Stats 102A - Homework 4 - Output File

Daren Sathasivam – UID: 306229580

Academic Integrity Statement

By including this statement, I, Daren Sathasivam, declare that all of the work in this assignment is my own original work. At no time did I look at the code of other students nor did I search for code solutions online. I understand that plagiarism on any single part of this assignment will result in a 0 for the entire assignment and that I will be referred to the dean of students.

```
# source("solutions.R")  # edit with your file name
source("102a_hw_04_script_Daren_Sathasivam.R")  # edit with your file name
print(Player)
```

```
## <Player> object generator
##   Public:
##     pos: 1
##     verbose: TRUE
##     jail_turns: 0
##     doubles_count: 0
##     move_fwd: function (n)
##     go_to_jail: function ()
##     go_to_space: function (n)
##     initialize: function (verbose = FALSE, pos = 1)
##     clone: function (deep = FALSE)
##   Parent env: <environment: R_GlobalEnv>
##   Locked objects: TRUE
##   Locked class: FALSE
##   Portable: TRUE
```

```
print(take_turn)
```

```
## function (player, spacetracker)
## {
##     dice_rolls <- dice$roll()
##     continue_turn <- TRUE
##     in_jail <- player$jail_turns > 0
##     just_released <- FALSE
##     third_turn <- FALSE
##     if (in_jail) {
##         player$jail_turns <- player$jail_turns + 1
##         if (dice_rolls[1] == dice_rolls[2] || player$jail_turns >
##             3) {
##             if (dice_rolls[1] == dice_rolls[2]) {
##                 if (player$verbose) {
##                   cat("In jail but rolled doubles. \nPlayer exits jail. \n")
```

```
##                   cat("Player starts at 11: Jail. \n")
##                 }
##                 player$move_fwd(sum(dice_rolls))
##                 just_released <- TRUE
##                 spacetracker$tally(player$pos)
##             }
##             if (player$jail_turns > 3) {
##                 if (player$verbose) {
##                   cat("Player's third turn in jail. Player must exit jail. \nPlayer exits jail. \n")
##                 }
##                 if (!dice_rolls[1] == dice_rolls[2]) {
##                   third_turn <- TRUE
##                 }
##             }
##             if (!just_released && !third_turn) {
##                 spacetracker$tally(player$pos)
##             }
##             player$jail_turns <- 0
##         }
##         else {
##             if (player$verbose) {
##                 cat("Player stays in jail. \n")
##             }
##             spacetracker$tally(11)
##             return
##         }
##     }
##     if (dice_rolls[1] == dice_rolls[2]) {
##         player$doubles_count <- player$doubles_count + 1
##         if (!just_released) {
##             if (player$verbose) {
##                 cat("Doubles count is now ", player$doubles_count,
##                   ". \n", sep = "")
##             }
##         }
##         if (player$doubles_count >= 3 && player$jail_turns ==
##             0) {
##             player$go_to_jail()
##             spacetracker$tally(player$pos)
##             return
##         }
##     }
##     else {
##         player$doubles_count <- 0
##     }
##     if (!just_released && player$jail_turns == 0) {
##         if (player$verbose) {
##             cat("Player starts at ", player$pos, ": ", gameboard$title[player$pos],
##                 ".\n", sep = "")
##         }
##         player$move_fwd(sum(dice_rolls))
##         if (player$pos != 31) {
##             spacetracker$tally(player$pos)
##         }
```

```
##     }
##     utilities <- c(13, 29)
##     railroads <- c(6, 16, 26, 36)
##     if (player$pos %in% c(8, 23, 37)) {
##         if (player$verbose) {
##             cat("Draw a Chance card. \n")
##         }
##         chance_card <- chance$draw()
##         if (chance_card %in% 1:9) {
##             if (chance_card == 1) {
##                 player$go_to_space(1)
##                 spacetracker$tally(player$pos)
##             }
##             if (chance_card == 2) {
##                 player$go_to_space(25)
##                 spacetracker$tally(player$pos)
##             }
##             if (chance_card == 3) {
##                 player$go_to_space(12)
##                 spacetracker$tally(player$pos)
##             }
##             if (chance_card == 4) {
##                 distances <- sapply(utilities, function(utility_pos) {
##                   if (utility_pos > player$pos) {
##                     return(utility_pos - player$pos)
##                   }
##                   else {
##                     return(40 - player$pos + utility_pos)
##                   }
##                 })
##                 nearest_utility_pos <- utilities[which.min(distances)]
##                 player$go_to_space(nearest_utility_pos)
##                 spacetracker$tally(player$pos)
##             }
##             if (chance_card == 5) {
##                 distances <- sapply(railroads, function(railroad_pos) {
##                   if (railroad_pos > player$pos) {
##                     return(railroad_pos - player$pos)
##                   }
##                   else {
##                     return(40 - player$pos + railroad_pos)
##                   }
##                 })
##                 nearest_railroad_pos <- railroads[which.min(distances)]
##                 player$go_to_space(nearest_railroad_pos)
##                 spacetracker$tally(player$pos)
##             }
##             if (chance_card == 6) {
##                 player$go_to_space(6)
##                 spacetracker$tally(player$pos)
##             }
##             if (chance_card == 7) {
##                 player$go_to_space(40)
##                 spacetracker$tally(player$pos)
```

```
##             }
##             if (chance_card == 8) {
##                 player$go_to_jail()
##                 spacetracker$tally(player$pos)
##                 continue_turn <- FALSE
##             }
##             if (chance_card == 9) {
##                 new_pos <- player$pos - 3
##                 player$pos <- ifelse(new_pos > 0, new_pos, new_pos +
##                   40)
##                 player$go_to_space(player$pos)
##                 spacetracker$tally(player$pos)
##             }
##         }
##     }
##     if (player$pos %in% c(3, 18, 34)) {
##         if (player$verbose) {
##             cat("Draw a Community Chest Card. \n")
##         }
##         community_card <- community$draw()
##         if (community_card %in% 1:2) {
##             if (community_card == 1) {
##                 player$go_to_space(1)
##                 spacetracker$tally(player$pos)
##             }
##             else if (community_card == 2) {
##                 player$go_to_jail()
##                 spacetracker$tally(player$pos)
##                 continue_turn <- FALSE
##             }
##         }
##     }
##     if (player$pos == 31) {
##         player$go_to_jail()
##         spacetracker$tally(player$pos)
##         continue_turn <- FALSE
##         return
##     }
##     if (dice_rolls[1] == dice_rolls[2] && !just_released && player$jail_turns ==
##         0) {
##         if (player$verbose) {
##             cat("\nPlayer rolled doubles, so they take another turn. \n")
##         }
##         take_turn(player, spacetracker)
##     }
## }
```

