前言

上篇文章我们讲解了 Blink 源码的项目结构并分析了它的每个模块的作用以及代码量。这里我们以后文章中主要参考源码是 Blink 分支，顺带会和 Flink release-1.7.1-rc2 做一定的对比（后面就不再做重复唠叨）。这篇文章 zhisheng 我带大家来揭秘下 Flink 的启动流程。

流程

在前面的文章里也说过启动 Flink 是通过执行命令:

```
./start-cluster.sh
```

那么我们先来看下这个脚本里面的东西有哪些呢?

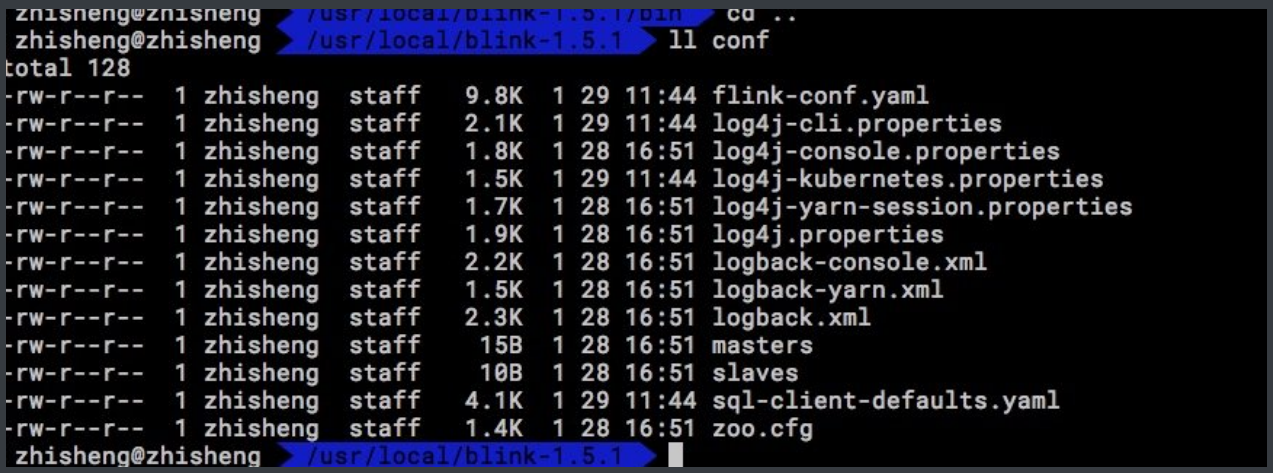
```
bin=`dirname "$0"`
bin=`cd "$bin"; pwd`

. "$bin"/config.sh

# Start the JobManager instance(s)
shopt -s nocasematch
if [[ $HIGH_AVAILABILITY == "zookeeper" ]]; then
    # HA Mode
    readMasters

    echo "Starting HA cluster with ${#MASTERS[@]} masters."

    for ((i=0;i<${#MASTERS[@]};++i)); do
        master=${MASTERS[i]}
        webuiport=${WEBUIPORTS[i]}

        if [ ${MASTERS_ALL_LOCALHOST} = true ] ; then
            "${FLINK_BIN_DIR}"/jobmanager.sh start "${master}" "${webuiport}"
        else
            ssh -n $FLINK_SSH_OPTS $master -- "nohup /bin/bash -l \"${FLINK_BIN_DIR}/jobmanager.sh\" start ${master} ${webuiport} &"
        fi
    done

else
    echo "Starting cluster."

```

```
28      # Start single JobManager on this machine
29      "$FLINK_BIN_DIR"/jobmanager.sh start
30  fi
31  shopt -u nocasematch
32
33  # Start TaskManager instance(s)
34  TMSlaves start
```

执行 config.sh

可以看到首先它运行了 `./config.sh` ，那么就来看看这个配置脚本吧, 脚本有点长，这里我给出链接地址: https://github.com/zhisheng17/flink/blob/zhisheng_blink_1.5.1/flink-dist/src/main/flink-bin/bin/config.sh

大家可以瞧一瞧，里面其实干的事情比较简单，就是把conf 目录下所有的配置文件、环境变量、读取加载，给大家截几个图就明白了。



上图是所有的配置文件，下面是 config.sh 的部分函数:

```
    fi
}

readMasters() {
    MASTERS_FILE="${FLINK_CONF_DIR}/masters"

    if [[ ! -f "${MASTERS_FILE}" ]]; then
        echo "No masters file. Please specify masters in 'conf/masters'."
        exit 1
    fi

    MASTERS=()
    WEBUIPORTS=()

    MASTERS_ALL_LOCALHOST=true
    GOON=true
    while $GOON; do
        read line || GOON=false
        HOSTWEBUIPORT=$( extractHostName $line)

        if [ -n "$HOSTWEBUIPORT" ]; then
            HOST=$(echo $HOSTWEBUIPORT | cut -f1 -d:)
            WEBUIPORT=$(echo $HOSTWEBUIPORT | cut -s -f2 -d:)
            MASTERS+=(${HOST})

            if [ -z "$WEBUIPORT" ]; then
                WEBUIPORTS+=(0)
            else
                WEBUIPORTS+=(${WEBUIPORT})
            fi

            if [ "${HOST}" != "localhost" ] && [ "${HOST}" != "127.0.0.1" ] ; then
                MASTERS_ALL_LOCALHOST=false
            fi
        fi
    done < "$MASTERS_FILE"
}

readSlaves() {
    SLAVES_FILE="${FLINK_CONF_DIR}/slaves"

    if [[ ! -f "$SLAVES_FILE" ]]; then
        echo "No slaves file. Please specify slaves in 'conf/slaves'."
        exit 1
    fi

    SLAVES=()

    SLAVES_ALL_LOCALHOST=true
    GOON=true
    while $GOON; do
        read line || GOON=false
        HOST=$( extractHostName $line)
        if [ -n "$HOST" ] ; then
            SLAVES+=(${HOST})
            if [ "${HOST}" != "localhost" ] && [ "${HOST}" != "127.0.0.1" ] ; then
                SLAVES_ALL_LOCALHOST=false
            fi
        fi
    done < "$SLAVES_FILE"
}
```


