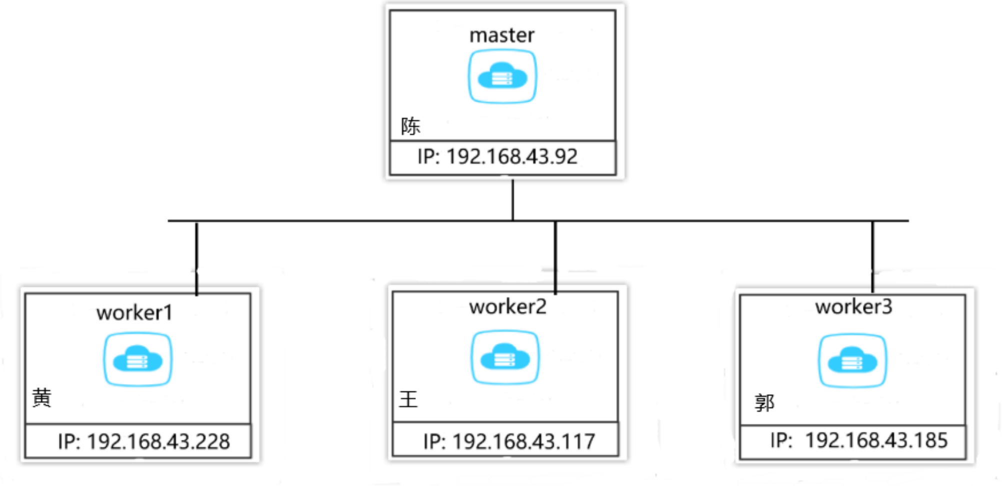
搭建Hadoop+Spark分布式集群

实验目的

搭建真实的分布式计算环境。

实验内容

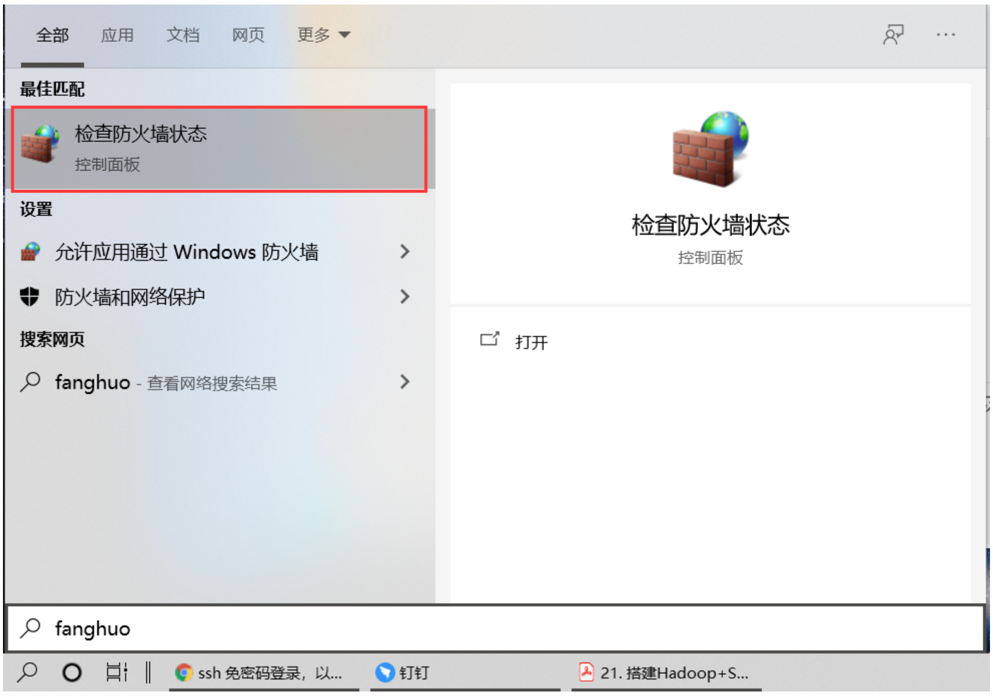
1.准备机器

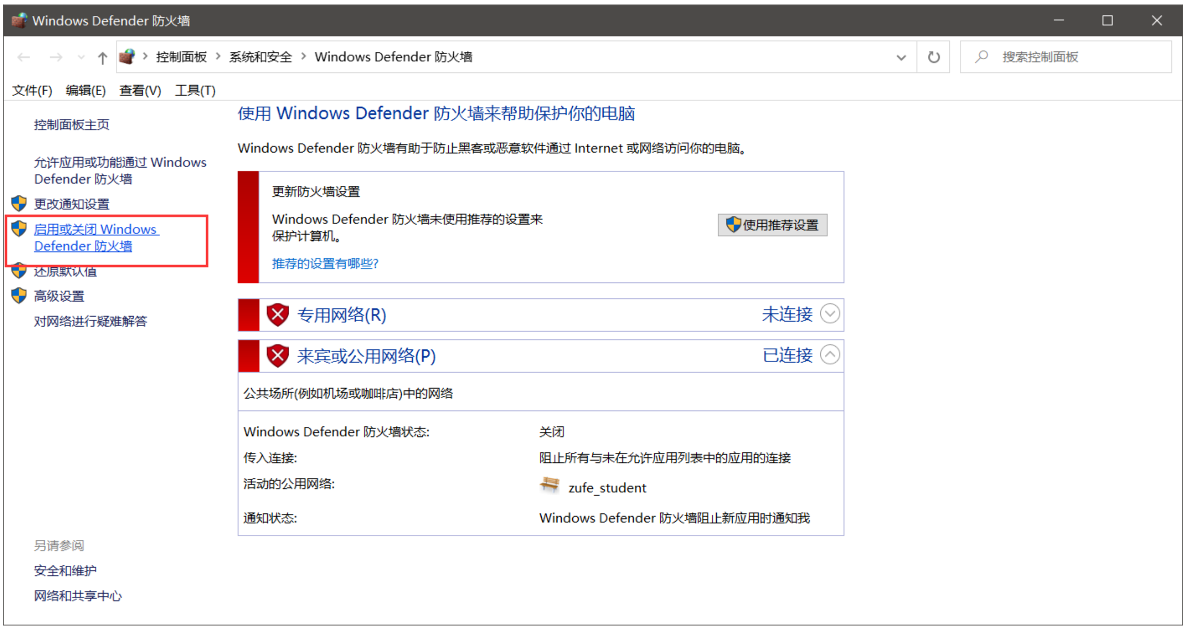


2.配置桥接网卡

以master为例说明网络配置：

> 1.首先关闭宿主机（windows10）的防火墙




Windows Defender 防火墙
控制面板 > 系统和安全 > Windows Defender 防火墙
搜索控制面板
文件(F) 编辑(E) 查看(V) 工具(T)
控制面板主页
允许应用或功能通过 Windows Defender 防火墙
更改通知设置
启用或关闭 Windows Defender 防火墙
还原默认值
高级设置
对网络进行疑难解答
另请参阅
安全和维护
网络和共享中心
使用推荐设置

使用 Windows Defender 防火墙来帮助保护你的电脑

Windows Defender 防火墙有助于防止黑客或恶意软件通过 Internet 或网络访问你的电脑。

更新防火墙设置

Windows Defender 防火墙未使用推荐的设置来保护计算机。

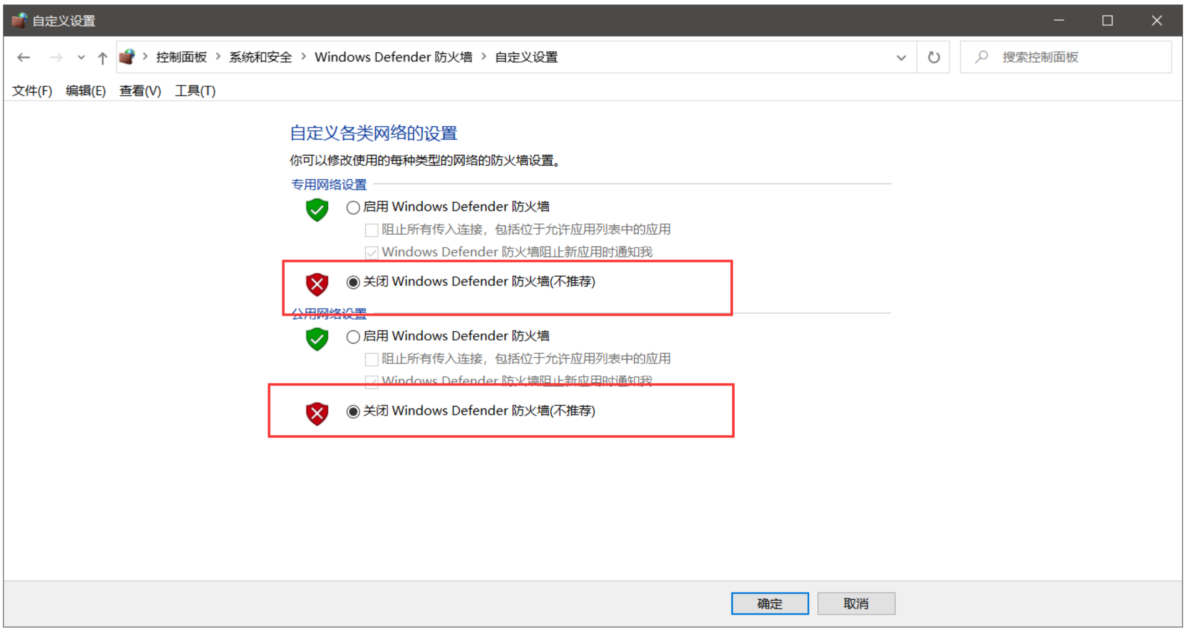
推荐的设置有哪些?

专用网络(R) 未连接

来宾或公用网络(P) 已连接

公共场所(例如机场或咖啡店)中的网络

Windows Defender 防火墙状态:	关闭
传入连接:	阻止所有与未在允许应用列表中的应用的连接
活动的公用网络:	zufe_student
通知状态:	Windows Defender 防火墙阻止新应用时通知我


自定义设置
控制面板 > 系统和安全 > Windows Defender 防火墙 > 自定义设置
搜索控制面板
文件(F) 编辑(E) 查看(V) 工具(T)
确定
取消

自定义各类网络的设置

你可以修改使用的每种类型的网络的防火墙设置。

专用网络设置

○ 启用 Windows Defender 防火墙

□ 阻止所有传入连接，包括位于允许应用列表中的应用

☑ Windows Defender 防火墙阻止新应用时通知我

● 关闭 Windows Defender 防火墙(不推荐)

公用网络设置

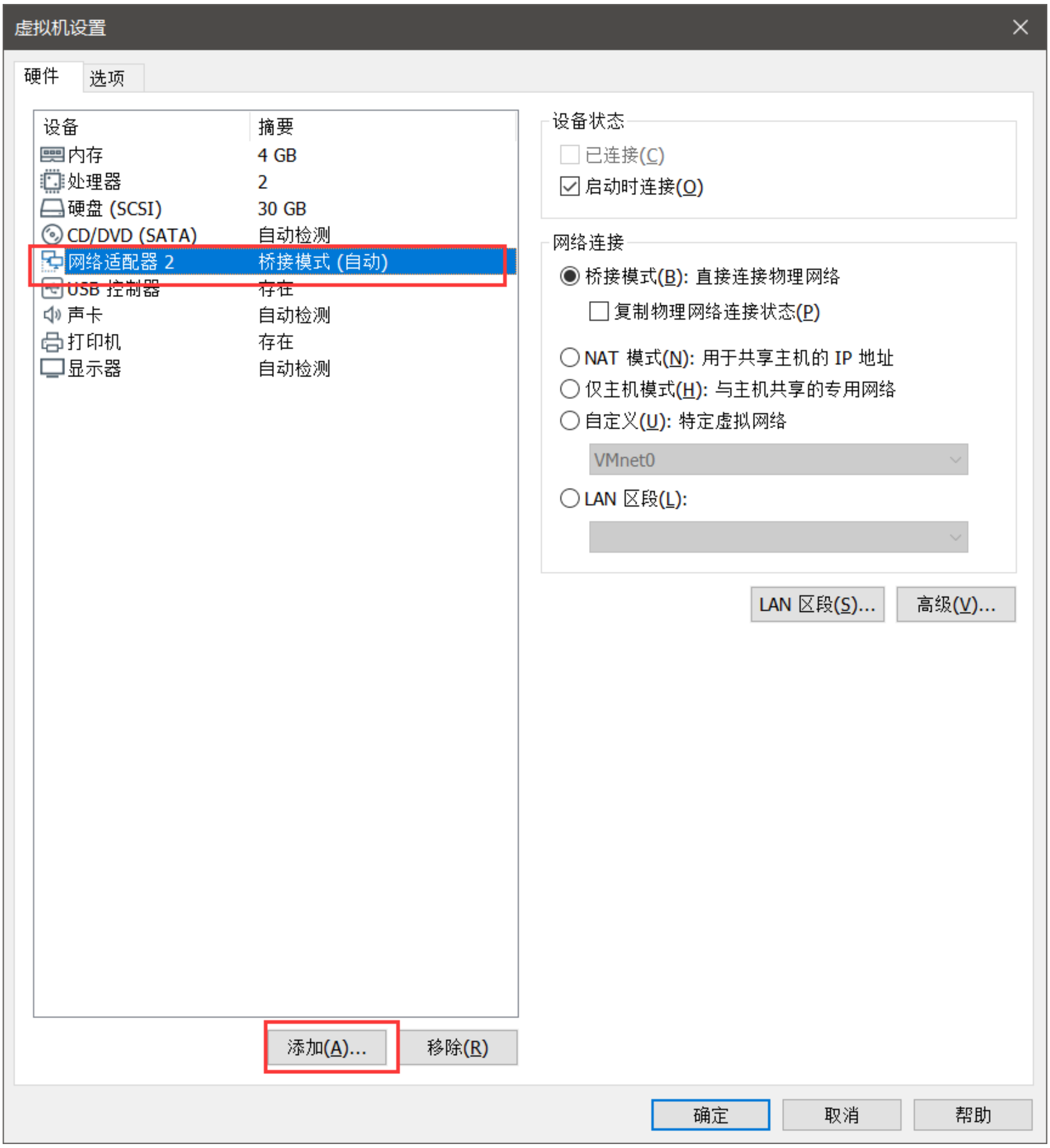
○ 启用 Windows Defender 防火墙

□ 阻止所有传入连接，包括位于允许应用列表中的应用

☑ Windows Defender 防火墙阻止新应用时通知我

● 关闭 Windows Defender 防火墙(不推荐)

