SE 471 Software Architecture

Lab 4

	Student Name	Student CSUSM ID	Contribution percentage
1	Lauren Gonzalez	gonza823	50
2	Sirena Murphree	murph135	50

Grading Rubrics (for instructor only):

Criteria	1. Beginning	2. Developing	3. Proficient	4. Exemplary
Program: functionality ***correctness***	0-9	10-14	15-19	20
Program: functionality ***Behavior Testing***	0-9	10-14	15-19	20
Program: quality -> ***Readability***	0-9	10-14	15-19	20
Program: quality -> ***Modularity***	0-9	10-14	15-19	20
Program: quality -> ***Simplicity***	0-9	10-14	15-19	20
Total Grade (100)				

Problems:

Given the following design (next page), implement it in Java. Note:

1. You may add more attributes or operations to a class if necessary. Specifically, you may use meaningful operations for FBI_Agent and CIA_Agent classes. Remember that your CIA_Agent and FBI_Agent class should implement runnable interface. Each agent object has its own thread for doing the assigned tasks.
2. Read textbook to see some example code snippets for the object pool pattern (pp. 170—174).
3. Some corrections:

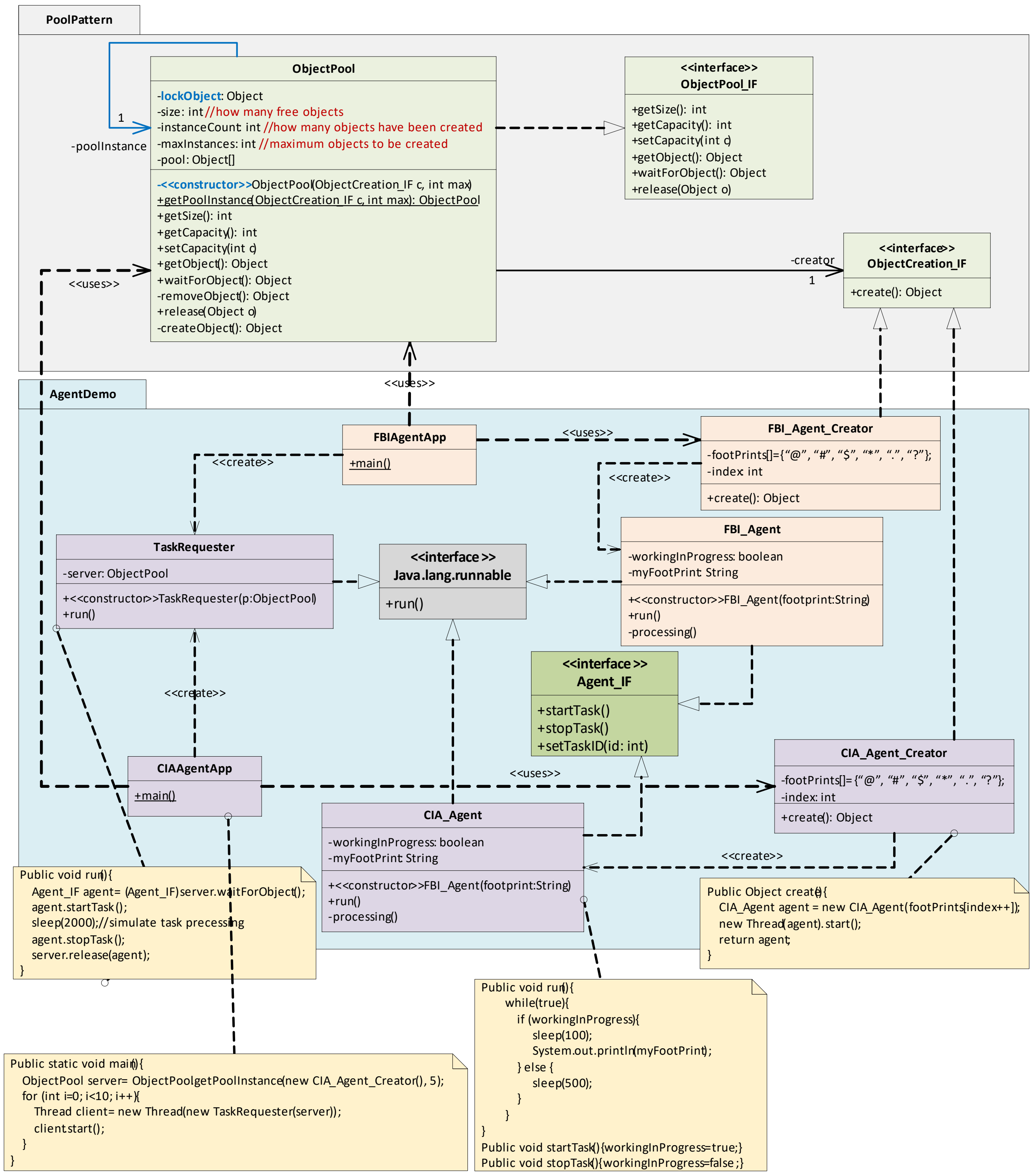
```
private ObjectPool(ObjectCreation_IF c, int max){
  instanceCount=0;
  creator=c;
  maxInstances=max;
  pool = new Object[maxInstances];
}

public static ObjectPool getPoolInstance(ObjectCreation_IF c, int max){
   if (poolInstance==null)
       poolInstance = new ObjectPool(c, max);
  return poolInstance;
}
```

