Assessing Multilinguality of Publicly Accessible Websites

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**Motivation**

- Although Internet today is multilingual, language presence on the World Wide Web is very disproportionate.
- “Nations, communities and individuals without access to the Internet and its resources will certainly be marginalized with limited access to information and knowledge, which are critical elements of sustainable development.” (UNESCO)
- UNESCO encourages its member states to develop comprehensive language-related policies (...) to promote and facilitate linguistic diversity and multilingualism, including on the Internet and in the media.

*Source: [Internet World Stats, 2020](https://www.internetworldstats.com/stats20.htm)*

*Languages used on the internet by share of internet users in 2020 | European Parliament*
Motivation

- Linguistic diversity is a fundamental value of the European Union.
- Making European websites more multilingual is one of the targets of the Connecting Europe Facility Automated Translation (CEF AT).
- CEF AT needs a methodology and a tool to assess the degree of multilingualism of a web site.
- We investigate methods and tools that automatically analyse language diversity on the Web and propose indicators and a methodology on measuring the multilingualism of European websites.
- We present a basic scoring tool developed based on open-source software.
Multilingual — "(of people or groups) able to use more than two languages for communication, or (of a thing) written or spoken in more than two different languages" (Wikipedia)

«A “multilingual” web site refers to a web site that uses more than one language." (W3C)

Three Broad Types of Multilingual Websites (Hillier, 2003)
• Multilingualism on the Internet:
  • the diversity of languages as a means of communication on the Internet (analysis of their visibility, accessibility and status)
  • the practices of multilingual Internet users and the ways in which they draw on and use resources provided by more than one language in their computer-mediated communication

• We found that only a few research papers analyse websites with respect to their multilinguality
**Criteria of Multilingualism Scoring**

- **Linguistic quality** criterion is applied to evaluate the linguistic quality of the content in a particular language.
- **Technical quality** criterion assesses use of internationalization attributes and other technical aspects.
- **Content parallelism** criterion assesses the degree of equivalence of the content in different languages.
CRITERIA OF MULTILINGUALISM SCORING

- **Language coverage** represents how many languages are present on a site.
- **Language balance** is a measure of evenness/balance of the content coverage in various languages.
- **Normalized language balance** represents both how many EU languages are found in a site and how equally the content is distributed between languages.
- **Lieberson's diversity index** (LDI) represents how content is distributed in various languages and how many languages are present on a website.

\[
LDI = 1 - \sum P_i^2
\]

where \( P_i \) represents the share of i-th language speakers in a community.
24 EU languages (extendable to 26 EEA languages or other set)
Each of EU languages found adds 1/24 (0.041667)

Minimum score 0.

Maximum score 1, all 24 EU languages present

Example website, 6 EU languages present – score 6/24=0.25

Example website, 5 EU languages present and one other language – score 5/24=0.2083
**Language balance and LDI**

Language balance = \( \frac{(0.1667 + 0.1667 + 1.0000 + 0.1667 + 0.1667)}{5} = 0.3333 \)

Normalised language balance = \( \frac{5}{24} \times 0.3333 = 0.069 \)

LDI = \( 1 - (0.01 + 0.01 + 0.36 + 0.01 + 0.01) = 1 - 0.4 = 0.6 \)

<table>
<thead>
<tr>
<th>Language</th>
<th>Page count</th>
<th>Share from Max</th>
<th>Share from total</th>
<th>Squared share from total ((P_i^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>1</td>
<td>0.1667</td>
<td>0.1</td>
<td>0.01</td>
</tr>
<tr>
<td>German</td>
<td>1</td>
<td>0.1667</td>
<td>0.1</td>
<td>0.01</td>
</tr>
<tr>
<td>French</td>
<td>6</td>
<td>1.0000</td>
<td>0.6</td>
<td>0.36</td>
</tr>
<tr>
<td>Latvian</td>
<td>1</td>
<td>0.1667</td>
<td>0.1</td>
<td>0.01</td>
</tr>
<tr>
<td>Lithuanian</td>
<td>1</td>
<td>0.1667</td>
<td>0.1</td>
<td>0.01</td>
</tr>
</tbody>
</table>
**LANGUAGE BALANCE AND LDI**

Language balance = \( \frac{(1.0000+1.0000+1.0000+1.0000+1.0000)}{5} = 1.0000 \)

