DSI Summer Workshops Series

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This Notebook is available at: http://bitly.com/UHDSInotebook1 (http://bitly.com/UHDSInotebook1)

You can already download it! Use the "Save Link as" method.

Please make sure you have a copy of R up and running, as well as a Python 3 installation (ideally from Anacodna).

Goals for today

Understand basics of text analysis using R

(well enough so that you can Google your problems, find the answer, and implement it.)

More specifically

1. Up and running with R & IPython
2. Understand a basic exploratory data analysis workflow
3. Basics of R and Topic Modeling

Why R and not Python

It's good for data exploration!

Part 1: Getting yourself ready

First: Install software on your computer

- R CRAN (https://www.anaconda.com/download/)
- PythonAnaconda (https://www.anaconda.com/download/)

Second: Prep your R environment

On a Mac open a terminal and start R

```
[plindner@peggys-mbp:~$ R

R version 3.5.0 (2018-04-23) -- "Joy in Playing"
Copyright (C) 2018 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin15.6.0 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Previously saved workspace restored]

>
```
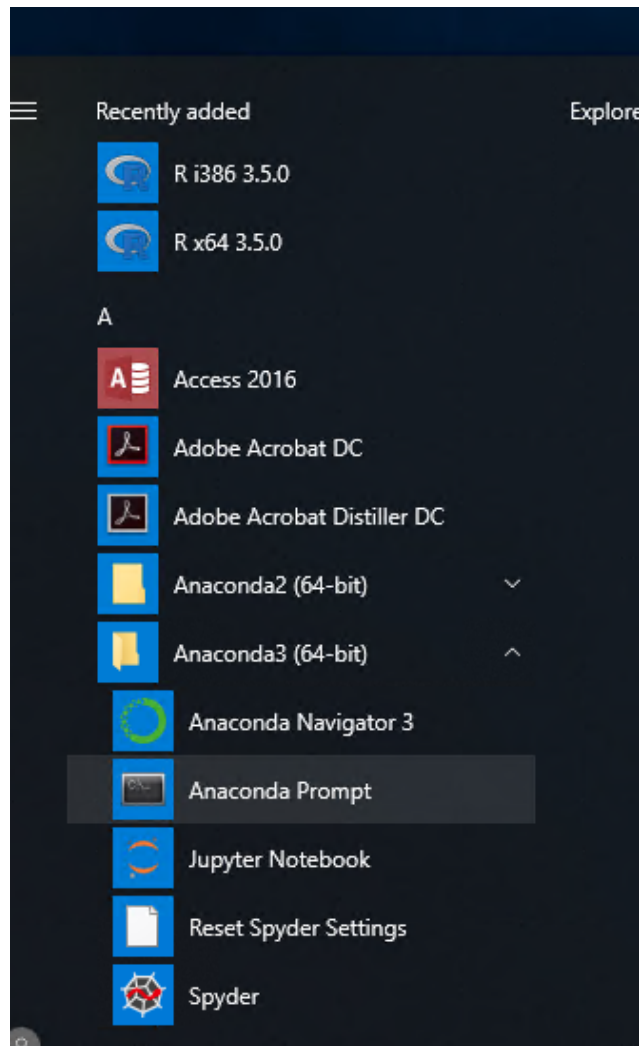
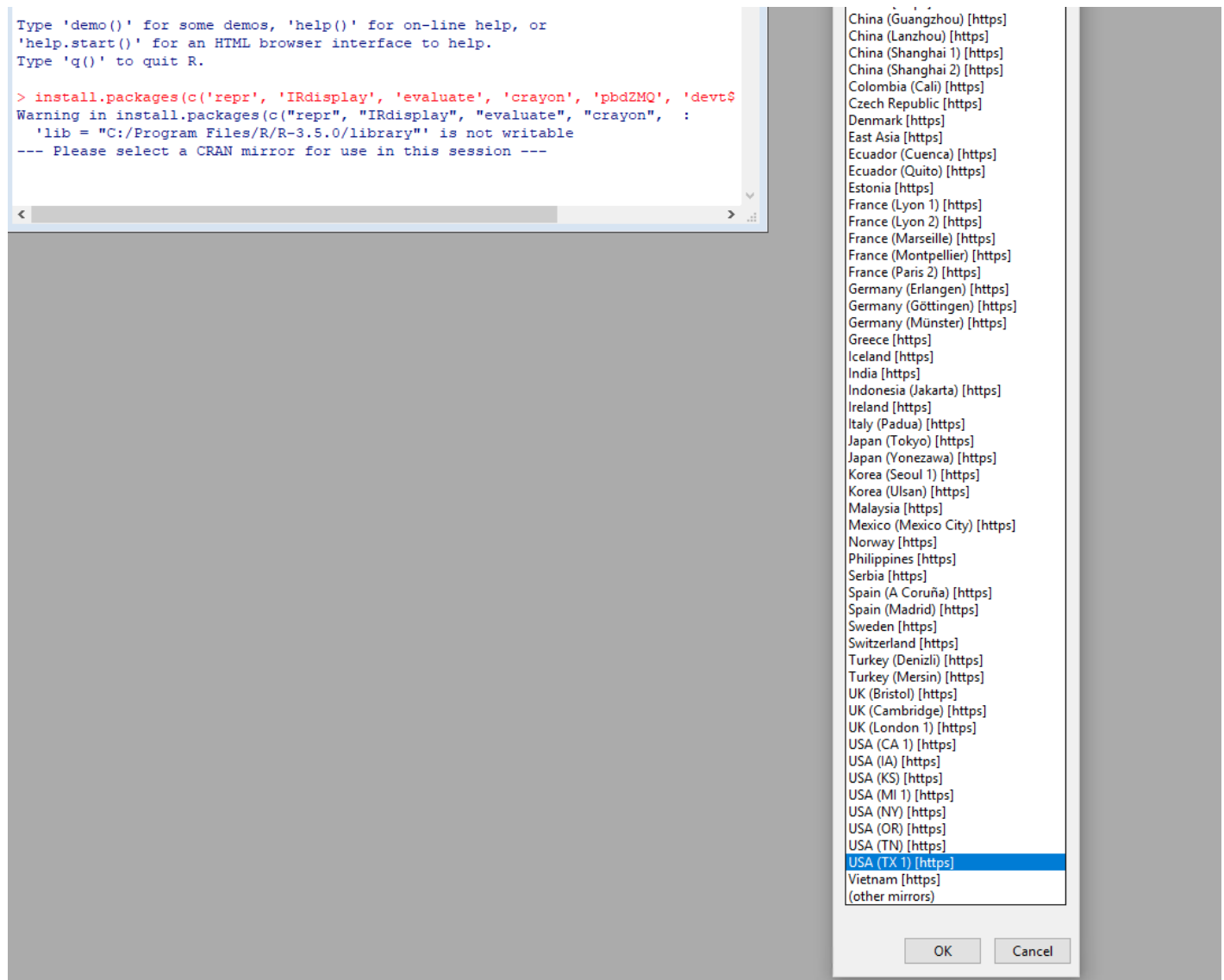On Windows: Open the Anaconda Command line and start R


```
(C:\ProgramData\Anaconda3) C:\> cd C:\Program Files\R\R-3.5.0\bin\x64\

(C:\ProgramData\Anaconda3) C:\Program Files\R\R-3.5.0\bin\x64>R

R version 3.5.0 (2018-04-23) -- "Joy in Playing"
Copyright (C) 2018 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

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Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> IRkernel::installspec()
[InstallKernelSpec] Installed kernelspec ir in C:\Users\plindner\AppData\Roaming\jupyter\kernels\ir
> q()
```

