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| **Description: UTS LOGO** | **ASSIGNMENT COVER SHEET** |
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| **Connected Intelligence Centre: Master of Data Science & Innovation** | |
| |  |  | | --- | --- | | **SUBJECT NUMBER & NAME** | 94692 Data Science Practice - Spring 2019 | | **NAME OF STUDENT**  **(PRINT CLEARLY - SURNAME, FIRST NAME)** | KAPIL, ANUJ | | **STUDENT ID NUMBER** | 12678708 | | **STUDENT EMAIL** | anuj.kapil@student.uts.edu.au | | **STUDENT CONTACT NUMBER** | 0424014131 | | **NAME OF INSTRUCTOR** | Perry Stephenson | | **DUE DATE** | 2019-10-20 | | **ASSESSMENT ITEM NUMBER/TITLE** | 2B: MDSI Slack Analysis | | **.** I confirm that I have read, understood and followed the advice about academic integrity at  <http://www.gsu.uts.edu.au/policies/academicpractice.html>  **.** I am aware of the penalties for plagiarism. This assignment is my own work and I have not handed in this assignment (either part or completely) for assessment in another subject.  **..** If this assignment is submitted after the due date I understand that it will incur a penalty for lateness unless I have previously had an extension of time approved and have attached the written confirmation of this extension. Please provide details of extensions granted here if applicable  **Signature of Student:** \_\_\_\_\_\_\_\_\_ANUJ KAPIL\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **­­Date: 18**/OCT /2019  If submitted electronically tick here to indicate you agree with the above    URL for Portfolio:  Viewing instructions: | | | |

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Slack Analysis

## Connect to Amazon RDS Slack database

A snapshot of Slack database has been configured as a cloud based service on Amazon’s Relational Database Service. It can be accessed via the following credentials. The database has been configured as PostgreSQL relational database management system, so we are going to need a compatible driver to connect to the remote cloud-based database server. A list of 3 tables has been provided that have been created in the slack database. We are going to extract all the 3 tables’ data from database and bring in to R memory.

# Connect to remote DB  
con <- dbConnect(drv = dbDriver('PostgreSQL'),  
 host = 'mdsislack.clnutj7nhgyn.us-east-2.rds.amazonaws.com',  
 port = 5432,   
 user = 'dsp2019',  
 password = 'oZkK6vgRbvDK',  
 dbname = 'mdsislack')  
  
# Extract all tables  
users <- dbGetQuery(con, "SELECT \*  
 FROM users")  
channels <- dbGetQuery(con, "SELECT \*  
 FROM channels")  
messages <- dbGetQuery(con, "SELECT \*  
 FROM messages")  
  
# Disconnect from remote DB  
dbDisconnect(con)

## Create a local SQLite database

Optional Step: Instead to connecting to a cloud database, we can create a local SQLite database as the tables are not too big and can be hosted on a local storage. This step is optional and has been done as sometimes the internet connection is patchy and the cloud database connections times-out or gets disconnected. The SQLite database is saved as a file on the storage and can be accessed later using the SQLite file connection.

# Create a new sqlite database and new connection to the database  
slackdb <- dbConnect(RSQLite::SQLite(), "db/slackdb.sqlite")  
  
# Create table & Append data  
dbWriteTable(slackdb, "users", users)  
dbWriteTable(slackdb, "channels", channels)  
dbWriteTable(slackdb, "messages", messages)  
  
# Verify the tables created  
dbListTables(slackdb)  
  
# Disconnect from local database  
dbDisconnect(slackdb)

## Query local SQLite database

Connect to the SQLite database file created in the previous step using the file identifier and SQLite database driver. All three tables that are available on the cloud PostgreSQL database are now available locally on the SQLite database. Let’s look at the number of records in each table. All the slack message on the public channels are stored in the ‘messages’ table. The information about public channels is stored in ‘channels’ table and information about the users in stored in the ‘users’ table. The ‘messages’ can be linked/joined with the ‘channels’ and ‘users’ to append additional information to the ‘messages’ about ‘channels’ and ‘users’. Most common use-case would be to assign human-friendly names to ‘id’ fields (channel\_id, user\_id) in the ‘messages’ to analyse ‘who’ sent message in ‘what’ channel. Implementing some queries from class exercise to find out the user with maximum posts/messages, channel with maximum posts/messages,user with maximum posts/messages in a specific channel.

# Database driver  
sqlite\_driver <- dbDriver("SQLite")  
  
# Database file  
slackdb\_file <- "db/slackdb.sqlite"  
  
# Database connection  
slackdb <- dbConnect(sqlite\_driver, dbname = slackdb\_file)  
  
# List all the tables  
dbListTables(slackdb)

## [1] "channels" "messages" "users"

# Number of users (including bots)  
total\_users <- 'SELECT count(\*) AS users  
 FROM users'  
  
dbGetQuery(slackdb, total\_users)

## users  
## 1 363

# Number of users (including archived)  
total\_channels <- 'SELECT count(\*) AS channels  
 FROM channels'  
  
dbGetQuery(slackdb, total\_channels)

