Use Cases in Big Data Software and Analytics

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Editor:
Gregor von Laszewski
Department of Intelligent Systems
Engeneering
Indiana University
laszewski@gmail.com

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Preface

1.0.1 Disclaimer

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  year =         {2017},
  volume =    {1},
  series =    {i523},
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Using Big Data to Battle Air Pollution

Karthik Vegi
Indiana University Bloomington
2619 East 2nd Street, Apt 11
Bloomington, IN 47401, USA
kvegi@iu.com

ABSTRACT

We have come a long way from the stone age to build large scale industries, big cities, bullet trains, and a booming automobile industry. Technological and industrial advances are making our cities smarter by the day and yet a nagging side-effect is air pollution. Air pollution is not only creating local health hazards like respiratory and heart problems, but also directly leading to an increase in temperatures and contributing to global warming. We show how the advances in *Big Data*, *Cloud Computing*, and *Internet Of Devices* can be used to combat air pollution.

KEYWORDS

i523, hid231, big data, environment, air pollution, global warming

1 INTRODUCTION

Air pollution is no longer a local problem. It is a global environmental issue which involves individual countries to come together and device measures to combat it [5]. It it causing about 3.7 million premature deaths worldwide from cardiovascular and respiratory diseases and also ruins the crops that feed the world [5]. Air pollution also has a direct effect on a number of environmental issues like global warming, depletion of ozone layer, acid rains and impacts wild-life [5].

Back in the year 1990, the job of a typical air quality scientist was to develop atmospheric dispersion models to evaluate the air pollution caused by industries and make sure that it is within the permissible level suggested by the *Environmental Protection Agency* [2]. These models gather historic data of many years from airports and weather balloons to predict the pollution with the help of meteorology theory [2]. Although the methods used to derive the values were good enough, the limitations with respect to the technology posed a real challenge which took weeks to run the simulations only to be cut-off in the middle due to power and storage issues [2]. The data processing engine was built on Sun-Solaris workstations with tapes handling the data storage [2]. The work-stations set up in major points in the country would communicate using a very slow network connection [2]. The data processing would be done locally and later written to all the servers which would then be split and distributed among many machines and consolidated in the end [2]. "If only we had that much more data and that much more ability to handle it, we could iterate through the model at a much finer scale. Real-time data processing remained a pipe dream" [2].

2 AIR POLLUTION AS A BIG DATA PROBLEM

The advent of *Big Data* and the technological advances changed the way the data is ingested and analyzed [2]. The network speeds have increased, wide range of sensors are available to collect data with a lot of precision which would feed the high speed data processing systems. Batch processing has become easier with *Hadoop* and *Map-Reduce*. The storage mechanisms have become cheaper and more disaster proof.

IBM is helping Beijing combat air pollution by analyzing huge amounts of data using a data analysis platform *Green Horizons* [3]. IBM has signed up partnerships with different cities in China and India to deploy *Big Data Analytics*, *Machine Learning* and *Internet Of Things* to improve traffic, keep a check on the pollution from industrial machines and other pollution causing agents [3]. *IBM* will deploy sensors in various place to collect data in real-time and analyze previous weather forecasts, and build improved iterative models over time [3]. The system continuously streams data form the sensors and improves the forecast by learning over time using *Machine Learning* algorithms [3]. Figure 1 shows the Green Horizons air quality management for Beijing.

[Figure 1 about here.]

IBM is collaborating with the United Nations to push the use of technological advances by every country for the common good of the world [3]. More and more cities and countries are opening air quality data to public where you can get reports in real time [1]. The *BreezoMeter* is the first mobile application that provides real-time information of the street's air quality information using geo-location maps [1]. *Copernicus* is another monitoring service that ingests data from satellites and on site sensors on land, air and sea to provide continuous information to the users [1]. *Open Data Week* is an intergovernmental organization where 34 states come together to bring reforms and discuss how to use technology and services like *Copernicus* that use *Big Data* to test prototypes of new products to ensure they operate within the permissible levels of pollution [1].

While these initiatives help bring awareness about the seriousness of the issue, each state and country should take strict measures to bring out reforms that will help eradicate pollution. *Big Data* might never replace the environmental responsibility but it will help to plan the vision for environmental awareness and its tools make it easier to achieve the vision [1]. These tools can also be used to gauge the alternative sources of energy and the feasibility of tapping into other natural resources ensuring responsible consumption of energy [1]. For example, *IBM Bluemix* analyzed data from a steel industry and the analysis uncovered an interesting insight that the furnace wastes a lot of energy to offset the temperature of the smoke which resulted in optimizing its operation [2]

3 BIG DATA TECHNIQUES TO COMBAT POLLUTION

3.1 Random Forest Approach for predicting air quality in Urban Sensing Systems

Air pollution in an urban setting is very important to monitor because of the population density. Air quality in these areas varies a lot in various parts of the city owing to traffic and presence of industries [6]. A random forest approach ingests data from meteorology, urban sensors, road information and real-time traffic and predicts the air quality with utmost precision [6]. Real-time air quality information consists of measuring the concentration of $PM_{2.5}$, PM_{10}, and NO_2 [6].

