Project 2

Title

Simple Blackjack Game

Course

CSC 11

Section

48598

Due Date

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Author

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Introduction

Title: Blackjack

This is a simple program that allows any player to quickly play a game of Blackjack. The object of the game is to beat the house by receiving a score of 21 or by getting a higher score than the house without going over 21 with any additional cards. The game begins by dealing two cards to the player; after displaying your score and if your score is less than 21 you will have the option to take another card to add to your total score or hold with your existing score. If you hold or go over 21 after choosing the additional card the program will automatically display the house's hand and then determine the outcome. Multiple decks of cards are used with the following values:

Cards 2 through 10 = face value points
Jacks = 10 points
Queens = 10 Points
Kings = 10 Points
Aces = 1 or 11 are determined by the random number generated

Summary

This assembly assignment has been one of the toughest thus far; fortunately having taking C++ last semester I was able to utilize project ideas, notes, and most of the C++ code from that semester. As references I utilized the class textbook, (*Raspberry Pi Assembly Language: Raspbian Beginners*) all available class GitHub repositories and their contents, as well as some of the notes that were discussed in class from the *Think In Geek* website.

I utilized many of the mnemonics covered in class and in the class textbook to develop my assembly program. I also used many of the ideas presented in class such as the random number generation procedure and function utilization. Based on project one I have streamlined the code as much as possible, as well as made additions of prompts to allow the user to follow the game. Another notable change to the program was based on a comment that you made last semester Dr. Lehr. The player will now have the ability to see the house's initial cards before making a decision to draw another card.

The program as it is now took a couple of days, which built upon project one's existing code. I think for the time allotted this program fully displays all concepts covered in class. I did try to include a floating point betting system but the program only kept returning a "Bus Error." Finally, I found that during this semester I found that using C++ to start up any homework or project was extremely helpful.

Concepts Used

From Textbook: *Raspberry Pi Assembly Language Raspbian*

<u>Chapter 6: Data Processing</u>
Addition
Subtraction
Move Instructions
Compare Instructions

Chapter 7: Raspbian Ins and Outs
Writing to the Screen
Reading From the Keyboard

Chapter 10: Branch and Compare
Branch Instructions
The Link Register
Using Compare Instructions
Compare Forward Thinking
Using Conditionals Effectively
Branch Exchange

Chapter 11: Shifts and Rotates
Logical Shifts
Logical Shifts Right
Arithmetic Shift Right
Rotations
Uses of Shifts and Rotates

