GLOSSA: A SELF-DRIVEN LANGUAGE LEARNING TOOL

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Synopsis:

In this paper, we introduce Glossa in detail and provide its execution results along with performance comparisons with similar tools. The experimental results demonstrate that our tool is superior to those implementations that are currently available for comparison.

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Abstract: The need for an accurate, fast, and user-friendly tool to facilitate the process of learning a foreign language is getting more and more prevalent. This requirement is promoted even more by the globalization we are experiencing at a time of accelerated access to technology. To meet this apparent demand, we present a novel language-learning tool: Glossa. Glossa provides a rich vocabulary repository, a wide variety of literary material, and it implements spaced repetition, a technique proven to help speed up language learning. In this paper, we introduce Glossa in detail and provide its execution results along with performance comparisons with similar tools. The experimental results demonstrate that our tool is superior to those implementations that are currently available for comparison.

Introduction

There is a growing interest in the intersection of software application development and language learning. This burgeoning market has sponsored the development of many mobile apps. Many come with severe drawbacks, however. The popular language-learning app called Duolingo has been criticized for being too slow and for keeping users from learning at their own pace. One study by the International Journal of English Linguistics examined Duolingo's pedagogical approach and the bold claims made by its founder Luis Von Ahn [8]. Despite its popularity and groundbreaking features, the study found that Duolingo falls short of its stated objective in a number of ways. For instance, many of the sample sentences it provides users to translate include bizarre phrases such as "Ella lleva comida al restaurante." or "she brings food to the restaurant." It is hard to conceive of circumstances where this phrase would indeed be useful. Time devoted to translating these sentences is time wasted since this approach provides little practical value for regular conversations in the user's target. Unfortunately, the rest of the app continues in a similar vein, ultimately limiting the amount of material the user can be exposed to by committing them to an inflexible learning plan that involves translating simple sentences. However, Duolingo does compensate for this by allowing more advanced learners who have committed a significant amount of time to the app by translating real sentences from the web, which is a feature we will explore in a later section. It would seem most language learning apps fall short in this regard, in the sense that they prohibit users from learning languages at their own pace. This is because the main impetus behind their language learning approach relies on an outdated methodology known as the Grammar-translation method. The Grammar-translation method the main means of learning a new language since the 17th and 18th centuries. One study in the US-China Education review which analyzed the top language learning approaches defined the Grammar-translation method as the acquisition of grammatical rules in a target language by translating sentences to and from that language [9].

Although the study concludes that it is relatively straightforward to implement, which is partly why it is still somewhat in vogue, it nonetheless concedes that the grammar-translation method has been criticized for causing frustration among learners by imposing tedious routine of memorizing endless lists of unusable grammar rules and vocabulary. This is precisely the same flaw the author of the aforementioned study noted when he observed Duolingo making memorization of sentences like "I have two weeks of not swimming" compulsory. Obviously, if a user is to become fluent in any given language, it requires that they commit to studying the material over long periods of time and regularly return to the app which they are exceedingly less likely to do if the approach they take to learning is rife with tedium and nonsense. By contrast, infants who grow up learning their first language, do not do so by following precise lesson plans but by being immersed in an environment where the language is constantly being spoken. Unsurprisingly, foreign language immersion has become the preferred pedagogical approach to language learning in recent years as noted by an article in The Journal of the National Network for Early Language Learning [12]. Foreign language immersion programs began in Canada in the 1960s and gave students the opportunity to study abroad in their target language. The aforementioned article noted that students involved in such programs attained near-native fluency in a short amount of time and that schooling in a foreign language did not adversely affect their studies. That study went on to conclude that foreign language immersion programs equally benefited foreign language acquisition for students of all backgrounds irrespective of race and socioeconomic background. Hence why Diane Larsen-Freedman, a leading expert on second language acquisition, in her book notes that that the grammar translation model has been eclipsed by communicative language methodologies such as the immersion paradigm [4]. This is thanks to the observation by Noam Chomsky that language is not just a set of patterns acquired through habit formation in addition to the fact that students of the Grammar-Translation approach were not equipped practical communicative experience. Immersion provides practical experience and achieves positive results quicker. In all fairness, Larsen-Freedman does not say there is any "correct" way of acquiring fluency in a foreign language and that each method has its own strengths and weakness, however, we chose to adopt an immersion paradigm for all the aforementioned reasons. This is the method Glossa aims to emulate by providing a large amount of literary material for users to immerse themselves in.

