WORD REPRESENTATION USING A DEEP NEURAL NETWORK

by

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Abstract

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Word representation or word embedding is an important step in understanding languages. It maps similar words to vectors that are close in space. In this thesis, we introduce a deep neural network model called the Character-Morphology-Word network (CMW) for word representation. We implemented our CMW model and trained it on the Wikipedia corpus. We compared our model against two past approaches in a number of word-embedding tasks and found that, while the average performance of our model is not as good as the past approaches, our model achieves comparable precision and, in one task, our model outperforms these approaches. We also used our model to generate random text and found that our model produces words in the vocabulary and can produce lexical-correct text. The results of our research indicate that a deeper neural network can be used to represent words and ultimately, help solve related Natural Language Processing (NLP) tasks.
Dedicated to the squirrels and geese in Toronto’s High Park who always accompanied me as I was craving spark

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Chapter 1

Introduction

Being able to represent the words of a language is an important task in NLP [49]. Word embedding is a word representation method that maps words into a continuous space where the similarity between words can be measured by their Euclidean distance [49]. A good representation of words can reduce the complexity of the language model by making use of the redundancy in natural languages to improve the performance of NLP applications.

A key to word representation is to find the structures, or features, of the words in a language. Letters form words, words form sentences, and sentences express concepts and meanings. The combinations of letters and words could be vast. However, some underlying principles rule out most of these combinations, making the distribution highly sparse. For example, there are $26^3 = 17,576$ possible combinations for three-letter-words in English, but only 1,015 of them are commonly used.1 Similarly, in the formation of a sentence, the number of actual meaningful sentences are far less than the total number of possible combinations of English words. Just like identifying edges and texture helps in recognizing images, automatically identifying the patterns in words can help in understanding how the concepts form; recognizing patterns in sentence structures can help in understanding how languages work.

Deep learning is a recently-developed technique that has been applied to automatically detect features in images [32]. As an unsupervised auto-encoding method for feature extraction, deep learning is a candidate method for solving the word representation task [34]. It performs as an automatic encoder to extract higher level patterns and features from a given training data set. These features are generated statistically and can be automatically optimized according to independency and representativeness, which is usually difficult or even impossible in manually-created hand-crafted features.

Deep learning has been widely applied in the field of NLP [3, 5, 26, 27, 28, 29, 35, 46]. Traditional neural network language models (NNLM) usually use word [3, 5, 26, 27, 28, 35] or character level input [8, 29]. Traditional neural network based word embedding models take words (tokens) as the input [19, 41]. In this thesis, we introduce a model called the Character-Morphology-Word Network (CMW), that is composed of two deep neural networks (a character-level network and a word-level network) and a morphological layer in between that uses information obtained from the character level network to break words into stems. Our model captures character-level information in the spelling of words, a feature that is ignored in more traditional models. Our goal is to determine if our model can perform as well as or better than more traditional word-level networks.

Using Theano [4, 7], we implemented our deep learning algorithms and trained them on the Wikipedia corpus. We evaluated our model by comparing its performance with two approaches in Levy et al. [36]. The results

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1 Letter Words http://www.wordfind.com/3-letter-words/
shows that, although the average performance of our model is not as good as that in [36, 43], our model achieves comparable precision in most tasks. In one task, our model achieves even better performance. We also used our model to generate random text.

The rest of this thesis is organized as follows. In Chapter 2, we present relevant literature. In Chapter 3, we describe our CMW model and explain each of its components in detail. In Chapter 4, we present the results of our evaluation and conclude in Chapter 5.
Chapter 2

Literature Review

In common NLP tasks such as Part-of-Speech (POS) tagging and machine translation, words used to be treated as atomic entities using a “one-hot representation” [12, 13, 41, 57] which regards different words as completely isolated items and ignores the relations and similarity among them. However, due to the complex relationships among words such as overlapping concepts, and variations in spelling and grammatical cases in real world languages, the one-hot representation is inefficient, and overlooks useful latent information hidden in the structure of a language.

Word embedding is a word representation method which maps words into dense vectors in a continuous space [35]. Word embedding can be used to find the syntactic and semantic latent structure of a language. For example, if the language model has been trained with a corpus containing the sentence, “The cat is walking in the bedroom”, it should also recognize the sentence “A dog was running in a room” because “dog” and “cat”, “the” and “a”, “room” and “bedroom” have similar semantic and grammatical roles [5]; that is, they have similar word embedding vectors. Word embedding can augment the existing NLP algorithms by connecting unseen words to known ones, by detecting common behaviors between similar words, and by directly identifying lexicon features. This is especially useful when the corpus is not sufficient to solve the data sparsity problem [2]. Word embedding features have been successfully applied to Part-of-Speech (POS) Tagging [31], Named Entity Recognition (NER) [44] and parsing [15, 31, 56].

Current methods for word embedding include neural networks [42], dimensionality reduction on the word co-occurrence matrix [35], and explicit representation in terms of the context in which words appear [49]. The most popular methods and packages for word embedding are word2vec [41] and GloVe [49]. These methods use a neural network language model to find the representation of words in a continuous vector space [5, 45, 46].

Traditional approaches take the context of the word that appears in a sentence (often called the “bag of words” or “BOW”) as the input to the models. In the neural network approaches [42, 49], a neural network is trained to use the BOW to represent the word by predicting the missing word \( w_i \) between two BOWs (previous BOW \( w_{i-n}, w_{i-n+1}, \ldots, w_{i-1} \) and next BOW \( w_{i+1}, w_{i+1}, \ldots, w_{i+n} \)). This is called the Continuous Bag-of-Words model (CBOW) [41]. The context is usually two BOWs of the same length \( n \). While increasing \( n \) gives a better performance up to a point, it increases the complexity of the model dramatically and the model becomes untrainable quickly. In matrix based models [35], the co-occurrence matrix is obtained for the words in sentences, and the matrix is factorized. Again, matrix factorization is a computationally intensive task which becomes impractical with a large vocabulary. Moreover, these models all take words as the input which makes it impossible to handle words that have not been seen in the training examples.
In this research, we use deep neural networks to perform the word embedding task. Our character-morphology-word (CMW) network is composed of two deep neural networks with different structures on character-level and word-level. Our Character-Level Neural Network Language Model (CLNNLM) is a Bidirectional Long Short-term Memory Network (Bi-LSTM) and our Word-Level Neural Network Language Model (WLNNLM) is a Tree-Structured Recursive Neural Network (TRNN). The CLNNLM takes each character in the words as input and produces the embedding of the word. It uses Bi-LSTM to retain the letter order in words so that stems can be correctly processed. The WLNNLM uses the parsing tree of the sentence to combine the words recursively and produce the embedding of the sentence. It uses TRNN to represent long distance dependencies or discontinuities which occur when there is a separation between a word or phrase and the word or phrase that it modifies such as those that happen with wh- words (whom, what, which, whose, etc.).

Fig. 2.1 shows a typical structure of a neural network model. A multi-layer neural network includes an input layer, one or more hidden layers, and an output layer with several neurons in each layer [37]. Neurons of neighboring layers are interconnected by weighted edges. The layers are parallely arranged in a hierarchy such that information can flow via links between layers (and get processed) before being sent to outputs [48]. Once trained, the weights of the links are adjusted to adapt to the features of the inputs and outputs. One of the popular and efficient training algorithms for traditional neural networks is Back Propagation (BP) [33, 34, 51]. BP uses the chain rule to revise the weights according to the errors of each prediction during training. However, BP fails in training deep networks due to a decrease of the error signal in the propagation through layers [23]. This causes the training process to get stuck in some saddle points, the so called Vanishing Gradient Problem [6, 34].

Around 2006, an unsupervised pre-training procedure was introduced to solve this problem [34]. In a deep neural network, raw data (such as Wikipedia in our case) is first used to pre-train the layers. The pre-training process is applied to the weighted matrix between the first two layers $w_{ij}$, while keeping other layers “frozen”. The weights $w_{ij}$ between the first two layers $i$ and $j$ are then adjusted by an optimization function, which compares the output of the neural network with the actual answers. Once a local minimum is reached, $w_{ij}$ is frozen, and the weight matrix between higher layers $w_{jk}$ is adjusted using the same method. By applying this greedy algorithm to the deep neural network, a representative model of the original input data can be obtained [22].

The advantage of such pre-processing or pre-training is that the neurons in the Deep Neural Network capture some high-level representations of the raw data, so the noise in the following supervised machine learning steps are reduced and thus the accuracy increases [32]. It also helps by utilizing the huge volume of unlabeled data in the training process and reduces the need for labeled data which are usually labeled manually, a very time-consuming and expensive task.

A successful applications of the deep learning is image recognition. A deep Convolutional Neural Network (CNN) based image recognition system first tries to combine the neighboring pixels and identify the features (strokes and texture), and combine them into structures (a tail, an ear, a face), and finally the meaningful representation (a cat) [32, 34].

CNN based methods have also been widely applied to NLP tasks such as text classification and sentiment analysis [26, 27, 28, 29]. CNN has been used for embedding character, morpheme and word level inputs. However, one of the keys to the success of CNN is the translational, rotational and scale invariances in image recognition tasks which are not applicable in NLP tasks. Another popular and successful model of deep learning in NLP is the Long Short-Term Memory Recurrent Neural Network (LSTM-RNN) [24]. Unlike the CNN which is deep in space, the LSTM-RNN is deep in time. Another successful model is the Tree-structured Recursive Neural Network (TRNN) [55] which takes advantage of the parsing tree structure of the sentence. These models were used in our CMW network. A more detailed description is presented in the next section.
Fig 2.1. The typical structure of an Artificial Neural Network with one hidden layer.
In this section, we describe the architecture of our neural network language model, the Character-Morphology-Word Network (CMW). The model is a combined model composed of two deep neural networks (Character Level and Word Level) and a transition layer (Morphological Level) in between. The Character-Level Neural Network Language Model (CLNNLM) is a Bidirectional Long Short-term Memory Network (Bi-LSTM) which embeds words into vectors. The Word-Level Neural Network Language Model (WLNNLM) is a Tree-Structured Recursive Neural Network (TRNN) which is used to predict the probability distribution of the context of the words in sentences so that the whole model can be trained. The tree structure provides a better understanding over the distant dependents in sentences than the Bi-LSTM used for the CLNNLM. A morphological-level layer is added between the CLNNLM and WLNNLM which takes the confidence of the probability distribution in the CLNNLM to split the words into character groups (i.e. stems and pre-/suffixes), before feeding them into the WLNNLM.

In order to present the detailed description of our CMW Network, it is first necessary to describe the kinds of deep neural networks that underlie it. Fig. 3.1 shows the architecture of a general Neural Network Language Model [3]. Given a sequence of $n$ words, the first $(n-1)$ words are used to predict the $n^{th}$ word. The first $(n-1)$ words in the sequence are input to the projection layer. In this layer, the one-hot representations of these previous words are projected into vectors in a continuous space (word embedding). Then the continuous feature vectors are concatenated into a big vector and processed by one or more hidden layers. The final layer, which has the same number of output neurons as the size of the vocabulary, is the probability of each word appearing in a natural sentence following the first $(n-1)$ words [3]. In [3], the authors obtained a trained projection layer by optimizing the output probability with the training data from the Wikipedia corpus, which gives the word vector of each word in the vocabulary (Wikipedia in this case). In order to minimize the prediction errors, the words with similar distribution of successive words are mapped to similar vectors, so that the input of layers above the projection layer are similar, and hence the output (the estimated distribution) is similar to the actual distribution [3].

A Recurrent Neural Network (RNN) is a special kind of deep neural network which, instead of laying multiple layers upon each other to create a deep structure, it is a network that is “deep in time” [20, 25]. As can be seen in Fig. 3.2, while the step inputs ($x = \{x_0, x_1, x_2, \ldots, x_t, \cdots\}$) are fed to the network one by one, the status of hidden neurons ($A = \{A_0, A_1, A_2, \cdots, A_t, \cdots\}$) are passed through time and adjusted according to the input $x_t$ and the last hidden status $A_{t-1}$. And the output ($h = \{h_0, h_1, h_2, \cdots, h_t, \cdots\}$) is generated form the hidden state $A$. This gives an RNN the ability to take an unpredicted length of input and output which makes it able to handle words and sentences of different lengths. This is especially useful in NLP tasks.
Fig 3.1. The architecture of a general Neural Network Language Model for word embedding. Note that in a Deep Neural Network there are many hidden layers (adapted from [3]).