Chapter 14: Debugging with GDB
Assembling for GDB
The Disassembler
Breakpoints

Chapter 17: Stacks
Push and Pull

Chapter 19: Using libc
Source File Structure
Number Input with Scanf

Chapter 20: Writing Functions
Function Standards
Register Use

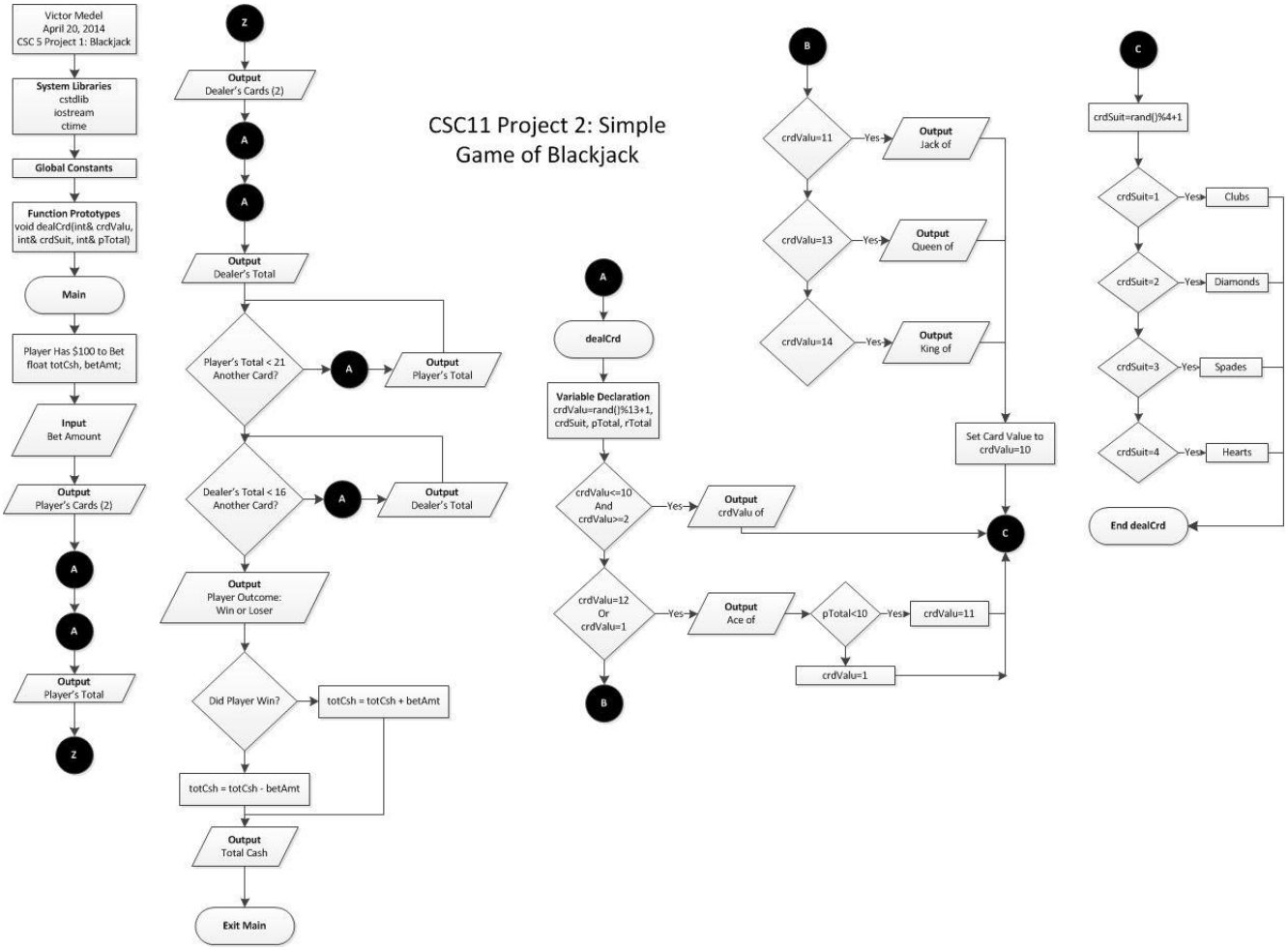
Chapter 22: Floating Point
Managing and Printing
Load Store and Move
Precision Conversion

From Class Lectures and Lab:

1. Input and Output
2. Loops
3. Branching Constructs
4. Mathematical Expressions
5. User interactivity
6. Functions
7. Programming Logic

