Lab sheet 7c: working with NASA data

Load necessary packages

```
library(jsonlite)
library(dplyr)
library(tidyr)
library(widyr)
library(tidytext)
library(ggplot2)
library(igraph)
library(ggraph)
```

Get the NASA data

```
# metadata <- fromJSON("https://data.nasa.gov/data.json")

load("metadata.rda")
names(metadata$dataset)
```

```
##  [1] "accessLevel"                 "landingPage"
##  [3] "bureauCode"                  "issued"
##  [5] "@type"                       "modified"
##  [7] "references"                  "keyword"
##  [9] "contactPoint"                "publisher"
## [11] "identifier"                  "description"
## [13] "title"                       "programCode"
## [15] "distribution"                "accrualPeriodicity"
## [17] "theme"                       "license"
## [19] "citation"                    "temporal"
## [21] "spatial"                     "language"
## [23] "graphic-preview-description" "graphic-preview-file"
## [25] "data-presentation-form"      "release-place"
## [27] "series-name"                 "creator"
## [29] "dataQuality"                 "editor"
## [31] "issue-identification"        "describedBy"
## [33] "describedByType"             "rights"
## [35] "systemOfRecords"
```

```
class(metadata$dataset$title)
```

```
## [1] "character"
```

```
class(metadata$dataset$description)
```

```
## [1] "character"
```

```
class(metadata$dataset$keyword)
```

```
## [1] "list"
```

Make tibble using the fields title, identifier, description, and keyword

```
nasa_title <- tibble(id = metadata$dataset$identifier,
                     title = metadata$dataset$title)
nasa_title
```

```
## # A tibble: 22,235 x 2
##    id                                                    title
##    <chr>                                                 <chr>
##  1 urn:nasa:pds:context_pds3:data_set:data_set.ro-e-rpcmag~ "ROS~
##  2 urn:nasa:pds:context_pds3:data_set:data_set.near-a-rss-~ "NEA~
##  3 urn:nasa:pds:context_pds3:data_set:data_set.nh-a-leisa-~ "NEW~
##  4 urn:nasa:pds:context_pds3:data_set:data_set.ro-c-rsi-1-~ "ROS~
##  5 urn:nasa:pds:context_pds3:data_set:data_set.ear-a-3-rdr~ "AST~
##  6 C2350113375-LARC_ASDC                                   "NAR~
##  7 urn:nasa:pds:context_pds3:data_set:data_set.vg2-j-mag-4~ "VOY~
##  8 C2600303267-ORNL_CLOUD                                  "Fir~
##  9 C1633993919-GES_DISC                                    "Sou~
## 10 C1577484501-LARC_ASDC                                   "CAT~
## # i 22,225 more rows
```

```
nasa_desc <- tibble(id = metadata$dataset$identifier,
                    desc = metadata$dataset$description)
nasa_desc %>%
  select(desc) %>%
  sample_n(5)
```

```
## # A tibble: 5 x 1
##   desc
##   <chr>
## 1 Planetary nomenclature, like terrestrial nomenclature, is used~
## 2 This is a Rosetta Radio Science data set, collected during the~
## 3 not available
## 4 This dataset includes high-resolution (~5 m) gridded estimates~
## 5 Data presented in this data set were collected during an inten~
```

```
nasa_keyword <- tibble(id = metadata$dataset$identifier,
                       keyword = metadata$dataset$keyword) %>%
  unnest(keyword)

nasa_keyword
```

```
## # A tibble: 114,995 x 2
##    id                                                   keyword
##    <chr>                                                <chr>
##  1 urn:nasa:pds:context_pds3:data_set:data_set.ro-e-rpcm~ earth
##  2 urn:nasa:pds:context_pds3:data_set:data_set.ro-e-rpcm~ unknown
##  3 urn:nasa:pds:context_pds3:data_set:data_set.ro-e-rpcm~ intern~
##  4 urn:nasa:pds:context_pds3:data_set:data_set.near-a-rs~ near e~
##  5 urn:nasa:pds:context_pds3:data_set:data_set.near-a-rs~ eros
##  6 urn:nasa:pds:context_pds3:data_set:data_set.nh-a-leis~ vega
##  7 urn:nasa:pds:context_pds3:data_set:data_set.nh-a-leis~ new ho~
##  8 urn:nasa:pds:context_pds3:data_set:data_set.ro-c-rsi-~ intern~
##  9 urn:nasa:pds:context_pds3:data_set:data_set.ro-c-rsi-~ 67p/ch~
## 10 urn:nasa:pds:context_pds3:data_set:data_set.ear-a-3-r~ satell~
## # i 114,985 more rows
```

