

## WIK

The legality of contract cheating services was reviewed by Newton and Lang in a 2016 book chapter of the Springer Handbook for Academic Integrity. The legal status of these services varies internationally. In New Zealand it is illegal to "advertise or provide third party assistance to cheat", with similar, older laws on the statutes of 17 states in the US. Australia has proposed laws similar to that of the New Zealand law, with a draft Bill at the federal level. In the United Kingdom, the Quality Assurance Agency published a report advocating the use of a legal approach as one way to tackle contract cheating.

## IJEI

Plagiarism, ghost writing, contract cheating, as well as student's motivation for breaching academic integrity have been the subject of numerous studies. Many, recently, have dealt specifically with the extent of contract cheating. Clarke and Lancaster (2006) examined a site RentACoder where computer solutions are being contracted both for legitimate uses and for cheating. They conclude that 236 posts requesting services (more than 12%) were published to facilitate cheating. The same authors evaluated number of postings and their attributes at one of the contract cheating sites. They found out that the number of postings requesting ghost writing services had been rising (Lancaster and Clarke 2012).

## ICAI

Lesson #3 – We Must Act Against Contract Cheating.

Perhaps our biggest shared struggle right now are the threats posed by the industry of contract cheating. We already knew that contract cheating undermines student learning and the integrity of our educational institutions, but presentations by Cath Ellis, David House & Kane Murdoch (of University of New South Wales, Sydney Australia), Thomas Lancaster (of Imperial College London), and Douglas Harrison (of UMUC) reminded us that it also endangers our students. Students are being tricked and seduced into the contract cheating world, where they not only have their education and identities stolen but where they also face threats of extortion.

## ARX

Another related approach has been proposed by [11] which suggests API invocation sequences to programmers who are looking to obtain a target object starting with a different object. They depend on code search engines to retrieve relevant code samples from the Web, and then statically analyze such code snippets to identify the method invocation sequences. Yet another novel approach that assists a programmer by suggesting him/her the code snippets is presented in [12]. It suggests to a programmer how an API should be used in a given programming context. Similarly, [13] proposes a "Context-Aware IDE-Based Meta Search Engine for Recommendation about Programming Errors and Exceptions".

## BELA

To find similar text, we rely on established text retrieval methods. For candidate retrieval, our approach employs a text fingerprinting method, which we realized by adapting the Sherlock tool . The method performs text chunking using word 3-grams and probabilistically selects a subset of chunks for computing a digital signature of the input text. The mean probability for chunk retention is  $1/16$  . For the detailed comparison, we offer users a choice between full string matching and the Encoplot algorithm. We adapted the Boyer-Moore algorithm to match all strings (including repetitions) with 12 or more identical words. Encoplot, developed by Grozea et al. [8], is an efficient character 16-gram comparison that achieves a time-complexity of  $O(n)$  by ignoring repeated matches.

WIK

QAA is suggesting that existing fraud laws might be used, since the activities of such services, and their clients, could be reasonably interpreted to fit with definitions of fraud as they involve 'false representation' and 'failure to disclose information'. A subsequent research project compared the UK Fraud laws with the terms and conditions used by contract cheating services and concluded that they would be unlikely to fall foul of Fraud law due to the disclaimers, terms and conditions they use which generally state that any custom written products are to be used only as 'study guides' or 'revision aids', thereby placing responsibility, and 'intent', onto the student client.

IJEI

For this paper, studies examining relative number of cheating students are also relevant. In a large North American survey, Donald McCabe (2005) found that 7% of undergraduate and 3% of graduate students reported cheating on written assignments by turning in work done by another person. Australian studies reported that in 2004, 1.1% of students surveyed admitted to being involved with ghost writing, whereas in 2009 the ratio increased to 3.5% (Curtis and Popal 2011). Zafarghandi et al. (2012) surveyed students in Iran and found that 7.9% of them reporting having engaged in contract cheating.

ICAI

To respond to this threat, we need the appropriate tools, policies and procedures to identify and respond to contract cheating, as well as a rethink of our approach to teaching and learning and a reconsideration for what measures should be used as the bases for admissions and graduation decisions. Our international day of action against contract cheating (the third Wednesday of October each year) is a good start for responding to the threat – as Evangeline Mourelatos of Deree, American College of Greece and I argued in our conference presentation – and we encourage more institutions to join us on the 4th day of action on October 16th 2019.\*

ARX

They implemented an IDE (Eclipse) plug-in that makes use of the APIs provided by popular web search engines (viz. Google, Yahoo, Bing) to search the entire Web using keywords from a programming context in an IDE. They determine relevant results by taking into consideration the programming context as well as popularity of the candidate search results. There have also been works such as [14] which infers possible links/relatedness among artifacts of a software development project by analyzing the projects artifact repositories. Main goal in case of most the existing works such as the ones highlighted above is to suggest code samples or relevant Q&A Discussions.

BELA

The HyPlag prototype consists of a backend server application and a web-based fronted application, which are loosely coupled via a REST web service interface. The backend is realized in Java using the Spring Boot framework. We use an Elasticsearch index as the main data storage for content features. To extract text, header metadata, citations, and references from PDF, we integrated the GROBID2 and ParsCit3 parsers. We combine the result sets of both parsers to increase precision and recall of the extraction. HyPlag relies on MathML4 to represent and process mathematical content. We use InftyReader5 to convert PDF that include mathematical content to TeX.

