

Otomind: A Text Mining Approach to Automatic Concept Mapping

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Abstract

Despite the linear use of PowerPoint presentation slides in classroom and lecture halls, the brain works primarily with key concepts that it links and integrates. This is a big contrast from the typical student behaviour of reading or memorizing the slides. This paper presents a new system that automatically generate a mind map based on a set of keywords and keyphrases extracted from PowerPoint presentation slides. The system takes a text mining approach and relies on a keyphrase extraction algorithm to extract the keywords and keyphrases. Survey results reflect a rising need of such application as part of educational technologies and the potential benefits are observed and discussed.

Keywords: Powerpoint presentation, ontology, text mining.

Introduction

In this technologically advanced era, coupled with the rapid progress of Information and Communication Technologies (ICTs), the incorporation of ICTs in education has attracted an increasingly high attention of educators and researchers. This can be reflected in the wide-spread use of PowerPoint presentations.

Microsoft PowerPoint is the most used presentation software today [9]. While it originated from the business sector, over the last 25 years it has steadily expanded into other private and public sectors [2]. PowerPoint is a common and well-received tool for teaching, even in some less-developed countries and is the staple for all forms of education, ranging from kindergarten all the way up to tertiary education [1, 20, 12]. Notwithstanding the fact that there are various forms of emerging and effective education technologies in developed countries, PowerPoint is the most familiar and popular educational technology for teachers throughout the world, including kindergarten teachers [22]. Surveys carried out by authors cited students have shown that 93% of undergraduate students attends a class where PowerPoint is used as the delivery medium. Other surveys discovered that two-thirds of faculty members use PowerPoint at least once a semester [27, 6].

In educational sector, PowerPoint presentations are created by teachers to supplement textbooks. The reason PowerPoint presentations are important because in class lectures are still a dominant form of teaching. 63% of educators in the disciplines of science, technology, engineering, and mathematics still report using extensive lecturing [3]. As such, PowerPoint presentations are a vital component to a lecture, acting as a visual aid to complement the lecture. The presentation slides also serve as a revision and study material for students instead of reading a textbook, as the key information from the textbook have already been summarized into the slides [10]. However, in a PowerPoint presentation, all the information is scattered across all slides. As much as student take the effort to skim through the slides to find for relevant and important points, there is a huge chance that students will miss out on a point or two, which goes to waste [24]. The information available in the slides may not also reflect the complete information required to be learnt by the students. Considering all this evidence, [8] found that note taking using PowerPoint neither help students identify the relevant words, nor improve their ability in learning using slides.

Other challenges that are faced by students when obtaining lesson points from presentation slides is determining the usefulness of the content, especially what 59% of students described as their incapability to confine topics and make them manageable. 60% of students also reported that they have tendency to be overwhelmed by the multitude of available resources [21]. Over reliance on slides has contributed to the irrational acceptance that it is unreasonable to expect students to read books, do research, be present for classes, take notes and carry out coursework [23]. To add on to the problem, courses now days are designed around slides, bringing forth an increased belief to the myth that students can become skilled and knowledgeable without the need to work through dozens of books, hundreds of articles, and thousands of problems [26].

The common theme of all these problems is that pure reliance on the slides alone is not sufficient. Something more must be done in order to make a difference. Although they are legitimate issues regarding the usage of PowerPoint slides in education, the pros outweigh the cons, and it has to be accepted that the usage of PowerPoint presentations in education will be here to stay [18, 19]. As such, steps have to be taken to ensure that the benefits of presentation slides are to be exploited to the maximum through creative means. Unfortunately, not much effort is considerate in order to overcome this problem. To address this issue, this paper presents OtoMind, an automatic mind map generator that extracts and builds the mind map directly from the PowerPoint presentation slides. This tool provides an interface for the users to browse for the PowerPoint file (.ppt or .pptx), subsequently read and analyze the slides, and generate a mind map with the central theme and content coming from the all the slides in the presentation [17]. This tool primarily uses a text mining approach, specifically keyphrase extraction along other natural language processing tasks. Text mining attempts to garner meaningful information from natural language text and is loosely characterized as the process of analyzing text to extract information that is useful for particular purpose. The phrase “text mining” is used to describe any system that analyzes large amount of natural language text and identifies etymological or linguistic usage patterns to extract probably useful (although only probably accurate) information [28]. According to the work, text mining goes through several processes, namely text summarization, document retrieval, information retrieval, text categorization, document clustering, language identification, crediting the author, determining keyphases, entity extraction, information extraction and lastly learning specific rules from text provided [16]. The remaining of this pa per proceeds as follows. Section 2 briefly explains existing mind mapping tools. Section 3 presents the

proposed system, OtoMind and the underlying text mining framework. Section 4 presents the prototype development; Section 5 presents the evaluation results and finally Section 6 concludes with plans for future work. This template provides authors with most of the formatting specifications needed for preparing electronic versions of their papers. All standard paper components have been specified for three reasons: (1) ease of use when formatting individual papers, (2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and (3) conformity of style throughout a conference proceedings. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. PLEASE DO NOT RE-ADJUST THESE MARGINS. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

