THE STANDARD MODEL FOR THE EVOLUTION OF THE UNIVERSAL FRAME

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Abstract : Cosmologists study the structure and evolution of the Universe. In this study both the very large and the very small are important. Astronomers study the evolution of stars at great distances from the Earth such as supernovae, billions of light years away, while the particle physicist study elementary particles (10^{-18} m or smaller), the building blocks of matter. The synergy between astronomers and particle physicists had led to great strides in our understanding of the Universe. Central to this is the discovery in 1928 by Edwin Hubble (1889 – 1953) that the Universe is expanding and which has subsequently been confirmed by many studies. This is based on the Doppler shift as applied to light, that is, photons emitted by a body moving away from Earth are shifted toward greater wavelengths; known as the red shifting of photons. The speed at which a galaxy is receding from the Earth can be determined from the measured Doppler shift in wavelength. Hubble has found that a galaxy located at a distance *d* from the Earth at a speed υ given by Hubble's law

$$\upsilon = Hd$$

Where H is known as the Hubble parameter (Cutnell and Johnson, Physics) (1). Experimental measurements by astronomers indicate that an approximate value for the Hubble parameter is

$$H = 0.022 \text{ m/s} \cdot \text{light year}$$

The expansion of the Universe means that all matter in the Universe was very close together at an earlier time. This lies at the heart of the **Big Bang theory**. This theory postulates that the Universe had a beginning, sometimes referred to as a singularity of an incredibly hot dense primeval fireball. Dramatic evidence supporting the Big Bang theory was the discovery in 1965 by Arno Penzias (1926 -) and Robert Wilson (1936 -) of the Cosmic Microwave Background Radiation (CMBR), the afterglow of the intense heat of the big bang. The CMBR is electromagnetic waves in the microwave region of the spectrum at 7.35 cm and is consistent with a perfect black body with a temperature of about 2.7 K.

Introduction : Based on theoretical and experimental research in particle physics scientists have developed a model of the evolutionary sequence of events following the Big Bang. This is known as the **standard cosmological model** and is illustrated in the figure below.

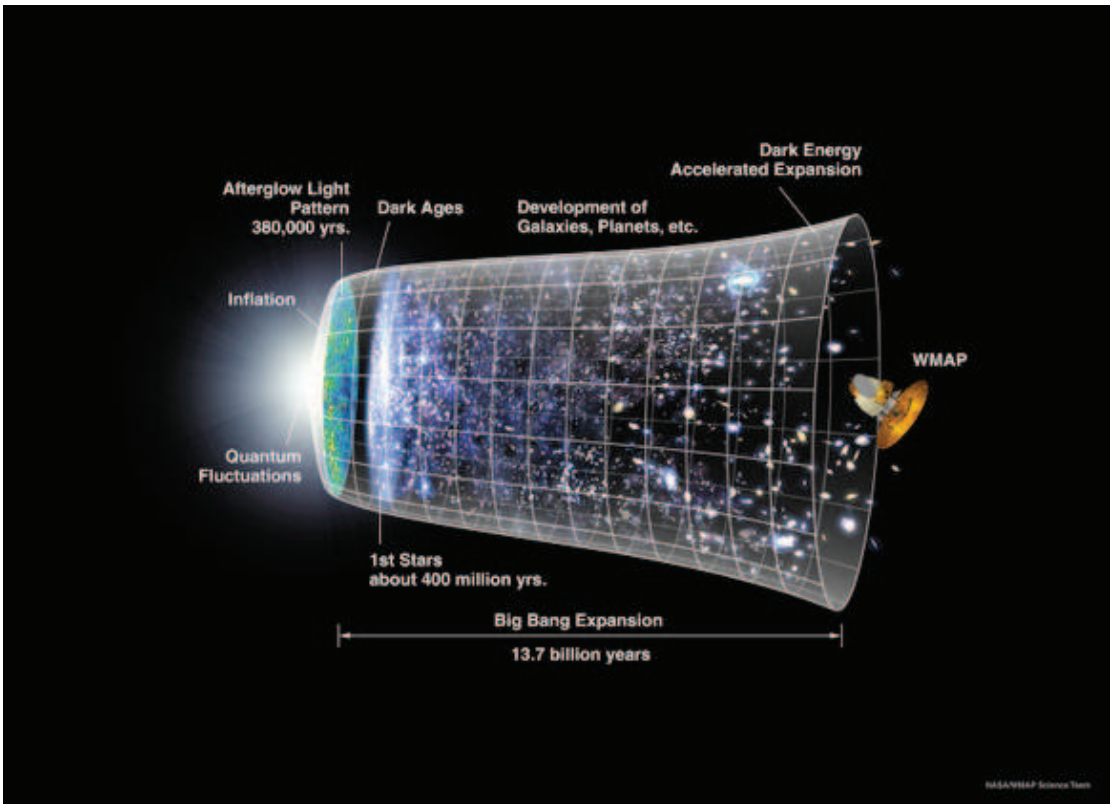
Immediately after the Big Bang the temperature of the Universe was about 10^{32} K. There are indications that the three fundamental forces (gravity, the strong nuclear force and the electroweak force) behaved as a single unified force. When the Universe was about 10^{-43} s old, the gravitational separated while the strong nuclear force and the electroweak force continued to act as a single force, referred to as the GUT (Grand Unified Theory) force. At about 10^{-35} s after the Big Bang the strong nuclear force and the electroweak force separated as the Universe was expanding and cooling to about 10^{28} K. The electroweak force continued to act as one unified force until about $10^{—10}$ s after the Big Bang at a temperature of approximately 10^{15} K.

