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COS 488/MAT 474
Problem Set 7, Q2

AC Program II.1   Write a program to simulate the Ehrenfest model, and use it to plot the distribution of the number of balls in chamber A after 10^3, 10^4, and 10^5 steps when starting with 10^3 balls in chamber A and none in chamber B.

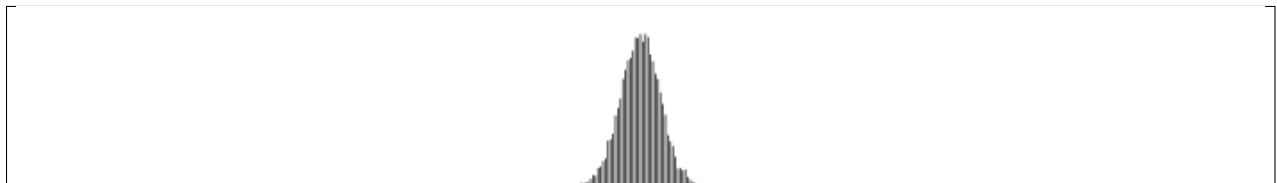*Solution.* My Java code is submitted under "Additional Files" as Ehrenfest.java.

The command "`java Ehrenfest k t`" simulaes `t` trials of the Ehrenfest model with $N = 1000$ balls and 10^k steps, and plots a histogram of the distribution of the number of balls in chamber A at the end of each trial. The resulting histogram has its x-axis ranging from 0 to N, and the heights of the bars show the relative likelihood of each outcome.

As one can see from the images below, when the number of steps is large (here I used `t` $= 10000$), the distribution resembles a normal distribution with mean $N/2 = 500$. This means that after a large number of steps, about half the balls will be in chamber A and about half will be in chamber B.

> `java Ehrenfest 4 10000`
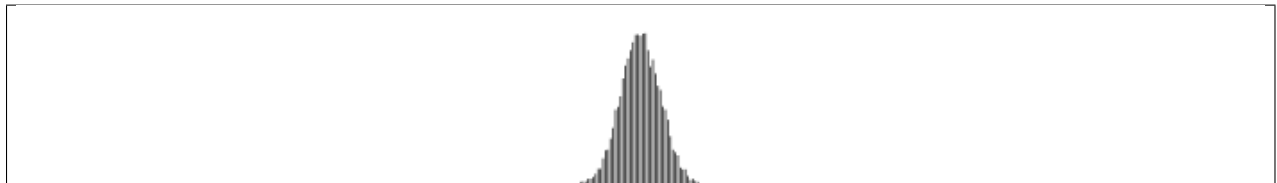
> `java Ehrenfest 5 10000`

> `java Ehrenfest 6 10000`