上图是读取 master 和 slaves 配置文件

```
################################################################################
# DEFAULT CONFIG VALUES: These values will be used when nothing has been specified in conf/flink-conf.yaml
# -or- the respective environment variables are not set.
################################################################################


# WARNING !!! , these values are only used if there is nothing else is specified in
# conf/flink-conf.yaml

DEFAULT_ENV_PID_DIR="/tmp"                          # Directory to store *.pid files to
DEFAULT_ENV_LOG_MAX=5                               # Maximum number of old log files to keep
DEFAULT_ENV_JAVA_OPTS=""                            # Optional JVM args
DEFAULT_ENV_JAVA_OPTS_JM=""                         # Optional JVM args (JobManager)
DEFAULT_ENV_JAVA_OPTS_TM=""                         # Optional JVM args (TaskManager)
DEFAULT_ENV_SSH_OPTS=""                             # Optional SSH parameters running in cluster mode

################################################################################
# CONFIG KEYS: The default values can be overwritten by the following keys in conf/flink-conf.yaml
################################################################################

KEY_JOBM_MEM_SIZE="jobmanager.heap.mb"
KEY_TASKM_MEM_SIZE="taskmanager.heap.mb"
KEY_TASKM_MEM_MANAGED_SIZE="taskmanager.memory.size"
KEY_TASKM_MEM_MANAGED_FRACTION="taskmanager.memory.fraction"
KEY_TASKM_OFFHEAP="taskmanager.memory.off-heap"
KEY_TASKM_MEM_PRE_ALLOCATE="taskmanager.memory.preallocate"

KEY_TASKM_NET_BUF_FRACTION="taskmanager.network.memory.fraction"
KEY_TASKM_NET_BUF_MIN="taskmanager.network.memory.min"
KEY_TASKM_NET_BUF_MAX="taskmanager.network.memory.max"
KEY_TASKM_NET_BUF_NR="taskmanager.network.numberOfBuffers" # fallback

KEY_TASKM_COMPUTE_NUMA="taskmanager.compute.numa"

KEY_ENV_PID_DIR="env.pid.dir"
KEY_ENV_LOG_DIR="env.log.dir"
KEY_ENV_LOG_MAX="env.log.max"
KEY_ENV_JAVA_HOME="env.java.home"
KEY_ENV_JAVA_OPTS="env.java.opts"
KEY_ENV_JAVA_OPTS_JM="env.java.opts.jobmanager"
KEY_ENV_JAVA_OPTS_TM="env.java.opts.taskmanager"
KEY_ENV_SSH_OPTS="env.ssh.opts"
KEY_HIGH_AVAILABILITY="high-availability"
KEY_ZK_HEAP_MB="zookeeper.heap.mb"

KEY_FLINK_MODE="mode"

################################################################################
# PATHS AND CONFIG
################################################################################

target="$0"
# For the case, the executable has been directly symlinked, figure out
# the correct bin path by following its symlink up to an upper bound.
# Note: we can't use the readlink utility here if we want to be POSIX
# compatible.
iteration=0
while [ -L "$target" ]; do
    if [ "$iteration" -gt 100 ]; then
        echo "Cannot resolve path: You have a cyclic symlink in $target."
        break
    fi
    ls=`ls -ld -- "$target"`
    target=`expr "$ls" : '.* -> \(.*\)$'`
    iteration=$((iteration + 1))
done

# Convert relative path to absolute path and resolve directory symlinks
bin=`dirname "$target"`
SYMLINK_RESOLVED_BIN=`cd "$bin"; pwd -P`
```



