

# CS342: Software Design



September 26, 2017

# Agenda

## Project 1 discussion:

- Overview
- Code examples
- Class designs

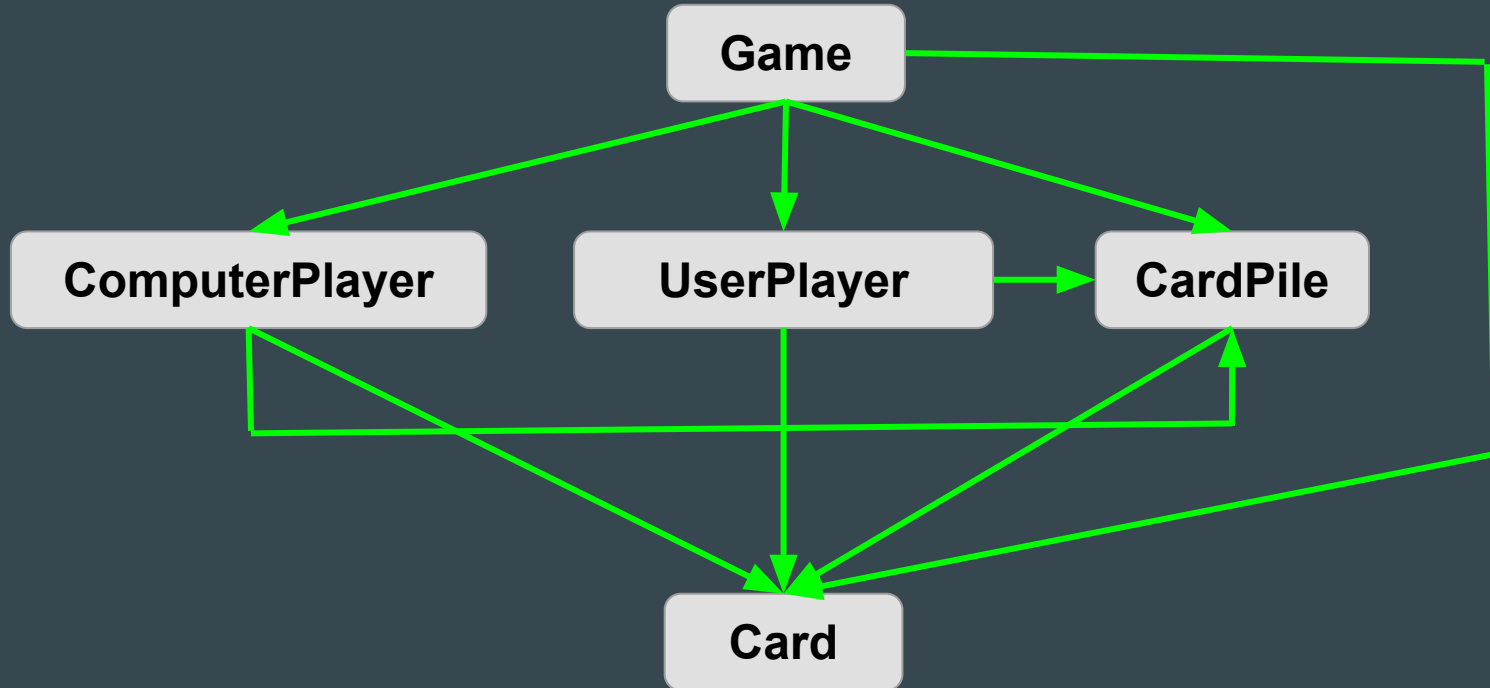
## Testing for Project 1

## Different levels of testing

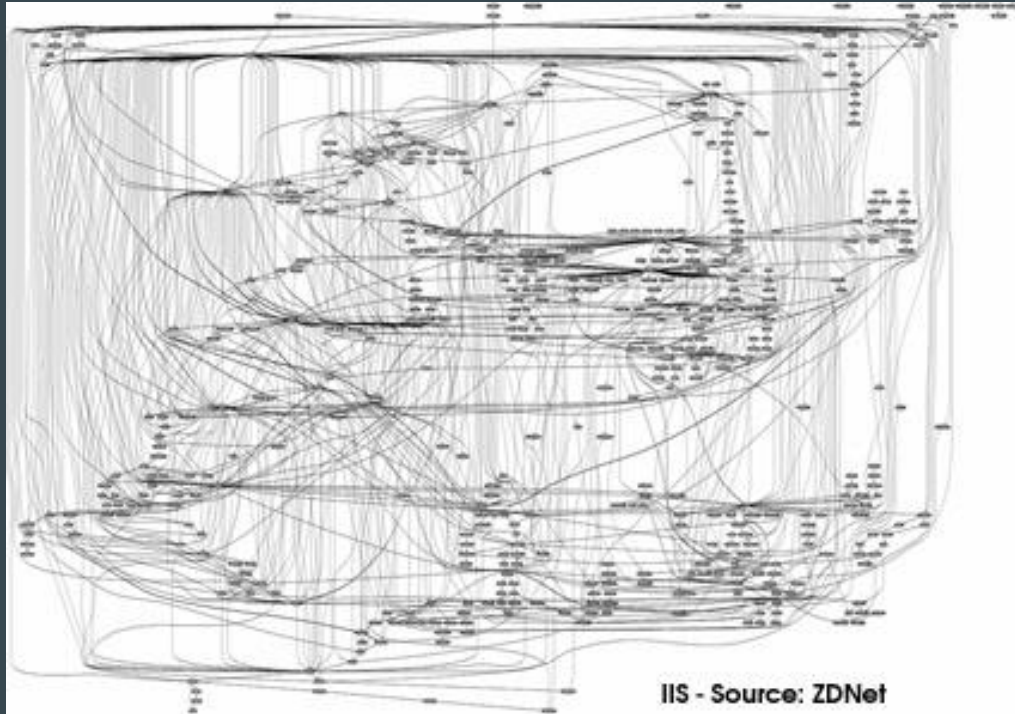
# Card Game: Poker - 5 Card Draw

1. A Card Class - This class will keep the information about each card.
2. A Card Pile Class - This class is a collection of cards. While this class **cannot** just be an instance of a Java Collection Class, you may use a Java Collection Class instance as a data member of the Card Pile Class.
3. A User Player Class - This class will keep track of the user's hand and interact with the user interface.
4. An Opponent Player Class - This class will keep track of the computer player's hand and interact with the Artificial Intelligence.
5. A Game Class - This class is to contain the method **main**. This class will also keep track of the particulars of the game, such as the order of actions of the game (shuffling, dealing, discarding and determining the winner) and the evaluation of the hand (does the player have a Straight Flush, Four of a Kind, Full House, etc.).  
Actually it might be better to divide this into two classes: one to deal with the order of the actions and one to evaluate the hands.

# Class dependency



You may get this when building large scale software...



# Cleaner class design

## Five CardDraw (Main): UI and orchestration

- Prompt # of players
