Exercise 1: ORGB 672

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Contents

1 Setup

```
library(tidygraph)
```

```
## Warning: package 'tidygraph' was built under R version 4.3.3
```

```
##
## Attaching package: 'tidygraph'
```

```
## The following object is masked from 'package:stats':
##
##     filter
```

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.2     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.3     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.2
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks tidygraph::filter(), stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(igraph)
```

```
## Warning: package 'igraph' was built under R version 4.3.3
```

```
##
## Attaching package: 'igraph'
##
## The following objects are masked from 'package:lubridate':
##
##     %--%, union
##
## The following objects are masked from 'package:dplyr':
##
##     as_data_frame, groups, union
##
## The following objects are masked from 'package:purrr':
##
##     compose, simplify
##
## The following object is masked from 'package:tidyr':
##
##     crossing
```

```
##
## The following object is masked from 'package:tibble':
##
##     as_data_frame
##
## The following object is masked from 'package:tidygraph':
##
##     groups
##
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
##
## The following object is masked from 'package:base':
##
##     union
```

```
library(ggplot2)
library(vroom)
```

```
##
## Attaching package: 'vroom'
##
## The following objects are masked from 'package:readr':
##
##     as.col_spec, col_character, col_date, col_datetime, col_double,
##     col_factor, col_guess, col_integer, col_logical, col_number,
##     col_skip, col_time, cols, cols_condense, cols_only, date_names,
##     date_names_lang, date_names_langs, default_locale, fwf_cols,
##     fwf_empty, fwf_positions, fwf_widths, locale, output_column,
##     problems, spec
```

```
library(scales)
```

```
##
## Attaching package: 'scales'
##
## The following object is masked from 'package:vroom':
##
##     col_factor
##
## The following object is masked from 'package:purrr':
##
##     discard
##
## The following object is masked from 'package:readr':
##
##     col_factor
```

```
library(ggraph)
library(ggtext)
library(ggrepel)
```

```r
library(ggforce)
library(ggthemes)
library(patchwork)
library(qualpalr)
```

```
## Warning: package ’qualpalr’ was built under R version 4.3.3
```

```r
# setwd("./Exercise 1")
```

2 Code

```r
data <- vroom("./Connections.csv", delim = ",", skip = 3)
```

```
## Rows: 3871 Columns: 7
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (7): First Name, Last Name, URL, Email Address, Company, Position, Conne...
##
## i Use ‘spec()‘ to retrieve the full column specification for this data.
## i Specify the column types or set ‘show_col_types = FALSE‘ to quiet this message.
```

2.1 Data cleaning

```r
data <- data %>%
  mutate(label = str_c(
    `First Name`,
    str_sub(`Last Name`, 1, 1),
    row_number()
  )) %>%
  select(label, Company) %>%
  drop_na()

data
```

```
## # A tibble: 3,663 x 2
##    label        Company
##    <chr>        <chr>
##  1 ScottM1      Stadia Ventures
##  2 AlexanderD2  McGill University
##  3 RyanR3       2U
##  4 RushitS4     Wayfair
##  5 JohnC5       Bain & Company
##  6 AlessandroF6 ASP Alumni Association - Alta Scuola Politecnica
##  7 EricB7       GBK Collective
##  8 JakeS8       Bain & Company
##  9 AlissaM9     PSP Investments
## 10 AlexandreP10 PSP Investments
## # i 3,653 more rows
```

2.2 Summary metrics

```r
data %>%
  count()
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1  3663
```

```r
data %>%
  group_by(Company) %>%
  count(sort = TRUE)
```

```
## # A tibble: 2,287 x 2
## # Groups:   Company [2,287]
##    Company                           n
##    <chr>                         <int>
##  1 Bain & Company                  155
##  2 Deloitte                         84
##  3 EY                               79
##  4 ZS                               34
##  5 Boston Consulting Group (BCG)    30
##  6 McKinsey & Company               30
##  7 American Express                 29
##  8 Accenture                        27
##  9 KPMG                             27
## 10 KPMG India                       27
## # i 2,277 more rows
```

