Duke Library Website Preliminary Accessibility Assessment

December 15, 2011

Michael Daul, Digital Projects Developer
Digital Experience Services
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EXECUTIVE SUMMARY

I was tasked in the Fall of 2011 to work on an accessibility assessment of the Duke Libraries website. To my knowledge, such an assessment has not been completed before. The plan for this assessment was to focus on three distinct pages and to conduct a thorough review of potential problem areas within them. The pages that were to be reviewed are:

I.  http://www.library.duke.edu (home page)

II. http://search.library.duke.edu/ (search page)

III. http://library.duke.edu/research/citing/ (citing sources page)

These pages were accessed between October 15, 2011 and December 15, 2011.

FINDINGS

In conducting my assessment, I identified several minor issues that can be fixed with limited resources. As the library moves towards adopting a more formalized set of accessibility standards, I think there will be much more work required to educate stakeholders and content developers on the methods and best practices for building accessible content.

RECOMMENDATIONS

• Implement template-level changes where appropriate (quick fixes)
• Develop organizational (site-wide) accessibility policies for the library
• Implement the standards on all new web projects
• Develop and implement a plan to handle legacy content
• Educate and promote best practices for content developers
METHODOLOGY

I reviewed the sample set of pages and analyzed them using a suite of free tools* including the following:

- **W3C Markup Validator** – checks page code for W3C validation
- **CynthisSays** – online tool for quick accessibility checks
- **Lynx Browser** – text-based web browser
- **Mozilla Firefox** with the following extensions:
  - **Fangs** – simulates screen reader output
  - **WCAG Color Contrast Checker** – checks color combinations
- **Color Oracle** – simulates 3 types of color blindness
- **JuicyStudio Readability Test** – analyzes page content and assigns a ranking
- **JAWS** – the most popular screen reading software (for windows)
- **Apple VoiceOver** – built-in assistive tool for OS X
- **WebAnywhere** – web-based screen reader

* A full list of tools recommended by the W3C WAI is available at http://www.w3.org/WAI/ER/tools/complete
OVERVIEW

Before I delve into the results of my assessment, I think it is first important to talk about the issue of Web accessibility and why this process is important. Traditionally Web accessibility is focused on discovering potential problems for how a website will be viewed for users using assistive technologies, meaning individuals who are not able to fully see (or sometimes hear) the content on a website. And this report will indeed address those concerns. However, I think it is important to also point out that by ensuring that a website is able to accommodate as wide of a range of users as possible, it most likely will also be doing the sorts of things that improve the sites usability. Approaching the design and development of a website from the point of view of ensuring that it is accessible will almost always lead to a site that is also easy for everyone to use. In short, ensuring your site is accessible will most likely help all of your users.

So why do we care about making a website accessible? It is important to keep in mind that there are many different users of websites with many different types of abilities. It should always be a goal to make sure your site can be easily used by as large a group of users as possible - young, old, users with disabilities (hearing, vision, etc.), and so on. Accessibility guidelines for websites fall under section 508 (added in 1998) of the Rehabilitation Act of 19731. The section 508 guidelines are primarily concerned with ensuring that all content that is presented on a website that is funded with federal money must be available in an accessible format for all users. So for example, if your website contains a video, it must also include a method to access the content of the video for users who are vision, hearing, or otherwise impaired. You can view the full regulations at http://section508.gov/index.cfm?fuseAction=stdsdoc

The 508 guidelines apply to a broad range of technologies, not just websites, so for the purposes of this report we are chiefly concerned with section 1194.222 of the 508 guidelines as they pertain specifically to websites. There are 16 specific rules that cover topics like providing alternate content, the use of color, organizing data in a table, user input (forms), and ease of navigation.

(a) A text equivalent for every non-text element shall be provided (e.g., via "alt", "longdesc", or in element content).

(b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.

(c) Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.

2 http://section508.gov/index.cfm?fuseAction=stdsdoc#Web
(d) Documents shall be organized so they are readable without requiring an associated style sheet.

(e) Redundant text links shall be provided for each active region of a server-side image map.

(f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.

(g) Row and column headers shall be identified for data tables.

(h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.

(i) Frames shall be titled with text that facilitates frame identification and navigation.

(j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.

(k) A text-only page, with equivalent information or functionality, shall be provided to make a web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.

(l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology.

(m) When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).

(n) When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.