- Trigger dealing
- User's turn
- AI's turn
- Display results

## Game Session: main logic and workflow

- Set up pile
- Instantiate Players
- Deal to Players
- Players replace cards
- Decide results and winners

**Computer Player**  
- AI function

**User Player**  
- Interactive selection

## Player Base class: common fields and methods for user and computer

- Add a card to hand
- Discard a card
- Has flush, has four suit, has etc
- Calculate rank
- Cal # of cards u can discard
- Get hand

**Card Pile**  
- Shuffle  
- Deal a card

**Card**

- Number, suit, string

# Main function class: orchestration

```
9 public class FiveCardDraw {
10
11     public static void main(String[] args) {
12         GameSession gameSession = new GameSession();
13         int numPlayers = promptPlayerNumber();
14         gameSession.SetPlayerNumber(numPlayers);
15         System.out.println("Starting Game. Dealing cards to " + numPlayers + " players");
16
17         gameSession.DealToAllPlayers();
18
19         displayHand(gameSession.GetUserPlayerHand());
20         displayReplaceInstruction(gameSession.GetUserReplaceChances());
21
22         gameSession.UserPlayerReplaceCards();
23
24         System.out.println("Your turn ends. Computer's turn");
25
26         gameSession.ComputerPlayersReplaceCards();
27
28         gameSession.CalculateRanking();
29
30         displayResults(gameSession.GetPlayersSortedByRanking());
31     }
32 }
```