## channels  
## 1 128

# Number of posts  
total\_posts <- 'SELECT count(\*) AS posts  
 FROM messages'  
  
dbGetQuery(slackdb, total\_posts)

## posts  
## 1 28693

max\_posts\_user <- 'SELECT u.user\_name  
 FROM messages m  
 LEFT JOIN users u  
 ON m.user\_id = u.user\_id  
 GROUP BY 1  
 ORDER BY count(\*) DESC LIMIT 1'  
  
dbGetQuery(slackdb, max\_posts\_user)

## user\_name  
## 1 Perry Stephenson

max\_posts\_channel <- 'SELECT c.channel\_name  
 FROM messages m  
 LEFT JOIN channels c  
 ON m.channel\_id = c.channel\_id  
 GROUP BY 1  
 ORDER BY count(\*) DESC LIMIT 1'  
  
dbGetQuery(slackdb, max\_posts\_channel)

## channel\_name  
## 1 dev\_r

max\_posts\_user\_dam <- 'SELECT u.user\_name  
 FROM messages m  
 INNER JOIN channels c  
 ON m.channel\_id = c.channel\_id  
 INNER JOIN users u  
 ON m.user\_id = u.user\_id  
 WHERE c.channel\_name = \'mdsi\_dam\_aut\_18\'  
 GROUP BY 1  
 ORDER BY count(\*) DESC LIMIT 1'  
  
dbGetQuery(slackdb, max\_posts\_user\_dam)

## user\_name  
## 1 Alex Scriven

dbDisconnect(slackdb)

## Data Analysis in R

Let’s create a dataset from SQLite database that can be used to do some analytics in R and Python. In the example below, we are extracting all the slack messages from the beginning of this year (2019) and appending the channels and users information to messages. Since the data in the messages table has data only till March 2019, we can call the dataset as ‘all messages in last 90 days’. These type of datasets can be used to analyse the activity of channels and users to classify them as active/inactive channels or users. One of the use-cases could be to analyse the seasonality of the activities to better manage the web traffic/load. Another use-case could be to archive messages from any inactive channel.

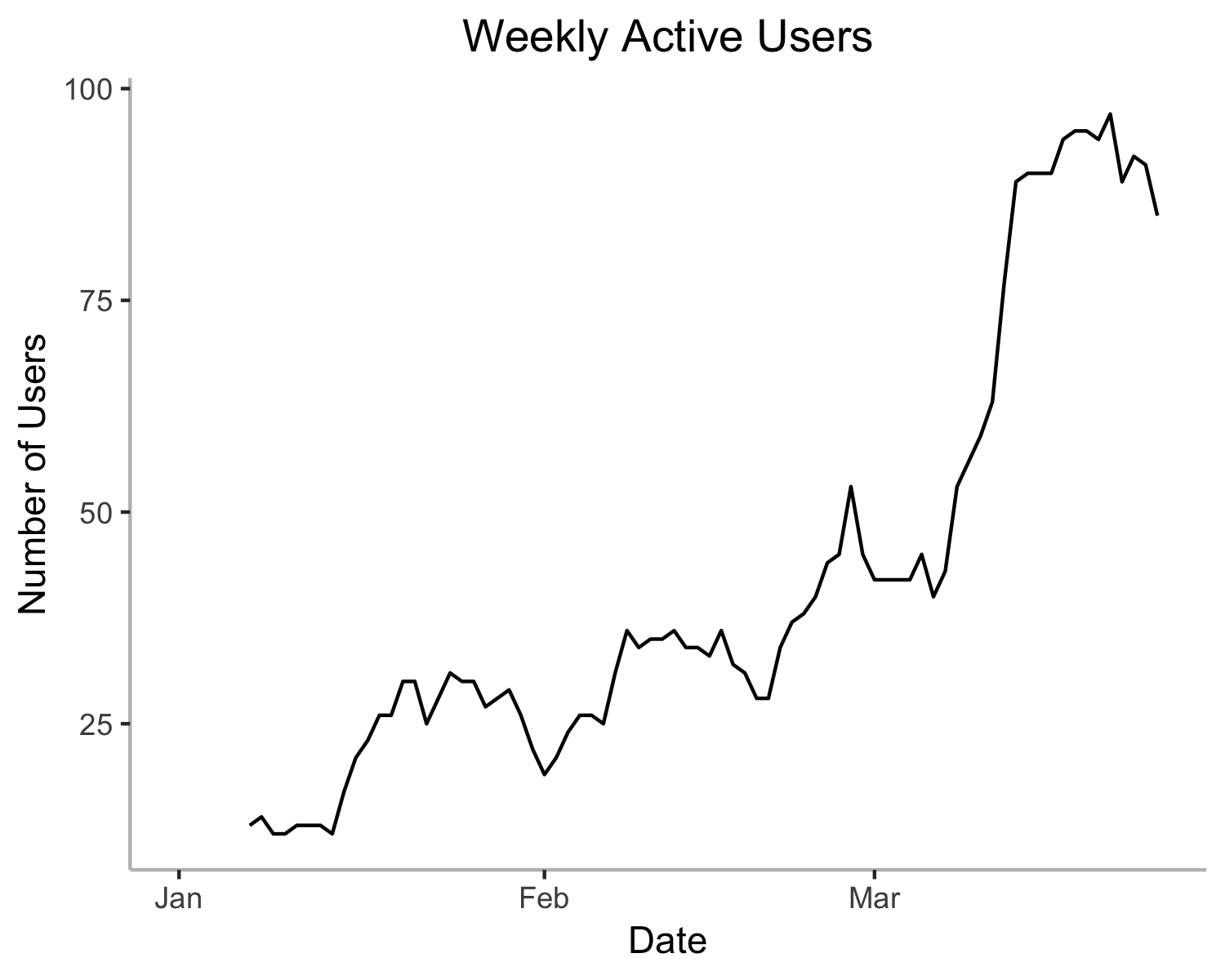
# Database driver  
sqlite\_driver <- dbDriver("SQLite")  
  