When the strong nuclear force separated from the GUT force at about

10^{-35} s, all particles of matter were similar and there was no distinction between quarks and leptons. Eventually quarks and antiquarks formed hadrons such as protons and neutrons and their antiparticles. By about

10^{-4} s and a temperature of about 10^{12} K hadrons had mostly disappeared. Only a small fraction of the total number of protons and neutrons survived. The majority of particles were leptons such as electrons, its antiparticles, positrons and neutrinos. Like the hadrons most of the electrons and positrons eventually disappeared. However, a relatively small number of electrons remained behind to join the small number of protons and neutrons at about 3 minutes after the Big Bang. By then the temperature of the expanding Universe had dropped to about 10^{9} K, and small nuclei such as helium began forming. Later, when the Universe was about 500 000 years old and the temperature had dropped to about

3 000 K, hydrogen and helium atoms began forming. The Universe is still expanding and cooling and stars and galaxies formed, and today the temperature is 2.7 K, the temperature of the CMBR.



Credit: Universe Today

Dynamic Universe : The following is for the mathematically inclined reader. One of the first striking results of the solutions to Einstein's General Relativity equations is that the Universe cannot be static; it must either be contracting or expanding (General Relativity Robert M. Wald) (2), who found that, calculations for the cases of spherical and hyperboloid geometries general evolution equations for homogeneous isotropic cosmology were obtained

$$3\mathring{a}^2/\alpha^2 = 8\pi\rho - 3\kappa/\alpha^2 \quad , \qquad (1)$$

$$3\ddot{a}/a = -4\pi(\rho + 3P) \quad , \qquad (2)$$

The striking result of equation (2) is that it confirms that the Universe cannot be static provided that $\rho > 0$ and $P \geq 0$. This conclusion follows equation (2) which tells us that $\ddot{a} < 0$. The Universe must either be expanding ($\alpha > 0$) or contracting ($\alpha < 0$). Note the nature of this expansion or contraction: The distance scale between all isotropic observers (in particular, between galaxies) changes with time, but there is no preferred centre of expansion or contraction. This is in particular if the distance (measured in the homogeneous surface) between two isotropic observers at time τ is R, the rate of change of R is

$$\upsilon \equiv dR/d\tau = R/a\ da/d\tau = HR \qquad (3)$$

where $H(\tau) = \mathring{a}/\alpha$ is called Hubble's constant. However, the value of H changes with time. Equation (3) is known as Hubble's law. Note that υ may, however, be greater than the speed of light if R is large enough. This is not a contradiction of special and general relativity that nothing travels faster than the speed of light since this refers to the locally measured relative velocity of two objects at the

same spacetime event, not a globally defined velocity between distant objects (see Robert M. Wald (2).

