mapreduce-for-top-n-items.html



```
}

public static class IntSumReducer
        extends Reducer<Text,IntWritable,Text,IntWritable> {
    private IntWritable result = new IntWritable();
    private Map<Text, IntWritable> countMap = new HashMap<>();

    public void reduce(Text key, Iterable<IntWritable> values,
                       Context context
    ) throws IOException, InterruptedException {
        int sum = 0;
        for (IntWritable val : values) {
            sum += val.get();
        }
        result.set(sum);
        countMap.put(new Text(key),new IntWritable(sum));
    }

    @Override
    protected void cleanup(Context context) throws IOException, InterruptedException {

        Map<Text, IntWritable> sortedMap = MiscUtils.sortByValues(countMap);

        int counter = 0;
        for (Text key : sortedMap.keySet()) {
            if (counter++ == 100) {
                break;
            }
            context.write(key, sortedMap.get(key));
        }
    }
}
```

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
log4j:WARN No appenders could be found for logger (org.apache.hadoop.util.Shell).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more info.

Process finished with exit code 0
```

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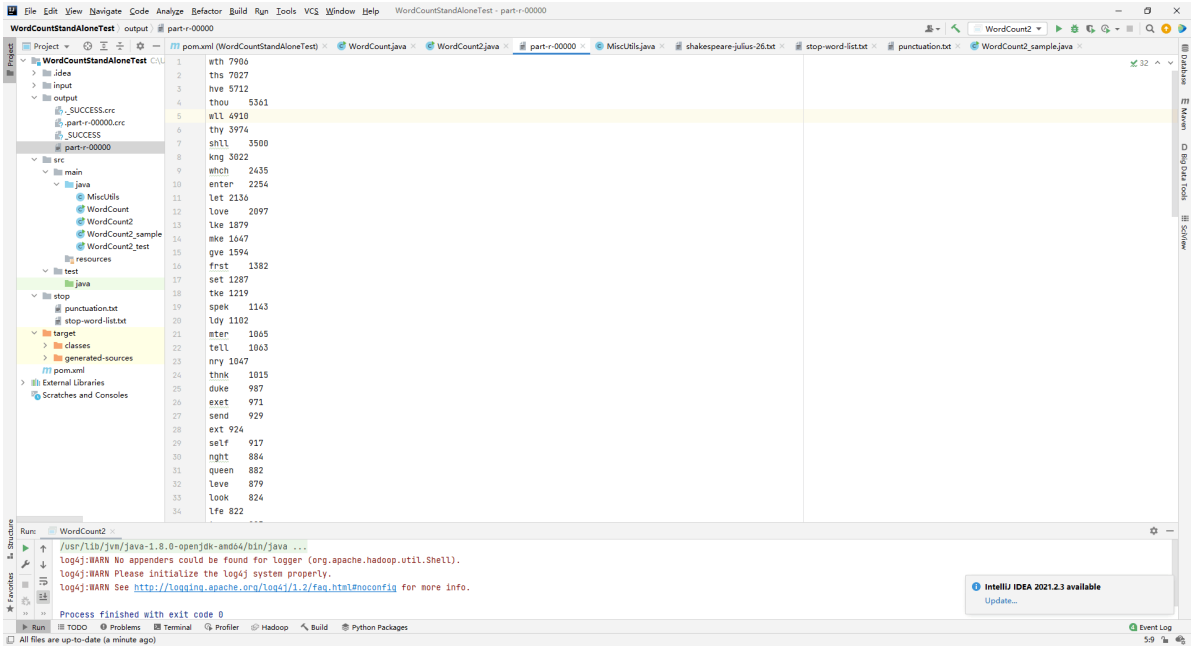
Update...

All files are up-to-date (a minute ago)

让reduce不急着输出，改写它的cleanup方法

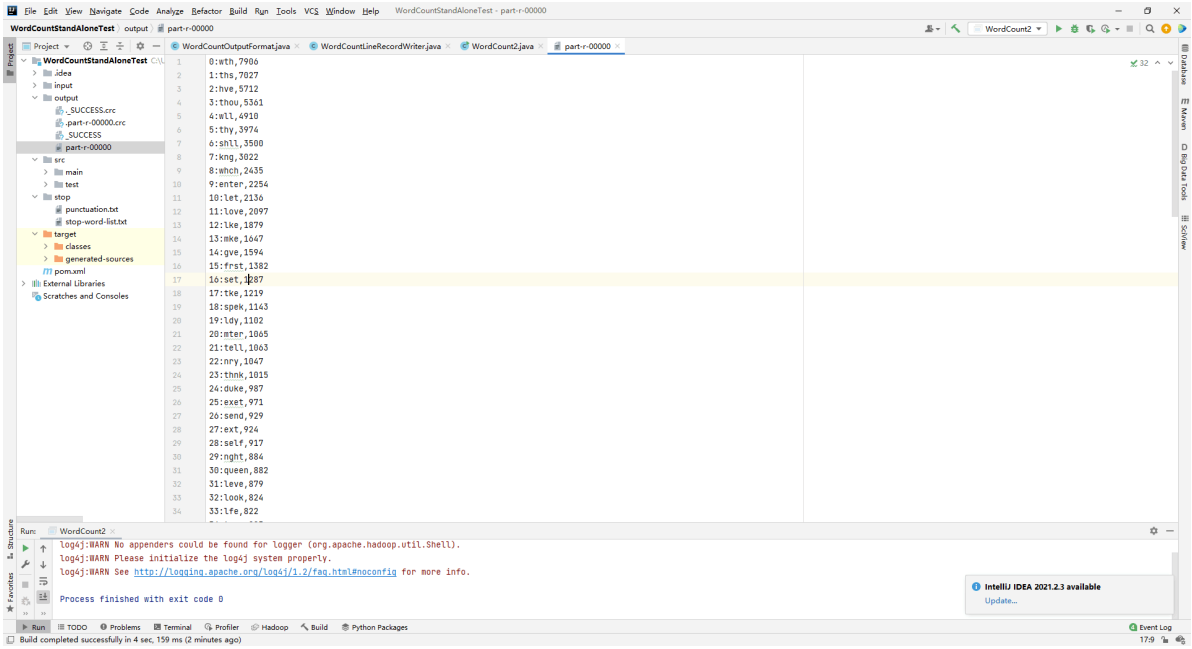


```
wth 7906
ths 7027
hve 5712
thou    5361
wll 4910
thy 3974
shll    3500
kng 3022
whch    2435
enter   2254
let 2136
love    2097
lke 1879
mke 1047
gve 1594
frst    1382
set 1287
tke 1219
spek    1143
ldy 1102
mter    1065
tell    1063
nry 1047
thnk    1015
duke    987
exet    971
send    929
ext 924
self    917
nght    884
queen   882
leve    879
look    824
lfe 822
```

```
/usr/lib/jvm/java-1.8.0-openjdk-amd64/bin/java ...
log4j:WARN No appenders could be found for logger (org.apache.hadoop.util.Shell).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more info.

Process finished with exit code 0
```

IntelliJ IDEA 2021.2.3 available
Update...