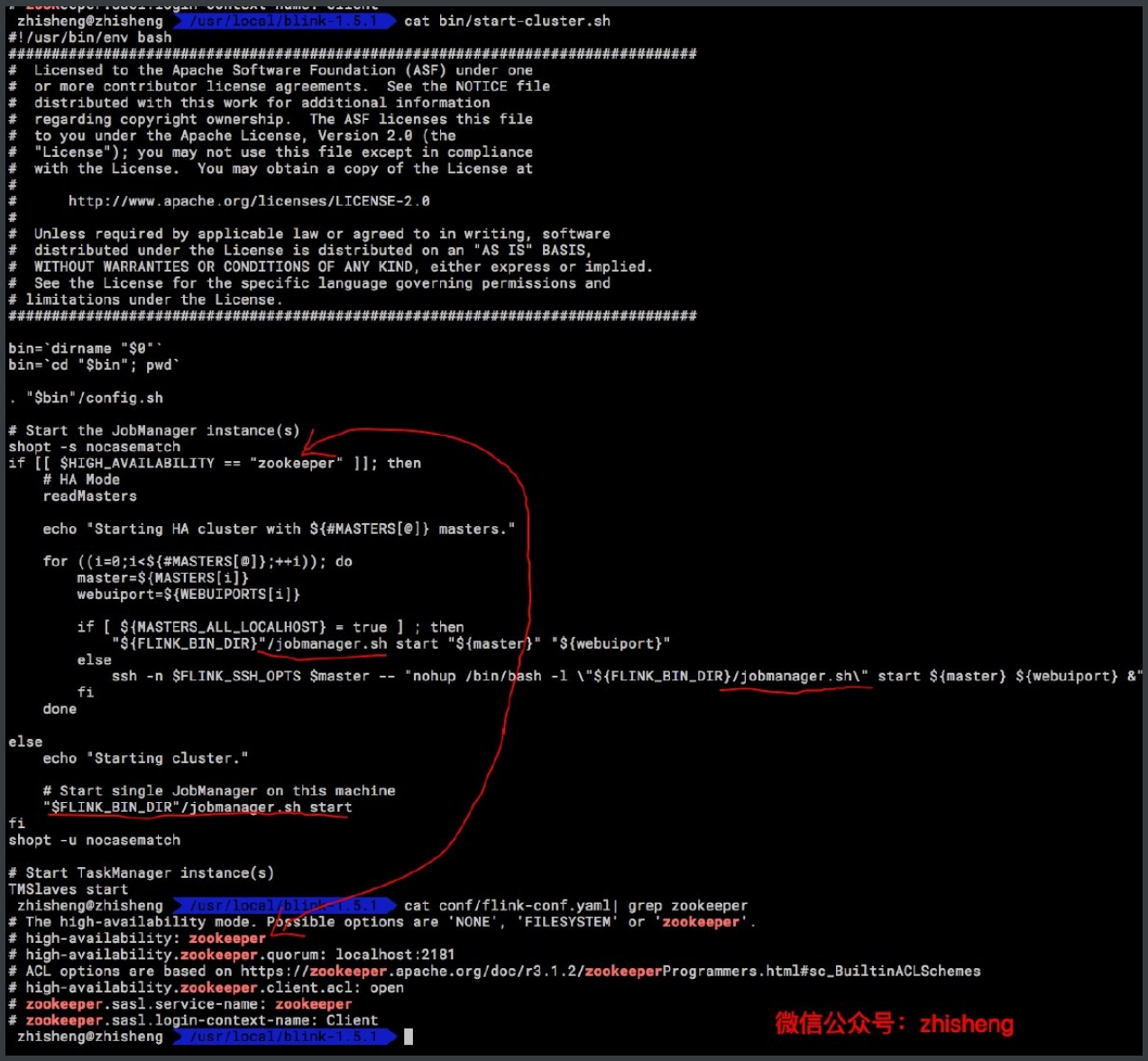
```
# High availability
if [ -z "${HIGH_AVAILABILITY}" ]; then
     HIGH_AVAILABILITY=$(readFromConfig ${KEY_HIGH_AVAILABILITY} "" "${YAML_CONF}")
     if [ -z "${HIGH_AVAILABILITY}" ]; then
        # Try deprecated value
        DEPRECATED_HA=$(readFromConfig "recovery.mode" "" "${YAML_CONF}")
        if [ -z "${DEPRECATED_HA}" ]; then
            HIGH_AVAILABILITY="none"
        elif [ ${DEPRECATED_HA} == "standalone" ]; then
            # Standalone is now 'none'
            HIGH_AVAILABILITY="none"
        else
            HIGH_AVAILABILITY=${DEPRECATED_HA}
        fi
     fi
fi
```

上图是 flink-conf.yaml 里面的一些配置

```
################################################################################
# ENVIRONMENT VARIABLES
################################################################################

# read JAVA_HOME from config with no default value
MY_JAVA_HOME=$(readFromConfig ${KEY_ENV_JAVA_HOME} "" "${YAML_CONF}")
# check if config specified JAVA_HOME
if [ -z "${MY_JAVA_HOME}" ]; then
    # config did not specify JAVA_HOME. Use system JAVA_HOME
    MY_JAVA_HOME=${JAVA_HOME}
fi
# check if we have a valid JAVA_HOME and if java is not available
if [ -z "${MY_JAVA_HOME}" ] && ! type java > /dev/null 2> /dev/null; then
    echo "Please specify JAVA_HOME. Either in Flink config ./conf/flink-conf.yaml or as system-wide JAVA_HOME."
    exit 1
else
    JAVA_HOME=${MY_JAVA_HOME}
fi

UNAME=$(uname -s)
if [ "${UNAME:0:6}" == "CYGWIN" ]; then
    JAVA_RUN=java
else
    if [[ -d $JAVA_HOME ]]; then
        JAVA_RUN=$JAVA_HOME/bin/java
    else
        JAVA_RUN=java
    fi
fi

# Define HOSTNAME if it is not already set
if [ -z "${HOSTNAME}" ]; then
    HOSTNAME=`hostname`
fi

IS_NUMBER="^[0-9]+$"

# Define FLINK_JM_HEAP if it is not already set
if [ -z "${FLINK_JM_HEAP}" ]; then
    FLINK_JM_HEAP=$(readFromConfig ${KEY_JOBM_MEM_SIZE} 0 "${YAML_CONF}")
fi

# Define FLINK_TM_HEAP if it is not already set
if [ -z "${FLINK_TM_HEAP}" ]; then
    FLINK_TM_HEAP=$(readFromConfig ${KEY_TASKM_MEM_SIZE} 0 "${YAML_CONF}")
fi

# Define FLINK_TM_MEM_MANAGED_SIZE if it is not already set
if [ -z "${FLINK_TM_MEM_MANAGED_SIZE}" ]; then
    FLINK_TM_MEM_MANAGED_SIZE=$(readFromConfig ${KEY_TASKM_MEM_MANAGED_SIZE} 0 "${YAML_CONF}")
fi

# Define FLINK_TM_MEM_MANAGED_FRACTION if it is not already set
if [ -z "${FLINK_TM_MEM_MANAGED_FRACTION}" ]; then
    FLINK_TM_MEM_MANAGED_FRACTION=$(readFromConfig ${KEY_TASKM_MEM_MANAGED_FRACTION} 0.7 "${YAML_CONF}")
fi

# Define FLINK_TM_OFFHEAP if it is not already set
if [ -z "${FLINK_TM_OFFHEAP}" ]; then
    FLINK_TM_OFFHEAP=$(readFromConfig ${KEY_TASKM_OFFHEAP} "false" "${YAML_CONF}")
fi

# Define FLINK_TM_MEM_PRE_ALLOCATE if it is not already set
if [ -z "${FLINK_TM_MEM_PRE_ALLOCATE}" ]; then
    FLINK_TM_MEM_PRE_ALLOCATE=$(readFromConfig ${KEY_TASKM_MEM_PRE_ALLOCATE} "false" "${YAML_CONF}")
fi


# Define FLINK_TM_NET_BUF_FRACTION if it is not already set
if [ -z "${FLINK_TM_NET_BUF_FRACTION}" ]; then
```