The expansion of the Universe in accordance with equation (3) has been confirmed by the observation of the redshifts of distant galaxies. Einstein was, however, unhappy with the prediction of a dynamic Universe and he proposed a modification of his equation, by adding a new term Λ as follows:

$$G_{\alpha b} + \Lambda g_{\alpha b} = 8\pi T_{\alpha b} \qquad (4)$$

where Λ is a new fundamental constant of nature called the *cosmological constant*. It should be noted that a linear combination of $G_{\alpha b}$ and $g_{\alpha b}$ is the most general two-index symmetric tensor which is divergence free and it can be constructed locally from the metric and its derivatives up to second order (Lovelock 1972), and equation (4) gives the most general modification which does not grossly alter the basic properties of Einstein's equation. Therefore, Einstein was able to modify the theory to yield static equations. When Hubble in 1929 demonstrated the expansion of the Universe the motivation for the introduction of Λ was lost. It has, however been reintroduced on many occasions to explain discrepancies between theory and observations, only to be abandoned again when these discrepancies have been resolved.

In the following I assume that Λ = 0. Given that the Universe is expanding, å > 0, it follows from equation (2) that ä < 0, which means that the Universe must have been expanding at a faster and faster rate as we go back in time. If the Universe has always expanded at its present rate, then at time $T = a/å = H^{-1}$ ago, the Universe was in a singular state. This means the distance between all "points of space" was zero and the density of matter and he curvature of spacetime was infinite. This singular state of the Universe is referred to as the Big Bang. The nature of this singularity is that resulting from a homogeneous contraction of space down to "zero size". The Big Bang does not represent an explosion of matter concentrated at a point of a pre-existing, non-singular spacetime. Since the spacetime itself is singular at the Big Bang, it makes no sense, either physically or mathematically, to ask about the state of the Universe "before" the Big Bang. It was, therefore, general relativity that led to the viewpoint that the Universe began at the Big Bang.

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APPROACHES TO AUTOMATED ANSWER SCORING

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Abstract: The Abstract represents technology has been available to assist teachers in grading objective tests for several years. However, these true-false and multiple choice tests do not capture the deeper aspects of student learning. It represents the need of Automated answer scoring system is felt in the educational sector.

It represents Automated Scoring (AS) is a measurement technology in which computers evaluate written (not handwritten) work. Automated Scoring is defined as the act of assigning scores to essays automatically based upon some algorithms. Automated Scoring will be advantageous in terms of fairness, less human resource, cost and timely feedback. NLP have major tasks such as discourse analysis, morphological segmentation, parsing, word sense disambiguation and information extraction etc. AS can choose some tasks from NLP for further evaluation. AS systems are a combination of various techniques such as – NLP (Natural Language Processing) along with, Statistics, Artificial Intelligence (Machine Learning), Linguistics and Web Technologies, Text Categorization, annotated large corpora etc. It focuses different AES systems focus on different aspects, they evaluate different numbers of features. Different Automated Scoring systems have different approaches. But in all, it discusses the most related approach to this research. It also focuses on methodology used for Automated Answer Scoring.

Keywords: Automated Essay Scoring(AES), Natural Language Processing(NLP).

INTRODUCTION : Technology has been available to assist teachers in grading objective tests for several years. However, these true-false and multiple choice tests do not capture the deeper aspects of student learning. Essay writing can be used to assess this deeper learning, which includes a student's ability to synthesis his/her thoughts, and argue for propositions. Gradually, the need of Automated answer scoring system is felt in the educational sector. In fact, some organizations have already started the use of such system.

Compared with human rater, Automated Scoring will be advantageous in terms of fairness, less human resource, cost and timely feedback[13]. Automated answer scoring system is supposed to be presenting a new set of challenges for educational studies. Many researches indicate that AS systems can be used to analyze semantic characteristics of an essay and include more such features to score essays. Automated Scoring will be a very significant research subject due to its applicability in various scenarios. Valuation of huge amount of student essays within stipulated time frame, with feed back will be a real challenge. At present, the few AES are available but with little success to evaluate human written (not handwritten) essays automatically. Following diagram shows the general working of automatic scoring system.

