暨南大學
JINAN UNIVERSITY

Course Project Report for Undergraduate Students

Course Type: Subject Elective

Course Name: Internet Application Development

互联网应用开发(全英)

Course Code: 60080049

Instructor: 何明昕，HE Mingxin

《Tic Tac Toe Game》

Name 黄稻浪

Student ID 2016052948

College International

Major CST

Email 949837845@qq.com

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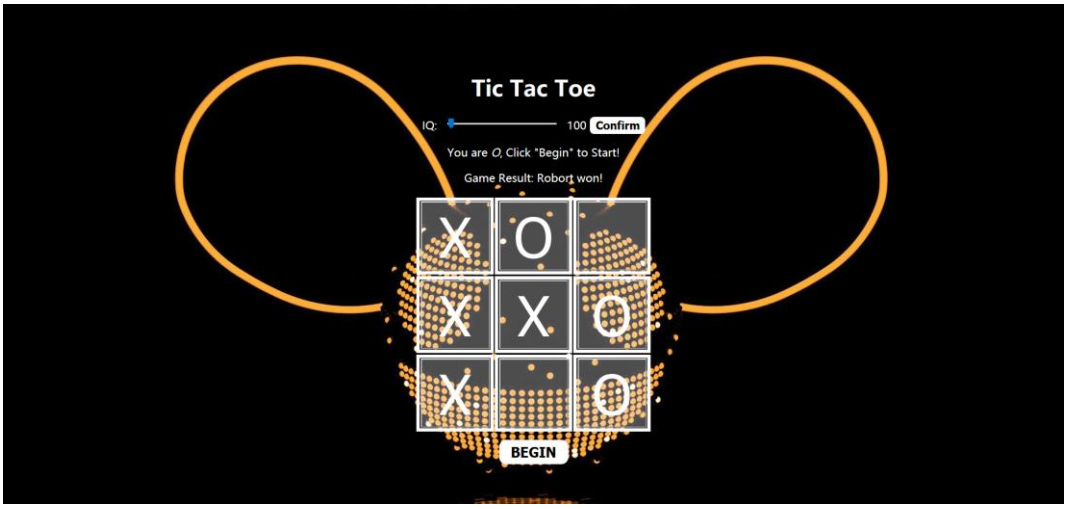
1. Project Description

1.1 Problem Statement

Design a Tic Tac Toe game, which can run on webpage, and can realize the function of automatic chess. And the robot has different levels of ability to determine whether it is a random agent or AI agent, through the IQ you assign to it.



1.2 Problem Statement

When you're doing with this project, please use the spark java web application framework to connect your web application to the java code. And use FreeMarker to update the value of the grids dynamically. Your game page should have following functions:

1) Choose the IQ of the robot at the beginning of the game, and send the value of IQ to the backstage.

2) At the beginning of the game, you can randomly specify whether your character is X or O, which determines whether you are a first mover or a backhand.

3) After starting the game, you can play chess with the robot in real time and get the game results in real time.

2. Configuration

2.1 Design Tools

2.1.1 Apache Maven

The Maven Project Object Model (POM), a project management tool software that manages project construction, reporting, and documentation through a small piece of descriptive information.

Maven allows you to complete project configuration in a very short time, the most powerful feature is the ability to automatically download project dependencies.

Homepage: http://maven.apache.org/download.cgi.

2.1.2 Spark Java

Spark was originally designed to make web applications simple and easy to create. It is a flexible, compact framework that is only 1MB in size. Spark allows users to choose their own template engine for designing applications and select the library that best suits their project. For example, HTML parsing options are available in FreeMarker, Mustaches, Velocity, Jade, Handlebars, Pebble or Water, and are rarely needed of configuration or template file. However, the price of flexibility is simple, and the user-selectable features are reduced. In short, Spark eliminates many of the bloated things of Java and provides a minimal, flexible web framework.

Homepage: http://sparkjava.com/download.

2.1.3 FreeMarker

FreeMarker is a template engine: a generic tool based on templates and data to be changed, and used to generate output text. It's not for the end user, it's a Java class library, a component that programmers can embed in their development.

The template is written as FreeMarker Template Language (FTL) and is a simple, proprietary language. The data needs to be prepared for display in a real programming language, such as database queries and business operations, after which the template displays the prepared data. In the template, it is mainly used to display data, and pay attention to what data to display outside the template.