Related Work

Mind maps and concept maps are tools known to help students and teachers to develop inquiry-based learning and teaching methods. At present, there are several mind map generator systems exists in the market such as the Mind- Meister and Mindomo. MindMeister is an online concept mapping tool that allows users to capture, develop and share ideas visually. People uses MindMeister as an editor during brainstorming, note taking, project planning and other creative tasks [30, 11]. MindMeister is completely web based (<https://www.mindmeister.com/>), which means there is no requirement for software download or update. Mindmeister also works on cross platforms whether Windows, Mac OS or Linux [7].

Another tool is Mindomo, an all-in-one visual tool from mind mapping, concept mapping, and outlining software. Mindomo (<https://www.mindomo.com/>) is the pioneer of turning a concept map into a presentation as well as students teachers' collaboration via concept map assignment [25, 29]. It also offers smart concept maps, which are partially filled templates that make concept mapping easy to comprehend by beginners. However, none of them offers capability for automatic generation of mind map from raw text, but rather manually drawing or constructing the maps from a list of keywords. This paper proposes Otomind, a mind mapping tool that intelligently extracts from a body of text and reconstruct the keywords or keyphrases extracted into a mind map

Oto Mind

OtoMind is a tool that extract keyphrases from a PowerPoint presentation slide and construct a concept map based on the keyphrases extracted. Given the input of a presentation file in a PowerPoint *.pptx format [13], OtoMind reads the content from each slide and performs various preprocessing procedures before identifying potential phrases, assigning weightage for each potential phrases that are recognized, and finally extracting the keywords or key phrases. The core technology underlying OtoMind that separates it from existing mind mapping tools lies in text mining approach, specifically the keyphrase extraction algorithm. This algorithm enables OtoMind to automatically generate a mind map based on keywords or keyphrases extracted by this algorithm [14]. Figure 1 presents the core of text mining framework in OtoMind, which consists of pre-processing and keyphrase selection.

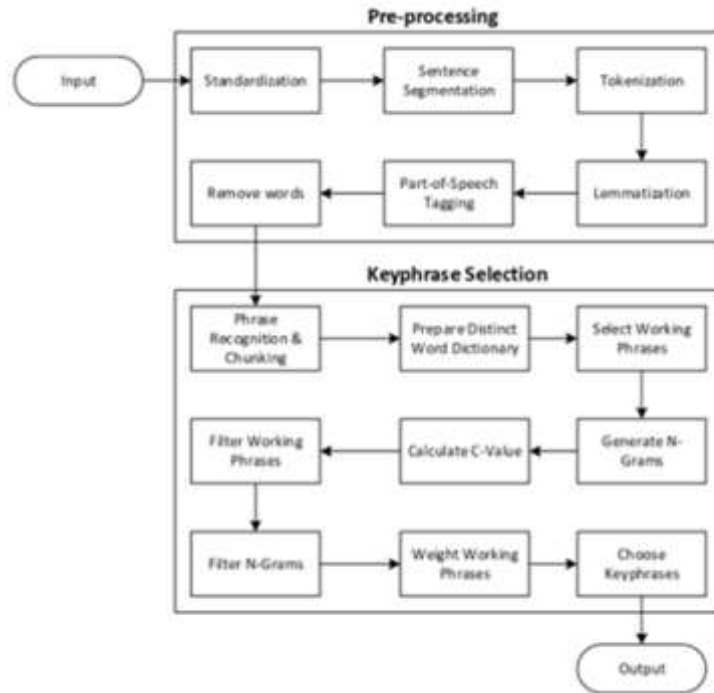


Fig. 1. Text Mining Framework of Otomind

Pre-Processing

Pre-processing in OtoMind performs various natural language processing tasks coded in C# programming language. The tasks begin from standardization, segmentation, tokenization, lemmatization, part-of-speech tagging, and finally words removal. These tasks as detailed out on Table 1 are required in preparing the list of phrases for the next phase, which is keyphrase selection.