8. Predication

Flowchart



Program Code

```
/*
 * Author: Victor Medel
 * Created on December 5, 2014
 * CSC11 Project 1 - Simple Game of Black Jack
 *
 */

 .data

 message0: .asciz "You have been delt the following card(s): \n"
 message1: .asciz "%d of "
 message2: .asciz "%d | "
 message3: .asciz "%d of "
 message4: .asciz "%d"
 message5: .asciz "\nYour current score is %d\n"
 message6: .asciz "Would you like another card? \n(Enter 0 for yes, anything else for no.): "


 message50: .asciz "The house has been delt the following cards: \n"
 message7: .asciz "%d of "
 message8: .asciz "%d | "
 message9: .asciz "%d of "
 message10: .asciz "%d | "
 message11: .asciz "%d of "
 message12: .asciz "%d\n"
 message13: .asciz "\nThe House's score is %d\n"

 message14: .asciz "You Win!\n"
 message15: .asciz "You Lose\n"

 message16: .asciz "Clubs | "
 message17: .asciz "Diamonds | "
 message18: .asciz "Hearts | "
 message19: .asciz "Spades | "

 message20: .asciz "Ace of "
 message21: .asciz "Jack of "
 message22: .asciz "Queen of "
 message23: .asciz "King of "

 message24: .asciz "You have $50, place your bet to start the game: $"
 message25: .asciz "You placed a bet of %f.\n"

 format: .asciz "%d"

 .text

scaleRight:
        push {lr}                                   @ Push lr onto the stack
            doWhile_r1_lt_r2:                       @ Shift right until just under the remainder
                mov r3,r3,ASR #1;                   @ Division counter
                mov r2,r2,ASR #1                    @ Mod/Remainder subtraction
                cmp r1,r2
                blt doWhile_r1_lt_r2
        pop {lr}                                    @ Pop lr from the stack
        bx lr
```

```
addSub:
        push {lr}                                   @ Push lr onto the stack
        doWhile_r3_ge_1:
                add r0,r0,r3
                sub r1,r1,r2
                bl scaleRight
                cmp r3,#1
                bge doWhile_r3_ge_1
        pop {lr}                                    @ Pop lr from the stack
        bx lr


scaleLeft:
        push {lr}                                   @ Push lr onto the stack
                doWhile_r1_ge_r2:                   @ Scale left till overshoot with remainder
                        mov r3,r3,LSL #1            @ scale factor
                        mov r2,r2,LSL #1            @ subtraction factor
                        cmp r1,r2
                        bge doWhile_r1_ge_r2        @ End loop at overshoot
        mov r3,r3,ASR #1                            @ Scale factor back
        mov r2,r2,ASR #1                            @ Scale subtraction factor back
        pop {lr}                                    @ Pop lr from the stack
        bx lr


division:
        push {lr}                                   @ Push lr onto the stack
                                                    @ Determine the
quotient and remainder
        mov r0,#0
        mov r3,#1
        cmp r1,r2
        blt end
        bl scaleLeft
        bl addSub

end:
        pop {lr}                                    @ Pop lr from the stack
        bx lr


                                @Suit Selection

suitselect:
        cmp r1, #1
        ble clubs
        bal select


select:
        cmp r1, #2
        ble diamonds
        bal select1


select1:
        cmp r1, #3
        ble hearts
        bal select2
```

```
select2:
        cmp r1, #4
        ble spades
        bal exit

clubs:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message16    @ Set message16 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr


diamonds:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message17    @ Set message17 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr


hearts:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message18    @ Set message18 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr


spades:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message19    @ Set message19 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr

                                        @End of Suit Selection

                                        @Ace, Jack, Queen, and King Selection

faceselect:
        cmp r1, #1
        ble ace
        bal facesel

facesel:
        cmp r1, #14
        bge king
        bal facesel1

facesel1:
        cmp r1, #13
        bge queen
        bal facesel2

facesel2:
        cmp r1, #12
        bge jack
```

```
        bal facesel3

facesel3:
        cmp r1, #11
        bge ace
        bal regular

ace:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message20    @ Set message20 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr


jack:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message21    @ Set message21 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr


queen:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message22    @ Set message22 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr


king:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message23    @ Set message23 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr

regular:
        push {lr}                                   @ Push lr onto the stack
        ldr r0, address_of_message1             @ Set message19 as the first parameter of printf