Homepage: freemarker.apache.org/freemarkerdownload.html.

2.2 Installation

Since we used maven to create our project, so we just add dependencies to the pom.xml file. For the dependencies query, we can use https://mvnrepository.com/ to query the repositories.

For the other user, just use Eclipse or IntelliJ to open this maven project, it will download the repositories automatically.

```
<dependency>
    <groupId>com.sparkjava</groupId>
    <artifactId>spark-core</artifactId>
    <version>2.5</version>
</dependency>

<dependency>
    <groupId>org.freemarker</groupId>
    <artifactId>freemarker</artifactId>
    <version>2.3.28</version>
</dependency>
```

3. Project Design

3.1 JAVA Part

1. Wrapper for FreeMarker Engine

Problem	I want to use FreeMarker in Spark.
Solution	Spark has community-provided wrappers for a lot of popular template engines, including a Java file called FreeMarker engine
Code	Can download it from *https://github.com/perwendel/spark-template-engines/tree/master/spark-template-freemarker*

2. Store the value of nine grids

Problem	I want to store the values corresponding to the nine grids in the tic tac toe game and update them to my page in real time via FreeMarker.
Solution	Create a new class called grid_list, set nine strings to store the values in the grid, and add getters and setters respectively.
Code	Example, not all codes: `public class grid_list {` `  private String grid11 = "";` `  private String grid12 = "";` `  private String grid13 = "";` `  private String grid21 = "";` `  private String grid22 = "";` `  private String grid23 = "";` `  private String grid31 = "";` `  private String grid32 = "";` `  private String grid33 = "";` `public String getGrid11() {` `  return grid11;` `}` `public void setGrid11(String grid11) {` `  this.grid11 = grid11;` `}`

	`` public void setGrid(String id, String temp) { if ("11".equals(id) && grid11=="") { this.grid11 = temp; } else if("12".equals(id) && grid12==""){ this.grid12 = temp; } else if("13".equals(id) && grid13==""){ this.grid13 = temp; } else if("21".equals(id) && grid21==""){ this.grid21 = temp; } ```

3. Hash table to store the attributes of the tic tac toe

Problem	I want to create a container to store the parameters in the game and render it to the browser in real time.
Solution	I can store all the information by creating a hash table. When I need to update, I only need to re-put the value corresponding to the hash table, and then return to the browser to complete the real-time rendering.
Code	``` Map<String, Object> attributes = new HashMap<>(); attributes.put("grid_list", list.toArray()); return fmg.render(new ModelAndView(attributes,"Template/ttt_html.ftl")); ```

4. Routes (Important thing)

Problem	I want to connect java code to my browser via the route function of spark.
Solution	The main building block of a Spark application is a set of routes. A route is made up of three simple pieces: • A **verb** (get, post, put, delete, head, trace, connect, options) • A **path** (/hello, /users/:name) • A **callback** (request, response) -> {}

Code	Example code: `get("/playttt", (request, response) -> {` `  attributes.put("turn", "?");` `  return fmg.render(new ModelAndView(attributes,"Template/ttt_html.ftl"));` `});`

5. Connect tic tac toe source code to Spark

Problem	I want to call the tic-tac-toe source code written by Mr. Max to connect to the Spark, so that it is more convenient to realize the chess game.
Solution	We can create a new tic-tac-toe object in the main function of spark, named “game”, and then complete a game through the session function of spark.
Code	First create a tic-tac-toe object, how to get iq will explain in the FTL part. Then we set value of game to “ttt”, then we can use attribute(“ttt”) to call the game: `TicTacToe game = new TicTacToe(iq);` `request.session().attribute("ttt",game);` `TicTacToe game =request.session().attribute("ttt");`

6. Get the game result

Problem	I want to get the message whether I win or robot win or we tied.
Solution	We can call the isGameWon () or isFull () function in the board class to determine the current situation after each move. If one party wins, it will end the game and output the result.
Code	If game has a result, it will return and print the result, if it does not end, it will switch the player and re-put the grid_list value.


```
if (game.board.isGameWon() || game.board.isFull()) {
    game.showGameResult();
    if (game.board.isGameWon()) {
        String result = game.player==game.person ? "You won!" : "Robot won!";
        attributes.put("result", result);
    }
    else if(game.board.isFull()) {
        String result = "We tied!";
        attributes.put("result", result);
    }
    attributes.put("grid_list", list.toArray());
    return fmg.render(new ModelAndView(attributes,"Template/ttt_html.ftl"));
}
else {
    game.player = game.oppositePlayer(); //change player to computer
    attributes.put("result", "Playing Game");
}
```

