HW5

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Question 1

```
  n <- 100000
  n_triangles <- 0

  set.seed(740)
  for (i in 1:n){
    breaks <- runif(2)

    L1 <- min(breaks)
    L2 <- max(breaks) - min(breaks)
    L3 = 1 - max(breaks)

    if(L1 + L2 > L3 & L1 + L3 > L2 & L2 + L3 > L1){
      n_triangles <- n_triangles + 1
    }
  }

n_triangles / n
```

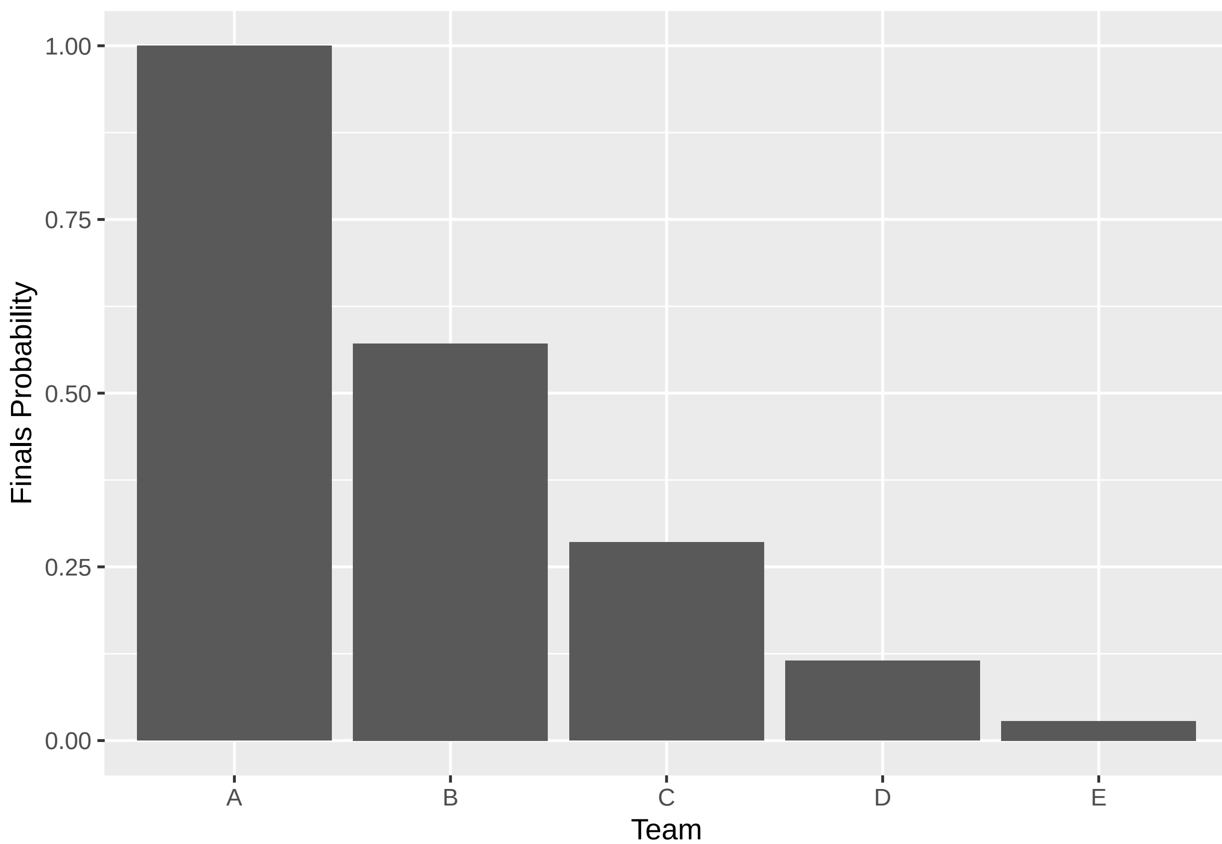
```
## [1] 0.24996
```

0.2500 or about 1/4.