# Database file  
slackdb\_file <- "db/slackdb.sqlite"  
  
# Database connection  
slackdb <- dbConnect(sqlite\_driver, dbname = slackdb\_file)  
  
# List all the tables  
dbListTables(slackdb)

## [1] "channels" "messages" "users"

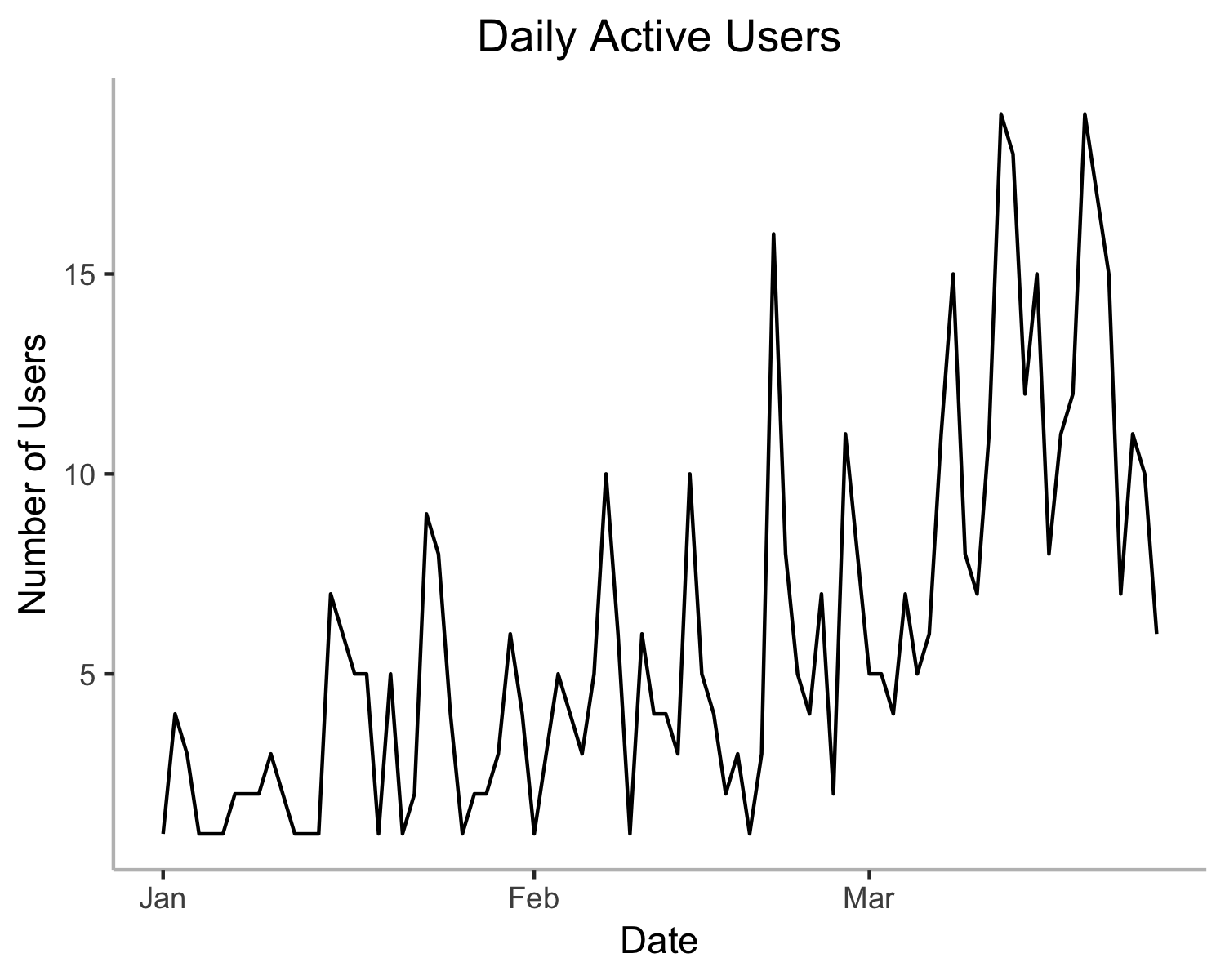
# Bring data from SQLite database in to R  
all\_msgs\_2019\_query <- 'SELECT m.\*,  
 c.channel\_name,  
 c.channel\_is\_archived,  
 u.user\_name,  
 u.user\_is\_bot  
 FROM messages m  
 LEFT JOIN channels c  
 ON m.channel\_id = c.channel\_id  
 LEFT JOIN users u  
 ON m.user\_id = u.user\_id  
 WHERE datetime( m.message\_timestamp, \'unixepoch\' ) >= DATETIME(\'2019-01-01 00:00:00\')'  
  
all\_msgs\_2019 <- dbGetQuery(slackdb, all\_msgs\_2019\_query)  
  
dbDisconnect(slackdb)