> 2.在虚拟机软件上添加一张桥接网卡



虚拟机设置

硬件 选项

设备	摘要
内存	4 GB
处理器	2
硬盘 (SCSI)	30 GB
CD/DVD (SATA)	自动检测
网络适配器 2	桥接模式 (自动)
USB 控制器	存在
声卡	自动检测
打印机	存在
显示器	自动检测

设备状态

□ 已连接(C)

☑ 启动时连接(O)

网络连接

● 桥接模式(B): 直接连接物理网络

□ 复制物理网络连接状态(P)

○ NAT 模式(N): 用于共享主机的 IP 地址

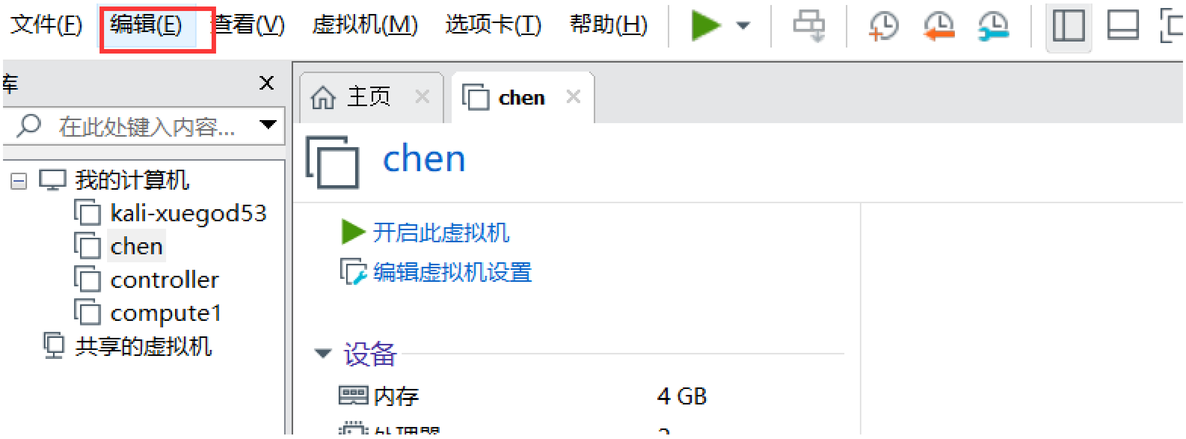
○ 仅主机模式(H): 与主机共享的专用网络

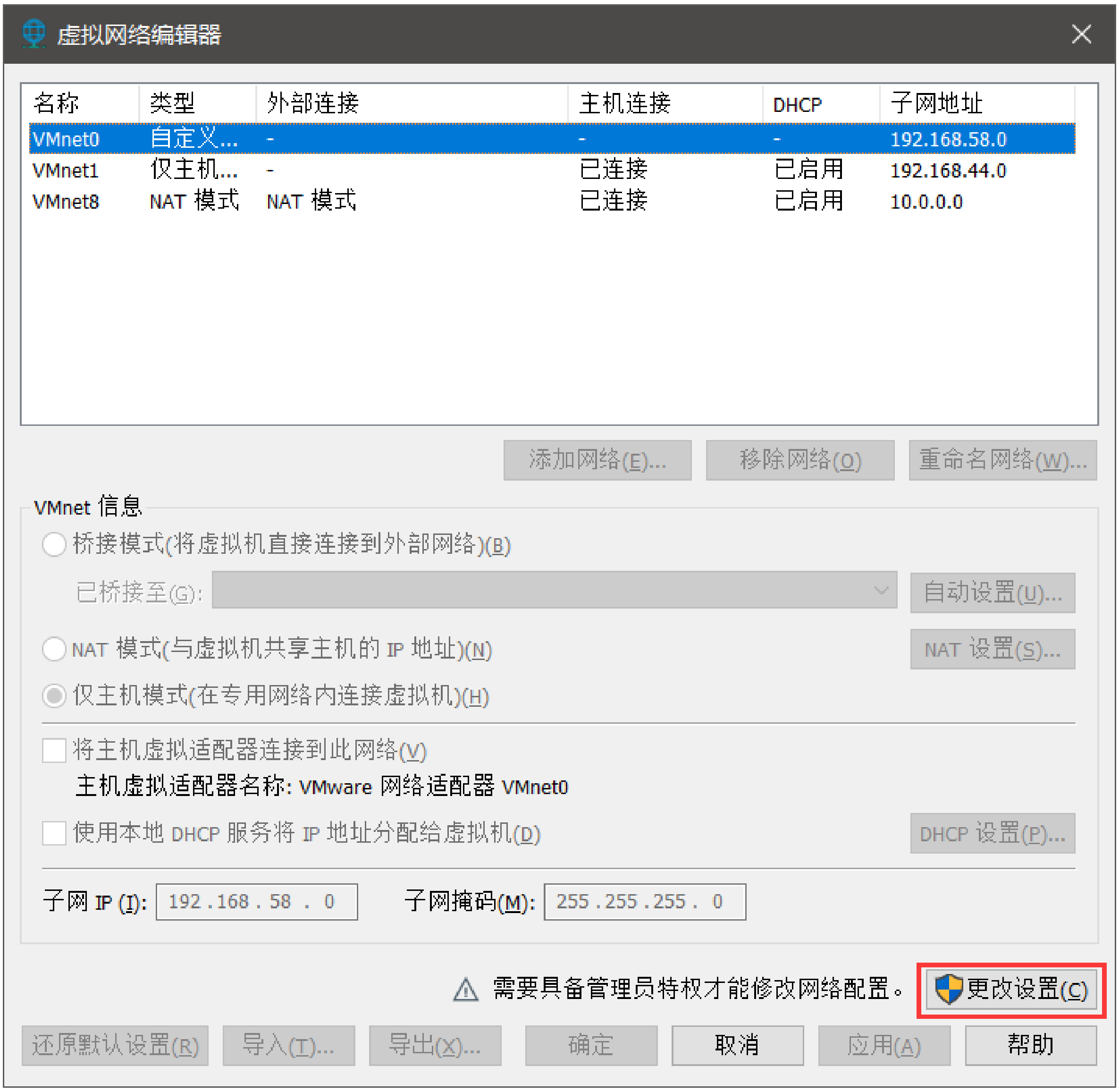
○ 自定义(U): 特定虚拟网络

VMnet0

○ LAN 区段(L):

2.编辑网卡设置





虚拟网络编辑器

名称	类型	外部连接	主机连接	DHCP	子网地址
VMnet0	自定义...	-	-	-	192.168.58.0
VMnet1	仅主机...	-	已连接	已启用	192.168.44.0
VMnet8	NAT 模式	NAT 模式	已连接	已启用	10.0.0.0

VMnet 信息

○ 桥接模式(将虚拟机直接连接到外部网络)(B)

已桥接至(G):

○ NAT 模式(与虚拟机共享主机的 IP 地址)(N)

● 仅主机模式(在专用网络内连接虚拟机)(H)

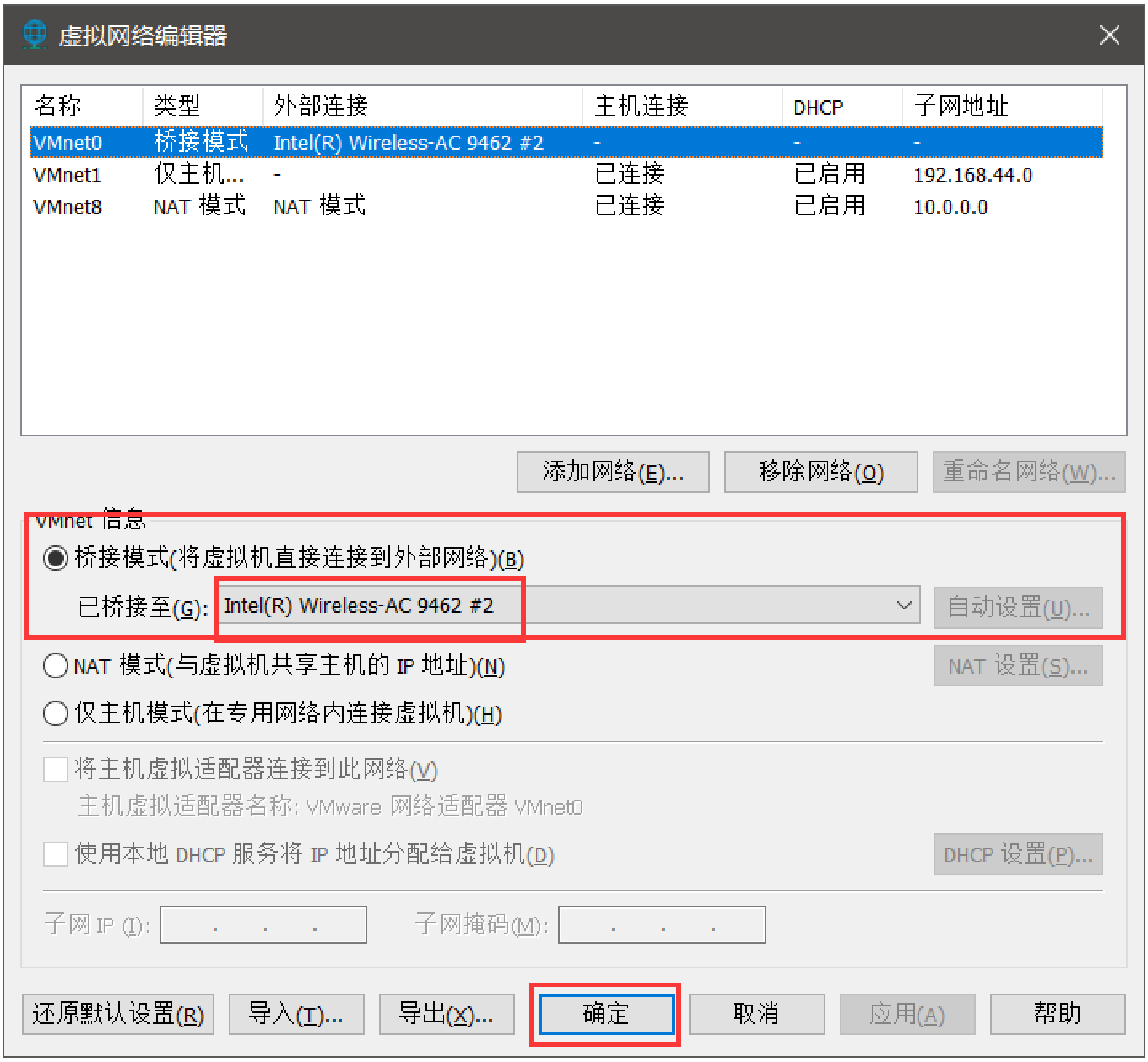
□ 将主机虚拟适配器连接到此网络(V)

主机虚拟适配器名称: VMware 网络适配器 VMnet0

□ 使用本地 DHCP 服务将 IP 地址分配给虚拟机(D)

子网 IP (I): 192 . 168 . 58 . 0　　子网掩码(M): 255 . 255 . 255 . 0

⚠ 需要具备管理员特权才能修改网络配置。



虚拟网络编辑器

名称	类型	外部连接	主机连接	DHCP	子网地址
VMnet0	桥接模式	Intel(R) Wireless-AC 9462 #2	-	-	-
VMnet1	仅主机...	-	已连接	已启用	192.168.44.0
VMnet8	NAT 模式	NAT 模式	已连接	已启用	10.0.0.0

VMnet 信息

● 桥接模式(将虚拟机直接连接到外部网络)(B)

已桥接至(G): Intel(R) Wireless-AC 9462 #2

○ NAT 模式(与虚拟机共享主机的 IP 地址)(N)

○ 仅主机模式(在专用网络内连接虚拟机)(H)

