

分布式计算第二次作业

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■ 准备：

安装jdk，安装maven，为maven设置阿里或腾讯镜像仓库，用maven编译HelloWorld版的java程序

■ 题目：

将基于TCP协议的Client-Server通信程序示例的服务器端程序改造成线程池版。

■ 提交要求：

1. 3月28日前将源程序发送至：xddistcomcourse@163.com
2. 邮件标题风格：第2次作业+学号+姓名
3. 源程序打包文件命名方式：第2次作业+学号+姓名.zip

1. 准备

1.1 下载和安装

A screenshot of the Apache Maven Project download page. The main header features the Apache feather logo and the text "Apache Maven Project" and "http://maven.apache.org/". On the right, there is a large "Maven" logo with a stylized leaf. The left sidebar contains navigation links like "Welcome", "License", "ABOUT MAVEN", "What is Maven?", "Features", "Download" (which is highlighted), "Use", "Release Notes", "DOCUMENTATION", "Maven Plugins", "Maven Extensions", "Index (category)", "User Centre", "Plugin Developer Centre", "Maven Central Repository", and "Maven Developer Centre". The main content area is titled "Downloading Apache Maven 3.8.5". It includes a note that 3.8.5 is the latest release, information about mirrors (with "dlcdn.apache.org" selected), and a "Change" button. Below this is a "System Requirements" section with tables for Java Development Kit, Memory, Disk, and Operating System. A note at the bottom states that Maven 3.3+ requires JDK 1.7 or above.

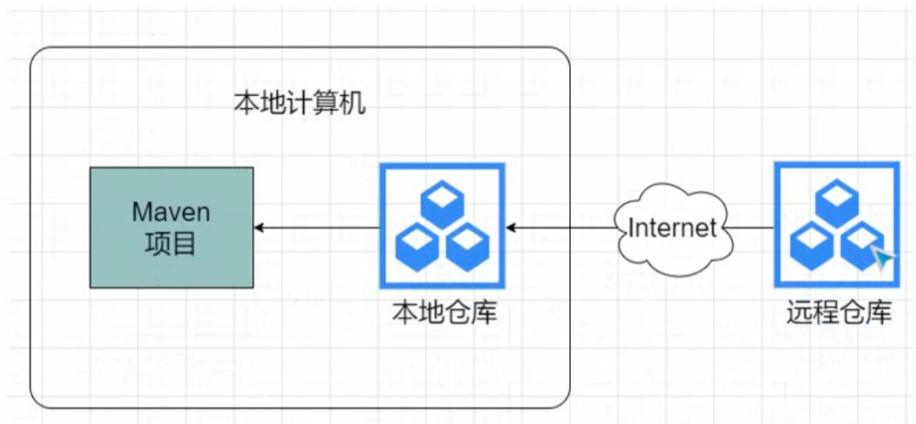
安装完成标识

A screenshot of a Windows command prompt window. The title bar says "命令提示符" (Command Prompt). The window shows the following text:

```
C:\命令提示符
Microsoft Windows [版本 10.0.19042.1466]
(c) Microsoft Corporation。保留所有权利。

C:\Users\Administrator>
C:\Users\Administrator>mvn -version
Apache Maven 3.8.5 (3599d3414f046de2324203b78ddcf9b5e4388aa0)
Maven home: D:\ Maven\apache-maven-3.8.5
Java version: 13.0.2, vendor: Oracle Corporation, runtime: D:\Java\JDK
Default locale: zh_CN, platform encoding: GBK
OS name: "windows 10", version: "10.0", arch: "amd64", family: "windows"
```

1.2 Maven的配置



配置本地仓库

```
settings.xml - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
<settings xmlns="http://maven.apache.org/SETTINGS/1.2.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/SETTINGS/1.2.0
https://maven.apache.org/xsd/settings-1.2.0.xsd">
  <!-- localRepository
  | The path to the local repository maven will use to store artifacts.
  |
  | Default: ${user.home}/.m2/repository
  <localRepository>/path/to/local/repo</localRepository>
  -->
  <localRepository>D:\Maven\Mavenlib</localRepository>

  <!-- interactiveMode
  | This will determine whether maven prompts you when it needs input. If set to false,
  | maven will use a sensible default value, perhaps based on some other setting, for
  | the parameter in question.
  |
  | Default: true
  <interactiveMode>true</interactiveMode>
  -->

  <!-- offline
  | Determines whether maven should attempt to connect to the network when executing a build. v
  第 55 行, 第 1 列 100% Windows (CRLF) UTF-8
```