Part 1: Test Cases

do not alter the code for the test cases

Test Case 1: Space: Go to Jail

```
dice <- PresetDice$new(
  rolls = c(3,4),
  verbose = TRUE
)
set.seed(16)
player1 <- Player$new(verbose = TRUE, pos = 24)
monopoly <- SpaceTracker$new(verbose = TRUE)

for (i in 1:1) {
  cat("--- Turn", i,"---\n")
  take_turn(player1, monopoly)
  cat("\n")
}
```

```
## --- Turn 1 ---
## Dice Rolled: 3 4
## Player starts at 24: Indiana Avenue.
## Player moves forward 7.
## Player is now at 31: Go to jail.
## Player goes to jail.
## Added tally to 11: Jail.
```

```
print(setNames(monopoly$counts, 1:40))
```

```
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
##  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
## 27 28 29 30 31 32 33 34 35 36 37 38 39 40
##  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

Test Case 2: Chance Card and Doubles Tests: Advance to Go, Reading Railroad, Nearest Railroad, Nearest Utility, No Movement

```
dice <- PresetDice$new(
  rolls = c(3,4, 4,3, 1,1, 3,4, 5,3),
  verbose = TRUE
)
set.seed(135)
chance <- CardDeck$new(chancedeck, verbose = TRUE)
community <- CardDeck$new(communitydeck, verbose = TRUE)
player1 <- Player$new(verbose = TRUE)
monopoly <- SpaceTracker$new(verbose = TRUE)

for (i in 1:4) {
  cat("--- Turn", i,"---\n")
  take_turn(player1, monopoly)
  cat("\n")
}
```

```
## --- Turn 1 ---
## Dice Rolled: 3 4
## Player starts at 1: Go.
## Player moves forward 7.
## Player is now at 8: Chance.
## Added tally to 8: Chance.
## Draw a Chance card.
## Card: Advance to Go
## Player moves to 1: Go.
## Added tally to 1: Go.
##
## --- Turn 2 ---
## Dice Rolled: 4 3
## Player starts at 1: Go.
## Player moves forward 7.
## Player is now at 8: Chance.
## Added tally to 8: Chance.
## Draw a Chance card.
## Card: Take a ride on the Reading Railroad
## Player moves to 6: Reading Railroad.
## Added tally to 6: Reading Railroad.
##
## --- Turn 3 ---
## Dice Rolled: 1 1
## Doubles count is now 1.
## Player starts at 6: Reading Railroad.
## Player moves forward 2.
## Player is now at 8: Chance.
## Added tally to 8: Chance.
## Draw a Chance card.
## Card: Advance token to the nearest Railroad
## Player moves to 16: Pennsylvania Railroad.
## Added tally to 16: Pennsylvania Railroad.
##
## Player rolled doubles, so they take another turn.
```