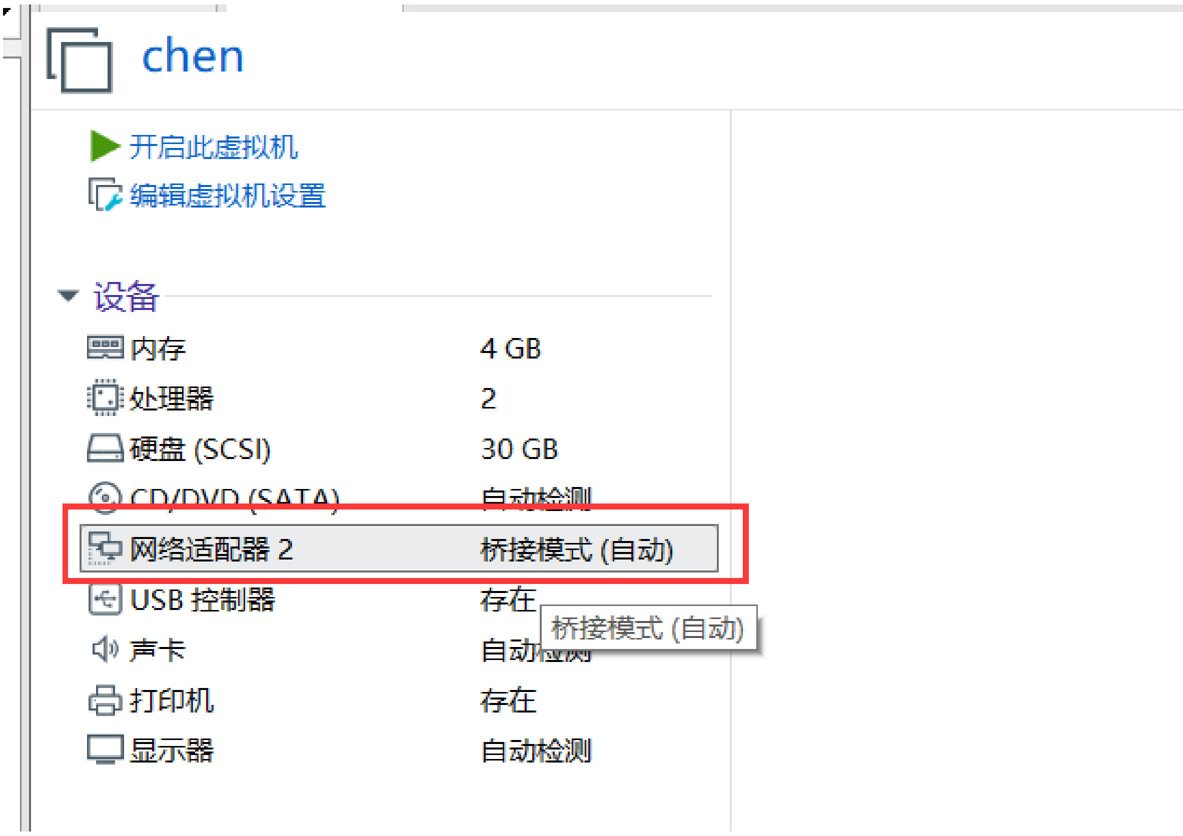
□ 将主机虚拟适配器连接到此网络(V)

主机虚拟适配器名称: VMware 网络适配器 VMnet0

□ 使用本地 DHCP 服务将 IP 地址分配给虚拟机(D)

子网 IP (I): . . .　　子网掩码(M): . . .

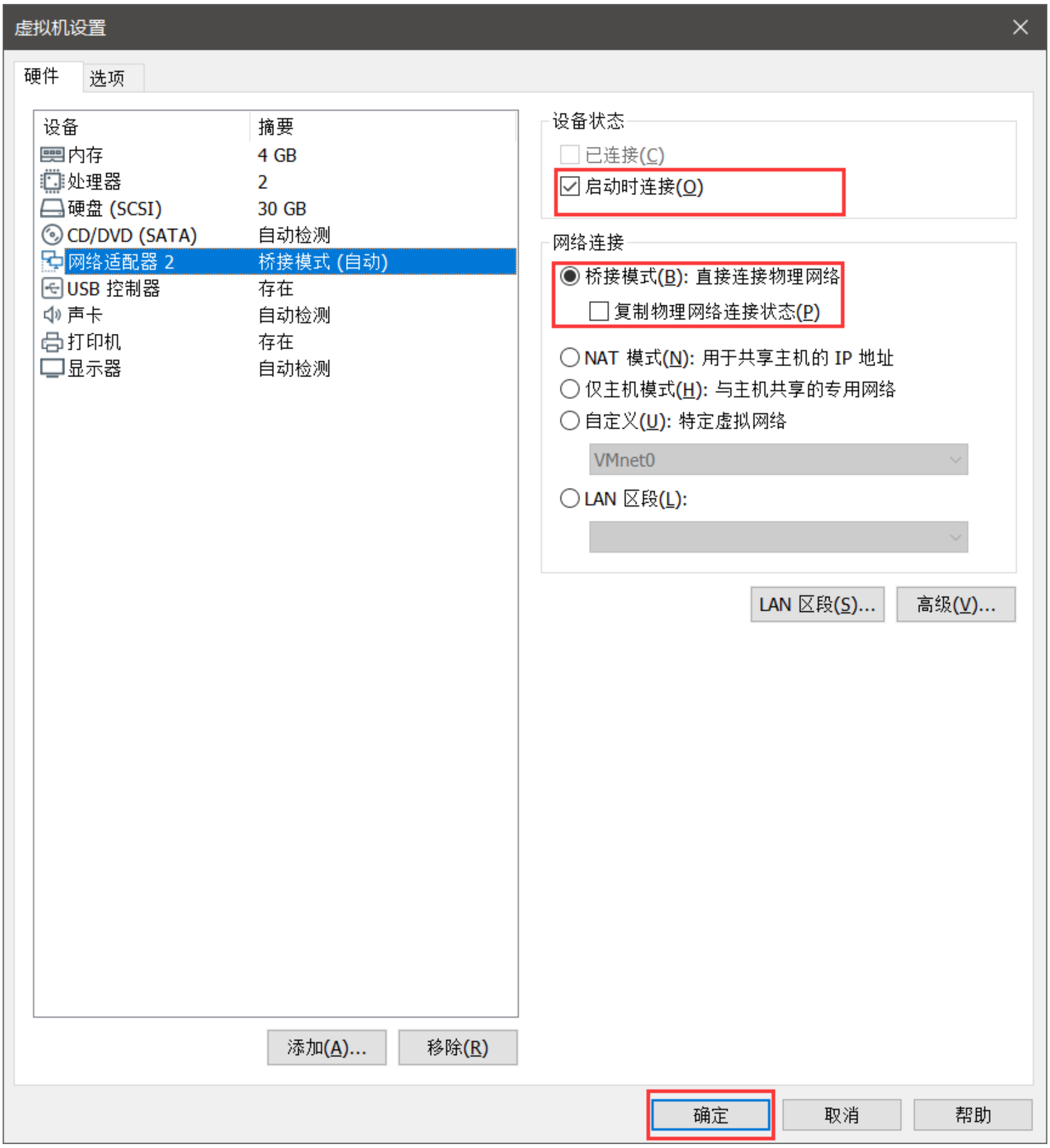
> 3.开启桥接网卡，同时关闭第一张网卡，也可以不关闭



chen

设备

内存	4 GB
处理器	2
硬盘 (SCSI)	30 GB
CD/DVD (SATA)	自动检测
网络适配器 2	桥接模式 (自动)
USB 控制器	存在
声卡	自动检测
打印机	存在
显示器	自动检测



虚拟机设置

硬件 选项

设备	摘要
内存	4 GB
处理器	2
硬盘 (SCSI)	30 GB
CD/DVD (SATA)	自动检测
网络适配器 2	桥接模式 (自动)
USB 控制器	存在
声卡	自动检测
打印机	存在
显示器	自动检测

设备状态

□ 已连接(C)

☑ 启动时连接(O)

网络连接

● 桥接模式(B): 直接连接物理网络

□ 复制物理网络连接状态(P)

○ NAT 模式(N): 用于共享主机的 IP 地址

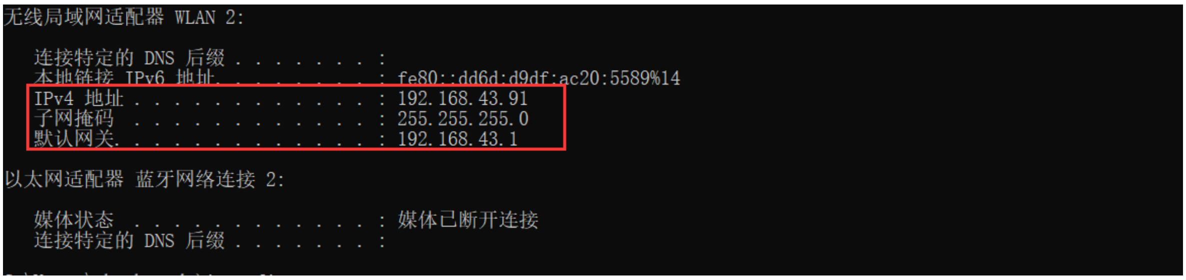
○ 仅主机模式(H): 与主机共享的专用网络

○ 自定义(U): 特定虚拟网络

VMnet0

○ LAN 区段(L):

> 4.然后令宿主机（windows10）连接到手机热点。打开cmd，使用命令【ipconfig】查看ip地址

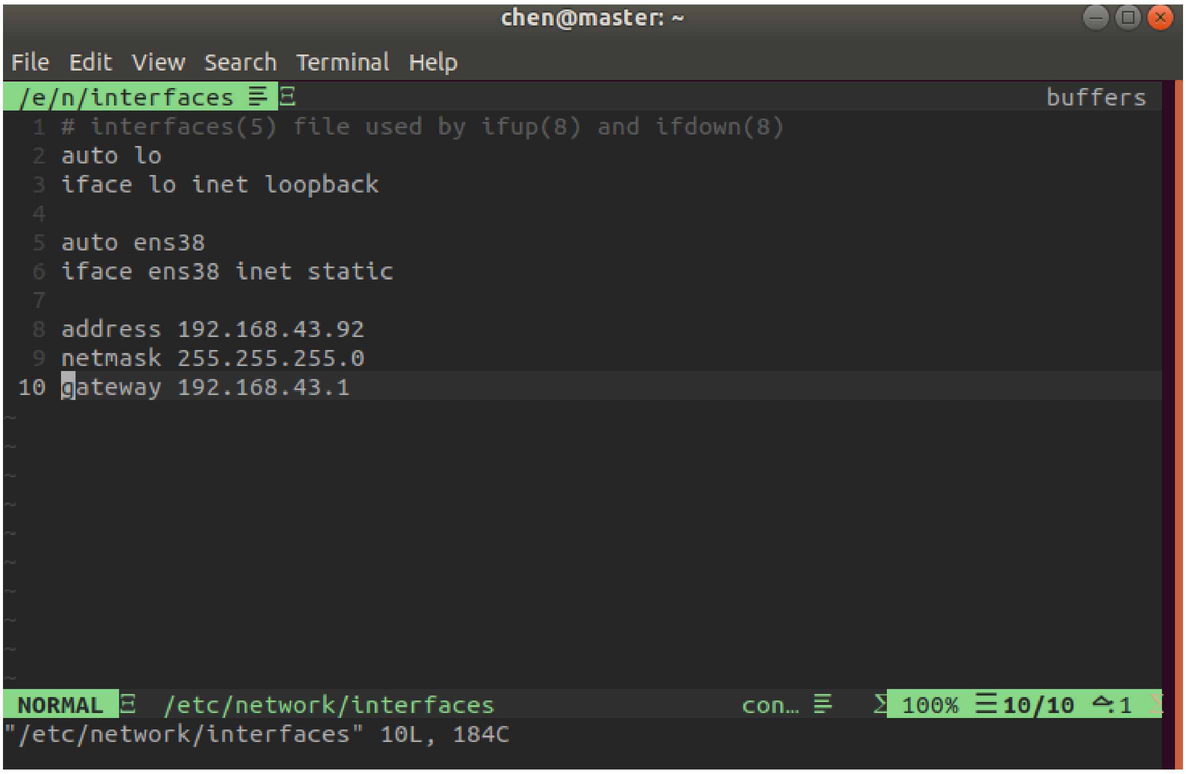


```
无线局域网适配器 WLAN 2:

   连接特定的 DNS 后缀 . . . . . . . :
   本地链接 IPv6 地址. . . . . . . . : fe80::dd6d:d9df:ac20:5589%14
   IPv4 地址 . . . . . . . . . . . . : 192.168.43.91
   子网掩码  . . . . . . . . . . . . : 255.255.255.0
   默认网关. . . . . . . . . . . . . : 192.168.43.1

以太网适配器 蓝牙网络连接 2:

   媒体状态  . . . . . . . . . . . . : 媒体已断开连接
   连接特定的 DNS 后缀 . . . . . . . :
```

再开启虚拟机，编辑配置文件【/etc/network/interfaces】

添加以下内容：

```
auto ens38
iface ens38 inet static
# IP地址和宿主机保持在同一网段，这里指定92
address 192.168.43.92
# 和宿主机一致
netmask 255.255.255.0
# 和宿主机一致
gateway 192.168.43.1
```



```
# interfaces(5) file used by ifup(8) and ifdown(8)
auto lo
iface lo inet loopback

auto ens38
iface ens38 inet static

address 192.168.43.92
netmask 255.255.255.0
gateway 192.168.43.1
```

```
NORMAL  /etc/network/interfaces        con…    100%  10/10  1
"/etc/network/interfaces" 10L, 184C
```

保存退出重启【reboot】

其他的机器和master配置方法相同。配置文件写入相对自己宿主机的内容

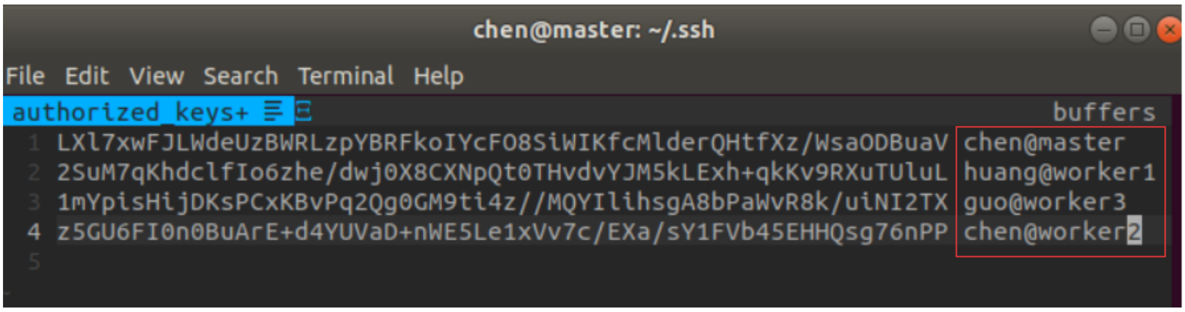
验证互相ping，可以通。

3.设置免密登录

每台机器上生成密钥

```
ssh-keygen -t rsa
# 选择覆盖原来的文件，其他都直接回车
# 私钥id_rsa 公钥 id_rsa.pub
```