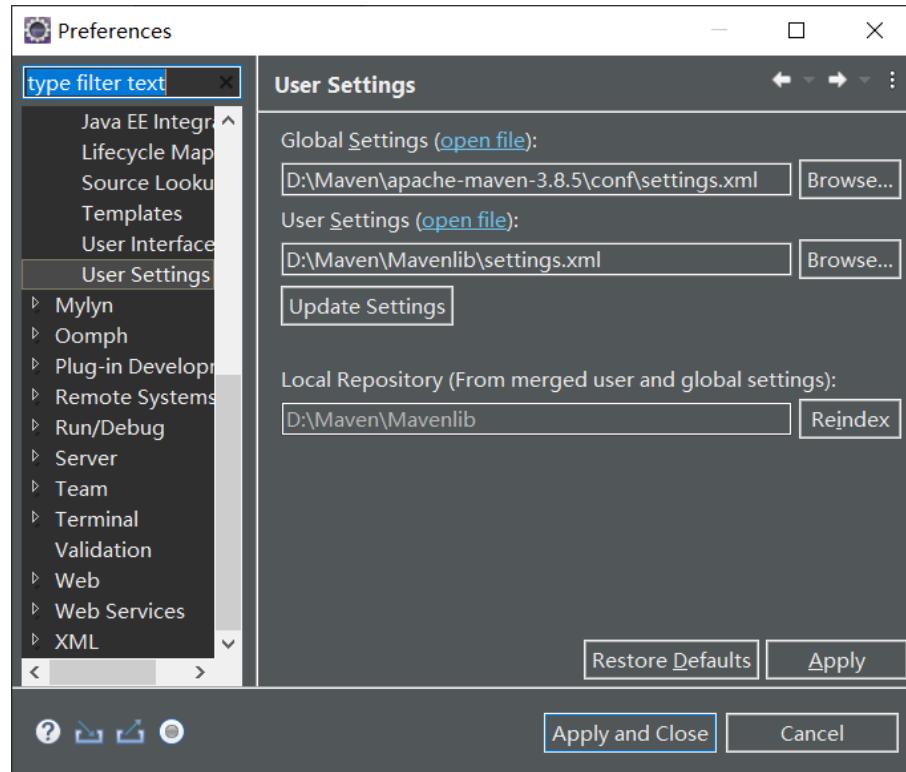
配置阿里云远程仓库

```
settings.xml - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
  | It works like this: a POM may declare a repository to use in resolving certain artifacts.
  | However, this repository may have problems with heavy traffic at times, so people have
  mirrored
  | it to several places.
  |
  | That repository definition will have a unique id, so we can create a mirror reference for that
  | repository, to be used as an alternate download site. The mirror site will be the preferred
  | server for that repository.
  |-->

  <mirrors>
    <mirror>
      <id>nexus-aliyun</id>
      <mirrorOf>central</mirrorOf>
      <name>Nexus aliyun</name>
      <url>http://maven.aliyun.com/nexus/content/groups/public/</url>
    </mirror>
  </mirrors>

  <!-- profiles
  | This is a list of profiles which can be activated in a variety of ways, and which can modify
  | the build process. Profiles provided in the settings.xml are intended to provide local machine-
  | specific paths and repository locations which allow the build to work in the local environment. v
  第 148 行, 第 1 列 100% Windows (CRLF) UTF-8
```

在eclipse进行配置



1.3 Maven项目结构

一个使用Maven管理的普通的Java项目，它的目录结构默认如下：

```
a-maven-project
├── pom.xml
├── src
│   ├── main
│   │   ├── java
│   │   └── resources
│   └── test
│       ├── java
│       └── resources
└── target
```