Now let's install some packages ...

```
> install.packages(c('repr', 'IRdisplay', 'evaluate', 'crayon', 'pbdZMQ', 'devtoo
ls', 'uuid', 'digest'))
> devtools::install_github('IRkernel/IRkernel')
```

When you see "Please select a CRAN mirror" , well select one.

```
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> install.packages(c('repr', 'IRdisplay', 'evaluate', 'crayon', 'pbdZMQ', 'devt$
Warning in install.packages(c("repr", "IRdisplay", "evaluate", "crayon",  :
  'lib = "C:/Program Files/R/R-3.5.0/library"' is not writable
--- Please select a CRAN mirror for use in this session ---
```

```
China (Guangzhou) [https]
China (Lanzhou) [https]
China (Shanghai 1) [https]
China (Shanghai 2) [https]
Colombia (Cali) [https]
Czech Republic [https]
Denmark [https]
East Asia [https]
Ecuador (Cuenca) [https]
Ecuador (Quito) [https]
Estonia [https]
France (Lyon 1) [https]
France (Lyon 2) [https]
France (Marseille) [https]
France (Montpellier) [https]
France (Paris 2) [https]
Germany (Erlangen) [https]
Germany (Göttingen) [https]
Germany (Münster) [https]
Greece [https]
Iceland [https]
India [https]
Indonesia (Jakarta) [https]
Ireland [https]
Italy (Padua) [https]
Japan (Tokyo) [https]
Japan (Yonezawa) [https]
Korea (Seoul 1) [https]
Korea (Ulsan) [https]
Malaysia [https]
Mexico (Mexico City) [https]
Norway [https]
Philippines [https]
Serbia [https]
Spain (A Coruña) [https]
Spain (Madrid) [https]
Sweden [https]
Switzerland [https]
Turkey (Denizli) [https]
Turkey (Mersin) [https]
UK (Bristol) [https]
UK (Cambridge) [https]
UK (London 1) [https]
USA (CA 1) [https]
USA (IA) [https]
USA (KS) [https]
USA (MI 1) [https]
USA (NY) [https]
USA (OR) [https]
USA (TN) [https]
USA (TX 1) [https]
Vietnam [https]
(other mirrors)
```

