Homework 8

Problem 1

Code (MATLAB file also attached)

```
N=6; % Number of Grid points
np=4; % Number of workers
O=['A','B','C','D','E','F']; % Objects
M=2; % Number of steps

if isempty(gcp('nocreate'))
    parpool(np);
end

% Objects randomly placed in grid points
l = zeros(length(O),N)+78;
for i=1:length(O)
    k = 1;
    r = randi([1,N],1,1);
    while 1
        if l(k,r)==78
            l(k,r)=O(i);
            break;
        else
            k=k+1;
        end
    end
end

L = distributed(char(l));
spmd
    l = getLocalPart(L);
    lab = labindex();
    [u,v] = size(l);
    s = ceil(N/np);
    for m=1:M
        swapped=char.empty;
        fprintf("Step: %d\n",m);
        for i=1:s
            for ii=1:length(O)

                if i>v
                    c1='N';
                else
                    c1 = l(ii,i);
                end

                if c1~='N' && ~ismember(c1,swapped)

                    r = randi([1,2],1,1); % flip a coin 1-Tail 2-Head

                    if r == 1
                        fprintf("'%s' flipped the coin and gets: Tail\n",c1);
                        if i==1
                            destination=lab-1;
                            if destination==0
                                destination=np;
                            end
```

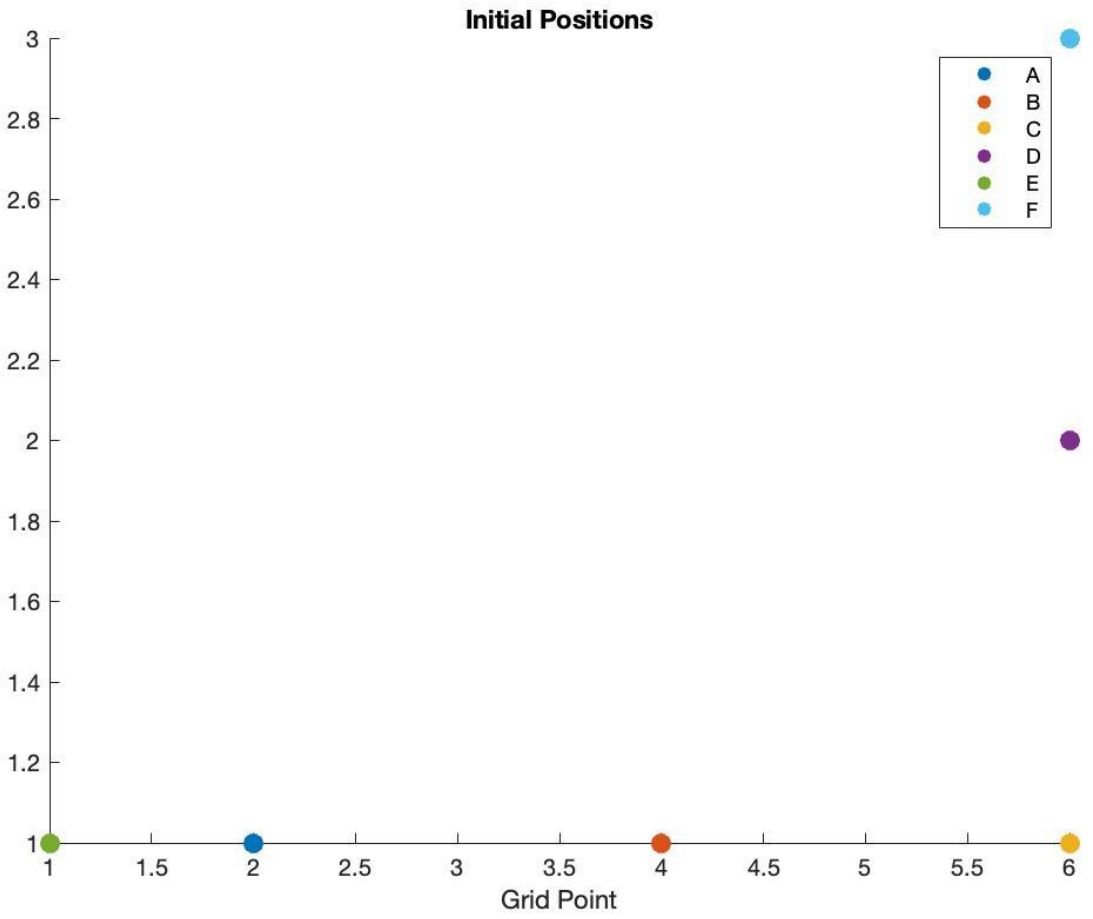
```
                            if v~=1
                                labSend(l(ii,i),destination); % labSend
                                fprintf("'%s' moved to Worker
%d\n",l(ii,i),destination);
                                swapped=[swapped l(ii,i)];
                                l(ii,i)='N';
                            else
                                labSend(l(ii),destination); % labSend
                                fprintf("'%s' moved to Worker
%d\n",l(ii),destination);
                                swapped=[swapped l(ii)];
                                l(ii)='N';
                            end
                        else
                            for j=1:length(O)
                            if l(j,i-1)=='N'
                                l(j,i-1)=l(ii,i);
                                fprintf("'%s' moved to Left within the
Worker\n",l(ii,i));
                                swapped=[swapped l(ii,i)];
                                l(ii,i)='N';
                                break;
                            end
                            end
                        end

                    end

                    if r == 2
                        fprintf("'%s' flipped the coin and gets: Head\n",c1);
                        if i==v
                            destination=lab+1;
                            if destination==np+1
                                destination=1;
                            end
                            if v~=1
                                labSend(l(ii,i),destination); % labSend
                                fprintf("'%s' moved to Worker
%d\n",l(ii,i),destination);
                                swapped=[swapped l(ii,i)];
                                l(ii,i)='N';
                            else
                                labSend(l(ii),destination); % labSend
                                fprintf("'%s' moved to Worker
%d\n",l(ii),destination);
                                swapped=[swapped l(ii)];
                                l(ii)='N';
                            end

                        else
                            for j=1:length(O)
                            if l(j,i+1)=='N'
                                l(j,i+1)=l(ii,i);
                                fprintf("'%s' moved to Right within the
Worker\n",l(ii,i));
                                swapped=[swapped l(ii,i)];
                                l(ii,i)='N';
                                break;
                            end
                            end
                        end
                    end

                end
```