Convert the timestamp to a date format and for each day we are caculating the total number of active users and messages posted. We are also calculating a rolling weekly sum of users and messages to get an aggregate view of weekly active users and messages being posted. Daily numbers are usually more volatile and less predictable and hence we are computing weekly aggregations as well, which will be less volatile and more predictable.

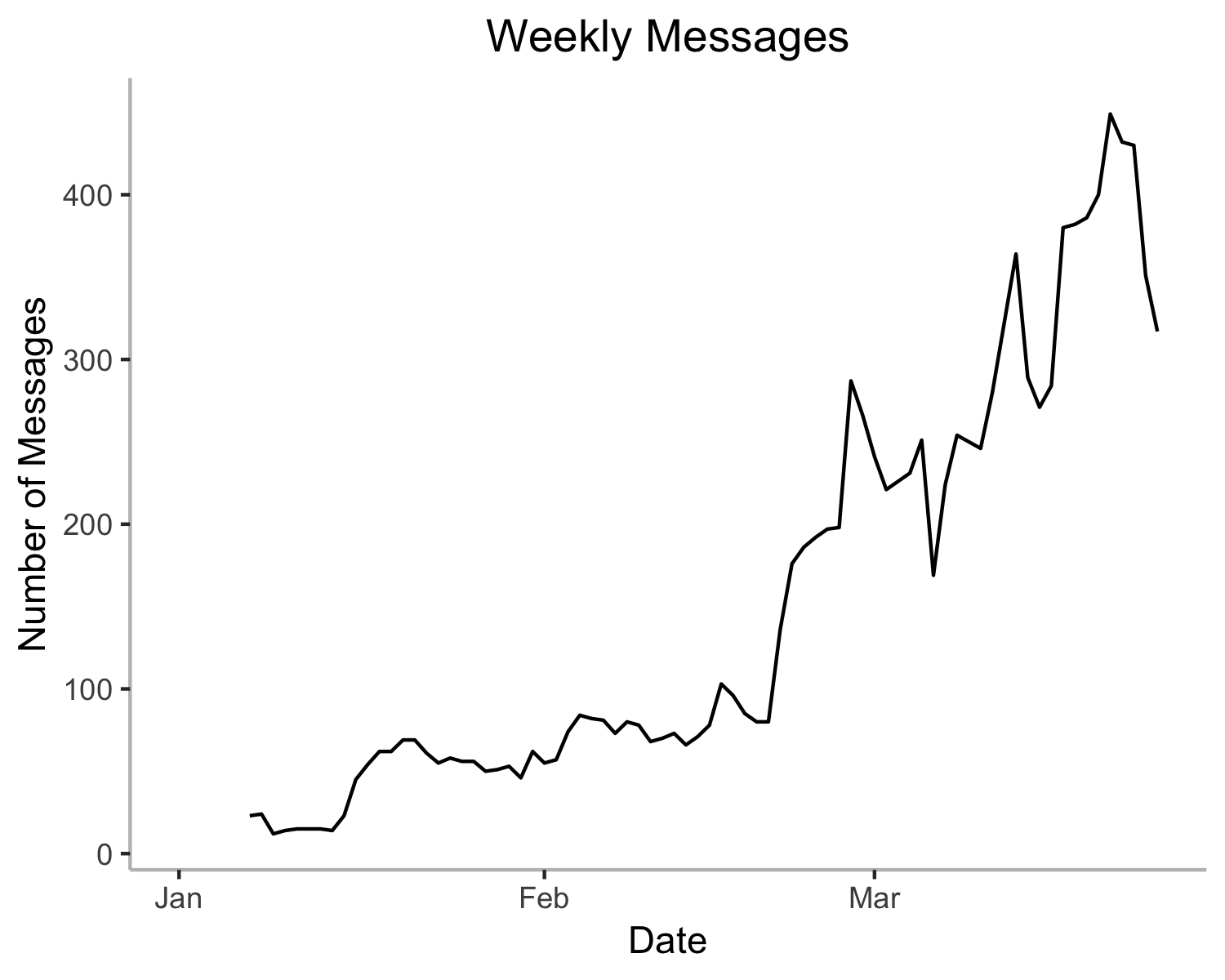
setDT(all\_msgs\_2019)  
  
# Convert unix timestamp to date  
all\_msgs\_2019[, message\_date := as.IDate(as.POSIXct(message\_timestamp, origin = "1970-01-01", tz = "UTC"))]  
  
# 90 days active users and messages counts  
plot\_data <- all\_msgs\_2019[, .(daily\_msgs = .N, daily\_users = uniqueN(user\_id)), by = message\_date]  
  