All files are up-to-date (a minute ago)

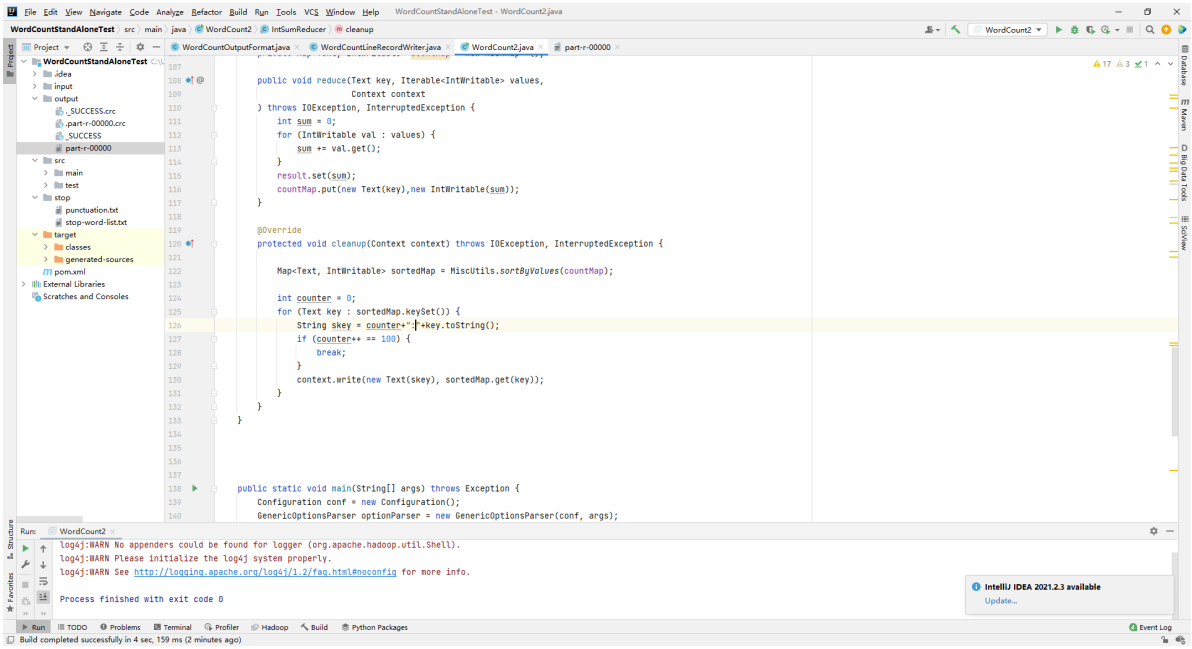


```
0:wth,7906
1:ths,7027
2:hve,5712
3:thou,5361
4:wll,4910
5:thy,3974
6:shll,3500
7:kng,3022
8:whch,2435
9:enter,2254
10:let,2136
11:love,2097
12:lke,1879
13:mke,1047
14:gve,1594
15:frst,1382
16:set,1287
17:tke,1219
18:spek,1143
19:ldy,1102
20:mter,1065
21:tell,1063
22:nry,1047
23:thnk,1015
24:duke,987
25:exet,971
26:send,929
27:ext,924
28:self,917
29:nght,884
30:queen,882
31:leve,879
32:look,824
33:lfe,822
```

```
log4j:WARN No appenders could be found for logger (org.apache.hadoop.util.Shell).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more info.

Process finished with exit code 0
```

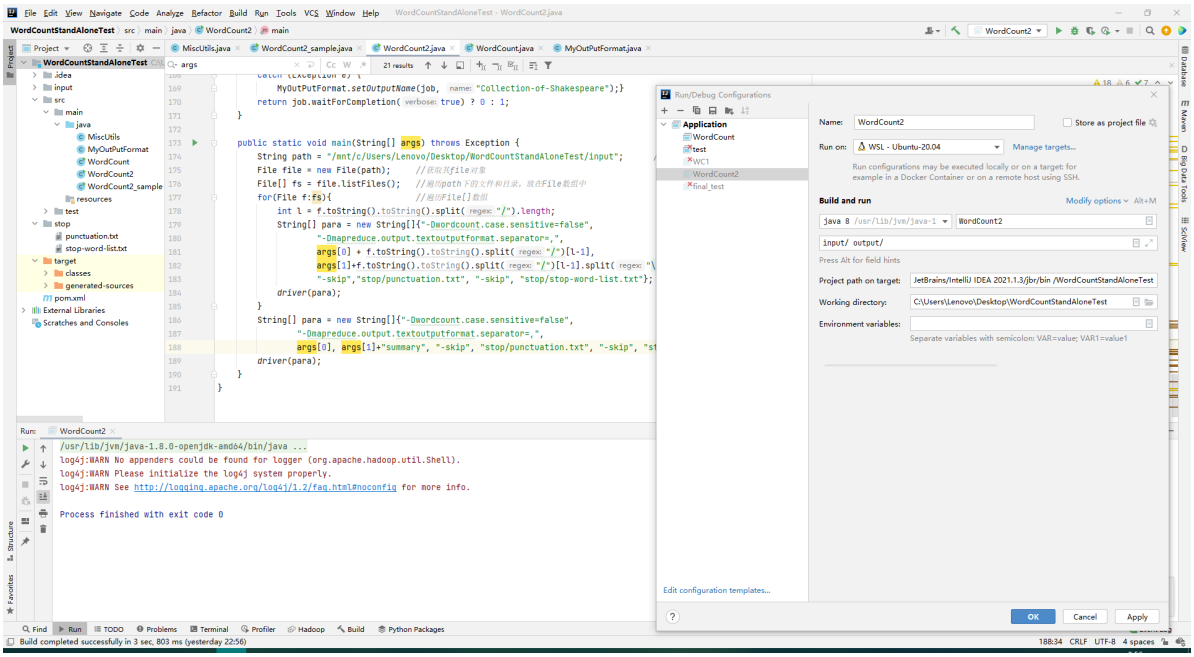
IntelliJ IDEA 2021.2.3 available
Update...