4. To demonstrate how a limited number of agents are requested to process tasks, your testing code (FBIAgentApp or CIAAgentAPP) should create a pool of 5 agents to service 10 task requesters. Each agent should leave a unique foot prints while it is serving a requester.

Solution:

- First, remember to zip the src folder of your project and submit the zip file to the ungraded assignment named "Lab4CodeSubmission". One submission from each team.
- Paste a screenshot of a run of your program here.
- Also paste all you source code here.
- Save this report in PDF, then **each student** needs to submit the pdf report to the graded assignment named "Lab4ReportSubmission".



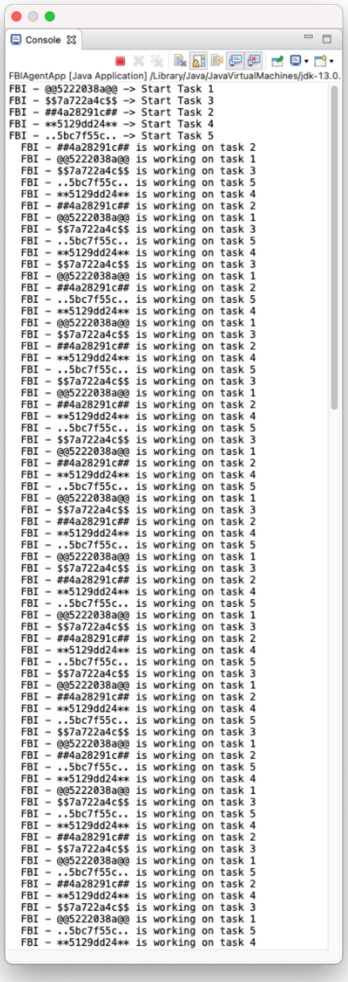
```
Public void run(){
    Agent_IF agent= (Agent_IF)server.waitForObject();
    agent.startTask();
    sleep(2000);//simulate task precessing
    agent.stopTask();
    server.release(agent);
}
```

```
Public Object create(){
    CIA_Agent agent = new CIA_Agent(footPrints[index++]);
    new Thread(agent).start();
    return agent;
}
```

```
Public void run(){
        while(true){
            if (workingInProgress){
                sleep(100);
                System.out.println(myFootPrint);
            } else {
                sleep(500);
            }
        }
}
Public void startTask(){workingInProgress=true;}
Public void stopTask(){workingInProgress=false;}
```

```
Public static void main(){
    ObjectPool server= ObjectPoolgetPoolInstance(new CIA_Agent_Creator(), 5);
    for (int i=0; i<10; i++){
        Thread client= new Thread(new TaskRequester(server));
        clientstart();
    }
}
```