# Main function class: UI

```
33 private int promptPlayerNumber() {
34     System.out.println("Welcome to Five Card Draw Game. Please enter number of players: ");
35     Scanner scanner = new Scanner(System.in);
36     int input2;
37     if (scanner.hasNextInt()) {
38         while (((numPlayers = scanner.nextInt()) > 3 || (numPlayers < 1))) {
39             System.out.println("Error.Please input a number between 1-3");
40         }
41     }else {
42         System.out.println("Error. Input is not a number. Exiting");
43     }
44     return input2;
45 }
46
47 private void displayHand (Card[] cards) {
48     System.out.println("Your hand currently:");
49     for (Card card : cards) {
50         //display card and index
51     }
52 }
53
54 //this should be refactored. UI is containing logic
55 private void displayReplaceInstruction(int numChances) {
56     if (numChances == 4) {
57         System.out.println("Since you have an Ace, you can keep the Ace and discard the oth
58     } else {
59         System.out.println("You can discard up to 3 cards");
60     }
61     System.out.println("List the card numbers you wish to discard. Type 'x' when done>");
62 }
63
64 private void displayResults (Result[] results) {
65     for (Result result : results) {
66         //print out result by rank, including type, hand, etc
67     }
68 }
69
```



# GameSession class: game level logic and workflow

```
3
4 public class GameSession {
5     private int numPlayers;
6     private UserPlayer userPlayer;
7     private ComputerPlayer [] computerPlayers;
8     private SessionStatus status; //Enumeration
9
10    public GameSession() { // do some initialization here
14    }
15
16    public void SetPlayerNumber(int num) {
23    }
24
25    public void DealToAllPlayers() {
33    }
34
35    public void UserPlayerReplaceCards() {
48    }
49
50    public void ComputerPlayersReplaceCards() {
65    }
66
67    public void CalculateRanking() {
72    }
73
74    public Result[] GetPlayersSortedByRanking() {
78    }
79
```