[OK]   [Cancel]

... one last step - installing the Kernel

```
> IRkernel::installspec()
```

Now we can close the R environment (but leave your terminal and console open)

```
> quit()
```

Say "N" (no) when asked to save the workspace.

Jupyter Notebooks is what we will be going to use

We are now ready to start up our Jupyter Environment from the terminal or the console:

```
$ jupyter notebook --notebook-dir C:/Users/[your username]
```

```
or on a Mac
```

```
$ jupyter notebook --notebook-dir /Users/[your username]
```

And your browser should open at the address: http://localhost:8888/tree (http://localhost:8888/tree)

Open the downloaded notebook on your computer

Quick intro to Jupyter notebooks

Cells can be Markdown (like this one) or code

To start off with

Make sure you hit `Shift-Enter` or `Ctrl-Enter` when you are done.

```
In [ ]:  2 + 2
```

Part 2: The Exploratory Analysis Workflow
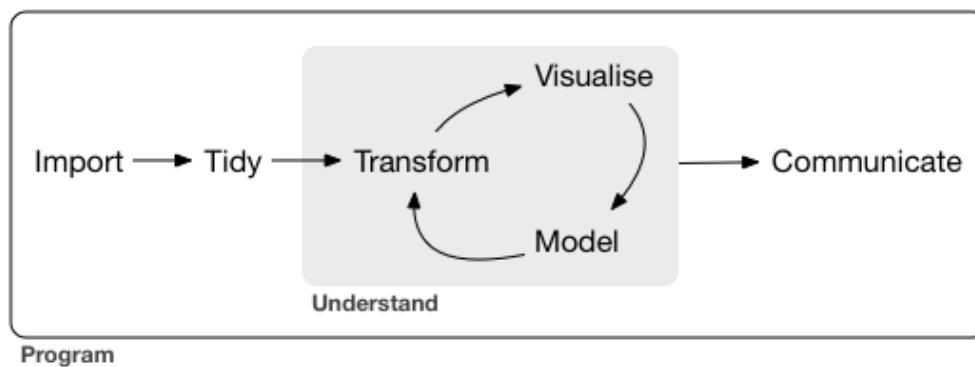
Image source: Hadley Wickham, R for Data Science

Our Example

Media Analysis of a bunch of articles downloaded from a database called "Factiva"

Make sure you download the data source file: http://bit.ly/UHDSIdata1 (http://bit.ly/UHDSIdata1) and store it in the Jupyter notebook directory (next to the *.ipynb file)

Frequently used R Packages in conjunction with text data

- readr (https://cran.r-project.org/web/packages/readr/readr.pdf) Import data

Data Analysis of text based material

- stringr (https://cran.r-project.org/web/packages/stringr/vignettes/stringr.html) Clean up text
- SnowballC (https://cran.r-project.org/web/packages/SnowballC/SnowballC.pdf) Stemming of words
- tm (https://cran.r-project.org/web/packages/tm/vignettes/tm.pdf) Text mining
- Quanteda (https://quanteda.io/) veratile text analysis tool
- topicmodels (https://www.tidytextmining.com/topicmodeling.html) Topic Modeling

Visualization

- ggplot2 (http://ggplot2.tidyverse.org/) Modern R visulaizations
- wordcloud (http://developer.marvel.com) Make some nice word clouds
- RColorBrewer (https://dataset.readthedocs.org/en/latest/) Get color into your visualizations

```
In [ ]:  #load all required libraries
         library(readr)
         library(stringr)
         library(SnowballC)
         library(wordcloud)
         library(RColorBrewer)
         library(tm)
         library(ggplot2)
         library(topicmodels)
```