Output Screenshots



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FBI - $$7a722a4c$$ -> Start Task 3
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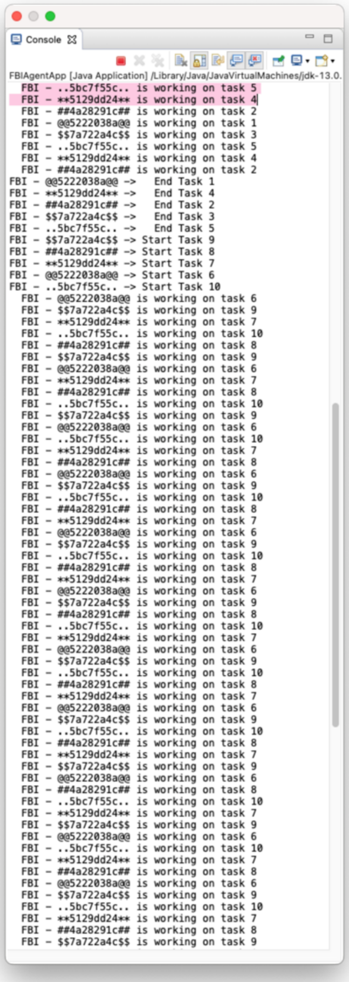

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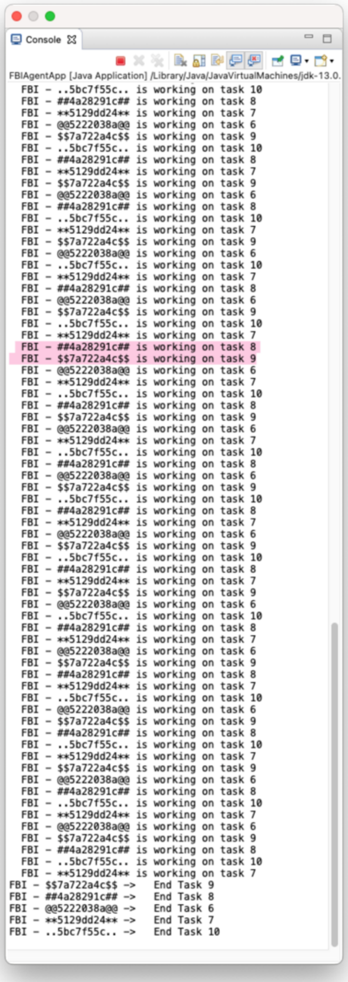

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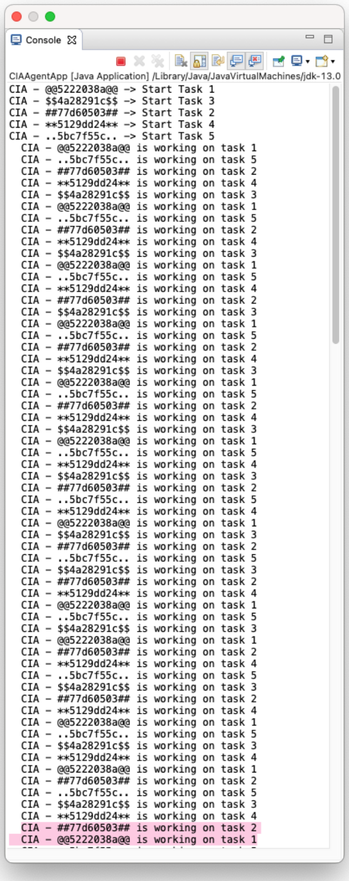