Normalised language balance = \( \frac{5}{24} * 1 = 0.208 \)

LDI = \( 1 - (0.04+0.04+0.04+0.04+0.04) = 1 - 0.2 = 0.8 \)

<table>
<thead>
<tr>
<th>Language</th>
<th>Page count</th>
<th>Share from Max</th>
<th>Share from total</th>
<th>Squared share from total ( (p_i^2) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>10</td>
<td>1.0000</td>
<td>0.2</td>
<td>0.04</td>
</tr>
<tr>
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<td>French</td>
<td>10</td>
<td>1.0000</td>
<td>0.2</td>
<td>0.04</td>
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<tr>
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<td>0.2</td>
<td>0.04</td>
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<tr>
<td>Lithuanian</td>
<td>10</td>
<td>1.0000</td>
<td>0.2</td>
<td>0.04</td>
</tr>
</tbody>
</table>
## Language Balance and LDI

Language balance = \( \frac{1}{1} = 1 \)

Normalised language balance = \( \frac{1}{24} \times 1 = 0.0416 \)

LDI = \( 1 - (1+0+0+0+0) = 1 - 1 = 0 \)

<table>
<thead>
<tr>
<th>Language</th>
<th>Page count</th>
<th>Share from Max</th>
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<td>10</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>German</td>
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<td>0</td>
</tr>
<tr>
<td>French</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Latvian</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Lithuanian</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Architecture

Docker

List with source URLs

Crawler (Scrapy)

Responses (webpages + metadata)

List with multilinguality scores

Report Builder

Statistics and score

Calculation of Statistics and final score

Content Processor
- Boilerplate/Content classification
- Boilerplate removal
- Main text language detection
- Link URL analysis
- Menu / boilerplate language
- HTML analysis
- Presence of multilingual features

Persistent storage – Folder with data files
COMPONENTS

• Crawler – Scrapy
• Boilerplate removal – jusText
• Language detection – LangDetect
• Scoring – 2 formulas:
  • Normalized language balance = sum(Share1, Share2, ..., ShareN)/N
  • Lieberson's diversity index \( LD1 = 1 - \sum P_i^2 \)
    • where \( P_i \) represents the share of i-th language
THE TOOL

Multilingualism Scoring Tool
This tool crawls web sites and performs analysis and calculates scores based on their multilingualism.

Crawling data
Urls (each in new line):

OR
Drag and Drop file here
Or
Click to select file

Crawling depth: Job name:
1
Alphanumeric symbols only

Start crawling
Get latest results

Stop crawling
Get latest results

Current crawl results
Average score: 7.43

| Url          | Coverage EU24|x_no | Normalised Language balance (Score) | LDI pages | LDI words | Language balance EU24 | Language balance x_no |
|--------------|----------------|-----------------------------------|----------------|-----------|------------------------|------------------------|
| census.gov.uk | 18             | 7.54                              | 87.58         | 85.26     | 7.69                   | 10.05                  | 10.05                 |
| chenki.by     | 0.00           | 0.00                              | 0.00          | 100.00    | 0.00                   | 0.00                   | 0.00                  |
| skardanams.com| 4              | 11.31                             | 74.30         | 69.34     | 51.67                  | 67.86                  | 67.86                 |
| gornyi.edu.pl | pl             | 4.17                              | 0.00          | 0.00      | 100.00                 | 100.00                 | 100.00                |
| ambrosia.eu   | 8              | 13.19                             | 85.45         | 53.06     | 37.22                  | 39.58                  | 39.58                 |
| toscrape.com  | en             | 4.17                              | 0.00          | 0.00      | 100.00                 | 100.00                 | 100.00                |
| skardanams.lv | lv             | 4.17                              | 0.00          | 0.00      | 100.00                 | 100.00                 | 100.00                |

Download results
Download detailed results

About Multilingualism Scoring Tool
Multilingualism Scoring Tool is available for download either as a code and Docker container on the github:
https://github.com/tilde-nlp/Multilingualism-scoring-tool
Observations while using tool

- Crawled 230 random websites with depth 1 in two days
- Found 34 empty results:
  - Redirects 14
  - No content 6
  - Bad address 10
  - Javascript 1
  - Restrictive robots.txt 2
  - Forbidden 1
  - OK 196
Observations while using tool

