

Spring 2026 COP 3330 Program #2: Tennis!!!

Note from the instructor: This is an atypical assignment. It strongly aligns with my interests (I played tennis in high school and my whole family are avid tennis fans). The first program in this assignment helps quantitatively answer a question I've had (to what extent does the scoring system in tennis amplify one player's slight advantage) while the second program is meant to introduce students to a crude simulation. My purpose with this assignment is twofold:

1. To show students that once they master the skills of basic programming, they can use programming as a tool to investigate quantitative issues they care about and get answers that they couldn't have gotten without the computer (or would have taken much longer without a computer).
2. Show the power of simulation. One of the huge strengths of a computer is that at low cost, we can simulate more time-consuming experiments and get a pretty good feel for, "what would have happened" if we had done it in real life. Simulation has many, many benefits including training individuals (at lower cost or lower risk) and helping make informed decisions about whether or not to try something in real life.

Program A: Game Probability (gameprob.java)

In a single game of tennis (singles), there is one player who is the server and the opponent is the returner. A game consists of several points. (This will be described in more detail for part B.) Typically, the server has a bit of an advantage to win individual points. For the purposes of this problem, you will prompt the user to enter the probability the server wins an individual point and we'll assume that this is probability that they win each point they play as a server and that each point is independent of the others. Given that the probability that the server wins a single point is p , we can prove that the probability that they win a game is:

$$p^4(10p^2 - 24p + 15) + \frac{20p^5(1 - p)^3}{(2p^2 - 2p + 1)}$$

Write a program that prints out a chart where the left column is the probability of the server winning a single point and the right-hand column shows the corresponding probability of winning a game. Your chart should have 101 rows, for each integer percentage from 0% to 100%, inclusive. This program has no user input. Instead, you will be graded on your correctness, programming style and use of the appropriate methods from the Math class.

For a bit of extra credit, submit a scanned document with your proof of this probability. (Please make sure that this is a .pdf file.)

Sample Output

```
p(Point)    p(Game)
-----    -
0%          0.0%
1%          1.495897980004080807E-5%
// 98 lines omitted
100%       100.0%
```

Program B: Tennis Simulation (tennisim.java)

Write a program that simulates a single game of tennis with the user being the server and the computer using random numbers to determine the outcome of individual points. To write this simulation, you must first understand tennis scoring in a game. The first point in a game is labeled 15. Thus, if the server wins the first point, the score is 15 – 0. If the returner wins the first point of a game, then the game score is 0 – 15. (We always list the server's score first.) The second point a player earns in a game is labeled 30 and the third point a player earns in a game is labeled 40. Thus, if the server wins points number 1, 2 and 5 out of the first five points, the score transcript would be:

0 – 0, 15 – 0, 30 – 0, 30 – 15, 30 – 30, and 40 – 30.

If either player wins the fourth point of the game before the other player wins the third point of the game, that player wins the game. Thus, if Aryna is serving to Ben and the score is 40 – 30 and she wins the next point, she wins the game. Similarly, if the score is 15 – 40 and Ben wins the next point, he wins the game.

However, if the returner wins the point at 40 – 30 or the server wins the point at 30 – 40, the ensuing score is not called "40 – 40." Instead, it is called deuce. Once the score is deuce, if the server wins the point the new score is called "Ad In". (On TV they'll say the word "Advantage" followed by the name of the person who won the point. When you play with friends, it's typical to just say "Ad In" if it's the server's advantage and "Ad Out" if it's the returner's advantage.) If the server loses the deuce point the new score is called, "Ad Out." If the returner wins the Ad In point or the server wins the Ad Out point, the score returns to deuce. Alternatively, if the server wins the Ad In point, she wins the game and if the returner wins the Ad Out point, he wins the game.

For this problem you will write a tennis simulation where the user is the server. For each point, you will ask the server what "play" they want to make and the user must answer an integer in between 1 and 10, inclusive. Your program will then generate the opponent's play by generating a random integer in between 1 and 10 inclusive, using a Random object. If the integer the computer generates is within an absolute value of 2 of the number played by the server, then the opponent wins the point, otherwise the server (user) wins the point. After each point, print out the random integer generated by the computer, the outcome of the point and the new score (listing the server's score first) utilizing the conventions described above.

Implementation Requirements

Please write everything in the main method without the use of other methods. A third goal of this assignment is to teach you how useful methods and arrays are. We'll rewrite this program later in the semester with access to writing other methods and using arrays to show you how useful both of these tools really are. Your code will be fairly long (my solution is 117 lines) and it will be very case-worky and repetitive. Real life problems tend to be case-worky and without access to methods, real life code, even something as simple as this, becomes quite repetitive. So please adhere to these implementation requirements so that I can teach you these very important lessons.

Sample Program Run #1 (User Input in Bold)

What play would you like to make(1-10)?

5

The computer played 5.

The computer won the point.

The score is 0-15.

What play would you like to make(1-10)?

1

The computer played 2.

The computer won the point.

The score is 0-30.

What play would you like to make(1-10)?

7

The computer played 8.

The computer won the point.

The score is 0-40.

What play would you like to make(1-10)?

2

The computer played 1.

The computer won the point.

Sorry, you have lost the game to the computer!

Sample Program Run #2 (User Input in Bold)

The score is 0-0.

What play would you like to make(1-10)?

10

The computer played 10.

The computer won the point.

The score is 0-15.

What play would you like to make(1-10)?

2

The computer played 8.

Congrats, you won the point!

The score is 15-15.

What play would you like to make(1-10)?

1

The computer played 5.

Congrats, you won the point!

The score is 30-15.

What play would you like to make(1-10)?

8

The computer played 6.

The computer won the point.

The score is 30-30.

What play would you like to make(1-10)?

4

The computer played 3.
The computer won the point.
The score is 30-40.
What play would you like to make(1-10)?
10
The computer played 1.
Congrats, you won the point!
The score is Deuce.
What play would you like to make(1-10)?
2
The computer played 6.
Congrats, you won the point!
The score is Ad In.
What play would you like to make(1-10)?
7
The computer played 7.
The computer won the point.
The score is Deuce.
What play would you like to make(1-10)?
1
The computer played 1.
The computer won the point.
The score is Ad Out.
What play would you like to make(1-10)?
10
The computer played 2.
Congrats, you won the point!
The score is Deuce.
What play would you like to make(1-10)?
10
The computer played 7.
Congrats, you won the point!
The score is Ad In.
What play would you like to make(1-10)?
10
The computer played 9.
The computer won the point.
The score is Deuce.
What play would you like to make(1-10)?
7
The computer played 2.
Congrats, you won the point!
The score is Ad In.
What play would you like to make(1-10)?
10
The computer played 9.
The computer won the point.

The score is Deuce.
What play would you like to make(1-10)?
1
The computer played 4.
Congrats, you won the point!
The score is Ad In.
What play would you like to make(1-10)?
1
The computer played 4.
Congrats, you won the point!
Congrats, you win the game!

Sample Program Run #3 (User Input in Bold)

The score is 0-0.
What play would you like to make(1-10)?
12
Sorry, that is not in between 1 and 10.
Please enter a number in between 1 and 10 for your play.
-2
Sorry, that is not in between 1 and 10.
Please enter a number in between 1 and 10 for your play.
5
The computer played 7.
The computer won the point.
The score is 0-15.
What play would you like to make(1-10)?
1
The computer played 1.
The computer won the point.
The score is 0-30.
What play would you like to make(1-10)?
4
The computer played 2.
The computer won the point.
The score is 0-40.
What play would you like to make(1-10)?
7
The computer played 9.
The computer won the point.
Sorry, you have lost the game to the computer!