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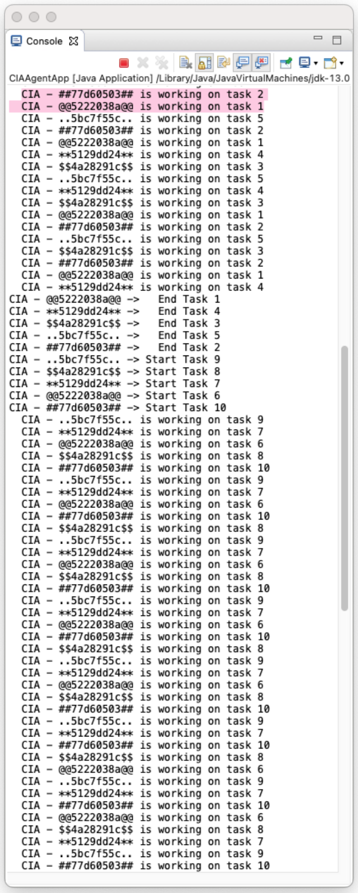

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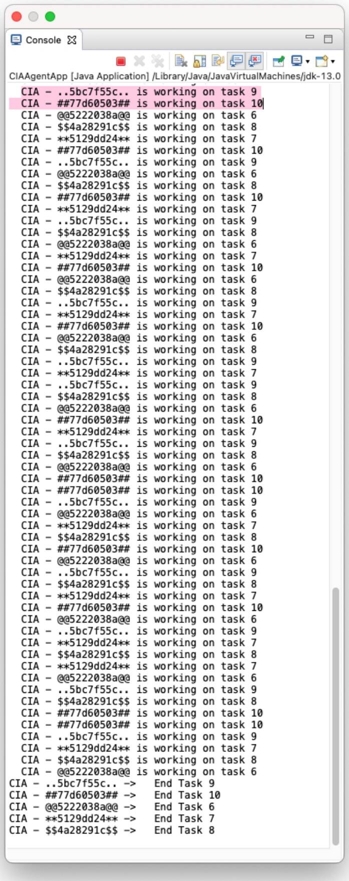
  CIA – ##77d60503## is working on task 10
```



```
CIAAgentApp [Java Application] /Library/Java/JavaVirtualMachines/jdk-13.0
  CIA – ..5bc7f55c.. is working on task 9
  CIA – ##77d60503## is working on task 10
  CIA – @@5222038a@@ is working on task 6
  CIA – $$4a28291c$$ is working on task 8
  CIA – **5129dd24** is working on task 7
  CIA – ##77d60503## is working on task 10
  CIA – ..5bc7f55c.. is working on task 9
  CIA – @@5222038a@@ is working on task 6
  CIA – $$4a28291c$$ is working on task 8
  CIA – ##77d60503## is working on task 10
  CIA – **5129dd24** is working on task 7
  CIA – ..5bc7f55c.. is working on task 9
  CIA – $$4a28291c$$ is working on task 8
  CIA – @@5222038a@@ is working on task 6
  CIA – **5129dd24** is working on task 7
  CIA – ##77d60503## is working on task 10
  CIA – @@5222038a@@ is working on task 6
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  CIA – ##77d60503## is working on task 10
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  CIA – ..5bc7f55c.. is working on task 9
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  CIA – @@5222038a@@ is working on task 6
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  CIA – $$4a28291c$$ is working on task 8
  CIA – ##77d60503## is working on task 10
  CIA – ##77d60503## is working on task 10
  CIA – ..5bc7f55c.. is working on task 9
  CIA – **5129dd24** is working on task 7
  CIA – $$4a28291c$$ is working on task 8
  CIA – @@5222038a@@ is working on task 6
CIA – ..5bc7f55c.. ->   End Task 9
CIA – ##77d60503## ->   End Task 10
CIA – @@5222038a@@ ->   End Task 6
CIA – **5129dd24** ->   End Task 7
CIA – $$4a28291c$$ ->   End Task 8
```

Agent_IF.java

