A Novel Algorithm for the Comparison of Bangla Strings for Sorting According to the Rules of Bangla Academy

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ABSTRACT
In this paper we discuss the comparison of two strings of Bangla language represented by Unicode character set. This comparison order maintains the Bangla Academy rule. This method can be used to sort Bangla words perfectly. A few works has been done on this topic but no standard is set up yet to sort Bangla words. Some of these works are based on ASCII representation. As a part of internationalization, Unicode representation is much more preferable than ASCII representation. We discussed an easy way to compare not only the Bangla words but also the Unicode Bangla strings. In our method, a mapping is used which simplified the sorting procedure. This method can compare any Unicode Bangla strings and it is not keyboard dependent.

Keywords
Bangla String Comparison, Bangla Word Sorting, Unicode Bangla Sorting, Bangla Text Sorting

1. INTRODUCTION
Bangla is an eastern Indo-Aryan Language. It is the native language of Bangladesh, the Indian state of West Bengal and parts of the Indian states of Tripura and Assam. It is written with the Bangla script. [1] About 181 million people are the native speaker of this language and nearly 250 million people can speak Bangla in total. It is one of the most spoken languages (ranking sixth) all over the world. [2] It is the national and official language of Bangladesh and one of the 23 official languages recognized by the Republic of India [1]. In order to honor Bangladesh, Bangla is declared as one of the official languages of Sierra Leone also.

As the Bangla language is a rich and widely used language, it must have some standardization such as Bangla keyboard layout, Bangla character recognition, voice synthesis etc. But unfortunately we have advanced a very little in this regard. In a rapidly developing environment of computerization of Bangla language, one of the most important issues is Bangla text sorting. For the development of Bangladesh database systems, an efficient, versatile sorting algorithm is a must. The problem is not with the sorting algorithm rather it is with how the Bangla strings are compared to maintain the right order. There are some papers on this topic but none of them could set standard for sorting Bangla text. None of the papers maintain sort Bangla strings in proper order. In this paper, we have shown the analysis of the previously proposed sorting algorithms and the comparison among the procedures to represent drawbacks, difficulties and limitations. Based on these observations we have proposed an algorithm based on Unicode to sort Bangla strings accurately, and the complexity is satisfying. The proposed algorithm is readable and very easy to code; hence it has the potential to be considered as standard algorithm for sorting Bangla strings. As Bangla Academy [3] is the national academy for promoting Bangla language in Bangladesh, we are following the Bangla Academy dictionary standard for our proposed method.

2. THE BANGLA LANGUAGE
Base Letters: In the written form of Bangla alphabets, there are 11 vowels and 39 consonants. When we use these alphabets, we call it base letters.

The vowels are -
অ আ ই ঈ উ ঊ ও ও য ন

The consonants are -
ক খ গ ঘ ঙ চ ছ জ ঝ ঞ ট ঠ ড ঢ ণ ত থ দ ধ

These are the base letters of Bangla language.

Modifiers: There two types of modifiers in Bangla, vowel modifiers and the consonant modifiers.

10 of the 11 vowels can be used as modifier to the consonants. We call them vowel modifier. They can never be used independently. Here is the list of vowel modifier:

<table>
<thead>
<tr>
<th>Word</th>
<th>Vowel Modifier</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>অ</td>
<td>-</td>
<td>কলম/kolom/</td>
</tr>
<tr>
<td>আ</td>
<td>আ</td>
<td>কলম/kolam/</td>
</tr>
<tr>
<td>ই</td>
<td>ই</td>
<td>পিঠা/pitha/</td>
</tr>
<tr>
<td>ঈ</td>
<td>ঈ</td>
<td>জীবন/djiban/</td>
</tr>
<tr>
<td>উ</td>
<td>উ</td>
<td>তুলা/tula/</td>
</tr>
<tr>
<td>ঊ</td>
<td>ঊ</td>
<td>সুচি/suci/</td>
</tr>
<tr>
<td>ঋ</td>
<td>ঋ</td>
<td>বিজ/bij/</td>
</tr>
<tr>
<td>এ</td>
<td>এ</td>
<td>কেমন/kemn/</td>
</tr>
<tr>
<td>ঐ</td>
<td>ঐ</td>
<td>হৈম/hojim/</td>
</tr>
<tr>
<td>঒</td>
<td>঒</td>
<td>কেমন/kemn/</td>
</tr>
<tr>
<td>ও</td>
<td>ও</td>
<td>খৌজিন/jowkzin/</td>
</tr>
</tbody>
</table>

Table-01: Vowel Modifiers

Like the vowel modifiers, the consonants have some short forms when they used with other consonant. They are called -ফল.