In addition, Glossa also provides flash card features that rely on spaced repetition. Spaced repetition is the process by which terms or phrases are reviewed more frequently by the user than terms they are most familiar with which are spaced further away inside a flashcard deck. This technique has proven especially efficacious for memorization. One study found that participants who utilized spaced repetition were able to retain information significantly better compared to those who studied the same material without spacing it out. The results of this study highlight the benefits of incorporating spaced repetition into study routines, as it can lead to more efficient and effective memorization [1]. Duolingo and similar apps have implemented spaced repetition to great effect as well and is what contributes to their popularity and utility. The language learning app we have developed combines foreign language immersion and spaced repetition. making it the most sophisticated and efficient language-learning platform. What makes Glossa unique, is not the technology itself, but the fact that it takes the best features of other language learning apps and combines them in one place. Unlike other applications, Glossa focuses on allowing users to take control of their language learning experience. There are other applications that opt for a similar approach but fail in execution for one reason or another as we will explore next.

Background

Glossa was designed as the answer to a lot of the inconveniences and drawbacks of other language learning applications with an emphasis on user freedom. In this vein, we decided to create an app that uses flashcards so the user can focus on the material they want to learn by creating their own custom flashcard decks. Essentially this involves a series of nested objects with a flash card deck being a list of flashcards, each containing however many flashcards the user finds sufficient. For this reason, we chose to develop Glossa using JavaScript because of the language's dynamic capabilities, making Glossa a web page application as well. This allows users to create as many decks and as many flashcards as they want and to generate these objects in run time. They can arrange their decks according to word type allowing them to study verbs and nouns independently of one another. All of their progress is stored in a text file which is stored on a back-end database. In this manner, the app follows a model-view-controller architecture with the text file serving as the model, the application UI serving as the view, and the JavaScript file serving as the controller by facilitating the program logic. The user is able to study their decks by opening one of their decks and reading the word or term on top of the deck. They then reveal the translation for that word and press a button denoting whether they guessed the correct translation or not. The app also uses employs a naive spaced repetition algorithm by taking the card the user got incorrect and placing it in the middle of the deck each time so that the user is more likely to see it again sooner while cycling through their deck. Glossa also comes equipped with premade flashcards called "lessons" which can help kickstart the user's language learning journey by giving them basic words and phrases to review right away.

We decided to develop the app using the spiral software development lifecycle model which allows us to continually update the app with new features according to user feedback. The app also comes equipped with reading material in the user's target language that will regularly be updated with new content with each new version of Glossa that is released. This spiral model also facilitates this endeavor. One reason we included reading material in the user's foreign language is so that the app does not put too much onus on the user to create their own flashcards. While reading the texts provided, the user is more likely to discover what terms and phrases they are unfamiliar with. Because Glossa uses google translate as a third-party API allowing the user is able to get an instant translation of a single word or set of words by highlighting the part of the text they do not know. This autogenerates a flash card with the term and definition already provided and the user can then decide to add that card to one of their existing decks or not.

In regard to non-functional requirements specifically, we expect Glossa to operate on the windows runtime environment with ambitions of accommodating IOS and Android platforms in the future. Performance-wise, the application should perform functions within a fraction of a second. The user should not experience any downtime when it comes to interacting with their flashcards. The weakest link, in this case, would be the time it takes for Glossa to interact with the Google Translate API. In that case, downtime should not last more than 2 seconds. The app itself should not take up more than 1 GB of space. The application will be funded off of ad sense revenue while remaining free to use.