```java
package AgentDemo;

public interface Agent_IF {
    public void startTask();
    public void stopTask();
    public void setTaskID(int id);
}
```

TaskRequester.java

```java
package AgentDemo;

import PoolPattern.ObjectPool;

public class TaskRequester implements Runnable {

    /**
     * Singlton object pool
     */
    private ObjectPool server;

    /**
     * constructor
     * @param p the Object pool that we are allowed to request service providers from
     */
    public TaskRequester(ObjectPool p) {
        this.server = p;
    }

    /**
     * On run we get an available agent from the service pool, then
     * the agent start working on a task for an amount of time.
     * When time is up the agent stops working on the task and the agent is returned to the
service pool.
     */
    @Override
    public void run() {
        Agent_IF agent;
        try {
            agent = (Agent_IF) server.waitForObject();
            agent.setTaskID(server.getNextTask());
            agent.startTask();
            try {
                Thread.sleep(2000);
            }catch (InterruptedException e) {
                System.out.println(this.getClass().getName());
                e.printStackTrace();
            }
            agent.stopTask();
            server.release(agent);
        } catch (InterruptedException e1) {
            e1.printStackTrace();
        }
    }
}
```

CIA_Agent_Creator.java

```
package AgentDemo.CIA;

import PoolPattern.ObjectCreation_IF;

public class CIA_Agent_Creator implements ObjectCreation_IF {

    /**
     * array if special characters
     */
    private String[] footPrints = {"@", "#", "$", "*", ".", "?"};

    /**
     * index
     */
    private int index = 0;

    /**
     * creates and returns a new CIA Agent with a unique footprint
     * @return the CIA Agent
     */
    @Override
    public Object create() {
        CIA_Agent agent = new CIA_Agent(this.footPrints[(index++)%footPrints.length]);
        new Thread(agent).start();
        return agent;
    }
}
```

CIA_Agent.java

```java
package AgentDemo.CIA;

import AgentDemo.Agent_IF;

public class CIA_Agent implements Runnable, Agent_IF {

    /**
     * is the agent currently working
     */
    private boolean workingInProgress;

    /**
     * foot print based of special character and instance number
     */
    private String myFootPrint;

    /**
     * not sure what this is for
     */
    private int taskID = -1;

    /**
     * constructor
     * @param footPrint special character used to help distinguish agent footprint
     */
    public CIA_Agent(String footPrint) {
            int at = this.toString().indexOf("@")+1;
            String intanceID = this.toString().substring(at);
        this.myFootPrint = String.format("CIA - %s%s%s%s%s", footPrint, footPrint, intanceID, 
footPrint, footPrint);
    }

    /**
     * start the process of working on a task
     */
    @Override
    public void startTask() {
        System.out.printf("%-15s -> %10s %d\n", myFootPrint, "Start Task", taskID);
        this.workingInProgress = true;
    }

    /**
     * finish up working on a task
     */
    @Override
    public void stopTask() {
        this.workingInProgress = false;
        System.out.printf("%-15s -> %10s %d\n", myFootPrint, "End Task", taskID);
        this.taskID = -1;
    }

    /**
     * give the agent a dedicated task
     * @param the task id that the agent is to work on
     */
    @Override
    public void setTaskID(int id) {
        this.taskID = id;
    }
    /**
     * while running the agent process a task if they have one.
     */
    @Override
    public void run() {
        while(true) {
            try {
                if(workingInProgress) {
                    processing();
                    Thread.sleep(100);
                }else {
                    Thread.sleep(500);
                }
            } catch (InterruptedException e) {
                System.out.println(this.getClass().getName());
                e.printStackTrace();
            }
        }
    }