Some of them are given below:

<table>
<thead>
<tr>
<th>Word</th>
<th>Consonant Modifier</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ন</td>
<td>ন/ফল</td>
<td>ফল /djal/</td>
</tr>
</tbody>
</table>
Generally vowel modifiers can be typed - tuent components and stored the following way the words the relative order in the character set are arranged in accordingly. In Table decomposed into their consti while computing. In case of compound characters, they are shifted after the character for the internal representation before or after the characters but for this algorithm the modifiers would be no dummy character between the constituent parts of a character. Moreover, it is also considered that there dummy character is placed after the character, which does not representation du.

M. Shahidur Rahman et al. [5] have proposed an alternative Method 1 PREVIOUS WORKS

DIFFICULTIES OF SORTING BANGLA TEXT

The problems associated with sorting of Bangla words are as follows-

- Bangla words should be sorted according to the Bangla Academy [4] standard. But unfortunately the Unicode for Bangla characters are not in Bangla Academy dictionary order. So, mapping is required to sort words correctly.
- Compound characters (ঁ, ং, ঃ, ঄, অ, ই, ঈ, উ, ঊ, ঋ, ঌ) make Bangla sorting complicated.
- In writing, vowel modifiers (অ + ব, ম + ল, র + য) can precede or follow the base letter in Bangla words, but in computation it should be placed after the base letter for proper sorting.
- Unicode characters ঃ, ঄, অ, আ can be written in two ways. For example, ঃ can be a single character ঃ (u09DD) or compound of ৃ + ৙ (u09A2+u09BC). These two cases should be considered as special case while sorting.
- Bangla characters in the Unicode chart are not aligned to be sorted.

PREVIOUS WORKS

Method 1

M. Shahidur Rahman et al. [5] have proposed an alternative representation during computation. According to their proposal a dummy character is placed after the character, which does not have any modifier. Moreover, it is also considered that there would be no dummy character between the constituent parts of a compound character. Generally vowel modifiers can be typed before or after the characters but for this algorithm the modifiers are shifted after the character for the internal representation while computing. In case of compound characters, they are decomposed into their constituent components and stored accordingly. In Table-4 internal representation of few words are shown where <space> represents the dummy character. To sort the words the relative order in the character set are arranged in the following way-

<table>
<thead>
<tr>
<th>Word</th>
<th>Compound Character</th>
<th>Decompressed Form</th>
<th>No. of Alphabet Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>উচ্ছল /aj̄b/</td>
<td>জে</td>
<td>জ + জ + 交接</td>
<td>3</td>
</tr>
<tr>
<td>বৃত্ত /br̥j̄y/</td>
<td>ই</td>
<td>ই + ই</td>
<td>2</td>
</tr>
<tr>
<td>যুক্ত /dudh̄/</td>
<td>স্ত</td>
<td>স + ত</td>
<td>2</td>
</tr>
<tr>
<td>রামন /brūmn̄/</td>
<td>আ</td>
<td>আ + ম</td>
<td>2</td>
</tr>
</tbody>
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<td>আ</td>
<td>আ + ম</td>
<td>2</td>
</tr>
</tbody>
</table>

This method has the following drawbacks:

- This work is based on ASCII based Bangla words.
- আ is considered as concatenation of অ and । which is not valid according to the Unicode consortium.
- Provides incorrect result for Bangla string sorting. (E.g. Provided incorrect result: সী, সী)

Method 2

According to Mafizul Haque Khan et al.’s “An Efficient And Correct Bangla Sorting Algorithm” [6] a character is represented with two digit unique number for every letter of Bangla alphabet along with the vowel modifiers and the consonant modifiers. The letters and their corresponding numbers are given in Table-05. It is to be noticed that here আ is treated as a set of two characters that is 'আ + ।'. The consonant modifiers are having the same number as their original consolants.