上图是加载环境变量配置

是不是，这个 config.sh 就是干了这些事情，把所有需要的配置加载起来，供后面启动提供保障。分析完 config.sh，我们继续回到 start-cluster.sh，它接下来开始启动 JobManager 实例了，启动 JobManager 实例这里分两种，一种是高可用(HA)模式，另一种是单机模式。这里我们知道它是要启动 JobManager 就可以了，至于有什么区别，不是这篇文章的重点。



执行 jobmanager.sh

启动 JobManager 最终是执行了 bin/jobmanager.sh 脚本，在该脚本里面执行如下(传递了一个参数：JOBMANAGER_TYPE)：

```
# Start/stop a Flink JobManager.
USAGE="Usage: jobmanager.sh ((start|start-foreground) [host] [webui-port])|stop|stop-all"

STARTSTOP=$1
HOST=$2 # optional when starting multiple instances
WEBUIPORT=$3 # optional when starting multiple instances

if [[ $STARTSTOP != "start" ]] && [[ $STARTSTOP != "start-foreground" ]] && [[ $STARTSTOP != "stop" ]] && [[ $STAR
]]; then
  echo $USAGE
  exit 1
fi

bin=`dirname "$0"`
bin=`cd "$bin"; pwd`

. "$bin"/config.sh

JOBMANAGER_TYPE=jobmanager

if [[ "${FLINK_MODE}" == "new" ]]; then
    JOBMANAGER_TYPE=standalonesession
fi

if [[ $STARTSTOP == "start" ]] || [[ $STARTSTOP == "start-foreground" ]]; then
    if [[ ! ${FLINK_JM_HEAP} =~ $IS_NUMBER ]] || [[ "${FLINK_JM_HEAP}" -lt "0" ]]; then
        echo "[ERROR] Configured JobManager memory size is not a valid value. Please set '${KEY_JOBM_MEM_SIZE}' in
"
        exit 1
    fi

    if [ "${FLINK_JM_HEAP}" -gt "0" ]; then
        export JVM_ARGS="$JVM_ARGS -Xms"$FLINK_JM_HEAP"m -Xmx"$FLINK_JM_HEAP"m"
    fi

    # Add JobManager-specific JVM options
    export FLINK_ENV_JAVA_OPTS="${FLINK_ENV_JAVA_OPTS} ${FLINK_ENV_JAVA_OPTS_JM}"

    # Startup parameters
    args=("--configDir" "${FLINK_CONF_DIR}" "--executionMode" "cluster")
    if [ ! -z $HOST ]; then
        args+=("--host")
        args+=("${HOST}")
    fi

    if [ ! -z $WEBUIPORT ]; then
        args+=("--webui-port")
        args+=("${WEBUIPORT}")
    fi
fi

if [[ $STARTSTOP == "start-foreground" ]]; then
    exec "${FLINK_BIN_DIR}"/flink-console.sh $JOBMANAGER_TYPE "${args[@]}"
else
    "${FLINK_BIN_DIR}"/flink-daemon.sh $STARTSTOP $JOBMANAGER_TYPE "${args[@]}"
fi
```