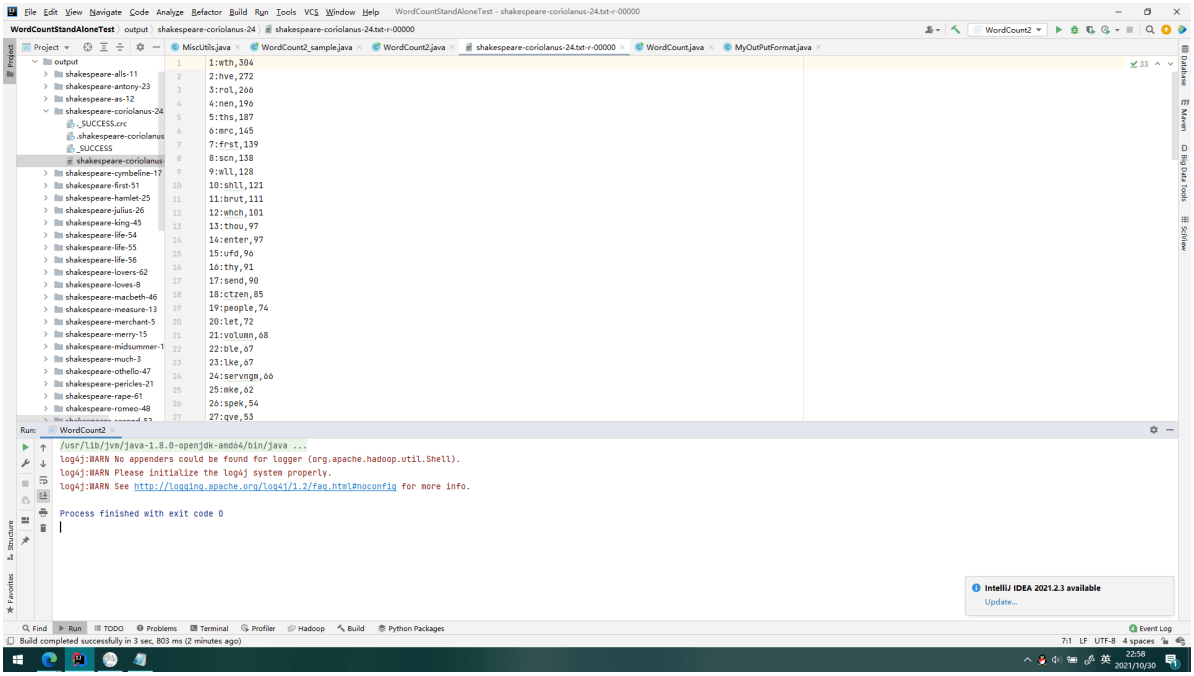
Build completed successfully in 4 sec, 159 ms (2 minutes ago)



顺便，针对输出格式，可以直接在cleanup中修改键值构造新字符串再转换为Text传入Context，中间的分隔符如果不这样也可以在运行参数中输入-Dmapreduce.output.textoutputformat.separator=",",效果一致。同理，稍事修改可以通过传参确定top k 的k具体数值，这里没有实现。

仔细考虑怎样避开mapreduce总是在文件夹下运行所有文件，更灵活地对数据文件进行操作，这里我不再在configuration中设置参数，直接拎到新的main函数中遍历调用，旧的main设置为driver接受参数。每读一个文件做一次MR，循环结束后再做一次总的，结果重命名后写入各自文件夹。重命名参考[MapReduce修改输出的文件名 - 嘣嘣嚓 - 博客园 (cnblogs.com)](), 自定义TextOutPutFormat重写setOutputName方法实现。

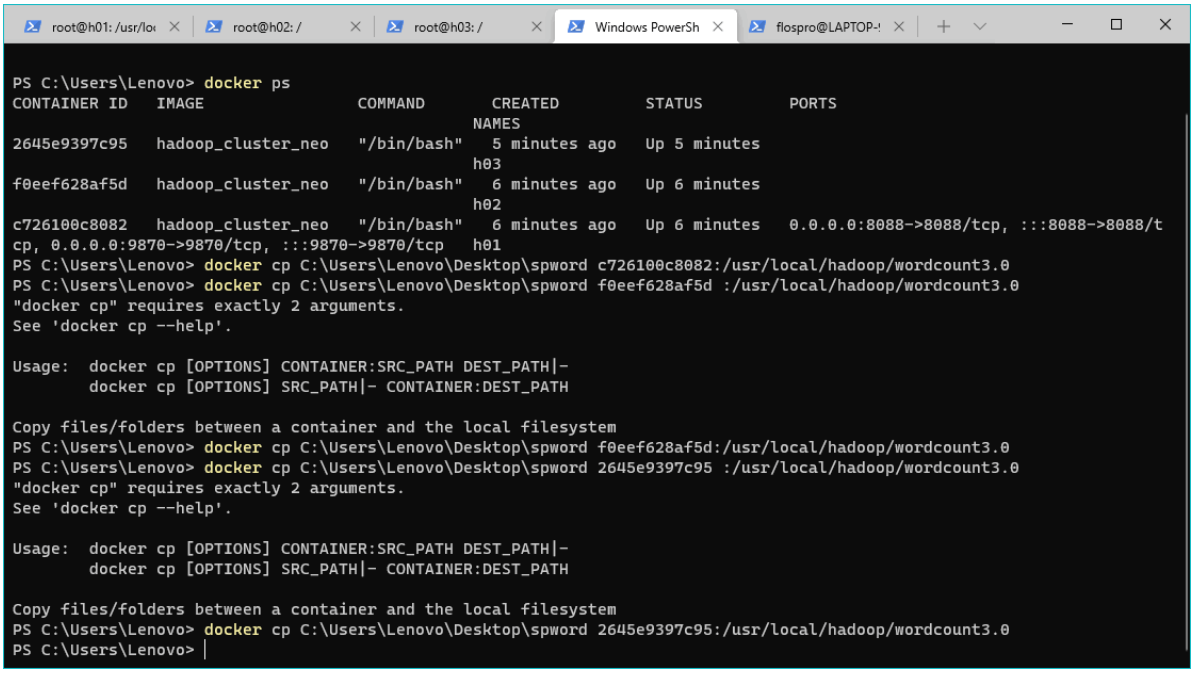




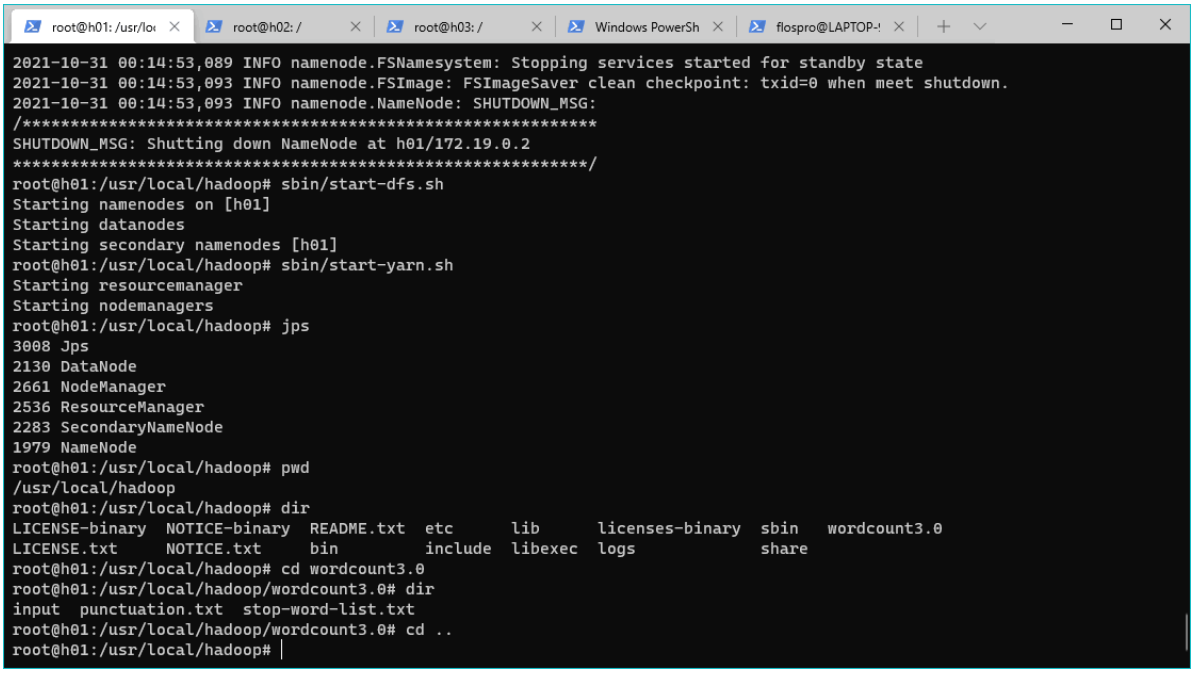
可见实现了单个文件和的词频按格式统计输出，要求的功能都已经实现了。

三、在docker集群上跑WordCount3.0

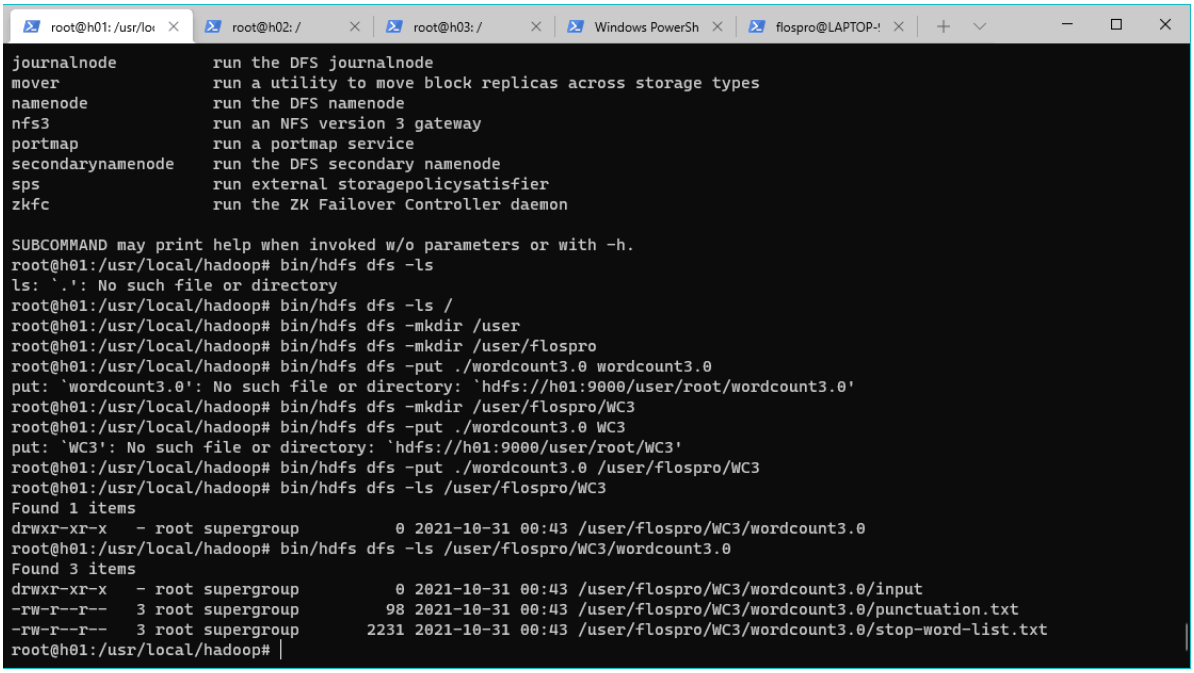
到了在集群上跑，由于代码也几乎完成了，并没有连接docker和idea的必要。当然一开始我也有连接集群运行代码的想法，按照官网教程下载了Big Data Tools、Scala和python插件，设置server type，file systems之类，也没摸清帮助也不大，还是准备好集群打好jar包跑就行。