```
## Dice Rolled: 3 4
## Player starts at 16: Pennsylvania Railroad.
## Player moves forward 7.
## Player is now at 23: Chance.
## Added tally to 23: Chance.
## Draw a Chance card.
## Card: Advance token to nearest Utility
## Player moves to 29: Water Works.
## Added tally to 29: Water Works.
##
## --- Turn 4 ---
## Dice Rolled: 5 3
## Player starts at 29: Water Works.
## Player moves forward 8.
## Player is now at 37: Chance.
## Added tally to 37: Chance.
## Draw a Chance card.
## Card: Bank pays you dividend of $50
```

```
print(setNames(monopoly$counts, 1:40))
```

```
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
##  1  0  0  0  0  1  0  3  0  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0
## 27 28 29 30 31 32 33 34 35 36 37 38 39 40
##  0  0  1  0  0  0  0  0  0  0  1  0  0  0
```

Test Case 3: Multiple doubles. Community Chest.

```
dice <- PresetDice$new(
  rolls = c(3,3, 2,2, 2,1, 3,1), verbose = TRUE)

player1 <- Player$new(verbose = TRUE)
monopoly <- SpaceTracker$new(verbose = TRUE)
for (i in 1:2) {
  cat("--- Turn", i,"---\n")
  take_turn(player1, monopoly)
  cat("\n")
}
```

```
## --- Turn 1 ---
## Dice Rolled: 3 3
## Doubles count is now 1.
## Player starts at 1: Go.
## Player moves forward 6.
## Player is now at 7: Oriental Avenue.
## Added tally to 7: Oriental Avenue.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 2 2
## Doubles count is now 2.
## Player starts at 7: Oriental Avenue.
## Player moves forward 4.
## Player is now at 11: Jail.
## Added tally to 11: Jail.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 2 1
## Player starts at 11: Jail.
## Player moves forward 3.
## Player is now at 14: States Avenue.
## Added tally to 14: States Avenue.
##
## --- Turn 2 ---
## Dice Rolled: 3 1
## Player starts at 14: States Avenue.
## Player moves forward 4.
## Player is now at 18: Community Chest.
## Added tally to 18: Community Chest.
## Draw a Community Chest Card.
## Card: Life insurance matures. Collect $100
```

```
print(setNames(monopoly$counts, 1:40))
```

```
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
##  0  0  0  0  0  0  1  0  0  0  1  0  0  1  0  0  0  1  0  0  0  0  0  0  0  0
## 27 28 29 30 31 32 33 34 35 36 37 38 39 40
##  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

Test Case 4: Doubles three times. Three turns in jail.

```
dice <- PresetDice$new(
  rolls = c(3,3, 3,3, 3,3, 5,6, 5,6, 5,6),
  verbose = TRUE
)

player1 <- Player$new(verbose = TRUE)
monopoly <- SpaceTracker$new(verbose = TRUE)

for (i in 1:4) {
  cat("--- Turn", i,"---\n")
  take_turn(player1, monopoly)
  cat("\n")
}
```

```
## --- Turn 1 ---
## Dice Rolled: 3 3
## Doubles count is now 1.
## Player starts at 1: Go.
## Player moves forward 6.
## Player is now at 7: Oriental Avenue.
## Added tally to 7: Oriental Avenue.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 3 3
## Doubles count is now 2.
## Player starts at 7: Oriental Avenue.
## Player moves forward 6.
## Player is now at 13: Electric Company.
## Added tally to 13: Electric Company.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 3 3
## Doubles count is now 3.
## Player goes to jail.
## Added tally to 11: Jail.
##
## --- Turn 2 ---
## Dice Rolled: 5 6
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 3 ---
## Dice Rolled: 5 6
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 4 ---
## Dice Rolled: 5 6
## Player's third turn in jail. Player must exit jail.
## Player exits jail.
## Player starts at 11: Jail.
## Player moves forward 11.
```

```
## Player is now at 22: Kentucky Avenue.
## Added tally to 22: Kentucky Avenue.
```

```
print(setNames(monopoly$counts, 1:40))
```

```
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
##  0  0  0  0  0  0  1  0  0  0  3  0  1  0  0  0  0  0  0  0  0  1  0  0  0  0
## 27 28 29 30 31 32 33 34 35 36 37 38 39 40
##  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

Test Case 5: After going to Jail, player's turn ends immediately. Rolling doubles while in Jail gets player out of jail.