```r
companies_with_more_than_15 <- data %>%
  group_by(Company) %>%
  count(sort = TRUE) %>%
  filter(n > 15)

companies_with_more_than_15
```

```
## # A tibble: 16 x 2
## # Groups:   Company [16]
##    Company                                                 n
##    <chr>                                               <int>
##  1 Bain & Company                                        155
##  2 Deloitte                                               84
##  3 EY                                                     79
##  4 ZS                                                     34
##  5 Boston Consulting Group (BCG)                          30
##  6 McKinsey & Company                                     30
##  7 American Express                                       29
##  8 Accenture                                              27
##  9 KPMG                                                   27
## 10 KPMG India                                             27
## 11 McGill University - Desautels Faculty of Management    21
## 12 Goldman Sachs                                           19
## 13 McGill University                                       19
## 14 United Airlines                                         19
## 15 Amazon                                                  16
## 16 Zomato                                                  16
```

2.3 Creating a graph data structure

```
connection_df <- data %>%
  filter(Company %in% companies_with_more_than_15$Company) %>%
  group_by(Company) %>%
  summarise(label_combinations = list(combn(label, 2, simplify = FALSE))) %>%
  unnest(label_combinations) %>%
  transmute(
    from = map_chr(label_combinations, 1),
    to = map_chr(label_combinations, 2),
    company = Company
  )

connection_df
```

```
## # A tibble: 22,355 x 3
##    from        to            company
##    <chr>       <chr>         <chr>
##  1 KritikaS770 DhruvG1276    Accenture
##  2 KritikaS770 AkhilA1373    Accenture
##  3 KritikaS770 DeepakS1380   Accenture
##  4 KritikaS770 KeshavG1486   Accenture
##  5 KritikaS770 AfifB1625     Accenture
##  6 KritikaS770 KanikaC1823   Accenture
##  7 KritikaS770 SiddhiK1848   Accenture
##  8 KritikaS770 KritikaS1904  Accenture
##  9 KritikaS770 SakshiY1936   Accenture
## 10 KritikaS770 VanshitaG2000 Accenture
## # i 22,345 more rows
```

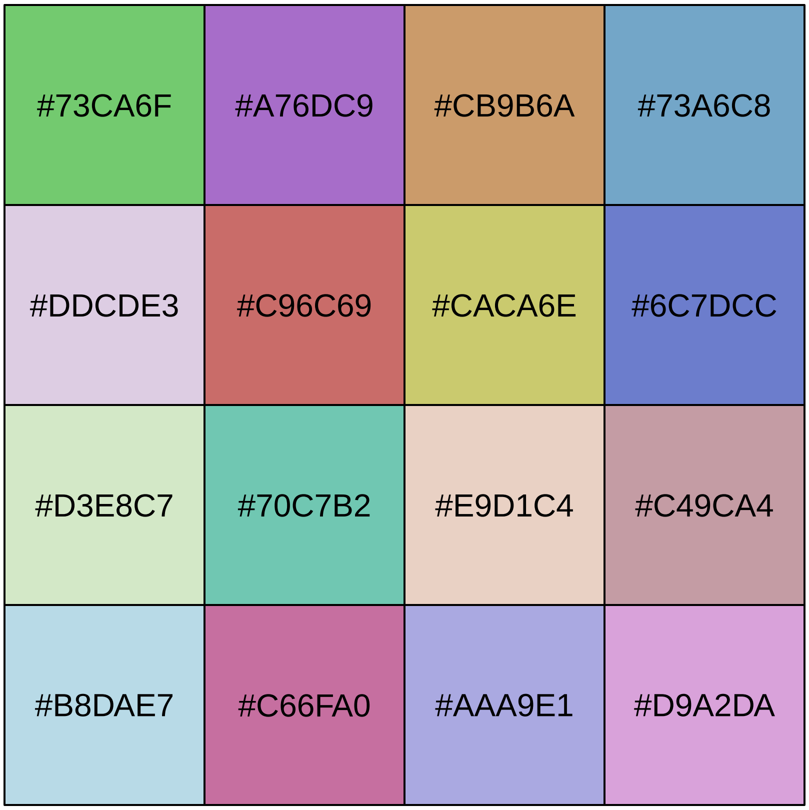
2.3.1 Taking a sample of the data