# Player classes

```
3
4 public class UserPlayer extends BasePlayer {
5     public int ScanAndValidateCardToDiscard() {
6         boolean validInput = false;
7         while(validInput) {
8             //scan for input
9             //if input is "X", break and return -1
10            //if input is between 1 and 5, break and return input
11            //otherwise repeat
12        }
13    }
14 }
```

```
4
5 public class OpponentPlayer extends BasePlayer {
6     public int AISelectCardToDiscard() {
7         // 1. First check if the computer player a
8         // 2. If the hand evaluates to "HighCard", deter
9         // 3. Next determine if the user has 4 car
10        // 4. Next if the user has an Ace, discard the othe
11        // 5. Otherwise, keep the two highest card
12    }
13
14 }
15 }
```

```
4 public class BasePlayer {
5
6     private int curNum = 0; //current number of cards in hand
7     private String name;
8     private Card[] hand = new Card[5]; //array of Card to hold all cards in
9
10    public UserPlayer(String _name){
11    }
12
13    public void ResolveReplaceChances () {
14    }
15
16    public void RepalceOneCard (int index, Card newCard) {
17        this.hand[index - 1] = newCard;
18    }
19
20    public int ScanAndValidateCardToDiscard() {
21    }
22
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33
34    public void addCard(Card c){
35    }
36
37    public boolean hasAce(){
38    }
39
40    public void reset(){
41    }
42
43    public boolean hasFlush()
44    {
45    }
46
47
48    public boolean hasFourSuit(CardPile pile, ArrayList<Card> discardPile)
49    {
50    }
51
52
53    //since the hand is straight. No need to discard any cards
54    public boolean hasStraight()
55    {
56    }
57
58    //if get here, no straight are found in hand
59    return false;
60 }
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```

# Card Class

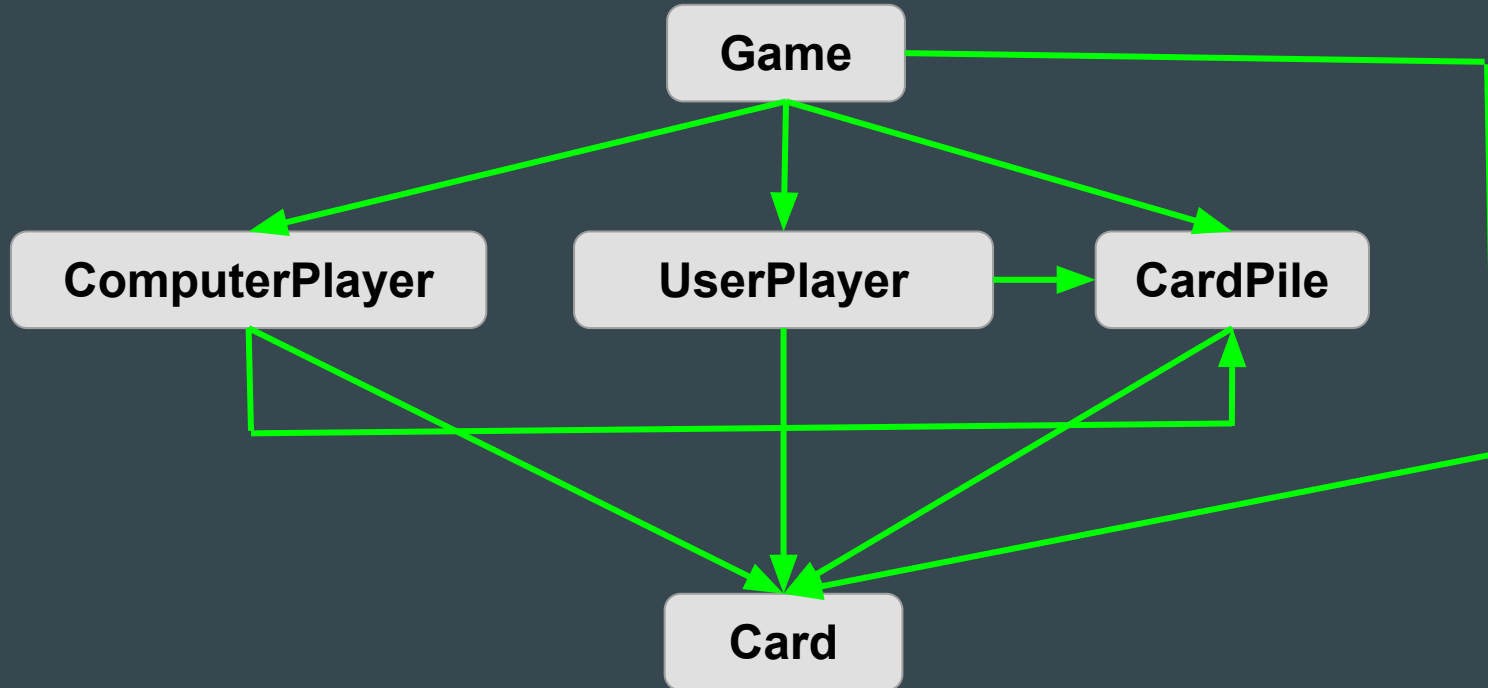
```
1
2 public class Card {
3
4     private int number;           //number of the card
5     private Suit suit;           //suit of the card
6     private static String[] Num = {"A","2","3","4","5"}
7
8
9     public Card(Suit s, int _number){
10        this.suit = s;
11        this.number= _number;
12    }
13
14    public String getString(){
15        return Num[number] + suit.toString();
16    }
17    public String getSuit(){
18        return this.suit.toString();
19    }
20    public int getNum(){
21        return this.number;
22    }
23 }
24
```

