RULE-BASED TEXT CLASSIFICATION

with R

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  - Choose class
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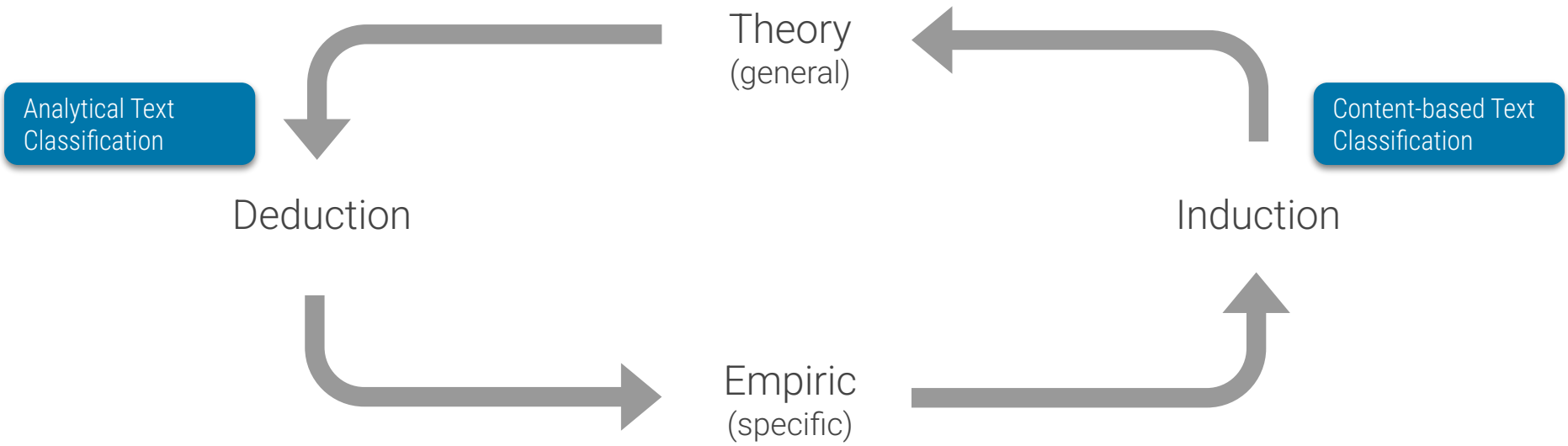
INDUCTIVE AND DEDUCTIVE

INDUCTIVE AND DEDUCTIVE

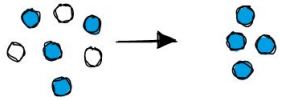


PREPARATION: TOKENIZE TEXT

Tokenization

Five steps to impose a structure on text

1. Filter or sample data



2. Clean and normalize text

"@all: This is the best course ever!!"

becomes

"this is the best course ever"

3. Split text into tokens

```
["this","is","the","best","course","ever"]
```

4. Remove stop words

```
["is","best","course","ever"]
```

5. Enrich tokens (lemmatization, stemming, part-of-speech)

```
["be" : [verb],
 "best": [adj],
 "course": [noun, obj],
 "ever": [temporal] ]
```