Related Work

There has been a profound increase in the development of language-learning apps in recent years. Another language learning app opting for a very similar approach is EWA. It is

listed on the google play store with over half a million ratings. The top review is by Katia Deg who writes "Unfortunately, there's just not a lot of capabilities unless you subscribe… Wish there was a slimmer free option to experience it more!" [7]. It seems most of the reviews express a similar sentiment. EWA does well in regard to its basic premise yet fails in implementation since many of the features it offers are lacking. For instance, EWA allows you to create flashcards, but you can only create one deck and instead of adding words and phrases to that deck, you can only add words. Glossa, on the other hand, allows users to create as many decks and cards as they like. There is no limitation on the amount of information you can include in a card. EWA also adds a variety of literature you can read in the foreign language you are trying to learn, but not every word comes equipped with an immediate translation. Not all words are immediately appended to your flashcard deck either unless you manually insert them. All in all, the user experience is just very clunky.

Another app that is becoming increasingly popular and which has studies affirming its success is Busuu. A study published in the Journal of Computer Assisted Language Learning testifies to its efficacy in second language acquisition by comparison with a control group [11]. Busuu derives its eponymous name from the nearly extinct language the app was designed to preserve. Since then it not only teaches users how to speak Busuu but has grown to include 12 different languages to learn from. The app has proven to be successful because of its immersive model. It is a language exchange app meaning users of different languages can connect and speak to one another teaching each other in the process. There's one major drawback, however, and that is the fact that new learners can't start speaking right away. Fluency, which is the ability to read, write, and speak in a language is a skill that obviously takes time to obtain, but to use Busuu in a language exchange capacity you have to possess some fluency already making the app inaccessible for new users. Busuu compensates for this by providing lessons users can follow along with. There are matching games and even lessons that use flashcards. The problem is that users cannot design their own lessons and many of the lessons available concern what to say in extremely specific circumstances, such as introductions, proper greetings, how to buy lunch, etc. but this approach will not arm learners with the right knowledge to have a conversation that can flow easily. Now Busuu does have sample conversations between two native speakers that the user can listen to but provides the user limited options if there are specific words and phrases they want to practice first. Essentially, you're forced to work with what's given to you. However, unlike some apps, such as Duolingo, the user has far more freedom in their language learning journey by doing any lessons they like regardless of their skill level. This removes the unnecessary progression feature that restricts the kind of content users can access before the application believes they're ready. This mentality plagues many apps and ultimately hinders the progress of other users who might learn at a different pace from the rest of the user base. But ultimately what separates Busuu from other language apps on the market is how they emphasize immersion. Hence why Glossa also aims to follow this pedagogical approach by exposing users to as much media as they desire in their target language.

Another popular app used for language learning is Quizlet. Quizlet is a flashcard app that allows people to learn any topic they want in general. Not only does it include spaced repetition for the users reviewing their flashcard decks. It also comes equipped with different games, exams/quizzes, and other modes of reviewing in case the user would prefer to learn the material in another way [3]. Because it is a web-based application, it is far more convenient and efficient than manually creating flash cards. Of course, one major drawback of Quizlet is that the user would have to create the flashcards themselves without them being autogenerated. This approach

is also more prone to user error since the user can create flashcards with the wrong definitions and inadvertently learn the wrong material. Hence why Glossa autogenerates cards for users using the Google Translate API. Google translate needs no introduction as attested by its sheer ubiquity in the online space. Most everyone is acquainted with it to some extent. For other flashcard apps, users must search for sources external to the application itself to find material to include in their flashcards. Glossa fulfills both these functions in one place in order to save the user time and for the sake of convenience. Many of Quizlet's original features are now locked behind a paywall and can only be exclusively accessed by premium members which has contributed to the app's decline in popularity. Glossa on the other hand will remain free to use.