Question 2

```
n <- 1000000
finals <- character(2 * n)
teams <- LETTERS[1:8]

set.seed(740)
for (i in 1:n){
  order <- sample(teams)

  top_side <- order[1:4]
  bot_side <- order[5:8]
```

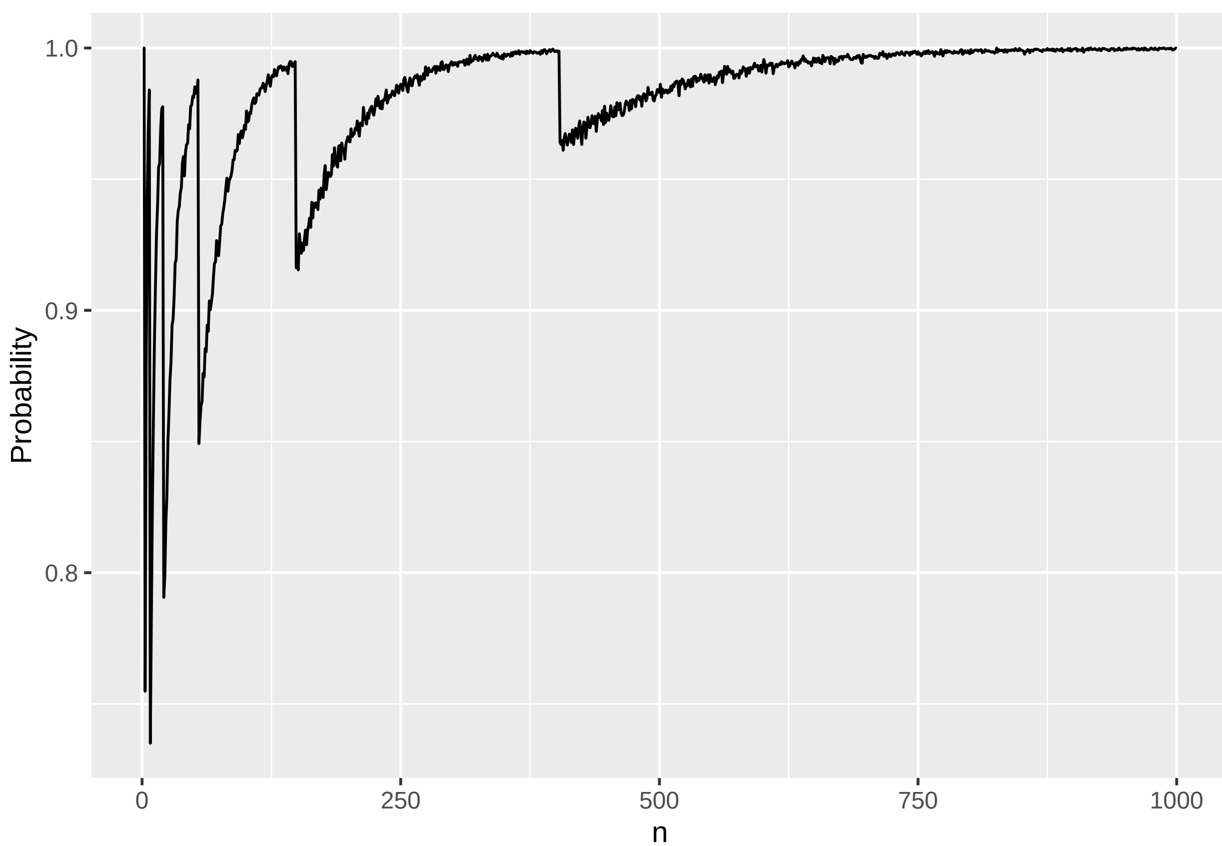
```
  t1 = min(top_side)
  t2 = min(bot_side)

  finals[2 * i - 1] <- t1
  finals[2 * i] <- t2
}

prob <- as.data.frame(table(finals)) |>
  mutate(prob = Freq / n)

prob |>
  ggplot() +
  aes(x = finals, y = prob) +
  geom_bar(stat = "identity") +
  labs(x = "Team",
       y = "Finals Probability")
```



b. Team Probabilities: A = 100%, B = 57.15%, C = 28.56%, D = 11.47%, E = 2.82%, and all the rest are 0.

Question 3

```r
n <- 1:1000
nsim <- 5000
prob <- c()

set.seed(740)
for (i in n) {
  success <- 0
  for (j in 1:nsim){
    flips <- rbinom(i, 1, 0.5)
    lr <- max(rle(flips)$lengths)
    if (lr >= log(i)) {
      success <- success + 1
    }
  }
  prob[i] <- success / nsim
}

viz <- data.frame(n = n, prob = prob)

viz |>
  ggplot(aes(x = n, y = prob)) +
  geom_line() +
  labs(x = "n",
       y = "Probability")
```



c. I think the probability will approach 1 as n approaches infinity. ln(x) grows too slow for the potential number of coin flips in a row for it to not consistently be greater than ln(x). For example, ln of 100 million is only 18.4, and I think you will pretty easily get a string of 19 of the same flips when you have 100 million flips. Plus, the graph agrees with me loser.