Intermediate Problems

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1 Intermediate Problems

1.1 MyRange and LinSpace Problem

Part 1

Let's create our own implementation of the range type. The `Range` type is what you get from `1:2:20`. It's form is `start:step:stop`. If you know `start`, `step`, and `stop`, how do you calculate the `i`th value? Create a type `MyRange` which stores `start`, `step`, and `stop`. Can you create a function `_MyRange(a,i)` which for `a` being a `MyRange`, it returns what `a[i]` should be? After getting this correct, use the Julia array interface in order to define the function for the `a[i]` syntax on your type.

[3]:

```julia
struct MyRange
    start
    step
    stop
end

function _MyRange(a::MyRange, i::Int)
    ans = a.start + (a.step)*(i-1)
    if ans > a.stop
        error("Index out of Range")
    else
        return ans
    end
end
```

[3]:

```
_MyRange (generic function with 1 method)
```

[5]:

```julia
_MyRange(MyRange(2,5,20),4)
```

[5]:

```
17
```

Part 2

A LinSpace object is a lazy representation of `N` values from `start` to `stop`. Use the Array interface to implement a lazy version of the LinSpace. Test against `range(start,stop=stop,length=N)`.

http://ucidatascienceinitiative.github.io/IntroToJulia/Html/ArrayIteratorInterfaces

(Note, Base's range type has extra accuracy enhancing changes. Just do the "simple" implementation")

[9]:

```
struct Mylinspace
    start
    stop
    length
end

function _Mylinspace(a::Mylinspace, i::Int)
    diff = (a.stop - a.start)/a.length
    ans = a.start + (i-1)*diff
    return ans
end
```

[9]:

```
_Mylinspace (generic function with 1 method)
```

[10]:

```
@show _Mylinspace(Mylinspace(1,20,100), 30)
@show range(1,stop=20,length=100)[30];
```

```
_Mylinspace(Mylinspace(1, 20, 100), 30) = 6.51
(range(1, stop=20, length=100))[30] = 6.565656565656566
```

Part 3 Check out the call overloading notebook:

http://ucidatascienceinitiative.github.io/IntroToJulia/Html/CallOverloading

Overload the call on the UnitStepRange to give an interpolated value at intermediate points, i.e. if a=1:2:10, then a(1.5)=2.

[14]:

```
(c::MyRange)(i::Float64) = (c.start + c.step * (i-1))
```

[15]:

```
r = MyRange(1,2,10)
r(1.5)
```

[15]:

```
2.0
```

1.2 Regression Problem

```
#### Prepare Data For Regression Problem

X = rand(1000, 3)               # feature matrix
a0 = rand(3)                    # ground truths
y = X * a0 + 0.1 * randn(1000);  # generate response

# Data For Regression Problem Part 2
```

```
X = rand(100);
y = 2X  + 0.1 * randn(100);
```

Given an Nx3 array of data (`randn(N,3)`) and a Nx1 array of outcomes, produce the data matrix `X` which appends a column of 1's to the front of the data matrix, and solve for the 4x1 array via `X  = b` using `qrfact`, or `\`, or the definition of the OLS estimator. (Note: This is linear regression).

Compare your results to that of using `llsq` from `MultivariateStats.jl` (note: you need to go find the documentation to find out how to use this!). Compare your results to that of using ordinary least squares regression from `GLM.jl`.

[17]:
```
#### Prepare Data For Regression Problem

X = rand(1000, 3)               # feature matrix
a0 = rand(3)                    # ground truths
y = X * a0 + 0.1 * randn(1000);  # generate response
```

[31]:
```
_X = hcat(X,ones(1000))

  = _X\y
println("Actual:$a0 ")
println("Calculated: $( [1:3])")
```

```
Actual:[0.357679, 0.863759, 0.510622]
Calculated: [0.351879, 0.867535, 0.523324]
```

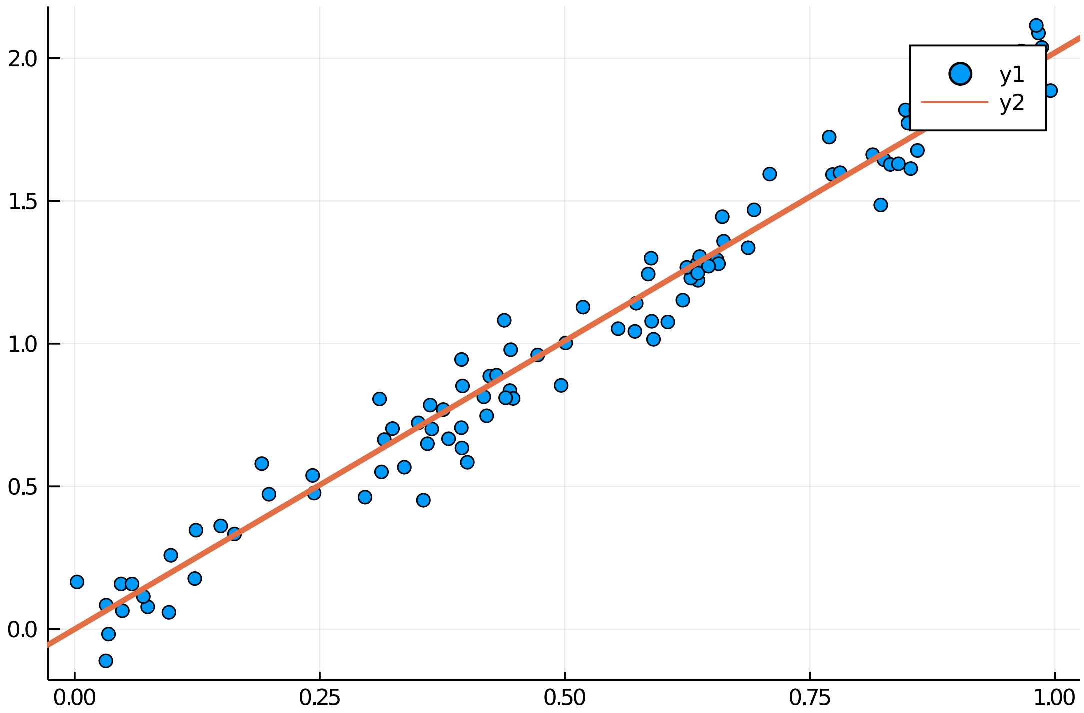
Regression Problem Part 2 Using your OLS estimator or one of the aforementioned packages, solve for the regression line using the (X,y) data above. Plot the (X,y) scatter plot using `scatter!` from Plots.jl. Add the regression line using `abline!`. Add a title saying "Regression Plot on Fake Data", and label the x and y axis.

[32]:
```
# Data For Regression Problem Part 2
X = rand(100);
y = 2X  + 0.1 * randn(100);
```

[35]:
```
using Plots
@show   = X\y
scatter(X,y)
Plots.abline!( [1],0.0, lw=3)
```

```
 = X \ y = 2.0196208903196835
```

[35]:


2.0
1.5
1.0
0.5
0.0
0.00
0.25
0.50
0.75
1.00
y1
y2

```
[ ]:
```