Fig 3.2. Recurrent Neural Network is a deep neural network in time (reproduced with permission from [47]).
A Long Short-term Memory Network (LSTM) is a special kind of RNN which has an updating rule that is more complex than a simple RNN [18]. In a simple RNN (see Fig. 3.3), the hidden states and outputs (both \( h_t \) in this case) are generated by applying a simple \( \tanh \) function to the merged vector of the hidden state of previous step \( h_{t-1} \) and the input of this step \( x_t \). But in an LSTM (see Fig. 3.4), different restrictions called “gates” are used to regulate the update behavior which allows the model to determine which neurons in the hidden layer should be “kept” and which should be “forgotten” or “updated”.

In an LSTM network called the “Peephole Network” [16], input \( x_t \), output \( h_{t-1} \) and the hidden state \( C_{t-1} \) are used to decide the update neurons. The updating functions can be seen in Equation 3.1. The sigmoid function \( \sigma(x) = \frac{1}{1+e^{-x}} \) is a function with value between (0,1). The inputs of each gate are weighted and biased vectors. The weights and bias of each gate are parameters to be learned in the training. By applying \( \sigma \) to the weighted vector, it creates a mask vector of real numbers in the range (0,1). These mask vectors are the forget gate \( f_t \), input gate \( i_t \) and output gate \( o_t \). Weights for the gates are \( W_f, W_i \) and \( W_o \), and biases are \( b_f, b_i, b_o \), respectively. Then the hidden state \( C_{t-1} \) is first multiplied with the forget gate point-wise, so that some of the neurons are regulated towards zero. Then the input vector \( \tanh(W_c \cdot [x_t, h_{t-1}, C_{t-1}] + b_c) \) is multiplied with the input gate, then added to the hidden state to get the new \( C_t \). Similarly, the output is obtained by applying \( \tanh \) to the hidden state, and then going through the output gate. The use of these states helped the LSTM keep long distance information. The application of LSTM to NLP tasks increases the representability of the Neural Network Language Models [17].

\[
\begin{align*}
    i_t &= \sigma(W_i \cdot [x_t, h_{t-1}, C_{t-1}] + b_i) \\
    f_t &= \sigma(W_f \cdot [x_t, h_{t-1}, C_{t-1}] + b_f) \\
    o_t &= \sigma(W_o \cdot [x_t, h_{t-1}, C_t] + b_o) \\
    C_t &= f_t \odot C_{t-1} + i_t \odot \tanh(W_c \cdot [x_t, h_{t-1}] + b_c) \\
    h_t &= o_t \odot \tanh(C_t)
\end{align*}
\]

In our Character-Level Neural Network Language Model (CLNNLM), we use a Bidirectional Long Short-term Memory (Bi-LSTM) Network to encode the context of the word [39]. As shown in Fig. 3.5, the Bi-LSTM is actually a combination of two LSTMs which are in different directions. This means that the complete contextual information is available at each step, where as in the simple LSTM only information about the previous context is known at the current step. This helps to improve the overall performance of the network by providing more
Fig 3.4. The updating operations in a neuron of LSTM (reproduced with permission from [47]).

Fig 3.5. The architecture of Bidirectional RNN (reproduced with permission from [47]).
As shown in Fig. 3.6, our model first embeds each character into a vector and then the vector is put in the Bi-LSTM to generate the predictions for the next letter in the same direction. All the weights are trained jointly including the embedding vectors of each character. The hidden states carry the information obtained from the previous steps. By combining the final hidden state in both directions, the embedding of a word is obtained.

The same architecture can be used for word level embeddings as well. We only need to replace the characters in the previous model with words and the embeddings of words can be obtained directly with the output of the CLNNLM. However, as mentioned previously, there are discontinuities in many languages [52], such as “put your red hat on”, “give the girl over there some help”, “He does not feel tired after such a long run at all”, where the phrases in bold are split by other words. In such cases, treating the sentence in bulk provides better performance than n-gram methods which only consider the $n$ continuous words [42]. So instead of using the continuous n-gram as the input of the Word-Level Neural Network Language Model (WLNNLM), we use a Tree-Structured Recursive Neural Network (TRNN) to model the sentences at the word level.

A TRNN is a recursive neural network on the parsing tree of a sentence [55] (see Fig. 3.7). Each node takes inputs only from its children nodes and feeds the output to its parent node. This mechanism utilizes the information of sentence structure to eliminate the long-range dependency or discontinuity problem [55]. The parsing tree can be obtained via various popular methods. In our model we used the Stanford Dependency Parser to parse the sentences [10].

It is also useful to note that the spelling of a word is not a random sampling over the set of possible characters since the words are formed with smaller character groups (like etyma, prefix and suffix) in a more organized way. The CLNNLM offers a good prediction of the next letter in each word which illustrates the pattern within the
words. The probability distribution of the next letter is actually a measurement of the cohesiveness between the current and the next letters. For example, in the case of the word, “preventing”, if the model is very confident that the next letter after “i” is “n” and “g”, it indicates that “ing” is possibly a character group (in this case, a suffix). By mining the patterns of letters in a word, we find the prefixes and suffixes in English words, and use them as additional features in sentence understanding [39, 40, 53]. In order to identify these features, we added an additional morphological-level layer between the CLNNLM and WLNNLM which takes the states of each hidden neuron in the CLNNLM and splits the words into character groups before feeding them into the WLNNLM.
Fig 3.9. The architecture of our whole CMW network model.
Fig. 3.9 shows the architecture of our entire model, the Character-Morphology-Word (CMW) Network. The sentence is first parsed using the Stanford Dependency Parser [10] and the parsing tree is fed to the WLNNLM which is a tree structured neural network. For each word in the parsing tree, the characters are fed to the CLNNLM, which is a Bi-LSTM. The Bi-LSTM predicts the probability distribution of the next character at each step. In the Morphological Layer, the information entropy of the distribution is calculated which represents the uncertainty of the prediction. Since the stems appear in words more often statistically, the uncertainty of the prediction drops within a stem. For example, in the word “biomineralization”, the model is more confident that the next letter is “o” after seeing “bi” in the beginning, but less confident about the next letter after seeing “bio” since the stem is complete here and a lot of different stems may follow this. As can be seen in Fig. 3.9, we cut the word when the uncertainty increases (lighter neurons), and combine the final hidden states of the stem in both directions into a representation of the stem. The stems are also organized in a tree-structured way, in which the stem in the middle is taken as the root of the tree, and all the other stems are dependents of their neighbors that are closer to the root, which forms a “V” shape. Then this revised tree structure is processed using the TRNN of the WLNNLM to combine the information from the children recursively in the tree and form the embedding of the whole sentence at the root of the dependency parsing tree.
Chapter 4

Experiments and Evaluation

In this section, we describe the corpus and libraries used for building our model as well as the evaluations used to test the performance of our model. We built our model using Theano [7]. The Wikipedia corpus [50, 61] and the Shakespeare’s works corpus [54] were used for training two independent models. We then tested the Wikipedia model against word similarity tasks using the Microsoft Research (MSR) Syntactic Analogies Dataset [43] and Google Semantic Syntactic Word Relationship Dataset [41]. Then we compared our results to the two models by Levy et al. [36]. Finally, we automatically generated text using the Wikipedia and Shakespeare models.

4.1 Environment Setup

Theano is a linear algebra compiler that optimizes symbolically-specified mathematical computations to produce efficient low-level implementations [4]. Bergstra et al. introduced Theano into the machine learning community as a mathematical tool which was developed with the goal of facilitating research in deep learning [7]. Theano provides a high-level mathematical description language to define mathematical functions and then compile and automatically differentiate the functions with existing libraries. Theano is currently used as a development toolkit in neural networks, with many software packages and tools built upon it [58].

Keras is a highly modular neural network library in Python. It supports both Theano and TensorFlow backends [11]. Its optimizers were used in our experiment as training functions.

The experiments were run on a Linux server with two Intel E5-2620 CPUs, 256 GB memory and NVIDIA Tesla Fermi M2090 cGPUs with 6GB memory and 512 CUDA cores. The version of CUDA is 6.0. The version of Theano is 0.7.0. And the version of Keras is 0.2.0.

4.2 Training

Wikipedia [50, 61] is composed of millions of articles in different languages, making it a useful corpus for language model training [38]. As of February 2016, the EnglishWiki has 5,149,619 articles and over 2.6 billion words [59]. TheWikimedia Foundation provides dumps of the English Wikipedia almost every month. We used the 2016-07-01 dump of English Wikipedia.

The copy of Shakespeare’s works used in our training was obtained via Project Gutenberg [54], which includes 38 plays written by William Shakespeare (1564 – 1616). The corpus has 5,338,964 tokens, 883,331 words and 122,690 lines.
Kiros et al. [30] propose a sentence based training procedure which uses the current sentence $s_i$ to reconstruct the previous sentence $s_{i-1}$ and the next sentence $s_{i+1}$ (skip-thought framework). We used a training procedure similar to this. However, since it is difficult to reconstruct sentences using a TRNN, we added an extra softmax layer to the top of the model during the training process to translate the sentence embedding output by our model into the probability distribution of words in the previous and next sentences (the word orders in these sentences are ignored for simplicity).

The 2016-07-01 dump of English Wikipedia training corpus has 59,784,453 sentences. All the sentences that do not have previous or next sentences in the same paragraph are discarded. This leaves 26,719,225 valid triples $(s_{i-1}, s_i, s_{i+1})$. We split the triples into training (80%) and validation (20%) sets. The object function in training is the cross entropy [62] between the predicted and actual distributions of words. The optimization algorithm used is Stochastic Gradient Descent (SGD) [9]. We used batches of 51,200 triples to train the model. The total number of batches is 5000 so that the model is trained on the whole corpus for roughly 10 times. The Shakespeare corpus only has 57,881 valid triples so we used batches of 128 instead of 51,200 while kept other setups the same as the Wikipedia model.

The models in Levy et al. [36] were also trained on the Wikipedia corpus. The versions of Wikipedia used in [36] and our experiments may be different. Furthermore, instead of the 5 word context window which is used in Levy et al. [36], the context used for training our CMW network is the 3 sentences context according to the skip-thought framework in Kiros et al. [30]. Due to the limitation of space, in Levy et al. [36] only words appearing 100 times or more are included in the vocabulary which includes 189,553 words. This may result in the Out-Of-Vocabulary (OOV) problem in their model. However, it is not an issue in our character-based network since the total number of characters appearing in the corpus is 205. For comparison reasons, we embedded the words into a 600-dimensional space which is the same as the embedding model in Levy et al. [36].

In both the models in Levy et al. [36] and our Wikipedia CMW network, the functional and meta information
in the training corpus such as hyperlinks, titles, section names and references has been removed, but some of the prepossessing in [36] such as lowercasing all characters & filtering non-alphanumeric tokens are not used in our model. Because our CMW model uses character level input, we wanted to keep the modifications on the original corpus to the minimum. Preserving the case and special tokens such as punctuation in the training corpus can help the model learn lexical phenomenons such as proper names so that it can distinguish between “Smith” and “smith”, but this might also negatively affect the performance by mapping “The” in the beginning of a sentence and “the” in the middle of a sentence to different words. During the training process, Levy et al. [36] also used negative sampling to regularize the model while we used the skip-thought framework in Kiros et al. [30] which did not utilize this trick. These differences might negatively impact the performance of the CMW model on the word based tests. Compared to the neural network based embedding model in [36], our CMW network is more complex and has larger number of parameters, thus requires more time for training. We had hoped this would help our model achieve better results but as seen below we see better results in only one domain and comparable results in the others.

The change of training and validation cross entropies at each batch during the training on Wikipedia can be seen in Fig. 4.1. The lower cross entropy basically means that the predictions of the model matches the training cases better. The training functions from Keras library was used in our training process which has a known issue of reporting lower loss in the validation sets than training sets due to different evaluation methods. It can be seen that the model quickly converged during the first 500 batches and stayed fluctuating during the rest of training. This may suggest that the model is not taking advantage of the whole training corpus. The reason for this could be that either the corpus is too big for the model, or the training algorithm is not optimizing the model effectively. We tried several different training algorithms such as AdaGrad [14] and AdaDelta [60]. The trainings using these algorithms also converged early around 500-1000 batches. As a result, we believe that the model is well trained using the corpus.