The *Air Quality Index* AQI is the measure that is used to understand how polluted the air is [6]. AQI is measured by reading the concentration of 6 pollutant gases namely, sulfur dioxide SO_2, nitrogen dioxide NO_2, air particles smaller than 10 μm PM_{10}, air particles smaller than 2.5 μm $PM_{2.5}$, carbon monoxide CO, and ozone O_3 [6]. Based on the level of AQI, the air quality is classified as shown in Figure 2.

[Figure 2 about here.]

Traffic Congestion Status TCS, explains the traffic status at the current hour [6]. Figure 3 shows how colors are used to represent the traffic congestion [6].

[Figure 3 about here.]

3.2 RAQ Algorithm

The RAQ algorithm collects data from air monitoring station AQI, meteorology data MD, traffic congestion TCS, road information RI, and point of interest POI which is the specific location that someone is interested to visit [6]. The data refresh rate is one hour and the data is collected from different parts of the city which are divided in grids from G_1 to G_n [6]. The data is divided into training and testing data sets to train the model and evaluate the model [6]. Figure 4 shows the structure of the data.

[Figure 4 about here.]

A decision tree is used to split and classify the data and the results are aggregated by collecting the data from all the sub-trees [6]. Figure 5 illustrates the procedure of RAQ.

[Figure 5 about here.]

The *Random Forest* algorithm is employed using the tree type classifier to recursively partition the dataset and generate sub-trees and finally aggregate the results of each sub-tree [6]. Each sub-tress is constructed using *Bootstrap Aggregating* where each data set is divided into different buckets by using statistical samples [6]. Once the trees are constructed, each subset of data is fed into a decision tree and the estimated AQI index is calculated [6]. The final AQI index is determined as the maximum value out of all the individual values [6]. Figure 6 shows the step-by-step RAQ algorithm.

[Figure 6 about here.]

4 MACHINE LEARNING MODELS

Machine Learning deals with augmenting computers with the ability to learn from data and program themselves [4]. These algorithms can be used to evaluate the air quality [4].

4.1 Artificial Neural Network Model

Artificial Neural Network Model tries to solve the problem by simulating the functioning of brain and neurons [4]. The model architecture is a function of a sigmoid [4]. For this experiment, the air quality data was divided into training, test, and validation data with split of 60, 20, and 20 with a back propagation network of two hidden layers [4]. To ensure consistency, the air quality data for the training and test sets are derived from the same season [4]. The air quality is forecast by looking at the historic data where the input and output are represented by the air qality data measured at different times [4]. The model turns out to be reliable with a good prediction accuracy with the lowest mean square error of 3.7×10^{-4} [4]. The Artificial Neural Network Model is combined with *Markov Chains* to develop a new improved model with improved prediction accuracy where the ANN computes the primary values and the results are re-computed and improved by the markov transitional probability matrices [4]. Figure 7 shows the Artificial Neural Network Model with two hidden layers.

[Figure 7 about here.]

5 CONCLUSION

ACKNOWLEDGMENTS

The author would like to thank Dr. Gregor von Laszewski and the teaching assistants for their support and suggestions in writing this paper.

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[2]

List of Figures

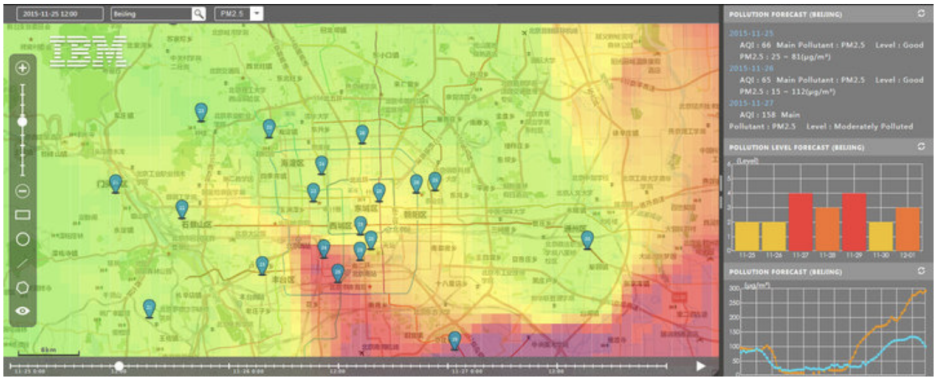

Figure 1: Green Horizons air quality management for Beijing [3]

AQI	Air Pollution Level
0–50	Excellent
51–100	Good
101–150	Lightly Polluted
151–200	Moderately Polluted
201–300	Heavily Polluted
300+	Severely Polluted

Figure 2: AQI classification [6]