Table 1. Pre-processing Phase

Task	Details
Standardization	Convert non-ASCII characters to ASCII characters. Cross-mark remaining non-ASCII characters not converted. Cross-mark hyperlink. Replace tab with newline. Remove additional whitespaces.
Sentence Segmentation	Divide input into multiple sentences. API sentence splitting criteria: period, question mark. Additional sentence splitting criteria added is newline only.
Tokenization	Split sentences into words by non-alphanumeric characters, except for hyphen mark in between words, such as "self-organization" will be treated as a token. But split hyphen marks followed by non-alphanumeric like "self-organization" will be split into 3 tokens [self] [-] [organization]. Split digits from letters. Remove continuous symbol tokens which are same.
Lemmatization	API lemmatizing in lowercase because some lemmatization error such as "Is" will be lemmatized to "I", but "is" will be lemmatized to "be". Reform lemma into original letter case.
Part-of-Speech Tagging	Stanford API POS tagging only (whole sentence).
Word Removal	Remove symbols and words less than four characters, excluding word with all capitalized & with 'CD' POS tag. Remove words with CC, DT, EX, FW, IN, LS, MD, PDT, POS, PRP, PRP\$, RB, RP, SYM, TO UH, WDT, WP, WPS, and WRB POS tags. Remove stop words get from online resource, cross mark stop words to form boundaries.

Keyphrase selection

The next phase is the keyphrase selection phase, which is detailed out in Table 2. At the heart of this phase, phrases are recognized and selected for generating the list of n-grams. Following [4], an n-gram in OtoMind is an n-word slice of long phrases.

Table 2

Task	Details
Phrase Recognition	Send whole sentence without cross marked to get chunk tags, chunk tag was then being modified to avoid having cross-marked tokens exist in phrase. For example: Change chunk tag to 'O' (Outside of phrase) if token is <u>cross-marked</u> . Change chunk tag 'I' (Inside of phrase) to 'B' (Begin of phrase) if previous token is 'O'.
Distinct Word	Store distinct words from all slides to get the distinct word count.
Selection of Phrases	Phrase not containing 'CD' POS tag, not cross-marked. Only select noun phrases. Re-tag part-of-speech because it might various if being tagged independently. For example, [thinking] was identified as a noun in the <u>sentence</u> , <u>but</u> was identified as a verb independently.
N-Gram for Phrases	If phrase word count > 1, minimum n-gram is 2, else is 1. If phrase word count > 3, maximum n-gram is 3, else is word count.
Calculate C-Value	C-value determine the independency of phrase, not the independency of previous version, but identify shorter phrase from longer phrase. For example: [expert system industry booms] will be presented as [expert system industry] [15].
Filter Phrases	Remove phrase in lemma form which is <u>unigram</u> and is substring of another phrase. For example: [environment] & [environment type], phrase [environment] will be removed. Remove phrase which do not contain any of these: JJ, NN, NNP, NNPS, & NNS POS tags. Remove duplicated phrase in lemma form. Remove phrases which is <u>unigram</u> and have less than 5 characters and are not all capitalized.
Filter N-Grams	Remove <u>trigram</u> and above with 2 leading JJ POS tag. For example: [simple JJ optimal JJ agent NN], "simple" & "optimal" are <u>both JJ</u> POS so will be removed. Remove n-grams which do not contain any of these: JJ, NN, NNP, NNPS, & NNS POS tags.
Weight Phrases	$TF \times IDF + B1$ TF= number of occurrence in pptx / number of distinct words IDF = $\text{Log}_{10}(\text{number of slides} / \text{number of slide occurred})$ B1 = sum of TF-IDF of words in phrase. For example: [Artificial Intelligent] have 0.25 as TF-IDF, and [Artificial] have 0.5 TF-IDF, [Intelligence] have 1.2 TF-IDF. The final weight will be $0.25 + 0.5 + 1.2$. This is used to boost longer phrase, as well as boosting <u>bigrams</u> onwards which have low frequency than their <u>unigrams</u> .
Choose Keyphrases	Choose top 5 keyphrases . Compare in lemma form, identify whether n-gram of phrase with highest c-value is substring of stored keyphrases or keyphrases are substring of phrase. N-grams of keyphrases with the highest c-value will be presented.

The main function in the keyphrase selection phase is the keyphrase extraction algorithm using c-value. In this algorithm, the candidate phrases are weighted using the tf-idf measure that is widely used in Information Retrieval. The term frequency (*tf*) is first calculated, which indicates the frequency of a phrase in the input presentation file as compared to other phrases. Next is to calculate the inverse

document frequency (idf), which represent the number of occurrences of the considered phrase in the particular PowerPoint presentation against the number of occurrences of all terms (phrases) in the presentation. The formula for tf-idf is shown in Equation 1:

$$tf-idf_{t,d} = tf_{t,d} \times idf_t \quad (1)$$

where $tf-idf_{t,d}$ assigns to term t a weight in slides document d such that it is:

- highest when t occurs many times within a small number of slide (therefore a high discriminating power to the slides)
- lower when the term occurs fewer times in a slide, or occurs in many slides (thus offering a less pronounced relevance signal)
- lowest when the term occurs in virtually all slides.

