Analysis

February 2, 2022

[1]:
```
import pandas as pd
from matplotlib import pyplot as plt
import seaborn as sns
import numpy as np

import csv
from collections import Counter
```

[2]:
```
def distribution(records, question):
    "Get distribution of answers, for a given question."
    c = Counter(record[question] for record in records)
    total = sum(c.values())
    empty = c['']
    counts = {key: {"number": value,
                    "percentage": (value/total) * 100,
                    "percentage_answered": (value/(total-empty)) * 100}
                for key, value in c.items()}
    try:
        del counts['']['percentage_answered']
    except:
        pass
    return counts


def get_questions(question, number):
    "Get questions for a range of questions in a grid."
    texts = []
    for i in range(1,number+1):
        item = f'Q{question}_{i}'
        text = questions[item]
        text = text.split('-')[-1].strip()
        texts.append(text)
    return texts


def get_texts(records, question):
    "Get answer texts."
```

```
    return [answer for record in records
                    if not (answer := record[question]) == ''] # Look at that␣
 ↪cool walrus operator!


def basic_stats(records, question):
    "Print basic statistics about the results."
    counts = distribution(records, question)
    for key, results in counts.items():
        if not key == '':
            print(f"{key}: {results['number']} ({results['percentage_answered']:
 ↪.2f}%)")


def underscored(base, number, records):
    "Get answer distribution for all subquestions."
    results = dict()
    for i in range(1, number+1):
        question = f"Q{base}_{i}"
        results[question] = distribution(records, question)
    return results


def agreement(counts):
    "Select percentage answered for all answers except the empty string."
    results = dict()
    for answer in ['Strongly disagree', 'Somewhat disagree', 'Neither agree nor␣
 ↪disagree', 'Somewhat agree', 'Strongly agree']:
        try:
            results[answer] = counts[answer]['percentage_answered']
        except:
            results[answer] = 0
    return results


def write_texts(texts, filename):
    "Write texts from a list to a file."
    with open('./texts/' + filename,'w') as f:
        writer = csv.writer(f)
        writer.writerows(texts)
```

[3]:
```
df = pd.read_excel("internal_survey_results.xlsx")
df = df.fillna('')
records = df.to_dict("records")
```

[4]:
```
consented = [record for record in records if str(record['Q1 ']).
 ↪startswith("Yes")]

# For subgroup analysis:
academia = [record for record in records if str(record['Q2'])=='Academia']
industry = [record for record in records if str(record['Q2'])=='Industry']
```

[5]:
```
# If necessary, here are all questions:
questions = records[0]
```

[6]:
```
"""
TODO:
- Subgroup analysis: academia vs industry
- Heatmap tables
"""
```

[6]:
```
'\nTODO:\n- Subgroup analysis: academia vs industry\n- Heatmap tables\n'
```

1 Demographics

[7]:
```
# Where do people come from?
basic_stats(consented, "Q2")
```

```
Academia: 10 (76.92%)
Other: 1 (7.69%)
Industry: 2 (15.38%)
```

[8]:
```
# Time spent working in NLG:
basic_stats(consented, "Q3")
```

```
2-5 years: 7 (53.85%)
11 or more years: 2 (15.38%)
Less than 2 years: 1 (7.69%)
6-10 years: 3 (23.08%)
```

[9]:
```
# Read an error analysis:
basic_stats(consented, "Q4")
```

```
Yes: 12 (92.31%)
No: 1 (7.69%)
```

[10]:
```
# Carried out an error analysis:
basic_stats(consented, 'Q9')
```

```
Yes: 8 (66.67%)
No: 4 (33.33%)
```

[11]:
```
# Considered carrying one out (only people who answered 'no'):
basic_stats(consented, 'Q12')
```

```
Once or twice: 3 (75.00%)
I'm planning to carry out an error analysis in the future: 1 (25.00%)
```

[12]:
```
# Willing to carry one out (only people who answered 'no'):
basic_stats(consented, 'Q14')
```

```
Definitely yes: 3 (75.00%)
Probably yes: 1 (25.00%)
```

2 Usefulness of error analyses

[13]:
```
# Found useful:
basic_stats(consented, 'Q5')
```

```
Extremely useful: 2 (16.67%)
Moderately useful: 2 (16.67%)
Slightly useful: 1 (8.33%)
Very useful: 6 (50.00%)
Not at all useful: 1 (8.33%)
```