7. Prevent the chess from being in the same position

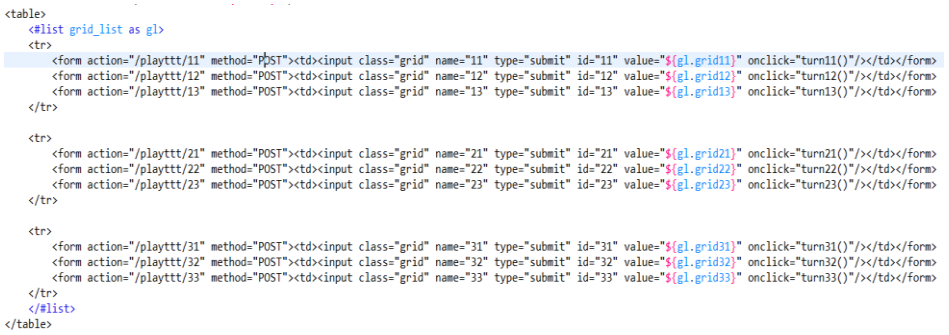
Problem	I don't want the computer to make the decision that the two moves are simultaneously in the same position when in one game.
Solution	After getting a move from the computer or the person, call the handlemove () function of the board class to fill the board to prevent duplicate positions.
Code	`game.board.handleMove(mymove, game.player);` `game.board.handleMove(next, game.player);`

8. Get my move from browser

Problem	I want to get the position of the chess I put in the browser in the background and pass it to the grid_list.
Solution	Through the cooperation of the requestParams () and params () functions of the spark, the position corresponding to my position and the value corresponding to the position are obtained.
Code	`String id = request.params("id");` `String value = request.queryParams(id); //get the value of my move` `grid_list.setGrid(id, value); //update the value of my move`

3.2 FTL Part (HTML5 + CSS3)

1. Tic-Tac-Toe Layout

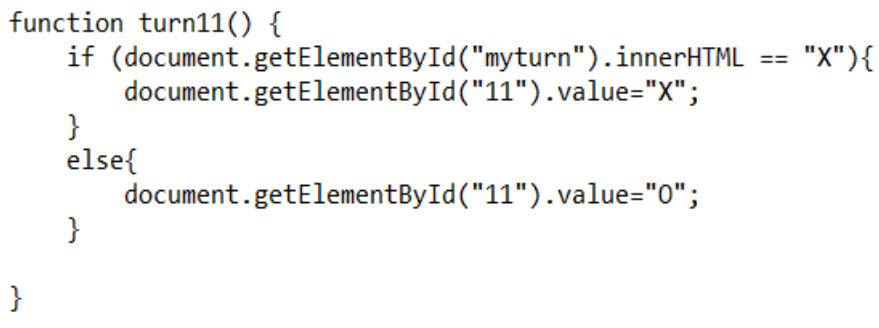
Problem	I want a tic tac toe game that can be displayed on a web page, and it can be played by clicking without typing the coordinate code.
Solution	By creating a 3×3 table and creating a button for each grid, each click of the grid is submitted to the background and the page is re-rendered.
Code	

```
<table>
    <#list grid_list as gl>
    <tr>
        <form action="/playttt/11" method="POST"><td><input class="grid" name="11" type="submit" id="11" value="${gl.grid11}" onclick="turn11()"/></td></form>
        <form action="/playttt/12" method="POST"><td><input class="grid" name="12" type="submit" id="12" value="${gl.grid12}" onclick="turn12()"/></td></form>
        <form action="/playttt/13" method="POST"><td><input class="grid" name="13" type="submit" id="13" value="${gl.grid13}" onclick="turn13()"/></td></form>
    </tr>

    <tr>
        <form action="/playttt/21" method="POST"><td><input class="grid" name="21" type="submit" id="21" value="${gl.grid21}" onclick="turn21()"/></td></form>
        <form action="/playttt/22" method="POST"><td><input class="grid" name="22" type="submit" id="22" value="${gl.grid22}" onclick="turn22()"/></td></form>
        <form action="/playttt/23" method="POST"><td><input class="grid" name="23" type="submit" id="23" value="${gl.grid23}" onclick="turn23()"/></td></form>
    </tr>

    <tr>
        <form action="/playttt/31" method="POST"><td><input class="grid" name="31" type="submit" id="31" value="${gl.grid31}" onclick="turn31()"/></td></form>
        <form action="/playttt/32" method="POST"><td><input class="grid" name="32" type="submit" id="32" value="${gl.grid32}" onclick="turn32()"/></td></form>
        <form action="/playttt/33" method="POST"><td><input class="grid" name="33" type="submit" id="33" value="${gl.grid33}" onclick="turn33()"/></td></form>
    </tr>
    </#list>
</table>
```