- Number of prepared requests in each depth (before filtering)
  - 'request_depth_count/0': 14,
  - 'request_depth_count/1': 1000,
  - 'request_depth_count/2': 72004,
  - 'request_depth_count/3': 1259091,

- Stopped after ~110K requests
  - 'exception_count': 17784 detailed breakdown:
    - 'ValueError': 2, 'IgnoreRequest': 12784, 'CancelledError': 1,
    - 'ConnectionRefusedError': 4929, 'DNSLookupError': 54, 'TimeoutError': 11, 'ResponseNeverReceived': 3,

- Responses 92927:
  200 – 73096; 301 – 7534; 302 – 6338; 307 – 598; 404 – 228; 500 – 77, others <15 each
Observations while using tool

https://president.ee/et/
- 1 Hops: Pages: 45; w/o 8, et 35, ru 1, en 1
- 2 Hops: Pages: 2892; w/o 1274, et 1497, ru 39, en 72, fi 2, lv 1, uk 1, lt 1, el 1, ...
- 3 Hops: Pages: 8272; w/o 3670, et 3164, ru 463, en 910, fi 10, lv 4, uk 5, lt 3, ...
- 4 Hops: Pages: 13179; w/o 6566, et 3938, ru 857, en 1694, fi 24, lv 6, uk 8, lt 9, ...

https://president.ee/ru/index.html
- 1 Hops: Pages: 37; w/o 7, ru 27, en 1, et 2
- 2 Hops: Pages: 673; w/o 158, ru 434, en 38, et 42, uk 1
- 3 Hops: Pages: 5373; w/o 2147, et 1540, ru 824, en 812, uk 5, fi 5, lv 3, lt 2, ...
- 4 Hops: Pages: 12031; w/o 5980, et 3367, ru 898, en 1670, uk 8, fi 19, lv 6, ...

- 1 Hops: Pages: 39; w/o 6, ru 1, en 31, et 1
- 2 Hops: Pages: 1133; w/o 293, ru 28, en 733, et 43, uk 2, fi 3, de 6, sv 2, lv 2, ...
- 3 Hops: Pages: 6162; w/o 2445, et 1625, ru 456, en 1537, fi 14, de 15, sv 4, lv 5, ...
- 4 Hops: Pages: 12471; w/o 6149, et 3421, en 1881, ru 879, fi 28, de 21, sv 5, lv 6, ...
## SOME RESULTS AND OBSERVATIONS

<table>
<thead>
<tr>
<th>URLs</th>
<th>Crawling depth</th>
<th>Crawl time (h)</th>
<th>Memory usage max (MB)</th>
<th>Average score (normalised lang. balance)</th>
<th>Average coverage of EU languages</th>
<th>Average number of pages/site</th>
<th>Average number of words/site</th>
</tr>
</thead>
<tbody>
<tr>
<td>198</td>
<td>1</td>
<td>0:50</td>
<td>160</td>
<td>4.65</td>
<td>1.89</td>
<td>33</td>
<td>14516</td>
</tr>
<tr>
<td>198</td>
<td>2</td>
<td>12:54</td>
<td>1030</td>
<td>5.57</td>
<td>2.15</td>
<td>262</td>
<td>44592</td>
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<tr>
<td>198</td>
<td>3</td>
<td>48</td>
<td>1238</td>
<td>5.97</td>
<td>2.25</td>
<td>885</td>
<td>93242</td>
</tr>
<tr>
<td>198</td>
<td>4</td>
<td>&gt;250</td>
<td>6672</td>
<td>6.08</td>
<td>2.29</td>
<td>8374</td>
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<tr>
<td>600</td>
<td>2</td>
<td>52</td>
<td>1023</td>
<td>5.56</td>
<td>2.02</td>
<td>227</td>
<td>53663</td>
</tr>
</tbody>
</table>
RESULTS ON TWO TEST LISTS

Average scores and Average Language count for different depths.

Crawled pages per site and Words per site for different depths.

Depth of crawling 3.
CONCLUSION

• To measure multilinguality, we created an open-source tool for scoring multilinguality that calculates several scores to measure multilingualism over the Web: Lieberson’s diversity index, language coverage, language balance and normalised language balance.

• European websites currently are not very multilingual – on average content is presented only in 2-3 languages.

• Our next steps include assessment of more complicated multilingualism criteria, such as linguistic quality, technical quality and content parallelism, and implement them into next versions of the tool.
THANK YOU FOR YOUR ATTENTION!

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