[14]:
```
# Uses:
texts = get_texts(consented, 'Q6')
write_texts(texts, "uses_of_error_analysis.csv")

for text in get_texts(consented, 'Q6'):
    print(text)
    print('----')
```

```
Error analyses better explain the capabilities of the systems, which is not
always the case with automatic metrics for evaluation as well as human ratings.
----
It provided me with a better understanding of the type and frequency of errors.
This is much more useful to me in terms of understanding the problem, than a
single number metric within a task.
----
The error analyses provided additional insight into the performance of the NLG
systems. Usually, the error analyses would include more details on the accuracy
or fidelity of the text generation system.
----
much better understanding of the kind of errors the systems make
----
It gives much better insight into the system behavior than overall statistics
from the automatic metrics or human evaluation.
----
```

Acknowledging patterns of model shortcomings was very helpful in making the differences (strengths and weaknesses) between different models more concrete than simply discussing small differences in automatic metrics.

Allows for a more detailed understanding of a system's failure modes
---
The analyses gave insights into the distribution of errors, and helped me to think of ways in which the system could be improved. Furthermore, it helped me see the ways in which flawed outputs could cause harm to users or other stakeholders.

They help to quantify the errors within that particular study but are not particularly helpful when comparing the results with other works.
---

[15]:
```
# Reasons for disappointment:
texts = get_texts(consented, 'Q7')
write_texts(texts, "reasons_for_disappointment.csv")

for text in texts:
    print(text)
    print('----')
```

It was impossible to find what steps we should follow to do a correct or complete error analysis or how we define it.
---

3 Barriers and enabling factors

[16]:
```
# Challenges:
texts = get_texts(consented, 'Q10')
write_texts(texts, "challenges.csv")

for text in texts:
    print(text)
    print('----')
```

I did not find carrying it out particularly challenging as the type of evaluation was "evaluation by annotation". Annotators had already found and categorised the errors, I was only looking for patterns within that, so, for example, within "Number" errors, looking at which we ordinal or cardinal, etc.

I found the following challenging when using human evaluation for error analysis:
- Selecting an appropriate error taxonomy for the evaluation. There is no standardised definitions for the error types, and it was hard to know the appropriate level of technical language acceptable for the annotators.

```
- Achieving a high inter-annotator agreement on a survey.
----
- establishing the taxonomy of errors
- selecting examples for the analysis
- finding the time for analyzing enough samples (usually operating given a paper
deadline)
- handling edge cases (e.g. in fluency errors) or ambiguous cases (error may be
of two differnt types)
----
It was very hard to define or categorise different types of errors.
----
- it is time consuming
- it is hard to come up with meaningful categories (not too detailed & not too
general)
- it may require some subjective judgement
----
Categorising the mistakes made by the system, because the errors were often
ambiguous between different categories. (Maybe I should have chosen a higher
level of abstraction to avoid this, but that would've made the analysis less
useful.)
----
The only complexity is that it adds additional time to prepare the results.
----
```

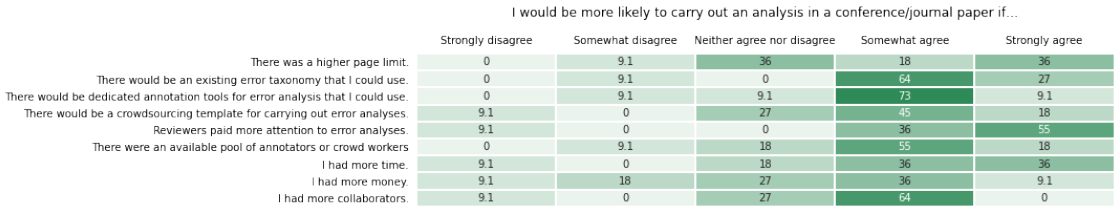
[17]:
```
# Enough resources/reference materials at the time?
basic_stats(consented,'Q11')
```

```
No: 7 (87.50%)
Yes: 1 (12.50%)
```

