



System	<pre>pwd() # print working directory cd("/Users/sswatson") # change directory readdir() # files and folders in current directory</pre>	<pre>import os os.getcwd() os.chdir("/Users/sswatson") os.listdir()</pre>	<pre>getwd() setwd("/Users/sswatson/") dir()</pre>
Packages	<pre>using Pkg; Pkg.add("Plots") using Plots</pre>	<pre>import numpy as np import matplotlib.pyplot as plt from sympy import *</pre>	<pre>install.packages('ggplot2') library(ggplot2)</pre>
Arithmetic	<pre>x = (1 + 2^3) % 4 x == 1 # returns true</pre>	<pre>x = (1 + 2**3) % 4 x == 1</pre>	<pre>x <- (1 + 2^3) %% 4 x == 1</pre>
Strings	<pre>length("Hello World") # string length "Hello" + "World" # concatenation join(["Hello", "World"], ",") # joining split("Hello, World", ",") # splitting 'H' # single-quotes are for characters, not strings</pre>	<pre>len('Hello world') 'Hello' + 'World' ','.join(['Hello', 'World']) 'Hello, World'.split(',') 'Hello, World' # alternate string syntax</pre>	<pre>nchar('Hello World') paste('Hello', 'World') paste(c('Hello', 'World'), collapse='') strsplit('Hello, World', ',') "Hello, World" # alternate string syntax</pre>
Booleans	<pre>true && false == false # and false true == true # or !true == false # not</pre>	<pre>True and False == False False or True == True not True == False</pre>	<pre>TRUE && FALSE == FALSE FALSE TRUE == TRUE !TRUE == FALSE</pre>
Loops	<pre>for i in 1:10 print(i) end while x > 0 x -= 1 end</pre>	<pre>for i in range(1,11): print(i) while x > 0: x -= 1</pre>	<pre>for (i in 1:10) { print(i) } while (x > 0) { x = x - 1 }</pre>
Conditionals	<pre>if x > 0 print("x is positive") elseif x == 0 print("x is zero") else print("x is negative") end # ternary conditional x > 0 ? 1 : -1</pre>	<pre>if x > 0: print('x is positive') elif x == 0: print('x is zero') else: print('x is negative') 1 if x > 0 else -1</pre>	<pre>if (x > 0) { print('x is positive') } else if (x == 0) { print('x is zero') } else { print('x is negative') } ifelse(x>0, 1, -1)</pre>
Functions	<pre>function f(x,y) x² = x * x # \^2[tab] gives the unicode superscript x² + sqrt(y*x²+1) end # -or- f(x) = x² + sqrt(y*x²+1) # -or- (anonymous) x -> x² + sqrt(y*x²+1)</pre>	<pre>def f(x,y): x2 = x * x return x2 + (y*x2+1)**(1/2) # -or- lambda x: x**2 + (y*x**2+1)**(1/2)</pre>	<pre>f <- function(x,y) { x2 <- x * x x2 + sqrt(y*x2+1) }</pre>
Splatting	<pre>args = [1,2] kwargs = (tol=0.1, maxiter=100) # a NamedTuple f(args...;kwargs...) # equiv. to f(1, 2; tol=0.1, maxiter=100)</pre>	<pre>args = [1,2] kwargs = {'tol':0.1, 'maxiter':100} # a dictionary f(*args, **kwargs) # equiv. to f(1, 2, tol=0.1)</pre>	<pre>library(plyr) splat(f)(c(1,2)) # equiv. to f(1,2)</pre>
Lists	<pre>myArray = [1, 2, "a", [10,8,9]] myArray[3] == "a" myArray[4][2] == 8 myArray[end] == [10, 8, 9] 2 in myArray</pre>	<pre>myList = [1, 2, "a", [10,8,9]] myList[2] == "a" myList[3][2] == 9 myList[-1] == [10, 8, 9] 2 in myList</pre>	<pre>myList <- list(1, 2, "a", list(10,8,9)) myList[3] == "a" myList[4][2] == 8 myList[length(myList)] # returns list(10,8,9) 2 %in% myList</pre>

			
Mapping and Filtering	<pre># list the subtotals for items with quantity less than 4 fruits = ["apples", "oranges", "pears"] prices = [1.60, 1.15, 0.85] quantities = [1, 4, 3] [(f, p*q) for (f,p,q) in zip(fruits, prices, quantities) if q < 4]</pre>	<pre># exactly the same as the Julia code fruits = ["apples", "oranges", "pears"] prices = [1.60, 1.15, 0.85] quantities = [1, 4, 3] [(f, p*q) for (f,p,q) in zip(fruits, prices, quantities) if q < 4]</pre>	<pre># we use Map to replicate Julia and Python's list comprehension with zip fruits <- c("apples", "oranges", "pears") prices <- c(1.60, 1.15, 0.85) quantities <- c(1, 4, 3) Map(function(f,p,q) list(f,p*q), fruits, prices, quantities)[quantities<4]</pre>
Ranges	<pre>range(0, 2π, step=0.1) # or 0:0.1:2π range(0, 2π, length=100) # or LinRange(0,2π,100) collect(0:5) == [0,1,2,3,4,5] # collect a range to get a vector</pre>	<pre>np.arange(0, 2*np.pi, step=0.1) np.linspace(0, 2*np.pi, num=100) list(range(5)) == [0,1,2,3,4]</pre>	<pre>seq(0, 2*pi, by=0.1) seq(0, 2*pi, length=100) 0:5 == c(0,1,2,3,4,5)</pre>