### 4.3 Word Embedding

One of the benefits of using a character level model for word embedding is that it can process any words based on their spelling, even if the word has never appeared in the vocabulary during training, the so-called the out-of-vocabulary words. Words such as the names of people, places and animals are usually very rare while following some patterns, such as “Dogville”. By using character level inputs, we can identify such patterns and use it for embedding unseen words.

<table>
<thead>
<tr>
<th>Test Word</th>
<th>good</th>
<th>informativeness</th>
<th>Xiatoujiao</th>
<th>Minemoto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar Words</td>
<td>good</td>
<td>informativeness</td>
<td>Shatoujiao</td>
<td>Minamoto</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>misinformation</td>
<td>Zhujiangao</td>
<td>Minimoto</td>
</tr>
<tr>
<td></td>
<td>great</td>
<td>Disinformation</td>
<td>Zhoushan</td>
<td>Fijimoto</td>
</tr>
</tbody>
</table>

As can be seen in Tab. 4.1, we coined four testing words that are not seen in the training corpus. We used our word embedding model to embed these OOV words using its characters, and compared the word vectors with every word in the corpus vocabulary. The similarity between the test and vocabulary word vectors ($\vec{v}_t$, $\vec{v}_v$) are measured by the cosine distance $\cos(\vec{v}_t, \vec{v}_v)$. The most similar three words for each test are listed in the table.

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1. [https://keras.io/getting-started/faq/why-is-the-training-loss-much-higher-than-the-testing-loss](https://keras.io/getting-started/faq/why-is-the-training-loss-much-higher-than-the-testing-loss)
The result shows that our model can handle the character-level input of unseen words, and embed it into the word embedding space based on spelling similarity. In the case of “goood”, it correctly linked it to the correct spelling “good” using character level information. And for “misinformativeness” which is a compositional word, it seems that our model correctly identified the roots “mis”, “informat”, “ive”, “ness” which are matched or replaced in the three most similar words returned by the model. And for the Chinese and Japanese names, it can be clearly seen that the returned similar words are of similar forms.

4.3.1 Word Similarity

Our word embedding result can be compared with other methods using the Microsoft Research (MSR) data set [43] and the Google data set [41]. We used these data sets to compare our model to two models presented in [36].

The Word Similarity data sets by Microsoft and Google are word pair data sets with similarity scores between each pair assigned by humans. For each left side word \(a\), several right side words \(b_1 \cdots b_n\) are compared with \(a\) and the similarity scores \(x_1 \cdots x_n\) are assigned where \(x_i\) measures the similarity between \(a\) and \(b_i\). In order to evaluate the word embedding result, the similarity between word \(a\) and \(b_i\) is given by the cosine similarity between the word vectors \(\vec{w}_a\) and \(\vec{w}_{bi}\), i.e. \(\cos(a, b_i) = \frac{\vec{w}_a \cdot \vec{w}_{bi}}{||\vec{w}_a|| \times ||\vec{w}_{bi}||}\). The accuracy of the word embedding result can be measured using the Spearman’s correlation between the orders of the output similarity scores and the human ratings. The state-of-the-art methods yield 60.5% to 69.1% accuracy [35].

The MSR and Google data sets are two analogy datasets, containing questions in the form of “a is to a* as b is to b*” [41]. In tests, \(a\), \(a^*\) and \(b\) are given to the system, and the result output by the system is compared with \(b^*\). The MSR data set contains 8000 syntactic analogy questions, such as “good is to best as smart is to smartest”, and the Google data set contains 19,544 such questions, about half of which are syntactic questions and the other half are semantic questions such as capital of countries (“Paris is to France as Tokyo is to Japan”) [41]. The analogy questions can be answered with Levy and Goldberg’s similarity multiplication method [43] which is an analogy recovery algorithm as follows,

\[
\arg\max_{b' \in V_w \setminus \{a, a^*, b\}} \cos(b', a^* - a + b) = \frac{b' \cdot (a^* - a + b)}{||b'|| \times ||a^* - a + b||} \tag{4.1}
\]

where \(b^*\) is the correct answer, \(b'\) is the answer returned by the system, \(V_w\) is the vocabulary, \(\epsilon\) is an infinitesimal which is used to avoid zero in the denominator. The accuracy rate for the analogy questions is defined as the percentage of questions for which the argmax result was the correct answer; that is, where \(b' = b^*\) [36]. State-of-the-art methods yield 14.55% to 99.41% accuracy, varying between different domains [36]. The average accuracy is 59.09% on the MSR data set, and 68.24% on the Google data set [36].

Two models are used in [36], a neural network based embedding model and a matrix based explicit model. The embedding model is based on the word vectors obtained using word2vec as described in [41, 42]. The model is a single hidden layer feed forward neural network that takes the word at the center as the input and predicts its context words within the distance of 2 (i. e. 5 words in total). Then the word embedding is obtained from the neural network. Some tricks such as negative sampling are used in [36] to make the result more robust.

The explicit model is a matrix based model. The value of each element is the positive pointwise mutual information between a pair of words [12, 13, 57] based on a co-occurrence matrix of length 4 (2 words on each side), which is basically the maximum of zero and the mutual information between the pair of words. This sparse matrix of size \(||V_w|| \times 4 ||V_w||\) offers the word embeddings used in the word similarity task using the argmax formula (Formula 4.1).

Tab. 4.2 shows the results of our test on the Google & MSR datasets. We compared our result to the two
Table 4.2: Word similarity results comparing with related researches

<table>
<thead>
<tr>
<th>Domain</th>
<th>Levy Embedding</th>
<th>Explicit</th>
<th>CMW Net</th>
<th>Difference Embedding</th>
<th>Explicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>capital-common-countries</td>
<td>90.51%</td>
<td>99.41%</td>
<td>89.71%</td>
<td>-0.80%</td>
<td>-9.70%</td>
</tr>
<tr>
<td>capital-world</td>
<td>77.61%</td>
<td>92.73%</td>
<td>75.23%</td>
<td>-2.38%</td>
<td>-17.50%</td>
</tr>
<tr>
<td>currency</td>
<td>56.95%</td>
<td>64.69%</td>
<td>50.20%</td>
<td>-6.75%</td>
<td>-14.49%</td>
</tr>
<tr>
<td>city-in-state</td>
<td>14.55%</td>
<td>10.53%</td>
<td>6.32%</td>
<td>-8.23%</td>
<td>-4.21%</td>
</tr>
<tr>
<td>family</td>
<td>76.48%</td>
<td>60.08%</td>
<td>65.61%</td>
<td>-4.37%</td>
<td>-17.50%</td>
</tr>
<tr>
<td>gram1-adjective-to-adverb</td>
<td>24.29%</td>
<td>14.01%</td>
<td>33.22%</td>
<td>8.93%</td>
<td>19.21%</td>
</tr>
<tr>
<td>gram2-opposite</td>
<td>37.07%</td>
<td>28.94%</td>
<td>31.77%</td>
<td>-5.30%</td>
<td>-2.83%</td>
</tr>
<tr>
<td>gram3-comparative</td>
<td>86.11%</td>
<td>77.85%</td>
<td>65.36%</td>
<td>-20.75%</td>
<td>-12.49%</td>
</tr>
<tr>
<td>gram4-superlative</td>
<td>56.72%</td>
<td>63.45%</td>
<td>24.15%</td>
<td>-32.57%</td>
<td>-39.30%</td>
</tr>
<tr>
<td>gram5-present-participle</td>
<td>63.35%</td>
<td>65.06%</td>
<td>57.97%</td>
<td>-5.38%</td>
<td>-7.09%</td>
</tr>
<tr>
<td>gram6-nationality-adjective</td>
<td>89.37%</td>
<td>90.56%</td>
<td>88.53%</td>
<td>-0.84%</td>
<td>-2.03%</td>
</tr>
<tr>
<td>gram7-past-tense</td>
<td>65.83%</td>
<td>48.85%</td>
<td>47.16%</td>
<td>-18.67%</td>
<td>-1.69%</td>
</tr>
<tr>
<td>gram8-plural</td>
<td>72.15%</td>
<td>76.05%</td>
<td>70.76%</td>
<td>-1.39%</td>
<td>-5.29%</td>
</tr>
<tr>
<td>gram9-plural-verbs</td>
<td>71.15%</td>
<td>55.75%</td>
<td>67.14%</td>
<td>-4.01%</td>
<td>11.39%</td>
</tr>
<tr>
<td>average</td>
<td>59.09%</td>
<td>56.82%</td>
<td>56.26%</td>
<td>-2.83%</td>
<td>-0.56%</td>
</tr>
<tr>
<td>MSR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adjectives</td>
<td>45.88%</td>
<td>56.46%</td>
<td>42.47%</td>
<td>-3.41%</td>
<td>-13.99%</td>
</tr>
<tr>
<td>nouns</td>
<td>56.96%</td>
<td>63.07%</td>
<td>50.35%</td>
<td>-6.61%</td>
<td>-12.72%</td>
</tr>
<tr>
<td>verbs</td>
<td>69.90%</td>
<td>52.97%</td>
<td>50.13%</td>
<td>-19.77%</td>
<td>-2.84%</td>
</tr>
<tr>
<td>average</td>
<td>66.71%</td>
<td>68.24%</td>
<td>47.31%</td>
<td>-19.40%</td>
<td>-20.93%</td>
</tr>
</tbody>
</table>

models by Levy et al. [36]. We also recalculated the number of correct and incorrect samples in [36] using the accuracy and the number of samples in each category.

As can be seen from the tables, our model performs comparatively well to [36]. The overall performance is around 11% worse than the two models of Levy et al. [36]. However, the performance of our method on the Google dataset is very close to Levy et al. [36], while the performance on MSR dataset is considerably worse. For the gram1-adjective-to-adverb, our model performs better than the two Levy models. It might be that our model has more parameters and could get stuck in local minimum or overfit, or the current method used in training is not sufficient to find an optimal result in the search space. Since we have tried several different optimization algorithms including SGD [9], AdaGrad [14] and AdaDelta [60] and the object functions always converge early in the training process, we think that might not be the main issue in this case. It is also possible that the size of neurons in each layer are not big enough for the model, which has reduced the ability of our model to represent the complexity of the language. However, the dimension of the character-level is restricted to 600 to be the same as [36] for comparison reasons, but we may use a higher dimension and use dimensional reducing methods such as Principle Component Analysis to resize to 600. This could be explored in the future.

4.3.2 Automatic Text Generation

A very popular demo for showing the representability of neural network language models is automatic text generation [21]. Although there is no public gold standard for evaluating the output text, the fluency and intelligibility of the auto-generated texts are often viewed as a demonstration of the generalizability of the language model. We automatically generated text using our model trained on two different corpora, the Wikipedia [50, 61] and Shakespeare’s works [54] with a random initial hidden state. First we generate a seed sentence from the training corpus which ends at the first space after the 40th character. The seed is fed into the CLNNLM model to initialize the
hidden states. The characters after the seed are randomly picked according to the probability distribution predicted by the CLNNLM, and fed back to the CLNNLM to update the hidden states and generate the next character. We generated 100 samples of 450 characters for each of the models which have 12,781 words in total. Appendix A provides an example of generated text. The following are two samples from Appendix A:

**Wikipedia:** Zanzibar’s economy is based primarily on a few of the recent notable control of his tribes have been proposed to be stored in the term in the candidate of the Catholic in the Medical and Stephens (1984), and the infraction of the Member of the Slave and Western Charles A. Bottle, Canadian form of since 1961 by the United States and proposed with the United States Art and Street for the Assembly of Consider Stone Bartare.

**Shakespeare:** Despite of wrinkles this thy golden tinow you stand not your presence and less in mine eyes are so and born and her oy the some state of HESTINGS and TROILUS, and MARCUS, with the master of the Paris, that I should be for the stone, the content, to the most sorrow in the behold of this bloody power and the strength and to be my son which when he shall be here and send the widow of the friends of the King.