[18]:
```
answers = ['Strongly disagree', 'Somewhat disagree', 'Neither agree nor␣
 ↪disagree', 'Somewhat agree', 'Strongly agree']
records = []
for question, counts in underscored(16,9,consented).items():
    for answer in answers:
        percentage = 0
        if answer in counts:
            percentage = counts[answer]['percentage_answered']
        record = dict(question=question, answer=answer, percentage=percentage)
        records.append(record)

df = pd.DataFrame(records)
# Pivot to make a square table:
df = df.pivot(index='question', columns='answer', values='percentage')
# Reorder columns:
df = df[['Strongly disagree', 'Somewhat disagree', 'Neither agree nor␣
 ↪disagree', 'Somewhat agree', 'Strongly agree']]
```

```
plt.rcParams["figure.figsize"] = (15,3)
ax = sns.heatmap(df,cmap=sns.light_palette("seagreen",␣
 ↪as_cmap=True),linewidth=1,cbar=False,annot=True)
ax.xaxis.tick_top()
plt.xticks(np.arange(5) + 0.5, labels=answers)
plt.yticks(np.arange(9) + 0.5, labels=get_questions(16,9))
plt.tick_params(top=False,left=False)
plt.xlabel('')
plt.ylabel('')
plt.title("I would be more likely to carry out an analysis in a conference/
 ↪journal paper if…", y=1.2)
plt.tight_layout()
plt.savefig("Q16.pdf")
```



[19]:
```
# Enough resources/reference materials currently?
basic_stats(consented,'Q20')
```

```
No, I am still missing:: 10 (90.91%)
Yes: 1 (9.09%)
```

[20]:
```
# What is still missing?
texts = get_texts(consented, 'Q20_2_TEXT')
write_texts(texts, "missing.csv")

for text in texts:
    print(text)
    print('----')
```

```
An error taxonomy!
----
Much like evaluation, there are guidelines, but researchers (particularly at the
PGR or small group level) are often left to try and just find something that
works for them.  This is in part also because there is no one way to do an error
analysis, and the problem/domain can have an effect on what you should do as
well.
----
Standardised error definitions and guidelines for conducting error analysis with
```

```
them.
----
I'd say "almost" -- since not much is needed. Some easy-to-use annotation tools
would be helpful, but not crucial -- simple ad-hoc scripts and spreadsheets work
well enough for me in most cases
----
a taxonomy agreed upon by the community which would make the results comparable
across papers
----
Either templates and a thorough how-to guide, or a repository of existing error
analyses to use as examples.
----
Available domain experts in the minority languages I deal with
----
A taxonomy of common errors.
----
Standardisation and the expectation from other researchers.
----
```

[21]:
```
# Other factors that make it more likely for you to carry out an error analysis?
texts = get_texts(consented, 'Q21')
write_texts(texts, "enabling.csv")

for text in get_texts(consented, 'Q21'):
    print(text)
    print('----')
```

```
If it is a standard approach in our field, then people will do it.
----
The main factors are reviewers not considering them a contribution, and paper
page limit.  All the resources in the world will make no difference whilst this
is the case.  As an author of our error analysis I tried to include one in a
journal submission (10 page ACL format) but had to cut it for space.  We include
2 pages of math that is basically the same as every other 2 pages of math, so we
can pretend we are generalizing, but no error analysis.
----
I would be more likely to carry out an error analysis if I see it as part of the
requirements to journals / conferences, and if I see more accepted papers
including error analysis.
----
I'd say the main thing missing is push/incentives to move the field to do them
on a larger scale.
----
Providing an effective training for the NLG community,  by conducting workshops,
tutorials, and demos.
----
If error analyses are incentivized/prioritized from a publishing/reviewer
perspective, this would help justify the time/resources required to complete
```

error analyses.

Changing text domains: some types of errors are impracticably time consuming to identify in the domains I work with due to the amount of input data consumed by the system.

As mentioned before. More encouragement from conference/workshop organisers for error analyses to be conducted.