```
set.seed(257)

graph_data <- connection_df %>%
  slice_sample(prop = 0.25) %>%
  as_tbl_graph(directed = FALSE)

graph_data
```

```
## # A tbl_graph: 630 nodes and 5588 edges
## #
## # An undirected simple graph with 16 components
## #
## # Node Data: 630 x 1 (active)
##    name
##    <chr>
##  1 TanishqA2552
##  2 AishveryaA1807
##  3 AnirudhV1164
##  4 SarthakS2851
##  5 AdityaM499
##  6 VishudhV1277
##  7 RivaG933
##  8 AnushkaS1879
##  9 SankalpN1297
## 10 RoopakG895
## # i 620 more rows
## #
## # Edge Data: 5,588 x 3
##    from    to company
##   <int> <int> <chr>
## 1     1    62 Bain & Company
## 2     2   526 Zomato
## 3     3   245 KPMG India
## # i 5,585 more rows
```

2.3.2 Generating a color palette

```r
color_palette <- qualpal(
  (graph_data %>%
    activate("edges") %>%
    pull(company) %>%
    unique() %>%
    length()
  ),
  colorspace = "pretty"
)

show_col(color_palette$hex)
```



2.3.3 Get a list of names in `McGill University + DFOM`

```
mcgill_names <- (connection_df %>%
  filter(company %in% c(
    "McGill University",
    "McGill University - Desautels Faculty of Management"
  ))
) %>%
  select(from, to) %>%
  pivot_longer(cols = c(from, to)) %>%
  distinct() %>%
  pull(value)
```

2.4 Creating the graph

```
graph_layout <- create_layout(graph_data, layout = "backbone", keep = 0.7)
```

```
## Warning in layout_as_backbone(graph, keep = keep, backbone = TRUE): input graph
## is disconnected. The algorithm works best on connected graphs and may lead to
## misleading results for graphs with disconnected components. Run the algorithm
## on each component separately and delete isolated nodes to mitigate this issue.
```

```
graph_vis <- ggraph(graph_layout) +
  geom_node_point(
    size = 4,
    color = ifelse(
      graph_data %>%
        activate("nodes") %>%
        pull(name) %in% mcgill_names,
      "red",
      "black"
    )
  ) +
  geom_node_text(aes(label = name),
    repel = TRUE,
    max.overlaps = 2, check_overlap = TRUE
  ) +
  geom_edge_link0(aes(color = company), show.legend = TRUE, width = 1) +
  scale_edge_color_manual(values = color_palette$hex) +
  theme_void() +
  theme(
    legend.position = "bottom",
    panel.border = element_rect(fill = NA)
  ) +
  plot_annotation(
    title = "LinkedIn Connection Network",
    subtitle = "Edges are colored based on the organization (sample of 25% of connections, organizations
    caption = "Data: LinkedIn | Graphic: @lakshyaag"
  )

# Saving the graph
ggsave("linkedin_networks_graph.png",
  graph_vis,
  width = 20,
  height = 15,
  dpi = 300,
  device = "png"
)
```