Because Glossa is Desktop application that runs in a web browser environment, Glossa uses Google Translate through its cloud translation feature. This allows Glossa to generate translations dynamically with little to no downtime. The efficacy of cloud computing services are widely attested. However, run time performance of the Glossa application can be impacted by the user's internet connection and for this reason performance may be unpredictable for each user. Other platforms, such as Duolingo, circumvent this problem altogether with crowd-sourced translations that the users supply in addition to the situational and conversational lessons already built into the app. As discussed previously in the introduction, rigid lesson plans may impair many learners who would likely benefit from a more organic learning model. In addition, some of the practice sentences the app uses are too situationally specific to yield any practical conversational results.

This is why the creator of Duolingo, Luis Von Ahn, has implemented a crowd-sourced translation model that is scalable and monetizable [8]. Another study found that many other popular language learning apps such as Babel and Busuu similarly employ this strategy so Duolingo is a useful point of comparison in this regard [5]. This model owes its ingenuity to the fact that it employs unpaid volunteers who simultaneously learn by translating sentences from web pages while providing a translation service at the same time. The translations are then sold and validated using built-in authentication measures such as AI algorithms as well as a voting system where users can rate the accuracy of such translations. Of course, this strategy is only as reliable as the user base is. For this reason, users have a high chance of receiving wrong feedback when bad translations slip past the AI algorithm. This is why the app aggressively prompts users with the tagline "Still think you are correct? Let us know," after receiving feedback which has the unintended consequence of annoying users and exacerbating their frustrations. Now there are many difficulties in adopting a similar approach with Glossa. One problem is that it is difficult to recruit enough multilingual volunteers for such an effort. For it to work, you already need active and dedicated user base. Secondly, this approach wouldn't afford users the same freedom as translating specific words and phrases on demand would. Perhaps they only want to translate a certain expression as opposed to an entire sentence. Naturally meaning and context of words can change when you read them in isolation divorced from their surrounding context, thus a dynamic translation model best our intended use case, and since humans can only translate one sentence at a time, this poses a great limitation on our application's functionality. In addition, there are restraints involved regarded space. Having a separate translation of each text would increase the size of the application on the user's end if all that data is stored locally, so a dynamic translation model would resolve this conundrum as well.

In spite of all these drawbacks, a study published in the journal for Association of Computer Machinery found that crowd-sourced translations are generally more accurate than

automated machine translation systems especially when machine translation serves a reduced role as a mediating device for moderating translation quality [2]. Still, given that Google translate is able to draw on a much larger corpus of data in addition to using machine learning algorithms which continuously improve its output over time, it should be able to produce comparable results in the long run without the vicissitudes of a committed user base or pool of volunteer translators.

There is also the issue of pricing. Google's cloud translation services are free to a point. If you translate more than 500,000 characters a month you are charged $1.50 for every 75,000 characters beyond that threshold [6]. While the crowd-sourced approach that Duolingo uses could be free, it would involve finding willing volunteers who are fluent in the user's target language. For the time being. Glossa only includes Spanish as a target language. The issue of characters might not pose a problem initially, but would if the user base continues to grow. Therefore our approach isn't as scaleable as the crowd-sourced approach Duolingo relies upon.

Implementation and Experimental Results

The interface for Glossa is quite simple. Once the user opens Glossa for the first time they will be greeted with two card decks. These default decks are tentatively referred to as "lessons" and will help the user kick-start their language learning journey. However, the cards inside the decks can be removed and appended to as the user desires. There are also other options in the top right corner allowing the user to review content, create flashcards, or create their own custom decks.
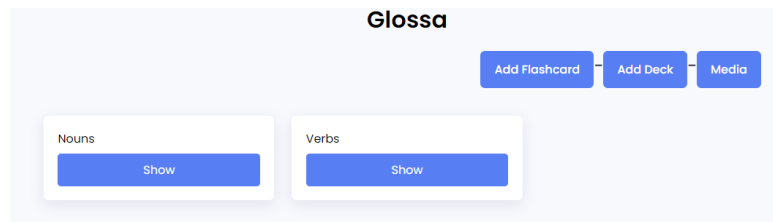