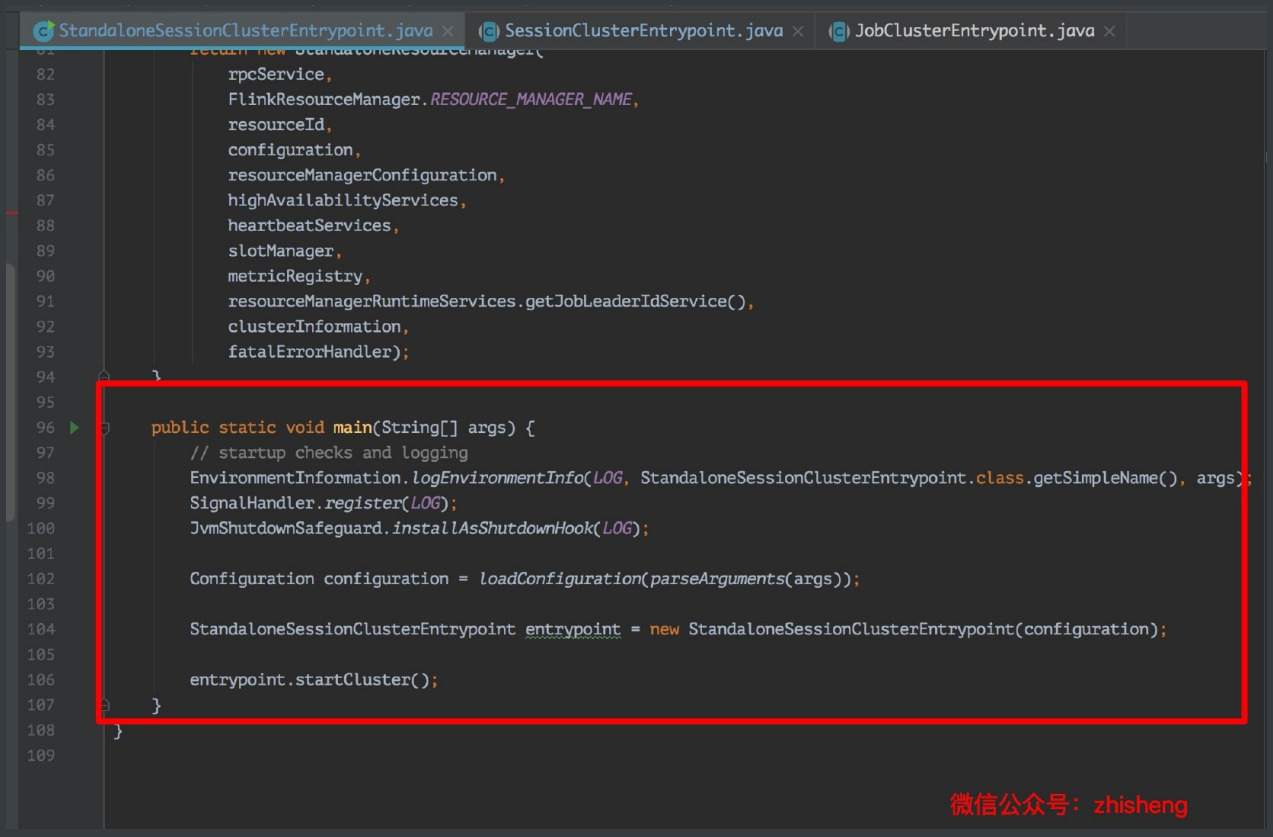

那我们接下来看下 bin/flink-daemon.sh 这个脚本：

```
# Start a Flink service as a console application. Must be stopped with Ctrl-C
# or with SIGTERM by kill or the controlling process.
USAGE="Usage: flink-console.sh (jobmanager|taskmanager|historyserver|zookeeper) [args]"

SERVICE=$1
ARGS=("${@:2}") # get remaining arguments as array

bin=`dirname "$0"`
bin=`cd "$bin"; pwd`

. "$bin"/config.sh

case $SERVICE in
    (jobmanager)
        CLASS_TO_RUN=org.apache.flink.runtime.jobmanager.JobManager
    ;;

    (taskmanager)
        CLASS_TO_RUN=org.apache.flink.runtime.taskmanager.TaskManager
    ;;

    (taskexecutor)
        CLASS_TO_RUN=org.apache.flink.runtime.taskexecutor.TaskManagerRunner
    ;;

    (historyserver)
        CLASS_TO_RUN=org.apache.flink.runtime.webmonitor.history.HistoryServer
    ;;

    (zookeeper)
        CLASS_TO_RUN=org.apache.flink.runtime.zookeeper.FlinkZooKeeperQuorumPeer
    ;;

    (standalonesession)
        CLASS_TO_RUN=org.apache.flink.runtime.entrypoint.StandaloneSessionClusterEntrypoint
    ;;

    (*)
        echo "Unknown service '${SERVICE}'. $USAGE."
        exit 1
    ;;
esac
```


该脚本就利用了传递的参数 JOBMANAGER_TYPE，这里有个 case 场景，不同的服务就会启动不一样的类，如果是 jobmanager 的话，启动的类是 `org.apache.flink.runtime.jobmanager.JobManager`，如果是 standalonesession，执行 `org.apache.flink.runtime.entrypoint.StandaloneSessionClusterEntrypoint` 类。

这里的结果是 standalonesession，所以运行 `org.apache.flink.runtime.entrypoint.StandaloneSessionClusterEntrypoint` 类。