2. Get the value of grid

Problem	I want to display the value of each grid in real time on the page, and I can fill it into the grid as soon as I type it.
Solution	First modify the value in the grid through JavaScript, but this is only temporary, then I need to get the current grid content of my input through spark, then update the form in the background, and finally pass the value in the background form to each grid through the list function of FreeMarker.
Pattern	

```
function turn11() {
    if (document.getElementById("myturn").innerHTML == "X"){
        document.getElementById("11").value="X";
    }
    else{
        document.getElementById("11").value="O";
    }

}
```

	<#list grid_list as gl> value="${gl.grid11}" value="${gl.grid12}" value="${gl.grid13}"

3. Set the IQ for the agent

Problem	I want to set the IQ value for the game's robot at the beginning of the game, in the range 0-100.
Solution	Use the input type =" range" function, it can generate a customizable range slider, and use the submit function to submit the value to the backstage.
Pattern	<form action="/playttt/iq" method="GET"> IQ: <input type="range" name="range" id="range" min="0" max="100" value="0"/> ${iq} <input type="submit" name="confirm" id="confirm" value="Confirm" /> </form>

4. Reference CSS File

Problem	I want to set some css styles for my page.
Solution	You can set the static file path through the static file of spark, and then reference the css file through html internally.
Pattern	<link rel="stylesheet" type="text/css" href="../css/ttt.css" />