```
1  /*
2  C = Clubs
3  D = Diamonds
4  H = Hearts
5  S = Spades
6  */
7
8  public enum Suit {
9
10     C,
11     D,
12     H,
13     S,
14 }
```

Good job with the enum!

What test cases do we need here?

# Let's take another look: Class dependency



# And Cleaner class design

## Five CardDraw (Main): UI and orchestration

- Prompt # of players
- Trigger dealing
- User's turn
- AI's turn
- Display results

## Game Session: main logic and workflow

- Set up pile
- Instantiate Players
- Deal to Players
- Players replace cards
- Decide results and winners

## Computer Player

- AI function

## User Player

- Interactive selection

## Player Base class: common fields and methods for user and computer

- Add a card to hand
- Discard a card
- Has flush, has four suit, has etc
- Calculate rank
- Calculate # of cards u can discard
- Get hand

## Card Pile

- Shuffle
- Deal a card

## Card

- Number, suit, string

# Discussions

## Create Loosely coupled, self-contained classes

- Less dependent on other class
- Can perform its own domain of business
- Respect other's boundary. Don't overreach
- Separate UI vs. logic, and logic vs. data access
- One direction dependency.
- Layer: lower layer shouldn't be aware of higher layer. High layer shouldn't care **how** lower layer does its job
- Why separate frontend and backend classes?
- Easier to debug, read, maintain, and scale.

## What could have been done differently?

- Player show hands: move display part out of Player class
- "Hand" class?

# CardPile Class

```
13 public class CardPile {
14     //data structure used to hold collection of cards
15     private ArrayList<Card> pile;
16     //default constructor
17     public CardPile(){
18         pile = new ArrayList<Card>();
19         for(int a = 0; a <= 3; a++){
20             for(int b = 0; b <= 12; b++){
21                 pile.add( new Card(Suit.values()[a],b));
22             }
23         }
24         //shuffle the deck before dealing to players
25         System.out.println("The cards are being shuffled");
26         Collections.shuffle(pile);
27     }
28     public Card draw(){
29         return pile.remove(pile.size() - 1);
30     }
31     public int gettotal(){
32         return pile.size();
33     }
34 }
```

```
4
5 ▼ public class TestCardPile {
6
7     CardPile cardPile = new CardPile();
8
9     @Test
10 ▼ public void testCreateNewPile() {
11         assertEquals(52, cardPile.gettotal(), 0.0);
12         // Is this enough?
13     }
14     @Test
15 ▼ public void testDraw() {
16         int beforeNumber = cardPile.gettotal();
17         Card card = cardPile.draw();
18         int afterNumber = cardPile.gettotal();
19         assertEquals(beforeNumber, afterNumber + 1, 0.0);
20     }
21 }
22
```

What are we missing here?

# CardPile test continues

How do we test the drawn card should match the missing card from pile?

How do we access private methods and fields of CardPile?