        bl printf                                   @ Call printf
        pop {lr}                                    @ Pop lr from the stack
        bx lr

                                        @ End Ace, Jack, Queen , and King Selection


        .global main
        .func main
main:
        push {lr}                                   @ Push lr onto the top of the stack
        mov r0,#0                                   @ Set time(0)
        bl time                                     @ Call time
        bl srand                                    @ Call srand

        mov r4,#0                                   @ Setup loop counter
```

```
@bet:
        @sub sp, sp, #8


        @ldr r0, address_of_message24   @ r0 <- message6
        @bl printf                                      @ call to printf

        @ldr r0, address_of_format              @ r0 <- scan_pattern
        @vldr s14, [r1]
        @vcvt.f32.s32 s15, s14
        @vcvt.f64.f32 d0, s15
        @bl scanf                               @ call to scanf

                                                                        @ Echo Results
        @ldr r0, address_of_message25   @ Set message25 as the first parameter of printf
        @vmov r2, r3, d5
        @bl printf

        @add sp, sp, #8                                 @ Discard the integer read by scanf
        @bx lr




        ldr r0, address_of_message0             @ Set message0 as the first parameter of printf
        bl printf                                       @ Call printf

        .global face1
face1:                                                          @ Create a random number
        bl rand                                         @ Call rand
        mov r1,r0,asr #1                        @ In case random return is negative
        mov r2,#14                                      @ Move 14 to r2
                                                                @ We want
rand()%14+1 so cal division function with rand()%14
        bl division                                     @ Call division function to get remainder
        add r1,#1                                       @ Remainder in r1 so add 1 giving
between 1 and 14
        mov r5, r1

        @ldr r0, address_of_message1    @ Set message1 as the first parameter of printf
        @bl printf                                      @ Call printf
        bl faceselect

        bl suit1

        .global suit1
suit1:
        bl rand                                         @ Call rand
        mov r1,r0,asr #1                        @ In case random return is negative
        mov r2,#4                                       @ Move 4 to r2
                                                                @ We want
rand()%4+1 so call division function with rand()%4
        bl division                                     @ Call division function to get remainder
        add r1,#1                                       @ Remainder in r1 so add 1 giving
between 1 and 4
        mov r10, r1
        @ldr r0, address_of_message2            @ Set message2 as the first parameter of printf
        @bl printf                                      @ Call printf
```

```
        bl suitselect
        bl face2

        .global face2
face2:                                                  @ Create a random number
        bl rand                                         @ Call rand
        mov r1,r0,asr #1                                @ In case random return is negative
        mov r2,#14                                      @ Move 14 to r2
                                                        @ We want
rand()%14+1 so cal division function with rand()%14
        bl division                                     @ Call division function to get remainder
        add r1,#1                                       @ Remainder in r1 so add 1 giving
between 1 and 14
        mov r6, r1

        @ldr r0, address_of_message3            @ Set message3 as the first parameter of printf
        @bl printf                                      @ Call printf
        bl faceselect
        bl suit2

        .global suit2
suit2:
        bl rand                                         @ Call rand
        mov r1,r0,asr #1                                @ In case random return is negative
        mov r2,#4                                       @ Move 4 to r2
                                                        @ We want
rand()%4+1 so cal division function with rand()%4
        bl division                                     @ Call division function to get remainder
        add r1,#1                                       @ Remainder in r1 so add 1 giving
between 1 and 4
        mov r10, r1
        @ldr r0, address_of_message4            @ Set message4 as the first parameter of printf
        @bl printf                                      @ Call printf
        bl suitselect

        cmp r5, #11
        movgt r5, #10
        cmp r6, #11
        movgt r6, #10

        add r7, r6, r5                                  @ Add players score and print it out
        mov r1, r7
        ldr r0, address_of_message5             @ Set message5 as the first parameter of printf
        bl printf

        ldr r0, address_of_message50    @ Set message50 as the first parameter of printf
