- Previous lecture:
  - Objects are passed by reference to functions
  - Details on class definition
    - Constructor
    - Methods
  - Overloading methods
- Today's lecture:
  - Array of objects
  - Methods that handle variable numbers of arguments
  - Attributes for properties and methods
- Announcements:
  - Discussion this week in Upson B7 lab
  - Prelim 2 to be returned at end of lecture. Unclaimed papers (and those on which student didn't indicate the lecture time) can be picked up after 5pm today during consulting hours (Su-R 5-10p) at ACCEL Green Rm (Carpenter Hall)

Overloading built-in functions

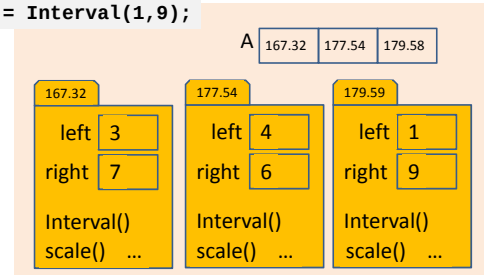
- You can change the behavior of a built-in function for an object of a class by implementing a function of the same name in the class definition
- Called "overloading"
- A typical built-in function to overload is **`disp`**
  - Specify which properties to display, and how, when the argument to **`disp`** is an object
  - Matlab calls **`disp`** when there's no semi-colon at the end of an assignment statement

See `Interval.m`

An "array of objects" is really an …

array of references to objects

```
>> A= Interval(3,7);
>> A(2)= Interval(4,6);
>> A(3)= Interval(1,9);
```



If a class defines an object that may be used in an array…

- Constructor must be able handle a call that does not specify any arguments
  - Use built-in command **`nargin`**, which returns the number of function input arguments passed
- An overloaded **`disp`** method, if implemented, should check for an input argument that is an array and handle that case explicitly. Details will be discussed next lecture.

Constructor that handles variable number of args

- When used inside a function, **`nargin`** returns the number of arguments that were passed

```
classdef Interval < handle

  properties
    left
    right
  end

  methods
    function Inter = Interval(lt, rt)

        Inter.left= lt;
        Inter.right= rt;

    end

    …

  end

end
```

Constructor that handles variable number of args

- When used inside a function, **`nargin`** returns the number of arguments that were passed
- If **`nargin`**≠2, constructor ends without executing the assignment statements. Then **`Inter.left`** and **`Inter.right`** get any default values defined under properties. In this case the default property values are **`[]`** (type **`double`**)

```
classdef Interval < handle

  properties
    left
    right
  end

  methods
    function Inter = Interval(lt, rt)
      if nargin==2
        Inter.left= lt;
        Inter.right= rt;
      end
    end

    …

  end

end
```

A function to create an array of Intervals

```
function inters = intervalArray(n)
% Generate n random Intervals.  The left and
% right ends of each interval is in (0,1)

for k = 1:n
  randVals= rand(1,2);
  if randVals(1) > randVals(2)
     tmp= randVals(1);
     randVals(1)= randVals(2);
     randVals(2)= tmp;
  end
  inters(k)= Interval(randVals(1),randVals(2));
end
```

See `intervalArray.m`

A function to find the biggest Interval in an array

```
function inter = biggestInterval(A)
% inter is the biggest Interval (by width) in
A, an array of Intervals
```

A weather object can make use of Intervals …

- Define a class LocalWeather to store the weather data of a city, including monthly high and low temperatures and precipitation
  - Temperature: low and high → an Interval
  - Precipitation: a scalar value
  - Include the city name: a string

```
classdef LocalWeather < handle

 properties
  city
  temps
  precip
 end

 methods
  …
 end

end
```

Weather data file

```
//Ithaca
//Monthly temperature and precipitation
//Lows (cols 4-8), Highs (col 12-16), precip (cols 20-24)
//Units:  English
      15      31    2.08
      17      34    2.06
      23      42    2.64
      34      56    3.29
      44      67    3.19
      53      76    3.99
      58      80    3.83
      56      79    3.63
      49      71    3.69
     NaN      59     NaN
      32      48    3.16
      22      36    2.40
```

Class `LocalWeather` should be able to construct an object from such data files, given the known file format.

See `ithacaWeather.txt`, `LocalWeather.m`

```
classdef  LocalWeather < handle

 properties
  city= '';
  temps= Interval.empty();
  precip
 end

 methods
  function lw = LocalWeather(fname)
   …
  end

  …
 end

end
```

Set property variable that will store an array of objects to the correct type, either under properties or in the constructor

```
classdef  LocalWeather < handle
 properties
  city=''; temps=Interval.empty(); precip=0;
 end
 methods
  function lw = LocalWeather(fname)
   fid= fopen(fname,'r');
   s= fgetl(fid);
   lw.city= s(3:length(s));
   for k= 1:3
      s= fgetl(fid);
   end
   for k=1:12
      s= fgetl(fid);
      lw.temps(k)= Interval(str2double(s(4:8), …
                            str2double(s(12:16)));
      lw.precip(k)= str2double(s(20:24));
   end
   fclose(fid);
  end
  …
 end  %methods
end  %classdef
```

```
//Ithaca
//Monthly temperature and p
//Lows (cols 4-8), Highs (c
//Units:  English
      15      31    2.08
      17      34    2.06
      23      42    2.64
      34      56    3.29
      44      67    3.19
      53      76    3.99
      58      80    3.83
      56      79    3.63
      49      71    3.69
     NaN      59     NaN
      32      48    3.16
      22      36    2.40
```

```
classdef LocalWeather < handle
  properties
    city=''; temps=Interval.empty();
    precip=0;
  end
  methods
    function lw = LocalWeather(fname)
      ...
    end

    function showCityName(self)

    end
    ...
  end  %methods
end  %classdef
```

Function to show data of a month of `LocalWeather`

```
function showMonthData(self, m)
% Show data for month m, 1<=m<=12.


end
```

Should display which month, the high and low temperatures, and precipitation

Function to show data of a month of `LocalWeather`

```
function showMonthData(self, m)
% Show data for month m, 1<=m<=12.

 mo= {'Jan','Feb','Mar','Apr','May','June',...
      'July','Aug','Sep','Oct','Nov','Dec'};
 fprintf('%s Data\n', mo{m})
 fprintf('Temperature range: ')
 disp(self.temps(m))
 fprintf('Average precipitation: %.2f\n', ...
         self.precip(m))
end
```

See `LocalWeather.m`

Observations about our class Interval

- We can use it (create Interval objects) anywhere
  - Within the Interval class, e.g., in method overlap
  - "on the fly" in the Command Window
  - In other function/script files – not class definition files
  - In another class definition
- Designing a class well means that it can be used in many different applications and situations