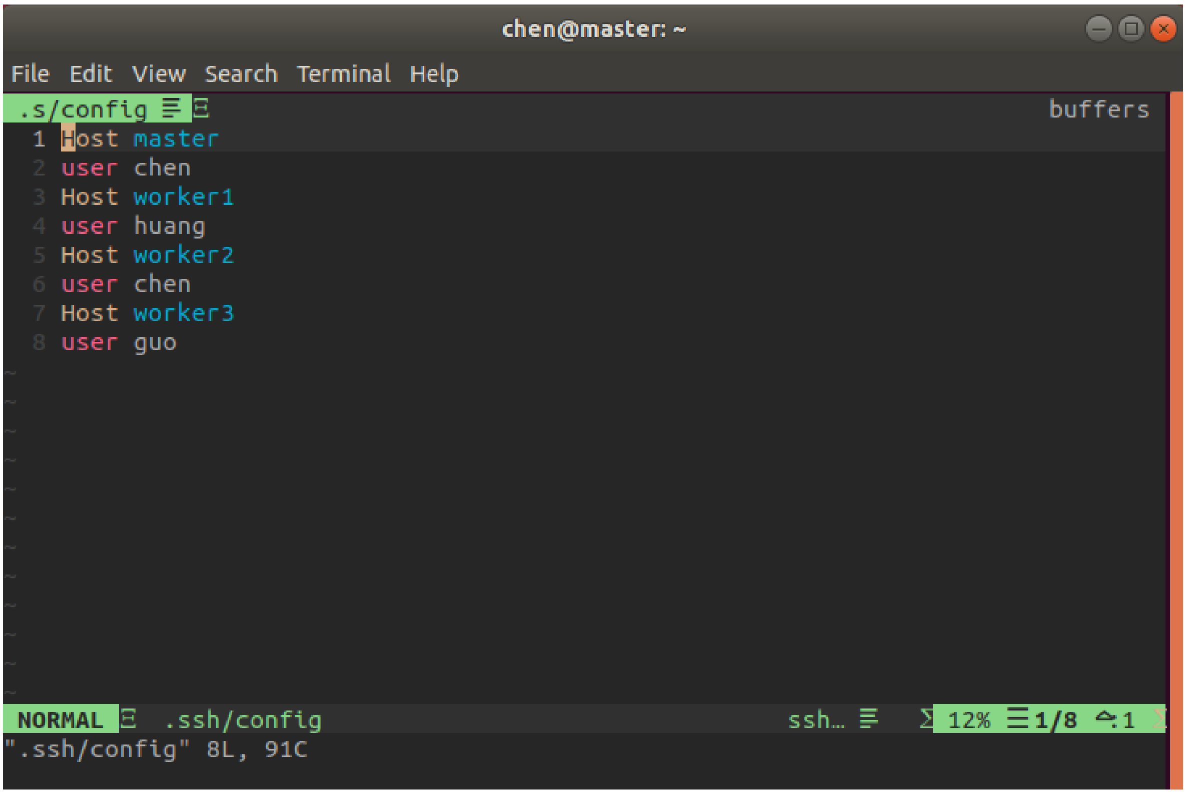
将每台机器的公钥（id_rsa.pub里的内容）都放到authorized_keys文件里，authorized_keys中有所有机器的公钥，所有机器都有authorized_keys这个文件。



```
LXl7xwFJLWdeUzBWRLzpYBRFkoIYcFO8SiWIKfcMlderQHtfXz/WsaODBuaV chen@master
2SuM7qKhdclfIo6zhe/dwj0X8CXNpQt0THvdvYJM5kLExh+qkKv9RXuTUluL huang@worker1
1mYpisHijDKsPCxKBvPq2Qg0GM9ti4z//MQYIlihsgA8bPaWvR8k/uiNI2TX guo@worker3
z5GU6FI0n0BuArE+d4YUVaD+nWE5Le1xVv7c/EXa/sY1FVb45EHHQsg76nPP chen@worker2
```

因为不同的机器用户名不一样，所以如果想通过【ssh worker1】实现连接，还需要修改（创建）【~/.ssh/config】写入如下内容：然后将其复制到所有机器。

```
Host master
user chen
Host worker1
user huang
Host worker2
user chen
Host worker3
user guo
```

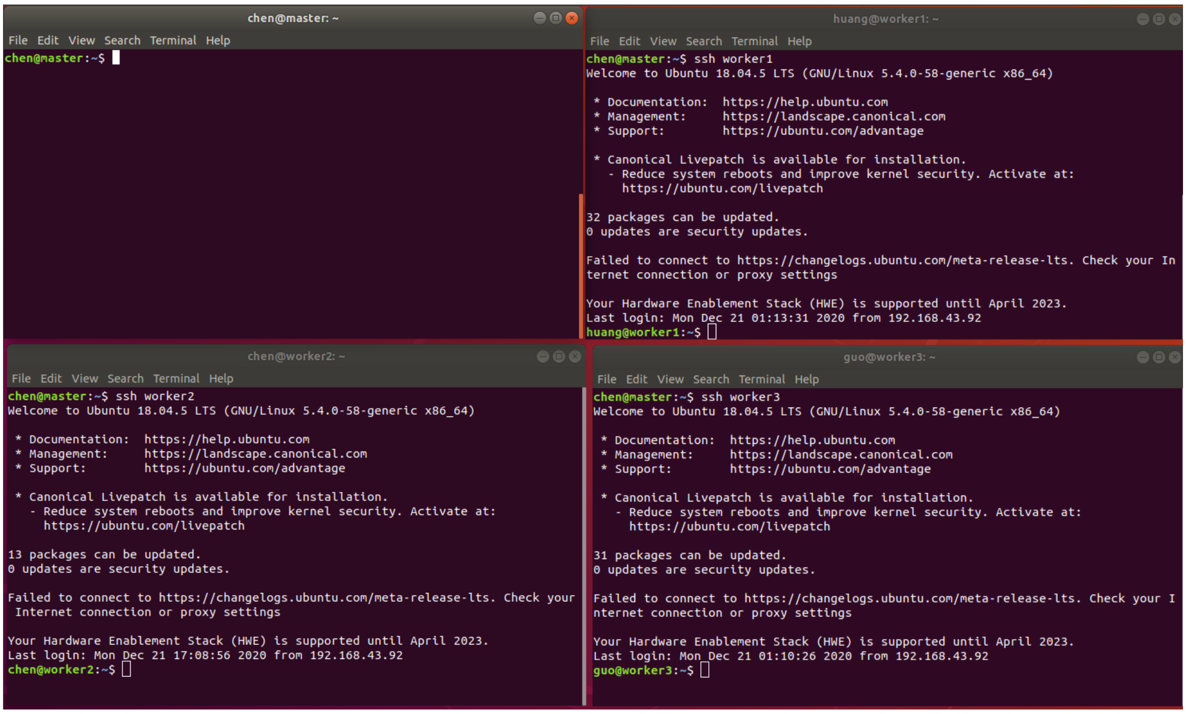


```
Host master
user chen
Host worker1
user huang
Host worker2
user chen
Host worker3
user guo
~
~
~
~
~
~
~
~
~
~
~
~
NORMAL  .ssh/config                    ssh…    12%  1/8  1
".ssh/config" 8L, 91C
```

分发给其他机器

```
scp ~/.ssh/config chen@worker2:~/.ssh/
scp ~/.ssh/config huang@worker1:~/.ssh/
scp ~/.ssh/config guo@worker3:~/.ssh/
```

测试


chen@master: ~
File Edit View Search Terminal Help
huang@worker1: ~
File Edit View Search Terminal Help
chen@worker2: ~
File Edit View Search Terminal Help
guo@worker3: ~
File Edit View Search Terminal Help

```
chen@master:~$ 
```

```
chen@master:~$ ssh worker1
Welcome to Ubuntu 18.04.5 LTS (GNU/Linux 5.4.0-58-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

 * Canonical Livepatch is available for installation.
   - Reduce system reboots and improve kernel security. Activate at:
     https://ubuntu.com/livepatch

32 packages can be updated.
0 updates are security updates.

Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your In
ternet connection or proxy settings

Your Hardware Enablement Stack (HWE) is supported until April 2023.
Last login: Mon Dec 21 01:13:31 2020 from 192.168.43.92
huang@worker1:~$ 
```

```
chen@master:~$ ssh worker2
Welcome to Ubuntu 18.04.5 LTS (GNU/Linux 5.4.0-58-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

 * Canonical Livepatch is available for installation.
   - Reduce system reboots and improve kernel security. Activate at:
     https://ubuntu.com/livepatch

13 packages can be updated.
0 updates are security updates.

Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your
 Internet connection or proxy settings

Your Hardware Enablement Stack (HWE) is supported until April 2023.
Last login: Mon Dec 21 17:08:56 2020 from 192.168.43.92
chen@worker2:~$ 
```

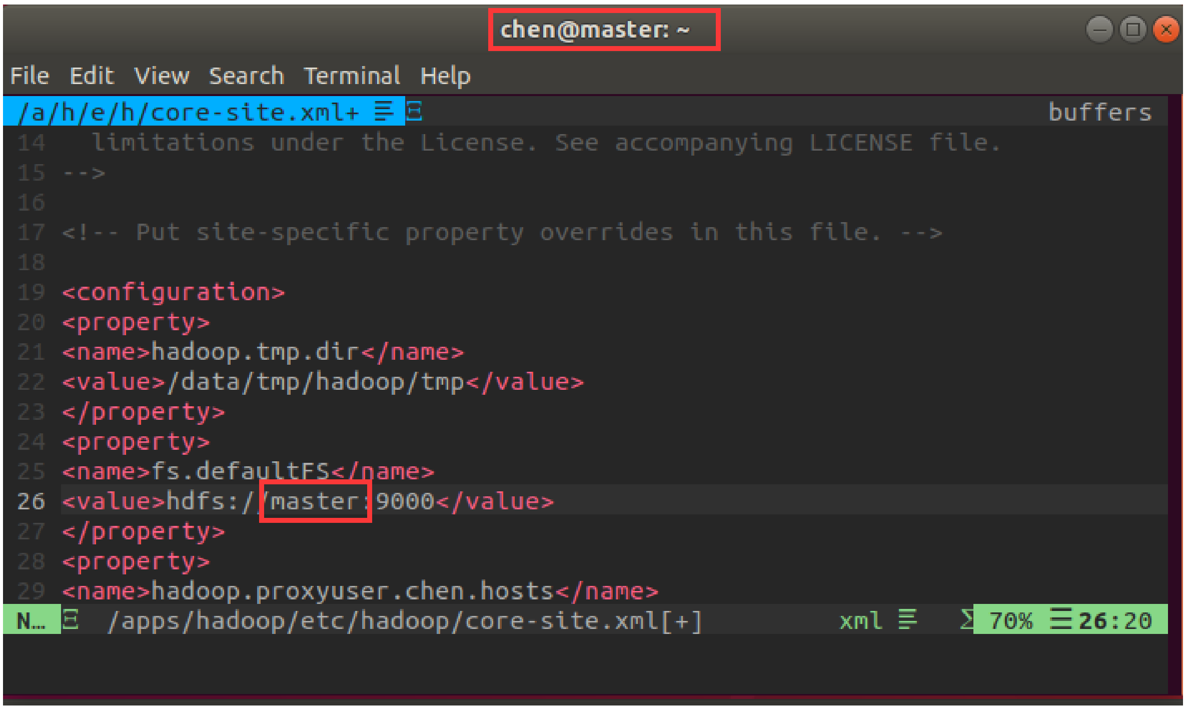
```
chen@master:~$ ssh worker3
Welcome to Ubuntu 18.04.5 LTS (GNU/Linux 5.4.0-58-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

 * Canonical Livepatch is available for installation.
   - Reduce system reboots and improve kernel security. Activate at:
     https://ubuntu.com/livepatch

31 packages can be updated.
0 updates are security updates.

Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your I
nternet connection or proxy settings

Your Hardware Enablement Stack (HWE) is supported until April 2023.
Last login: Mon Dec 21 01:10:26 2020 from 192.168.43.92
guo@worker3:~$ 
```