# Calculate weekly active users and messages counts  
setorderv(plot\_data, "message\_date")  
plot\_data[, weekly\_msgs := rollsumr(daily\_msgs, k = 7, fill = NA)]  
plot\_data[, weekly\_users := rollsumr(daily\_users, k = 7, fill = NA)]  
  
# Plot Active Users (Weekly)  
ggplot(plot\_data, aes(x = as.IDate(message\_date), y = weekly\_users)) +  
 geom\_line() +  
 theme(panel.background = element\_blank(), axis.line = element\_line(colour = "grey"), plot.title = element\_text(hjust = 0.5)) +  
 labs(x = "Date", y = "Number of Users") +  
 ggtitle("Weekly Active Users")



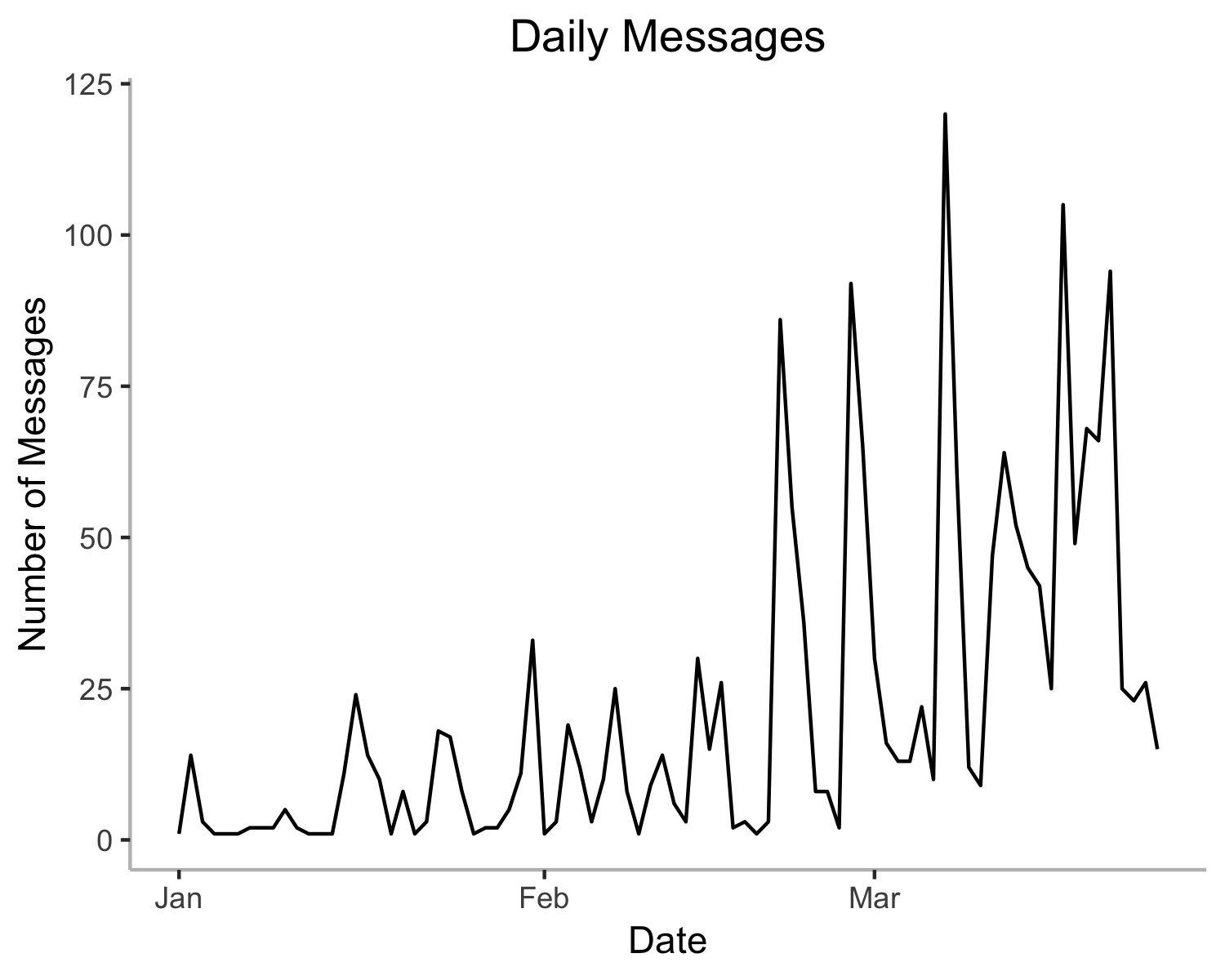
# Plot Active Users (Daily)  
ggplot(plot\_data, aes(x = as.IDate(message\_date), y = daily\_users)) +  
 geom\_line() +  
 theme(panel.background = element\_blank(), axis.line = element\_line(colour = "grey"), plot.title = element\_text(hjust = 0.5)) +  
 labs(x = "Date", y = "Number of Users") +  
 ggtitle("Daily Active Users")



# Plot All Msgs (weekly)  
ggplot(plot\_data, aes(x = as.IDate(message\_date), y = weekly\_msgs)) +  
 geom\_line() +  
 theme(panel.background = element\_blank(), axis.line = element\_line(colour = "grey"), plot.title = element\_text(hjust = 0.5)) +  
 labs(x = "Date", y = "Number of Messages") +  
 ggtitle("Weekly Messages")