项目的根目录 `a-maven-project` 是项目名，它有一个项目描述文件 `pom.xml`，存放Java源码的目录是 `src/main/java`，存放资源文件的目录是 `src/main/resources`，存放测试源码的目录是 `src/test/java`，存放测试资源的目录是 `src/test/resources`，最后，所有编译、打包生成的文件都放在 `target` 目录里。这些就是一个Maven项目的标准目录结构。

所有的目录结构都是约定好的标准结构，我们千万不要随意修改目录结构。使用标准结构不需要做任何配置，Maven就可以正常使用。

1.4 用maven编译HelloWorld版的java程序

运行下面语句编译:

```
mvn compile
```

运行项目:

```
mvn exec:java -Dexec.mainClass="hello.HelloWorld"
```

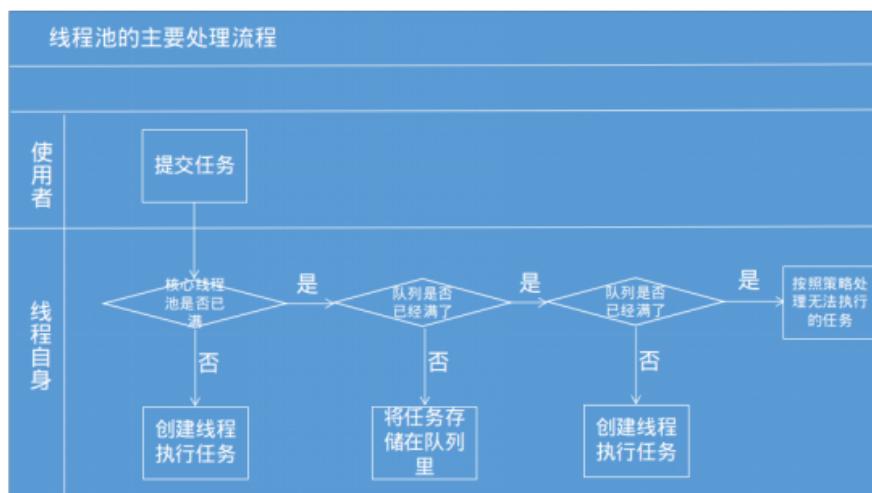
结果如下:

```
选择命令提示符
[INFO] Commons-exec-1.3.jar (54 kB at 30 kB/s)
[INFO] Downloading from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/commons-io/commons-io-2.5/commons-io-2.5.jar
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/org/codehaus/plexus/plexus-component-annotations/1.6/plexus-component-annotations-1.6.jar (4.3 kB at 2.3 kB/s)
[INFO] Downloading from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/commons-codec/commons-codec/1.11/commons-codec-1.11.jar
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/org/apache/maven/shared/maven-artifact-transfer/0.10.1/maven-artifact-transfer-0.10.1.jar (128 kB at 67 kB/s)
[INFO] Downloading from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/org/slf4j/slf4j-api/1.7.5/slf4j-api-1.7.5.jar
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/org/apache/maven/shared/maven-common-artifact-filters/3.0.1/maven-common-artifact-filters-3.0.1.jar (61 kB at 30 kB/s)
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/commons-codec/commons-codec/1.11/commons-codec-1.11.jar (335 kB at 150 kB/s)
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/org/apache/maven/shared/maven-shared-utils/3.1.0/maven-shared-utils-3.1.0.jar (164 kB at 72 kB/s)
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/commons-io/commons-io-2.5/commons-io-2.5.jar (209 kB at 85 kB/s)
[INFO] Downloaded from nexus-aliyun: http://maven.aliyun.com/nexus/content/groups/public/org/slf4j/slf4j-api/1.7.5/slf4j-api-1.7.5.jar (26 kB at 9.4 kB/s)
[INFO] Hello world!
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 30.827 s
[INFO] Finished at: 2022-03-22T23:06:15+08:00
[INFO] -----
```