Vectors and matrices	<pre>A = [1 2; 3 4] # matrix with rows [1 2] and [3 4] b = [1, 2] # (column) vector A' # transpose size(A) # matrix dimension: (2, 2) A \ b # solve the equation AX = b b .> 0 # elementwise comparison A.^2 # elementwise product A * A # matrix product findall(x -> x>0, b) # indices of positive values fill(2, (10,10)) # 10 x 10 matrix of 2's I # multiplicative identity hcat(A, b') # (or [A b']) concatenate side-by-side vcat(A, b) # (or [A;b']) concatenate vertically</pre>	<pre>A = np.array([[1, 2], [3, 4]]) b = np.array([1, 2]) np.transpose(A) # or A.T A.shape np.linalg.solve(A, b) b > 0 # elementwise comparison b**2 # elementwise function application A @ A # matrix product np.where(b > 0) np.full((10,10), 2) np.eye(4) # 4 x 4 identity matrix np.hstack((A,b[:np.newaxis])) np.vstack((A,b))</pre>	<pre>A <- matrix(c(1,3,2,4),nrow=2) # column-wise! b <- c(1,2) t(A) dim(A) solve(A,b) b > 0 # elementwise comparison A^2 # elementwise product A %*% A # matrix product which(b > 0) matrix(rep(2,100), nrow=10) diag(4) cbind(A,b) rbind(A,b)</pre>
Slicing	<pre>A = rand(10,10) A[1:5,1:2:end] # first five rows, odd-indexed columns</pre>	<pre>A = np.random.rand(10,10) A[:5,1::2]</pre>	<pre>A <- matrix(runif(100), nrow=10) A[1:5, seq(1,10,by=2)]</pre>
Random numbers	<pre>using Random; Random.seed!(1234) rand(10,10) # matrix with Unif[0,1]'s randn(10) # vector with N(0,1)'s rand(10:99) # random two-digit number</pre>	<pre>np.random.seed(1234) np.random.rand(10,10) np.random.randn(10) np.random.randint(10,100)</pre>	<pre>set.seed(1234) matrix(runif(100),nrow=10) rnorm(10) sample(10:99,1)</pre>
Data frames and Query	<pre>using DataFrames, FileIO myDataFrame = DataFrame(load("data.csv")) save("mydata.csv", myDataFrame) using Query, RCall # get nycflights13 data from R rcopy(R"nycflights13::flights") > # (> is the pipe operator) @filter(_month == 1 && _day < 5 && # (_^2 is short for x + x^2) _air_time != NA && _distance != NA) > # filter rows @orderby(_day) > @thenby(_distance) > # sort rows @select(:month, :day, :distance, :air_time) > # select columns @mutate(speed = _distance / _air_time * 60) > # new columns @groupby(_day) > # grouping @map({day = key(_), avgspeed = mean(_speed)}) # aggregating</pre>	<pre>import pandas as pd myDataFrame = pd.read_csv("data.csv") myDataFrame.to_csv("mydata.csv") from rpy2.robjects import r, pandas2ri, conversion, default_converter from rpy2.robjects.packages import importr; importr('nycflights13') with conversion.localconverter(default_converter + pandas2ri.converter): flights = pandas2ri.conversion.rpy2py(r['flights']) (flights.query('month == 1 & day < 5') .sort_values(['day', 'distance']) [['month', 'day', 'distance', 'air_time']] .assign(speed = lambda df: df.distance/df.air_time * 60) .groupby('day') .agg({'speed': 'mean'}))</pre>	<pre>myDataFrame = read.csv("data.csv") write.csv(myDataFrame, "mydata.csv") library(dplyr); library(nycflights13) flights %>% filter(month == 1, day < 5) %>% arrange(day, distance) %>% select(month, day, distance, air_time) %>% mutate(speed = distance / air_time * 60) %>% group_by(day) %>% summarise(avgspeed = mean(speed, na.rm=TRUE))</pre>
Plotting	<pre>using StatsPlots # select the rows with an air_time value and plot a histogram histogram(filter(!missing, flights[:air_time])) # scatter plot (using the first 10,000 records) flights[1:10^4,:] > @df scatter(:air_time, :distance, group=:carrier)</pre>	<pre>import seaborn as sns # histogram sns.distplot(flights['air_time'].dropna()) # scatter plot sns.pairplot(flights, x_vars='air_time', y_vars='distance', hue='carrier', plot_kws={'alpha': 0.2})</pre>	<pre>library(ggplot2) # aesthetic mapping: connects data to visual elements (x, y, size, color) # geom: geometric object used to represent data (point, line, bar) # geom functions return layers that you add to a ggplot ggplot(data = flights) + geom_point(mapping=aes(x=air_time,y=distance,color=carrier),alpha=0.2)</pre>
Optimization	<pre>using Optim rosenbrock(x) = (1.0 - x[1])^2 + 100.0 * (x[2] - x[1]^2)^2 result = optimize(rosenbrock, zeros(2), BFGS())</pre>	<pre>from scipy.optimize import minimize def rosenbrock(x): return (1-x[0])**2 + 100*(x[1]-x[0]**2)**2 minimize(rosenbrock, [0,0], method='BFGS')</pre>	<pre>rosenbrock <- function(x) { (1-x[1])^2 + 100*(x[2]-x[1]^2)^2 } optim(c(0,0), rosenbrock, method = "BFGS")</pre>
Root finding	<pre>using Roots f(x) = exp(x) - x^4 find_zero(f,3)</pre>	<pre>import numpy as np from scipy.optimize import root def f(x): return np.exp(x[0]) - x[0]**4 root(f, [0])</pre>	<pre>f <- function(x) { exp(x) - x^4 } uniroot(f,c(0,3))</pre>