4. Snapshots with Interpretation

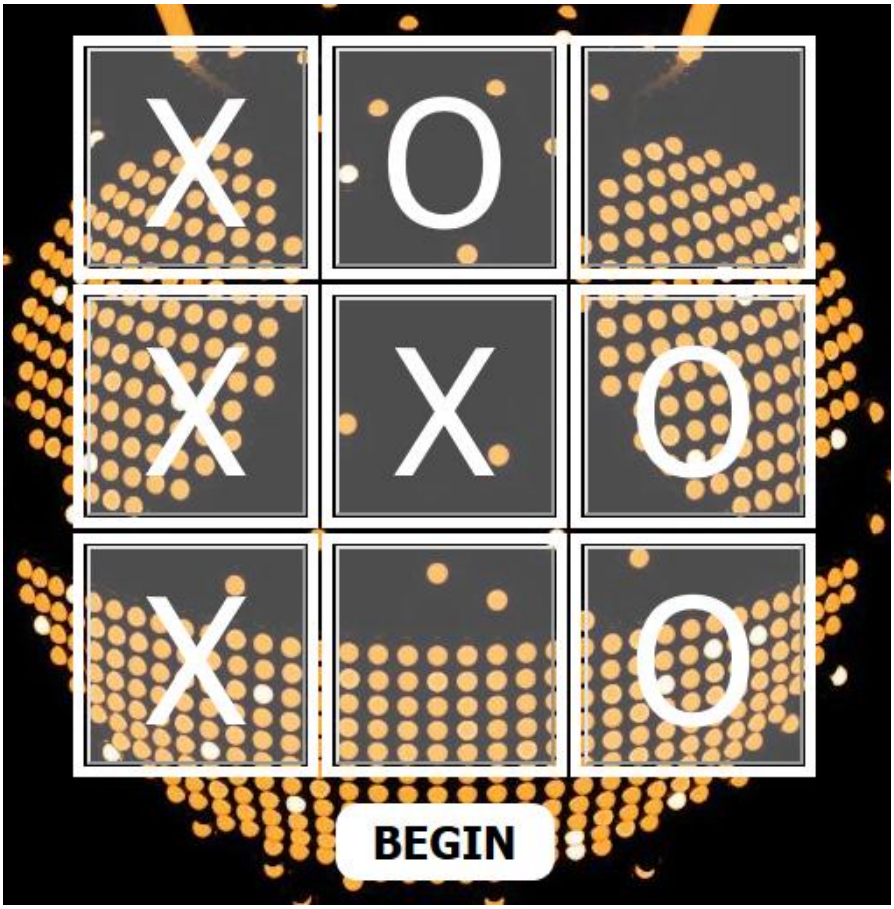
4.1 Components Analysis

4.1.1 IQ Setting Bar

4.1.2 Role assignment and prompt bar

4.1.3 Game Result Bar

4.1.4 Main View