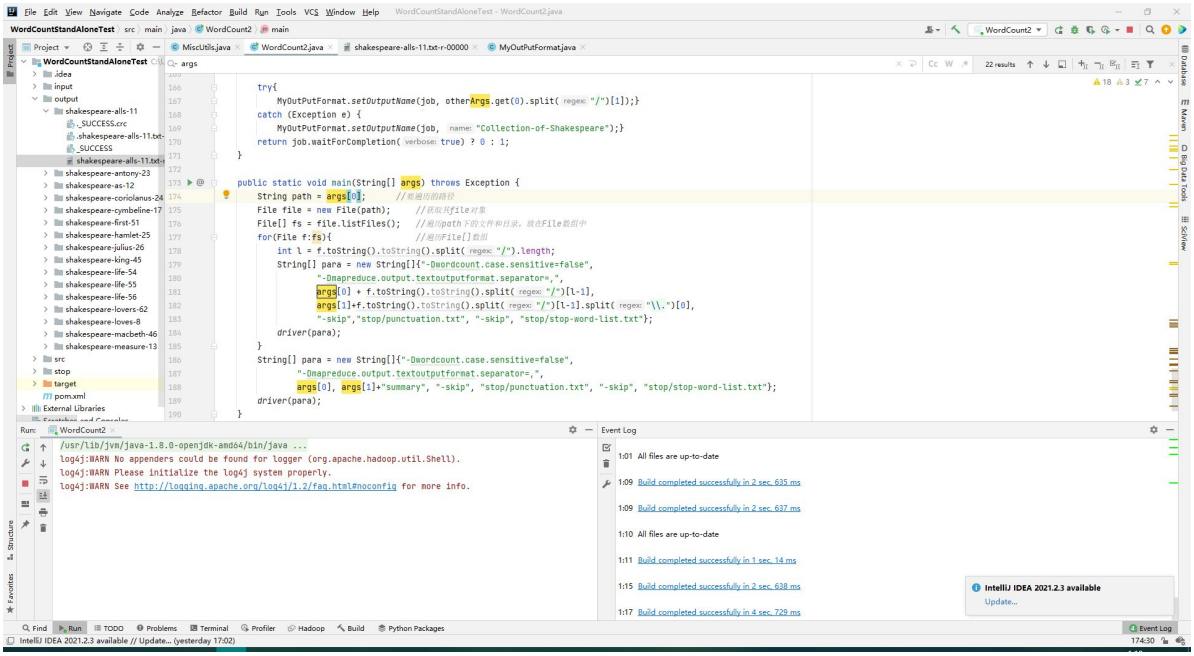
宿主机向容器传输文件



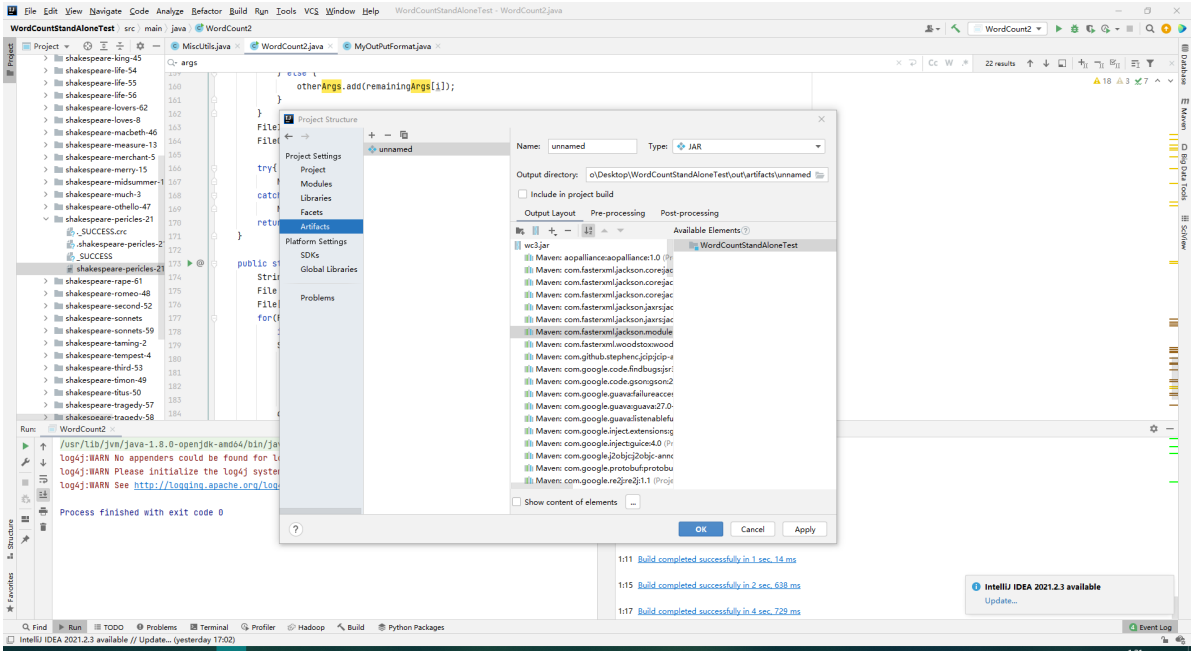
这里发现了一个很严重的问题，在实验二中的docker集群配置中，由于改造镜像时的配置文件全都照抄了伪分布式的，当时报告以为完成了实际上并没有起到集群的效果，当时对整体架构不太清楚也没能从网页上只显示有一个活跃节点等显著变量中察觉。现在已经按照分布式的配置文件重新导出了镜像，包括网页与运行时的提示已不再显示localhost而是h01，也显示三个节点可用，之前疏忽了。



向hdfs中放入文件



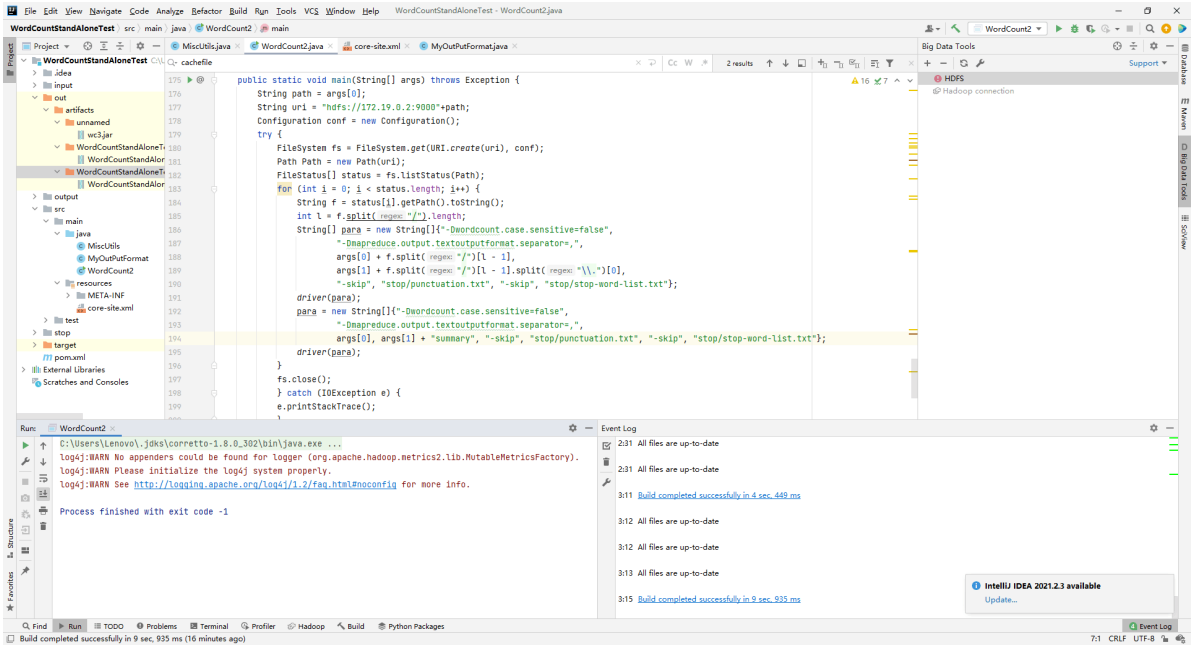
这里先发现了一点需要修改的参数和代码，当时图省事对于遍历目录用了绝对目录，这样在hdfs里是行不通的，应该改成传参控制。



打jar包

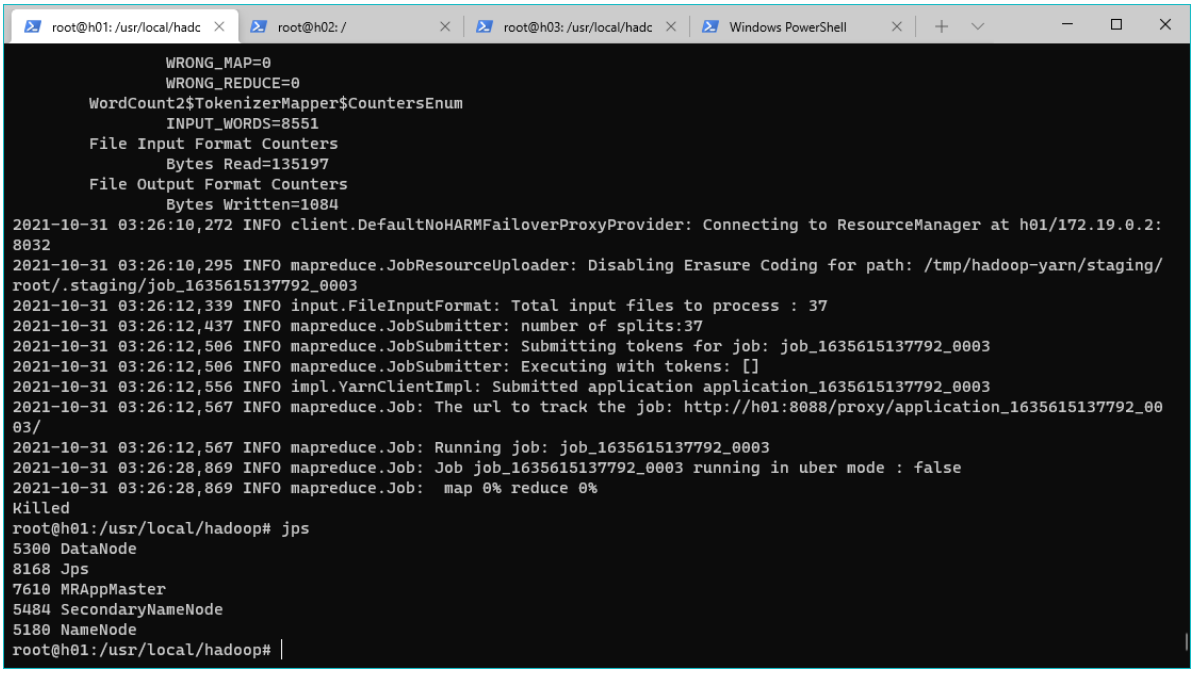
```
See 'docker cp --help'.

Usage:  docker cp [OPTIONS] CONTAINER:SRC_PATH DEST_PATH|-
        docker cp [OPTIONS] SRC_PATH|- CONTAINER:DEST_PATH

Copy files/folders between a container and the local filesystem
PS C:\Users\Lenovo> docker cp C:\Users\Lenovo\Desktop\spword f0eef628af5d:/usr/local/hadoop/wordcount3.0
PS C:\Users\Lenovo> docker cp C:\Users\Lenovo\Desktop\spword 2645e9397c95 :/usr/local/hadoop/wordcount3.0
"docker cp" requires exactly 2 arguments.
See 'docker cp --help'.

Usage:  docker cp [OPTIONS] CONTAINER:SRC_PATH DEST_PATH|-
        docker cp [OPTIONS] SRC_PATH|- CONTAINER:DEST_PATH

Copy files/folders between a container and the local filesystem
PS C:\Users\Lenovo> docker cp C:\Users\Lenovo\Desktop\spword 2645e9397c95:/usr/local/hadoop/wordcount3.0
PS C:\Users\Lenovo> docker cp C:\Users\Lenovo\Desktop\WordCountStandAloneTest\out\artifacts\unnamed\wc3.jar 2645e9397c95
:/usr/local/hadoop/wc3.jar
PS C:\Users\Lenovo> docker cp C:\Users\Lenovo\Desktop\WordCountStandAloneTest\out\artifacts\unnamed\wc3.jar f0eef628af5d
:/usr/local/hadoop/wc3.jar
PS C:\Users\Lenovo> docker cp C:\Users\Lenovo\Desktop\WordCountStandAloneTest\out\artifacts\unnamed\wc3.jar c726100c8082
 :/usr/local/hadoop/wc3.jar
"docker cp" requires exactly 2 arguments.
See 'docker cp --help'.