Remove unnecessary words

```
nasa_title <- nasa_title %>%
  unnest_tokens(word, title) %>%
  anti_join(stop_words)
```

```
## Joining with `by = join_by(word)`
```

```
nasa_desc <- nasa_desc %>%
  unnest_tokens(word, desc) %>%
  anti_join(stop_words)
```

```
## Joining with `by = join_by(word)`
```

```
nasa_title %>%
  count(word, sort = TRUE)
```

```
## # A tibble: 12,549 x 2
##    word        n
##    <chr>   <int>
##  1 v1.0     6184
##  2 data     4627
##  3 2        4153
##  4 rosetta  4031
##  5 1        3941
##  6 orbiter  3887
##  7 3        3794
##  8 67p      2676
##  9 ges      1719
## 10 disc     1718
## # i 12,539 more rows
```

```
my_stopwords <- tibble(word = c(as.character(1:10),
                                "v001","0.5","v1","v1.0","v2.0","0.4","r2022.0","67p", "v03", "l2", "l3
                                "v003", "v004", "v005", "v006", "v7"))
nasa_title <- nasa_title %>%
  anti_join(my_stopwords)
```

```
## Joining with `by = join_by(word)`
```

```
nasa_desc <- nasa_desc %>%
  anti_join(my_stopwords)
```

```
## Joining with `by = join_by(word)`
```

Grouping and counting keywords

```
nasa_keyword %>%
  group_by(keyword) %>%
  count(sort = TRUE)
```

```
## # A tibble: 9,104 x 2
## # Groups:   keyword [9,104]
##    keyword                                n
##    <chr>                              <int>
##  1 earth science                       9762
##  2 atmosphere                          4248
```

```
##  3 international rosetta mission          3806
##  4 67p/churyumov-gerasimenko 1 (1969 r1)  2977
##  5 land surface                           2201
##  6 oceans                                 1926
##  7 spectral/engineering                   1580
##  8 biosphere                              1399
##  9 atmospheric water vapor                1354
## 10 mars                                   1321
## # i 9,094 more rows
```

Capitalize the keywords

```
nasa_keyword <- nasa_keyword %>%
  mutate(keyword = toupper(keyword))
```

Some usefull graphs

```
title_word_pairs <- nasa_title %>%
  pairwise_count(word, id, sort = TRUE, upper = FALSE)

title_word_pairs
```

```
## # A tibble: 189,748 x 3
##    item1   item2       n
##    <chr>   <chr>   <dbl>
##  1 rosetta orbiter  3672
##  2 ges     disc     1717
##  3 rosetta rsi      1295
##  4 orbiter rsi      1295
##  5 rosetta comet    1138
##  6 orbiter comet    1138
##  7 rosetta escort   1084
##  8 orbiter escort   1084
##  9 comet   escort   1024
## 10 rsi     comet     847
## # i 189,738 more rows
```