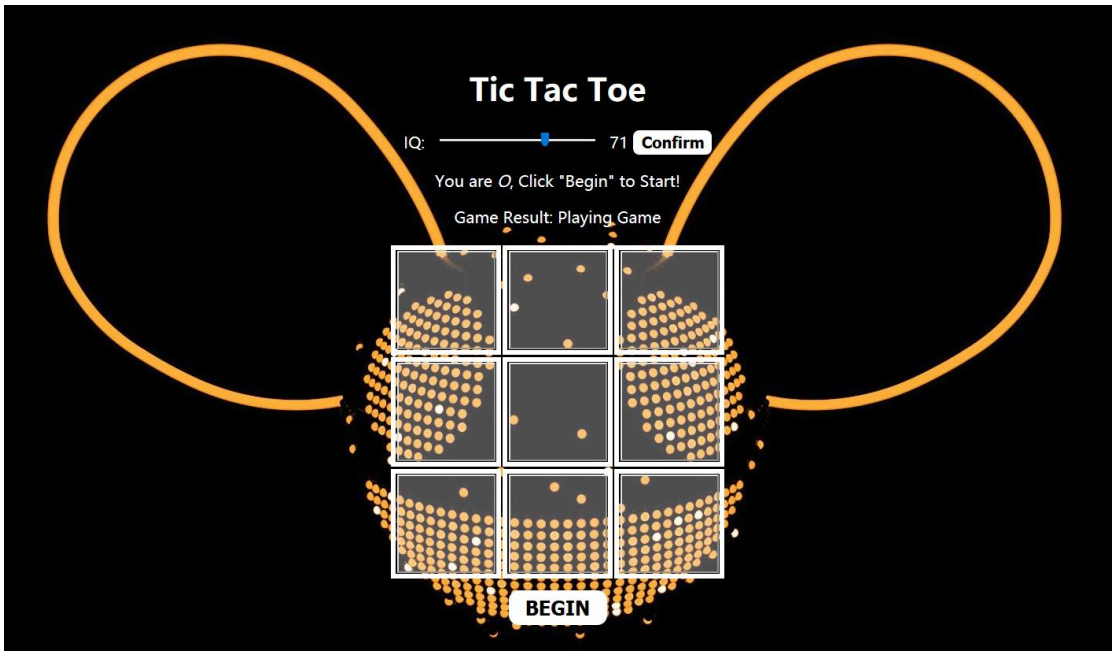


4.2 Overall Process

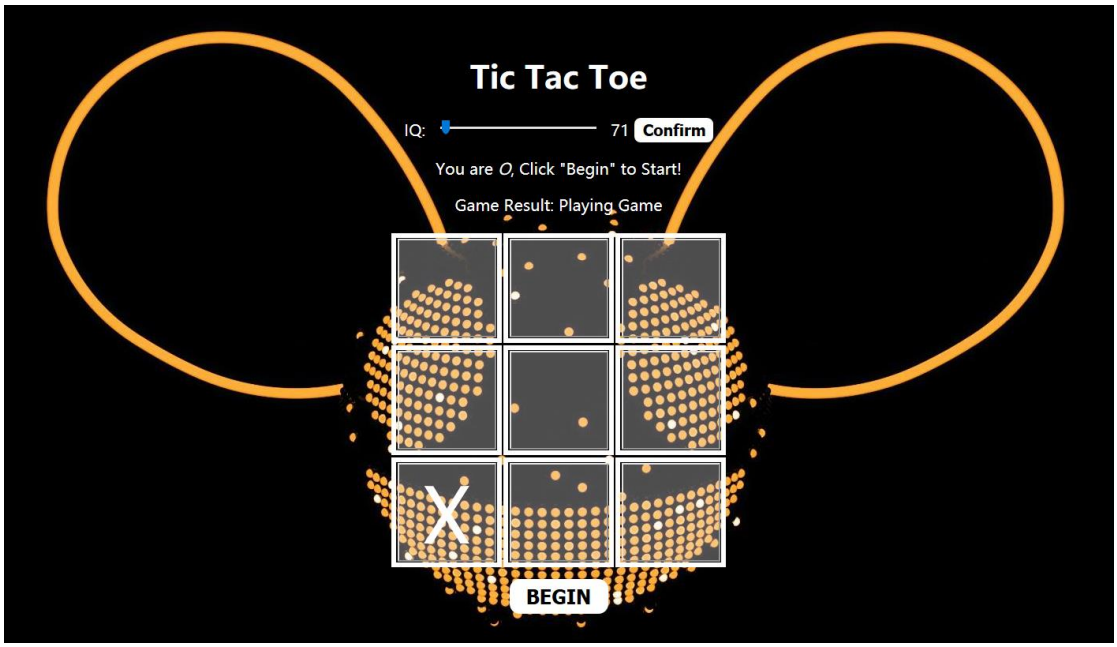
4.2.1 Enter URL

localhost:1120/playttt

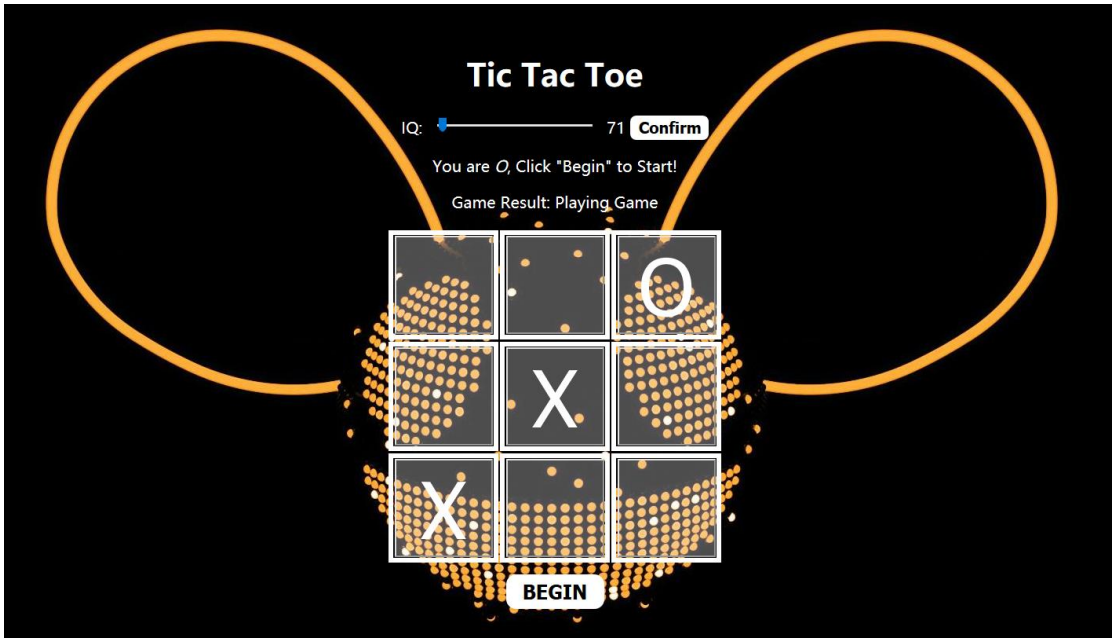
4.2.2 Setting IQ (set IQ to 71)



