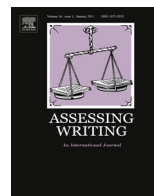




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Assessing Writing



A hierarchical classification approach to automated essay scoring



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ABSTRACT

This study evaluates the use of a hierarchical classification approach to automated assessment of essays. Automated essay scoring (AES) generally relies on machine learning techniques that compute essay scores using a set of text variables. Unlike previous studies that rely on regression models, this study computes essay scores using a hierarchical approach, analogous to an incremental algorithm for hierarchical classification. The corpus in this study consists of 1243 argumentative (persuasive) essays written on 14 different prompts, across 3 different grade levels (9th grade, 11th grade, college freshman), and four different time limits for writing or *temporal* conditions (untimed essays and essays written in 10, 15, and 25 minute increments). The features included in the analysis are computed using the automated tools, Coh-Metrix, the Writing Assessment Tool (WAT), and Linguistic Inquiry and Word Count (LIWC). Overall, the models developed to score all the essays in the data set report 55% exact accuracy and 92% adjacent accuracy between the predicted essay scores and the human scores. The results indicate that this is a promising approach to AES that could provide more specific feedback to writers and may be relevant to other natural language computations, such as the scoring of short answers in comprehension or knowledge assessments.

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1. Introduction

Teaching students how to write well is a fundamental objective of our educational system for obvious reasons. Students who cannot write well are less likely to effectively convey their ideas, persuade others, and succeed in various personal and academic endeavors. However, writing instruction takes an inordinate amount of teacher time, not only for the instruction of how to write but also in scoring essays and providing subsequent feedback to students. Done well, essay scoring is an enormously complex cognitive task that involves a multitude of inferences, choices, and preferences on the part of the grader. What features are attended to, which characteristics and sections are weighted most highly, and what standards are held are all factors that may vary widely across human graders. Indeed, essay ratings are highly variable from human to human (Huot, 1990, 1996; Meadows & Billington, 2005).

A solution to this variability across raters has been to train expert raters to use scoring rubrics (Bridgeman, 2013). For example, the SAT asks students to write essays in response to prompts such as those presented in Table 1. The SAT rubric for persuasive writing (College Board, 2011; see Appendix) includes six levels that address writers' critical thinking, use of examples and evidence, organization and coherence, language and vocabulary, sentence structure, and mechanics. For example, high scoring essays that receive a score of 6 are classified as using "clearly appropriate examples, reasons, and other evidence" and exhibiting "skillful use of language, using a varied, accurate, and apt vocabulary" whereas low-scoring essays receiving a score of 1, provide "little or no evidence" and display "fundamental errors in vocabulary." While the reliability of human scores using such rubrics (with training and examples) is quite high, essay scoring remains relatively time demanding, be it for a teacher tasked to score 150 essays over the weekend, or for a company challenged to score thousands of essays for the purpose of standardized assessment. The increased recognition of the importance of writing, combined with cost considerations and the obvious time demands to reliably and validly score writing, heightens the need for more rapid feedback and, by consequence, has fed the growth of research on automated essay scoring (AES; Dikli, 2006; Graesser & McNamara, 2012; Shermis & Burstein, 2013; Weigle, 2013; Xi, 2010).

The focus of this study is to describe a new method of AES that we have designed using hierarchical classification and report on its reliability in comparison to more common scoring models that have been reported in the literature. AES technologies have been largely successful, reporting levels of accuracy that are in many situations as accurate as expert human raters (Attali & Burstein, 2006; Burstein, 2003; Elliott, 2003; Landauer, Laham, & Foltz, 2003; Rudner, Garcia, & Welch, 2006; Shermis, Burstein, Higgins, & Zechner, 2010; Streeter, Psotka, Laham, & MacCuish, 2002; Valenti, Neri, & Cucchiarelli, 2003). AES systems assess essays using a combination of computational linguistics,

Table 1
SAT instructions and examples of SAT writing prompts and assignments.

<i>SAT instructions</i>	Your essay must be written on the lines provided on your answer sheet – you will receive no other paper on which to write. You will have enough space if you write on every line, avoid wide margins, and keep your handwriting to a reasonable size. Remember that people who are not familiar with your handwriting will read what you write. Try to write or print so that what you are writing is legible to those readers.
Prompt 1	Think carefully about the following statement. Then read the assignment below it and plan and write your essay as directed. "The more things change, the more they stay the same." Assignment: Do you agree with this statement? Plan and write an essay in which you develop your position on this issue. Support your point of view with reasoning and examples taken from your reading, studies, experience, or observations.
Prompt 2	Consider carefully the following statement. Then read the assignment below it and plan and write your essay as directed. "It is as difficult to start things as it is to finish things." Assignment: Do you agree with this statement? Plan and write an essay in which you develop your position on this issue. Support your point of view with reasoning and examples taken from your reading, studies, experience, or observations.

Note: Additional examples of SAT writing prompts are available from the following websites: <http://www.bcps.org/offices/cte/pdf/SAT-Writing-Prompts.pdf>, <http://www.collegeboard.com/student/testing/sat/after/essay-prompts.html>, <http://www.sparknotes.com/testprep/books/newsat/power tactics/essay/chapter7.rhtml>.

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