```
dice <- PresetDice$new(
  rolls = c(3,3, 1,2, 3,3, 3,4),
  verbose = TRUE
)

player1 <- Player$new(verbose = TRUE, pos = 25)
monopoly <- SpaceTracker$new(verbose = TRUE)

for (i in 1:3) {
  cat("--- Turn", i,"---\n")
  take_turn(player1, monopoly)
  cat("\n")
}
```

```
## --- Turn 1 ---
## Dice Rolled: 3 3
## Doubles count is now 1.
## Player starts at 25: Illinois Avenue.
## Player moves forward 6.
## Player is now at 31: Go to jail.
## Player goes to jail.
## Added tally to 11: Jail.
##
## --- Turn 2 ---
## Dice Rolled: 1 2
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 3 ---
## Dice Rolled: 3 3
## In jail but rolled doubles.
## Player exits jail.
## Player starts at 11: Jail.
## Player moves forward 6.
## Player is now at 17: St. James Place.
## Added tally to 17: St. James Place.
```

```
print(setNames(monopoly$counts, 1:40))
```

```
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
##  0  0  0  0  0  0  0  0  0  0  2  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0
## 27 28 29 30 31 32 33 34 35 36 37 38 39 40
##  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

Test Case 6: 20 Predetermined Turns

```
## You must use these dice for Part 1
dice <- PresetDice$new(
  rolls = c(6,4, 5,3, 3,5, 4,4, 4,4, 2,2, 4,3, 4,4, 1,4,
            3,4, 1,2, 3,6, 5,4, 5,5, 1,2, 5,4, 3,3, 6,1,
            1,1, 2,3, 5,5, 5,4, 4,1, 2,2, 2,4),
  verbose = TRUE
)
set.seed(2)
chance <- CardDeck$new(chancedeck, verbose = TRUE)
community <- CardDeck$new(communitydeck, verbose = TRUE)
# if your chance cards different from mine,
# check to make sure sample(15) returns the following
# > set.seed(2)
# > sample(15)
#  [1]  5  6 14  8  1 11  9  2  3 10  7 12  4 13 15
```

```
player1 <- Player$new(verbose = TRUE)
monopoly <- SpaceTracker$new(verbose = TRUE)

for (i in 1:20) {
  cat("--- Turn", i,"---\n")
  take_turn(player1, monopoly)
  cat("\n")
}
```

```
## --- Turn 1 ---
## Dice Rolled: 6 4
## Player starts at 1: Go.
## Player moves forward 10.
## Player is now at 11: Jail.
## Added tally to 11: Jail.
##
## --- Turn 2 ---
## Dice Rolled: 5 3
## Player starts at 11: Jail.
## Player moves forward 8.
## Player is now at 19: Tennessee Avenue.
## Added tally to 19: Tennessee Avenue.
##
## --- Turn 3 ---
## Dice Rolled: 3 5
## Player starts at 19: Tennessee Avenue.
## Player moves forward 8.
## Player is now at 27: Atlantic Avenue.
## Added tally to 27: Atlantic Avenue.
##
## --- Turn 4 ---
## Dice Rolled: 4 4
## Doubles count is now 1.
## Player starts at 27: Atlantic Avenue.
## Player moves forward 8.
## Player is now at 35: Pennsylvania Avenue.
```

```
## Added tally to 35: Pennsylvania Avenue.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 4 4
## Doubles count is now 2.
## Player starts at 35: Pennsylvania Avenue.
## Player moves forward 8.
## Player is now at 3: Community Chest.
## Added tally to 3: Community Chest.
## Draw a Community Chest Card.
## Card: You have won second prize in a beauty contest
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 2 2
## Doubles count is now 3.
## Player goes to jail.
## Added tally to 11: Jail.
##
## --- Turn 5 ---
## Dice Rolled: 4 3
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 6 ---
## Dice Rolled: 4 4
## In jail but rolled doubles.
## Player exits jail.
## Player starts at 11: Jail.
## Player moves forward 8.
## Player is now at 19: Tennessee Avenue.
## Added tally to 19: Tennessee Avenue.
##
## --- Turn 7 ---
## Dice Rolled: 1 4
## Player starts at 19: Tennessee Avenue.
## Player moves forward 5.
## Player is now at 24: Indiana Avenue.
## Added tally to 24: Indiana Avenue.
##
## --- Turn 8 ---
## Dice Rolled: 3 4
## Player starts at 24: Indiana Avenue.
## Player moves forward 7.
## Player is now at 31: Go to jail.
## Player goes to jail.
## Added tally to 11: Jail.
##
## --- Turn 9 ---
## Dice Rolled: 1 2
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 10 ---
## Dice Rolled: 3 6
```

```
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 11 ---