4.配置hadoop

首先将Hadoop改为集群模式。在master主机中修改下面四个文件。

> 1.修改 core-site.xml

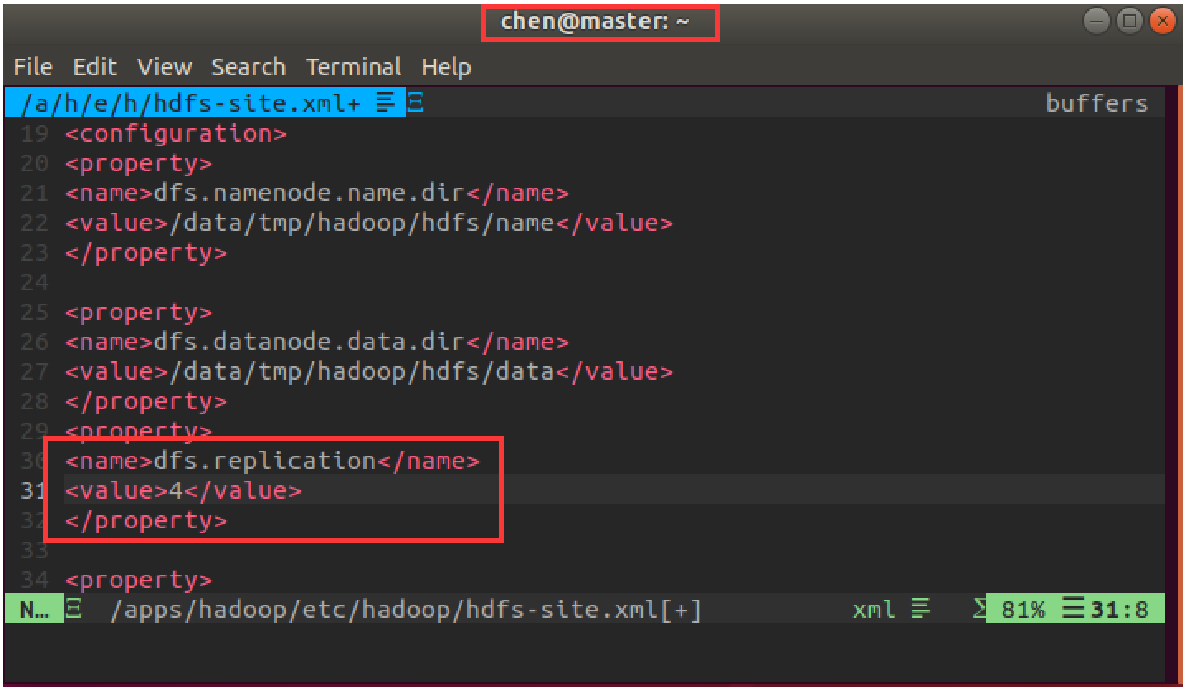
将配置文件 /apps/hadoop/etc/hadoop/core-site.xml中fs.defaultFS的值由hdfs://localhost:9000改为hdfs://master:9000，修改以后，如下图所示



```
 /a/h/e/h/core-site.xml+                                            buffers
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
<property>
<name>hadoop.tmp.dir</name>
<value>/data/tmp/hadoop/tmp</value>
</property>
<property>
<name>fs.defaultFS</name>
<value>hdfs://master:9000</value>
</property>
<property>
<name>hadoop.proxyuser.chen.hosts</name>
N…   /apps/hadoop/etc/hadoop/core-site.xml[+]          xml      70%  26:20
```

> 2.修改hdfs-site.xml文件

将配置文件/apps/hadoop/etc/hadoop/hdfs-site.xml中dfs.replication的值由1改为4,修改以后如下图所示



chen@master: ~
File Edit View Search Terminal Help
/a/h/e/h/hdfs-site.xml+
buffers

```
<configuration>
<property>
<name>dfs.namenode.name.dir</name>
<value>/data/tmp/hadoop/hdfs/name</value>
</property>

<property>
<name>dfs.datanode.data.dir</name>
<value>/data/tmp/hadoop/hdfs/data</value>
</property>
<property>
<name>dfs.replication</name>
<value>4</value>
</property>

<property>
```

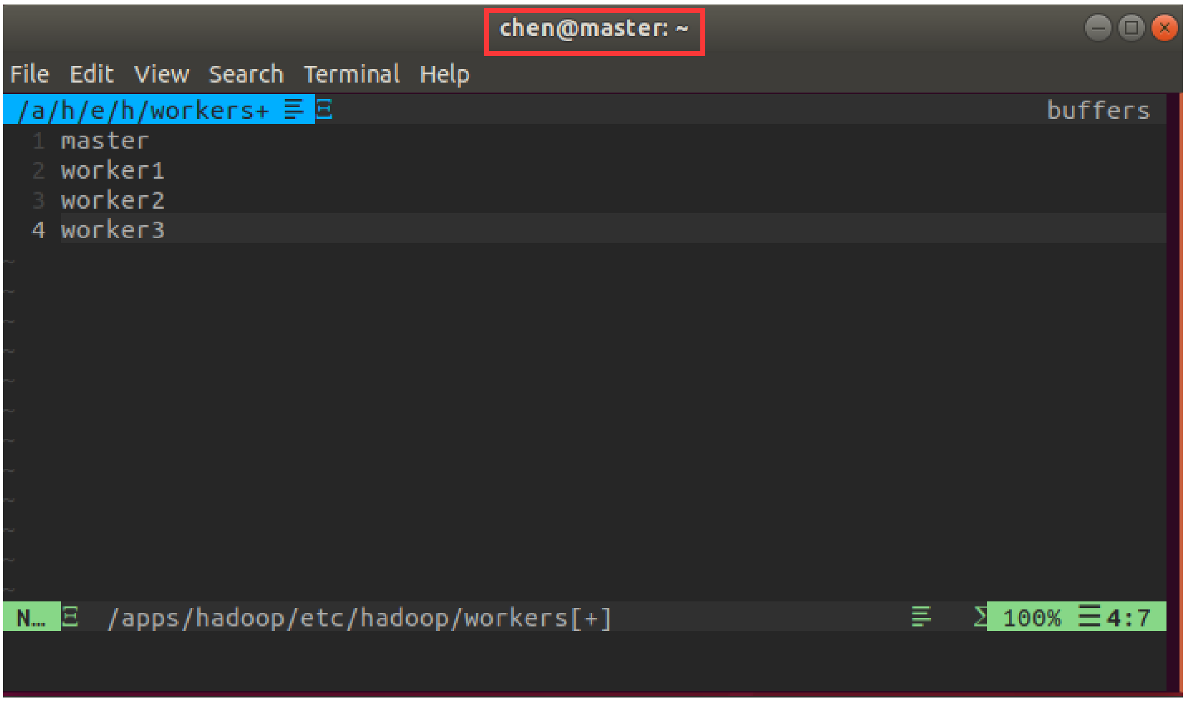
N… /apps/hadoop/etc/hadoop/hdfs-site.xml[+] xml 81% 31:8

> 3.修改workers文件

将配置文件/apps/hadoop/etc/hadoop/workers中localhost改为

```
master
worker1
worker2
worker3
```

修改后如下图所示



chen@master: ~
File Edit View Search Terminal Help
/a/h/e/h/workers+
buffers

```
master
worker1
worker2
worker3
```

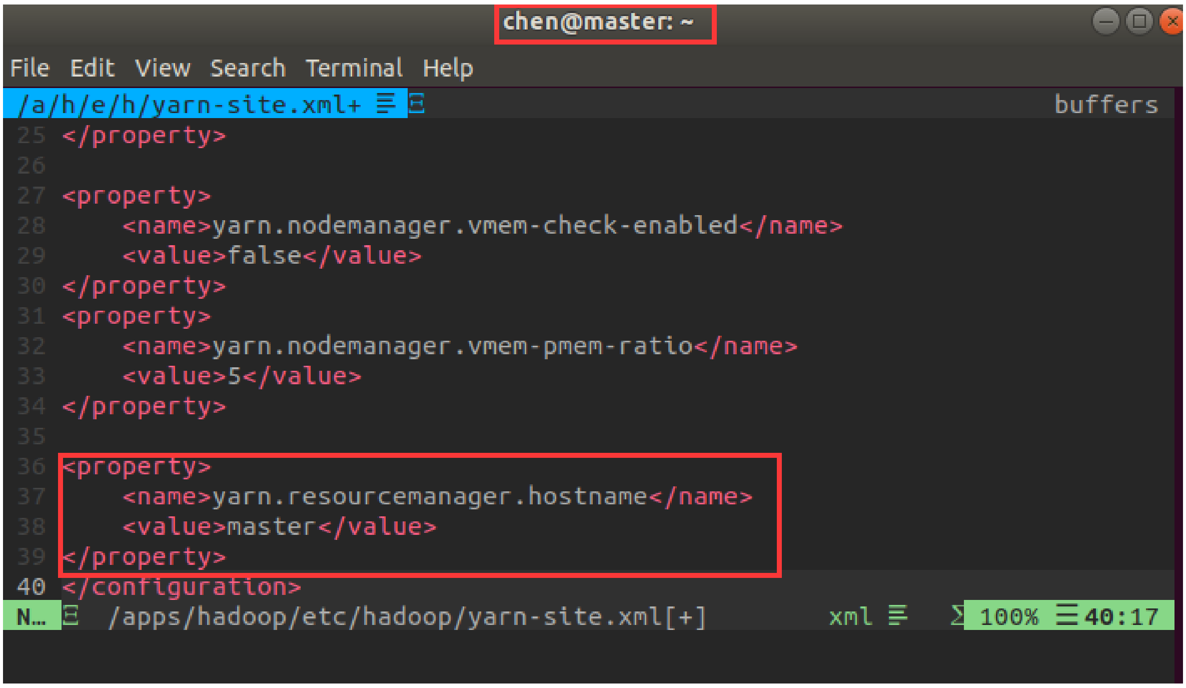
N… /apps/hadoop/etc/hadoop/workers[+] 100% 4:7

> 4.修改yarn-site.xml文件

将以下内容添加到配置文件/apps/hadoop/etc/hadoop/ yarn-site.xml中

```
<property>
<name>yarn.resourcemanager.hostname</name>
<value>master</value>
</property>
```

修改以后的文件内容如下图所示


chen@master: ~
File Edit View Search Terminal Help
/a/h/e/h/yarn-site.xml+
buffers
N…
/apps/hadoop/etc/hadoop/yarn-site.xml[+]
xml
100%
40:17

```
</property>

<property>
    <name>yarn.nodemanager.vmem-check-enabled</name>
    <value>false</value>
</property>
<property>
    <name>yarn.nodemanager.vmem-pmem-ratio</name>
    <value>5</value>
</property>

<property>
    <name>yarn.resourcemanager.hostname</name>
    <value>master</value>
</property>
</configuration>
```

> 5.将上面修改的四个文件复制到worker1和worker2两个节点，覆盖原来的文件

```
cd /apps/hadoop/etc/hadoop/
scp core-site.xml hdfs-site.xml workers yarn-site.xml \
worker1:/apps/hadoop/etc/hadoop/
scp core-site.xml hdfs-site.xml workers yarn-site.xml \
worker2:/apps/hadoop/etc/hadoop/
scp core-site.xml hdfs-site.xml workers yarn-site.xml \
worker3:/apps/hadoop/etc/hadoop/
```

删除伪分布式namenode文件

重新对分布式文件系统进行格式化前，需要删除三台主机中/data/tmp/hadoop/hdfs/目录下的文件和文件夹。首先删除master上/data/tmp/hadoop/hdfs/目录下的文件和文件夹

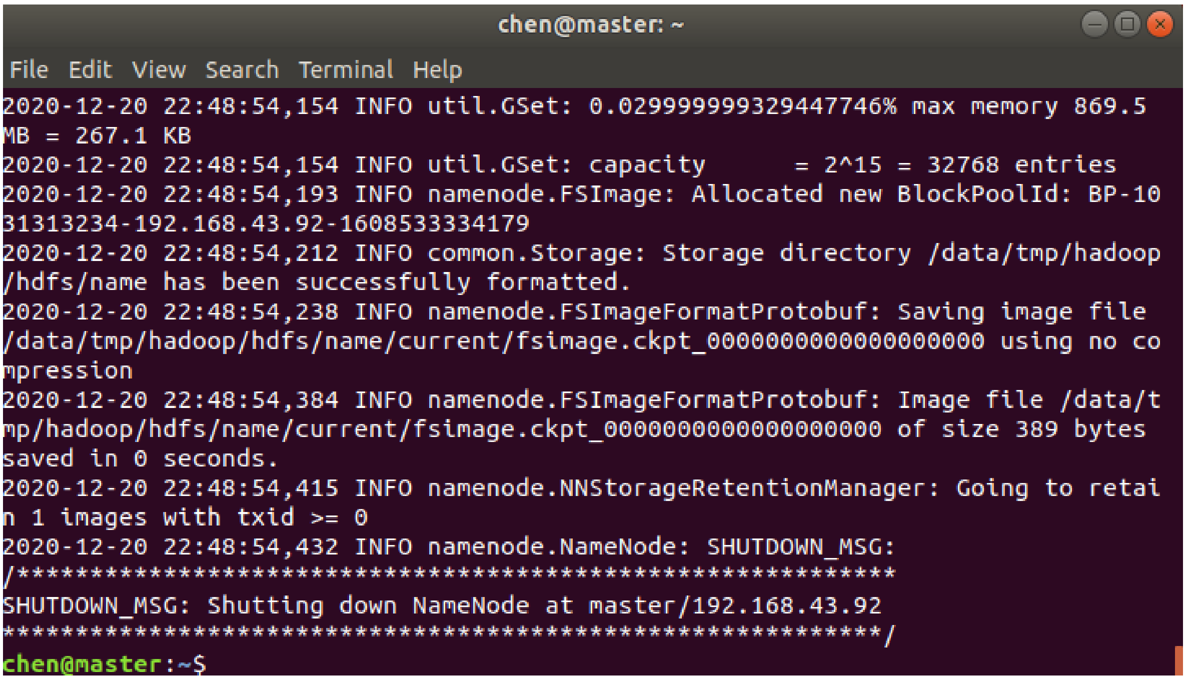
```
rm -rf /data/tmp/hadoop/hdfs/*
```

删除另外三台主机上相应的文件.