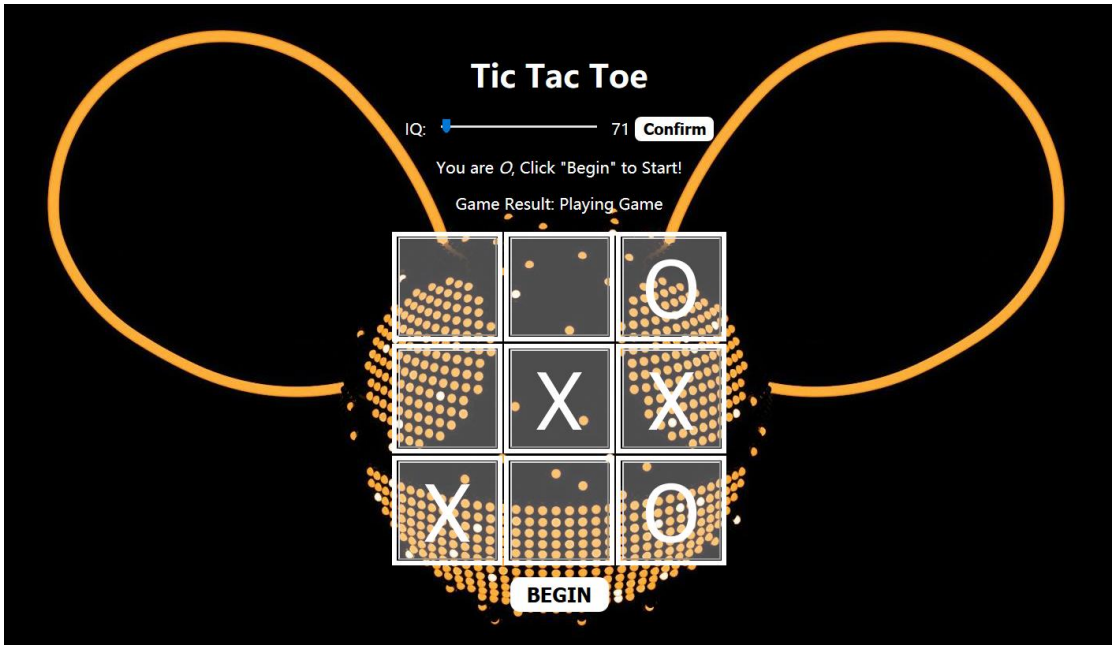
4.2.3 Click Begin (I am O, so computer give a move first)



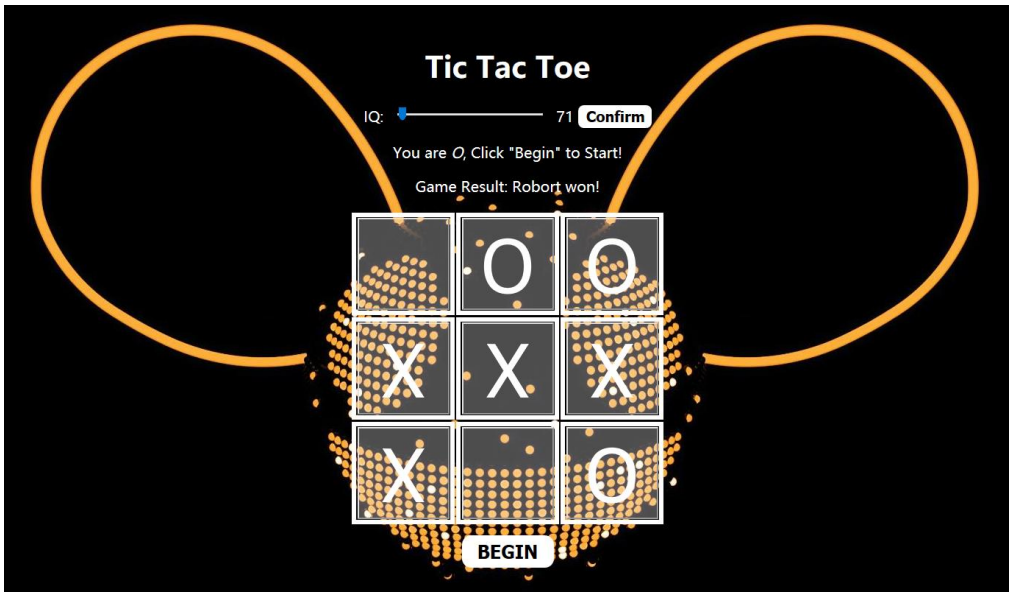
4.2.4 Make a move by myself (then computer give another move)