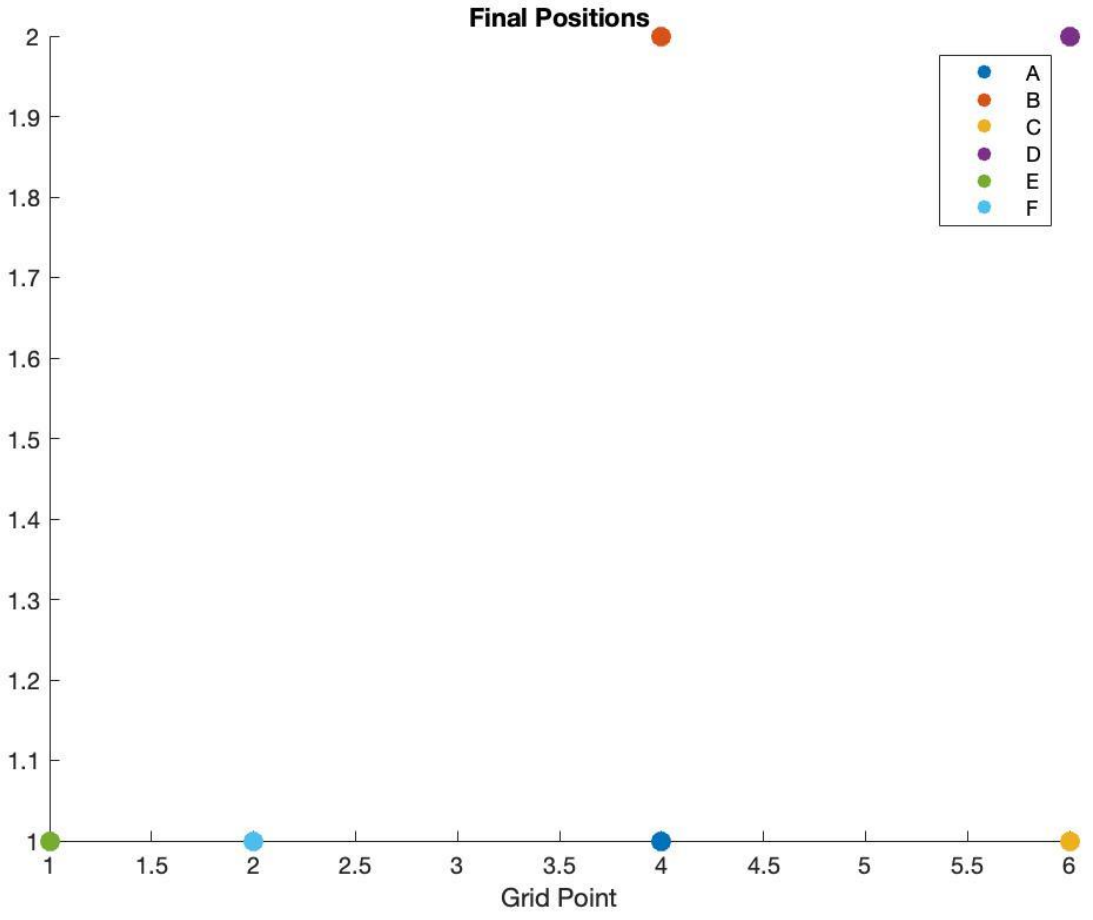
```
                labBarrier; % labBarrier
                isDataAvail = labProbe; % labProbe

                if isDataAvail
                    [data,srcWkrIdx,tag] = labReceive; % labReceive
                    if ~ismember(data,swapped)
                        swapped=[swapped data];
                    end
                    if v~=1
                        if srcWkrIdx==1 && lab==np
                            for j=1:length(O)
                                if l(j,v)=='N'
                                    l(j,v)=data;
                                    break;
                                end
                            end
                        elseif srcWkrIdx==np && lab==1
                            for j=1:length(O)
                                if l(j,1)=='N'
                                    l(j,1)=data;
                                    break;
                                end
                            end
                        elseif srcWkrIdx>lab
                            for j=1:length(O)
                                if l(j,v)=='N'
                                    l(j,v)=data;
                                    break;
                                end
                            end
                        else
                            for j=1:length(O)
                                if l(j,1)=='N'
                                    l(j,1)=data;
                                    break;
                                end
                            end
                        end
                    else
                        for j=1:length(O)
                            if l(j)=='N'
                                l(j)=data;
                                break;
                            end
                        end
                    end
                end

            end
        end
    end
end

X = gather(l);

initial_pos = zeros(length(O),2);
final_pos = zeros(length(O),2);
Z = char.empty;

for i=1:np
    Z = [Z, X{i}];
end
for i=1:length(O)
    o = O(i);
    [x,y] = find(L==o);
```

```
    initial_pos(i,1)=x;
    initial_pos(i,2)=y;
    [x,y] = find(Z==o);
    final_pos(i,1)=x;
    final_pos(i,2)=y;
end

% Plot Initial and Final positions

figure;
for i=1:length(O)
    scatter(initial_pos(i,2),initial_pos(i,1),75,'filled');
    hold on;
end
title('Initial Positions');
xlabel('Grid Point');
legend('A','B','C','D','E','F');

figure('Name','Final Positions');
for i=1:length(O)
    scatter(final_pos(i,2),final_pos(i,1),75,'filled');
    hold on;
end
title('Final Positions');
xlabel('Grid Point');
legend('A','B','C','D','E','F');

poolobj = gcp('nocreate');
delete(poolobj);
```