## Dice Rolled: 5 4
## Player's third turn in jail. Player must exit jail.
## Player exits jail.
## Player starts at 11: Jail.
## Player moves forward 9.
## Player is now at 20: New York Avenue.
## Added tally to 20: New York Avenue.
##
## --- Turn 12 ---
## Dice Rolled: 5 5
## Doubles count is now 1.
## Player starts at 20: New York Avenue.
## Player moves forward 10.
## Player is now at 30: Marvin Gardens.
## Added tally to 30: Marvin Gardens.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 1 2
## Player starts at 30: Marvin Gardens.
## Player moves forward 3.
## Player is now at 33: North Carolina Avenue.
## Added tally to 33: North Carolina Avenue.
##
## --- Turn 13 ---
## Dice Rolled: 5 4
## Player starts at 33: North Carolina Avenue.
## Player moves forward 9.
## Player is now at 2: Mediterranean Avenue.
## Added tally to 2: Mediterranean Avenue.
##
## --- Turn 14 ---
## Dice Rolled: 3 3
## Doubles count is now 1.
## Player starts at 2: Mediterranean Avenue.
## Player moves forward 6.
## Player is now at 8: Chance.
## Added tally to 8: Chance.
## Draw a Chance card.
## Card: Advance token to the nearest Railroad
## Player moves to 16: Pennsylvania Railroad.
## Added tally to 16: Pennsylvania Railroad.
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 6 1
## Player starts at 16: Pennsylvania Railroad.
## Player moves forward 7.
## Player is now at 23: Chance.
## Added tally to 23: Chance.
## Draw a Chance card.
## Card: Take a ride on the Reading Railroad
```

```
## Player moves to 6: Reading Railroad.
## Added tally to 6: Reading Railroad.
##
## --- Turn 15 ---
## Dice Rolled: 1 1
## Doubles count is now 1.
## Player starts at 6: Reading Railroad.
## Player moves forward 2.
## Player is now at 8: Chance.
## Added tally to 8: Chance.
## Draw a Chance card.
## Card: You have been elected Chairman of the Board
##
## Player rolled doubles, so they take another turn.
## Dice Rolled: 2 3
## Player starts at 8: Chance.
## Player moves forward 5.
## Player is now at 13: Electric Company.
## Added tally to 13: Electric Company.
##
## --- Turn 16 ---
## Dice Rolled: 5 5
## Doubles count is now 1.
## Player starts at 13: Electric Company.
## Player moves forward 10.
## Player is now at 23: Chance.
## Added tally to 23: Chance.
## Draw a Chance card.
## Card: Go to Jail
## Player goes to jail.
## Added tally to 11: Jail.
##
## --- Turn 17 ---
## Dice Rolled: 5 4
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 18 ---
## Dice Rolled: 4 1
## Player stays in jail.
## Added tally to 11: Jail.
##
## --- Turn 19 ---
## Dice Rolled: 2 2
## In jail but rolled doubles.
## Player exits jail.
## Player starts at 11: Jail.
## Player moves forward 4.
## Player is now at 15: Virginia Avenue.
## Added tally to 15: Virginia Avenue.
## Player's third turn in jail. Player must exit jail.
## Player exits jail.
##
## --- Turn 20 ---
```

```
## Dice Rolled: 2 4
## Player starts at 15: Virginia Avenue.
## Player moves forward 6.
## Player is now at 21: Free Parking.
## Added tally to 21: Free Parking.
```

```
monopoly$counts
```

```
##  [1] 0 1 1 0 0 1 0 2 0 0 9 0 1 0 1 1 0 0 2 1 1 0 2 1 0 0 1 0 0 1 0 0 1 0 1 0 0 0
## [39] 0 0
```

```
cbind(gameboard, counts = monopoly$counts)
```

```
##    space                 title counts
## 1      1                    Go      0
## 2      2  Mediterranean Avenue      1
## 3      3       Community Chest      1
## 4      4         Baltic Avenue      0
## 5      5            Income Tax      0
## 6      6      Reading Railroad      1
## 7      7       Oriental Avenue      0
## 8      8               Chance      2
## 9      9        Vermont Avenue      0
## 10    10    Connecticut Avenue      0
## 11    11                  Jail      9
## 12    12     St. Charles Place      0
## 13    13      Electric Company      1
## 14    14         States Avenue      0
## 15    15       Virginia Avenue      1
## 16    16 Pennsylvania Railroad      1
## 17    17       St. James Place      0
## 18    18       Community Chest      0
## 19    19      Tennessee Avenue      2
## 20    20       New York Avenue      1
## 21    21          Free Parking      1
## 22    22       Kentucky Avenue      0
## 23    23               Chance      2
## 24    24        Indiana Avenue      1
## 25    25       Illinois Avenue      0
## 26    26        B & O Railroad      0
## 27    27       Atlantic Avenue      1
## 28    28        Ventnor Avenue      0
## 29    29           Water Works      0
## 30    30        Marvin Gardens      1
## 31    31            Go to jail      0
## 32    32        Pacific Avenue      0
## 33    33 North Carolina Avenue      1
## 34    34       Community Chest      0
## 35    35   Pennsylvania Avenue      1
## 36    36   Short Line Railroad      0
## 37    37               Chance      0
## 38    38            Park Place      0
## 39    39            Luxury Tax      0
## 40    40             Boardwalk      0
```