Usage:  docker cp [OPTIONS] CONTAINER:SRC_PATH DEST_PATH|-
        docker cp [OPTIONS] SRC_PATH|- CONTAINER:DEST_PATH

Copy files/folders between a container and the local filesystem
PS C:\Users\Lenovo>
```

转运jar包到h01

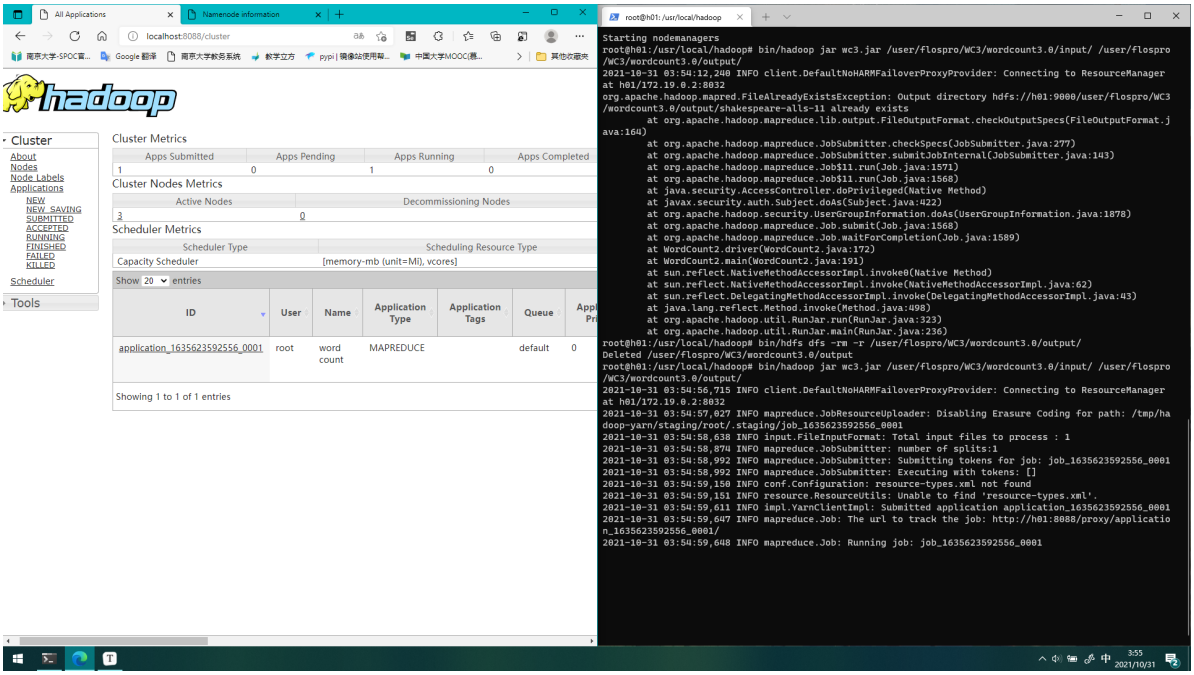


运行方法是在hadoop目录下运行bin/hadoop jar wc3.jar /user/flospro/WC3/wordcount3.0/input/ /user/flospro/WC3/wordcount3.0/output/，由于有些折磨就没顾及细节，参数的任意增添，文件夹"/"符号的增减、停用词相对位置的变化都会导致无法运行，这里是成大事不拘小节了。

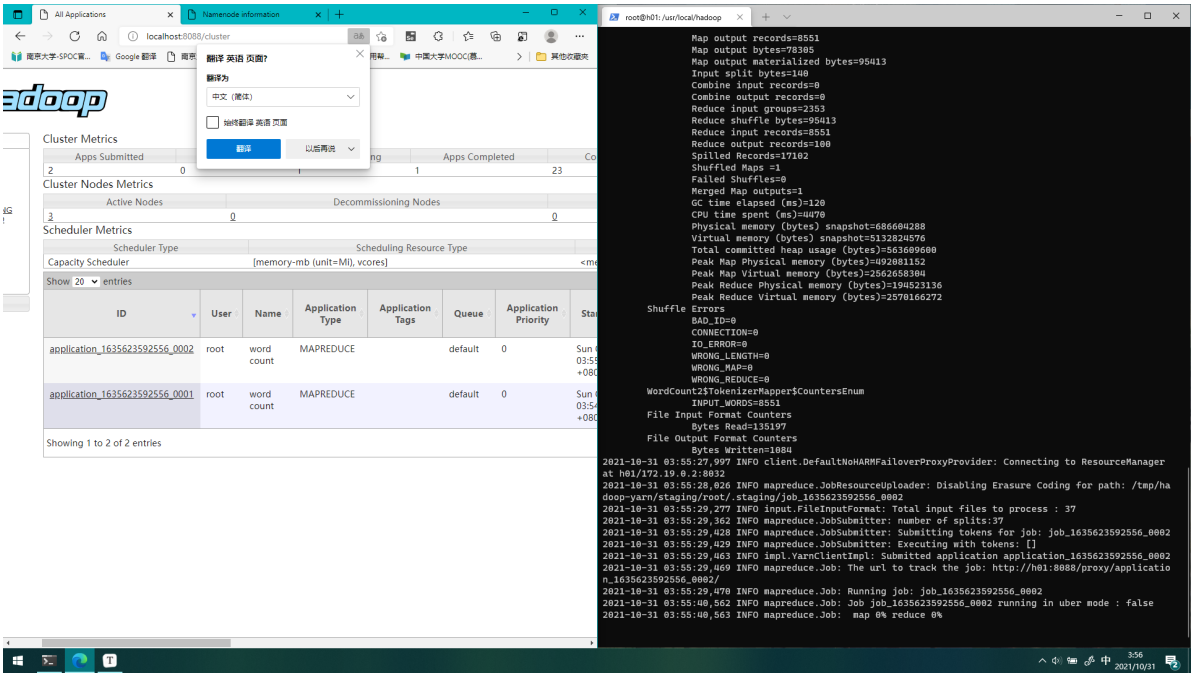
这里在docker跑不通后就发现了另一处问题，file读不到内容。之前idea的遍历可以直接用file类进行文件操作，但是file类并不能对hdfs操作，应该改为FileSystem类对文件系统操作。参考了[HDFS的Java客户端操作代码(查看HDFS下所有的文件或目录)详解大数据IT虾米网 (itxm.cn)](#)。

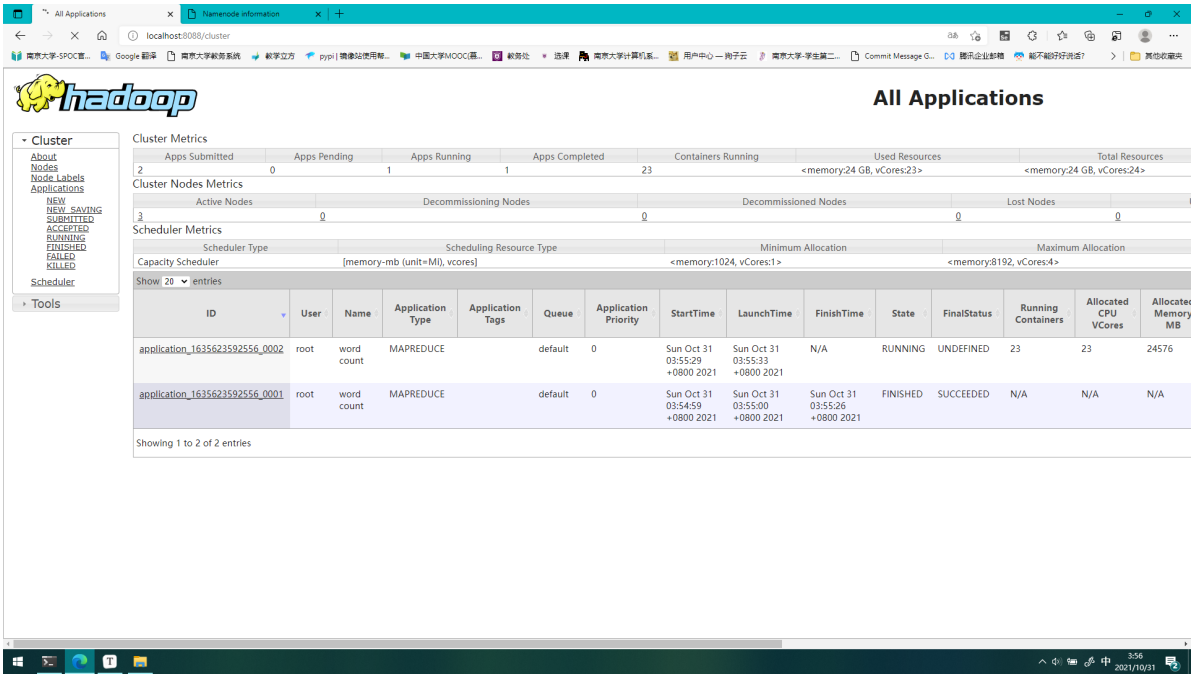


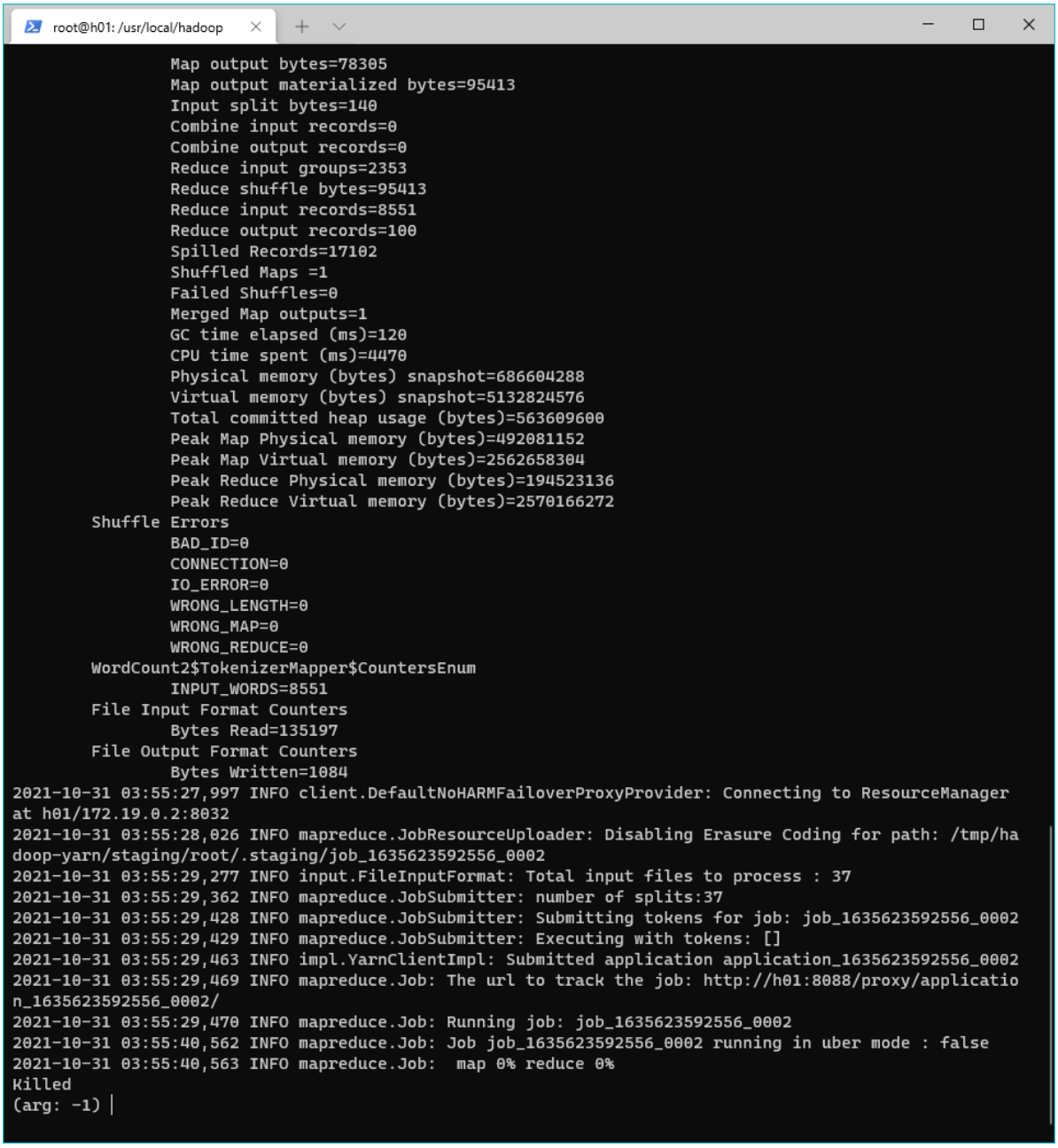
不幸的是，可能因为电脑负载过大，散热扇呼呼地转，点开此电脑c盘也接近爆满，ResourceManager挂了，进程被杀死了。



不过为了确保不是代码问题任务确实是开始运行的，同时监控网页端口，发现确实是接收到了任务，至少还完成了一个接到了第二个。


All Applications
Namenode information
localhost:8088/cluster
Cluster Metrics
Apps Submitted
Apps Completed
Cluster Nodes Metrics
Active Nodes
Decommissioning Nodes
Scheduler Metrics
Scheduler Type
Scheduling Resource Type
Capacity Scheduler
[memory-mb (unit=Mi), vcores]
ID
User
Name
Application Type
Application Tags
Queue
Application Priority
application_1635623592556_0002
root
word count
MAPREDUCE
default
0
application_1635623592556_0001
Showing 1 to 2 of 2 entries
root@h01: /usr/local/hadoop
Map output records=8551
Map output bytes=78305
Map output materialized bytes=95413
Input split bytes=140
Combine input records=0
Combine output records=0
Reduce input groups=2353
Reduce shuffle bytes=95413
Reduce input records=8551
Reduce output records=100
Spilled Records=17102
Shuffled Maps =1
Failed Shuffles=0
Merged Map outputs=1
GC time elapsed (ms)=120
CPU time spent (ms)=4470
Physical memory (bytes) snapshot=686604288
Virtual memory (bytes) snapshot=5132824576
Total committed heap usage (bytes)=563609600
Peak Map Physical memory (bytes)=492081152
Peak Map Virtual memory (bytes)=2562658304
Peak Reduce Physical memory (bytes)=194523136
Peak Reduce Virtual memory (bytes)=2570166272
Shuffle Errors
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGTH=0
WRONG_MAP=0
WRONG_REDUCE=0