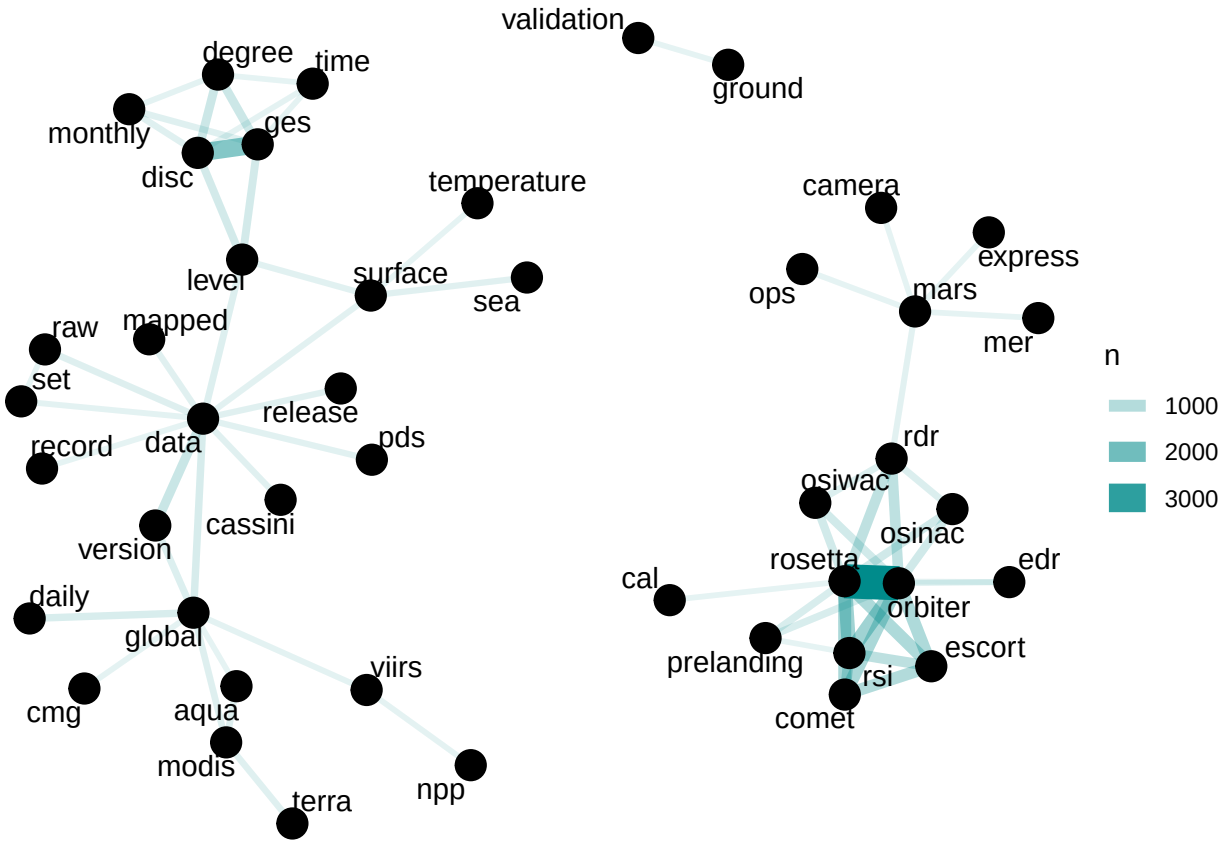
```
desc_word_pairs <- nasa_desc %>%
  pairwise_count(word, id, sort = TRUE, upper = FALSE)

desc_word_pairs
```

```
## # A tibble: 7,957,269 x 3
##    item1 item2          n
##    <chr> <chr>      <dbl>
##  1 data  set         9359
##  2 data  time        4951
##  3 data  phase       4889
##  4 data  mission     4713
##  5 data  level       4555
##  6 data  version     4519
##  7 data  instrument  4506
##  8 set   phase       4259
##  9 data  global      4092
```

```
## 10 data  product     4022
## # i 7,957,259 more rows
```

```
set.seed(1234)
title_word_pairs %>%
  filter(n >= 250) %>%
  graph_from_data_frame() %>%
  ggraph(layout = "fr") +
  geom_edge_link(aes(edge_alpha = n, edge_width = n), edge_colour = "cyan4") +
  geom_node_point(size = 5) +
  geom_node_text(aes(label = name), repel = TRUE,
                 point.padding = unit(0.2, "lines")) +
  theme_void()
```