Figure 1: Glossa Home Page

The way cards and decks relate to each other is by way of nested objects. A deck object is an object that contains a list of cards. The only other parameter it has besides this list is the name associated with it. A card object on the other hand has a word and a definition parameter. Below is some pseudo code demonstrating the functionality involved:

```
DeckConstructorClass(name){
    DeckName = name;
    ListOfCards = null;
}

CardConstructor(term, definition){
    CardsTerm = term;
    CardsDefintion = definition;
```

}

Figure 2: Card and Deck object pseudocode

Now if a user wants to examine the cards in a deck they simply click the "Show" button below which displays a new set of options and objects. In Figure 3, a screenshot of what a deck looks like is provided:
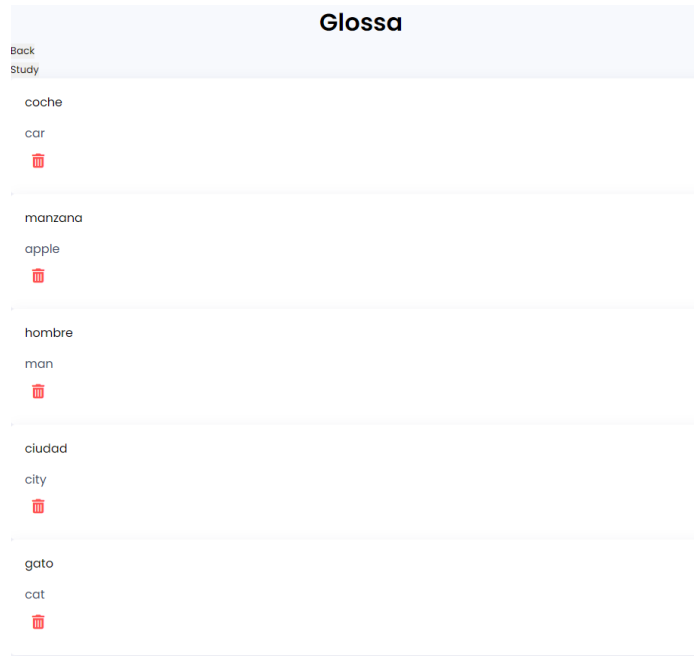

Glossa

Back
Study

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Figure 3: Display Deck page of Glossa showing all the cards inside a deck.

As can be seen in Figure 3, there are a variety of options in a deck including a red trashcan icon that allows the user to delete cards they don't like. There is also an option to study the cards and an option to go back as well. The cards are all clearly formatted with the term and its associated definition visible. This was all accomplished by hiding and unhiding div tags in the html. Hiding and unhiding merely toggles the visibility of these different pages, so clicking back would hide this current page and reveal the original page once more. The study option allows the user to review their terms using spaced repetition, as shown in Figure 4 below:
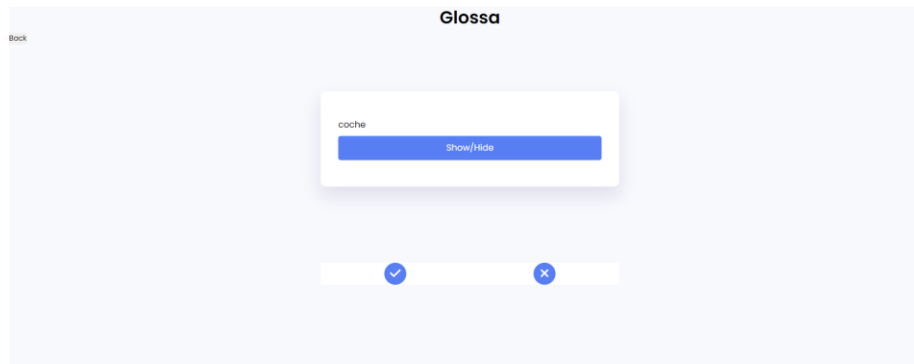
Figure 4: Glossa Study page