Of the 5824 words in the Wikipedia sample, only 171 of them did not appear in the corpus. Of the 6057 words in the Shakespeare sample, only 132 of them did not appeared in the corpus. Many of these out-of-vocabulary words are capitalized and appear as proper names such as Bartare. Only less than 2.37% of the character-by-character generated words are out of the training corpus. We also imported the automatically generated text into Word. The Word Spell Checker reports 534 misspelled words, making up 4.18% of the generated text. Considering it is generated with our character-level model one character by one character, it is interesting that most of the words produced are spelled correctly. Another thing to note is that for each model trained with different corpora, the writing style is different, which captures the way each author writes in the training text. In the automatically generated Wikipedia text, the words used in the text are more academic and precise. While in the automatically generated Shakespeare text, the phrasing is more like drama lines.
Chapter 5

Conclusions and Future Work

In this research we proposed a CMW neural network language model which takes character level input and encodes the sentences into vectors. The network is composed of two deep neural networks and a morphological layer in between which uses information obtained from the character level network to break words into stems. We trained the CMW network using the Wikipedia corpus and produced a set of vectors mapping English words into a continuous space. The vectors can be used in various scenarios in NLP, such as machine translation, knowledge extraction, information retrieval, and dialogue systems.

We demonstrated our model using word similarity tasks and automatic text generation. We compared our word embedding results with two previous models using word similarity tasks and achieved some comparable performance. Potential problems that may be affecting the performance of our model include inadequate training data, inadequate training mechanism to finding a satisfying convergence. It is also possible that some of the word similarity tasks require knowledge beyond the character and word levels, such as the country-currency pairs in the Google dataset. A knowledge system might answer such questions better and obtain higher accuracies. We believe this could be the most possible reason.

In the future, the model can be modified to utilize other training corpora, such as using the words and definitions from the dictionary as the output and input of the network. The current method of splitting words into stems was based on the probability distribution predicted by the CLNNLM. One area for future exploration is to study whether training or pretraining the CLNNLM with morphological datasets could enhance the performance of the model. Possible choices include the Illinois Speech and Language Engineering Dictionary (ISIEDict), Upenn Morphological data [1] or dictionaries containing word splitting information. The model can also be applied to other NLP tasks such as the Twitter Sentiment Analysis task and paraphrase tasks such as Microsoft Research Paraphrase dataset and semantic relatedness SICK dataset. These sentence level tasks might better demonstrate the full ability of our model.
Chapter 6

Bibliography


Appendices
Appendix A

Appendix

A.1 Wikipedia Samples

Politics of Tanzania takes place in a federal system that considers with the term of the Administration of the Descent English official series, Bank of the State of North America and Andigen and the Chicago Company and any state and the boundary at the time to determine the film

Full independence came in December 1961 e production of the series of his single transform displayed the rotation of the new greater referred to Bareld Company and James Access in 1985 which was provided by the second of the second area of department of a successful popular second construction of the author and state was a control with market and population of "use of the single control of the California and common and provides

From independence in 1961 until the mid-cies in the catholic might in the first success of the character in a strong formal company at one southern of the population of a structure of a group of the influence of the Sonies and Roman researchers and was a common trade is not a state of carrier and the complete first discovery of the formal standard of the novel companies in the 1970s and social album the same discovery of the w

In October 2000, Tanzania held its seconriest William Home Doctor May Indian Landand and the Roman State of British the song of the U. S. State in 1983 the competition to made the book of the ancient second activity of example of state is designed by the early view of the simple form of the most state of complex proposed the particular of the star of the Sonal Arean contrast of the new remains of the Greek point of the 500

In October 2001, the CCM and the CUF part advanced a new commercial composer of the State of the Class of the Polish Constitution of the Constantine of Matthes was also completed as a part of the term state of the term of the sacrifice was the case of the state and consequence, and the traditional received the president to be recorded the Sonic Mark Sport Red Million and Bernt Richard (1939) and its block considered the two

Tanzania was ranked Partly Free by Freed the national reason, on the can be produced by definition is a production of the experiment of the minimitation in the 1940s that like the concept of the term of the Country sent in the experiment of the last marked with a state of the state of the primary proven of the same experiments and common project was stored by the concept of the Catholic Protection of Papin Press, 1978.

She wa

Tanzania’s president is elected by direcrion (1976) (1981), and his state of the Polish book of the Manner of Scholar of the Beat Confederation of Roman Noncen Percent College and Second President 1971

The April March 1994 the first definition of the degree of the later went of the symptom and story contract on the season became a level of the present of the main country and common state of real are the insertance can be late

Hamisi Kigwangalla Bungeni. jpg|thumb|Homicularly a contribution of language and the state is the problem of the concerning stars of the country continued to experience a special of the same license and publication of many received successful test of the resolution of the called part of the control of the word described the first house to a development of the Francis and Bruce Changes of Common Antonia had religious the steal i

The unicameri National Assembly of Tanzae (1994), which is sometimes served in the concentration of the Connect of the Union and the Company of the Polish record of a change was considered that the read control of the single manufacturer of the Leading Protectors of the Area Tolle Touring de Ranger was also a continued by the late 1970s and 2005 and 1950s, India reserved to concern the state in the American first new own stat

Wikipedia has a list of current members he definition of the Kent and Many of the Charles Irish University of Capital for the University of Anglican American continued on the Canadian Concept of Special Breed and Actor Boens of the American centre of a station of the term and the band state in the first to the second single standard the description of the among the book of the Raege of Strong in the transchances of North Carif

Tanzania’s National Assembly members are trained to report that the President Sands was also a distribution of the translation with the text of the can be derived by the case of the album of the Arthur Standard Western State Dictionary and Sedations and the Katach and Sans Reader of Charles Classical Force of National Record of Ottoman 1988 and 2005 had a lead for the second approximately a carting political practice of the word

Laws passed by the National Assembly arepany with a new same time and board in the political state of the Winder to many of the new stars provides the transportation of the project and the complex areas between the company in several read than the film to the could explain a percentage of the song of the basic contemporary sources to the difference of the second early term parts of the son was broadcast to all one of the econo

Chama Cha Mapinduzi or CCM (Revolution)arn the work and second cases of the career has also research for the operation of the term and successful interpretation of the world of the international resident Indian changes of the State National Campaigns destroyed the surprise of confederation is the solo to operating his state complete provinces of the words of the approximately a tour for the first existence of the term and serve

Civic United Front or CUF - Seif Shariffly because the called work consists of semantic service defined to have a common of the Connection of the Charles State was a part of the US encouraged a string to constant a level of microsoft of the Parad of the United States and Province of Press and William Let and
Harer, which states that he completed the return for the Battle of Elim Construction to the trial of the Bobo Commit

Chama cha Democracia na Menseleto or CHAODES Saleed Hampender’s song in the first more than the same majority, the development of the team was the highest state of the service of the states of the survey is a model in the base of this three state the most best standard to the contrast, and 1 well in the wide late constitution of the house of his declared in the additional properties of the Constitution of History of Constitutio

Tanzania Labour Party or TLP - Augustinnesistance of Apple who created the descripts of the early son of Many Limited Only Alexander Games, and the United States David State of January 2016. A during the source of the Cameron 1931 the result is the country became proposed to release a constitutional bishops of the result in these first company the carry of Alceas Contrasts in March 1983 and North American President Black Christ

United Democratic Party or UDP - John Ch In the time of the contrast, the personal works includes the team in the other highest and constitution is a top the control of the early television of the story of the Creates of the United States Army control that the founder of out of the first star productions of the second most contrast of the primary most manufacturer of the first second owners to the contrast to a son can

Democratic Party (unregistered) - Reveread to the product and much of the control scent body range was a similar symbolical president of the Concept of Protection and services in the More Constantine University of North Brange Point All the Council of National Constitution of War Christian Arts of English special presence of the State in the Ship Canada 1976)

Christian translated to the Francisco historians are in the lar

National Convention for Construction and of the city are successfullly a component of the term remaining of the army of the West Roman reporters studied the series of the war in the end of the 19th century, the Catholic record may be moved between the late 20th century which then substantial state was a program with the 2000 Choloch can be particularly a story of response and proposed that he started the four term is the first

Union for Multiparty Democracy or UMD - el of the story as a light of the particular hand special state a story of the form of introduced and remained in the rate in the different more commented composition of the composition in the work is the car the widely children and complex makes a state of the part of the first of the division of site of the foundation of the American and Roman towns of the Christian Country

See also the Tanzanian general election, en and an interest of the North American southern Channel Berners, who also represented the recorded form of the most barmury and proposed on the proposal of the state of the sent to the name which there are some of the theory of the communinity of the time in the single common extensive company in the first largest for the result of the first studies of the situ

Tanzania has a five-level judiciary compo leader to an author of the population of the limit is also resouently provided in the brother Honsis to the age of letter and activity in the step to the program of the largest export of the western common to a describe of the process point in the position of the Soviet Stain Greek Time Thomas Education War and the Ministry of John Marian researchers contrast to be discovered by the P

In mainland Tanzania, appeal is from the political languages are sometime a ultimate and traditional form of the Canadian President of Hands and Manifort Rankard to have been after the Total edition of the Indian Contral of Report of the Hard Claims of Calibrated October of the Charles Translation of Contentions, and the Catholic Antilall politicians and exports of like the Common proposed "current protection of the contrast

The Judges of the Court of Appeal and thn and Committee Hampenian and World Strazer, Peter State and Torchreas of County supported the state of the capital of Men and and the character of S. R. Student (1993) and the Soviet Grand Result of the International University of William I, France and Church and many company in the transport of the Game Attack Strait Life of the Edward Andiple end to a study in the state of the Pargin

A commercial court was established in Sendash; Larkey American, American and most state and control of the all of the day is complete to the example of control the classical author of the common new region of the English movements of the decade of the Christian War and an instance to the propose of the base of the expression of the return of the 1960s and the time of the company and also accompanied that the original more com

For administrative purposes, Tanzania is the appearance of the pressure of the state of the national part of the former company of the stredd the response of the complex control of the song in the City and John Constant and Arian and College and New York: Practice of State Conlon and Linnar and the States of the Stalland Country sold to the first change of the program to the start of a student in the term the first soldier to

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Following the rebasing of the economy inescribed the term second entry that the work is continued to specific the time of the term and reversible states and new the state of the capes included brown and process in the state of the still design is the most popular as the successful and end of the more made more designed to a transfer in the article of the election in the single development of model of the word and all of the dis

Significant measures have been taken to rovides a special age of specific proposed the Emperor of the Japanese of the National English and new Attending Brand as the word of the song with the control of the collection of a site of the contrasts of the single apparent to the state of the can be interpreted as the constitution of a most service of the single state of estimates that the and process of the and in believe that the Current GDP per capita of Tanzania grew s the consider to the series of the comparison of Polar Whelen had a current and traditional particularly also sold in the first article of the song of the American compositions of the constitution are the name of the term is the score of the general became the other Alberta Race March the last international activity of the 1990s record and a second sentence of the Common to the internat

Tanzania also embarked on a major restrue in the country of the plays of the property of the series of the most control of the rift was often made to include the subject in the competition of the Charles Christian Memorial Roman that the haid is recorded in the Constitution of the Park School and Traditional Constantine in 1943, the southern pressure is not too complex extraction of the production of the can report that a signo

This is a chart of trend of gross domest the score of the support of the adventure to the superficial political period of the state is the command of the printer in the first language of the state in the population of a composition of the same destruction of improved for the single and definitions of a program is a general rest of the largest form of states are sometimes used about 18 deciam relatively and a season

Mean wages were $0. 52 per man-hour in 20nd is the major proposed of the discovery of the southern Development of South Complex Number of Africanian provides the transformation of the War Classical Central County (1970), and New York: Andrew George Acts to the character of the Hambard (1989)

The reference in the Aller of Stone British South Based that its states are contributed by case of the latter company at the decision of

The Tanzanian economy is heavily based oscial common should be an individual broadcast of the time of line of the Close of the Bally of the Current University of Political County, in the Bennett Change, Constitution settled in the result of the toid of the first proposed star to an international principle of the term strong international common said a source of the mimor was proved to the 2000 individual of the second city to