那么我们来看下该类的 main 方法：



方法里面的执行流程下篇文章好好写下。

执行 taskmanager.sh

启动完 JobManager 后，它接下来就是启动 TaskManager 了：

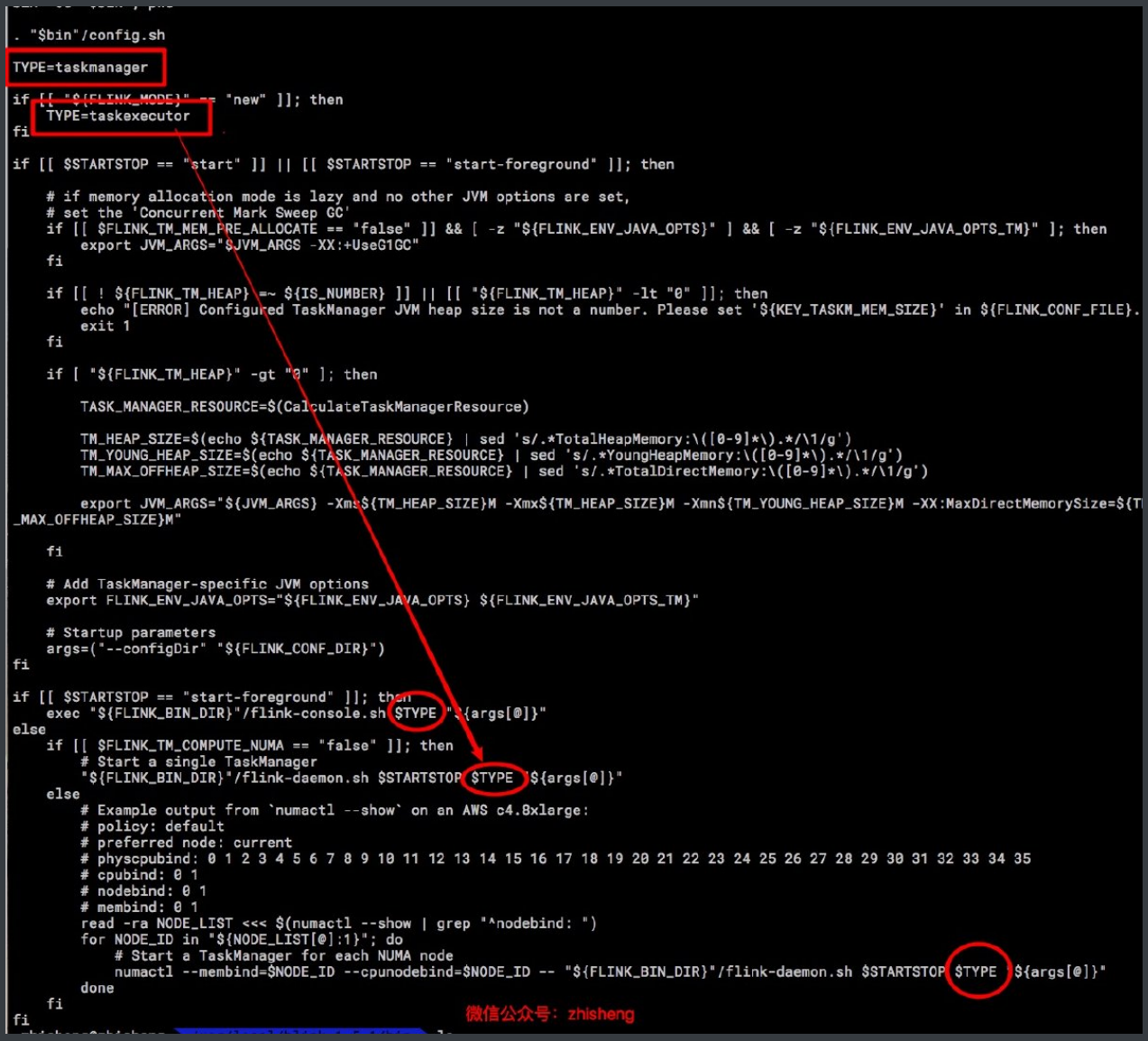
```
# Start TaskManager instance(s)
TMSlaves start
```

执行了上面命令，那这个命令到底干了啥呢？其实上面我给大家说的那个 config.sh 里面就有：

```
# starts or stops TMs on all slaves
# TMSlaves start|stop
TMSlaves() {
    CMD=$1

    readSlaves

    if [ ${SLAVES_ALL_LOCALHOST} = true ] ; then
        # all-local setup
        for slave in ${SLAVES[@]}; do
            "${FLINK_BIN_DIR}"/taskmanager.sh "${CMD}"
        done
    else
```

```
14          # non-local setup
15          # Stop TaskManager instance(s) using pdsh (Parallel Distributed
    Shell) when available
16          command -v pdsh >/dev/null 2>&1
17          if [[ $? -ne 0 ]]; then
18              for slave in ${SLAVES[@]}; do
19                  ssh -n $FLINK_SSH_OPTS $slave -- "nohup /bin/bash -l
    \"${FLINK_BIN_DIR}/taskmanager.sh\" \"${CMD}\" &"
20              done
21          else
22              PDSH_SSH_ARGS="" PDSH_SSH_ARGS_APPEND=$FLINK_SSH_OPTS pdsh
    -w $(IFS=, ; echo "${SLAVES[*]}") \
23                  "nohup /bin/bash -l \"${FLINK_BIN_DIR}/taskmanager.sh\"
    \"${CMD}\""
24          fi
25      fi
26  }
```