# Plot All Msgs (daily)  
ggplot(plot\_data, aes(x = as.IDate(message\_date), y = daily\_msgs)) +  
 geom\_line() +  
 theme(panel.background = element\_blank(), axis.line = element\_line(colour = "grey"), plot.title = element\_text(hjust = 0.5)) +  
 labs(x = "Date", y = "Number of Messages") +  
 ggtitle("Daily Messages")



The weekly charts show that the message activities start to grow significantly in March and this is usually when the Autumn session of MDSI starts. The users become really active from March onwards although there is some activity in February and very less in January. Usually, the activity before the semester starts, is about electives discussions and from March onwards the discussions are more about the subjects which are running in Autumn session. As shown in the top 10 channels below, the ‘mdsi\_electives’ channel gets dropped in Feb and March’s top 10 list as there is not much activity in that channel once the semester starts. Also, the ‘mdsi\_deeplearn\_aut\_19’ is the most active channel in March since that was a running subject in Autumn 2019 session. A good use of this information, combined with text analytics on the messages, could be to gauge the interest of students about the electives (from pre-session commencement period) to better plan the electives schedule. This will result in better servicing of the electives from the management, the teaching staff and students’ perspective and can also help in measuring the revenue estimates. Another use of this information could be that if an important announcement (for example in ‘mdsi\_announcement’ channel) needs to be made, March (in this sample data) would be the ideal time to make that announcement for it to reach maximum users/for maximum users to respond to that announcement.

# Jan top 10 channels  
all\_msgs\_2019[message\_date <= as.IDate('2019-01-31'),.N, by = channel\_name][order(-N)][1:10]

## channel\_name N  
## 1: mdsi\_announcements 36  
## 2: dev\_machine\_learning 34  
## 3: 36100decepticons 31  
## 4: fliparound\_chat 31  
## 5: mdsi\_electives 24  
## 6: dev\_r 22  
## 7: dev\_python 15  
## 8: dev\_data\_vis 5  
## 9: ds\_hackathons 4  
## 10: ds\_cool\_stuff 3

# Feb top 10 channels  
all\_msgs\_2019[message\_date %between% c(as.IDate('2019-01-31'), as.IDate('2019-02-28')),.N, by = channel\_name][order(-N)][1:10]

## channel\_name N  
## 1: dev\_r 288  
## 2: dev\_python 46  
## 3: mdsi\_announcements 42  
## 4: dev\_machine\_learning 37  
## 5: fliparound\_chat 31  
## 6: 36100decepticons 29  
## 7: ds\_jobs 26  
## 8: mdsi\_deeplearn\_spr\_17 24  
## 9: mdsi\_course\_review 16  
## 10: ds\_cool\_stuff 11

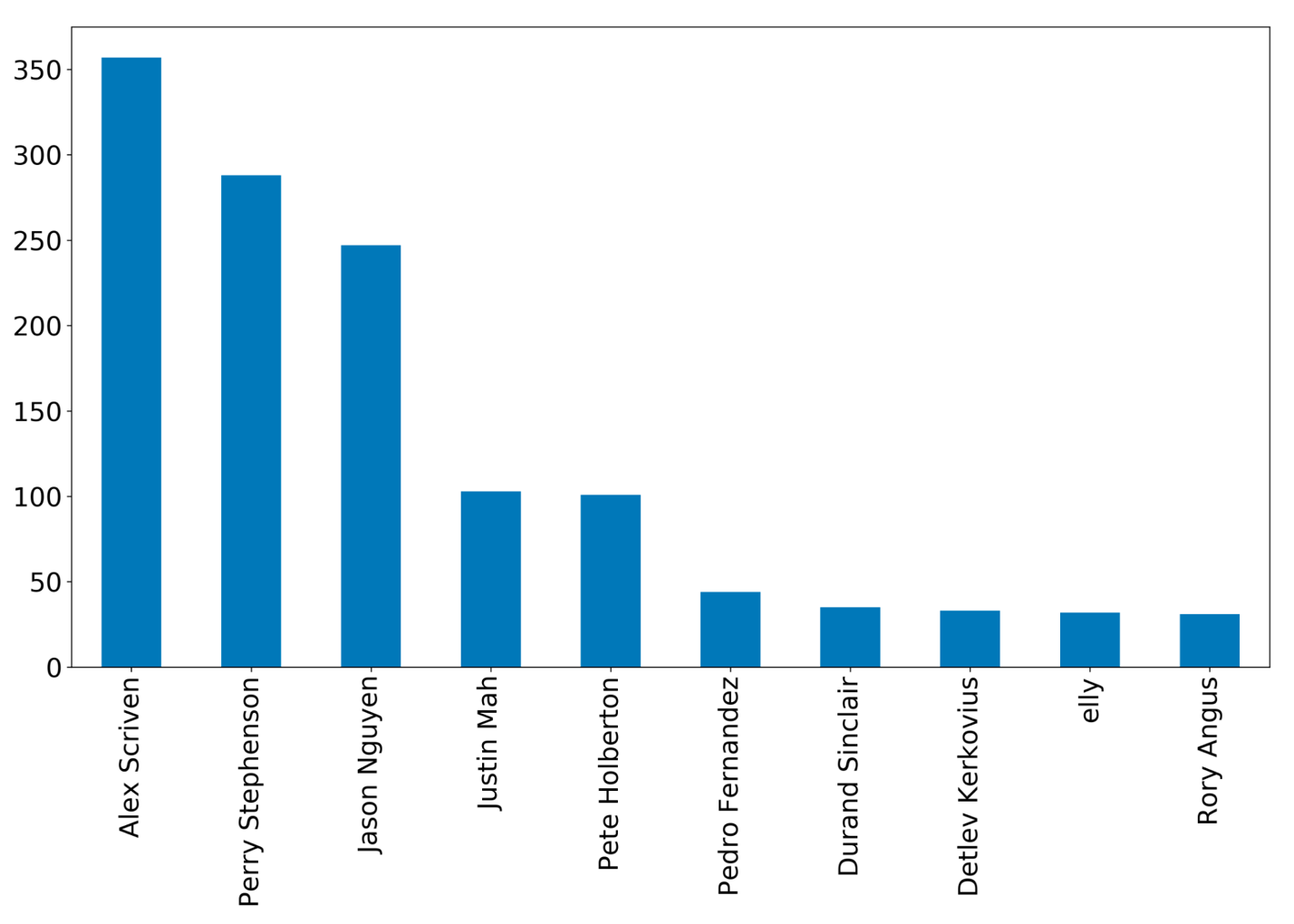
# March top 10 channels  
all\_msgs\_2019[message\_date >= as.IDate('2019-03-01'),.N, by = channel\_name][order(-N)][1:10]