Next, it will rank the phrases in descending order based on the n -gram weightage. The phrases with a higher weightage will be ranked higher. After ranking the phrases, the phrases will be cross-checked against the phrases in Protégé Keyphrase Ontology plugin. The Protégé plugin includes traditional statistical methods for keyphrase extraction, however its main input lies in the usage of shallow linguistics to extract structured information from individual sentences[5].

After the entire key phrase extraction process, OtoMind proceeds with generation of mind map or concept map based on the list of keyphrases extracted in the keyphrase selection phase. OtoMind visualizes the top keyphrases and inserts the keyphrases accordingly into a new Microsoft PowerPoint presentation file, using the Smart Art function that is present in PowerPoint. OtoMind uses a radial cluster algorithm to determine the specific location of the keyphrases. After the Smart Art is completed, the 'Open Concept Map' button in OtoMind will be enabled and user may view the output mind map or concept map.

Prototype Development

The design language of OtoMind adheres to the latest design trends and provides users with a simple, minimalistic and uncluttered interface, in order to cater novice users. Although the interface looks like a metro application, it is desktop application with familiar interface. The design closely adheres to Human Computing Interface concepts in order to provide users with the best user experience when using OtoMind. Figure 2 shows the home screen of OtoMind. In this figure, user clicks on the 'Browse' button to select input file, which is any PowerPoint presentation file that the user wishes to convert to a mind map or a concept map. In this beta version, the input file format to OtoMind is limited to .pptx extension. OtoMind also support only one input file at a time, and it functions best with presentation slides in the slide format of Title Slide layout or Title Content layout. Figure 3 shows an error message indicating that only.pptx file is allowed, and user would be brought back to the home screen to try again.

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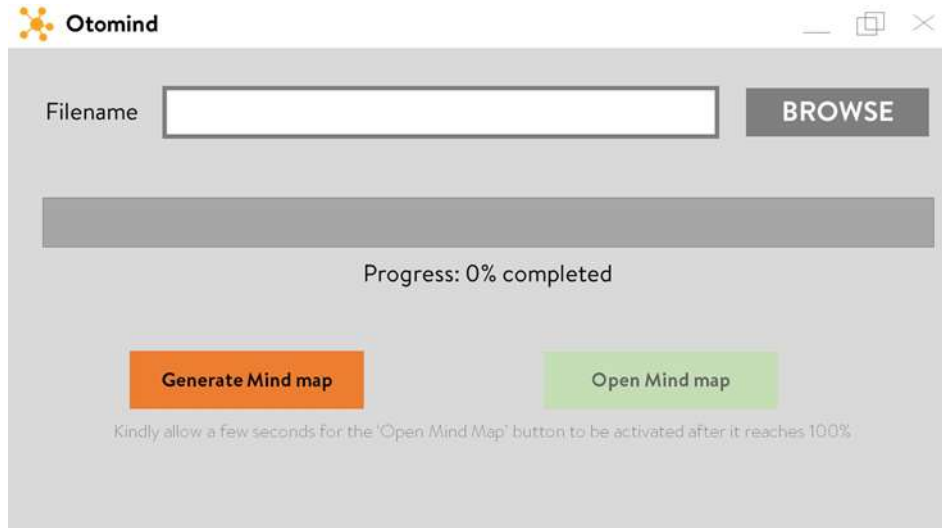


