CISC 1600/1610 Computer Science I

Classes

Professor Daniel Leeds
dleeds@fordham.edu
JMH 328A

Data types

Single pieces of information
- one integer – `int`
- one symbol – `char`
- one truth value – `bool`

Multiple pieces of information
- group of symbols – `string`
- group of anything – ***array***
- group of multiple things – `struct`, ***`class`***

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Introducing: classes

- A **class** defines a new data type
- Each instance of a class is an **object**
- Each object can contain
  - Actions to perform (functions)
  - Information about the object (variables)

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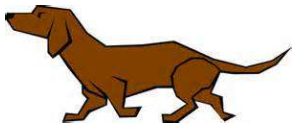
Class dog

Example information
- Size
- Weight
- Location



Example actions
- Eat
- Walk
- Bark

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Class syntax – declaration

```
class Dog
{
public:
   void Bark();
   void Eat(float foodQuantity);
   void Walk(float distance);
   float size, weight, location;
};
```

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Class syntax – function definitions

```
void Dog::Bark()
{
   cout << "Woof woof!\n";
}

void Dog::Eat(float foodQuantity)
{
   weight+=foodQuantity/2;
   size+=foodQuantity/10;
}
```

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Class syntax – create and use an object

```
int main()
{
   Dog fido;
   fido.weight=40.5;
   fido.size=10;
   fido.Eat(20);
   cout << fido.weight << " "
        << fido.size << endl;
   return 0;
}
```

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Typical program layout

```
class Dog {
   . . .
};
int main() {
   Dog fluffy;
   fluffy.Bark();
   . . .
}
void Dog::Bark() {
   . . .
}
```

Declaration

Usage

Definitions

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The Dot Operator `.`

- Used for functions and data of individual objects
- `fido.Bark()`

The Scope Resolution Operator `::`

- Used for functions of a class
- `Dog::Bark()`

Note: a function inside a class is called a "member function"

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Multiple instances of a class

```
int main()
{
   Dog fido, spot;
   fido.weight=40.5; fido.size=10;
   spot.weight=30; spot.size=7.5;
   fido.Eat(20); fido.Eat(2);
   cout << fido.weight << " "
        << spot.weight << endl;
   return 0;
}
```

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Time to walk the dog…

```
int main()
{
   Dog rufus;
   rufus.weight=35; rufus.size=7.2;
   rufus.location=5;
   rufus.Walk(3.4);
   cout << "New location for Rufus: "
        << rufus.location << endl;
   // Will output location 8.4
   return 0;
}
```

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Exercises

- Write the `Walk` function
- Modify the `Walk` function so the dog loses 0.2 pounds for every foot he walks
- Let's say dogs hide a bone at each location where they have stopped. Add an array `hiddenBones` that records each location where the dog object has hidden bones and modify `Walk` again to leave a record in `hiddenBones`

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Class syntax – declaration

```
class Dog
{
public:
   float size, weight, location;
   void Bark();
   void Eat(float foodQuantity);
   void Walk(float distance);
};
```

Member variables

Member functions

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Class syntax – create and use an object

```
int main()
{
   Dog fido;
   fido.weight=40.5;
   fido.Bark();
   ?? // Set fido's location to 3
   cout << ??; // output location
   ?? // Have fido change location
   return 0;
}
```

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`public` vs. `private`

- `public`: any function can see and use
- `private`: only visible to member functions
- Good style:
  - make all member variables private
  - use public functions to access and mutate variables

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Class declaration, take 2

```
class Cat
{
public:
   void set(float inWeight, float inSize,
            float inLoc);
   float getSize();
   float getWeight();
   float getLocation();
   . . .
   void Walk(float distance);
private:
   float size, weight, location;
};
```

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Function definitions – take 2

```
void Cat::set(float inWeight,
              float inSize,
              float inLoc)
{
   weight=inWeight;
   size=inSize;
   location=inLoc;
}
```

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Class usage – take 2

```
int main()
{
   Cat feline1;
   feline1.set(5.5,20.1,2);
   cout << feline1.location; // Error
   cout << feline1.getLocation()
        << endl;
   return 0;
}
```

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Bank account

Variables
- Name
- Current balance
- History of cash in (and out)

Functions
- Deposit:
  - Add entry to history
  - Update balance

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```
class Account {
public:
   void open(string inName);
   void deposit(float money);
   float getBalance();

private:
   string name;
   float balance;
};
```

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```
void Account::open(string inName){
   name=inName;
   balance=0;
}

void Account::deposit(float money) {
   if(money>=0) {
      balance = balance+money;
   }
   else {
     cout << "Error! "
          << "Negative deposit!\n";
   }
}
```

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What does this do?

```
int main()
{
  Account acc1;
  acc1.open("Tina");
  cout << acc1.getBalance() << endl;
  acc1.deposit(250);
  acc1.deposit(20.25);
  cout << acc1.getBalance() << endl;
}
```

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Withdrawal function?

- How can we write `withdraw` function to reduce the money in our account?
- How can we prevent over-drawing?

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Account review

Member variables
- `name`
- `balance`
- `history`, `num_transactions`

Member functions
- `open`
- `deposit`
- `getBalance`
- `withdraw`
- `printHistory`

New accessor function
- `string getName()`

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Declaring/initializing

- We can declare and then initialize a variable

```
int a;
a=1;
```

```
Account acc1;
acc1.open("Tiana");
```

- Or we can declare and initialize together

```
int b=1;
Account ...?
```

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Constructor functions

- Declaring and initializing object simultaneously

```
int main() {
  . . .
    Account acc1("Tiana",200.20);
  . . .}
```

- Constructor function(s) defined to initialize object

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Constructor definition

- Constructor has same name as class
- Constructor has no return type

```
Account::Account(string inName,
                 float inDollars)
{
   name=inName;
   balance=inDollars;
   history[0]=balance;
   num_transactions=1;
}
```

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Constructor definition

- Constructor has same name as class
- Constructor has no return type

```
Account::Account(string inName,
                 float inDollars)
{
   name=inName;
   if(inDollars>=0) {
     balance=inDollars;
     history[0]=balance;
     num_transactions=1;
   } else {
     cout << "Error, negative dollar amount!";
     exit(1);
   }
}
```

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Testing equality

- Simple variables can use ==

```
int a=5, b=7;
if(a==b)
   cout << "Variables equal\n";
```

- Complex variables cannot use ==

```
Account acc1("Tiana",20.50),
        acc2("Jim",9.95);
if(acc1==acc2) // Does not work!
   cout << "Accounts equal\n";
```

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Testing object equality

- Can use functions to test equality

```
Account acc1("Tiana",20.50),
        acc2("Jim",9.95);
if(acc1.equals(acc2))
   cout << "Accounts equal\n";
```

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Equality function

```
bool Account::equals(Account accA)
{  // test balance match
   if(balance!=accA.getBalance())
      return false;
   // test name match

   // don't worry about matching
   // histories
}
```

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Testing array equality:

```
int a[4]={4,-5,0,2}, b[4]={4,-5,0,2};
if(a==b) // Will not work correctly
  cout << "Equal arrays\n";
```

- Can use functions to test array equality

```
bool equalArrays(int arr1[], int size1,
                 int arr2[], int size2
{
}
```

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Abstraction

- Function – a set of actions called by one word
- Class – a set of data held in one word

Information hiding

- So long as action/data unit acts correctly, we don't need to know the details
- Hiding details can prevent accidents in programming (e.g., overdrawn account)

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