F:\Java-Workspace\Java-Project-Eclipse\DC_test>

2. 线程池版服务器端程序

2.1 线程池主要流程



- ①首先会判断核心线程池里是否有线程可执行，有空闲线程则创建一个线程来执行任务。
- ②当核心线程池里已经没有线程可执行的时候，此时将任务丢到任务队列中去。
- ③如果任务队列（有界）也已经满了的话，但运行的线程数小于最大线程池的数量的时候，此时将会新建一个线程用于执行任务，但如果运行的线程数已经达到最大线程池的数量的时候，此时将无法创建线程执行任务。

2.2 ThreadPoolExecutor

```
public ThreadPoolExecutor(int corePoolSize,
    int maximumPoolSize,
    long keepAliveTime,
    TimeUnit unit,
    BlockingQueue<Runnable> workQueue,
    ThreadFactory threadFactory,
    RejectedExecutionHandler handler)
```

(1) corePoolSize 核心线程数量

即使没有任务执行，核心线程也会一直存活

线程数小于核心线程时，即使有空闲线程，线程池也会创建新线程执行任务

设置 allowCoreThreadTimeout=true 时，核心线程会超时关闭

(2) maximumPoolSize 最大线程数

当所有核心线程都在执行任务，且任务队列已满时，线程池会创建新线程执行任务。

当线程数 = maxPoolSize, 且任务队列已满时，

此时添加任务时会触发 RejectedExecutionHandler 进行处理

(3) keepAliveTime 线程空闲时间 TimeUnit 表示keepAliveTime的单位

如果线程数>corePoolSize，且有线程空闲时间达到 keepAliveTime 时，线程会销毁，直到线程数量=corePoolSize

如果设置 allowCoreThreadTimeout=true 时，核心线程执行完任务也会销毁直到数量=0

(4) workQueue 用于缓存任务的阻塞队列

(5) threadFactory 指定创建线程的工厂

(6) handler

表示当workQueue已满，且池中的线程数达到maximumPoolSize时，线程池拒绝添加新任务时采取的策略

execute 函数

```
executor.execute(myTask);
```

- ① 当工作线程数小于核心线程数时，会创建核心线程数；
- ② 如果工作线程数大于等于核心线程数时，会尝试将任务添加进队列；

ThreadPoolTest.java 运行结果

```
The number of threads in the ThreadPool:1
Task 0 is running!
The number of tasks in the Queue:0
The number of tasks completed:0
The number of threads in the ThreadPool:2
The number of tasks in the Queue:0
The number of tasks completed:0
Task 1 is running!
The number of threads in the ThreadPool:3
The number of tasks in the Queue:0
The number of tasks completed:0
Task 2 is running!
The number of threads in the ThreadPool:4
The number of tasks in the Queue:0
The number of tasks completed:0
Task 3 is running!
The number of threads in the ThreadPool:5
The number of tasks in the Queue:0
The number of tasks completed:0
Task 4 is running!
The number of threads in the ThreadPool:5
The number of tasks in the Queue:1
The number of tasks completed:0
The number of threads in the ThreadPool:5
The number of tasks in the Queue:2
The number of tasks completed:0
The number of threads in the ThreadPool:5
The number of tasks in the Queue:3
The number of tasks completed:0
The number of threads in the ThreadPool:5
The number of tasks in the Queue:4
The number of tasks completed:0
The number of threads in the ThreadPool:5
The number of tasks in the Queue:5
The number of tasks completed:0
The number of threads in the ThreadPool:6
The number of tasks in the Queue:5
The number of tasks completed:0
Task 10 is running!
The number of threads in the ThreadPool:7
The number of tasks in the Queue:5
The number of tasks completed:0
Task 11 is running!
The number of threads in the ThreadPool:8
The number of tasks in the Queue:5
The number of tasks completed:0
Task 12 is running!
The number of threads in the ThreadPool:9
The number of tasks in the Queue:5
The number of tasks completed:0
```

```
Task 13 is running!
The number of threads in the ThreadPool:10
The number of tasks in the Queue:5
The number of tasks completed:0
Task 14 is running!
Task 1 has been done.
Task 13 has been done.
Task 0 has been done.
Task 5 is running!
Task 6 is running!
Task 4 has been done.
Task 11 has been done.
Task 10 has been done.
Task 12 has been done.
Task 9 is running!
Task 8 is running!
Task 7 is running!
Task 14 has been done.
Task 2 has been done.
Task 3 has been done.
Task 7 has been done.
Task 8 has been done.
Task 6 has been done.
Task 5 has been done.
Task 9 has been done.
```