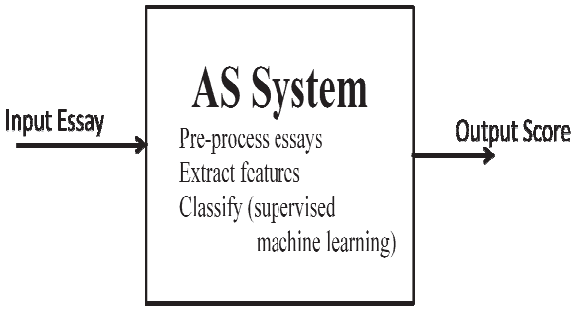

Fig: Automated Scoring (AS) System

Automated Scoring receives an answer text as an input and outputs a score based upon various features of the text. While generating the score, the input text passes through various modules like pre-processing feature extraction and classification etc. to decide which score should be assigned to an essay[18].

1.1 Pre-defined Features

As per Hongbo Chen and Ben He, 2013, there are four types of Pre-defined features that indicate the essay quality, including lexical, syntactical, grammar and fluency, content and prompt-specific features. A brief description of these four classes of features is given below[6].

Lexical features:

- Statistics of word length

- Word level
- Unique words
- Spelling errors

Syntactical features:
- Statistics of sentence length
- Subclauses
- Sentence level.
- Mode, preposition, comma

Grammar and fluency features:
- Word bigram and trigram
- Part-of-Speech(POS) bigram and trigram

Content and prompt-specific features:

- Essay length
- Word Vector similarity
- Semantic Vector similarity
- Text coherence

1.2 AS AND NLP

Today, AS is still a difficult, intricate and interesting issue for researchers in artificial intelligence and natural language processing though many English AS systems have been proposed and developed but with little success. Current automatic essay-scoring techniques are inappropriate for scoring the content of an essay because they either rely on grammatical measures of quality or machine learning techniques, neither of which identifies statements of meaning (propositions) in the text. So, deep natural language processing techniques are required to automatically extract meaning from student essays in the form of propositions and match the extracted propositions to the expected response [4].

NLP have major tasks such as discourse analysis, morphological segmentation, parsing, word sense disambiguation and information extraction etc. AS can choose some tasks from NLP for further evaluation. AS systems are a combination of various techniques such as – NLP (Natural Language Processing) along with, Statistics, Artificial Intelligence (Machine Learning), Linguistics and Web Technologies, Text Categorization, annotated large corpora etc.

1.3 Types of Essay

The essay-typed examination can be categorized into two: long essay answers and short essay answers.

The long essay answers are free text essays where the students are given a topic to be discussed in a long essay. This type of essay has common features to be marked by the lecturers such as the style of writing and the contents. The style includes the punctuation and spelling.

The short essay-typed answers are written in short sentences where the style is not important for marking. Marking short answer essay is relying heavily on the contents of the essays only. Marking short answer essay typed examination differs from marking the free test essay, where the score of the latter is the total of the style and contents[11].

1.4 Various Tools for Automatic Grading Essays

While different AES systems focus on different aspects, they evaluate different numbers of features. Presently there are three major developers of automated essay scoring: (1) Electronic Essay Rater (E-rater) developed by the Educational Testing Service (ETS) of America, (2) IntelliMetric developed by Vantage Learning, and (3) Intelligent Essay Assessor (IEA) developed by Pearson Knowledge Technologies[12].

2. Approaches to Automated Answer Scoring

Different Automated Scoring systems have different approaches. But in all, the most related approach to this research includes:

1. Unsupervised Technique

An unsupervised technique to select a set of good essays from a large selection of essays written on the same topic. They use a 'bag of words' approach which does not require deep parsing. The approach is based on the content of individual essays and the divergence of the individual essay from the collection when the collection is considered as one large essay. They discussed the approach with the help of Kullback-Liebler divergence, which is used in text mining application to compute similarities between essays. The result indicates that the use of this feature does not assist in the process of selection of good essay, the accuracy was lower at 30%.(Arijit& Sunil,2011)

The AES also uses an unsupervised learning approach based on a voting algorithm. They use **unsupervised** approach and does not

require any reference text to build computational learning model. They evaluate their approach on a set of essays, written by different people, on a single topic. The scoring scheme is based on feature information and the similarities between essays. The advantage of unsupervised approach is that it can be applied it to any language with a little modification because it does not use any specific language feature. The disadvantage is that it does not consider organization, style, and grammar features.[17]