4.2.5 Make second move (3,3) by myself

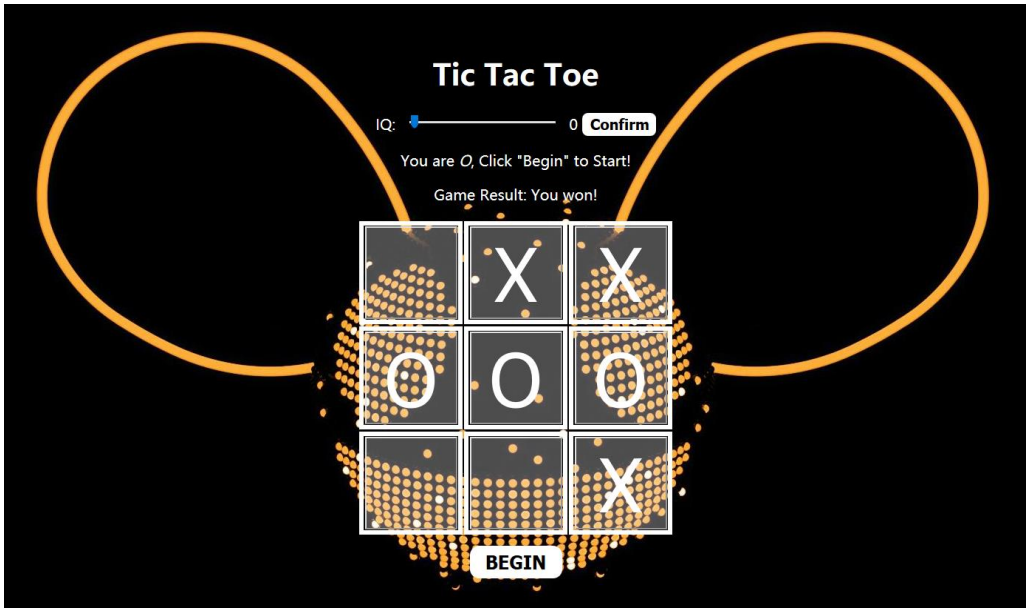


4.2.6 Make last move (1,2) by myself (Robot Win)

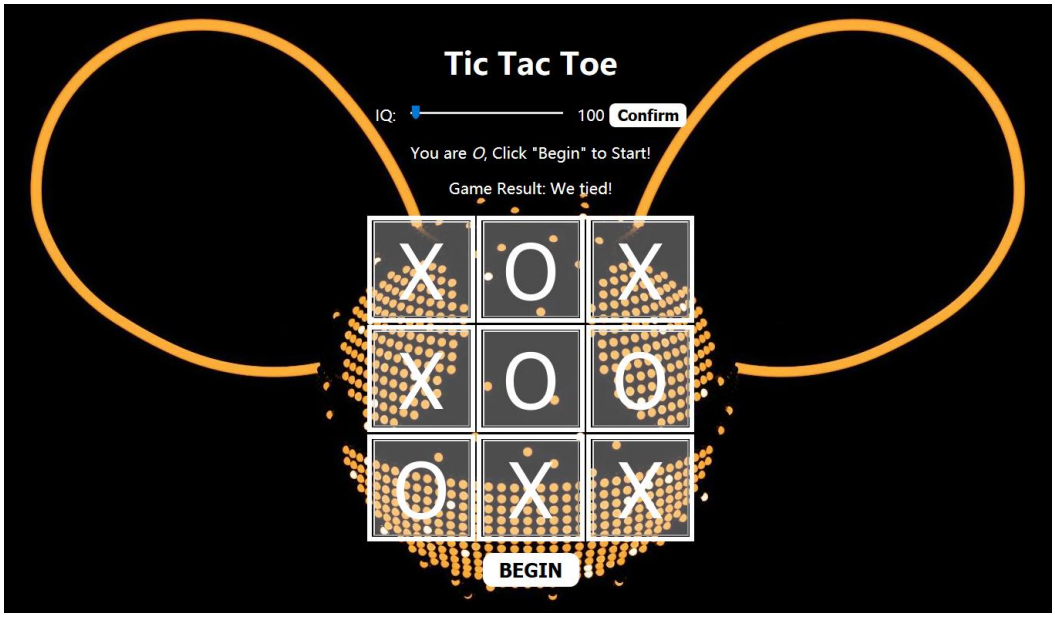


4.2.7 Some Other Results

1. I won:



2. We tied:


Tic Tac Toe
IQ:
100
Confirm
You are O, Click "Begin" to Start!
Game Result: We tied!
X O X
X O O
O X X
BEGIN