    /**
     * prints a message of what is bing processed
     */
    private void processing() {
        System.out.printf("%20s is working on task %d\n", myFootPrint, taskID);
    }
}
```

CIAAgentApp.java

```
package AgentDemo.CIA;

import AgentDemo.TaskRequester;
import PoolPattern.ObjectPool;

public class CIAAgentApp {

    public static void main(String[] args) {
        ObjectPool server = ObjectPool.getPoolInstance(new CIA_Agent_Creator(), 5);
        for(int i = 0; i < 10; i++) {
            Thread client = new Thread(new TaskRequester(server));
            client.start();
        }
    }
}
```

FBI_Agent_Creator.java

```
package AgentDemo.FBI;

import PoolPattern.ObjectCreation_IF;

public class FBI_Agent_Creator implements ObjectCreation_IF {

    /**
     * array if special characters
     */
    private String[] footPrints = {"@", "#", "$", "*", ".", "?"};

    /**
     * index
     */
    private int index = 0;
```

```java
    /**
     * creates and returns a new FBI Agent with a unique footprint
     * @return the FBI Agent
     */
    @Override
    public Object create() {
        FBI_Agent agent = new FBI_Agent(this.footPrints[(index++)%footPrints.length]);
        new Thread(agent).start();
        return agent;
    }
}
```

FBI_Agent.java

```java
package AgentDemo.FBI;

import AgentDemo.Agent_IF;

public class FBI_Agent implements Runnable, Agent_IF {

    /**
     * is the agent currently working
     */
    private boolean workingInProgress;

    /**
     * foot print based of special character and instance number
     */
    private String myFootPrint;

    /**
     * not sure what this is for
     */
    private int taskID = -1;

    /**
     * constructor
     * @param footPrint special character used to help distinguish agent footprint
     */
    public FBI_Agent(String footPrint) {
            int at = this.toString().indexOf("@")+1;
            String intanceID = this.toString().substring(at);
        this.myFootPrint = String.format("FBI - %s%s%s%s%s", footPrint, footPrint, intanceID,
footPrint, footPrint);
    }

    /**
     * start the process of working on a task
     */
    @Override
    public void startTask() {
        System.out.printf("%-15s -> %10s %d\n", myFootPrint, "Start Task", taskID);
        this.workingInProgress = true;
    }

    /**
     * finish up working on a task
     */
    @Override
    public void stopTask() {
        this.workingInProgress = false;
        System.out.printf("%-15s -> %10s %d\n", myFootPrint, "End Task", taskID);
        this.taskID = -1;
    }
    /**
     * give the agent a dedicated task
     * @param the task id that the agent is to work on
     */
    @Override
    public void setTaskID(int id) {
        this.taskID = id;
    }

    /**
     * while running the agent process a task if they have one.
     */
    @Override
    public void run() {
        while(true) {
            try {
                if(workingInProgress) {
                    processing();
                    Thread.sleep(100);
                }else {
                    Thread.sleep(500);
                }
            } catch (InterruptedException e) {
                System.out.println(this.getClass().getName());
                e.printStackTrace();
            }
        }
    }

    /**
     * prints a message of what is bing processed
     */
    private void processing() {
        System.out.printf("%20s is working on task %d\n", myFootPrint, taskID);
    }

}
```

FBIAgentApp.java

```
package AgentDemo.FBI;

import AgentDemo.TaskRequester;
import PoolPattern.ObjectPool;

public class FBIAgentApp {

    public static void main(String[] args) {
        ObjectPool server = ObjectPool.getPoolInstance(new FBI_Agent_Creator(), 5);
        for(int i = 0; i < 10; i++) {
            Thread client = new Thread(new TaskRequester(server));
            client.start();
        }
    }
}
```

ObjectCreation_IF.java

```
package PoolPattern;

public interface ObjectCreation_IF {
    public Object create();
}
```

ObjectPool_IF.java