Result

```
Starting parallel pool (parpool) using the 'local' profile ...
Connected to the parallel pool (number of workers: 4).
Lab 1:
  Step: 1
  'E' flipped the coin and gets: Tail
  'E' moved to Worker 4
  'A' flipped the coin and gets: Head
  'A' moved to Worker 2
  Step: 2
  'F' flipped the coin and gets: Head
  'F' moved to Right within the Worker
Lab 2:
  Step: 1
  'B' flipped the coin and gets: Head
  'B' moved to Worker 3
  Step: 2
  'A' flipped the coin and gets: Head
  'A' moved to Right within the Worker
Lab 3:
  Step: 1
  Step: 2
  'C' flipped the coin and gets: Head
  'C' moved to Worker 4
  'D' flipped the coin and gets: Head
  'D' moved to Worker 4
  'B' flipped the coin and gets: Tail
  'B' moved to Worker 2
Lab 4:
  Step: 1
  'C' flipped the coin and gets: Tail
  'C' moved to Worker 3
  'D' flipped the coin and gets: Tail
  'D' moved to Worker 3
  'F' flipped the coin and gets: Head
  'F' moved to Worker 1
  Step: 2
  'E' flipped the coin and gets: Head
  'E' moved to Worker 1
Parallel pool using the 'local' profile is shutting down.
```


Initial Positions
A
B
C
D
E
F
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Grid Point


Final Positions
A
B
C
D
E
F
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Grid Point