WordCount2$TokenizerMapper$CountersEnum
INPUT_WORDS=8551
File Input Format Counters
Bytes Read=135197
File Output Format Counters
Bytes Written=1084
2021-10-31 03:55:27,997 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at h01/172.19.0.2:8032
2021-10-31 03:55:28,826 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/root/.staging/job_1635623592556_0002
2021-10-31 03:55:29,277 INFO input.FileInputFormat: Total input files to process : 37
2021-10-31 03:55:29,362 INFO mapreduce.JobSubmitter: number of splits:37
2021-10-31 03:55:29,428 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1635623592556_0002
2021-10-31 03:55:29,429 INFO mapreduce.JobSubmitter: Executing with tokens: []
2021-10-31 03:55:29,463 INFO impl.YarnClientImpl: Submitted application application_1635623592556_0002
2021-10-31 03:55:29,469 INFO mapreduce.Job: The url to track the job: http://h01:8088/proxy/application_1635623592556_0002/
2021-10-31 03:55:29,470 INFO mapreduce.Job: Running job: job_1635623592556_0002
2021-10-31 03:55:40,562 INFO mapreduce.Job: Job job_1635623592556_0002 running in uber mode : false
2021-10-31 03:55:40,563 INFO mapreduce.Job: map 0% reduce 0%


All Applications
Namenode information
localhost:8088/cluster
All Applications
Cluster
About
Nodes
Node Labels
Applications
NEW
NEW_SAVING
SUBMITTED
ACCEPTED
RUNNING
FINISHED
FAILED
KILLED
Scheduler
Tools
Cluster Metrics
Apps Submitted
Apps Pending
Apps Running
Apps Completed
Containers Running
Used Resources
Total Resources
2
0
1
1
23
<memory:24 GB, vCores:23>
<memory:24 GB, vCores:24>
Cluster Nodes Metrics
Active Nodes
Decommissioning Nodes
Decommissioned Nodes
Lost Nodes
3
0
0
0
0
Scheduler Metrics
Scheduler Type
Scheduling Resource Type
Minimum Allocation
Maximum Allocation
Capacity Scheduler
[memory-mb (unit=Mi), vcores]
<memory:1024, vCores:1>
<memory:8192, vCores:4>
ID
User
Name
Application Type
Application Tags
Queue
Application Priority
StartTime
LaunchTime
FinishTime
State
FinalStatus
Running Containers
Allocated CPU VCores
Allocated Memory MB
application_1635623592556_0002
root
word count
MAPREDUCE
default
0
Sun Oct 31 03:55:29 +0800 2021
Sun Oct 31 03:55:33 +0800 2021