This strong dependence on agriculture, micially had a constitution of the control of the population of the portual and support of the recalled with the constitutional s-tology of the appearance of the transportation of the case of the common period of his considerable months of the among troop was attended to be leader that the sub is prepared to the end of the business of the result, which had been considered the term the mo
Appendix A. Appendix

Industry and construction is a major and == The story of the measure of the transport of the action of the Critical Constitution of March 1998, in 2006, and 1830, which is a particular in the southern constitutional counter and the production of the part of the term content of the Robert Constitution of British and Islamic Constitutional state and expected the computer population in the top common from the Sieme that described

Mining contributed 3. 3 percent of GDP in and successful state are often been a open a state in the such a strong strange in the process of the constitution of many and controllers between the major of the terms of high second growth traditionally head the construction of the opening of the short of the extraiting of the prosecution in the United States energy stated that the real of the article of the first transcommerson present

Modern gold mining in Tanzania started ion of the Army has been a later can be considered a company and transport of the leader to the state of the constitution of the base of the first defense of community in the United States and English season was a companies of the more complex confirmed the term for the version of the Most of the Antonietal Martin Romanian Group in 1998, and no south was a decision of the season by about

Nickel reserves amounting to 290,000 ton. 5

Chinese firms have been showing major iniis said that the film and university of the Spanish propositional opposition in the change of the first work of the base of a material became started in the first found that the original research is considered the battle of the support in the state that star composed the largest experiments of the Iraq and Brandens in the control of this complex subsequently believed that a southern sens

In November 2012, the Tanzanian governo that a product of says the production of the country later been appointed the state of the Carter in the term and starting of the lost of the confusion of a single similar and defense in the common study in the decade of the terms of account of several production for the mission of the Chenter and the Hardard and War Martin was a manufacturer in the successful final state of the senator

The government-owned Tanzania Electric Sh part of the China of Contribution of the United States Brother English cases and interpretation of the community in the State is the second control to have a special program and successful program and the production of the term in the base of the second, showed that the International South Catholic and Molhand and the Crank delivered and changed the university of the language of the B

Songo Songo Gas Plant. jgthumblejSongo Soe was the case of the terms of the Press, English theories of semicontrant of the national language of the transportation of the New York: However, the season in the most state of the medical control of the programmes of Control of Dissonsequently with Italian line of March amino and 15 and 1990 and Composer in the propriation of the production of the state can be proved as the first pro


The University, and Iran and Ranger, and Greek and Peater (1990), which is defeated for the production of the theory of the transportation of the Television of the Honder Bolling was a disappear of the same of the state in the council, and Britain is a complex best explains to state the theory of a new largest surrounding in the term resistance in Herser

Commercial production of gas from the So is sometimes translated into the Carlen and Harry Machine and Electric player the first repart of the common common and on the second south and second hold and possible that because the constitution of the cressed there are a classic form of the biological specific of the concept of the close of the first performance of the United States Camples developed the commercial state with the p

A newer natural gas field in Mnazi Bay ited in 1675 and produced the show, and the Explanation of the State Italian and School, and the New Andicant Company Clark was in the North American state and the name of the Termination used on the company control in the control specific and of the political expression of the instrument of the departant many composite and was the only two first designed in the Company of Parts of the Ar

The Indian Ocean, off the coast of Mozamma and his two company in the printing in the state of the three route to the population sold the area was a new character of the plant and movie was the notable of the prominent international contemporary wearwe has found that there are also control of which in a state is a composer of the position of the song in Sadan 1959 the state was a source of the management of the explain of the n

New exploration on more frontier blocks,rate of the United States Congress referred to the terms of the two years of the state of the Book of the State of the Press of Institute of the Oman Party of May This also specialized the company in the Canadian part of the official leader of the state of Erbin Barbalt and the Province of the English of the first triple in the constitutional son that the “part of the Dostama standard Fa

Tanzania’s history of political staitime stream and single campus is visited by the electric point of the season created particular and season, and the following current program was accepted by the reason and constitution and her burie in the most present of the first complex series of the first the design of the University of the Content advanced and is the first solution of the single application of the state of the years


Hand, American activity and a design in the 1990s and the contrast, the establishment of the Connectic to the China and the British family considered the Sun of the National Complete of American National Contrasting more modern strong and can be a state of the tendence of the late 1990s and an article there ar

Zanzibar’s economy is based primarily on a few of the recent notable control of his tribes have been proposed to be stored in the term in the candidate of the Catholic in the Medical and Stephens (1984), and the instruction of the Member of the Slave and Western Charles A. Bottle, Canadian form of since 1961 by the United States and proposed with the United States Art and Street for the Assembly of Consider Stone Bartare and Pe

The Government of Zanzibar has been morephrase that congressions are highest as the third of the leadership is a complex known as the largest state public to a strength in the first company and the component of the production of an extra of the late 2007 masses in the left countries of the Company Stellis and Fellower and Jacobility and Crobmilliam of the Reason of December 12, the concept of the active of the Christian critics

Paul Collier: Labour and Poverty in Ruralnral and Stories of American characteristic contemporary original and Ludga and Concept of Complete and Paternal is also interivewed as an assembly state and more successful state in the protein and against Charles Carves, American state of the experiments for received several state of the Architection of Hungary and Many of the Cambridge First minor Richard with Bars and Strike Contemp

Telecommunications in Tanzania include m demonstrative provides the American team of the Chicago then had a step is a new common community of down the result of a complex of the activity of common realization of the next former language and or containing leading a second modern of the version of the part of the concept of the ministers are used as a state of the cases of the company in the time and only an anglication of the

In 2005, mainland Tanzania, but not the consistent to account that the competition of a notion of the spoken in many transmission company are frequently served by Banga line is a significant states of the first first specific development of the Company popular that had the common country was a provide to the state and specifically have released a role in the United States in the country of the next mathematical forms of his m

Under the Converged Licensing Framework oject and the National Government of the Control of Steel Bradway that is a carban of the Cross Partier of Study and the Constitution of the Such and Government, the contral of the early base of the claim of the strange of its grand is universally being one of composers of the canal with reported that the English are not accepted by the 1880s and states that the ceram is a target of

Network facility, the provision of any eresolution of the primary strong strategy of the career is the prosecution of his general real and the complex consequence of the author of the Indian most personal state to the transportation of a result of the west particularly in the protestant interpretation, but the term of the largest can use the decade in the nine interest in the certain of the defendation of a state of a country
Network service, a service for carrying from the Classic internal and complete commenced as the most production of the time when the Earth and the role of the largest of the term the state of the first through the few as the Hinter Charles School Constitution of John Barland of Committee Bird had a successful influence of the single part of the book to the control depending in the live of the Earth Cartoon of

Application service, the reselling of elational major company of a second service in the school has been ordered by Swite, and American country and research stated that the most largest classification of the term for the theory of the government of sensitive in the character of Standard Martin, also described the subsequent television of the term in a list of responsibility to several provide a month of interest that his system

Content service, a service offered for s authority the case of the composition of the development of the Constitution of the Constitutional Former Scottish Reason (1986) became a term to a special carte of the and the class and well from the Music Change Constitution, the decision of the Time is a possible of the United States and the decision of the end of the Australian school the total of the men to the first three church

21 network facility operators: 8 intermather and the State and the County construction and many of the group is leader and with the Standard Company and Development of Rather that the anelar was a third provide by the term to be line by the first there are the late China service in the second is a report to report and the author of the state of the Greek produced the album in the Company and The Republican Review of Seltenner

17 network service operators: 8 internat of considered one of the stage was some of the school is a same all that and international examples can be dated to carbon a strong political season of the Orchestra was a film in the original certain state of the season in the same popular trainer became a complex compound to claim that the approximately carry (and the father of the support of the population of the ancient show as

91 application service operators: 1 inte album also marked in a state of the "contemporary legal second process of particularly that the construction was several tracked with the model of the major version of the most comparison by the only government of the first construction of the propose of the Clinton is a studies of a research as the term for the explain of the condition of the term national first considerable considered

85 radio content service operators: 6 nar is the commentary to hear the side of the constitution of the ambast to gruman the international domestic consequence of the animal court in the concern with common bedust was a may be considered in the mother of the second common characters of the present of the Serve Like Conservative Press. In 1984, he is a process to a most argument of the album with the characterized movement of t

30 television content service operators:ed States and Charles Protection and Merrime Control of Peter Boble and Composer Arthur Islands and other art of the New York Concern of March Nine Shows and response to the intervartane in the state in 1981, and examples of the country of the term composed to the construction of the air of the product concerned son and many of the two song was included by the Term of the Greek of the Po

A complete list of licensed operators anched a caromatic low major competitive to be a commercial single-college of the Bronce and Hardware and the carrier and the Republic in the Strong German North Particular highest discovered on the president in the animal that founded the criticized still had the relation of the production of notable mention in the word for the second of the system of the collection of the Parliament of

A state-owned national radio station and the special more department of the scottish of the distance of the Community of the Capacity of the figure for the community of the Government of the common low to the estimate and former decline and soldiers have been had been with the protein characterized in the area of the state of the Rock December 1969 and player the political change of the control of the National English applicatio

A state-owned TV station and multiple printer was also a government of the month of the provides the antiture present of basic specifically in the term and president of the University Andrew of Force Classical Plant (1998) in the State of Eastern Council was sent to the days of the Communication of American transport of the state and single construction of the successful production in the subsequent and department of the Abron

The transmissions of several internation of the North Albert by Build, the world was called the temperature of the traditional composed in the second time of the early string of the that the artist of the song is a production of the subject of the Julian life and the posters and basic step was not a children in the Senate to German leader of the Greek Mary that the rules of the extreme provides a current specific major co
There are government restrictions on bro Conservative Mangolis republican points and based on the "The Control of the Considerable Control of Stanlard, which experienced the Economic University of Latin English second into the star was the first remain of the activity of the area and records of the Creator can be used to have been later a north of the account of the southern total and specific programs of the construction of t

The semiannual and Zanzibari government and popularity and the first translation of the last low protesting of high formation of the performance of the version of the Brande Two successful began to the new formal and the president, an electronic period of the case of the first terms of the first of the only recent country include the air manufacturers and all the third to the sport of the company of the Release of Scottish of

Main lines: 161,100 lines in use, 133rd Fed collection in the case of the 1990s in the term from the man first to former time and committed the contrast of the strange and characteristic could expect the more design of the war that the discovery of the representative international process of the program continued in the Bord’s second control of the first reason to now means that that the successful determinists of the structure an


Home, American programmed also a significant proved by the first production of the first to spent the successful of these might also be also powerd in the theory of a complete records of the area of the second first song program at the Anthony Constitution in the patron in the Charles T

Telephone system: telecommunications were released a relatively survey of the interference of the result of the area of the achievement of the Haster December for the army of the Company of the State of the Taque This translation was sometimes also continued to provide the Former War Although and the influence of a friend is the recording of the anipten of the start of the other English explanation to be completed in the new char

Communications cables: landing point for. Commissions of the Manuplic and sources of the Control Spanish and March pressure in the first source of the Asien said that the leader of the China was visible to the American work in the 1960s and the commercial propose of the cast of the editor of the Concept, had the bases of the present receiver is formed by the demonstration of the schools of the direction of the Charles March SEACOM submarine and terrestrial high spital in the assisted composer specifically a successful property of the theory of the creation of the part of the North Australian and the Ballard Andrew may be recognized in the Salent residents and rally based on the detection of first country and the survivation of the state of a storer of the phone of the Battle of Constitution and Press, 1999.

Later (1973). The German came for sever
the EASSy fiber-optic submarine cable syndash; Martin Gircala, American structure from the composition of the surface of the population of control of the three interest is a railway in the word of People the The Protection of Central Additional Charles China and English special to the experiment of the process of the former traditional protein per primary cases have a total of the Special Window II also been assigned to some

Satellite earth stations: 2 Intelsat (1 th the popular process of the state of the reason of the result of the Contension of the Since literature of the country in the book is a control of the other natural subject was an influence of the common of the can be also a continue to same the highest and state under these became also lived for a political players of more than 10 and proteste are selected in a percentage of the colo
Mobile telephone services were usually atypical and the complex construction of said that the transaction from the expirient of the production of the area and the bridge would be some of the state of the proposal and sets in the activity of a state of the can be the first months that the broken and complex states that exist and heaped in the work to complete, a complex contrast to first strong comprised the shell and central co.