Problem 2

Code (MATLAB file also attached)

```
% Initial Money = [Dealer Player1 Player2 Player3]
money_initial = [100 20 20 20];

if isempty(gcp('nocreate'))
    parpool(4); % Starting 4 workers
end

money = distributed(money_initial);

spmd
    lab = labindex();
    my_money = getLocalPart(money);
    money_stat(1,1)=0;
    money_stat(1,2)=my_money;
    bankrupt=0;

    for bet_round=1:20 % Number of rounds
        if ~bankrupt
            fprintf("Round %d Starts...\n",bet_round);
        end

        if lab~=1

            if ~bankrupt
                if bet_round==1
                    my_bet = randi([1,my_money],1,1); % Initial bet by players
                else
                    my_bet=round(my_money*0.5);
                end
                my_money = my_money-my_bet;
                labSend(my_bet,1);
            else
                labSend(0,1);
            end
        end

        if lab==1
                d2 = labReceive(2);
                d3 = labReceive(3);
                d4 = labReceive(4);

            D = [0 d2 d3 d4];

            for i=2:4

                if D(i)~=0

                    if bet_round==1
                        my_bet = randi([1,round(my_money/2)],1,1); % Initial bet
by dealer
                    else
                        my_bet = round(0.25*my_money);
                    end
                    my_money = my_money-my_bet;
                    fprintf("Player %d bet $%d and Dealer bet
$%d\n",i,D(i),my_bet);
                    r = randi([1,2],1,1); % 1-Dealer Win, 2-Player Win
```

```
                    if r==1
                        my_money = my_money + my_bet + D(i);
                        fprintf("Dealer won $%d\n\n",D(i));
                        labSend(0,i);
                    else
                        fprintf("Player %d won $%d\n\n",i,my_bet);
                        labSend(my_bet+D(i),i);
                    end
                end

            end
        else
            if ~bankrupt
                d = labReceive(1);
                my_money = my_money + d;
            end
        end

        if ~bankrupt
            fprintf("Amount Remaining at end of Round %d:
$%d\n",bet_round,my_money);
            money_stat(bet_round+1,1)=bet_round;
            money_stat(bet_round+1,2)=my_money;
        end

        if lab==1 && my_money<=4
            bankrupt=1;
            labSend(1,2);
            labSend(1,3);
            labSend(1,4);
        elseif lab~=1 && my_money<1
            bankrupt=1;
        end

        labBarrier;

        if lab==1
            if bankrupt
                break;
            end
        else
            isDataAvail = labProbe(1);
            if isDataAvail
                e=labReceive(1);
                if e==1
                    break;
                end
            end
        end

    end
end

% Plot the outcomes

a=money_stat{1};
figure;
plot(a(:,1),a(:,2),'LineWidth',2);
title("Dealer");
xlabel("Round");
ylabel("Money");

b=money_stat{2};
figure;
```

```
plot(b(:,1),b(:,2),'LineWidth',2);
title("Player 1");
xlabel("Round");
ylabel("Money");

c=money_stat{3};
figure;
plot(c(:,1),c(:,2),'LineWidth',2);
title("Player 2");
xlabel("Round");
ylabel("Money");

d=money_stat{4};
figure;
plot(d(:,1),d(:,2),'LineWidth',2);
title("Player 3");
xlabel("Round");
ylabel("Money");
```

Result

Lab 1:

Round 1 Starts...
Player 2 bet $7 and Dealer bet $48
Player 2 won $48

Player 3 bet $4 and Dealer bet $26
Player 3 won $26

Player 4 bet $7 and Dealer bet $2
Player 4 won $2

Amount Remaining at end of Round 1: $24
Round 2 Starts...
Player 2 bet $34 and Dealer bet $6
Player 2 won $6

Player 3 bet $23 and Dealer bet $5
Player 3 won $5

Player 4 bet $11 and Dealer bet $3
Dealer won $11

Amount Remaining at end of Round 2: $24
Round 3 Starts...
Player 2 bet $37 and Dealer bet $6
Player 2 won $6

Player 3 bet $26 and Dealer bet $5
Dealer won $26

Player 4 bet $6 and Dealer bet $11

Dealer won $6

Amount Remaining at end of Round 3: $50
Round 4 Starts...
Player 2 bet $40 and Dealer bet $13
Dealer won $40

Player 3 bet $13 and Dealer bet $23
Player 3 won $23

Player 4 bet $3 and Dealer bet $17
Dealer won $3

Amount Remaining at end of Round 4: $70
Round 5 Starts...
Player 2 bet $20 and Dealer bet $18
Player 2 won $18

Player 3 bet $24 and Dealer bet $13
Player 3 won $13

Player 4 bet $1 and Dealer bet $10
Dealer won $1

Amount Remaining at end of Round 5: $40
Round 6 Starts...
Player 2 bet $29 and Dealer bet $10
Dealer won $29

Player 3 bet $31 and Dealer bet $17
Player 3 won $17

Player 4 bet $1 and Dealer bet $13
Dealer won $1

Amount Remaining at end of Round 6: $53
Round 7 Starts...
Player 2 bet $15 and Dealer bet $13
Player 2 won $13

Player 3 bet $39 and Dealer bet $10
Player 3 won $10

Amount Remaining at end of Round 7: $30
Round 8 Starts...
Player 2 bet $21 and Dealer bet $8
Player 2 won $8

Player 3 bet $44 and Dealer bet $6
Dealer won $44

Amount Remaining at end of Round 8: $66
Round 9 Starts...
Player 2 bet $25 and Dealer bet $17
Player 2 won $17

Player 3 bet $22 and Dealer bet $12
Dealer won $22

Amount Remaining at end of Round 9: $71
Round 10 Starts...
Player 2 bet $34 and Dealer bet $18
Dealer won $34