Fig. 2. Home Screen of OtoMind

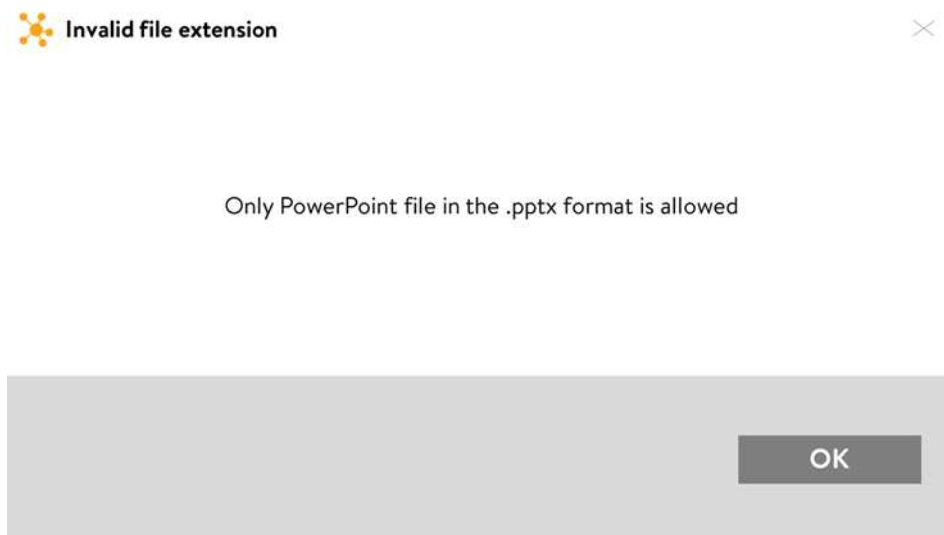


Fig. 3. Invalid Message of OtoMind

Upon selection of the presentation file, a 'Generate Concept map' button in OtoMind initiate reading of the file, extraction of keyphrases in the file, and generating the map. The processing time to read, extract, and generate depends on the size of the input file. The larger the number of slides, the longer processing time is required. The progress bar is provided to track the progress of the loading time alongside the loading percentage. Figure 4 shows the processing screen of OtoMind.

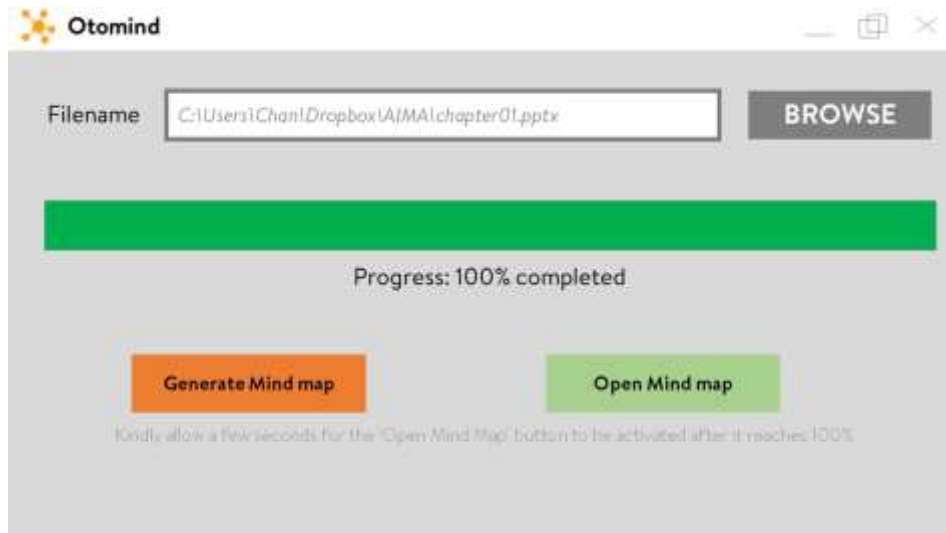


Fig. 4. Processing Screen of OtoMind

After the process is complete, the ‘Open Concept map’ button will be activated, and users are able to view the generated mind map in a separate .pptx file with the word ‘- Mind-map’ appended to the original file name. This mind mapfile will be saved in the same location as the original PowerPoint file. Figure 5 shows the output of OtoMind.

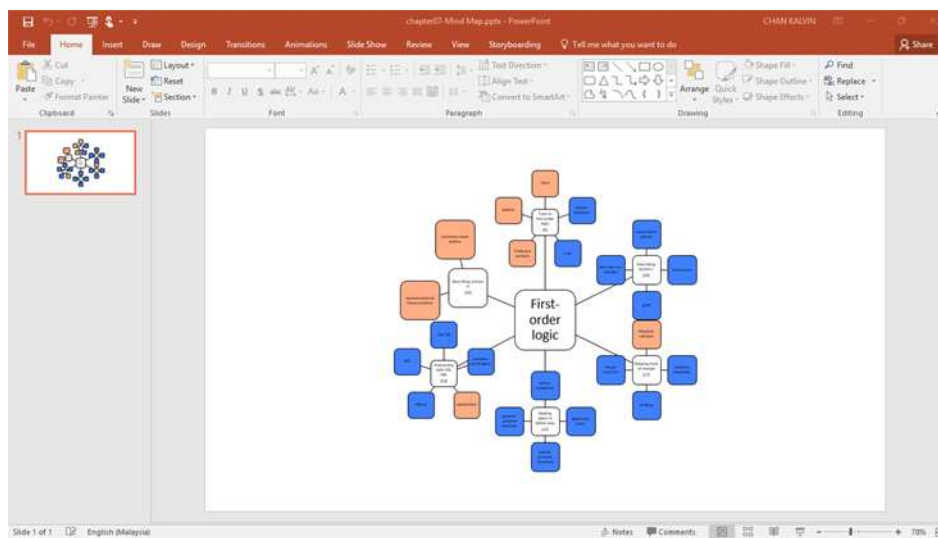


Fig. 5. Output of OtoMind

Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

Units

- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.

- Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.
- Do not mix complete spellings and abbreviations of units: “Wb/m²” or “webers per square meter”, not “webers/m²”. Spell out units when they appear in text: “. . . a few henries”, not “. . . a few H”.
- Use a zero before decimal points: “0.25”, not “.25”.

Equations

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

Number equations consecutively. Equation numbers, within parentheses, are to position flush right, as in (1), using a right tab stop. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in

Note that the equation is centered using a center tab stop. Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1)”, not “Eq. (1)” or “equation (1)”, except at the beginning of a sentence: “Equation (1) is . . .”

Some Common Mistakes

- The word “data” is plural, not singular.
- The subscript for the permeability of vacuum μ_0 , and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
- In American English, commas, semi-/colons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
- A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
- Do not use the word “essentially” to mean “approximately” or “effectively”.
- In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
- Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
- Do not confuse “imply” and “infer”.
- The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.

- There is no period after the “et” in the Latin abbreviation “et al.”.
 - The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.
- An excellent style manual for science writers is [7].

Evaluation and Discussion

In effort to gauge the impact of a new tool such as OtoMind, a questionnaire was distributed and responded by 51 respondents. This survey is important in order to understand the users’ expectations and needs, trend of the industry and feasibility of the application in the eyes of the users. Figure 6 shows the age range of respondents, which majority is aged between 16 to 24 and perfectly fulfils the required target group of this questionnaire and of OtoMind. The ages 16-17 are usually high school students whereas ages 18-24 are typically college or university students.

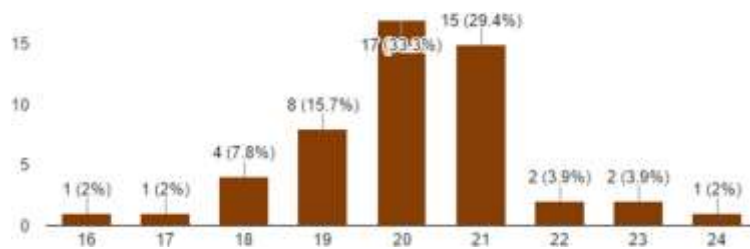


Fig. 6. Age Range of Respondents

Figure 7 shows the participating universities that the respondents are affiliated with, which are Asia Pacific University of Innovation and Technology (APU), IACT College, Multimedia University (MMU), Sunway College, and University of the West of England (UWE) Bristol.



Fig. 7. Educational Institutions of Respondents

Figure 8 shows current course of study of the respondents, whereby most of the respondents are doing A-Levels.

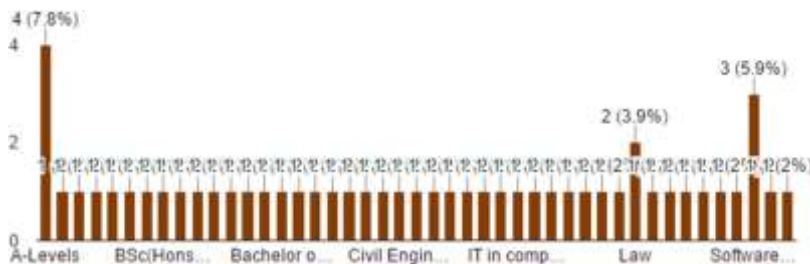


Fig. 8. Name of Degree of Respondents

Figure 9 shows the majority of respondents are Level 2 of tertiary education.



Fig.9. Year of Study of Respondents

Figure 10 shows the preferred learning methods among students. A large majority of the respondents prefer to learn via PowerPoint presentations and rely on PowerPoint slides as their primary study material if compared to textbooks.

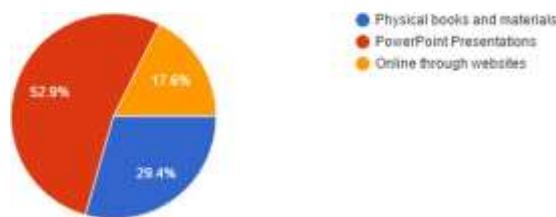


Fig. 10. Preferred Learning Method of Respondents

Figure 11 shows the learning style of the respondents. This result shows that a large majority of the respondents are visual learners and Otomind will help them a lot in their studies due to the visual mind maps. This also proves that Otomind will be a very relevant tool among students and educators alike due to the high amount of visual learners.