(o) A method shall be provided that permits users to skip repetitive navigation links.

(p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.

In addition to the 508 guidelines, there are more extensive guidelines developed by the Web Accessibility Initiative (WAI)\(^3\) called the Web Content Authoring Guidelines (WCAG). WCAG 1.0\(^4\) was published in 1999. A revised version, WCAG 2.0\(^5\), was published in 2008. WCAG 1.0 consists of 14 points:

1. Provide equivalent alternatives to auditory and visual content.

2. Don't rely on color alone.

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\(^3\) [http://www.w3.org/WAI/](http://www.w3.org/WAI/)

\(^4\) [http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/](http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/)

\(^5\) [http://www.w3.org/TR/2008/REC-WCAG20-20081211/](http://www.w3.org/TR/2008/REC-WCAG20-20081211/)
3. Use markup and style sheets and do so properly.
4. Clarify natural language usage
5. Create tables that transform gracefully.
7. Ensure user control of time-sensitive content changes.
8. Ensure direct accessibility of embedded user interfaces.
10. Use interim solutions.
11. Use W3C technologies and guidelines.
12. Provide context and orientation information.
13. Provide clear navigation mechanisms.
14. Ensure that documents are clear and simple.

WCAG 2.0 establishes four overarching principles for accessibility that are then further described in several guidelines for each. The four principles are:

1. Perceivable - Information and user interface components must be presentable to users in ways they can perceive.
2. Operable - User interface components and navigation must be operable.
3. Understandable - Information and the operation of user interface must be understandable.
4. Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

**APPROACH**

The initial accessibility assessment was conducted following the guidelines of the WAI’s Preliminary Review of Web Sites for Accessibility document and was further supplemented by an assortment of tools as well as some in-person testing with users who have extensive experience browsing the Web using assistive technology. Using the following tools, I conducted what could be called the objective portion of the assessment. The detailed output from all of these tests can be found in the appendix section of this document. I will also summarize the results in the following section.

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6 [http://www.w3.org/WAI/impl/Overview](http://www.w3.org/WAI/impl/Overview)
• **W3C Markup Validation Service** ([http://validator.w3.org/](http://validator.w3.org/))
  This tool is provided in order to do a quick check to see if the rendered html of a particular Web page is using valid code according to W3C standards. It should be noted that validation is not required in order for a page to function in a Web browser, and that many popular websites have numerous validation errors using this tool (library.harvard.edu, 22 errors; google.com, 37 errors; amazon.com, more than 500 errors).

• **CynthiaSays** ([http://www.cynthiasays.com/](http://www.cynthiasays.com/))
  This tool runs a number of checks against the W3C and WCAG accessibility guidelines. As with most of these tests, it is a quick starting point for evaluating overall accessibility. In general, this test is ideal for evaluating the sorts of things computers are good at finding, such as alternative text descriptions for images. I run the tool twice for each page checking for the more loose section 508 standards, and the more rigorous WCAG standards.

• **Lynx Browser** ([http://lynx.browser.org/](http://lynx.browser.org/))
  Lynx is a plain-text only Web browser that can be very revealing about the structure of a web page. It also is excellent for testing navigation elements using only the keyboard.

• **Fangs Screen Reader Emulator**
  Fangs is an add-on for the Mozilla Firefox browser that outputs a simulation of how a screen reader would read the page. It’s not perfect, but it serves as a great way to quickly visualize how a person with visual impairment would experience browsing a page.

• **WCAG Contrast checker**
  This is another add-on for Firefox that quickly checks the contrast between the background and foreground on a page in order to ensure that they are easily readable.

• **Color Oracle**
  This is a software application is a color blindness simulator. It allows for quick testing of how the colors used on a page will translate for users with the three most common types of color blindness.

• **Readability Test** ([http://juicystudio.com/services/readability.php](http://juicystudio.com/services/readability.php))
  This tool performs a quick evaluation of the readability of the content on a webpage. It uses a scale based on the number of words in a paragraph and the average length of the words used. A more detailed explanation of the algorithm can be found in the appendix.

• **JAWS (Job Access for Windows and Speech)**
  JAWS is the most popular screen reading software tool for windows. It
enables a user who is vision impaired to navigate their computer while the software ‘reads’ what the user is interacting with on the screen. In the context of evaluating webpages, using JAWS is extremely good at quickly identifying problem areas for accessibility.