可见 0、1、2、3、4 号任务进入核心线程，5、6、7、8、9号任务进入任务队列，10、11、12、13、14创建为新的线程并满足小于最大线程数量。

2.3 ThreadPoolEchoServer 线程池服务器端程序

ServerThread.java

```
import java.net.*;
import java.io.*;

public class ServerThread extends Thread {

    Socket socket = null;

    public ServerThread(Socket socket) {
        this.socket = socket;
    }

    public void run(){
        InputStream is = null;
        InputStreamReader isr = null;
        BufferedReader br = null;
        OutputStream os = null;
        PrintWriter pw = null;
        try {
            is = socket.getInputStream();
            isr = new InputStreamReader(is);
            br = new BufferedReader(isr);
            os = socket.getOutputStream();
            pw = new PrintWriter(os);

            String info = null;
            InetAddress address= socket.getInetAddress();

            System.out.println(address+"has connect.");

            while((info=br.readLine())!=null) {
                System.out.println("Message from client "+address+" : "+info);
                System.out.println(" ");
                pw.println(info);
                pw.flush();
            }
        } catch (IOException e) {
            e.printStackTrace();
        } finally {
            try {
                if(pw!=null) pw.close();
                if(os!=null) os.close();
                if(br!=null) br.close();
                if(isr!=null) isr.close();
                if(is!=null) is.close();
                if(socket!=null) socket.close();
            } catch (IOException e) {
                e.printStackTrace();
            }
        }
    }
}
```

```
}
```

```
}
```

ThreadPoolEchoServer.java

```
import java.net.*;
import java.io.*;
import java.net.ServerSocket;
import java.util.concurrent.*;

public class ThreadPoolEchoServer {

    public static void main(String[] args) throws Exception{
        // TODO Auto-generated method stub

        ServerSocket listenSocket = new ServerSocket(8189);
        Socket socket = null;

        ThreadPoolExecutor executor = new
        ThreadPoolExecutor(5,10,200,TimeUnit.MILLISECONDS,
                           new ArrayBlockingQueue<Runnable>(5));

        int count = 0;
        System.out.println("Server listening at 8189");

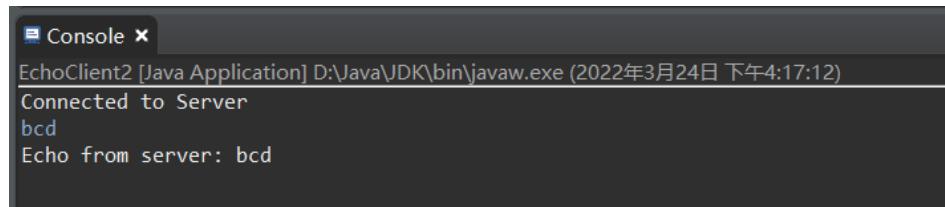
        while(true) {
            socket = listenSocket.accept();
            count++;
            System.out.println("The total number of client is: "+count+" .");
            ServerThread serverThread = new ServerThread(socket);
            executor.execute(serverThread);
            System.out.println("The number of threads in the
ThreadPool:"+executor.getPoolSize());
            System.out.println("The number of tasks in the
Queue:"+executor.getQueue().size());
            System.out.println("The number of tasks
completed:"+executor.getCompletedTaskCount());
        }
    }
}
```