## channel\_name N  
## 1: mdsi\_deeplearn\_aut\_19 217  
## 2: dev\_r 215  
## 3: dev\_python 142  
## 4: mdsi\_announcements 77  
## 5: dev\_machine\_learning 67  
## 6: mdsi\_dam\_aut\_19 51  
## 7: dev\_data\_vis 32  
## 8: ds\_jobs 27  
## 9: 36100decepticons 25  
## 10: mdsi\_dvn\_aut\_19 22

## Data Analysis in Python

The same dataset that we created in R chunk, can be accessed in the Python enironment using the ‘r’ object. Here we have created a **pandas** dataframe from ‘r’ datatable. In the example below we are trying to find the top 10 active users (excluding the bots) & channels. Alternatively, we can look at the top 10 inactive users & channels. We can even combine the two counts to look at the number of messages and users in any channel.

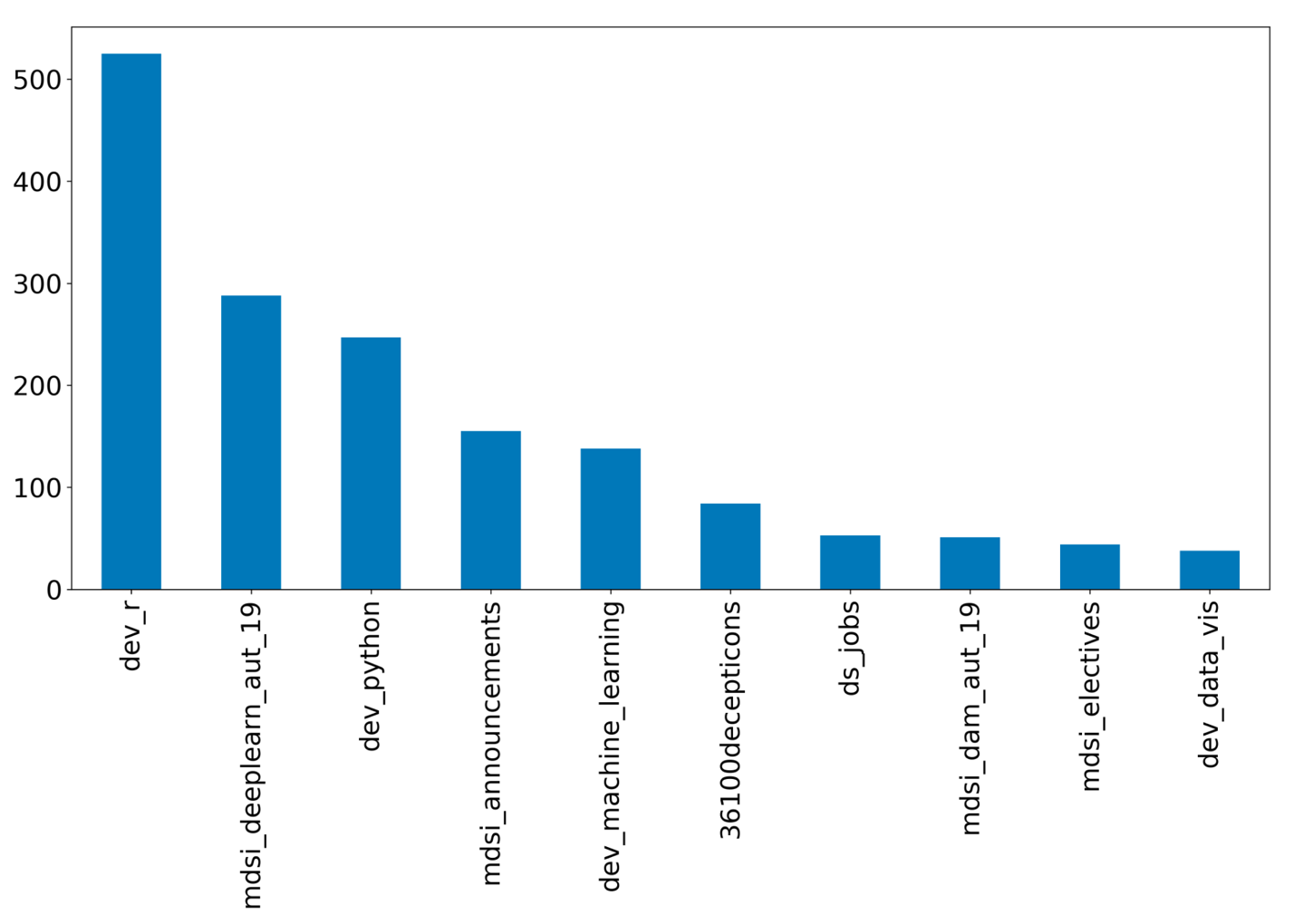
import pandas as pd  
import matplotlib.pyplot as plt  
  