格式化分布式文件系统

在主节点master执行以下命令

```
hadoop namenode -format
```



```
2020-12-20 22:48:54,154 INFO util.GSet: 0.029999999329447746% max memory 869.5
MB = 267.1 KB
2020-12-20 22:48:54,154 INFO util.GSet: capacity      = 2^15 = 32768 entries
2020-12-20 22:48:54,193 INFO namenode.FSImage: Allocated new BlockPoolId: BP-10
31313234-192.168.43.92-1608533334179
2020-12-20 22:48:54,212 INFO common.Storage: Storage directory /data/tmp/hadoop
/hdfs/name has been successfully formatted.
2020-12-20 22:48:54,238 INFO namenode.FSImageFormatProtobuf: Saving image file
/data/tmp/hadoop/hdfs/name/current/fsimage.ckpt_0000000000000000000 using no co
mpression
2020-12-20 22:48:54,384 INFO namenode.FSImageFormatProtobuf: Image file /data/t
mp/hadoop/hdfs/name/current/fsimage.ckpt_0000000000000000000 of size 389 bytes
saved in 0 seconds.
2020-12-20 22:48:54,415 INFO namenode.NNStorageRetentionManager: Going to retai
n 1 images with txid >= 0
2020-12-20 22:48:54,432 INFO namenode.NameNode: SHUTDOWN_MSG:
/************************************************************
SHUTDOWN_MSG: Shutting down NameNode at master/192.168.43.92
************************************************************/
chen@master:~$
```

至此，Hadoop分布式集群就设置好了，下面进行测试。

5.测试hadoop

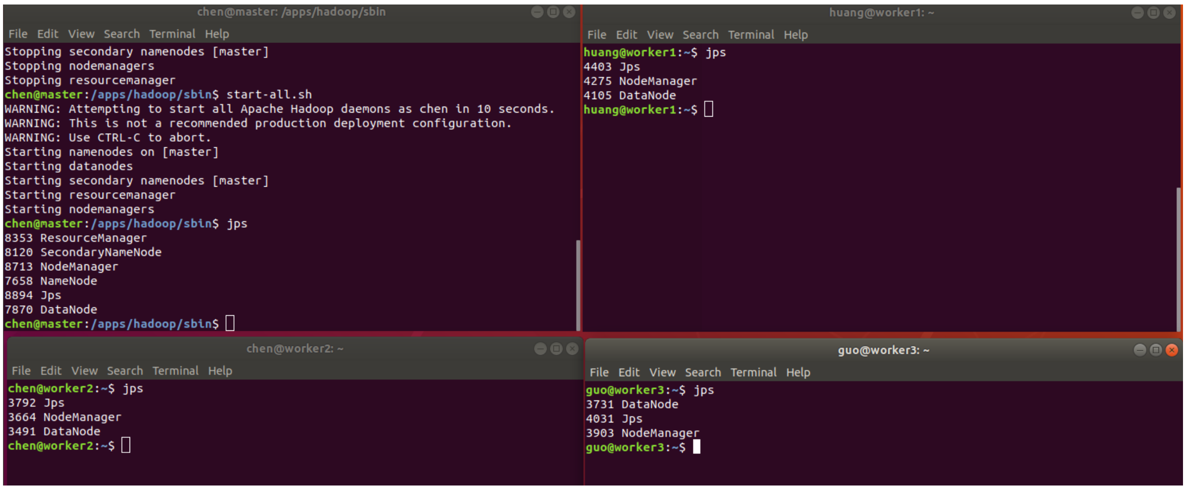
启动Hadoop

在master节点执行

```
/apps/hadoop/sbin/start-all.sh
```

查看Hadoop进程

查看主节点和其他节点的Hadoop进程



chen@master: /apps/hadoop/sbin
File Edit View Search Terminal Help

```
Stopping secondary namenodes [master]
Stopping nodemanagers
Stopping resourcemanager
chen@master:/apps/hadoop/sbin$ start-all.sh
WARNING: Attempting to start all Apache Hadoop daemons as chen in 10 seconds.
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [master]
Starting datanodes
Starting secondary namenodes [master]
Starting resourcemanager
Starting nodemanagers
chen@master:/apps/hadoop/sbin$ jps
8353 ResourceManager
8120 SecondaryNameNode
8713 NodeManager
7658 NameNode
8894 Jps
7870 DataNode
chen@master:/apps/hadoop/sbin$
```

```
huang@worker1:~$ jps
4403 Jps
4275 NodeManager
4105 DataNode
huang@worker1:~$
```

```
chen@worker2:~$ jps
3792 Jps
3664 NodeManager
3491 DataNode
chen@worker2:~$
```

```
guo@worker3:~$ jps
3731 DataNode
4031 Jps
3903 NodeManager
guo@worker3:~$
```

可以看到HDFS的NameNode和SecondaryNameNode，以及Yarn的ResourceManager只运行在主节点；HDFS的DataNode 和MapReduce的NodeManager只运行在从节点。

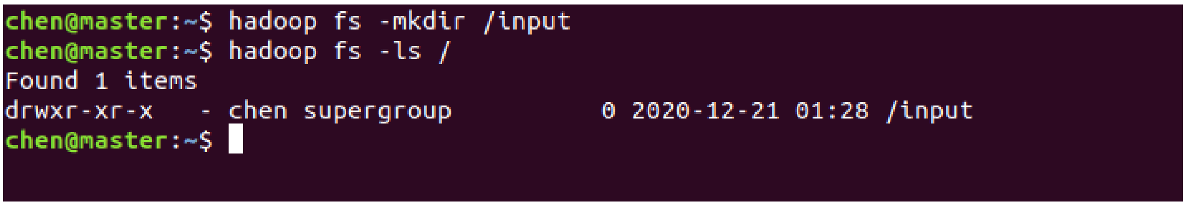
测试HDFS

在HDFS上创建目录/input

```
hadoop fs -mkdir /input
```

查看是否创建成功

```
hadoop fs -ls /
```



```
chen@master:~$ hadoop fs -mkdir /input
chen@master:~$ hadoop fs -ls /
Found 1 items
drwxr-xr-x   - chen supergroup          0 2020-12-21 01:28 /input
chen@master:~$ 
```

将文件传到HDFS

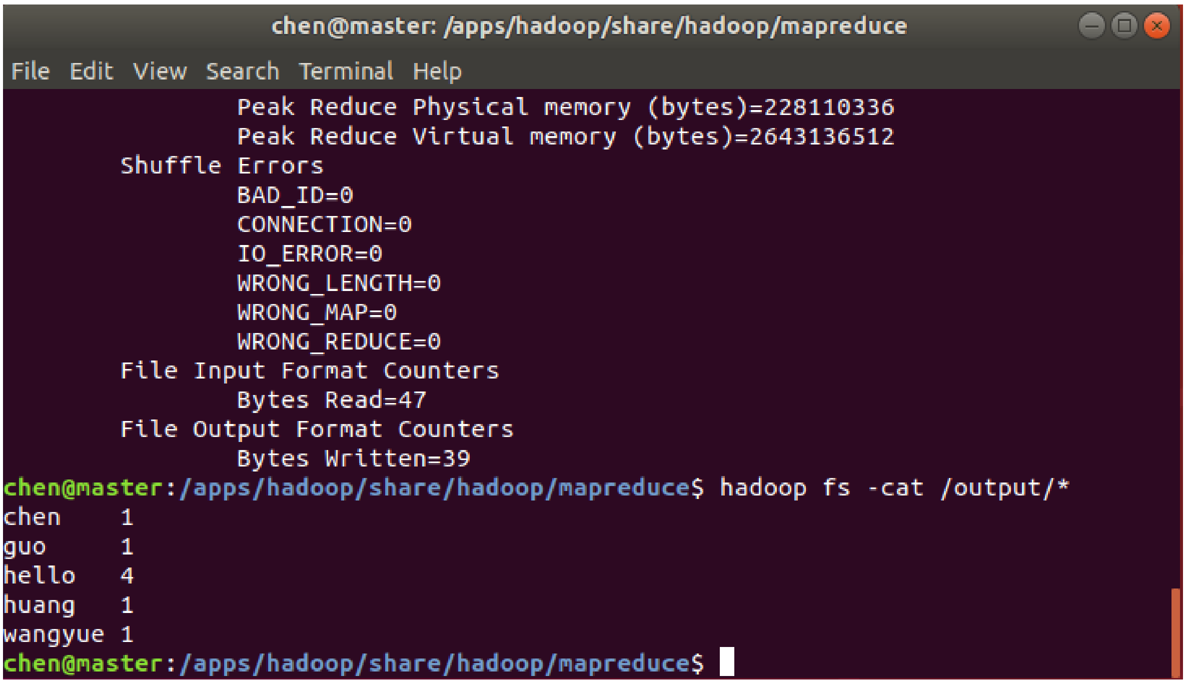
```
hadoop fs -put /data/testfile /input
```

运行wordcount

```
cd /apps/hadoop/share/hadoop/mapreduce/ hadoop jar hadoop-mapreduce-examples-3.0.0.jar wordcount /input/testfile /output
```

查看结果

```
hadoop fs -cat /output/*
```

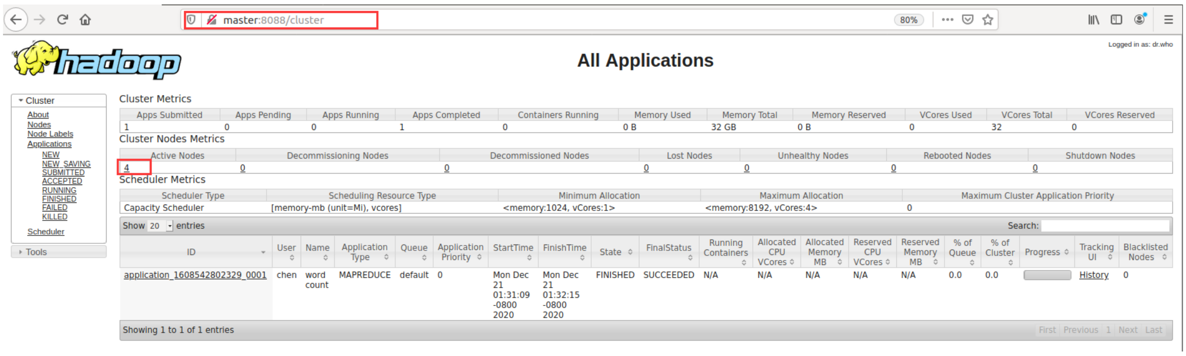


chen@master: /apps/hadoop/share/hadoop/mapreduce
File Edit View Search Terminal Help

```
                Peak Reduce Physical memory (bytes)=228110336
                Peak Reduce Virtual memory (bytes)=2643136512
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=47
        File Output Format Counters
                Bytes Written=39
chen@master:/apps/hadoop/share/hadoop/mapreduce$ hadoop fs -cat /output/*
chen    1
guo     1
hello   4
huang   1
wangyue 1
chen@master:/apps/hadoop/share/hadoop/mapreduce$ 
```

webUI

http://master:8088/ 可以查看 Hadoop 集群，节点及任务相关信息。可以看到现在活跃的节点数是4。



Cluster Metrics

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved
1	0	0	1	0	0 B	32 GB	0 B	0	32	0

Cluster Nodes Metrics

Active Nodes	Decommissioning Nodes	Decommissioned Nodes	Lost Nodes	Unhealthy Nodes	Rebooted Nodes	Shutdown Nodes
4	0	0	0	0	0	0

Scheduler Metrics

Scheduler Type	Scheduling Resource Type	Minimum Allocation	Maximum Allocation	Maximum Cluster Application Priority
Capacity Scheduler	[memory-mb (unit=Mi), vcores]	<memory:1024, vCores:1>	<memory:8192, vCores:4>	0

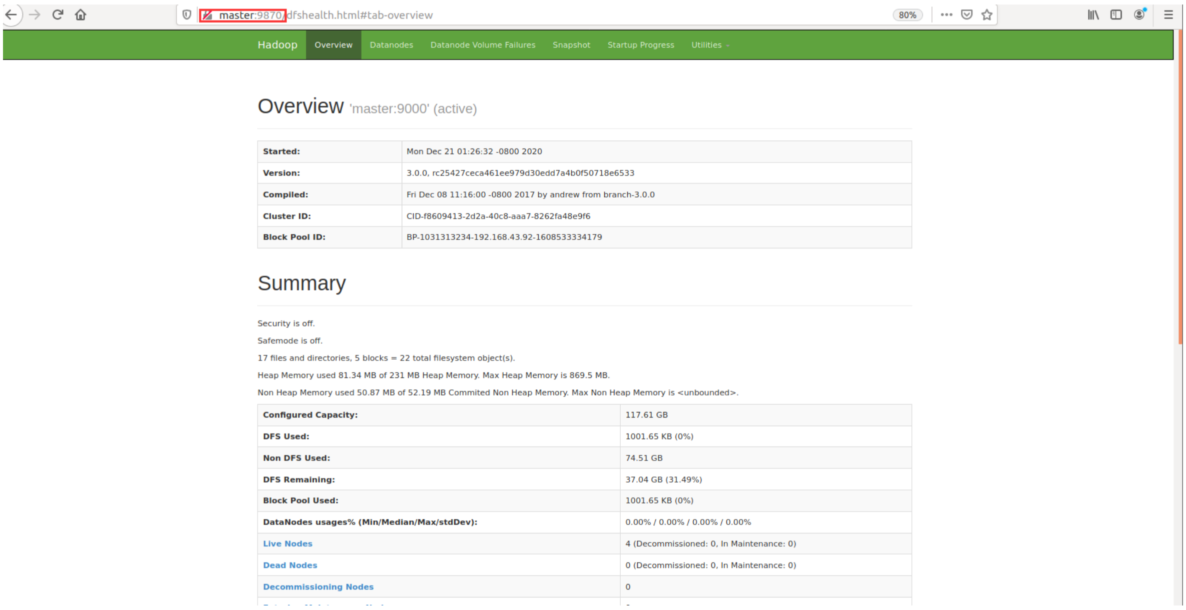
Show 20 entries Search:

ID	User	Name	Application Type	Queue	Application Priority	StartTime	FinishTime	State	FinalStatus	Running Containers	Allocated CPU VCores	Allocated Memory MB	Reserved CPU VCores	Reserved Memory MB	% of Queue	% of Cluster	Progress	Tracking UI	Blacklisted Nodes
application_1608542802329_0001	chen	word count	MAPREDUCE	default	0	Mon Dec 21 01:31:09 -0800 2020	Mon Dec 21 01:32:15 -0800 2020	FINISHED	SUCCEEDED	N/A	N/A	N/A	N/A	N/A	0.0	0.0		History	0

Showing 1 to 1 of 1 entries

HDFS Web 界面

在浏览器中访问 http://master:9870，可以查看 HDFS 相关信息，浏览 HDFS 上的文件系统



Overview 'master:9000' (active)

Started:	Mon Dec 21 01:26:32 -0800 2020
Version:	3.0.0, rc25427ceca461ee979d30edd7a4b0f50718e6533
Compiled:	Fri Dec 08 11:16:00 -0800 2017 by andrew from branch-3.0.0
Cluster ID:	CID-f8609413-2d2a-40c8-aaa7-8262fa48e9f6
Block Pool ID:	BP-1031313234-192.168.43.92-1608533334179

Summary

Security is off.