<table>
<thead>
<tr>
<th>Character</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>আ, ই, ঈ, উ, ঊ, ঋ, ।</td>
<td>11-23</td>
</tr>
<tr>
<td>ক-ঙ, চ-ঁ</td>
<td>25-34</td>
</tr>
<tr>
<td>ধ, ধ, ফ, ধ, ফ, ।</td>
<td>35-42</td>
</tr>
<tr>
<td>জ, জ, ধ, জ, ফ, ।</td>
<td>43-52</td>
</tr>
<tr>
<td>ঘ, ঘ, ঘ, ঘ, ঘ, ঘ</td>
<td>53-61</td>
</tr>
<tr>
<td>ঙ, ঙ, ঙ, ঙ, ঙ, ।</td>
<td>71-80</td>
</tr>
</tbody>
</table>

This work is based on ASCI based Bangla words.

DIFFICULTIES OF SORTING BANGLA TEXT

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Method 3
Shah Md. Emrul Islam et al. proposed a method to Sort Unicode Bengali Text Using Ancillary Maps. [7] In this method, the Unicode characters are mapped and given a Sort Weight. The structure of the Ancillary table is like the following:

<table>
<thead>
<tr>
<th>Unicode</th>
<th>Sort Weight</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0985</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>0986</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>09BE</td>
<td>03</td>
<td>RM</td>
</tr>
<tr>
<td>0987</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td>09BF</td>
<td>05</td>
<td>LM</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>09B6</td>
<td>56</td>
<td>BL</td>
</tr>
<tr>
<td>09B7</td>
<td>57</td>
<td>BL</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>09FA</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>09BD</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>

Table-06: Structure of Ancillary Maps

For each word the mapped value are concatenated and a decimal point is added after two digits from the starting. Then it becomes a floating point number. By comparing all the floating point numbers, the list of words is sorted. For example, the word কলকাতা (Unicode Representation 099509BE09A8099509CB) gets the value 25.0346002519. The algorithm uses the decimal number system for determination of the value of a Bangla Word. Let’s consider an example of two Bangla words “কলকাতা” and “কলকে” for which the decimal values become 25.005463510030035407 and 25.0354635200250540050034915 respectively. Now it’s easy to compare the two numbers. By this way a list of Bangla words can be sorted.

Drawbacks
- Adds extra complexity while converting a string to floating point number
- The range for the floating point decimal number may exceed if the length of the word is much longer which will arise round-off error
- Does not provide correct result for Bangla string sorting (E.g. Provided incorrect result- কীর্তি, কীর্তি)

Method 4
According to “A New Approach to Sort Unicode Bengali Text”, a Bangla word is converted to integers of 64/128/192 bit through a complex procedure. In this approach modifiers are assigned integer number between 1-11, including . Characters starting from  ঃ are assigned number multiple of 12. For example- ঃ is 12(=1*12), ঃ is 24(=2*12), ঃ is 36(=3*12), and so on. When a modifier number is added to the previous character number, it generates a unique number. Consider a word- কাঠ.

<table>
<thead>
<tr>
<th>কাঠ</th>
<th>ফ্রি</th>
<th>গু</th>
<th>তি</th>
<th>ফিল</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 (15*12)</td>
<td>1</td>
<td>1</td>
<td>576 (48*12)</td>
<td>396 (33*12)</td>
</tr>
</tbody>
</table>

Now, these numbers are converted to their binary representation and if they are less than 10 digits, then 0’s are added in front of each binary number. E.g.-

<table>
<thead>
<tr>
<th>ফিল</th>
<th>ফ্রি</th>
<th>গু</th>
<th>তি</th>
<th>ফিল</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 (15*12)</td>
<td>1</td>
<td>1</td>
<td>576 (48*12)</td>
<td>396 (33*12)</td>
</tr>
</tbody>
</table>

Number representation
191(=181+11) 576 398(=396+2)

Binary representation
0010111111 1001000000 0110001110

Concatenating these binary values we get: 0010111111 1001000000 0110001110. In the next step, if the length of the binary value is less than 64 bit, extra 0’s are added to make the length of the binary string 64 bit. After adding 0’s, the binary value is-

0010111111 1001000000 0110001110 00000000000000000000000000000000

This is equivalent to hexadecimal value- 2FE406380000000H. The binary value is then converted to integer and it is ready for sorting.