If other researchers cared more about error analysis. If others don't understand the importance of error analysis, the practice of carrying one out will be limited, and readers probably won't care to read about it in papers that have been written.
---

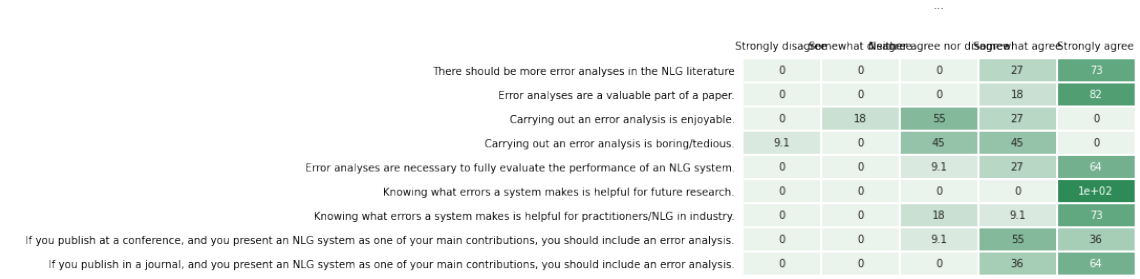
4 General opinions

[22]:
```
answers = ['Strongly disagree', 'Somewhat disagree', 'Neither agree nor␣
 ↪disagree', 'Somewhat agree', 'Strongly agree']
records = []
for question, counts in underscored(18,9,consented).items():
    for answer in answers:
        percentage = 0
        if answer in counts:
            percentage = counts[answer]['percentage_answered']
        record = dict(question=question, answer=answer, percentage=percentage)
        records.append(record)

df = pd.DataFrame(records)
# Pivot to make a square table:
df = df.pivot(index='question', columns='answer', values='percentage')
# Reorder columns:
df = df[['Strongly disagree', 'Somewhat disagree', 'Neither agree nor␣
 ↪disagree', 'Somewhat agree', 'Strongly agree']]

plt.rcParams["figure.figsize"] = (15,4)
ax = sns.heatmap(df,cmap=sns.light_palette("seagreen",␣
 ↪as_cmap=True),linewidth=1,cbar=False,annot=True)
ax.xaxis.tick_top()
plt.xticks(np.arange(5) + 0.5, labels=answers)
plt.yticks(np.arange(9) + 0.5, labels=get_questions(18,9))
plt.tick_params(top=False,left=False)
plt.xlabel('')
plt.ylabel('')
plt.title("...", y=1.2)
plt.tight_layout()
```

```
plt.savefig("Q18.pdf")
```



	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
There should be more error analyses in the NLG literature	0	0	0	27	73
Error analyses are a valuable part of a paper.	0	0	0	18	82
Carrying out an error analysis is enjoyable.	0	18	55	27	0
Carrying out an error analysis is boring/tedious.	9.1	0	45	45	0
Error analyses are necessary to fully evaluate the performance of an NLG system.	0	0	9.1	27	64
Knowing what errors a system makes is helpful for future research.	0	0	0	0	1e+02
Knowing what errors a system makes is helpful for practitioners/NLG in industry.	0	0	18	9.1	73
If you publish at a conference, and you present an NLG system as one of your main contributions, you should include an error analysis.	0	0	9.1	55	36
If you publish in a journal, and you present an NLG system as one of your main contributions, you should include an error analysis.	0	0	0	36	64

[23]:
```
# More/less/equally likely to include error analysis in journal
basic_stats(consented, 'Q19')
```

```
Equally: 2 (18.18%)
More: 9 (81.82%)
```

5 Requirements for reports of error analyses

[24]:
```
texts = get_texts(consented, 'Q23')
write_texts(texts, "reporting_requirements.csv")

for text in texts:
    print(text)
    print('----')
```

```
Details about who the annotators are (researchers, professionals, crowd workers)
and what if any qualification work they had to indicate they were capable of
doing the error annotation.
----
Samples of the system output with errors, and analysis of the cause for the
error.
----
- examples for the different error types described
- details on the methodology (chosen system variants and samples, motivation for
the chosen error taxonomy)
----
several representative outputs of the system (not cherry-picking the best ones,
but not random either - rather highlighting the advantages & problems of the
system)
----
Example outputs showing errors/the context in which errors tend to occur.
----
Relevant background of the annotators, e.g. whether journalists or crowd workers
analyzed news text.
```

Definitions for each type of error, and an appendix with annotation guidelines.

If carrying out a comparison between two systems, I would appreciate some statistics to see if an error occurs significantly more in the output of System A than of System B.
---

6 General comments

[25]:
```
texts = get_texts(consented, 'Q24')
write_texts(texts, "general_comments.csv")

for text in texts:
    print(text)
    print('----')
```

With the question: ~"Would I be more likely to do an error analysis for a journal", we could maybe have an additional comments field so people can ask why?

AUTHOR

[ ]:
```

```