        bl printf                                       @ Call printf

        .global houseface1
houseface1:                                             @ Create a random number
        bl rand                                         @ Call rand
        mov r1,r0,asr #1                                @ In case random return is negative
        mov r2,#14                                      @ Move 14 to r2
                                                        @ We want
rand()%14+1 so cal division function with rand()%14
        bl division                                     @ Call division function to get remainder
        add r1,#1                                       @ Remainder in r1 so add 1 giving
between 1 and 14
        mov r5, r1
```

```
        @ldr r0, address_of_message7    @ Set message1 as the first parameter of printf
        @bl printf                      @ Call printf
        bl faceselect
        bl housesuit1

        .global housesuit1
housesuit1:
        bl rand                         @ Call rand
        mov r1,r0,asr #1                @ In case random return is negative
        mov r2,#4                       @ Move 4 to r2
                                        @ We want
rand()%4+1 so call division function with rand()%4
        bl division                     @ Call division function to get remainder
        add r1,#1                       @ Remainder in r1 so add 1 giving
between 1 and 4
        mov r10, r1
        @ldr r0, address_of_message8    @ Set message2 as the first parameter of printf
        @bl printf                      @ Call printf
        bl suitselect
        bl houseface2

        .global houseface2
houseface2:                             @ Create a random number
        bl rand                         @ Call rand
        mov r1,r0,asr #1                @ In case random return is negative
        mov r2,#14                      @ Move 14 to r2
                                        @ We want
rand()%14+1 so cal division function with rand()%14
        bl division                     @ Call division function to get remainder
        add r1,#1                       @ Remainder in r1 so add 1 giving
between 1 and 14
        mov r6, r1

        @ldr r0, address_of_message9    @ Set message3 as the first parameter of printf
        @bl printf                      @ Call printf
        bl faceselect
        bl housesuit2

        .global housesuit2
housesuit2:
        bl rand                         @ Call rand
        mov r1,r0,asr #1                @ In case random return is negative
        mov r2,#4                       @ Move 4 to r2
                                        @ We want
rand()%4+1 so cal division function with rand()%4
        bl division                     @ Call division function to get remainder
        add r1,#1                       @ Remainder in r1 so add 1 giving
between 1 and 4
        mov r10, r1
        @ldr r0, address_of_message10   @ Set message4 as the first parameter of printf
        @bl printf                      @ Call printf
        bl suitselect


        cmp r5, #11
        movgt r5, #10
        cmp r6, #11
        movgt r6, #10
        add r9, r6, r5                  @ Add house's score and print it out
        mov r1, r9
```

```
        ldr r0, address_of_message5     @ Set message5 as the first parameter of printf
        bl printf

cmp r7, #21                                     @ Compare players score with 21
        blt     ask                             @ Ask player if the
would like another card
        bge     scorecomp0

        .global ask
ask:
        str lr, [sp,#-4]!                       @ Push lr onto the top of the stack
        sub sp, sp, #4                          @ Make room for one 4 byte integer in the
stack
                                                @ In these 4 bytes
we will keep the number
                                                @ entered by the
user

        ldr r0, address_of_message6     @ r0 <- message6
        bl printf                               @ call to printf
        ldr r0, address_of_format       @ r0 <- scan_pattern
        mov r1, sp                              @ Set variable of the stack as
        bl scanf                                @ call to scanf

        add r1, sp, #4          @ Place sp+4 -> r1
        ldr r1, [sp]                            @ Load the integer b read by scanf into r2
        bl compare

        add sp, sp, #4                          @ Discard the integer read by scanf
        ldr lr, [sp], #+4                       @ Pop the top of the stack and put it in lr
        bx lr           @ return from main using lr

        .global compare
compare:
        cmp r1, #0
        beq face3
        bne scorecomp0


        .global face3
face3:                                          @ Create a random number
        bl rand                                 @ Call rand
        mov r1,r0,asr #1                        @ In case random return is negative
        mov r2,#14                              @ Move 14 to r2
                                                @ We want
rand()%14+1 so cal division function with rand()%14
        bl division                             @ Call division function to get remainder