Drawbacks
- Cannot sort strings in order using described method. (Tested)
- The authors describes this process saves space, but, this process requires 3 arrays, one for the words, one for the integer, and one for the map, requires 3 arrays. This absolutely does not save space.
- Cannot sort random strings. (E.g. Provided incorrect result- কীর্তি, কীর্তি)

Method 5
Sorting process described in “Computer Representation of Bangla Characters And Sorting Of Bangla Words” proceeds by comparing a pair of characters of same index of two words. Whenever difference is found between the pair of characters, the word which has character with higher precedence is returned smaller. For example-

```
<table>
<thead>
<tr>
<th>অ</th>
<th>ব</th>
<th>ন</th>
<th>আ</th>
</tr>
</thead>
</table>
```

According to this approach, if the pair of characters found has same precedence, then it is checked whether there are link characters followed by characters of current index. If, there are link characters or no link characters for both the words, then the process proceeds. Else, the word with link character is declared
bigger than the other one. For example, for two words সকল, সানাদী, সকল is declared smaller সানাদী.

If the comparing process ends, the word with the higher length is declared bigger than the other word. For example, for two words, পৃথিবী, পৃথিবী, পৃথিবী is greater than পৃথিবী.

**Drawbacks**
- Described for ASCII character set.
- Cannot sort random string. (E.g. Provided incorrect result- ১২,৩৭৩৭)

5. **PROPOSED SOLUTION**

As we see that not any procedure proposed to sort the Bangla strings could complete the job properly, our observation is that the lack of standard comparison method is the main reason behind the failure of all the existing procedure. So we propose a standard comparison method.

**Main Process**
The rules followed in our approach are:

1. Any character without any modifier is considered as character followed by null modifier.
2. Any character with vowel modifier is considered as character followed by vowel modifier.
3. Any character with consonant modifier is considered as character followed by link character followed by consonant followed by a null modifier.
4. Any compound character is considered as character followed by link character followed by character followed by null modifier.
5. Any modifier not followed by character is considered as null character followed by the modifier.

In our algorithm the precedence of the Bangla character is maintained using the following rule:

Null Character / Null Modifier < Digits < Vowel Modifier < Consonant Modifier < Vowel < Consonant

**Explanation**

**Why characters cannot be compared to modifier and vice versa or, why do we need null modifier?**

Consider two words, for example- আশা, অশা

<table>
<thead>
<tr>
<th>অ</th>
<th>ও</th>
<th>শ</th>
<th>ও(12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>অ</td>
<td>ও</td>
<td>শ</td>
<td>ক(37)</td>
</tr>
</tbody>
</table>

When last character of the first word is compared to last character of the second word, the first word is smaller than the second word, which is incorrect.

There can be found several words like these. For example - বাসন, বৃসন or কিমন, কিমন etc.

If we introduce null modifier, the strings will be sorted properly. For example, for the example above, we introduce null modifier.

**Why do we need Null Character?**

Consider two strings- হাজির | হাজি.

Complication arises when two modifiers come side by side. For example- হাজি. Here is the explanation what happens. According to the rule, the characters are in even position and modifiers are in odd position.

<table>
<thead>
<tr>
<th>হ</th>
<th>Null Modifier(0)</th>
<th>জ</th>
</tr>
</thead>
<tbody>
<tr>
<td>হ</td>
<td>জ(12)</td>
<td>জ</td>
</tr>
</tbody>
</table>

The second character of first string is compared to the second character of the second string, which results second string is smaller than the first one, which is incorrect.

Some other strings which cannot be sorted are- ২য়, ২২য় and কিনি, কিনি and ১২, ১ম etc.

If we introduce null character for the above example keeping all other rules as it was, we see-

<table>
<thead>
<tr>
<th>হ</th>
<th>Null Character(0)</th>
<th>জ</th>
</tr>
</thead>
<tbody>
<tr>
<td>হ জ(30)</td>
<td>জ</td>
<td></td>
</tr>
</tbody>
</table>

3rd | Null character of first string is compared to the character of the second string, and give the proper result. That is why null character is introduced.

**Mapping**

As stated earlier, Bangla characters are not in order in the Unicode chart. So, the characters need to be mapped in order to get the proper result. The whole mapping serial is given below-

(NULL), ০,১,২,৩,৪,৫,৬,৭,৮,৯,০,১,২,৩,৪,৫,৬,৭,৮,৯, অ, আ, ই, এ, ঐ, ও, এই, ওই, ওহ, ওহই, এইহ, এছ, এহ, এহই, এহহ, এইহই, এহহই, এইহহ, আইহ, আইহই, আইহহ, আইহহই, আইহহহ, আইহহহই, আইহহহহ, আইহহহহই, আইহহহহহ, আইহহহহহই, আইহহহহহহ, আইহহহহহহই, আইহহহহহহহ, আইহহহহহহহই, আইহহহহহহহহ, আইহহহহহহহহই, আইহহহহহহহহহ, আইহহহহহহহহহই, আইহহহহহহহহহহ, আইহহহহহহহহহহই, আইহহহহহহহহহহহ, আইহহহহহহহহহহহই, আইহহহহহহহহহহহহ, আইহহহহহহহহহহহহই, আইহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহ, আইহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহহই, 