DEDUCTIVE TOPIC CLASSIFICATION

DEDUCTIVE TOPIC CLASSIFICATION

APPROACH

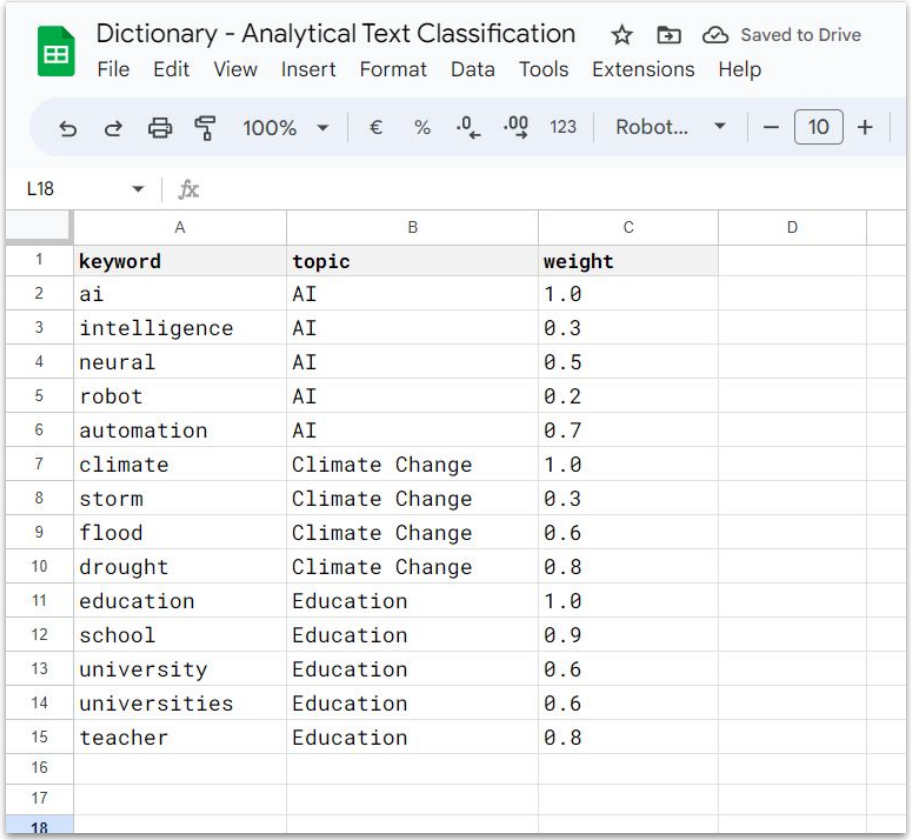
- Deductive text classification **starts with a predefined set of rules or hypotheses** and tests them against the data to classify it:

    - **Step 1**: Create a dictionary *keywords* → *topic* based on theory or hypotheses
    - **Step 2**: Join tokens with dictionary and extract keyword hits
    - **Step 3**: Aggregate keyword matches and assign topics. For instance:
        - Calculate absolute keyword count for each text (all and distinct hits)
        - Calculate relative keywords counts → Determine length of text first
        - Calculate weighted sum of keywords → Introduce weights to dictionary
    - **Step 4**: Choose class with highest score based on chosen metric
    - **Step 5**: Refine dictionary

DEDUCTIVE TOPIC CLASSIFICATION

STEP 1: CREATE DICTIONARY

- Driven by theory, we fill a dictionary in which we assign keywords to classes
- Classes can be hierarchical, e.g., *category → topic*
- Typically the exists a `1:n` relationship between class and keywords
- Optional: weights to distinguish important keywords from less important ones



	A	B	C	D
1	**keyword**	**topic**	**weight**	
2	ai	AI	1.0	
3	intelligence	AI	0.3	
4	neural	AI	0.5	
5	robot	AI	0.2	
6	automation	AI	0.7	
7	climate	Climate Change	1.0	
8	storm	Climate Change	0.3	
9	flood	Climate Change	0.6	
10	drought	Climate Change	0.8	
11	education	Education	1.0	
12	school	Education	0.9	
13	university	Education	0.6	
14	universities	Education	0.6	
15	teacher	Education	0.8	
16				
17				
18				

DEDUCTIVE TOPIC CLASSIFICATION

STEP 2: JOIN DICTIONARY TO DATA

Load the dictionary (here: XLSX) and join with text data (here: transcripts from TED-talks). An inner join removes texts with no keyword hits (yet):

```
keywords <- read_excel("inductive_topics.xlsx")

ted_stop <-
  inner_join(keywords, by = join_by(word == keyword)) |>
```