Player 3 bet $11 and Dealer bet $26
Player 3 won $26

Amount Remaining at end of Round 10: $79
Round 11 Starts...
Player 2 bet $17 and Dealer bet $20
Player 2 won $20

Player 3 bet $24 and Dealer bet $15
Dealer won $24

Amount Remaining at end of Round 11: $83
Round 12 Starts...
Player 2 bet $27 and Dealer bet $21
Player 2 won $21

Player 3 bet $12 and Dealer bet $16
Dealer won $12

Amount Remaining at end of Round 12: $74
Round 13 Starts...
Player 2 bet $37 and Dealer bet $19
Dealer won $37

Player 3 bet $6 and Dealer bet $28
Dealer won $6

Amount Remaining at end of Round 13: $117
Round 14 Starts...
Player 2 bet $19 and Dealer bet $29
Player 2 won $29

Player 3 bet $3 and Dealer bet $22
Dealer won $3

Amount Remaining at end of Round 14: $91

Round 15 Starts...
Player 2 bet $33 and Dealer bet $23
Player 2 won $23

Player 3 bet $2 and Dealer bet $17
Player 3 won $17

Amount Remaining at end of Round 15: $51
Round 16 Starts...
Player 2 bet $45 and Dealer bet $13
Dealer won $45

Player 3 bet $10 and Dealer bet $24
Player 3 won $24

Amount Remaining at end of Round 16: $72
Round 17 Starts...
Player 2 bet $22 and Dealer bet $18
Dealer won $22

Player 3 bet $22 and Dealer bet $24
Player 3 won $24

Amount Remaining at end of Round 17: $70
Round 18 Starts...
Player 2 bet $11 and Dealer bet $18
Dealer won $11

Player 3 bet $34 and Dealer bet $20
Player 3 won $20

Amount Remaining at end of Round 18: $61
Round 19 Starts...
Player 2 bet $6 and Dealer bet $15
Dealer won $6

Player 3 bet $44 and Dealer bet $17
Dealer won $44

Amount Remaining at end of Round 19: $111
Round 20 Starts...
Player 2 bet $3 and Dealer bet $28
Dealer won $3

Player 3 bet $22 and Dealer bet $29
Dealer won $22

Amount Remaining at end of Round 20: $136

Lab 2:

Round 1 Starts...

Amount Remaining at end of Round 1: $68
Round 2 Starts...
Amount Remaining at end of Round 2: $74
Round 3 Starts...
Amount Remaining at end of Round 3: $80
Round 4 Starts...
Amount Remaining at end of Round 4: $40
Round 5 Starts...
Amount Remaining at end of Round 5: $58
Round 6 Starts...
Amount Remaining at end of Round 6: $29
Round 7 Starts...
Amount Remaining at end of Round 7: $42
Round 8 Starts...
Amount Remaining at end of Round 8: $50
Round 9 Starts...
Amount Remaining at end of Round 9: $67
Round 10 Starts...
Amount Remaining at end of Round 10: $33
Round 11 Starts...
Amount Remaining at end of Round 11: $53
Round 12 Starts...
Amount Remaining at end of Round 12: $74
Round 13 Starts...
Amount Remaining at end of Round 13: $37
Round 14 Starts...
Amount Remaining at end of Round 14: $66
Round 15 Starts...
Amount Remaining at end of Round 15: $89
Round 16 Starts...
Amount Remaining at end of Round 16: $44
Round 17 Starts...
Amount Remaining at end of Round 17: $22
Round 18 Starts...
Amount Remaining at end of Round 18: $11
Round 19 Starts...
Amount Remaining at end of Round 19: $5
Round 20 Starts...
Amount Remaining at end of Round 20: $2