- **Apple VoiceOver**
  VoiceOver is an accessibility tool that is built into the operating system on Apple computers. It behaves very similarly to JAWS in that it reads what the user interacts with on the screen. Again, for our purposes it is a great tool for identifying website accessibility problems.

- **WebAnywhere**
  WebAnywhere is an accessible tool developed by the University of Washington. It behaves much like Apple VoiceOver and JAWS in that it functions as a screen reader for web pages. It is unique, however, in that it is a web-based tool and is completely free for anyone to use.
ASSESSMENT

I. Home Page

W3C Validation
There were 18 errors, 6 warnings. Most of the errors are related to javascript and
general HTML markup and not to accessibility. There are no significant problems.

CynthiaSays
Using the section 508 setting there were no major problems. The WCAG settings
revealed a few small issues including the use of deprecated tags, missing link target
names, missing meta tags, and missing form labels.

Lynx
The page was easy to navigate. The content is arranged in a logical manner and can
be easily understood. The one problem that stuck out to me was that the search
functions do not seem to work.

Fangs
The content reads fine for the most part. One thing that stuck out to me was the
length of the text describing the social media links in the footer area.

Color contrast
The page content has excellent contrast.

Color blindness
There are no issues with discerning content via the color blindness filters.

Readability
No problems found – readability levels are appropriate for university audiences.

JAWS
Recording of screen reading output available at:
http://library.duke.edu/media/mp3/accessibility/jaws.mp3

Apple VoiceOver
Recording of screen reading output available at:
http://library.duke.edu/media/mp3/accessibility/voiceover.mp3

WebAnywhere
Recording of screen reading output available at:
http://library.duke.edu/media/mp3/accessibility/webanywhere.mp3
General notes
The keyboard navigation for the page could be improved. For example, when using tab key to navigate, the search tabs lack any visual indicators. Overall the tab ordering is intuitive and very usable.

Suggested Changes

• Use unique and descriptive ID names (IDs should not start with numeric characters)

• Use link target names where appropriate

• Include label elements for all input fields in forms

• Do not use depreciated html (h-space used in some img tags)

• Use shorter descriptions for social media links in footer

• Make sure images are using alt descriptions for content-related images (leave empty for decorative images)

• Include language meta tag in header

• Add tabindex attributes for form items

• Add accesskey attributes for form items
II. Search Page and Search Results Page

Search Page

W3C Validation
There were 158 errors and 225 warnings. The errors consist of several JavaScript errors and markup errors (orphaned closing tags, duplicate IDs, missing alt text). However, the majority of the errors seem to be from URL syntax and can likely be ignored. In general, a few small fixes could be implemented to improve the validation results.

CynthiaSays
The section 508 filter fails the page for the lack of alt text with image tags. The WCAG filter also addresses the lack of alt text, and also adds unlabeled form elements and deprecated tags to the list of problems. With some simple fixes to the code, the scores for the search page could be easily improved.

Lynx
The page structure is easy to follow, but search function does not seem to work. As the primary purpose of this page is to enable searching, this seems like a serious problem. However, the number of users who are actually using a text-only browser is extremely small, so in a real-world context I don’t think this is a critical fix. However, it would be nice to have the search working in Lynx.

Fangs
Same comments as the previous section – the content is easy to follow, but the social media links seem very heavy compared to the rest of the page.

Color contrast
The page has excellent contrast.

Color blindness
No problems found.

Readability
No problems found.

JAWS
Recording of screen reading output available at: http://library.duke.edu/media/mp3/accessibility/jaws_catalog-search.mp3

General Notes
There is no visual indication that a user is currently on the ‘Catalog Search’ page. The primary navigation item is not highlighted and only named ‘catalog’ while the
page’s title is ‘Duke Libraries Catalog’ – so there is inconsistency in the navigation and page naming schemas. This could potentially be confusing for users, especially those using assistive technologies. Including an additional element like a breadcrumb trail would help users understand the page hierarchy more easily.

As with the home page, the keyboard navigation could be improved. On this page in particular, the tab ordering seems unintuitive and may confuse users. This could be easily improved upon.

**Search Results Page**

_I conducted a test search for ‘Tom Sawyer’ using the default options. There were 217 results for Duke and an additional 479 for the TRLN._

**W3C Validation**
There were 768 errors and 1133 warnings. Both of these numbers seem excessively large – I think we should work to reduce them for certain. The errors seem to be similar in nature to the previous section – javascript errors, markup errors, and a large percentage coming from URL syntax.

