1. Compute $\sum_{0 \leq i \leq 10} 2^i$.

2. One way to get upper and lower limits on $\pi$ is to draw a unit circle with a regular polygon inside the circle and a regular polygon outside the circle. The perimeter of the inside polygon is less than $\pi$, the perimeter of the outside polygon is greater than $\pi$. The best bounds for this method are obtained if the polygons just touch the circle. What bounds do you get when the polygon is a square?

![Square](image)

3. You have coin $A$ which comes up heads $2/3$rd of the time and coin $B$ which comes up heads $1/3$rd of the time. Suppose you flip coin $A$ $n$ times and obtain $i$ heads. Also, you flip coin $B$ $n$ times and obtain $j$ heads. For each subproblem, give a general answer in as simple of form as you can find. Also, give a numerical answer for the case that $n = 3$.
   a. What is the probability that $i = j$?
   b. What is the probability that $i < j$?

4. You have sequence of $n$ elements. For each element, the probability that the element is an $A$ is $p$, independently of the other elements. Thus, the sequence might have any where between 0 and $n$ occurrences of $A$.
   a. What is the probability that the $i$ element on the list is the first $A$ on the list?
      In other words, what is the probability that the elements in position 1 to $i - 1$ are not $A$, but the element in position $i$ is $A$?
   b. What is the probability that $A$ is not in the sequence at all?
   c. Suppose we extend the sequence by having the $n + 1$st element be $A$. What is the average position of the first $A$ on this extended sequence?
   d. Why is the question: “what is the average position of $A$ on the original list?” not a well formed question?