programming language:

Java is a generic term for the Java object-oriented programming language and the Java platform that was introduced by Sun Microsystems in May 1995. It was co-developed by James Gosling and colleagues, and was officially launched in 1995.

放截图？

revision control

Git is an excellent distribution version control system. The version control system can keep a history of a collection of files and can roll back the file collection to another state (history state). Another state can be a different file, it can be a different file content. In a distributed version control system, everyone has a complete source code (including all the history of the source code information) and can operate on the local data. The distributed version control system does not require a centralized code repository.

放点截图？

测试部分：

（1）3\*3 3代结果是否准确

（2）random生成数据是否合法

（3）边界值-----能否画出来

Where to get, and how to build and install, any third-party packages needed by your code (for packages that are not already on the Physics Computational Lab machines).

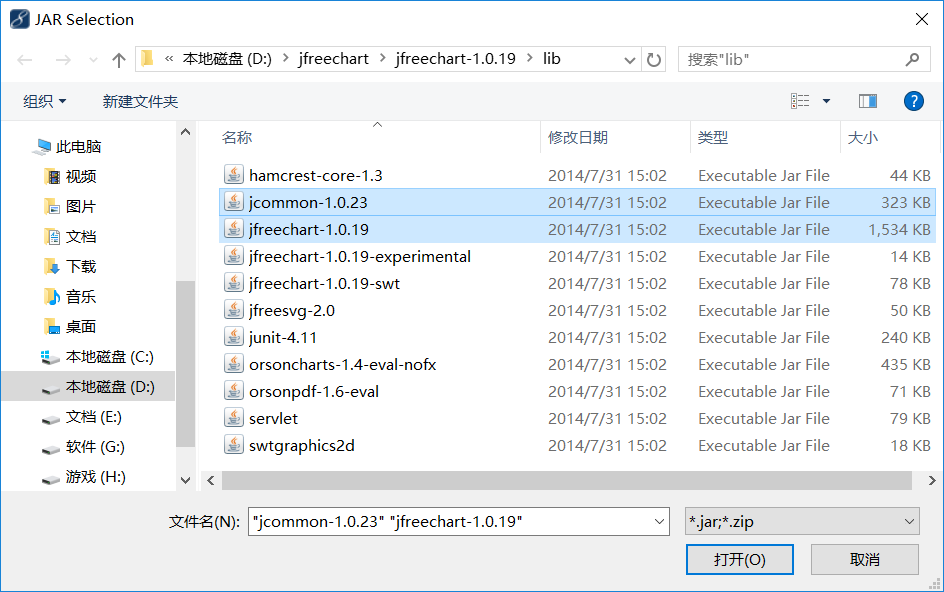
We use Jfreechart to draw the line chart of average density of the result.

Before we use it, we need to install it into our project. The procedure is as followed:

1. Download the latest version of Jfreechart by the website : <https://sourceforge.net/projects/jfreechart/files/1.%20JFreeChart/1.0.19/>. Then unzip it.

2. Next step is to import the necessary jar files into the project. If we use eclipse, we can select the current program, right click it, select “build path- configure build path”.

3. In “libraries”, click “add external jars”, find the path of jfreechart and then go into the lib, select “jcommon-1.0.23” and “jfreechart-1.0.19”. Add them into reference libraries.



How to run the code?

1. Fisrtly, we need to build the project into a runnable jar file with the help of eclipse or other IDE.
2. Next, copy the runnable jar to the dictionary we want, where java environment has been installed.
3. Last, use the command “java -jar xxxx.jar” to run the program successfully.

System requirements

To follow along and try out the code for this tutorial, you need a working installation of Sun's JDK 1.5.0\_09 (or later) or the IBM developer kit for Java technology 1.5.0 SR3. For the sections on running JUnit 4 in Eclipse, you need a working installation of Eclipse 3.2 or later. For the section on Ant, you need version 1.6 or greater.

The recommended system configuration for this tutorial is as follows:

A system supporting either the Sun JDK 1.5.0\_09 (or later) or the IBM developer kit for Java technology 1.5.0 SR3 with at least 500MB of main memory

At least 20MB of disk space to install the software components and examples covered

The instructions in the tutorial are based on a Microsoft Windows operating system. All the tools covered in the tutorial also work on Linux and UNIX systems.

（<https://www.ibm.com/developerworks/java/tutorials/j-junit4/index.html>）

2.for the algorithm,

2.1 initialize the animal information

First two animal classes (hare and puma) have been declared to store the information of these.

In the 2 classes, they contain the basic static statistics information (like birthrate, predationRate and so on), the location on the map and the density value.

And then, with the help of the map architecture(where contains land and water), we give all the land nodes of pumas and hares some random values which are between 0 and 5 so that all the land nodes have the initial values for algorithm.

2.2 make the model of algorithm

Next step is to achieve the algorithm. In order to get the right model of puma and hare, we need to calculate every node's neighbor first because accroding to the formula [picture of it], [前四邻居之和] is a necessary part and the number of neighbor is another essential part.

The core part of the algorithm is how to get the correct number of neighbor

Our method is to calculate different situations of the location for the map

(1)

When we find the current node is one of the 4 vertex nodes (in the red circles), the neighbour number of current node is 2, and then detect how many water nodes the neighbours contain. If there is no water node, the final neighbour number is 2. If one water node, the neighbour number is 1. If two water node, the number is 0. After that we the calculate the sum of the density of the neighbours for the current node.



(2)

When we find the current node is on the boundary but not the vertex ones (in the ovals), the neighbour number is 3, and then dealing with the water node just like part(1) do. Last, we calculate the sum of the density of the neighbour nodes.



When we find the current node is in the middle part of the map which means it is not on the border lines (in the shadow part), the number of neighbours is 4. Next, the water node should be considered and the calculation will be done finally.



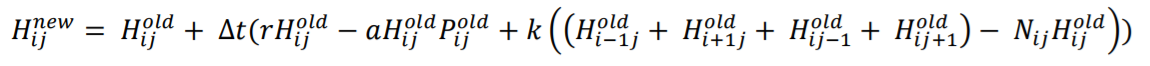
2.3 calculate the next generation of puma and hare

After we get the number of the neighbors and the value respectively, we have the result of the next formula:





We can calculate the result of density of next generation using the formula (NO.)as followed.





In the 2 formulas, we can use the value of parameters in table(No.):

|  |  |
| --- | --- |
| parameters | values |
| r: the birth rate of hares | 0.08 |
| a: the predation rate at which pumas eat hares | 0.04 |
| b: the birth rate of pumas per one hare eaten | 0.02 |
| m: the puma mortality rate | 0.06 |
| k: the diffusion rates for hares | 0.2 |
| l: the diffusion rates for pumas | 0.2 |
| Δt: the size of the time step | 0.4 |