**CynthiaSays**
Again the results are very similar to the previous section. The 508 filter fails for lack of alt text in image tags. The WCAG filter fails for alt text, form elements, and use of deprecated tags. All of these problems should be simple to fix.

**Lynx**
The page structure is easy to follow, but again search function doesn’t seem to work here.

**Fangs**
Same assessment as above – no problems, but social media content is too heavy.

**Color contrast**
No problems found.

**Color blindness**
No problems found.

**Readability**
No problems found.
JAWS
Recording of screen reading output available at:
http://library.duke.edu/media/mp3/accessibility/jaws_catalog-search-results.mp3

General Notes
Same comments as above. Also, the results page seems very heavy visually to me. It's a bit difficult to differentiate between the results and the faceting search options. It's also not immediately clear what the faceting links in the left-hand area of the page will do (for example if you are new to the concept of refining a search using facets). I think check boxes work much better for this purpose (see sites like zappos.com, kayak.com, and so on) as the visual metaphor is more revealing than a simple link. This seems to be a common problem for interfaces using Endeca, so perhaps it's best left for a larger discussion.

Suggested Changes (for both Search and Results pages)

• Use unique and descriptive ID names
• Use link target names where appropriate
• Include label elements for all input fields in forms
• Change page markup to not use table-based layout for content (reserve use of tables for displaying tabular data)
• Make sure to specify script types (js, etc.)
• Make sure all markup tags are nested and closed correctly (fix orphaned tags)
• Make sure images are using alt descriptions for content-related images (leave empty for decorative images)
III. Citing Sources Page

W3C Validation
There were 4 errors and no warnings. Two of the errors are simple markup issues that can be easily fixed, while the other two are javascript related.

CynthiaSays
No problems found.

Lynx
The page was very easy to navigate.

Fangs
The content is easy to follow – no problems (aside from the previously mentioned social media links).

Color contrast
The page content has excellent contrast.

Color blindness
There are no issues with discerning content via the color blindness filters.

Readability
No problems found.

JAWS
Recording of screen reading output available at:
http://library.duke.edu/media/mp3/accessibility/jaws_citing-sources.mp3

General notes
The page has very simple content and as such it is easy to read and seems to have no accessibility issues.

Suggested Changes

• Use link target names where appropriate

• Include label elements for all input fields in forms

• Make sure images are using alt descriptions for content-related images (leave empty for decorative images)

• Use <br clear="all" /> instead of <br clear="both" /> (in footer)

• Include language meta tag in header
RECOMMENDATIONS FOR IMPROVING ACCESSIBILITY

There are a number of small fixes that can be easily implemented on the reviewed pages that will help improve accessibility. In general these changes amount to ensuring that markup is valid and that general accessibility paradigms are followed, such as using alt text with images, including an accompanying label tag with every input field, and using unique IDs on a given page. None of the changes are mandatory, meaning they are not seriously harming the user experience. However, as it should not take a great deal of staff time to implement them I’d suggest making it a priority to do so.

One area that this initial assessment did not cover is multimedia content. As the library relies more and more on multimedia, especially video content, it is important to always remember that we should strive to keep this content accessible by providing alternate versions whenever possible. For video and audio files, a common means of providing an alternate version is to provide a text-based transcript or captioned version of the media.

A great deal of video content that is used on the library site is housed on Youtube. Over the past few years Google and Youtube have been making great strides on enabling users to easily add captions to video content. Users can now upload caption files or attempt to let Youtube caption the video automatically, then correcting any errors that were made.

I think it is also important to note that improving accessibility going forward will largely depend on those who actively produce content for the library websites, especially as we continue to implement content management systems which enable library staff and others to build pages on their own. Educating our content developers on best practices for developing accessible content is vitally important to the goal of providing web content that is usable and accessible for all of our users. In our efforts to establish library-wide accessibility standards, we should make certain to dedicate the required resources to train library staff that will be developing web pages. Key points to focus on should include:

- Building pages with appropriate and consistent semantic and hierarchical structure (header levels, paragraphs, lists)
- Providing alternate versions of content where applicable (text-only versions)
  - Multimedia content (audio, video)
  - Content-related photos/graphics (alt text)
  - Charts and graphs (descriptive summaries, longdesc)
- Including label tags for all form input elements
• Formatting data tables correctly and with appropriate structure (header rows) and summarize/describe overly complex layouts