        add r1,#1                               @ Remainder in r1 so add 1 giving
between 1 and 14
        mov r8, r1

        bl faceselect
        bl suit3

        .global suit3
suit3:
        bl rand                                 @ Call rand
        mov r1,r0,asr #1                        @ In case random return is negative
        mov r2,#4                               @ Move 4 to r2
```

```
                                                                @ We want
rand()%4+1 so cal division function with rand()%4
        bl division                                             @ Call division function to get remainder
        add r1,#1                                               @ Remainder in r1 so add 1 giving
between 1 and 4
        mov r10, r1
        @ldr r0, address_of_message2            @ Set message4 as the first parameter of printf
        @bl printf                                              @ Call printf
        bl suitselect
        bal addhand

addhand:
        cmp r8, #11
        movgt r8, #10
        add r7, r7, r8                                          @ Add players score and print it out
        mov r1, r7
        ldr r0, address_of_message5             @ Set message5 as the first parameter of printf
        bl printf
        bal houseface3


        .global houseface3
houseface3:                                                     @ Create a random number
        bl rand                                                 @ Call rand
        mov r1,r0,asr #1                                @ In case random return is negative
        mov r2,#14                                              @ Move 14 to r2
                                                                @ We want
rand()%14+1 so cal division function with rand()%14
        bl division                                             @ Call division function to get remainder
        add r1,#1                                               @ Remainder in r1 so add 1 giving
between 1 and 14
        mov r5, r1

        bl faceselect
        bl housesuit3

        .global housesuit3
housesuit3:
        bl rand                                                 @ Call rand
        mov r1,r0,asr #1                                @ In case random return is negative
        mov r2,#4                                               @ Move 4 to r2
                                                                @ We want
rand()%4+1 so cal division function with rand()%4
        bl division                                             @ Call division function to get remainder
        add r1,#1                                               @ Remainder in r1 so add 1 giving
between 1 and 4
        mov r10, r1
        @ldr r0, address_of_message12   @ Set message4 as the first parameter of printf
        @bl printf                                              @ Call printf
        bl suitselect
        bal addhand2

addhand2:
        cmp r5, #11
        movgt r5, #10

        add r9, r5, r9                                          @ Add house's score and print it out
        mov r1, r9
        ldr r0, address_of_message13    @ Set message5 as the first parameter of printf
        bl printf
```

```
        bal scorecomp0

scorecomp0:                                                     @ The following compare
numonics are used to compare score and determine winner
        cmp r7, #21
        ble housescore
        bgt youlose

housescore:
        cmp r9, #21
        ble scorecomp
        bgt youwin

scorecomp:
        cmp r7, r9
        bgt youwin
        blt youlose

youwin:
        ldr r0, address_of_message14
        bl printf
        bal exit

youlose:
        ldr r0, address_of_message15
        bl printf
        bal exit

        @add r4,#1
        @cmp r4,#1                                              @ How many hands do you
want the dealer to deal?
        @blt face1

exit:
        pop {lr}                                        @ Pop the top of the stack and put it in lr
        bx lr                                                   @ Leave main


 address_of_message0: .word message0
 address_of_message1: .word message1
 address_of_message2: .word message2
 address_of_message3: .word message3
 address_of_message4: .word message4
 address_of_message5: .word message5
 address_of_message6: .word message6
 address_of_message7: .word message7
 address_of_message8: .word message8
 address_of_message9: .word message9
 address_of_message10: .word message10
 address_of_message11: .word message11
 address_of_message12: .word message12
 address_of_message13: .word message13
 address_of_message14: .word message14
 address_of_message15: .word message15
 address_of_message16: .word message16
 address_of_message17: .word message17
 address_of_message18: .word message18
 address_of_message19: .word message19
 address_of_message20: .word message20
```

```
address_of_message21: .word message21
address_of_message22: .word message22
address_of_message23: .word message23
address_of_message24: .word message24
address_of_message25: .word message25

address_of_message50: .word message50
address_of_format: .word format

                                                    @ External
Functions
.global printf
.global time
.global srand
.global rand
```