Part 2: 1000 simulated games

```
library(dplyr)
```

```
## Use non-verbose random dice for Part 2
set.seed(2)
chance <- CardDeck$new(chancedeck, verbose = FALSE)
community <- CardDeck$new(communitydeck, verbose = FALSE)
dice <- RandomDice$new()

player1 <- Player$new(verbose = FALSE)
player2 <- Player$new(verbose = FALSE)
monopoly <- SpaceTracker$new(verbose = FALSE)

for (g in 1:1000) {
  if (g %% 100 == 0) {
    cat("#### SIMULATING GAME", g, "##### \n")
  }
  for (i in 1:150) {
    take_turn(player1, monopoly)
    take_turn(player2, monopoly)
  }
}
```

```
## #### SIMULATING GAME 100 #####
## #### SIMULATING GAME 200 #####
## #### SIMULATING GAME 300 #####
## #### SIMULATING GAME 400 #####
## #### SIMULATING GAME 500 #####
## #### SIMULATING GAME 600 #####
## #### SIMULATING GAME 700 #####
## #### SIMULATING GAME 800 #####
## #### SIMULATING GAME 900 #####
## #### SIMULATING GAME 1000 #####
```

```
print(setNames(monopoly$counts, 1:40))
```

```
##     1     2     3     4     5     6     7     8     9    10    11    12    13
## 10247  6930  6870  7156  7715  9550  7353  7649  7629  7668 41754  8985  9176
##    14    15    16    17    18    19    20    21    22    23    24    25    26
##  7548  8465  8722  9485  9260  9952  9856 10039  9154  9722  8892 10494  9592
##    27    28    29    30    31    32    33    34    35    36    37    38    39
##  8909  8909  9180  8343     0  8746  8555  8754  8000  7984  7462  7136  7114
##    40
##  8801
```

```
results <- cbind(gameboard, tally = monopoly$counts)
results <- cbind(results, rel = monopoly$counts/sum(monopoly$counts))
arrange(results, desc(tally))
```

```
##    space                title tally        rel
## 1     11                 Jail 41754 0.11353724
## 2     25       Illinois Avenue 10494 0.02853522
## 3      1                   Go 10247 0.02786358
## 4     21          Free Parking 10039 0.02729799
## 5     19      Tennessee Avenue  9952 0.02706142
```

```
## 6     20       New York Avenue  9856 0.02680038
## 7     23                Chance  9722 0.02643601
## 8     26        B & O Railroad  9592 0.02608251
## 9      6      Reading Railroad  9550 0.02596831
## 10    17       St. James Place  9485 0.02579156
## 11    18       Community Chest  9260 0.02517974
## 12    29           Water Works  9180 0.02496220
## 13    13      Electric Company  9176 0.02495133
## 14    22       Kentucky Avenue  9154 0.02489150
## 15    12     St. Charles Place  8985 0.02443196
## 16    27       Atlantic Avenue  8909 0.02422530
## 17    28        Ventnor Avenue  8909 0.02422530
## 18    24        Indiana Avenue  8892 0.02417908
## 19    40             Boardwalk  8801 0.02393163
## 20    34       Community Chest  8754 0.02380383
## 21    32        Pacific Avenue  8746 0.02378207
## 22    16 Pennsylvania Railroad  8722 0.02371681
## 23    33 North Carolina Avenue  8555 0.02326271
## 24    15       Virginia Avenue  8465 0.02301798
## 25    30        Marvin Gardens  8343 0.02268624
## 26    35   Pennsylvania Avenue  8000 0.02175355
## 27    36   Short Line Railroad  7984 0.02171005
## 28     5            Income Tax  7715 0.02097858
## 29    10    Connecticut Avenue  7668 0.02085078
## 30     8                Chance  7649 0.02079912
## 31     9        Vermont Avenue  7629 0.02074473
## 32    14         States Avenue  7548 0.02052448
## 33    37                Chance  7462 0.02029063
## 34     7       Oriental Avenue  7353 0.01999424
## 35     4         Baltic Avenue  7156 0.01945855
## 36    38            Park Place  7136 0.01940417
## 37    39            Luxury Tax  7114 0.01934435
## 38     2  Mediterranean Avenue  6930 0.01884402
## 39     3       Community Chest  6870 0.01868086
## 40    31             Go to jail     0 0.00000000
```