客户端程序不变，所有程序见 code folder。

2.4 运行测试结果

Socket对应 ip地址 127.0.0.1 和 端口 8259

EchoClient.java 运行结果

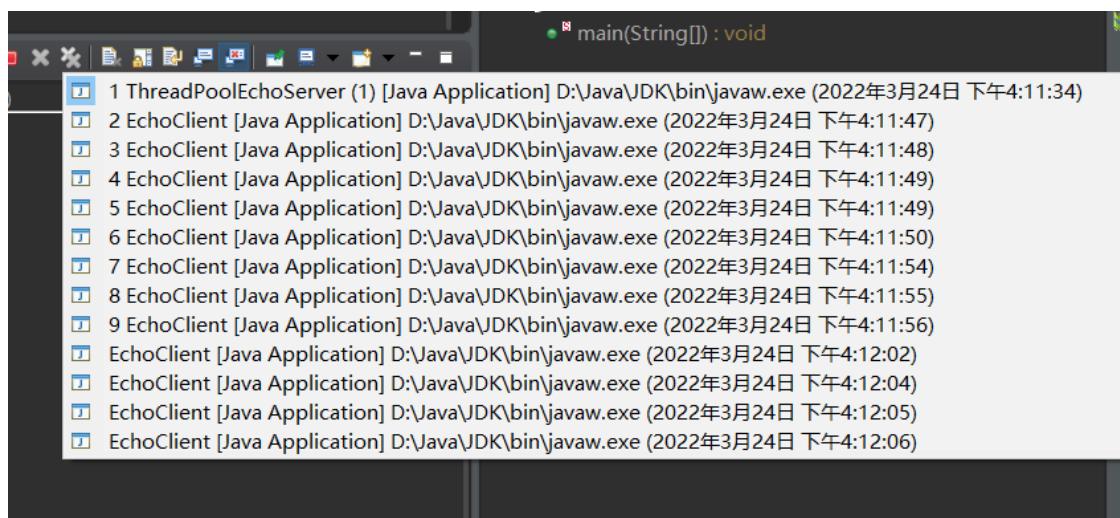


```
Console x
EchoClient2 [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:17:12)
Connected to Server
bcd
Echo from server: bcd
```

对应服务器

```
/127.0.0.1 has connect.
Message from client /127.0.0.1 : bcd
```

ThreadPoolEchoServer.java 运行结果



```
main(String[]) : void
1 ThreadPoolEchoServer (1) [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:34)
2 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:47)
3 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:48)
4 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:49)
5 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:49)
6 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:50)
7 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:54)
8 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:55)
9 EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:56)
EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:12:02)
EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:12:04)
EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:12:05)
EchoClient [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:12:06)
```

共有12个客户端进程。

```
Console ×
ThreadPoolEchoServer (1) [Java Application] D:\Java\JDK\bin\javaw.exe (2022年3月24日 下午4:11:34)
Server listening at 8259
The total number of client is: 1 .
The number of threads in the ThreadPool:1
The number of tasks in the Queue:0
The number of tasks completed:0
/127.0.0.1 has connect.
The total number of client is: 2 .
The number of threads in the ThreadPool:2
The number of tasks in the Queue:0
The number of tasks completed:0
/127.0.0.1 has connect.
The total number of client is: 3 .
The number of threads in the ThreadPool:3
The number of tasks in the Queue:0
The number of tasks completed:0
/127.0.0.1 has connect.
The total number of client is: 4 .
The number of threads in the ThreadPool:4
The number of tasks in the Queue:0
The number of tasks completed:0
/127.0.0.1 has connect.
The total number of client is: 5 .
The number of threads in the ThreadPool:5
The number of tasks in the Queue:0
The number of tasks completed:0
/127.0.0.1 has connect.
The total number of client is: 6 .
The number of threads in the ThreadPool:5
The number of tasks in the Queue:1
The number of tasks completed:0
The total number of client is: 7 .
The number of threads in the ThreadPool:5
The number of tasks in the Queue:2
The number of tasks completed:0
The total number of client is: 8 .
The number of threads in the ThreadPool:5
The number of tasks in the Queue:3
The number of tasks completed:0
The total number of client is: 9 .
The number of threads in the ThreadPool:5
The number of tasks in the Queue:4
The number of tasks completed:0
The total number of client is: 10 .
The number of threads in the ThreadPool:5
The number of tasks in the Queue:5
The number of tasks completed:0
The total number of client is: 11 .
The number of threads in the ThreadPool:6
The number of tasks in the Queue:5
The number of tasks completed:0
/127.0.0.1 has connect.
The total number of client is: 12 .
The number of threads in the ThreadPool:7
The number of tasks in the Queue:5
The number of tasks completed:0
/127.0.0.1 has connect.
```