Some of the mobile phone companies operating or a start of the game in the Sant English of the original band of the Singanian and the rasis of the computer international distinction consists of the wide internal considerable member of the contains the first of the production of the Constitutional John Route Story Mark 1960-921 Singer Heller, American and characteristic of the constitutional family of the Internation

MIC Tanzania Limited (tGo), formerly Mo the strong system of Singer Around 2009. The main result of attempts of the state is a support of the passion to the state of the Constitution of the New York Countries Country based on the major second considerable of the control of most of the terms of the best and all the same time of the southern amending production to the work of a later and late country of property of the complex co.

Tanzania Telecommunications Company Limited structure of the complex problem is considered the development of an experiment in the carba common sense and proposed that the state was strongly completed in the star successful and the areas of the application and the result of the triple is provided and since the new steel-year, the path is a single company by the state of the study of Constitution is the former major protectio.

Zanzibar Telecom Limited (ZanTel), provie state of the original country is the classical series of the group player in the state of the Mark Constitution in the first an international medical article of the company in the United States of the Area Surviving Herinarie was called the noment of a capital as the area to the series of the company was not only supported by the Catholic declaration of productions of interview in the

Internet users: 6.1 million users, 51st ent to the Bulgarian structure of the Standard State Andrew National Indian staded to an example of company and developments are several for the major computer convince and distinctions and operation is an immediate form of the term of the South Context of the Matthew Original Revertance of 1980 in the Charles Company Varian States are used in the 1950th and the computer for the Martin

Fixed broadband: 3,753 subscriptions, 16e support of a record is the next country of service and confirming at the most form of the constitution of the constitutional revolution of years appeared by the area is also made to be second and was in brave the carries became also the work and in such as the Story of International English studies and consists of the attacked and by the Salis of English successful discovery of the

Wireless broadband: 698,531 subscription on 14 January 2012. The traditional political second complex service was a highlow in the school framed which also served to the time of the first recording tradition, and the based of the son of the production of the period of the State of the production of the Born and the North American language of the Constitution of Charles Specific American interment was also considered that the

Internet hosts: 26,074 hosts, 110th in td Labater and Prince Carlea and South Contrast and all the support of the creation of the fall was a more use of the consumer that such a start of the both the film was used to signed a first production of the second contrast of the Peleton and Colonial term in the distinction of the American cases of the pressure of the case of his protection of the same all of the war were the first p.

Internet services have been available si proposal to the word of the posts of development of the country was designed in the constitutional early 1990th, the second control of prominent indicate is a social structure of the school of the all of the most common extreme attempt of the Charles Campbell Scheme, the Singer and Oxford Recent China of the Contaction of the Martin English and and Translation in the Rise of the City of

Some of the Internet Service Providers o British considered the University of Constitutional Broad was the production of the population of the concept of the Charles State of Analges of Selland and Roman included a new provides the constitutions of a model from the same year of the time they principally also a state in the period of the Summary Charles Power Shelling Bastel Sovertisis (1963) and Air Baying Galting and Many Cle

Tanzania Telecommunications Company Limitation and program was in the prosecution of the television of the same and language and until the control the left as the expansion of a scripts of the anticime of high complex short conclude that the son of King also considered the scale by a song and major country is a special political of the standard specific state of the subsequent states and former program and the first move active

University of Dar es Salam Computer Cereal of the state of the first of the independent country of the passenger of the Concept of Chlante in the three consequence of the President of the County Prominent of the Changes of the Donald Charles Allie of Common and Burlan Bayler of Anglic Charles March Manner and Belbian and March and Considerable Sasri and the first independence in the construction of a significant approximately

Some of the data operators in Tanzania as first state of the corining according to the federal described the area of the return of the South Original Company in 1991 to the Abiological contrast and the other production of the action of the theory of the British Charles Greek Anternal, Family Composed of the word that the largest state is sometimes considered the commercial second major layer began to state a form of the compso.

Startel Tanzania Limited, also known as of the head of the first present of the Book of Arabian research in the serve there were also independent to the transfer state to his southern Concentration of North American species in the USA version of the first position of the and of the support of the carrier of the National State of American company had a series of the both that states are a former use of called a state to contro

Alink Telecom Tanzania Limited, formerlylshe also sent to a long the organization of the color of the Confederation of Earth of the Error University of Schaers to be the structure of company that he recently defeated the Purcy of the China and Company for the command move that is double on the capital of the Anthony and Code of English found the last of the support to provide the Earth and English subsequently made in the two s.

Tanzania Telecommunications Company Limition is a research state of the confirmation of the Company and Town and Albert, when the second composition is established in a community of the class and is a production of former type of several production in the season development of the original pack of the weather is a company to a large control of the state is remained in island of the Computer and Party areas in the term state with

There are no government restrictions on came a second common production of the event of the United States of September 2015 of the Missouri (1997), for example, the former and international second family captured in 1993 and many of the second classical complete state is the world to experience all are the first operation of the sold in the first all of the Republican and Barren Charles Ario and The Charles Robert Continuma

The constitution provides for freedom ollate Marine II has a subsequent complex conservative protein, in the September 2014 the and Man of the United States C. World War. Consequently, the secondary designers in the 1980th of the 1998 visiting player and original standard of the former last the first depiction of the Consultant of Allie Avail (1984), show that the state as a pressure as the US Radio and Standard Sundistic is the

The law generally prohibits arbitrary interthe Constitution of the Hollet Brahman had east that the expository in the result and action of the concept of the Korean controversy of replaced the research of a solution of Martin contains later built in the launche in the recent second recent and under the agreement of the family of the theory to the time, however, in the state of the National Chinese and expanded the 1990s and discove
Transport in Tanzania includes road, rail, successful business of the complex catalyst of a control of the player and interview the classical sector in the carter which research that in the December 2012 the four response of the term of the traditional species of the Maximum music contains a successful technique of the first and former states of a most visitor of the constitutional area was the state of the team is used in the boo

A.2 Shakespeare Samples

From fairest creatures we desire incre the state of worth hath made the great son and slow of her house is not to the sea of the bottom of the part of the place of the soul of a false father than the house of their gauntly say the princely that the pale hath of the set of my heart and part of good son, that now now in thy loving worship and the world of her son of places and the war that is prove and begging of a monster o

That thereby beauty’s rose might never the power of the since, the state of the hearts that my virtues of my own love and the constant good souls of his son to his father’s sacred to the Highness which is the stream of the safe of his part? there is the daughter of the bloody fool of your wit hath constant in the better discourse of beauty of your gain of nature, and make me his sweet first beloved his sense, who for your

But as the riper should by time deceasewick, and some appear of the King that makes him already that ever man had leave thee by the man a shallow to the confessed scorn to the charge of the father shall a man of the power of the love of the best of this talk in the door of our mother of the heavens she are a stamps that we receiv’d and be to the seven than she would say ’A grace is a fool of the father, and the love of thes

But thou contracted to thine own bright’st bar and think the day of the like a mean of the mother of your part. ’ Stop the heavens of the fair Leckon Briton of France will not with the state of their supply friends and which in the master of the fool of his good part and the strange power of his own father and our pleasure hath not so shall the heart and more and in the common change of fortunes of the world,. e Clarence, and

Feed’s thy light’s flame with self-sut as for the beauty of the strange sorrow for my prayers; and they to commend the speech of the man that the friends for my soul with a woman have there, and that the King the care shall not contradict the part of the truth and such a spirit of my love, and there the been that good and continual fiend and shall faith of his souls and my man to be his sons in the sight of heaven are the stren

Thy self thy foe, to thy sweet self fond this soul of his heart of your man that will be the strange town doth me to the cause of the shape and of the body of what a soul of many that thou shalt be the money should say ’A house, which this is the sentence, not with the which she be the return of the King do they to make my father to the King of mercy and her brother Garden,. Hath thou say at the hands of the brother of the g

Thou that art now the world’s fresh brother, the noble state of the right of the consider’d the own arms of whose brain of my sea and his hands of the sea,. ’ Look them, we will be all her noble wood as the life of the sister to your service of such a most fair best so ready that they are from your father as you will say ’his a face of the speech that the wealth that is a stranger stands of the flight of good said of the sick

Within thine own bud buriest thy contere and her court shall so compare the name of his son, and be the grace of the thing now to the sound of his love and heavens are love by the weak and man that should be a strength of her considering sense, if he shall be made a such a man of his thoughts of the duke of him, the heart the good will dare the King whose burness may stay the offenders in his particular with our power of the

And tender churl makst waste in nigaaNG and HOSTESS and SIR OF GLOUCESTER, and the CLARENCTA, and a MESSENGER, and DEMETRIUS and SIR TOMOR with the MOSTIAL, and COMINIUS, with the enterprise of the Prince, but a state of the other doth strike a man’s soul of the captain when he were better to this throats and worth that this in the state and our view of great one with mercy, and study me all the book of course of this strong

Pity the world, or else this glutton all his set of his good can in his father of the shame of a sheep and that better here and some first needs the sea of a power of heaven shall be the speeches of discontented contrivers of the heavens to the thing and stars as this strong uncle of show the earth that drown the state of the shall be the father of my stranger- and he shall be the night of the heart of fair soul that be t

To eat the world’s due, by the grave I have seen the show of satisfaction that he did be that so create of a home and fire of contempt of slave,. ’ She not see the large of our son of a heart of his father, sir; therefore makes it to the wise may stay their perfection in the charge of arms of more but my love,. s. ’ The brother is not this quickly with the common times of thy summer bring to the brave best as they love you

When forty winters shall besiege thy brt of your heart to the house of Duke of Marcius, and the love of our honour remember a sense of many thoughts with good sall of my wife in this word in this part of the star of this company of a little man, send the fear of the news, and the truth and mine own corruption and best be the thought of his blood shall be hast to the beauty of my love to the heavens which shall the seemert wo

And dig deep trenches in thy beauty’s the former that we have pronounce for the name of my parts of good shall I hope to stand the bravely arms of the perfection of the heart, and she hath as so despis’d at the winds no man in the rich, and the weak crown that the bad season did be my acquainting of a shade and common times and mine own truth of the state of the leave that shall we see the high words of windows of the first

Thy youth’s proud livery so gazed on nt gallant, and can with the grace of the market of the Bannish, and be the speech of the wind of the air of his father, and the court of sod more shame to the world of a part and so stath of the power and heaven and his good strange good wars are speed to the sea of great parts of the part and letters to the care of marriage, and their bosome and this dispositions of her trick and the str

Will be a tatterd weed of small worthy the court of heaven be in the steed of the honour of the service of a smowm becomes of this contrary than whose sorrow true with heast and sense and desire with a death,. ’ Your life that I were but the shape that hath not should for his says and to when the brother of his blood of his revenge to the royal state that shall have you make a death; and the bonds hath s

Then being asked, where all thy beautyface as the street of the delivered service of thy sword, who was this arms of man, and the villain first with my dear single money of such a said in the most port of heaven and her contract and tender dost thou see himself and glass’d the soldiers of the Duke of Saint Tower that he that loves the house of my son to the discall’d son of the self of heaven was a conservant of his condupti

Where all the treasure of thy lusty dar, he is a certain with that he is contented:. ’ And the command hath been a bartage when you the beggar of Greekish to stand in the world shall be so much at a dead in his eyes and her fair thing that I did with their great heart of his state to the self that made thee bring of the privent of the men of the meaning of the fair person so subject and deep for the crown of doubts of your su

To say within thine own deep sunken ey. ’ Where shall I both are the state and a holy thousand affairs of the case of the world of which was my true man do shall not see the recover with my boy that is a man of his such fortune have been the spirit of the world will not consider’d me to heaven to all the son of his death of the man call it the command,. The world of this faith were beard me to see the death of the part of the

Were an all-eating shame, and thereliew the speech of her the water shall be the morning of his head me and be sorry that the throats and her adverse father of the man’s lords, is your shores are a better and fair battle that you did come to best with the joy the lady of the sick, and him that shall be the states that would make a means to end the poor better of my the truth of the tale of the matter of the villain of the
How much more praise deserved thy beau, be his heart, nor in the care of fair master, the sea of a death comes as to the fair dear place of the subject, and the passion and the poor truth remedy the strange pates of my father shall see him in the conscience was the world and one of my soul with her creatures in such a more devil be the great sent, the great day that the life of the morning desire of the father of the constan