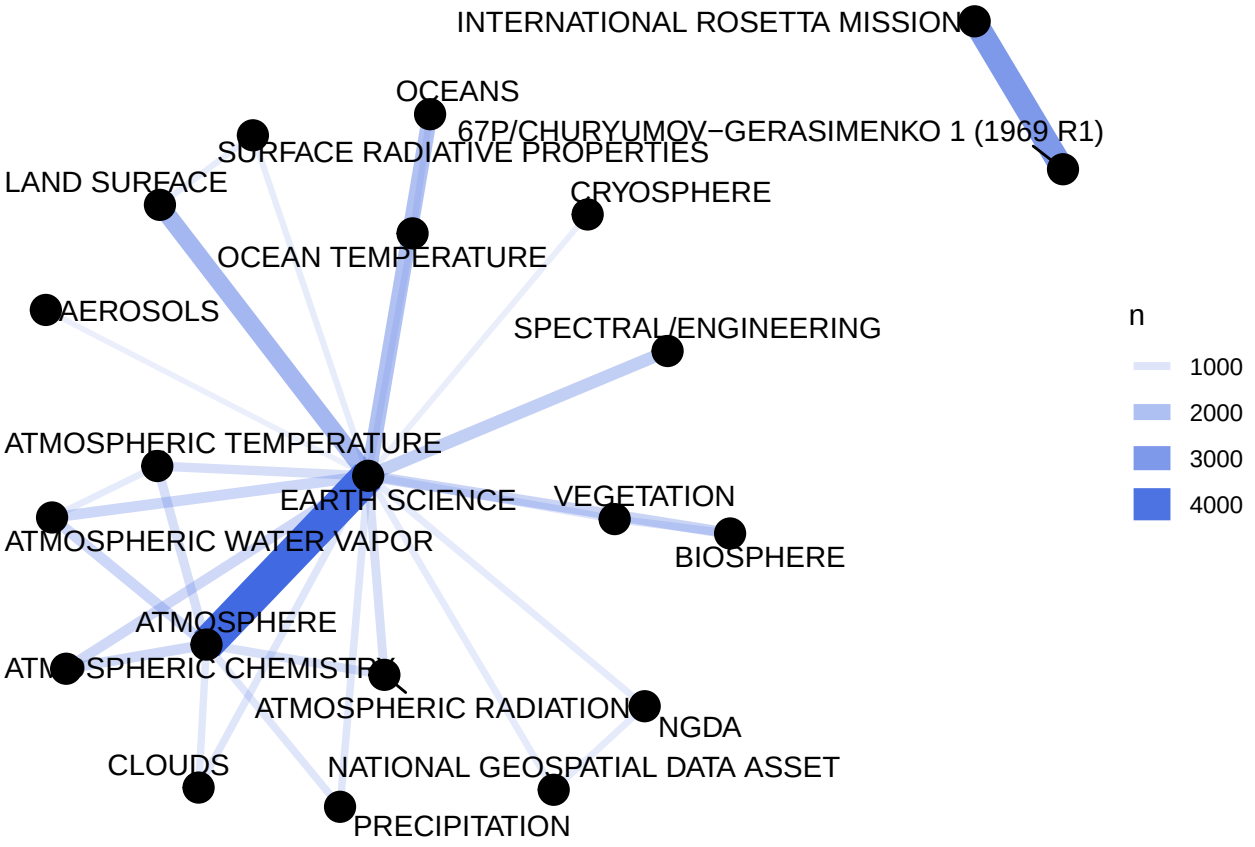

```
keyword_pairs <- nasa_keyword %>%
  pairwise_count(keyword, id, sort = TRUE, upper = FALSE)

keyword_pairs
```

```
## # A tibble: 3,008,145 x 3
##    item1                          item2                          n
##    <chr>                          <chr>                      <dbl>
##  1 EARTH SCIENCE                  ATMOSPHERE                  4244
##  2 INTERNATIONAL ROSETTA MISSION  67P/CHURYUMOV-GERASIMENKO~  2971
##  3 EARTH SCIENCE                  LAND SURFACE                2201
##  4 EARTH SCIENCE                  OCEANS                      1923
##  5 EARTH SCIENCE                  SPECTRAL/ENGINEERING        1580
##  6 EARTH SCIENCE                  BIOSPHERE                   1398
```

```
##  7 EARTH SCIENCE                ATMOSPHERIC WATER VAPOR     1354
##  8 ATMOSPHERE                   ATMOSPHERIC WATER VAPOR     1354
##  9 EARTH SCIENCE                ATMOSPHERIC CHEMISTRY       1309
## 10 ATMOSPHERE                   ATMOSPHERIC CHEMISTRY       1309
## # i 3,008,135 more rows
```

```
set.seed(1234)
keyword_pairs %>%
  filter(n >= 700) %>%
  graph_from_data_frame() %>%
  ggraph(layout = "fr") +
  geom_edge_link(aes(edge_alpha = n, edge_width = n), edge_colour = "royalblue") +
  geom_node_point(size = 5) +
  geom_node_text(aes(label = name), repel = TRUE,
                 point.padding = unit(0.2, "lines")) +
  theme_void()
```