# Create pandas dataframe from R datatable  
all\_msgs\_2019\_df = pd.DataFrame(r.all\_msgs\_2019)  
  
# Top 10 Users - 90 days  
all\_msgs\_2019\_df[all\_msgs\_2019\_df["user\_is\_bot"] == 0]["user\_name"].value\_counts().nlargest(10).plot.bar()  
plt.rcParams.update({'font.size': 20})  
plt.tight\_layout()  
plt.show()



# Top 10 Channels - 90 days

all\_msgs\_2019\_df["channel\_name"].value\_counts().nlargest(10).plot.bar()  
plt.rcParams.update({'font.size': 20})  
plt.tight\_layout()

plt.show()



# Details by channel (message count and unique users count)

channel\_details\_df = all\_msgs\_2019\_df.groupby(by='channel\_name', as\_index=False)["user\_name"].agg({'msg\_count': pd.Series.count, 'user\_count': pd.Series.nunique})  
  
channel\_details\_df.sort\_values(by=['msg\_count'], ascending=False).head()

## channel\_name msg\_count user\_count  
## 7 dev\_r 525 19  
## 22 mdsi\_deeplearn\_aut\_19 217 14  
## 6 dev\_python 203 14  
## 17 mdsi\_announcements 155 36  
## 4 dev\_machine\_learning 138 10

## Data Analysis in R

Just like ‘r’ objects can be accessed in Python environment, the objects that were created in Python environment are accessible in R using the ‘py’ object. The only difference is the method of accessing the objects. In R, Python objects are accessible using the ‘py’ followed by ‘$’ operator to access a particular nested object in ‘py’ object. In Python, the ‘r’ objects can be accessed using a ‘.’ operator instead of ‘$’ operator. Using the insights created in the Python chunk, we can write some rules to identify active/inactive channels and convert those insights into actions. For example, a highly active channel was found from the insights which has only one active user (a bot). Upon inpsecting the channel messages, it appears that the channel was created by a group of students for assignment purpose and they had setup a reminder bot to post a reminder message everyday in that channel. While the real users of the channel have gone inactive within that channel, only the bot user is active currently and spamming it with reminder messages. This channel can be clearly archived.

# Create R dataframe from Python dataframe  
channel\_details\_dt <- py$channel\_details\_df  
setDT(channel\_details\_dt)  
  
# Order by lower user count but high message count  
channel\_details\_dt[order(user\_count, -msg\_count)][1:10]

## channel\_name msg\_count user\_count  
## 1: 36100decepticons 84 1  
## 2: free-stuff 1 1  
## 3: oth\_humour 1 1  
## 4: fliparound\_chat 31 2  
## 5: dev\_datasets 12 2  
## 6: ds\_hackathons 5 2  
## 7: mdsi\_cicaround\_help 4 2  
## 8: events-of-interest 2 2  
## 9: oth\_random 2 2  
## 10: mdsi\_deeplearn\_spr\_17 32 3

all\_msgs\_2019[channel\_name == "36100decepticons", list(user\_id, message\_text, channel\_is\_archived)][1:10]

## user\_id message\_text channel\_is\_archived  
## 1: USLACKBOT Reminder: write data. 0  
## 2: USLACKBOT Reminder: write data. 0  
## 3: USLACKBOT Reminder: write data. 0  
## 4: USLACKBOT Reminder: write data. 0  
## 5: USLACKBOT Reminder: write data. 0  
## 6: USLACKBOT Reminder: write data. 0  
## 7: USLACKBOT Reminder: write data. 0  
## 8: USLACKBOT Reminder: write data. 0  
## 9: USLACKBOT Reminder: write data. 0  
## 10: USLACKBOT Reminder: write data. 0