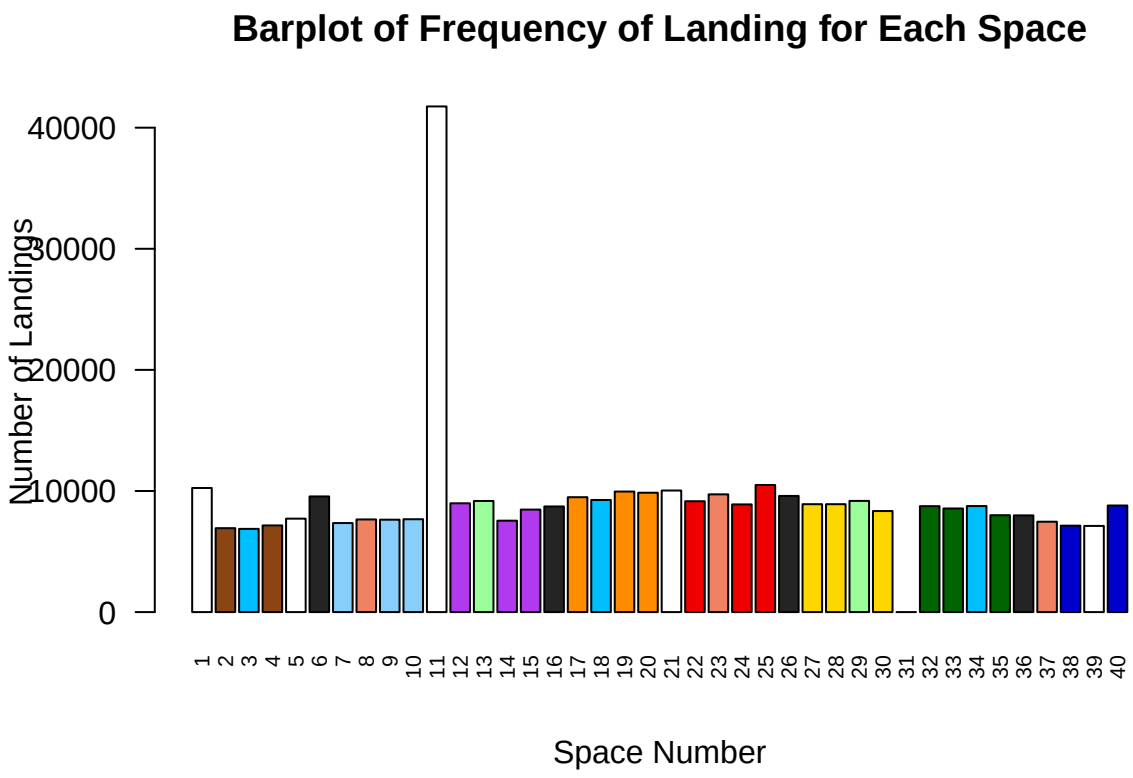
```
print(results)
```

```
##    space                 title tally        rel
## 1      1                    Go 10247 0.02786358
## 2      2  Mediterranean Avenue  6930 0.01884402
## 3      3       Community Chest  6870 0.01868086
## 4      4         Baltic Avenue  7156 0.01945855
## 5      5            Income Tax  7715 0.02097858
## 6      6      Reading Railroad  9550 0.02596831
## 7      7       Oriental Avenue  7353 0.01999424
## 8      8                Chance  7649 0.02079912
## 9      9        Vermont Avenue  7629 0.02074473
## 10    10    Connecticut Avenue  7668 0.02085078
## 11    11                  Jail 41754 0.11353724
## 12    12     St. Charles Place  8985 0.02443196
## 13    13      Electric Company  9176 0.02495133
## 14    14         States Avenue  7548 0.02052448
## 15    15       Virginia Avenue  8465 0.02301798
## 16    16 Pennsylvania Railroad  8722 0.02371681
```