Once the user clicks the "Show/Hide" option, the card reveals the answer. This allows the user to self-evaluate, i.e, to see if they got the answer right or not. If they did, they can simply click the check box which will reveal the next term and the current card will be put at the bottom of the deck to be reviewed last. If they click the x button, showing that they don't know the term well, the card is put in the middle of the deck to be reviewed sooner down the line. To accomplish this, we used a naive heuristic for our spaced repetition algorithm by simply moving the card in question to the middle of the deck by means of JavaScript's built-in splice function. Here is the accompanying pseudo code:

```
checkMark.onclick => {
    remove first element on top of the deck using shift
    command;
    add same card to the end using push command;
}
exMark.onClick {
  if(deck.length > 2) {
    find middle of the deck and round to floor if the
    length is even. insert at the index which was just
    calculated (deck.splice(insertAtIndex, element to be
    inserted))
} else {
    repeat instruction from the check mark function;
}
```

Figure 5: Glossa Pseudocode for spaced repetition functionality

The next two figures show the translate feature in action. As seen in Fig. 6, with google translate, the user is able to highlight some text, right-click it, and use the "Translate" option from a drop-down menu.

Figure 6: The user is translating some sample text from the material provided

The translation is displayed for the user through an "Add Flashcard form" as Fig.7 shows giving the user the option to add this translation to their deck of cards if they want to review it in the future, or to discard it all together. Users can translate entire sentences, phrases, and individual words.
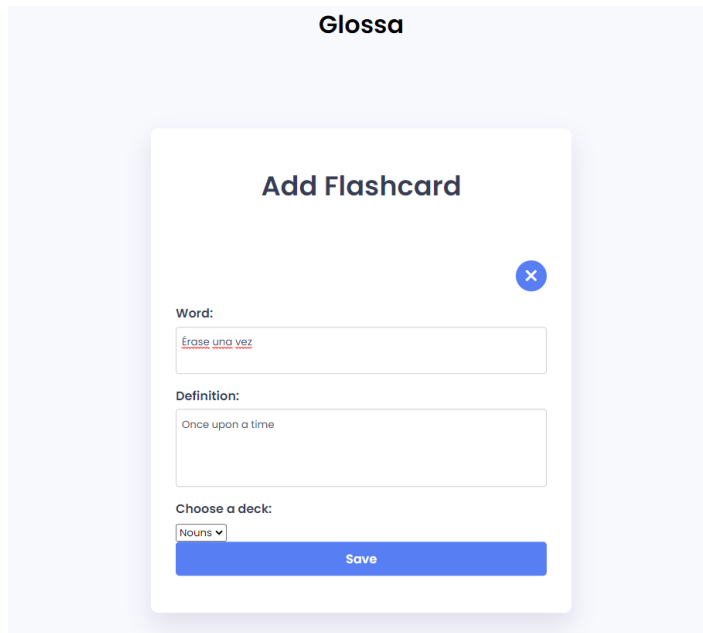

Figure 7: Translation view

As seen in Fig.7, the user can click the x-button to discard the translation or the save button to add it to their deck.

Our hope is that the simple interface that Glossa provides will be sufficient for users to smoothly acquire fluency in a second language of their choosing in the most adaptable and efficient way possible. Particularly in a manner that emphasizes user autonomy so as not to limit their achievement outcomes.

Conclusion & Future Work

We present a novel language-learning tool called Glossa. We present the implementation details of our tool, along with performance comparison results. The results confirm the practicality with respect to user-friendliness and ease of use. Moreover, the performance comparisons with similar tools are promising that make Glossa stand out and a good candidate for further extension.

As future work, we are considering adding a text to speech feature to the current design of Glossa. Additionally, we are planning to extend it by incorporating games to turn language learning into more fun. Once gaming capability is included, a good benchmark to eventually compare Glossa will be Lingopie [10].

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