Safemode is off.

17 files and directories, 5 blocks = 22 total filesystem object(s).

Heap Memory used 81.34 MB of 231 MB Heap Memory. Max Heap Memory is 869.5 MB.

Non Heap Memory used 50.87 MB of 52.19 MB Commited Non Heap Memory. Max Non Heap Memory is <unbounded>.

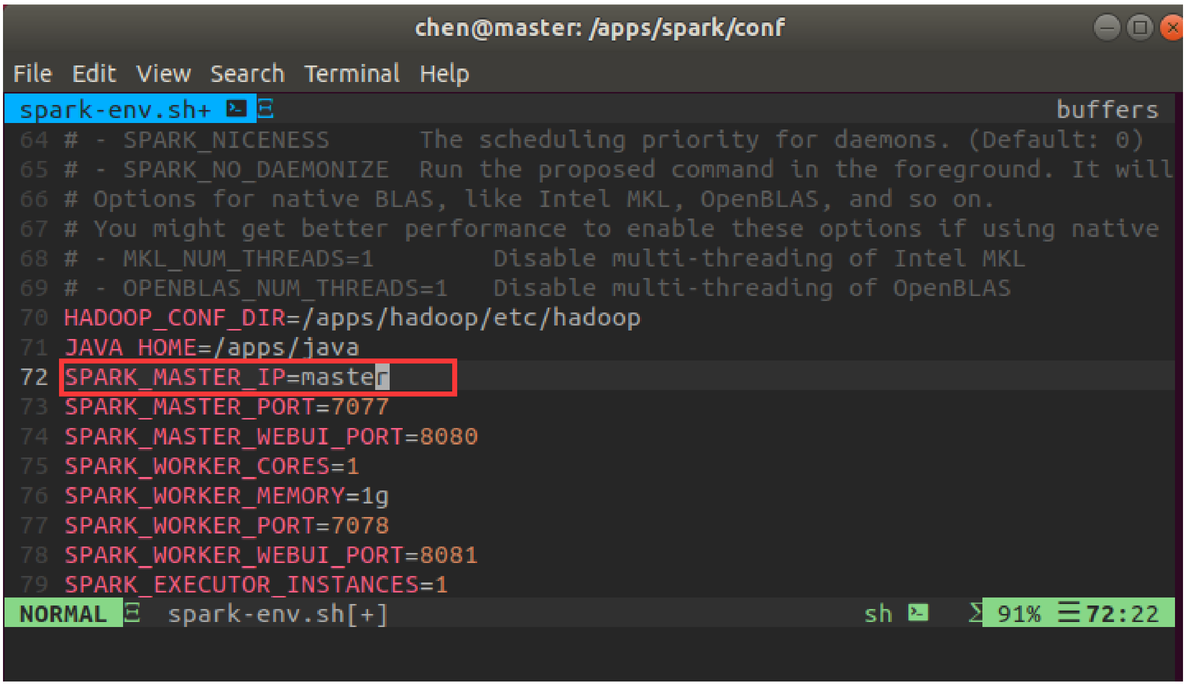
Configured Capacity:	117.61 GB
DFS Used:	1001.65 KB (0%)
Non DFS Used:	74.51 GB
DFS Remaining:	37.04 GB (31.49%)
Block Pool Used:	1001.65 KB (0%)
DataNodes usages% (Min/Median/Max/stdDev):	0.00% / 0.00% / 0.00% / 0.00%
Live Nodes	4 (Decommissioned: 0, In Maintenance: 0)
Dead Nodes	0 (Decommissioned: 0, In Maintenance: 0)
Decommissioning Nodes	0

6.配置spark

修改配置文件

在master节点修改下面三个文件

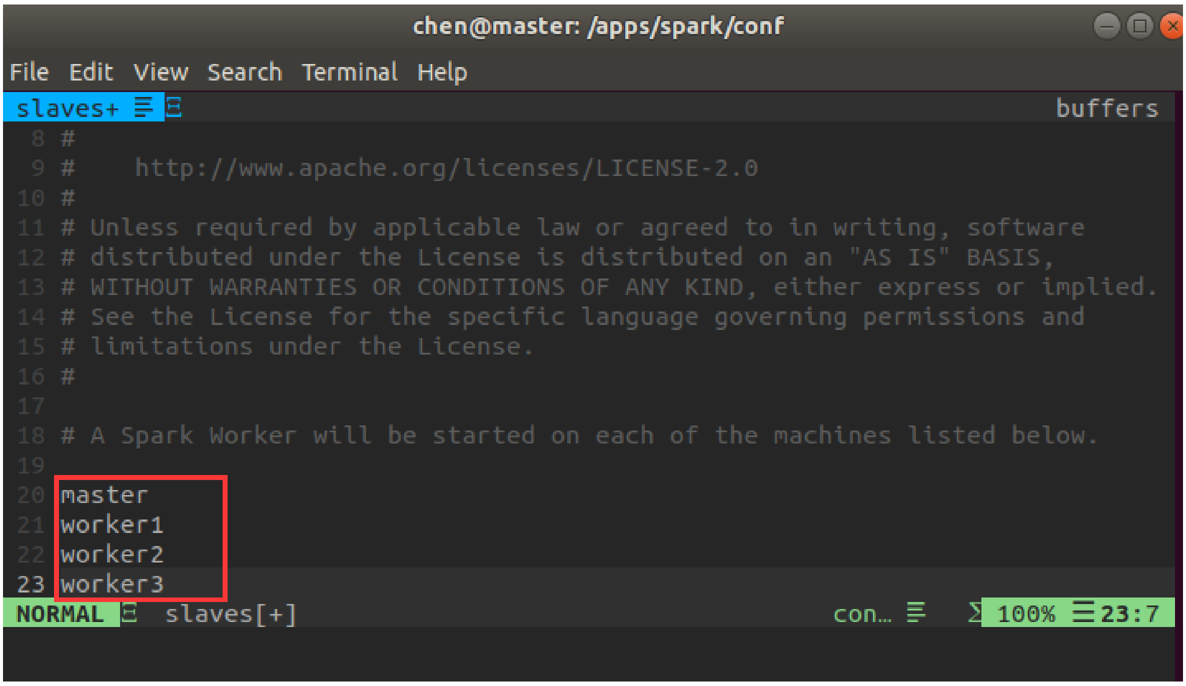
> 1.修改spark-env.sh，将SPARK_MASTER_IP的值改为master，修改后，如下图所示



```
# - SPARK_NICENESS      The scheduling priority for daemons. (Default: 0)
# - SPARK_NO_DAEMONIZE  Run the proposed command in the foreground. It will
# Options for native BLAS, like Intel MKL, OpenBLAS, and so on.
# You might get better performance to enable these options if using native
# - MKL_NUM_THREADS=1        Disable multi-threading of Intel MKL
# - OPENBLAS_NUM_THREADS=1   Disable multi-threading of OpenBLAS
HADOOP_CONF_DIR=/apps/hadoop/etc/hadoop
JAVA_HOME=/apps/java
SPARK_MASTER_IP=master
SPARK_MASTER_PORT=7077
SPARK_MASTER_WEBUI_PORT=8080
SPARK_WORKER_CORES=1
SPARK_WORKER_MEMORY=1g
SPARK_WORKER_PORT=7078
SPARK_WORKER_WEBUI_PORT=8081
SPARK_EXECUTOR_INSTANCES=1
```

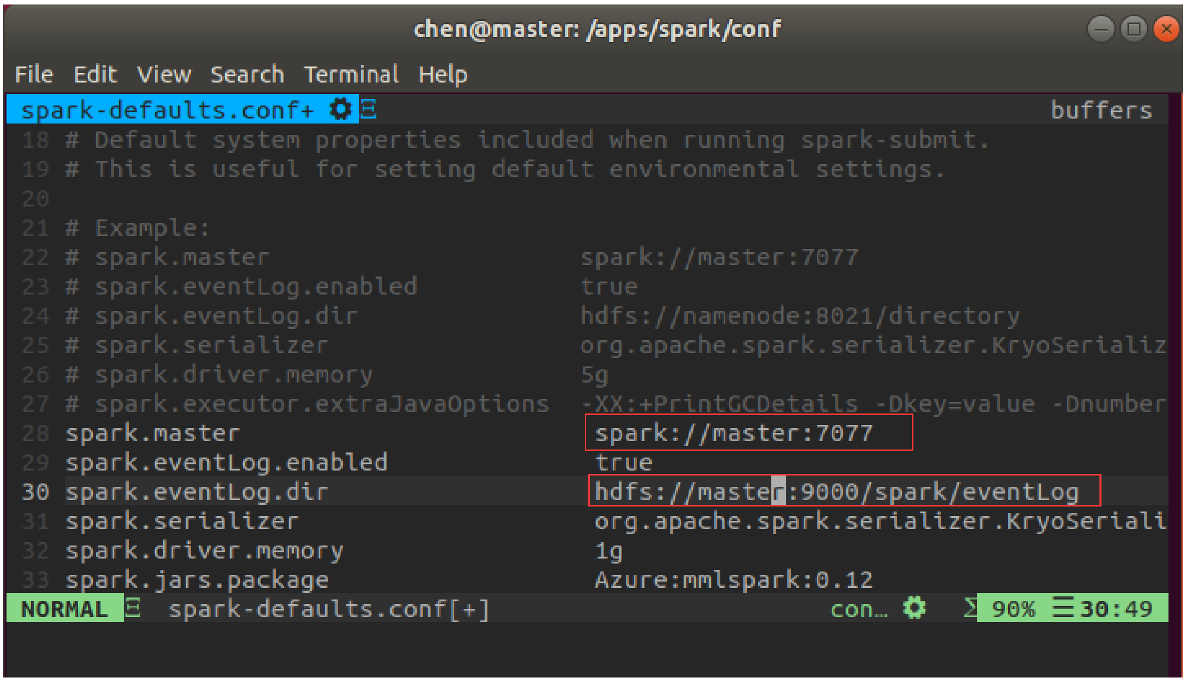
> 2.修改slaves文件，将localhost改为

```
master
worker1
worker2
worker3
```


chen@master: /apps/spark/conf
File Edit View Search Terminal Help
slaves+
buffers
NORMAL
slaves[+]
con…
100%
23:7

```
#
#    http://www.apache.org/licenses/LICENSE-2.0
#
# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.
#

# A Spark Worker will be started on each of the machines listed below.

master
worker1
worker2
worker3
```

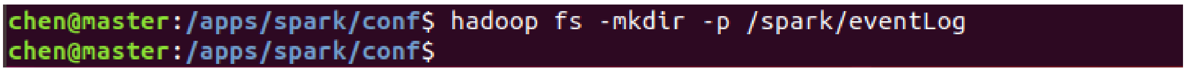
> 3.修改spark-defaults.conf，将spark.master 改为spark://master:7077，spark.eventLog.dir 改为 hdfs://master:9000/spark/eventLog。修改后 如下图所示



```
# Default system properties included when running spark-submit.
# This is useful for setting default environmental settings.

# Example:
# spark.master                     spark://master:7077
# spark.eventLog.enabled           true
# spark.eventLog.dir               hdfs://namenode:8021/directory
# spark.serializer                 org.apache.spark.serializer.KryoSerializ
# spark.driver.memory              5g
# spark.executor.extraJavaOptions  -XX:+PrintGCDetails -Dkey=value -Dnumber
spark.master                        spark://master:7077
spark.eventLog.enabled              true
spark.eventLog.dir                  hdfs://master:9000/spark/eventLog
spark.serializer                    org.apache.spark.serializer.KryoSeriali
spark.driver.memory                 1g
spark.jars.package                  Azure:mmlspark:0.12
```

eventLog 用来存放日志，需要手动创建

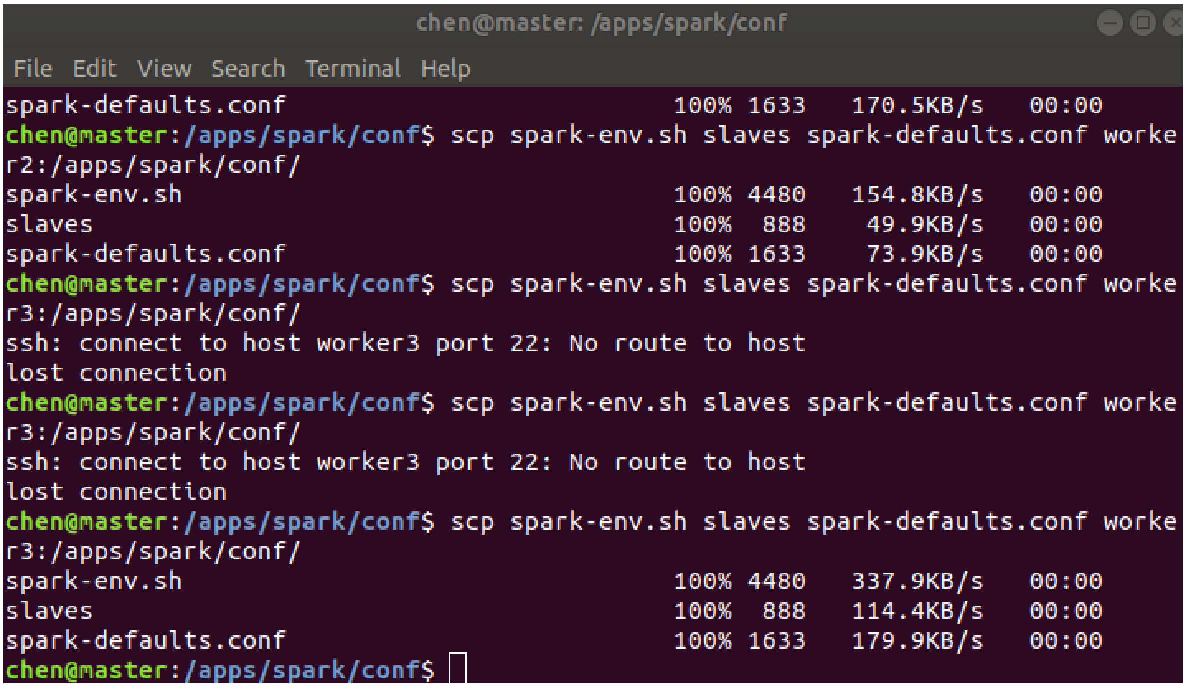
```
hadoop fs -mkdir -p /spark/eventLog
```



```
chen@master:/apps/spark/conf$ hadoop fs -mkdir -p /spark/eventLog
chen@master:/apps/spark/conf$
```