```
## Warning: Using the ‘size‘ aesthetic in this geom was deprecated in ggplot2 3.4.0.
## i Please use ‘linewidth‘ in the ‘default_aes‘ field and elsewhere instead.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```

```
## Warning: ggrepel: 487 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

3 Result

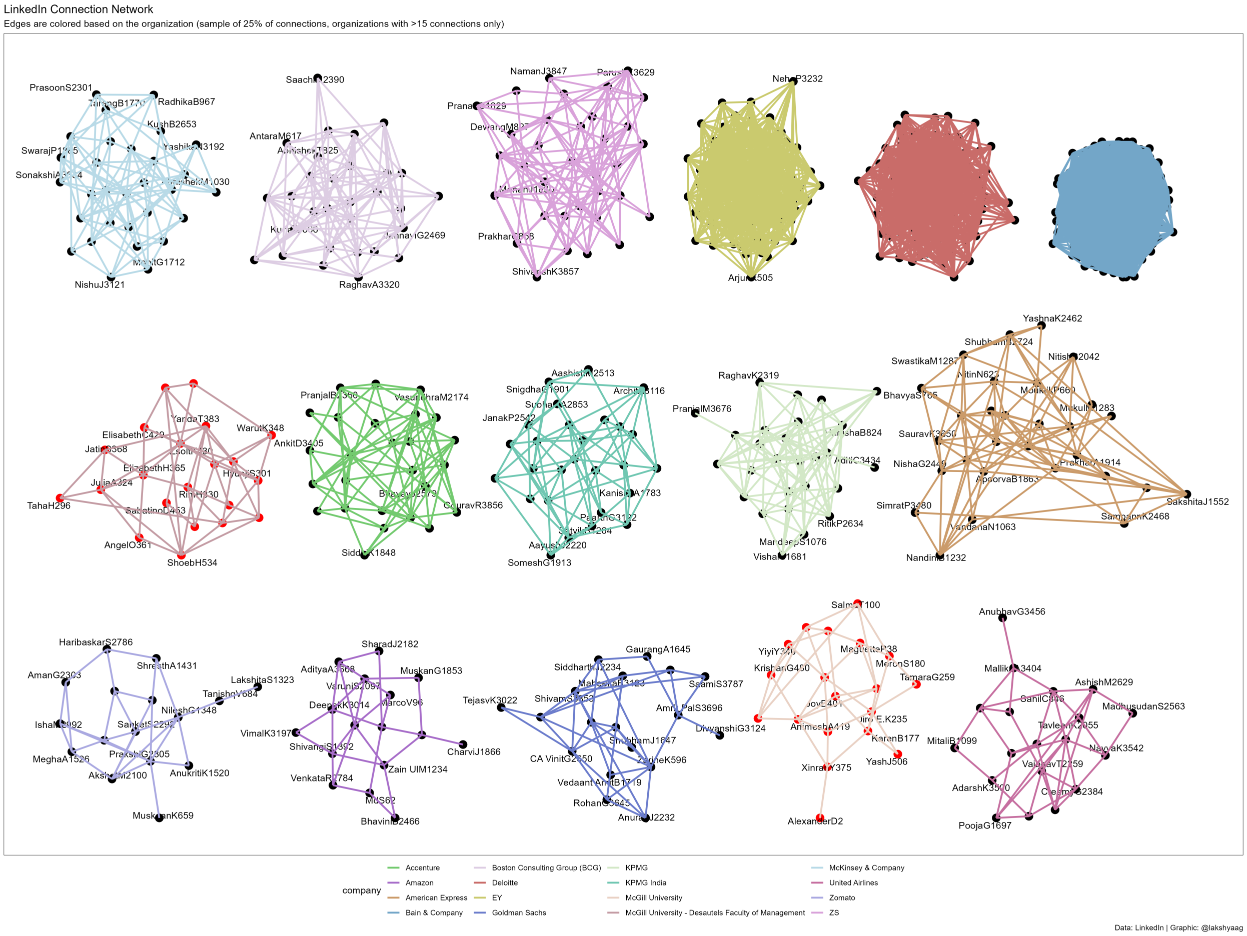


Figure 1: LinkedIn Connections