• Making hyperlinked text descriptive and relevant (avoiding ‘click here’) and including meaningful content in title attribute

GUIDELINES FOR FUTURE EVALUATIONS

Moving forward I would suggest for the library to follow the guidelines set forth by the W3C and the WAI. We should formalize our accessibility evaluation process by following these steps:

1. Developing organizational policies including:
   a. Choosing an accessibility target level, such as WCAG 2.0 level A
   b. Establishing intervals for further accessibility reviews
   c. Setting milestones for evaluation

2. Implementing departmental accessibility standards on all new projects

3. Developing and implementing a plan to update legacy content to the standards

There is more detailed information to be found on the W3C website:

• http://www.w3.org/WAI/impl/improving
• http://www.w3.org/WAI/impl/pol
• http://www.w3.org/WAI/bcase/pol
Appendix

Fangs Output

Lynx Screen Shots

Readability check

Color blindness screen shots
FANGS OUTPUT

http://library.duke.edu
http://search.library.duke.edu
http://library.duke.edu/research/citing/
## READABILITY CHECK

### http://library.duke.edu

<table>
<thead>
<tr>
<th>Summary</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sentences</td>
<td>97</td>
</tr>
<tr>
<td>Total words</td>
<td>365</td>
</tr>
<tr>
<td>Average words per Sentence</td>
<td>3.76</td>
</tr>
<tr>
<td>Words with 1 Syllable</td>
<td>187</td>
</tr>
<tr>
<td>Words with 2 Syllables</td>
<td>81</td>
</tr>
<tr>
<td>Words with 3 Syllables</td>
<td>62</td>
</tr>
<tr>
<td>Words with 4 or more Syllables</td>
<td>35</td>
</tr>
<tr>
<td>Percentage of word with three or more syllables</td>
<td>26.58%</td>
</tr>
<tr>
<td>Average Syllables per Word</td>
<td>1.85</td>
</tr>
<tr>
<td>Gunning Fog Index</td>
<td>12.14</td>
</tr>
<tr>
<td>Flesch Reading Ease</td>
<td>46.56</td>
</tr>
<tr>
<td>Flesch-Kincaid Grade</td>
<td>7.70</td>
</tr>
</tbody>
</table>

### http://search.library.duke.edu

<table>
<thead>
<tr>
<th>Summary</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sentences</td>
<td>168</td>
</tr>
<tr>
<td>Total words</td>
<td>393</td>
</tr>
<tr>
<td>Average words per Sentence</td>
<td>2.34</td>
</tr>
<tr>
<td>Words with 1 Syllable</td>
<td>171</td>
</tr>
<tr>
<td>Words with 2 Syllables</td>
<td>105</td>
</tr>
<tr>
<td>Words with 3 Syllables</td>
<td>74</td>
</tr>
<tr>
<td>Words with 4 or more Syllables</td>
<td>43</td>
</tr>
<tr>
<td>Percentage of word with three or more syllables</td>
<td>29.77%</td>
</tr>
<tr>
<td>Average Syllables per Word</td>
<td>1.97</td>
</tr>
<tr>
<td>Gunning Fog Index</td>
<td>12.84</td>
</tr>
<tr>
<td>Flesch Reading Ease</td>
<td>37.63</td>
</tr>
<tr>
<td>Flesch-Kincaid Grade</td>
<td>8.59</td>
</tr>
</tbody>
</table>
http://library.duke.edu/research/citing/

<table>
<thead>
<tr>
<th>Summary</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sentences</td>
<td>97</td>
</tr>
<tr>
<td>Total words</td>
<td>527</td>
</tr>
<tr>
<td>Average words per Sentence</td>
<td>5.43</td>
</tr>
<tr>
<td>Words with 1 Syllable</td>
<td>240</td>
</tr>
<tr>
<td>Words with 2 Syllables</td>
<td>138</td>
</tr>
<tr>
<td>Words with 3 Syllables</td>
<td>82</td>
</tr>
<tr>
<td>Words with 4 or more Syllables</td>
<td>67</td>
</tr>
<tr>
<td>Percentage of word with three or more syllables</td>
<td>28.27%</td>
</tr>
<tr>
<td>Average Syllables per Word</td>
<td>1.95</td>
</tr>
<tr>
<td>Gunning Fog Index</td>
<td>13.48</td>
</tr>
<tr>
<td>Flesch Reading Ease</td>
<td>35.97</td>
</tr>
<tr>
<td>Flesch-Kincaid Grade</td>
<td>9.59</td>
</tr>
</tbody>
</table>