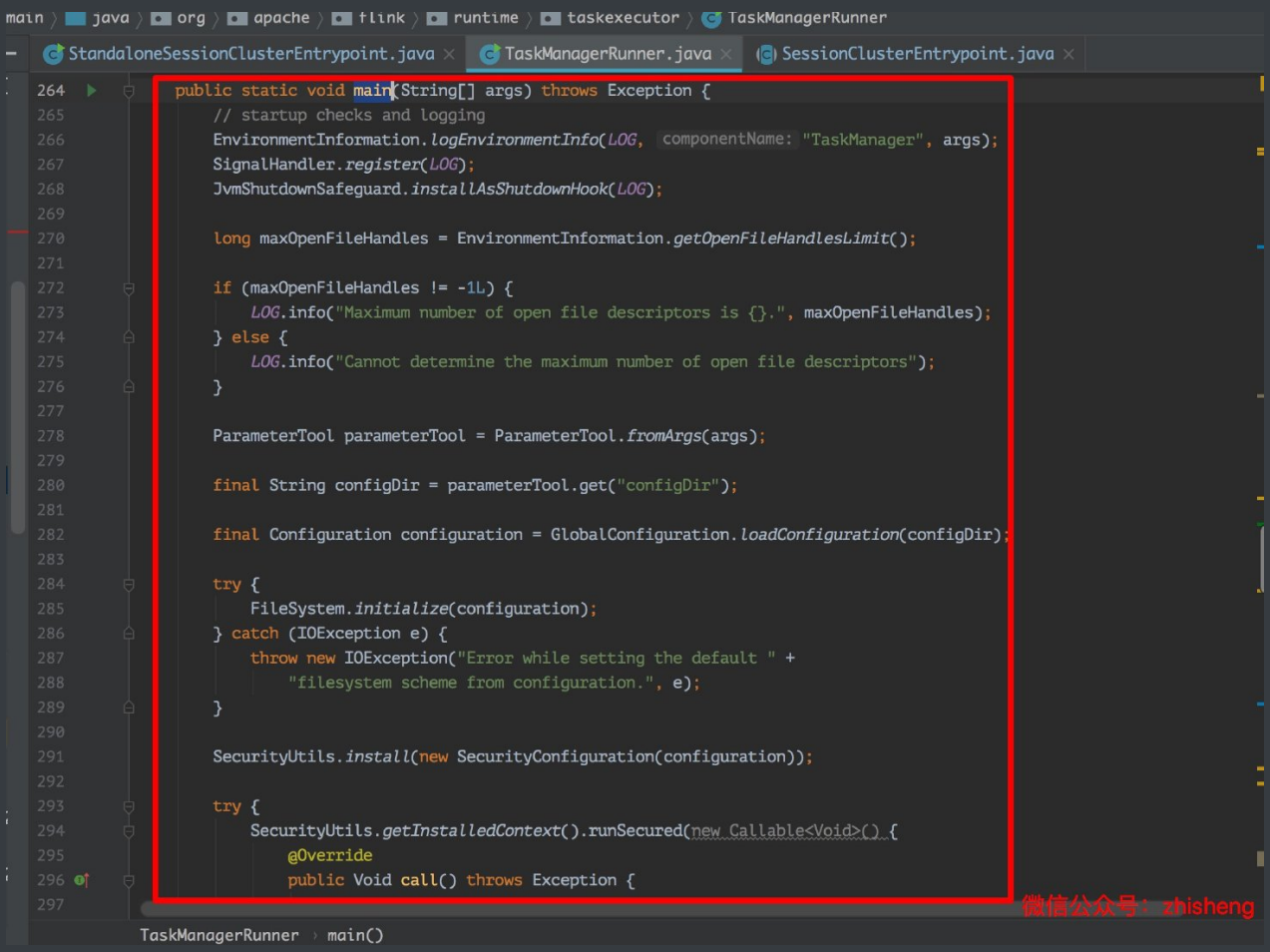
就是执行了 taskmanager.sh 脚本：



最后还是执行了 flink-daemon.sh 脚本：

```
################################################################################

# Start/stop a Flink daemon.
USAGE="Usage: flink-daemon.sh (start|stop|stop-all) (jobmanager|taskmanager|zookeeper|historyserver) [args]"

STARTSTOP=$1
DAEMON=$2
ARGS=("${@:3}") # get remaining arguments as array

bin=`dirname "$0"`
bin=`cd "$bin"; pwd`

. "$bin"/config.sh

case $DAEMON in
    (jobmanager)
        CLASS_TO_RUN=org.apache.flink.runtime.jobmanager.JobManager
    ;;

    (taskmanager)
        CLASS_TO_RUN=org.apache.flink.runtime.taskmanager.TaskManager
    ;;

    (taskexecutor)
        CLASS_TO_RUN=org.apache.flink.runtime.taskexecutor.TaskManagerRunner
    ;;

    (zookeeper)
        CLASS_TO_RUN=org.apache.flink.runtime.zookeeper.FlinkZooKeeperQuorumPeer
    ;;

    (historyserver)
        CLASS_TO_RUN=org.apache.flink.runtime.webmonitor.history.HistoryServer
    ;;

    (standalonesession)
        CLASS_TO_RUN=org.apache.flink.runtime.entrypoint.StandaloneSessionClusterEntrypoint
    ;;

    (*)
        echo "Unknown daemon '${DAEMON}'. $USAGE."
        exit 1
    ;;
esac
```


在这里执行了 `org.apache.flink.runtime.taskexecutor.TaskManagerRunner` 类，同样，我们先看一眼这个类的 main 方法长啥样：



大概看了下该类后，接着回到 flink-daemon.sh 脚本，该脚本后面配置了对应的 TaskManager 的运行日志和 GC 日志，这里 Flink 是没有单独的 GC 日志打印出来。