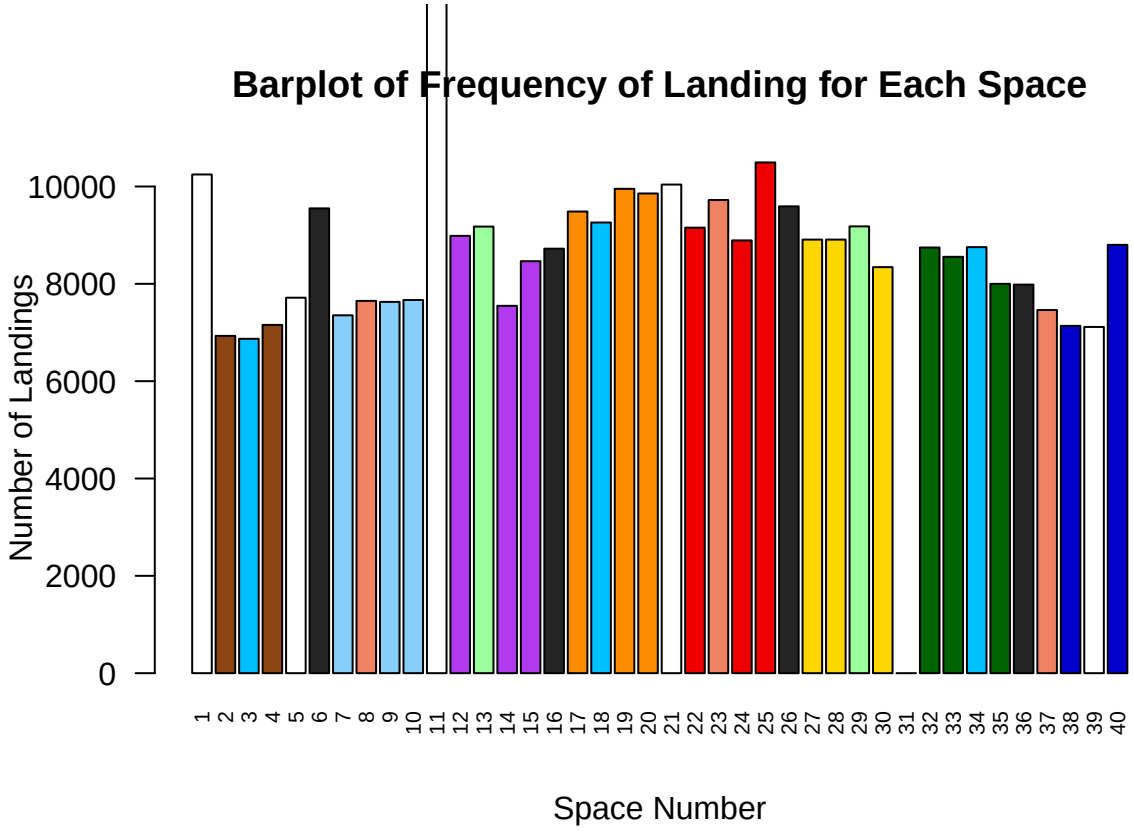
```
## 17    17       St. James Place  9485 0.02579156
## 18    18       Community Chest  9260 0.02517974
## 19    19      Tennessee Avenue  9952 0.02706142
## 20    20       New York Avenue  9856 0.02680038
## 21    21          Free Parking 10039 0.02729799
## 22    22       Kentucky Avenue  9154 0.02489150
## 23    23                Chance  9722 0.02643601
## 24    24        Indiana Avenue  8892 0.02417908
## 25    25       Illinois Avenue 10494 0.02853522
## 26    26        B & O Railroad  9592 0.02608251
## 27    27       Atlantic Avenue  8909 0.02422530
## 28    28        Ventnor Avenue  8909 0.02422530
## 29    29           Water Works  9180 0.02496220
## 30    30        Marvin Gardens  8343 0.02268624
## 31    31            Go to jail     0 0.00000000
## 32    32        Pacific Avenue  8746 0.02378207
## 33    33 North Carolina Avenue  8555 0.02326271
## 34    34       Community Chest  8754 0.02380383
## 35    35   Pennsylvania Avenue  8000 0.02175355
## 36    36   Short Line Railroad  7984 0.02171005
## 37    37                Chance  7462 0.02029063
## 38    38            Park Place  7136 0.01940417
## 39    39            Luxury Tax  7114 0.01934435
## 40    40             Boardwalk  8801 0.02393163
```

```r
# set colors for the bar plot
color_vec <- rep(NA, 40)
color_vec[c(2,4)] <- "chocolate4" # mediterranean, baltic
color_vec[c(7,9,10)] <- "lightskyblue" # oriental, vermont, connecticut
color_vec[c(12,14,15)] <- "darkorchid2" # st charles, states, virgina
color_vec[c(17,19,20)] <- "darkorange" # st james, tennessee, new york
color_vec[c(22,24,25)] <- "red2" # kentucky, indiana, illinois
color_vec[c(27,28,30)] <- "gold1" # atlantic, ventnor, marvin
color_vec[c(32,33,35)] <- "darkgreen" # pacific, n. carolina, pennsylvania
color_vec[c(38,40)] <- "blue3" # park place, boardwalk
color_vec[c(6,16,26,36)] <- "gray14" # railroads
color_vec[c(13,29)] <- "palegreen1" # utilities
color_vec[c(8,23,37)] <- "salmon2" # chance
color_vec[c(3,18,34)] <- "deepskyblue" # community chest

barplot(monopoly$counts,
  main = "Barplot of Frequency of Landing for Each Space",
  xlab = "Space Number", ylab = "Number of Landings",
  las = 2, col = color_vec, names.arg = 1:40, cex.names = 0.65)
```




```r
# this one sets the y-limits so the max count of jail doesn't shrink everything
barplot(monopoly$counts,
  main = "Barplot of Frequency of Landing for Each Space",
  xlab = "Space Number", ylab = "Number of Landings",
  las = 2, col = color_vec, names.arg = 1:40, cex.names = 0.65,
  ylim = c(0, sort(monopoly$counts, decreasing = TRUE)[2]))
```


Barplot of Frequency of Landing for Each Space
Number of Landings
0
2000
4000
6000
8000
10000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Space Number