**Description of Metrics from juicystudio.com**:  

**Gunning-Fog Index**  
The following is the algorithm to determine the Gunning-Fog index.

- Calculate the average number of words you use per sentence.
- Calculate the percentage of difficult words in the sample (words with three or more syllables).
- Add the totals together, and multiply the sum by 0.4.
- **Algorithm**: \((\text{average\_words\_sentence} + \text{number\_words\_three\_syllables\_plus}) \times 0.4\)

The result is your Gunning-Fog index, which is a rough measure of how many years of schooling it would take someone to understand the content. The lower the number, the more understandable the content will be to your visitors. Results over seventeen are reported as seventeen, where seventeen is considered post-graduate level.

**Flesch Reading Ease**  
The following is the algorithm to determine the Flesch Reading Ease.

- Calculate the average number of words you use per sentence.
- Calculate the average number of syllables per word.
- Multiply the average number of syllables per word multiplied by 84.6 and subtract it from the average number of words multiplied by 1.015.
- Subtract the result from 206.835.
- **Algorithm**: \(206.835 - (1.015 \times \text{average\_words\_sentence}) - (84.6 \times \text{average\_syllables\_word})\)

*available at http://juicystudio.com/services/readability.php*
The result is an index number that rates the text on a 100-point scale. The higher the score, the easier it is to understand the document. Authors are encouraged to aim for a score of approximately 60 to 70.

**Flesch-Kincaid grade level**
The following is the algorithm to determine the Flesch-Kincaid grade level.

- Calculate the average number of words you use per sentence.
- Calculate the average number of syllables per word.
- Multiply the average number of words by 0.39 and add it to the average number of syllables per word multiplied by 11.8.
- Subtract 15.50 from the result.
- Algorithm: \(0.39 \times \text{average_words_sentence} + (11.8 \times \text{average_syllables_word}) - 15.9\)

The result is the Flesch-Kincaid grade level. Like the Gunning-Fog index, it is a rough measure of how many years of schooling it would take someone to understand the content. Negative results are reported as zero, and numbers over twelve are reported as twelve.

**Reading Level Algorithms**
Readability is the measure of how easy it is to read and comprehend a document. Readability tests were first developed in the 1920s in the United States. They are mathematical formulas, designed to determine the suitability of books for American students at a certain age, or grade level. Automating the process was intended to make it easier for tutors, librarians, and publishers to determine whether a book would be suitable for its intended audience. The formulas are based around the average words to a sentence, and the average syllables used per word. As such, they tend to reward short sentences made up of short words.

Being mathematically based, readability tests are unable to determine the likelihood that the document is comprehensible, interesting, or enjoyable. It's possible to obtain good readability scores with gobbledygook, providing the content contains short sentences made up of monosyllabic words. We'll leave the question as to why the word "monosyllabic" has five syllables for another day. Layout and design are also important factors to the readability of a document that cannot be determined using readability tests. Documents aimed at a higher level may require background knowledge, which cannot be determined by the tests.

For a document to be easily understood, the writing style should be clear and simple. This involves a writing style that is direct, and familiar to the intended reader. The structure of the document should be logical, unambiguous, and avoid redundant words.

Many of these factors cannot be measured using readability tests. Instead, readability tests provide a prediction of the reading ease for a document. Sentence length and polysyllabic words do have a direct impact on the readability of documents, albeit a surface measure of the characteristics of the text. They provide an indication that the content may be too dense with a quantifiable measure. The results should be used in conjunction with good writing style guidelines.

**Guideline 14** of the Web Content Accessibility Guidelines requires that documents are clear and simple. Readability tests can provide a rough guide to the likelihood of a document being clearly understood. This service is to provide content authors with a guide to the readability of their website.
Color Blindness Screen Shots
http://library.duke.edu

Normal

Deuteranopia
(red-green, most common)

Protanopia (red-green, rare)

Tritanopia
(blue-yellow, very rare)
http://search.library.duke.edu

Normal

Protanopia (red-green, rare)

Deuteranopia
(red-green, most common)

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