```
4
5 ▼ public class TestCardPile {
6
7     CardPile cardPile = new CardPile();
8
9     private void verifyCardsAreComplete() {
10         //make sure all the 52 cards are still in the pile
11     }
12 ▼ private void checkRandomized() {
13         //sport check a few cards make sure they are not all in intial order
14         //use asserts...
15     }
16     private void verifyDrawnCardMatches() {
17         //
18     }
19     @Test
20 ▼ public void testCreateNewPile() {
21         assertEquals(52, cardPile.gettotal(), 0.0);
22         // we miss at least
23         checkRandomized();
24         verifyCardsAreComplete();
25     }
26     @Test
27 ▼ public void testDraw() {
28         int beforeNumber = cardPile.gettotal();
29         Card card = cardPile.draw();
30         int afterNumber = cardPile.gettotal();
31         assertEquals(beforeNumber, afterNumber + 1, 0.0);
32         //drawn card should match the missing card from pile
33     }
34 }
```



# BasePlayer Test

Test “hasAce”:

- Both positive and negative cases
- how many times do we need to run
- Same for hasFourSuit,

ResolveReplaceChances:  
need to test path hasAce  
and not haveAce

Hint: use @Before, @After  
to set up hands

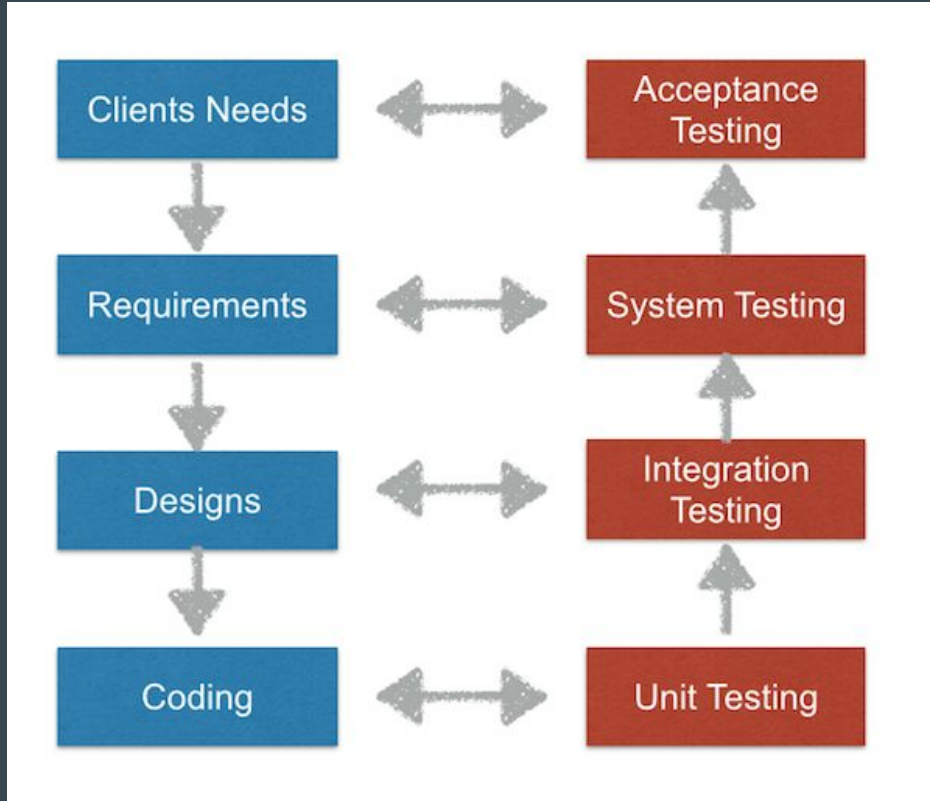
addCard() → hasAce() → ResolveReplaceChances()

```
public boolean hasAce(){
    if(this.hand[0].getNum() ==
        || this.hand[2].get
        return true;
    }
    else return false;
}
```

```
public boolean hasFlush()
{
    int hasFlush = 0;
    for(int i = 0; i < 4; i++){
        if(this.hand[i].getSuit
            hasFlush = 1;
        }
    }
    if(hasFlush == 0){
        return true;
    } else return false;
}
```

```
3
4 public class BasePlayer {
5     private int curNum = 0; //current number of cards in h
6     private String name;
7     private Card[] hand = new Card[5]; //array of Card
8
9     public UserPlayer(String _name){
10        this.name = _name;
11        this.reset();
12    }
13    public void ResolveReplaceChances () {
14        if (hasAce()) {
15            return 4;
16        }
17        return 3;
18    }
19    public void RepalceOneCard (int index, Card newCard) {
20        this.hand[index - 1] = newCard;
21    }
22    public int ScanAndValidateCardToDiscard() {
23
24    }
25
26    public void addCard(Card c){
27        if(curNum > 5) //something went wrong here
28        {
29            System.out.println("Error. Player should not have
30        }
31    }
32
33    //another check so that program doesnt go out of bound
```

# Different levels of testing



- UAT: real users
- System testing: QA
- Integration: Developers, maybe QA
- Unit testing: developers

# More about testing

- System testing vs. functional testing
- Regression testing
- Smoke testing
- Continuous testing
- Load/performance testing
- Edge case (what happen to GameSession if two players have same hand rank? What if someone's birthday is right at 0:00AM? What if...)