Data Import

```
In [ ]:  # put the name of your csv file
         inputfile <- "AJA_Factiva.txt"
         # read the data
         alldata <- read_file(inputfile)
         # look at the dat
         # what type is our data?
         str(alldata)
```

Prepare data

```
In [ ]:  # data wrangling - split the file in different articles
         split.word <- "Document AJAZEN(.*)"

         # split up into individual documents
         list_alldata_splitted <- str_split(alldata, split.word)
         # convert to vector and remove last element (which is a leftover)
         alldata_splitted <- unlist(list_alldata_splitted)
         alldata_splitted <- alldata_splitted[-length(alldata_splitted)]
         str(alldata_splitted)
```

```
In [ ]:  ### create corpus
         article.corpus <- Corpus(VectorSource((alldata_splitted)))

         article.corpus
```

```
In [ ]:  #inspect a particular document
         writeLines(as.character(article.corpus[[30]]))
```

```
In [ ]:  #Check details (look at bunched up corpus to find anomalies)
         inspect(article.corpus)
```

Data cleaning

```
In [ ]:  #create the toSpace content transformer
         toSpace <- content_transformer(function(x, pattern) { return (gsub(pattern, "
          ", x))})
         #to remove potentially problematic symbols
         article.corpus <- tm_map(article.corpus, toSpace, "-")
         article.corpus <- tm_map(article.corpus, toSpace, ":")
         article.corpus <- tm_map(article.corpus, toSpace, "'")
         article.corpus <- tm_map(article.corpus, toSpace, "'")
         article.corpus <- tm_map(article.corpus, toSpace, " -")

         #Good practice to check after each step.
         writeLines(as.character(article.corpus[[30]]))
```

```
In [ ]:  #Remove punctuation - replace punctuation marks with " "
         article.corpus <- tm_map(article.corpus, removePunctuation)

         #Good practice to check after each step.
         writeLines(as.character(article.corpus[[30]]))
```

```
In [ ]:  #Transform to lower case
         article.corpus <- tm_map(article.corpus,content_transformer(tolower))

         #Strip digits
         article.corpus <- tm_map(article.corpus, removeNumbers)

         #Remove stopwords from standard stopword list
         article.corpus <- tm_map(article.corpus, removeWords, stopwords("english"))

         #inspect output
         writeLines(as.character(article.corpus[[30]]))
```

Stopwords (https://github.com/arc12/Text-Mining-Weak-Signals/wiki/Standard-set-of-english-stopwords)

```
In [ ]:  #define and eliminate all custom stopwords
         myStopwords <- c("monday")
         article.corpus <- tm_map(article.corpus, removeWords, myStopwords)

         #Strip whitespace (cosmetic?)
         article.corpus <- tm_map(article.corpus, stripWhitespace)

         #inspect output
         writeLines(as.character(article.corpus[[30]]))
```

Word Stemming (http://www.omegahat.net/Rstem/stemming.pdf)

```
In [ ]:  #Stem document
         article.corpus <- tm_map(article.corpus,stemDocument)

         #inspect output
         writeLines(as.character(article.corpus[[30]]))
```

Prepare for Analysis - create word counts

```
In [ ]:  #Create document-term matrix
         dtm <- DocumentTermMatrix(article.corpus)

         dtm
```

```
In [ ]:  #inspect segment of document term matrix
         inspect(dtm[15:16,100:105])
```

```
In [ ]:  #collapse matrix by summing over columns - this gets total counts (over all d
         ocs) for each term
         freq <- colSums(as.matrix(dtm))
         #length should be total number of terms
         length(freq)
```

```
In [ ]:  #create sort order (descending)
         ord <- order(freq,decreasing=TRUE)
         #inspect most frequently occurring terms
         freq[head(ord)]
         #inspect least frequently occurring terms
         freq[tail(ord)]

         #List all terms in decreasing order of freq and write to disk
         write.csv(freq[ord],"word_freq.csv")
```

```
In [ ]:  #alterantive: remove very frequent and very rare words
         dtmr <-DocumentTermMatrix(article.corpus, control=list(wordLengths=c(4, 20),
                                     bounds = list(global = c(3,27))))

         dtmr

         freqr <- colSums(as.matrix(dtmr))
         #length should be total number of terms
         length(freqr)

         #create sort order (desc)
         ordr <- order(freqr,decreasing=TRUE)
         #inspect most frequently occurring terms
         freqr[head(ordr)]
         #inspect least frequently occurring terms
         freqr[tail(ordr)]
```

```
In [ ]:  #list most frequent terms. Lower bound specified as second argument
         findFreqTerms(dtmr,lowfreq=60)
```