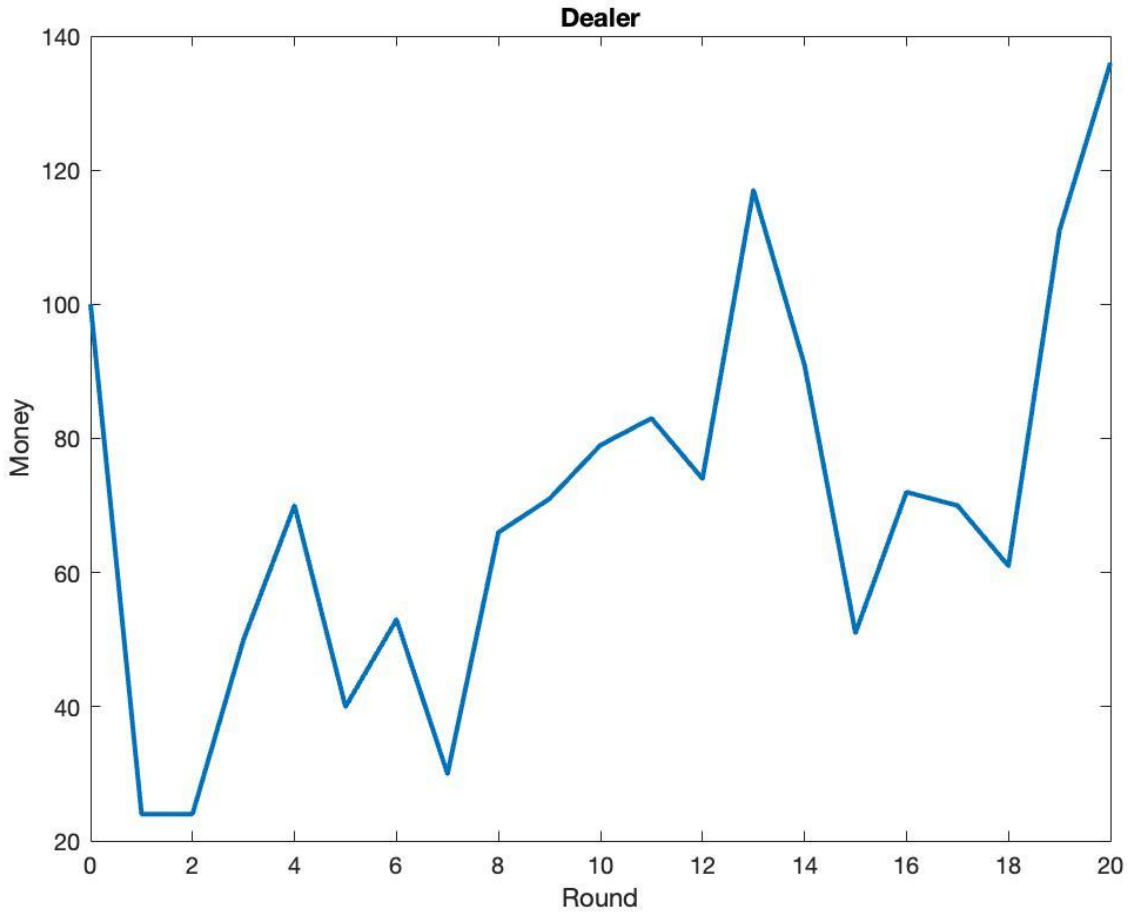
Lab 3:

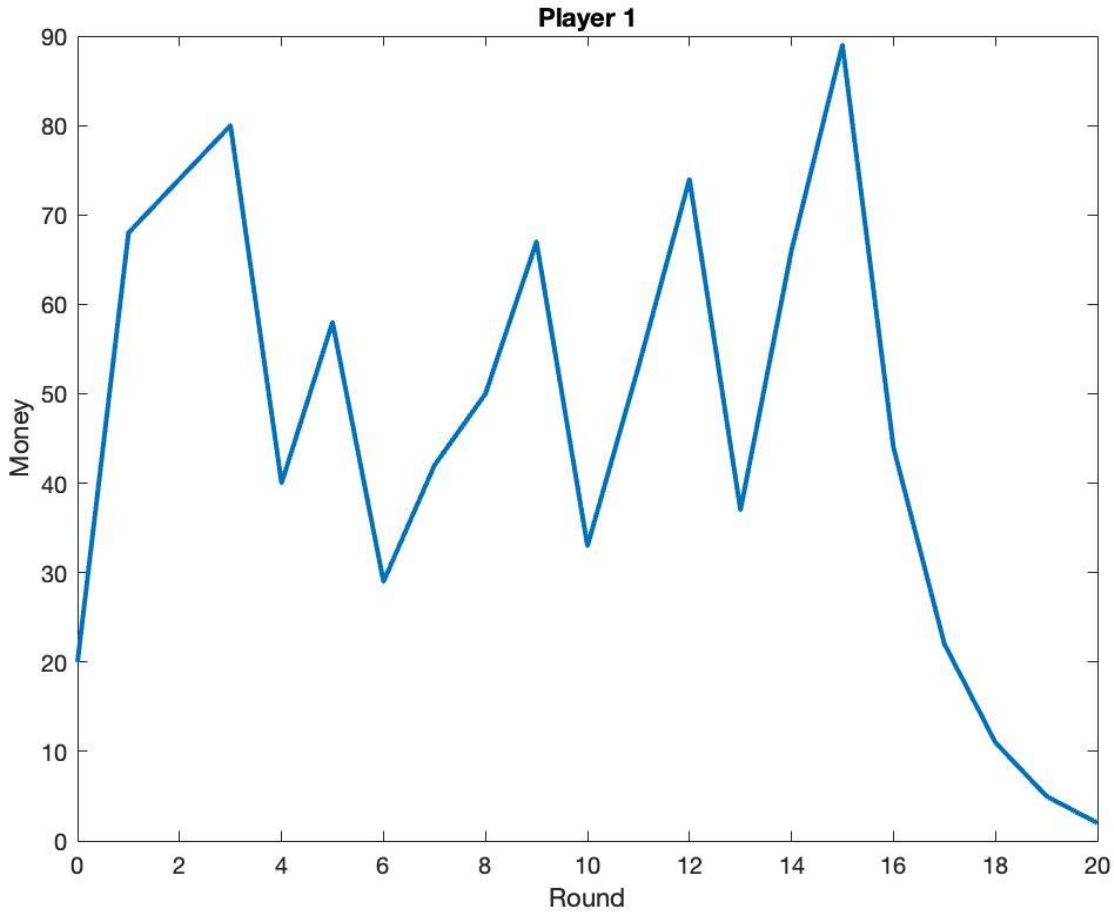
Round 1 Starts...
Amount Remaining at end of Round 1: $46
Round 2 Starts...
Amount Remaining at end of Round 2: $51
Round 3 Starts...
Amount Remaining at end of Round 3: $25
Round 4 Starts...
Amount Remaining at end of Round 4: $48
Round 5 Starts...
Amount Remaining at end of Round 5: $61