<table>
<thead>
<tr>
<th>অ</th>
<th>ও</th>
<th>শ</th>
<th>ও(12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>অ</td>
<td>ও</td>
<td>শ</td>
<td>ক(37)</td>
</tr>
</tbody>
</table>

The fourth character of the first word is compared to the null modifier for the second word. Now the strings can be sorted properly.

**Steps for Sorting Bangla Text**

5.4.1 Word Sorting
Consider two words- কল | লম

**Computer Representation of these words**

<table>
<thead>
<tr>
<th>Word: 1</th>
<th>Word: 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>কল</td>
<td>লম</td>
</tr>
</tbody>
</table>
5.4.2 String Sorting

Consider two strings- ‘কল’ and ‘কলাম’. Computer Representation of these words-

<table>
<thead>
<tr>
<th>String 1</th>
<th>String 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>क</td>
<td>क</td>
</tr>
</tbody>
</table>

Comparison Steps

Step 1: String 1 < String 2

**The upper word weighs less than the lower, so the correct sorting sequence will be returned is - कल < कलाम**

Algorithm

Bangla characters are inserted in array called MappedInt maintaining the mapping order described in section 5.3.

We used Merge Sort to sort; to compare two words following Comare method is used.

Compare (Word1, Word2)

1. L = minimal length between Word1 and Word2
2. For i = 1 to L
   i. IF MappedInt [Word1 [i]] = MappedInt [Word2 [i]]
      a. IF word1 [i] is Character
         Flag= TRUE
         CONTINUE
      b. ELSE IF word1 [i] is Modifier AND word2 [i] is Modifier
         AND Flag=TRUE
         Return 1
   ii. ELSE IF word1 [i] is Character
      Return 1
   iii. ELSE IF word1 [i] is Modifier AND word2 [i] is Character
      Return -1
   iv. ELSE
      IF MappedInt [Word1 [i]] < MappedInt [Word2 [i]]
      Return 1
      ELSE
      Return -1
3. IF Length(Word1) < Length(Word2)
   Return 1
4. ELSE
   Return Length(Word1) - Length(Word2) ? - 1 : 0

Complexity

Complexity for the comparison of two Bangla strings = O (L), where L is the minimum number of character in one of the strings. Since the proposed comparison method has linear time complexity like the comparison method of English string algorithm hence the complexity to sort the N bangla words depend on the complexity of sorting algorithm. Also we have mapped each bangla unicode character once so we are ignoring it. We have used merge sort algorithm here. So the complexity for sorting bangla string algorithm is similar to the complexity of the standard sorting algorithm. In our case we used Merge Sort algorithm; hence complexity is O (NlogN).

6. DISCUSSION

In this paper we have proposed an efficient and proper way to compare Bangla strings that conforms with the proper structure of Bangla words i.e. each modifier comes with a base letter. Our main effort was to maintain the right order according to the standard set by Bangla Academy while sorting and to preserve the general complexity of standard sorting algorithm. We have also tested the algorithm with more than 56,000 data taken randomly from Samsad Bengali-English Dictionary [17] in our algorithm and the output is completely in proper sequence as represented in Bangla Academy Dictionary. So this algorithm has the potential to be considered as the standard procedure for sorting Bangla strings based on Unicode character.

7. CONCLUSION

So far the works carried out related to Bangla sorting procedure have at least one of two major problems: either their time and space complexity is higher or produce wrong results. Our goal was to design an algorithm that can be used to sort Bangla strings accurately without any additional cost of time and space complexity. We devoted ourselves to find out the basic rules for sorting Bangla strings. In order to find out those rules, we had to implement all the procedures described in section 4. Then we came up with theories and ideas described in section 5.2 and put them in rigorous tests to check their validity. We designed the compare method the way a normal compare method works for English. It returns 0, 1 and -1 for equal, greater than and less than respectively. So we propose this method as the standard for comparing Bangla strings.

8. REFERENCES


[18] Ishida, Richard - Bengali script notes http://rishida.net/scripts/bengali