Resulting tibble from tokenization

DEDUCTIVE TOPIC CLASSIFICATION

STEP 3: COUNT MATCHES

Load the dictionary (here: XLSX) and join with text data (here: transcripts from TED-talks). A left join keeps the texts with no keyword matches (yet):

```
ted_stop |>
  inner_join(keywords, by = join_by(word == keyword)) |>
  group_by(title, topic) |>
  mutate(num_hits = n()) |>
  mutate(num_dist_hits = n_distinct(word))
```

DEDUCTIVE TOPIC CLASSIFICATION

STEP 3: CALCULATE RELATIVE COUNTS

Count the number of words per text before joining the dictionary and calculating the keywords hits:

```
ted_stop |>
  group_by(title) |>
  mutate(num_words = n()) |>
  ungroup() |>
  inner_join(keywords, by = join_by(word == keyword), keep = T) |>
  group_by(title, topic) |>
  mutate(num_distinct_hits = n_distinct(keyword)) |>
  mutate(num_total_hits = n()) |>
  mutate(pct_total_hits = num_total_hits / num_words)
```

Determine the number of words per text

Use it to calculate relative count

DEDUCTIVE TOPIC CLASSIFICATION

STEP 3: WEIGHTED SUM

Introduce a weight column to the dictionary and apply it to calculate a weighted sum:

```
ted_stop |>
  inner_join(keywords, by = join_by(word == keyword), keep = T) |>
  group_by(title, topic) |>
  mutate(num_total_hits = n()) |>
  mutate(weighted_total_hits = sum(weight)) |>
  ungroup()
```

Sum up all weights for the keyword hits

DEDUCTIVE TOPIC CLASSIFICATION

STEP 4: CHOOSE CLASS

Choose the class with the highest score (here: relative counts):

```
ted_stop |>
  group_by(title) |>
  mutate(num_words = n()) |>
  ungroup() |>
  inner_join(keywords, by = join_by(word == keyword), keep = T) |>
  ...
  distinct(id, topic, title, pct_total_hits) |>
  group_by(id, title) |>
  slice_max(order_by = pct_total_hits)
```

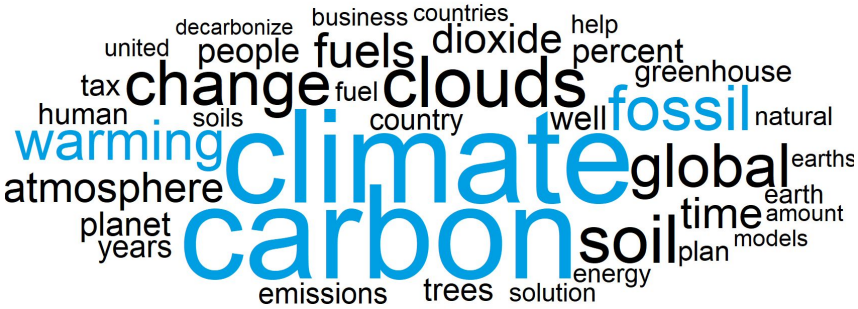
Reduce to only one row per title/topic

Get the top row within each id/title

DEDUCTIVE TOPIC CLASSIFICATION

STEP 5: REFINE DICTIONARY

- Add more keywords from theory / hypotheses and re-run
- Browse top word lists of texts that are not categorized yet or have a low count → look for missing matches for the topics and extend the dictionary
- Check the texts that have been categorized for more keywords.



INDUCTIVE TOPIC CLASSIFICATION

INDUCTIVE TOPIC CLASSIFICATION

APPROACH

- Inductive text classification **starts with the data and extracts potential topics** into a dictionary while analyzing the data. The process is cyclic:

    - **Step 1**: Look at the most common tokens (words) that could be associated with a specific topic.
    - **Step 2**: Create a dictionary and add identified tokens and assign topics
    - **Step 3**: Apply dictionary to text data and refine:
        A. Add new tokens for existing topics by looking at already classified texts
        B. Identify new topics by looking at unclassified texts (or with low probability)