N/A
RUNNING
UNDEFINED
23
23
24576
application_1635623592556_0001
Sun Oct 31 03:54:59 +0800 2021
Sun Oct 31 03:55:00 +0800 2021
Sun Oct 31 03:55:26 +0800 2021
FINISHED
SUCCEEDED
N/A
N/A
N/A
Showing 1 to 2 of 2 entries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2021-10-31 03:55:29,469 INFO mapreduce.Job: The url to track the job: http://h01:8088/proxy/application_1635623592556_0002/
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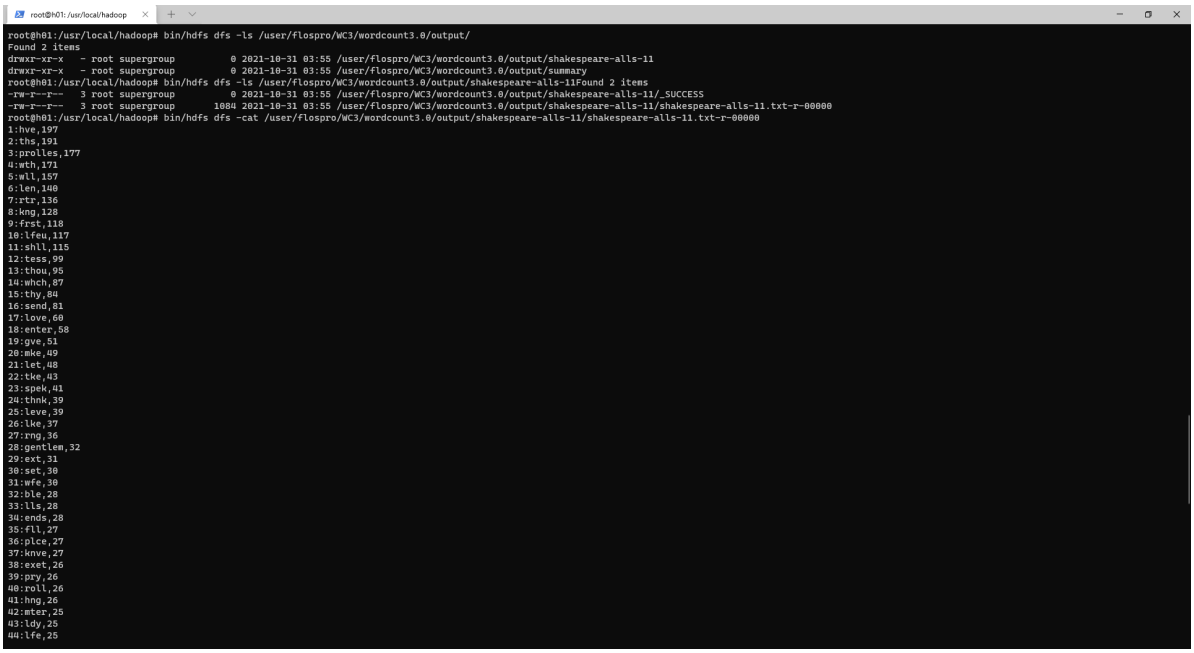
2021-10-31 03:55:40,562 INFO mapreduce.Job: Job job_1635623592556_0002 running in uber mode : false
2021-10-31 03:55:40,563 INFO mapreduce.Job: map 0% reduce 0%
Killed
(arg: -1)


root@h01:/usr/local/hadoop# bin/hdfs dfs -ls /user/flospro/WC3/wordcount3.0/output/
Found 2 items
drwxr-xr-x   - root supergroup   0 2021-10-31 03:55 /user/flospro/WC3/wordcount3.0/output/shakespeare-alls-11
drwxr-xr-x   - root supergroup   0 2021-10-31 03:55 /user/flospro/WC3/wordcount3.0/output/summary
root@h01:/usr/local/hadoop# bin/hdfs dfs -ls /user/flospro/WC3/wordcount3.0/output/shakespeare-alls-11Found 2 items
-rw-r--r--   3 root supergroup   0 2021-10-31 03:55 /user/flospro/WC3/wordcount3.0/output/shakespeare-alls-11/_SUCCESS
-rw-r--r--   3 root supergroup   1084 2021-10-31 03:55 /user/flospro/WC3/wordcount3.0/output/shakespeare-alls-11/shakespeare-alls-11.txt-r-00000
root@h01:/usr/local/hadoop# bin/hdfs dfs -cat /user/flospro/WC3/wordcount3.0/output/shakespeare-alls-11/shakespeare-alls-11.txt-r-00000
1:hve,197
2:ths,191
3:prolles,177
4:wth,171
5:wll,157
6:len,108
7:rtr,136
8:kng,128
9:frst,118
10:lfeu,117
11:shll,115
12:tess,99
13:thou,95
14:whch,87
15:thy,84
16:send,81
17:love,60
18:enter,58
19:gve,51
20:mke,49
21:let,48
22:tke,43
23:spek,41
24:thnk,39
25:leve,39
26:lke,37
27:rng,36
28:gentlem,32
29:ext,31
30:set,30
31:wfe,30
32:ble,28
33:lls,28
34:ends,28
35:fll,27
36:plce,27
37:knve,27
38:exet,26
39:pry,26
40:roll,26
41:hng,26
42:mter,25
43:ldy,25
44:lfe,25

但还是很不幸地被killed了，不过如图在hdfs中打开已经计算完毕的结果来看，已经运行出来的结果都是正确且符合要求的。对代码验证的担心一方面是变了环境，另一方面是宿主机无法连上hdfs的接口，ping docker也超时，file类修改成filesystem类的那段代码没法得到验证，还好结果是没问题的，不过全部文本都跑一遍MR确实吃不消，应该考虑优化。下周上课前有必要去和老师申请BDKit。