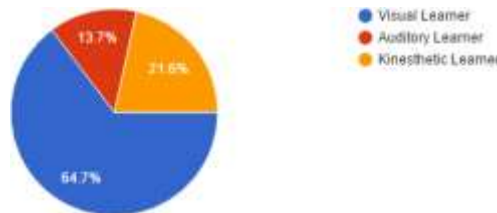


Figure 11 : Learning Style of Respondents

From Figure 12, it is discovered that a majority of respondents' study materials is through reading PowerPoint materials to complement their physical materials, which means PowerPoint slides are their primary study materials of students. This is agreed by 40 respondents.

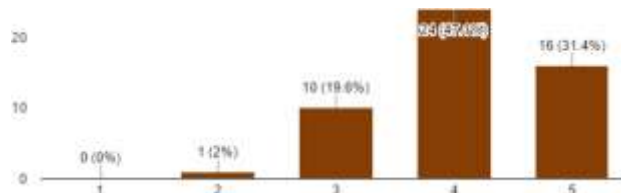


Fig. 12. Usefulness of PowerPoint Sides

When sourcing the primary source of information among the respondents, the results in Figure 13 indicate that students are less reliant on PowerPoint slides as compared to using the slides for studying

purposes. This may be due to the lack of in-depth information in slides, as compared to alternative sources of materials such as the web and books when it comes to obtaining information.

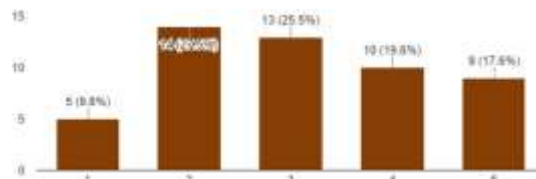


Fig. 13. Primary Source of Information among Respondents

When asked on the preference, Figure 14 shows that a slightly higher than average number of respondents agreed that more information can be obtained through PowerPoint slides as compared to physical materials. This is due to the availability of e-books that has the same content as a physical book.

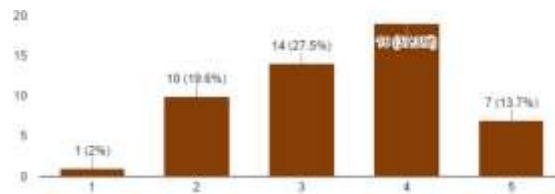


Fig. 14. Preference of Study Materials

Despite the claim of widely used mind map or concept map in lectures, Figure 15 shows that majority of the respondents do not draw a mind map while learning.

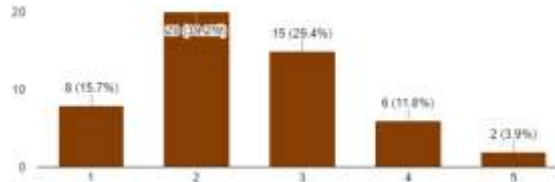


Fig. 15. Use of Mind Maps

The primary reasons to this scenario are summarized in Figure 16. It is discovered that the main reason as to why students do not draw a mind map while studying is because they find it too troublesome to draw a mind map as it requires more time and effort. Many students do not know how to draw a mindmap. Students feel that it is a waste of time and effort to draw a mind map by themselves when there are presentation slides readily available. There are also some form of skillset that a student has to possess in order to draw an effective mind map. This has discouraged many students from drawing a mind map to complement their study materials.

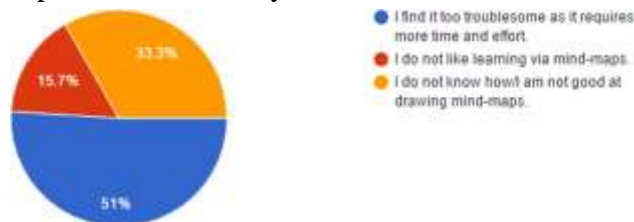


Fig. 16. Reasons for Not Using Mind Map

Nonetheless, a huge majority of respondents agreed that studying via mindmaps would greatly benefit them academically as shown in Figure 17. This shows that there is a huge potential for mind maps,

only to be hindered by a general lack of know-how on the ways to draw mind maps. Students are open and eager to the idea of mind maps, which is something Otomind can take full advantage of. Finally, Figure 18 shows that students like the idea of a tool that will automatically generate mind maps from PowerPoint presentation slides. Respondents have overwhelmingly agreed to the implementation of Otomind and would appreciate for such a tool.