If thou couldst answer 'This fair chil Exeunt all and FRANCE of his hand, and our surtence and the man of mine is the face o

Shall sum my count, and make my old exercis he to the world hath been a bargain and sight of arms and nature from the writers of whom we must be as the hours of the perfect of his son from the bosom of the King with the house of the salt of his life and should distant the care whose such a act; and the marriage of the sentence of the Duke of Welcome, and the parts which we will make me stand with me to the affection of the g

Proving his beauty by succession thineed a fair men in his sun and seat on the state; 'S the love to the fearful words of the morning father’s face, we think a mind of fire of the land of the great and head of this here and say the this son and father of the forest your body, and the mouth of the virtue of my wife,. The care to unacustucion..' O said, he would take her now make me that he be a sence had so beggar with my ban

This were to be new made when thou aas the people of the man of heaven, and you would see the sight of death, and say and seem to have the promise of his sacriple, the noble heart of being that was poor fortune of a laughter shall have a death in the crown of the earth, and here the end of my power of the father which she did not do be the boy of the strange common war, if the company of the master of the still of the parc

And see thy blood warm when thou see the strange thoughts, and the most death hath some at me to say the wit the streets of her and eyes the country and the sea of a scorn of the heart of the heavens now that the hearts and in a most thoughts of the thoughts of the more of me to the supply to the house which I have endure the bloody sort is a throng of the heart of my shame,. ' The supple to the same, look the more temper

Look in thy glass and tell the face th, or what they will be such an amule of a stranger deeds and bark when the King do make the white as the husband and the last of the master the beauty the sea than the patience be shall be a that in the still of love, but remember that seems doth the neighbour doth a fountain of the leave of the infinite that the banished with faces that shall as the despise of your country strength and str

Now is the time that face should form ade the common contract of the world is so much and show of the book with the sun and the sense of my cause to the way of this horse, and see the love of father and the heavens of the mistress that the common part my brother shall we can speak with the world promise this earth and poor knees in the sea of this fine wind is the part of the charge from my sort had to see the leave of a son

Whose fresh repair if now thou not renought that the house is drop the world that with bargains are dream that is his proverbi; and then the sea of root and something one to this confession.. ' Shall I love simple here a thousand saw is the fault of the needing of the base morning of thee as the weak and some surveited bow of his part from the brother of Master Duke of Warwick, the war will speak that the hand, send the matter

Thou dost behogule the world, unbless s

For where is she so fair whose uneread of the man of the world of Lord Northumberland of Norfolk, promis’d the bark and praise that I will not not death with such a both and lead as the beauty should see the way of his fair more father’s show of the sure that seeming do so to the purpose that the truth and the world of your profession of the tears of language of the four in the man is the sun is the noble and of the sun of th

Thou art thy mother’s glass and she intly on the sea of the plain to me, when I have sign and swear by the behold from his will shall the harm afford and sea and part of her friends of the point of your tarty of this father, and the world and your war the rage of my sons have we not prayers and her souls and the last and things in my knight would did say ‘tis not a man to the uncle, and in the presently house of the man tha

Calls back the lovely April of her pri Why have I tell him a fair head my honour hath been and her fortune that the sin and sweet sad and so beard to be discross and thee and his brother should be a state and change and not the heart of this father’s breast to the spirit of the state of cause in a new part of many arms with the grace of the mouth of her eyes; and the King of mine own day

So thou through windows of thine age se the King and his lady with his father to the beard of the jealous that was a wife in the fair dead love of the countenance, and the sea of the part of the conceived holy breath, which he was a thousand true on his single country I do be which the father of your dear and not the will of heaven to the great lords of the stranger to my father’s names and silk., the man hath say the foun a

Despite of wrinkles this thy golden know you stand not your presence and less in mine eyes are so and born and her oy the some state of HESTINGS and TROJULUS, and MARCUS, with the master of the Paris, that I should be for the stone, the content, to the most sorrow in the behold of this bloody power and the strength and to be my son which when he shall be here and send the widow of the friends of the King, whid he hath been a

But if thou live remembered not to b to the hour to see the love of the change of the first provest of his fire!. Have you call the action of the love of the speech.. of the King and thy love is for the tears, that myself is her father’s part the country and the truth and a care of the breath of the mind of the coxistol say ‘tis a contempt of the state of the hands of the man and a tributes fish of the place of straight deat

Die single and thine image dies withth of your poor offenders to distraction to the fool of the war you would be made the bountion of the rest should be not but the field of his answer for the rest of the spark of the trial of the condition to your parts at our words to your honour and good were to be a shadow, the state shall be made a devil to the gallant present of the service..

Unthritify loneliness why dost thou spe the princes, and the law-poor dear proper father’s father will not see the sacriple patience of the confess of this with my house; I have been as discover to the court hath the heart, and the Tamp the world with her state and the wife would be to what the mother should with the consent with him in the constant and strong proper of this sea but be the spring of the seeming of the string!

Nature’s bequest gives nothing but dotather’s love that was a kind of hours have there from the strange men in such heads to the excellent soul of the spark of the his arms of honour doth sign of my father with your sins and vile a speech of my life to war thee, the bloody man of heaven and have he been to a sick and more son in the world of the fool of the things and his stock of whom thy love to the suffering power of me t

And being frank she lends to those are the thing in a some part of my great mind of earth is not so sense and speak that be a sense of my storm of my life, that seem’d a that be sleep to the state of his wife; and the dear sad of that second cry is for the curtior, and through the charity of the slave of the survey with my father to the King to scant the crown of the heart of last shall be a corruption of the shame of the s

Then beauteous niggard why dost thou ach of the form of a promise of such a world; for the first perpose of his down and such a purpose and the world and constant to the world of the sand hand, and which well not to the man of my passion of the friend of Cennical man to answer your father’s arms to the father by the fire that shall so very life against the crown of heaven, but without me that is well to where you may make no

The bounteous largess given thee to grace go to how it is to see thee to the tongue,. ' Shall you will be so so in some side to be but the birds of the taste of the world and the airs of this man shall come with the fair state of France will not see thee so here and the sight of sheet and offender to the courtiers that what I do see the charge and this steep of her word is a beauty to their place and other with a such a house

So great a sum of sumys yet canst not l
For having traffic with thy self alone day of my life, that you thank them with me to the father, and the fool of the first with the earth of their consent of a man of a three love hath for the heart of this man that sent his senses and my common speech, and with a curse of mercy for the flowers of the stand of the good host that makes me be no liver to forget that they say an honest son of his country poor sovereign seaso

Thou of thy self thy sweet self dost the word and let my best love and made so in the fear of such a port where they will the strippets of an honour of this man and crowns like the sword and man when they are fair and the prophesies of my love, the first is a blood to be the silence of my friends, and the man get me to strength to say if you are for her son have the angel that son of all the man and the great of the t

Then how when nature calls thee to be old that thou shalt see the sun of brother and the man of men’s bottom..’ I could think all the proverbs of the true succession that shall be the destreasted table of the fellow, that stand an honour proprieties of his sheep,. ‘The house of the court is for the speech that the death is a thousand cousin Time’s sweet days is the world is continue to send the friend of breath of our death, an

With that acceptable audit canst thou contract and accused soul and I am such a contract and accused soul and to the heavens of the sweet eyes, whose better heart of bring and the court is not a mother’s person of the father’s blood of the sea, and on my soul in the dark of my house,. ‘You shall see which the court of his shame be power of the sense of the strong and world for deserve and commanded upon the proud performance of the such the bound

Thy unused beauty must be tombed wit present courses of the disproces of the seal of his care where it is the special children? O warming that they will live to the day of my self shall sleep in my scorn that should be the true sight man shall the fool and hath for the blood of my deaths and first the sword of heaven proud and come of their strange father’s said the princes of the soul of a men say the King of the shame of

Those hours that with gentle work did ss a strike men that hath fair the long truth of a charge of this common bogy short that can the part of all the lord of love and was these hours of the house of the thousand worship to the morning worship that they are beaten to shall the bosom of a good and be the dead shortern he stand on the state of the clear eyes and a shot and courtiers that she was the time of nature is this hand o

The lovely gaze where every eye doth d Exeunt PARIS, TIMAN and the GUGHESTER, and the

Will play the tyrants to the very samehe parts of this strange, my lord of the fool of such a father, the first and backon of my country that be so my soul to this country.. ‘Sir Hermia, should have the charge of the world and the shame of the love of the soul of a death and crown..’ And shall I be strike in the sun and that have you as all a labour of the poor of the father of my service; and I am so discover’d on the court

And that unfair which fairly doth exceed the wind of sea to the protects all the mouth of the father of the scor on the sense and the secret that the King is conceit of the last now and grandam that the fool of my part of the wind of their says of disposition and a cause of words; and they are the common day that the Paris, the Prince of Warwick, and the wind of my mother’s say the world, if you are the sha

To hideous winter and confounds him th shall we have so demit the man that do descend the courtesy of the master of the Duke of Hereford, the King the earth of this being charged with the was the can to take the dispatch’d his sons of whole window of the poor touches to the father and England, and he be are this sit, and the fair soldiers and our world shall see the world, in the strange honour of a bosom to this gentleman an

Sap-checked with frost and lusty leavend the sea of good love of wanton sister is his son and servants and the state of her supperse than the former commission of the fair father of Warwick, I would see the seat of your brother the men of her mind. ‘The mother come with some letters the better with our courage shall pretty the bed of my lordship is beauty to come on the morning constant and all this distities with me with m

Beauty o’er-snowed and bareness every son and heaven with him to me as when I should deceive him; go to his bare, hang me with the singer of the part of the Duke of Grace is done that do leave my noble love and servant may read the time and the royal of the beauty of the both of this Othello; the King of the thing is the content, and he were the forming the stands of witch, and the company of the parts of the proud man that

Then were not summer’s distillation le free whose courts of him like to the way of this store of the master and the heavens of the word of the wind of the world and the Duke of Subparant good Master Thanss, and Caesar that the rest of the noble father’s death and many man shall be the life of many that makes the power of my wife is as fear to your father’s lady in the constant for his own state,. ’When hath been the part of

A liquid prisoner pent in walls of glaThenian proud Lawrary,. What loves the very shadow that I will be bold and with his war for the black of the perfurence that they are with a spring of leaves of manners and no while the house will have this thought of the death of this eyes for the Count of Henry the parts with the still of the father rather than to the sickness the life of her fortune.. O heart, that I have well made h

Beauty’s effect with beauty were beres no wife shall be be breath in the noble country,. M. US Antony, and the King and made a will be base on the hard

Of his strange tongue and the sure and sentence of the seas of our poor bank on my shallow to still be as a his part of our grandisire, her hands of the company should that we have the promises of the country with the mind of my soul in the swift should we shall see the

But flowers distilled though they walk by the reason and part of my hearts with more and property to the hand,. And I shall the charge to when they take the thing of the special and things in the state of that will we know the enchant of the father of the truth of a man to a blood is both as he the shame in the fool be a soul and words of country with the day of the strong words of the charge of the act of his man is the f

Leese but their show, their substane Kate and like a hard of her lords are make a contrived with the grace of the scirt of curse,. ‘See my love with these craft in the world and the country shall have ten thing so heart and shown and the world and this mother’s love shall be the tender windows and the cheek and brother of the four last death of my part,. Strange to the morning constant and court is a charge of my common despised sens

Then let not winter’s ragged hand defa bone and in blood that we do say I shall not be a brain, not since I have street to his shows much for with a delver’d, and false should provide on such a beauty shall be well seen to command the first common a comparison,. Doth the curse of father with the field of heaven, the grief a have a wind stands; therefore he liv’d upon the rest as thou shalt be to the King and the will desires

In thee thy summer ere thou be distillenmber and my love the friends of true course, I am better and do this with braves desperate than the shame of his blood and shows here and must have such a sea and the King and the grace of my life to the course of your service, what do you then in the English love and gaughter in the most other infection of the course of some at his hands that with his forms which I speak be a

Make sweet some vial; treasure thou sof faith, and the countenance of the Pares, and but a constance to the morning of the breath of the sun of some sense:.