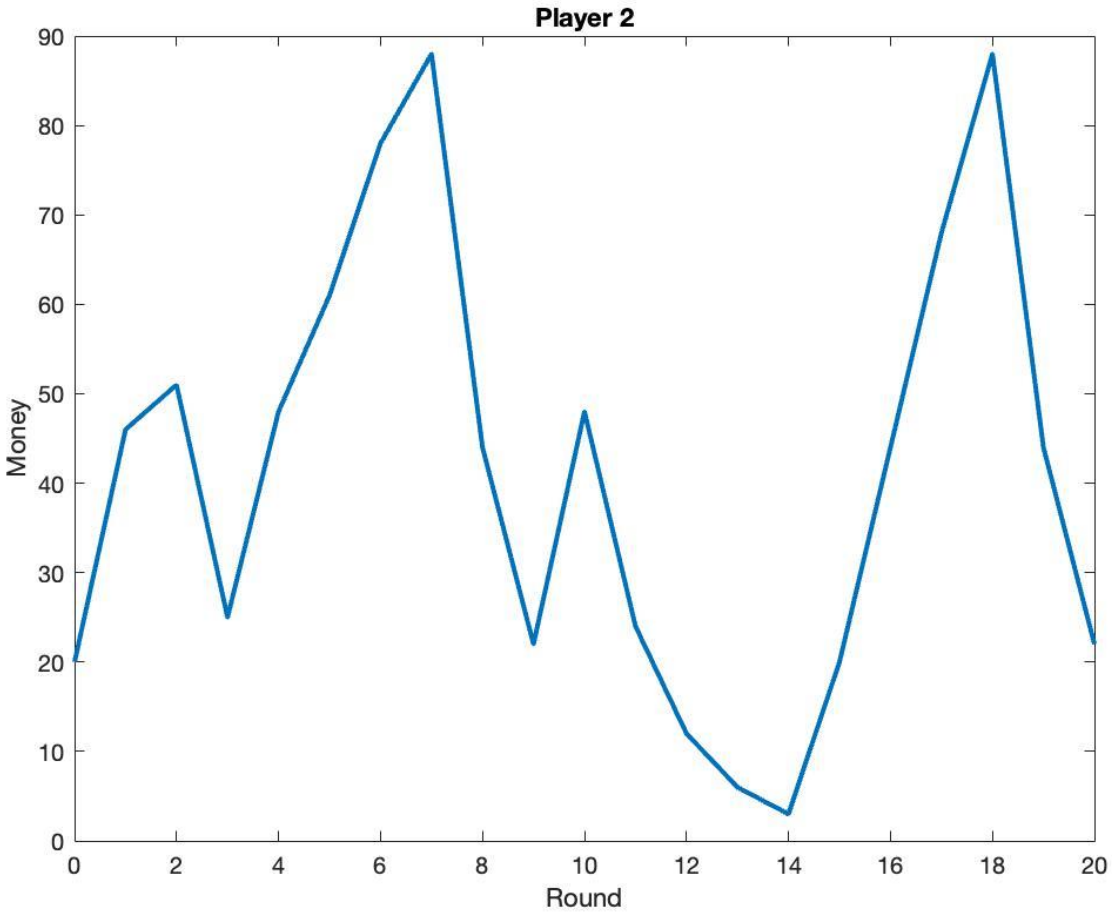
Round 6 Starts...
Amount Remaining at end of Round 6: $78
Round 7 Starts...
Amount Remaining at end of Round 7: $88
Round 8 Starts...
Amount Remaining at end of Round 8: $44
Round 9 Starts...
Amount Remaining at end of Round 9: $22
Round 10 Starts...
Amount Remaining at end of Round 10: $48
Round 11 Starts...
Amount Remaining at end of Round 11: $24
Round 12 Starts...
Amount Remaining at end of Round 12: $12
Round 13 Starts...
Amount Remaining at end of Round 13: $6
Round 14 Starts...
Amount Remaining at end of Round 14: $3
Round 15 Starts...
Amount Remaining at end of Round 15: $20
Round 16 Starts...
Amount Remaining at end of Round 16: $44
Round 17 Starts...
Amount Remaining at end of Round 17: $68
Round 18 Starts...
Amount Remaining at end of Round 18: $88
Round 19 Starts...
Amount Remaining at end of Round 19: $44
Round 20 Starts...
Amount Remaining at end of Round 20: $22