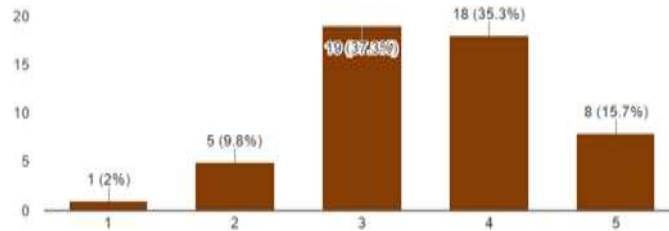


Fig. 17. Benefits using Mind Maps

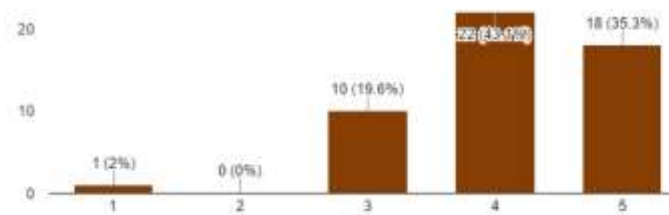


Fig. 18. Need of Mind Map Generator

From the evaluation of this questionnaire carried out, OtoMind has been found useful for school teachers and even university lecturers to summarize a lesson and teach in a more visually engaging and interactive method. Instead of presenting a lesson using traditional teaching methods, they can utilise this tool to summarize the lesson into a concept map and elaborating on it. It can even be distributed as notes for the students after a lesson so that they would have something tangible to take back home, which can be used as revision materials to complement textbooks. Besides acting as a visual aid, Otomind has the potential to revolutionize the learning experience for students and provide students a simpler way to study the slides given to them.

Mind maps or concept maps can clearly highlight the most important slides, keywords and keyphrases, which reduces the revision time of the student. OtoMind can also act as a complementary extension of Microsoft PowerPoint to deliver effective and interactive visual aids. Overall, OtoMind offers the following benefits to the users:

- **Increased efficiency:** OtoMind increases the efficiency of students by helping students make better and more efficient notes through the generated mind maps. Besides that, it also reduces the time taken for students to carry out revision on the subject matter as there is already a visual aid provided through the mind map. Therefore, it reduces the time taken for students to make notes regarding a particular subject.
- **Time Management:** OtoMind helps students to manage their time by enabling students to manage their time more effectively. The time saved in taking notes could be used for other activities, such as sports or even spending time with family. Students will have more time to revise instead of spending too much time on making notes. Besides that, there will be more time for students to complete their assignments as the time taken to do revision is reduced via OtoMind. Students can manage their time more effectively as OtoMind analyses the relevant content from a selected PowerPoint presentation and convert the text into mind map, instead of requiring the student to

do it themselves.

- **Increased effectiveness:** Otomind increases the effectiveness of students as it helps students focus on the important content that not miss out on points that matters the most in the particular subject or chapter that the presentation slide is describing. This allows students save time and effort by summarizing the content into a mind map instead of having to read through the entire presentation. Besides that, it increases the effectiveness of studying and revision because students can easily memorize and understand a particular topic as mind map boosts memory. Not only it will benefit the students, Otomind also allows teachers to convey information to students in a more effective manner.
 - **Improved academic results:** With Otomind, students have even more opportunity to score good results due to the simplicity in studying and revising through mind maps. Teachers would also be able to teach more effectively, leading to improved results among the students. This will lead to an all-around benefit for the academic excellence of students.
 - **User satisfaction:** This tool is mainly developed to be useful and dependable when students are studying or carrying out revision. Both students and teachers alike can have the satisfaction of automatically converting PowerPoint presentations into mind maps effortlessly. Otomind can save students' precious time as they just have to browse to the location of the presentation file and a mind map would be generated instead of having to read through the presentation slides.
 - **Boost memory:** Otomind can boost the memory of students as it is scientifically proven that Concept maps can help people become more creative, remember more, and solve problems more effectively (Diaz, 2013). With a greater problem solving ability, student's memory can be effectively boosted through reading Concept maps.
 - **Inspire creative learning methods:** Otomind will inspire students study and do revision through creative means. It also reduces the cost, effort and time need to take the journey to a physical library. When there is a demand for a more creative approach to teaching, academicians would be more than happy to fulfil the demand, which will benefit students.

In summary, Otomind can potentially be an important aspect to a student's study style and to encourage students to study hard and study smart. After reviewing various literature and other similar systems, a conclusion can be reached in regard to the technological concepts and systems used in the implementation of Otomind.

Conclusion

This paper presents the technologies behind Otomind, specifically focusing in the keyphrase extraction algorithm among other natural language processing tasks. The target users of Otomind are students and academicians. Otomind is especially useful for students at secondary and tertiary level due to their high tendency to rely on lecture notes in the form of PowerPoint slides as opposed to the traditional textbook. It is also useful for academicians, ranging from high school teachers to university lecturers. The mind maps or concept maps generated from PowerPoint presentations can be used as supplementary teaching materials. Although Otomind is tested on presentation slides, the algorithm behind the tool is capable to extract other types of text such as a word processing file, a website, or newspaper articles. Therefore, Otomind is also useful for representing any text in an easy-to-understand graphical format

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