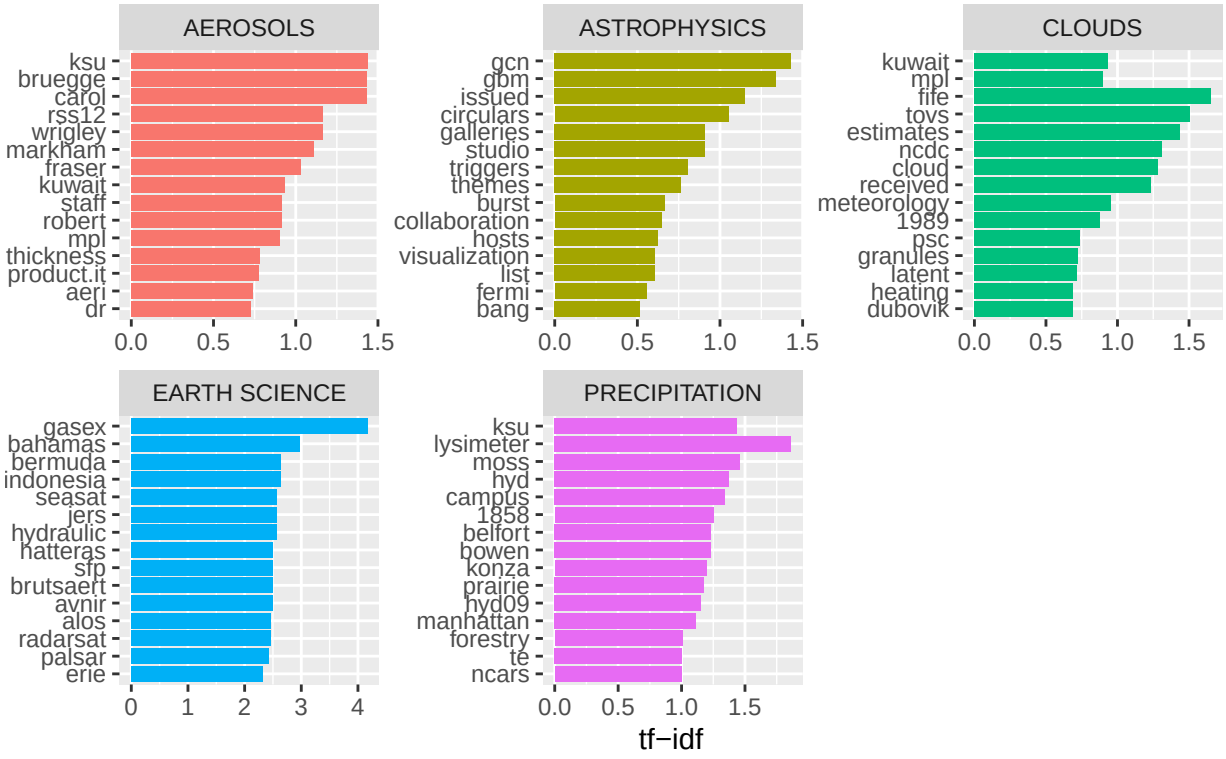



```
desc_tf_idf <- nasa_desc %>%
  count(id, word, sort = TRUE) %>%
  bind_tf_idf(word, id, n)
desc_tf_idf %>%
  arrange(-tf_idf)
```

```
## # A tibble: 1,123,591 x 6
##    id                          word      n    tf   idf tf_idf
##    <chr>                       <chr> <int> <dbl> <dbl>  <dbl>
##  1 C1206487217-ASF             pals~     1     1 10.0   10.0
##  2 C1206487504-ASF             pals~     1     1 10.0   10.0
```

```
##  3 C1633360161-OB_DAAC             bio_~     1     1 10.0   10.0
##  4 urn:nasa:pds:context_pds3:data~ unk       1     1  9.31   9.31
##  5 urn:nasa:pds:context_pds3:data~ unk       1     1  9.31   9.31
##  6 urn:nasa:pds:lab.hydrocarbon_s~ ____~     1     1  9.31   9.31
##  7 urn:nasa:pds:mgs_tes_recalib_a~ ____~     1     1  9.31   9.31
##  8 C2263929260-OB_DAAC             temp~     1     1  7.93   7.93
##  9 C2263929262-OB_DAAC             temp~     1     1  7.93   7.93
## 10 C2263929265-OB_DAAC             temp~     1     1  7.93   7.93
## # i 1,123,581 more rows
```

```
desc_tf_idf <- full_join(desc_tf_idf, nasa_keyword, by = "id")
desc_tf_idf %>%
  filter(!near(tf, 1)) %>%
  filter(keyword %in% c( "CLOUDS",
                         "AEROSOLS", "ASTROPHYSICS",
                         "PRECIPITATION", "EARTH SCIENCE")) %>%
  arrange(desc(tf_idf)) %>%
  group_by(keyword) %>%
  distinct(word, keyword, .keep_all = TRUE) %>%
  slice_max(tf_idf, n = 15, with_ties = FALSE) %>%
  ungroup() %>%
  mutate(word = factor(word, levels = rev(unique(word)))) %>%
  ggplot(aes(tf_idf, word, fill = keyword)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~keyword, ncol = 3, scales = "free") +
  labs(title = "Highest tf-idf words in NASA metadata description fields",
       caption = "NASA metadata from https://data.nasa.gov/data.json",
       x = "tf-idf", y = NULL)
```



NASA metadata from https://data.nasa.gov/data.json