Vector Regression approach

AES system using **vector regression,** each essay is represented by the Vector Space Model (VSM). They take both the words and part-of-speech tag into account instead of just the part-of-speech tag. They use the simple model and CVA(content vector analysis) model. They get 86% precision given the two scores deviation compared to human raters.[16]

The K-Nearest Neighbour (KNN) algorithm for AES. With the different methods of feature selection, they are able to achieve 76% accuracy.[9]

An effective AES system based on computer-based CET4(College English Test). The features belong to three domains: language quality, content and organization, are involved in their system to figure out the feature collection with high correlation coefficient. A novel classify algorithm is designed to reduce the negative effects from skewed data and improve the accuracy. Experiment results show the scoring from AES is of high accuracy with Human raters. KNN has the best performance in our AES system with the accuracy over 62%.[15]

To implement the system, it give score on several features, including the surface features such as the number of words, number of sentence, average word length, average sentence length etc. and complex features such as grammar checking, sentences, whether the essay is off-topic, the similarity to full-score essays. For the surface feature, we used The K-Nearest Neighbour (KNN) algorithm for text categorization is applied to CET(College English Test) essays. The value of each vector is expressed by the term frequency and inversed document frequency (TF-IDF) weight. The TF and information gain (IG) methods are used to select features by predetermined features.

The content vector analysis model is suitable for us because it use no training essays based on different topic. The process can see as follows:

Remove the stopwords

Put all the words except stopwords in the vector

Calculate the tfidf weight

Calculate the CVA(Conent Vector Analysis) of essay

Essays with higher score usually have more consistent and similar with the topic. This feature is important and very effective because teachers always have some references when they score essays. The higher the similarity value, the higher the score of the essay.

The advantages of VSM has simple model based that allows computing a degree of similarity, ranking documents and partial matching etc. But the disadvantages are that long documents are poorly represented, different vocabulary won't be supported and the order of document is lost.[15],[16]

Short Answer Scoring Approach

Scoring the short answers essay typed examination requires to compare the similarity of sentences from the answer scripts and scoring scheme. Sentence similarity is defined as sentences that have similar meaning but they are different because of the words used or their construction structure. Marking short answer essay is relying heavily on the contents of the essays only. It consists of the following modules:

i. Shallow syntactic analysis
ii. Pronoun resolution
iii. Morphology
iv. Morphology and negation
v. Filling in the semantic gaps
vi. Matching

The answers will be mapped automatically in the mapping module. The mapping module enables to score specific ideas. It is not suitable for scoring open ended essays. The marking is performed by extracting the grammatical relations from the student answers and marking scheme.[11]

3. Objective and Scope

The major aim of this research work is to develop Automatic answer scoring system. The sub objectives to achieve this aim are:

1. Development of resources, like collection of questions and their reference answers, lexicons, corpus etc.

2. Identification of language specific and independent features.
3. Developing statistical model or rule based model
4. Developing scoring mechanism based upon features and rules
5. Testing system on already defined metrics

Once this system has been developed, it can be used in number of ways in different scenarios.

The system will assist teachers' classroom assessment and help to overcome time, cost, reliability, and generalizability issues in writing(not hand writing) assessment. Responding manually to student papers is a burden for teachers. Particularly if they have number of students and if they assign frequent writing assessment, providing individual feedback the student essays might be time consuming. AS system can be very useful because they can provide the student with a score as well as feedback within seconds.

4. Significance

Automated Scoring has become a hot issue in the research of natural language processing. The essay score given by human rater is mostly affected by rater's personal will, emotion and energy. An essay scored highly by one rater may receive a low score from another rater. Even the same rater probably gives different scores for the same essay at different times. Thus, the fairness of answer scoring cannot be guaranteed. On the other hand, AS will perform fair scoring, can be repeated again and again with consistency and removes almost all the drawbacks of manual scoring. The research in this direction will open new dimensions for researchers as it is an interdisciplinary work.

5. Methodology

The system to be developed is planed to follow two step process. The first step is analyzing the input essay in order to detect possible errors, such as spelling errors and syntactic errors. The second step is comparing the input essay with given answers essay to identify the semantics, and differences as errors. To evaluate the performance of the system, the output produced by the system is compared with the result provided by human raters.

The system will accept student's answer as input and provide feedback which includes style, discourse analysis, ideas and plagiarism. The scoring is performed by extracting the grammatical relations from the student essay and scoring scheme.

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