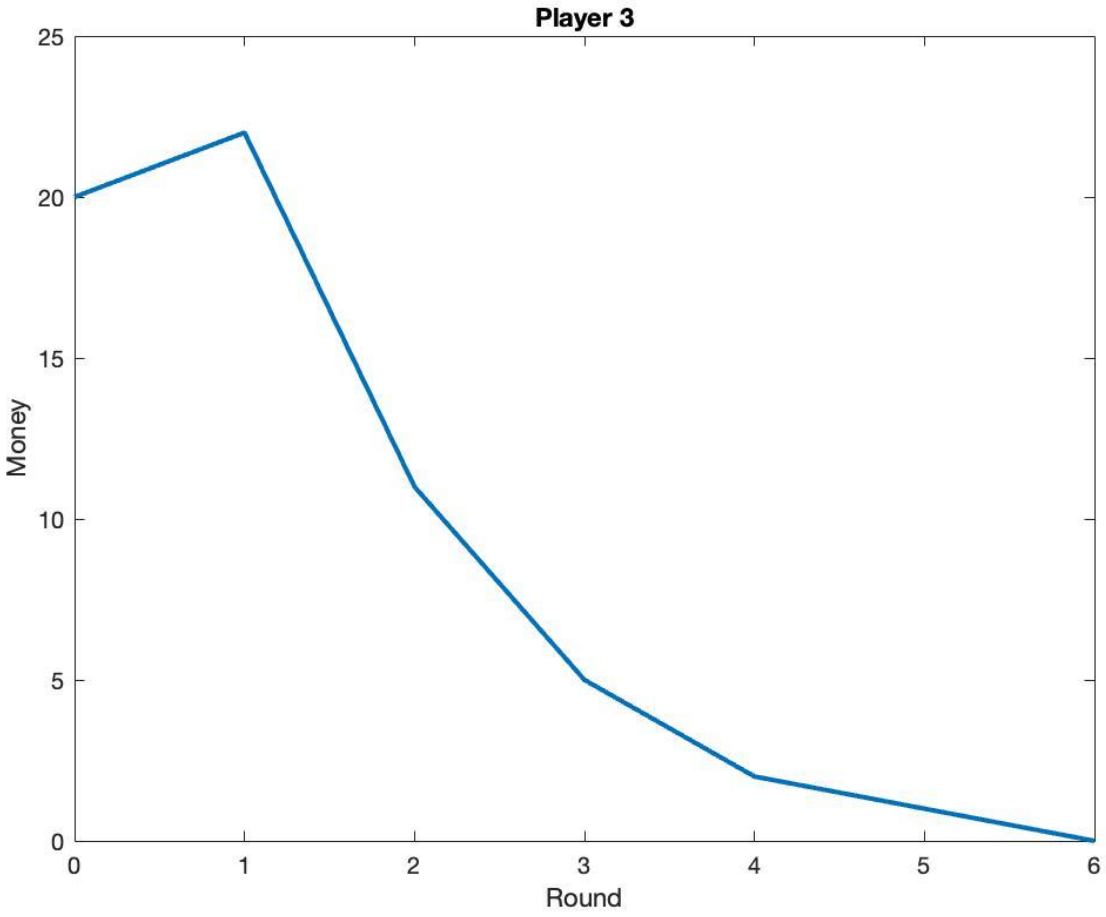
Lab 4:

Round 1 Starts...
Amount Remaining at end of Round 1: $22
Round 2 Starts...
Amount Remaining at end of Round 2: $11
Round 3 Starts...
Amount Remaining at end of Round 3: $5
Round 4 Starts...
Amount Remaining at end of Round 4: $2
Round 5 Starts...
Amount Remaining at end of Round 5: $1
Round 6 Starts...
Amount Remaining at end of Round 6: $0


Dealer
Money
Round
140
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
20


Player 1
Money
Round
90
80
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20


Player 2
Money
Round
0
10
20
30
40
50
60
70
80
90
0
2
4
6
8
10
12
14
16
18
20


Player 3
Money
Round
0
5
10
15
20
25
0
1
2
3
4
5
6