WIK

Despite this, media 'stings' have shown that companies can be complicit in the inappropriate use of these products. A similar analysis in Lithuania concluded that contract cheating services were unlikely to fall foul of existing laws, although an analysis of Australian law concluded that fraud, as well as forgery and conspiracy, might be legal avenues via which contract cheating could be targeted. All three studies called for the introduction of new legal approaches to tackle contract cheating. Contract cheating is not illegal in Canada. A follow-up research study proposed such a new law, based on the principle of strict liability, which lessens the requirement for prosecutors.

#### IJEI

A study claiming to be the first economic investigation of essay market was conducted at 3 UK universities in 2013. Researchers examined behaviour of 90 students using a hypothetical discrete choice experiment and found that half of the students revealed a willingness to buy an essay. Some of them responded that they would not hesitate to pay up to \$445 for a 1st grade essay (Rigby et al. 2015). An earlier study dealt with the crowd working markets (crowd-sourcing). Researchers found that “79.0% of crowd workers agreed to provide their work for assistance on exams or homework assignments without additional incentive; this increased to 81.4% when additional incentives were offered” (Harris and Srinivasan 2012).

#### ICAI

Lesson #4 – We Are Doing Good Work.

The jewel of the conference is seeing the absolutely fantastic and diverse work being done by professionals and students around the world to make cheating the exception and integrity the norm.

We learned from those who are working to proactively educate our students about academic integrity, whether through integrity tutorials like those at Ryerson University and Sheridan College (both in Canada), honesty awareness weeks like that at Adelphi University (in the USA), or new academic integrity courses like those being implemented in Ukrainian Secondary Schools.

#### ARX

Emphasis is on assisting a programmer in writing the code by leveraging code snippets (or discussions about code) from different sources. Secondly, most of the existing works leverage standard information retrieval (IR) techniques to fetch relevant code/content from various sources such as the Web. For instance, [9], [10] make use of term frequency-inverse document frequency based text mining techniques, whereas [11], [13] make use of existing search engines/APIs for retrieving relevant content. Specifically, in the area of code review there have been sentiment analysis of reviews [9], study on parameters that affect code review [10], and semi-automation in the review process [15].

#### BELA

HyPlag's user interface includes two main views to present the results of the hybrid detection approach: the Results Overview shown in Figure 2 and the Detailed Comparison View shown in Figure 3. HyPlag also features a dashboard area that allows users to upload and manage files as well as to configure, start and track analyses. We explain the functionality of the analysis views using a retracted journal article from bioengineering [20]. The retraction note explains that the journal retracted the article, because it reused a three-page mathematical analysis without attribution from a paper by Freeman et al. [4]. We used HyPlag to compare the retracted article with the source indicated in the retraction note and with other publications by Freeman, the source paper's first author

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Prosecutors do not have to demonstrate that they 'intended to help student cheat', but instead would make them liable for prosecution simply for offering services that could be reasonably interpreted as being used for contract cheating. More broadly, despite the apparent potential of a legal challenge to contract cheating companies, prosecutions are currently rare, largely due to the limitations of existing laws. In addition, the simple act of outlawing a service would not necessarily reduce demand for it; the aforementioned research studies all call for a holistic, multi-pronged approach to tackling contract cheating.

## IJEI

Many researchers have also addressed the reasons students give for engaging in contract cheating. Devlin and Gray (2007) conducted focus groups with students at Melbourne University and identified eight main motivators: Inadequate admission criteria, poor understanding of plagiarism, poor academic skills, teaching/learning issues, laziness/convenience, pride in plagiarizing, pressures, education costs (Devlin and Gray 2007). Another list of students' reasons for plagiarism more generally is provided by Gullifer and Tyson (2010): lacking the time to complete tasks (poor time management), perceived disjuncture between award (grade) and effort required, too much work to complete over too many subjects, pressure to do well.

## ICAI

Many people spoke to us about their work on integrity culture creation like that being done by Azalea Hulbert (West Virginia University, USA), the Emory Integrity Project (Emory University, USA), and the University of Monterrey (Mexico). We learned about how we can improve our responses to integrity violations from the folks at MacEwan University (Canada) who talked about implementing restorative practices in academic integrity processes, the team at the College of William & Mary (USA) who shared their new mentoring program to enhance student success and retention after suspension, and the research being conducted by Adriana Barberena (University of Monterrey, Mexico) on what students learn through the process.

## ARX

Here, although [9] differs from our work as it just reviews the comments of three OSS and characterizes them on the basis of their sentiment and [15] proposes a tool based on static analysis of code to automate the code review process. [16] gives a detailed description of various (semi-) automated tools of code reviews available for use but concerning specifically to security aspect of the software. These tools are based on static analysis and their performance depends on code quality. Main aim of the work presented in this paper, however, is to assist in reviewing a given piece of source code.

## BELA

For the example, the match views in Figure 2 show the similarity of text (left), citations (middle) and mathematical content (right) in the retracted article by Xu et al. and two papers by Freeman et al. The upper result summary represents the source paper named in the retraction note. The match views for text indicate moderate similarity of the retracted article, particularly in the introduction, to both comparison documents. This similarity is largely due to overlap in keywords and general scientific phrases and likely would not have caused suspicion for either of the two comparison documents. However, the match view for mathematical content (right) in the upper result summary shows a clearly suspicious similarity that should prompt a user to review the documents in detail.