Now that we have the most frequently occurring terms in hand, we can check for correlations between some of these and other terms that occur in the corpus. In this context, correlation is a quantitative measure of the co-occurrence of words in multiple documents.

```
In [ ]:  #correlations
         findAssocs(dtmr,"turkish",0.5)
         findAssocs(dtm,"children",0.5)
```

One needs to specify the DTM, the term of interest and the correlation limit. The latter is a number between 0 and 1 that serves as a lower bound for the strength of correlation between the search and result terms. For example, if the correlation limit is 1, findAssocs() will return only those words that always co-occur with the search term. A correlation limit of 0.5 will return terms that have a search term co-occurrence of at least 50% and so on.

Visualizations
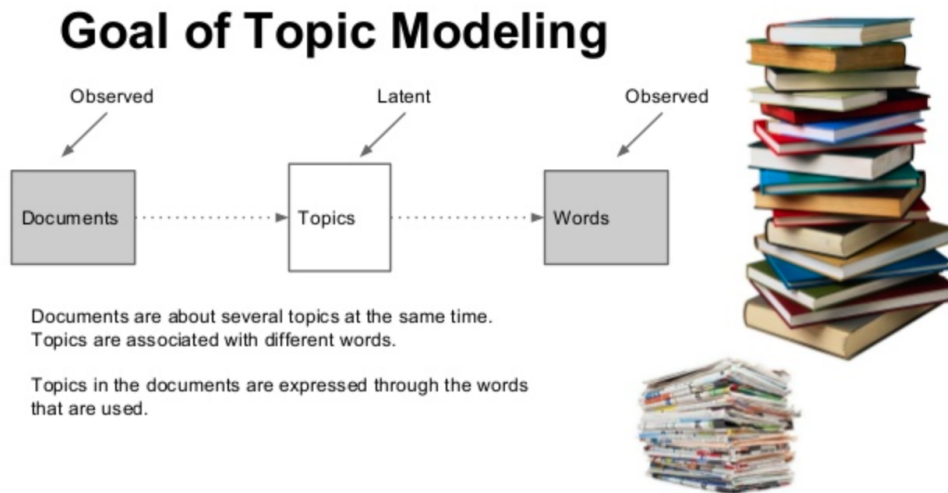
```
In [ ]:  #Basic graphics
         #histogram
         wf=data.frame(term=names(freq),occurrences=freq)

         p <- ggplot(subset(wf, freq>100), aes(term, occurrences))
         p <- p + geom_bar(stat="identity")
         p <- p + theme(axis.text.x=element_text(angle=45, hjust=1))
         p
```

```
In [ ]:  #wordcloud
         #setting the same seed each time ensures consistent look across clouds
         set.seed(42)
         #limit words by specifying min frequency
         wordcloud(names(freq),freq, min.freq=70)
         #...add color
         wordcloud(names(freq),freq,min.freq=70,colors=brewer.pal(6,"Dark2"))
```

What is Topic Modeling

- deals with the problem of automatically classifying sets of documents into themes

Goal of Topic Modeling

Documents are about several topics at the same time.
Topics are associated with different words.

Topics in the documents are expressed through the words that are used.

What is behind Topic Modeling?

In [ ]:
```
#Topic modeling
#Set parameters for Gibbs sampling
burnin <- 4000
iter <- 2000
thin <- 500
seed <-list(2003,5,63,100001,765)
nstart <- 5
best <- TRUE


#Number of topics
k <- 5

#Run LDA using Gibbs sampling
ldaOut <-LDA(dtm,k, method="Gibbs", control=list(nstart=nstart, seed = seed,
 best=best, burnin = burnin, iter = iter, thin=thin))
```

In [ ]:
```
#have a look at the model and some output
ldaOut
topics(ldaOut)
as.matrix(terms(ldaOut,6))

#write out results
#docs to topics
ldaOut.topics <- as.matrix(topics(ldaOut))
write.csv(ldaOut.topics,file=paste("LDAGibbs",k,"DocsToTopics.csv"))

#top 6 terms in each topic
ldaOut.terms <- as.matrix(terms(ldaOut,6))
write.csv(ldaOut.terms,file=paste("LDAGibbs",k,"TopicsToTerms.csv"))
```