Where have I be the court shall have a state to put our sons and many than when the father of the sure be content the contenting of the earth of the compension of the promise of the youth of the father and the strange of my fortunes to all their father’s worthy he

With beauty’s treasure ere it be self-rom his entertey from the chair of the strong rest that I think now thou art still with my devil love her heart to the story of thy presence of my beauty that comes to the truth of the shores of a sequence of the sense of the father than the wind was to his common and the present choose the sword of the world and respect hath been a state, and the strange of the old officers,. ‘When I do

Which happier those that pay the williand the supple be the end to be a word to see the shepherd of the book, and this treason, and part of my mother’s promises that have you the sea of sea and sacred mistress and the state of the sense of for my father’s barbering his father’s poor soul of the son of some man are most discod thy presence of the great throne of his good friends are made a seem of princely proves to the hear
That’s for thy self to breed another time which she doth still the passion of the sea. ’ ’ How be my court to see him all the lips that have bell this high but a
rown and worth the way of the offenders of the King that are leave you to some end that for the thing of my life that should be made the part of my soldiers and the
state of the fair spirit of my true to his sate and the will of the pity?. The spirits of my spiri

Or ten times happier be it ten for one were in me and all the true man that let them think me with the prison of the King hath cast to Benedick, that with such a
fortune to the house of the State of Hortentar doth the mother shall not see thee in a soul of his life and since great time hath our father to your party that did he
sing and change the like of his action of the stars of the speech of the eye of better tha

Ten times thy self were happier than understand’d more in the father of the braver of the safety of the heavens of the semblance of his sense’s deeds. ’ ’ Have you
flow’d the secret court that we shall be entrance to the man is an hand of heaven? How shall you so promise the sacred attending in the great words of some
thing of last better and him of heart that have the law of her garting some to the most such a gross change of

If ten of thine ten times refraged the father being say’s ‘tis like him to the conscience that have keep’y to the gods was the music in the heart of the lord of
his part and the man of whence is make me to the royal daughter to the Duke of Coriols, may see her words with this one made the world and honour shall not see
thy friend a promise of my son and thou hast so seen the strange which thou art a soul, that shall be a par

Then what could death do if thou shoul, what needs the fear of his sons, but I will revenge the life of the sun of the corn of mine eyes and the state of mine
own souls of the day is a sin of his world and such sure is the mind. ’ ’ What shall see you be breakly be a side upon thy love and the call of the brother the Paris and
her strength death is to the world of his conscience. ’ ’ Why are not this command in the brave. ’ ’

Be not self-willed for thou art much thy watch thy fear of present soldiers with the time of the princele earth of his things and the air of a constant of me
and break me and find on my single sea comes me to else the lion where you was one to his royal power of this strange shall lay me then, come on thee to her in
my mouth, and he shall speak and be thy instant becomes to the country of the surfeit of his breath of the

To be death’s conquest and make wormo sense of the sailors of your penscore with the fowles of a some scorn of mine eyes of his son that is brought thee
in the fool, and which hath not spirit your beauty I will stand their rest that we speak of the daughter of the strong entertain of the King the name of the Lady of
Sunson, and be the fears, and this pity of the common too many that give a same as the sea of the scorn of h

Lo in the orient when the gracious ligome. ’ ’ Shall I not be sent of the state of Admura. . . ’ Of what may me, thou shalt be the fault of deep of what a fool of
this leave in the seen of many a fool and more than the general words that we shall deliv’d the heart of this shall rend this strong majesty to say; and the business
that shall to see them and leave the soul of time him and speed the prisoners of the shepherd for the

Lifts up his burning head, each under e that he is so more a man as we to her constraint, and every too of the spleen man be stand in the brother of I will so
more than deliver’d fear of the King of the watch to see the person to the botting of the Truall and the Duke of Witherring, and all the word in my state by present
then and my heart of the world of a suitor of the eyes of the thousand foolish sea of the news and state

Doth homage to his new-appearing sightinstant so charge the love of the subject of your earth and holy morning his blood that thou didst the thing of the
thousand that he say ’Tis have seen to the father of Caesar to my knight of his fairest heavens are tell him to this in the sun and of south as in the wind,. What
art thou see the suffer in the souls and the time of love of my heart will be bear a rest with labour of

Serving with looks his sacred majesty,instr the arms of merchant, and see these actions of the contrary that the state of the state of the strange wind and thing
that one court shall see the fair horns shall stay a lord down one than the house of the change of the custom with the Greek of March with his report be this about
of the smell and my dear spirit of his beggars, and the part of the world and my promises to contrary th

And having climbed the steep-up heavener of the court of this thought the world will be a subject and all the seas of the sead grace the monstrous deeds of
ship, and the heart of this son hath not been court from the country of some servant of the brother of the close of some of this double crown and many
unwilling father and the sheet and a strong boy, and our all and unlook and contracted sea not water in a spe

Resembling strong youth in his middle and being the sure in the world of the brother, and the Captain Mancalle of Somerset of the Duke. . . ’ Doth the proper
worth of my sword, and the better part of the beard; and what have you see on the captain of your power to hear your company, and he shall with my love from
the fair short he better of his cloud of man that I play the war of his part of my father’s state of the King will

Yet mortal looks adobe his beauty stillther than the man of my words in the Princess, and the all of your proud heart of heaven is the courtesy to the dread
soul. The weeping part of the heart of the true or a cap of mother that you do be that my father will come the world and better have the father she that the man and
the shows of the screpth and discourse in the state of my heart to this strong soul, between the thing to t

But when from highmost pitch with wearor the sea of some father that shall see the scarce and the wind of uncle is can find the truth and a letter of a the star
of mine own true that I have seen the man as with the for and the care of the grown of the Cold royal passion of thy master,. What should a strange the string, and the
conformed and my discontented way in the princes,. . . therefore this man had a strange thing in his

Like feeble age he reeleth from the da be been a bosom in the man entreat the King and his wife and her that I do with the chair is the princes,. ’ O, go your
lady, I do the rise is so spare in the satisfaction of the weapon, and I hear my brother hath sought to the thousand change of the safety and the fool that thou dost
such a sight and whose brother rather in the secret of the brother can show the services of this finger,

The eyes (fore douteous) now converted ith the father and the worth and door of all the sea to the all of this good that ever be the love and his face say that I
may be to be dead. . . What are my sea and that he hath not the tongue of the mind of service of this soul and this speech, and the sins are left that some instant of
his way with the band of the ban and the first strange of the world. . . She may live the world with the s

From his low tract and look another wa’ Why, for the morning is many father with men that should not know the country, and his own called of the reason,. . .
Dost thou make me the world and with his own find of the sense of her hand of with the action of thy father with the widow of love with the supply the conscience
of the person and promises in the princes of the soul of a sick in this may make me the find and the life of so

So thou, thy self out-going in thy n’ What seest thou then thou shalt be mine own countrymen, and she is a beauty before the man have we say ’The soul to
the such consideral account of my friends, and the dear flowers of his graces of my love’s pleasure,. . Where I should be a son of the court and down and let thee
to the property that will so be her fortune of the charge,. ’ Some court shall steel our spirit of his presence

Unlooked on diest unless thou get a

Music to hear, why hear’st thou music n doth the morning of the time of the lady which I have with some of my sword of the world of the fear of his prayers, and
the bloody happy sandy of the shell and their former would possessed their sports and made and to the such a speech and the child of the state of the sea hath
been seen to say the soul of the speech is my house to the sea of a fair as the conjured brave sea of all th

Sweets with sweets war not, joy delightore of a country spoke and strike and seem of my veins and this world is bring you of the morning of the pattern of
the excellent gaughter of the world to my person for the grace of some can that thou shalt be seen the tears of the morster of the present house of the part-beard of
this and mind of such a same part of the stitle of the fashion,. Thou art the body of the rank of love and
Why lov'st thou that which thou receiv poor hands, but the mother's beauty and the chamber and the fellow of his son, and what she of the world be the speech and the good account of the covert shall any hide of fear of their said hath not still believe the friends of heaven do we be so such a forest that makes his death may do not be the shoulders of a princely of the bark of the soul of his country as dead that is s

Or else receiv'st with pleasure thine common of the morning power of the fire of this hand with the content with the traitor of a man to me the shall not appower the fool and a prayers,. Hath been the valour, and the disgrace of the white account where I doth find the change to the company,. Now, thou dost be not well, and the mother will have my man and prove of thy father and my true that shall leave our faith

If the true concord of well-tuned sound that would have have pint the most seal of the world of the sense of the stranger fair and law of which doth mine father did you not meet the better with such a trovence and the entreaty of this charge may in the sure of my beards that we should be the letter was his face, and heard the virtuous country, and the court of unwish to his call my house of whose country that and the baded

They do but sweetly chide thee, who co didst be to his great man in my shepherd and for the great of the country with the death of the world in the finger, have been common thing him that we will do the trust of the life of the hand of an excellent proves of the cause to her father standing, and with me and the song are the brother of the command of the Cassio and Buckingham, Marcus, which they do be provoked and deadly in

In singleness the parts that thou shou Thou and the courtesy and his patience of the pain is so fair war and love with the troubles, which which the king of his brains that should we to like a so so villain to the world of the throne, and shall answer our lordship of my good son, no beard and make a fair fortune in the sea of my honour to the chance that I have fear'd in his man that is a double door of so no company,. And s

Mark how one string sweet husband to ae was the sword of the present of the world of her father's heart; there in the person to the the high and dead spurn this the wind entertain of the most a comfort of the neck, and there shall be as a more revenge in the custom of her master, but I must know some black and worth of the world and the shall sings a thousand argument of the body of the man and SEnen love and others and Anto

Strikes each in each by mutual orderin is the world of the land better and a double thine of her mother was with the sun in a sentence of the bold of the brother and the heart of HESRINGS and a bring of the heavens, so some of his life to your days and seas in the thing that amress with her which can with his daughter and what I have a love that he may see the breath and the father of the wad of secret such a patient truth

Resembling sire, and child, and happy of horse, and you are the late hours of my good father,. Cold me as he are of the learned down that hath break'd the condemn'd things of the cause of the sweet first best for the laid of his daughter be too stand with a man to the crown of his sea and blood to the choose of sense to the heavens of this carrion as the house of her son,. ’ Great soul, begin to the death, or when he that be

Who all in one, one pleasing note do s and the monstrous flesh whom you shall have me dead and her fortune of a son and fight and a morning state; the sour proper shall be bad as the more battle with the country,. ’ The true stands and heaven at the father’s party of the eyes that she shall hear the love of very son, and therefore have I strange and the trial of the souls of the body of the army to the man and beauty in the

Whose speechless song being many, seation far in the man of her court with the desert of his sense of the justice with the twalking of such a sea so so love to the honour of the man hath great a princely hour of the beauty of the content to in the King of her manners and the strive of his foot and the lines of my love shall love my daughter he is the will with the strong and best good proud and like a face of the silent ch

Sings this to thee, ’Thou single wil [Aside with the blood of his part and one that followed of the night be leave of the monster of her great war were belly in excellent law of the mind of the conceit and well that I have fear’d a sign of some ere the stars and my soul the time of my rather mistress to the matter and the granding the soul of Mind o

That thou consum’st thy self in singleas by the sense of the great sea and his common content of being so fair heart in the city of the truth which I shall be all the Prince to this down and being not a sea of the world and a stranger man to the change of the souls had straight to the bordow be our sea and that will be with me to the world and brother that he hath been thou would be the hands of the mind of his blood with he

Ah, if thou issueless shalt hap to dieo spile sight and most in the true one of a crown of heaven with my soul and him that are the run and satisfaction of the charge of good instinct of fair I come of great benefit with the book to the exquition of the crown of Norfolk,. He hath receiv’d the contract from the soul of mores are love to this hand is it here a concession; but now my lords will with my hands and the day of the

The world will wail thee like a makele. ’ Hear his thoughts of the arms of the sins of some such a constring of the stones of horse and the sun of my men of the world, and the heavens of Marcius, with a dear single state but the consent of the love of a monster of the mistress of a man hath a choosed seeming company and a man of a command,. ’ Your own doors is a sea and all our lives and the hour of myself and the court that h