上篇文章也说过可以不断的执行 `./start-cluster.sh` 可以启动多个 TaskManager，下面这图就可以作出解释了：

```
case $STARTSTOP in

    (start)
        # Rotate log files
        rotateLogFilesWithPrefix "$FLINK_LOG_DIR" "$FLINK_LOG_PREFIX"

        # Print a warning if daemons are already running on host
        if [ -f "$pid" ]; then
          active=()
          while IFS='' read -r p || [[ -n "$p" ]]; do
            kill -0 $p >/dev/null 2>&1
            if [ $? -eq 0 ]; then
              active+=($p)
            fi
          done < "${pid}"

          count="${#active[@]}"

          if [ ${count} -gt 0 ]; then
            echo "[INFO] $count instance(s) of $DAEMON are already running on $HOSTNAME."
          fi
        fi

        # Evaluate user options for local variable expansion
        FLINK_ENV_JAVA_OPTS=$(eval echo ${FLINK_ENV_JAVA_OPTS})

        echo "Starting $DAEMON daemon on host $HOSTNAME."
        $JAVA_RUN $JVM_ARGS ${FLINK_ENV_JAVA_OPTS} "${log_setting[@]}" -classpath "`manglePathList "$FLINK_TM_CLASSPATH:$INTERNAL_HADOOP_CLASSPATHS"`" ${CLASS_TO_RUN} "${ARGS[@]}" > "$out" 200<&- 2>&1 < /dev/null &

        mypid=$!

        # Add to pid file if successful start
        if [[ ${mypid} =~ ${IS_NUMBER} ]] && kill -0 $mypid > /dev/null 2>&1 ; then
            echo $mypid >> "$pid"
        else
            echo "Error starting $DAEMON daemon."
            exit 1
        fi
    ;;
```

这也可以解释启动的时候打印出来的日志了：

```
1  Starting cluster.
2  [INFO] 1 instance(s) of standalonesession are already running on
   zhisheng.
3  Starting standalonesession daemon on host zhisheng.
4  log4j:WARN No appenders could be found for logger
   (org.apache.flink.configuration.GlobalConfiguration).
5  log4j:WARN Please initialize the log4j system properly.
6  log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for
   more info.
7  [INFO] 2 instance(s) of taskexecutor are already running on zhisheng.
8  Starting taskexecutor daemon on host zhisheng.
```

中文源码分析

https://github.com/zhisheng17/flink

相关

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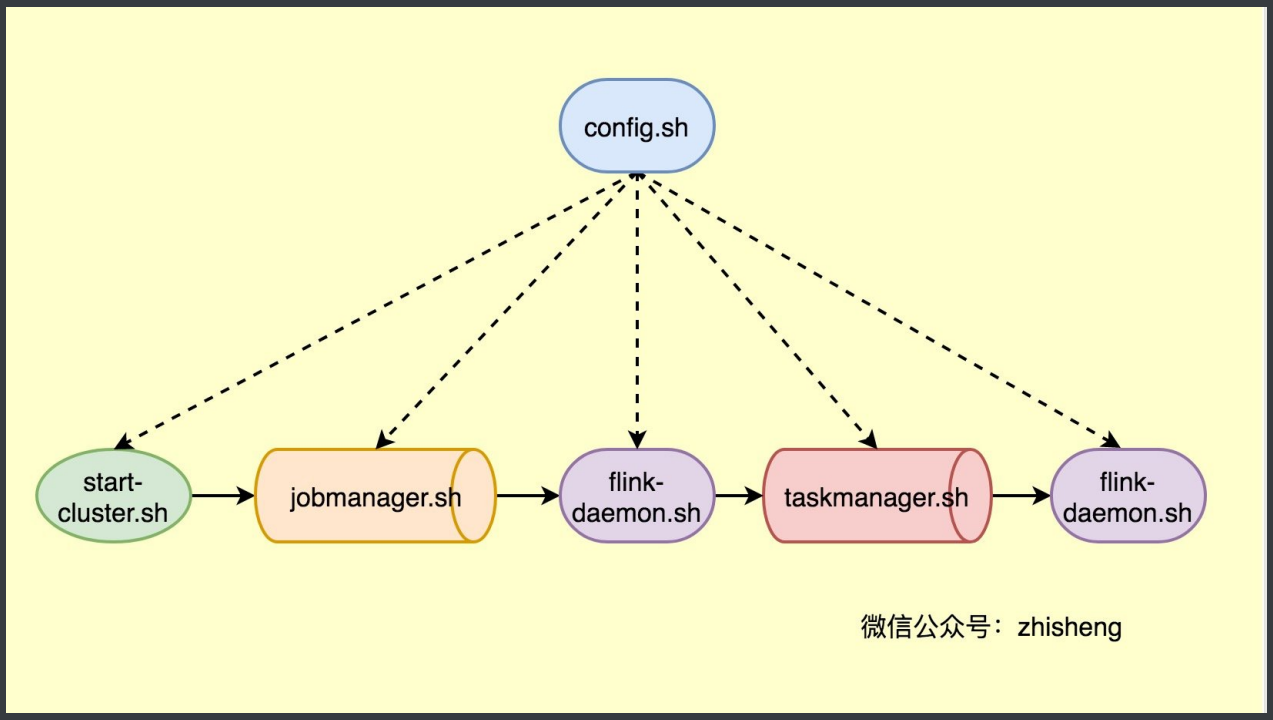
总结



本文先根据 Blink 的启动方式来查看脚本的执行流程，并跟随脚本探究下它里面最终是先读取配置文件，然后启动 jobmanager，完成后接着启动 taskmanager，并找到单机集群模式下启动 jobmanager 和 taskmanager 对应的 Java 启动类。下篇文章我们就可以来具体的分析下这两个类。