# EE231002 Introduction to Programming

## Lab05. Blackjack Probabilities

**Due: Oct. 18, 2019**

Blackjack is a popular card game. In this game, a player is dealt two cards initially. The number of points can then be calculated as follows. The cards **2** to **10** have the face values, face cards (**J**, **Q**, and **K**) have 10 points, and an **A** can have either 1 or 11 points. An **A** is treated as 11 points if the total does not exceed 21 points, otherwise, it is treated as 1 point.

In this lab, you will practice using the **rand**() function to find the probabilities of each Blackjack hands, from 4 points to 21 points. Example program output is given below.

| Points | Probability | #Cards |
|:------:|:-----------:|:------:|
| 4  | x.xx%  | 2.00 |
| 5  | x.xx%  | 2.00 |
| 6  | x.xx%  | x.xx |
| 7  | x.xx%  | x.xx |
| 8  | x.xx%  | x.xx |
| 9  | x.xx%  | x.xx |
| 10 | x.xx%  | x.xx |
| 11 | x.xx%  | x.xx |
| 12 | xx.xx% | x.xx |
| 13 | xx.xx% | x.xx |
| 14 | xx.xx% | x.xx |
| 15 | xx.xx% | x.xx |
| 16 | xx.xx% | x.xx |
| 17 | xx.xx% | x.xx |
| 18 | xx.xx% | x.xx |
| 19 | xx.xx% | x.xx |
| 20 | xx.xx% | x.xx |
| 21 | xx.xx% | x.xx |

The Blackjack game is usually played with 2 or 4 decks of cards. A deck of cards has 52 cards with 4 different suits and each suit has 13 cards. In this lab, we assume the game is played using a large number of decks and thus, the cards **A** to **K** all have equal probability whenever is dealt. You can use the following expression to draw a card:

```
k = rand() % 13 + 1;
```

The variable k has the value of the drawn card.

In practice, one need to play the game a large number of times to get an accurate expected value. Thus, each row of the table should be the results of at least 100,000 experiments. For example, for a particular target points, say 10 points, two cards are drawn first. If the sum of these two cards exceeds 10 points then this experiment is a failure. If the sum is exactly 10 points, then it is a success. If it is less than 10 points, then another card is drawn. If case of neither a failure (more than 10 points) or a success (exactly 10 points), cards are continuous drawn until a conclusive results is obtained. After 100,000 experiments, the probability of getting 10 points should be printed together with the average number of cards of getting 10 points (the third column of the table).

**Notes.**

1. Create a directory **lab05** and use it as the working directory.

2. Name your program source file as **lab05.c**.

3. The first few lines of your program should be comments as the following.

   ```
   // EE231002 Lab05. Blackjack probabilities
   // ID, Name
   // Date:
   ```

4. In order to use the **rand** function, you need to include the standard library as follows.
   ```
   #include <stdlib.h>
   ```

5. After you finish verifying your program, you can submit your source code by

   ```
   $ ~ee2310/bin/submit lab05 lab05.c
   ```

   If you see a "submitted" message, then you are done. In case you want to check which file and at what time you submitted your labs, you can type in the following command:

   ```
   $ ~ee2310/bin/subrec
   ```

   It will show the last few submission records.

6. You should try to write the program as efficient as possible. The format of your program should be compact and easy to understand. These are part of the grading criteria.