将修改的三个文件复制到worker1和worker2两个节点，覆盖原来的文件

```
cd /apps/spark/conf
scp spark-env.sh slaves spark-defaults.conf worker1:/apps/spark/conf
scp spark-env.sh slaves spark-defaults.conf worker2:/apps/spark/conf
scp spark-env.sh slaves spark-defaults.conf worker3:/apps/spark/conf
```


chen@master: /apps/spark/conf
File Edit View Search Terminal Help

```
spark-defaults.conf                           100% 1633   170.5KB/s   00:00
chen@master:/apps/spark/conf$ scp spark-env.sh slaves spark-defaults.conf worke
r2:/apps/spark/conf/
spark-env.sh                                  100% 4480   154.8KB/s   00:00
slaves                                        100%  888    49.9KB/s   00:00
spark-defaults.conf                           100% 1633    73.9KB/s   00:00
chen@master:/apps/spark/conf$ scp spark-env.sh slaves spark-defaults.conf worke
r3:/apps/spark/conf/
ssh: connect to host worker3 port 22: No route to host
lost connection
chen@master:/apps/spark/conf$ scp spark-env.sh slaves spark-defaults.conf worke
r3:/apps/spark/conf/
ssh: connect to host worker3 port 22: No route to host
lost connection
chen@master:/apps/spark/conf$ scp spark-env.sh slaves spark-defaults.conf worke
r3:/apps/spark/conf/
spark-env.sh                                  100% 4480   337.9KB/s   00:00
slaves                                        100%  888   114.4KB/s   00:00
spark-defaults.conf                           100% 1633   179.9KB/s   00:00
chen@master:/apps/spark/conf$ 
```

至此，配置文件就修改好了，下面进行测试。

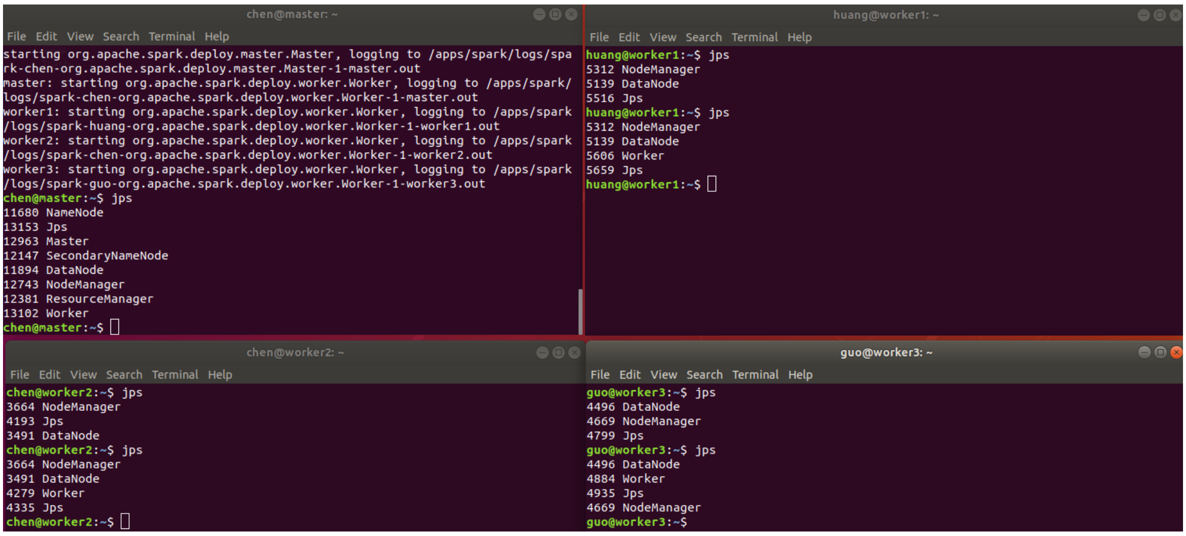
7.测试spark

启动spark集群

```
/apps/spark/sbin/start-all.sh
```

查看进程

主节点多了两个进程Master和Worker。从节点多了一个进程Worker


chen@master: ~
File Edit View Search Terminal Help
huang@worker1: ~
File Edit View Search Terminal Help
chen@worker2: ~
File Edit View Search Terminal Help
guo@worker3: ~
File Edit View Search Terminal Help

```
starting org.apache.spark.deploy.master.Master, logging to /apps/spark/logs/spa
rk-chen-org.apache.spark.deploy.master.Master-1-master.out
master: starting org.apache.spark.deploy.worker.Worker, logging to /apps/spark/
logs/spark-chen-org.apache.spark.deploy.worker.Worker-1-master.out
worker1: starting org.apache.spark.deploy.worker.Worker, logging to /apps/spark
/logs/spark-huang-org.apache.spark.deploy.worker.Worker-1-worker1.out
worker2: starting org.apache.spark.deploy.worker.Worker, logging to /apps/spark
/logs/spark-chen-org.apache.spark.deploy.worker.Worker-1-worker2.out
worker3: starting org.apache.spark.deploy.worker.Worker, logging to /apps/spark
/logs/spark-guo-org.apache.spark.deploy.worker.Worker-1-worker3.out
chen@master:~$ jps
11680 NameNode
13153 Jps
12963 Master
12147 SecondaryNameNode
11894 DataNode
12743 NodeManager
12381 ResourceManager
13102 Worker
chen@master:~$ 
```

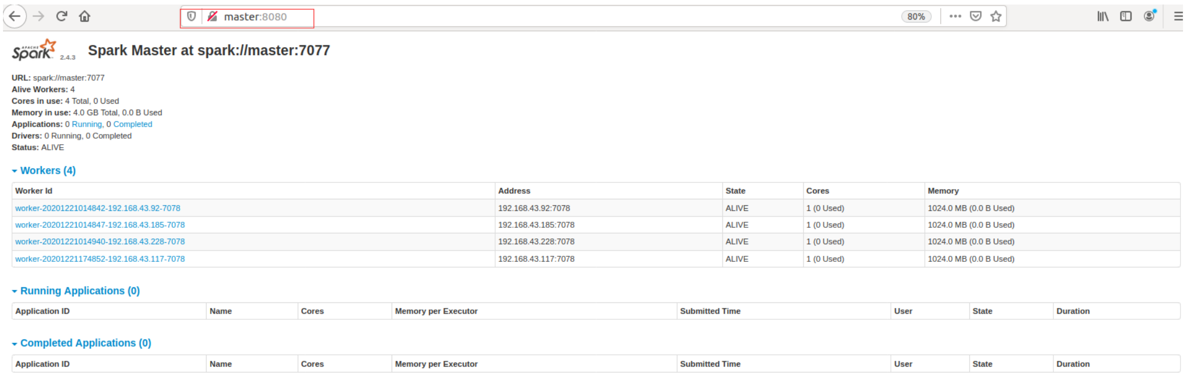
```
huang@worker1:~$ jps
5312 NodeManager
5139 DataNode
5516 Jps
huang@worker1:~$ jps
5312 NodeManager
5139 DataNode
5606 Worker
5659 Jps
huang@worker1:~$ 
```

```
chen@worker2:~$ jps
3664 NodeManager
4193 Jps
3491 DataNode
chen@worker2:~$ jps
3664 NodeManager
3491 DataNode
4279 Worker
4335 Jps
chen@worker2:~$ 
```

```
guo@worker3:~$ jps
4496 DataNode
4669 NodeManager
4799 Jps
guo@worker3:~$ jps
4496 DataNode
4884 Worker
4935 Jps
4669 NodeManager
guo@worker3:~$
```

Web UI

查看spark管理界面，在浏览器中输入http://master:8080，可以看到Worker有四个。



Spark Master at spark://master:7077

URL: spark://master:7077
Alive Workers: 4
Cores in use: 4 Total, 0 Used
Memory in use: 4.0 GB Total, 0.0 B Used
Applications: 0 Running, 0 Completed
Drivers: 0 Running, 0 Completed
Status: ALIVE

Workers (4)

Worker Id	Address	State	Cores	Memory
worker-20201221014842-192.168.43.92-7078	192.168.43.92:7078	ALIVE	1 (0 Used)	1024.0 MB (0.0 B Used)
worker-20201221014847-192.168.43.185-7078	192.168.43.185:7078	ALIVE	1 (0 Used)	1024.0 MB (0.0 B Used)
worker-20201221014940-192.168.43.228-7078	192.168.43.228:7078	ALIVE	1 (0 Used)	1024.0 MB (0.0 B Used)
worker-20201221174852-192.168.43.117-7078	192.168.43.117:7078	ALIVE	1 (0 Used)	1024.0 MB (0.0 B Used)

Running Applications (0)

Application ID	Name	Cores	Memory per Executor	Submitted Time	User	State	Duration

Completed Applications (0)

Application ID	Name	Cores	Memory per Executor	Submitted Time	User	State	Duration

运行演示实例

计算PI的值会出错

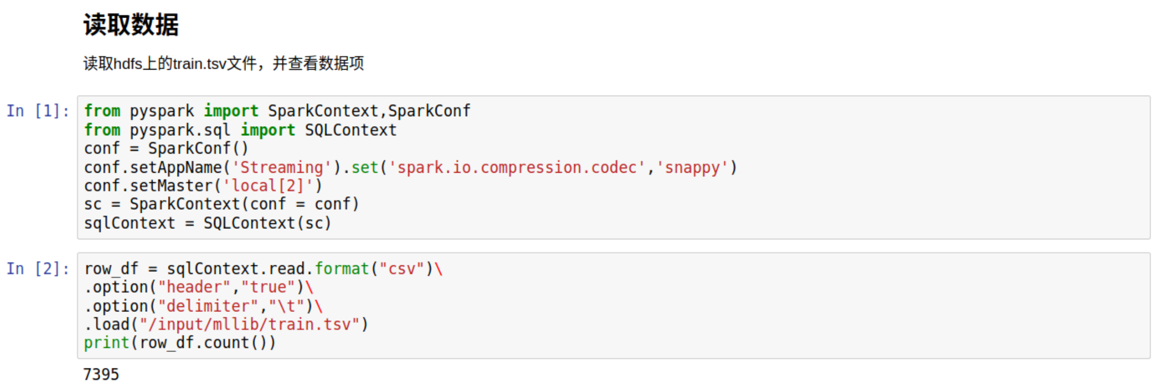
```
java.lang.NoSuchMethodError: net.jpountz.lz4.LZ4BlockInputStream.<init>
(Ljava/io/InputStream;Z)Vat
```

原因：

> 应用在执行时对数据解码（反序列化）时，使用了默认的lz4解压缩算法，在spark-core中依赖的lz4版本是1.4，而kafka-client中依赖的lz4版本是1.3版本，在生成解压器时，版本不兼容异常。

解决办法：

> 可参考网上修改源码解决，也可通过设置"spark.io.compression.codec","snappy"或其他压缩算法规避。鉴于修改源码重新打包替换较为繁琐，建议设置其他压缩算法规避



读取数据

读取hdfs上的train.tsv文件，并查看数据项

```
In [1]: from pyspark import SparkContext,SparkConf
        from pyspark.sql import SQLContext
        conf = SparkConf()
        conf.setAppName('Streaming').set('spark.io.compression.codec','snappy')
        conf.setMaster('local[2]')
        sc = SparkContext(conf = conf)
        sqlContext = SQLContext(sc)
```

```
In [2]: row_df = sqlContext.read.format("csv")\
        .option("header","true")\
        .option("delimiter","\t")\
        .load("/input/mllib/train.tsv")
        print(row_df.count())
```

```
7395
```

参考：https://blog.csdn.net/zhenzi_PeppaPig/article/details/84442296?utm_medium=distribute.pc_relevant_t0.none-task-blog-BlogCommendFromMachineLearnPai2-1.control&depth_1-utm_source=distribute.pc_relevant_t0.none-task-blog-BlogCommendFromMachineLearnPai2-1.control