```java
package PoolPattern;

public interface ObjectPool_IF {
    public int getSize();
    public int getCapacity();
    public void setCapacity(int c);
    public Object getObject();
    public Object waitForObject() throws InterruptedException;
    public void release(Object o);
    public int getNextTask();
}
```

ObjectPool.java

```java
package PoolPattern;


public class ObjectPool implements ObjectPool_IF {

    private static Object lockObject = new Object();

    /**
     * the number of free objects
     */
    private int size;

    /**
     * the number of objects that have been created
     */
    private int instanceCount;

    /**
     * the maximum number of objects that may be created
     */
    private int maxInstances;

    /**
     * the pool of objects
     */
    private Object[] pool;

    /**
     * singleton ObjectPool
     */
    private static ObjectPool poolInstance = null;

    /**
     * the Object creator
     */
    private ObjectCreation_IF creator;

    /**
     * counts all the tasks
     */
    private int taskCounter = 0;
    /**
     * constructor
     * @param c
     * @param max
     */
    private ObjectPool(ObjectCreation_IF c, int max) {
        this.creator = c;
        this.maxInstances = max;
        this.size = 0;
        this.instanceCount = 0;
        this.pool  = new Object[maxInstances];
    }

    /**
     * get a object pool
     * @param c
     * @param max
     * @return the instance of the ObjectPool
     */
    public static ObjectPool getPoolInstance(ObjectCreation_IF c, int max) {

        synchronized(lockObject){
            if(poolInstance == null) {
                poolInstance = new ObjectPool(c, max);
            }
        }
        return poolInstance;
    }

    /**
     * @return size - the number of free objects
     */
    @Override
    public int getSize() {
        return this.size;
    }

    /**
     * @return capacity - the total number of objects
     */
    @Override
    public int getCapacity() {
        return pool.length;
    }

    /**
     * set the total number of objects that make up the object pool
     * @param c the new capacity
     * copied from book P.172
     */
    @Override
    public void setCapacity(int c) {
        if(c != pool.length) {
            if(c <= 0) {
                String msg = "Capacity must be greater than zero.\n\tValue Entered:\t" + c;
                throw new IllegalArgumentException(msg);
            }
            synchronized(lockObject){
                this.maxInstances = c;
                Object[] newPool = new Object[maxInstances];
                System.arraycopy(pool, 0, newPool, 0, maxInstances);
                pool = newPool;
            }
        }
    }
```

```
/**
 * get an object from the object pool
 * @return the object
 * copied from book P.172
 */
@Override
public Object getObject() {
    synchronized(lockObject){
        if(size > 0) {
            return removeObject();
        }else if(instanceCount < maxInstances) {
            return createObject();
        }else {
            return null;
        }
    }
}

/**
 * get an object from the object pool when it becomes available
 * @return the object
 * copied from book P.173
 */
@Override
public Object waitForObject() throws InterruptedException{
    synchronized(lockObject){
        if(size > 0) {
            return removeObject();
        }else if(instanceCount < maxInstances) {
            return createObject();
        }else {
            do {
                lockObject.wait();
            }while(size <= 0);
            return removeObject();
        }
    }
}

/**
 * return an object to the object pool
 * @param o - the object to be placed back in the object pool
 * copied from book P.173-174
 */
@Override
public void release(Object o) {
    if(o == null) {
        throw new NullPointerException();
    }
    synchronized(lockObject){
        if(size < getCapacity()) {
            pool[size] = o;
            size++;
            lockObject.notify();
        }
    }
}
```

```
    /**
     * remove an object from the object pool
     * @return the object that has been removed
     * copied from book P.173
     */
    private Object removeObject() {
        size--;
        return pool[size];
    }

    /**
     * make a new object
     * @return the new object
     */
    private Object createObject() {
        instanceCount++;
        return creator.create();
    }

    /**
     * get the next task number
     * @return the next task number
     */
    @Override
    public int getNextTask() {
        return ++taskCounter;
    }
}
```