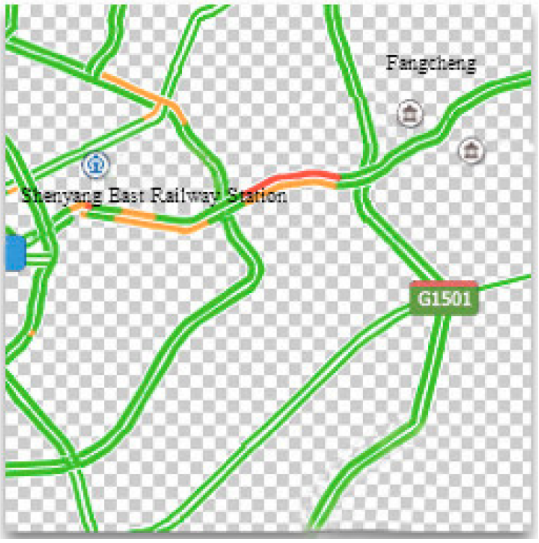

Figure 3: Traffic Congestion[6]

temperature Numeric	humility Numeric	pressure Numeric	wind Numeric	visibility Numeric	road_length Numeric	tfs Numeric	poi_number Numeric	aqi Nominal
5.5	89.0	758.1	2.0	14.0	2185.0	2371.0	63.0	excellent

Figure 4: Structure of RAQ data[6]

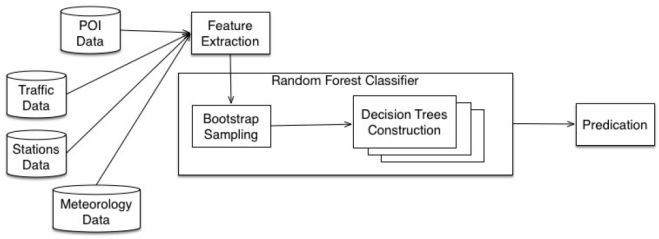

Figure 5: Procedure of RAQ [6]

Algorithm 1. RAQ

Input:	A dataset S with features: F_{mt}, F_{mh}, F_{mp}, F_{mw}, F_{mv}, F_{ri}, F_{tcs}, F_{pn} and labeled AQI level; unlabeled dataset UI; trees quantity T; features quantity m;
Output:	AQI level
1	for T trees
2	randomly select m features from S;
3	for m features in each node
4	calculate information gain by Equation (3);
5	choose maximum gain to split the dataset in the node;
6	remove used feature from feature candidates;
7	input unlabeled data into trees;
5	get predicted AQI level according to Equations (5) and (6);

Figure 6: RAQ Algorithm [6]

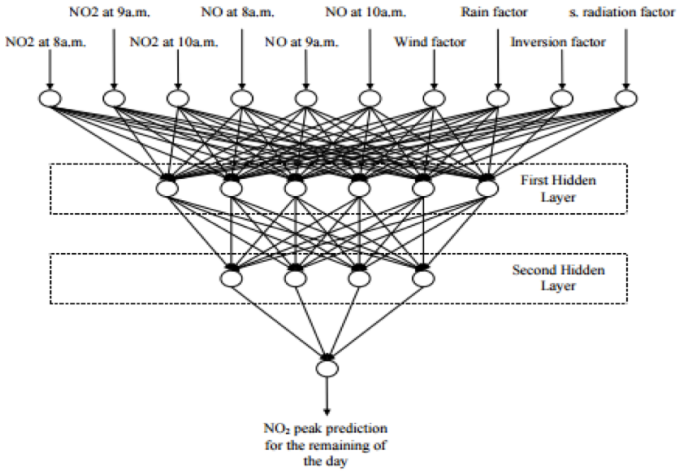

Figure 7: Artificial Neural Network(ANN) Model [4]

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latex report
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  15:27     error    trailing spaces  (trailing-spaces)

Compliance Report
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name: Vegi, Karthik
hid:  231
paper1: Oct 29 17 100%
paper2: 70%

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wc 231 paper2 5 565 content.tex
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find "
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102: Do not use "these quotes" but use these ‘‘these quotes’’.

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62: In Figure \ref{f:fly} we show a fly. Please note that because we use
68: \begin{figure}[!ht]
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figures 1
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True : ref check passed: (refs >= figures + tables)
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True : include graphics passed: (figures >= includegraphics)

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105: Do not use Figure 1 user the ref for the figure while using its label
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find ""
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Sociological Methods of Big Data

Jeramy Townsley
IUPUI
425 University Ave
Indianapolis, Indiana 46202
jtownsle@indiana.edu

ABSTRACT

KEYWORDS

i523, hid347, social sciences, big data, methods, data mining, regression

```
bibtext report
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latex report
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Compliance Report
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paper2: In Progress

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Big Data Analysis for Computer Network Defense

Jordan Simmons
Indiana University
Smith Research Center
Bloomington, IN 47408, USA
jomsimm@iu.edu

ABSTRACT

Computer security threats and attacks are constantly evolving. Everyday, hackers are creating new techniques to bypass network security for the purpose of malicious attacks. To keep up with the changing intrusion technologies, the technologies that defend these attacks need to constantly evolve also. Modern day technologies use deep learning techniques to monitor network activity, and detect malicious code. We will provide an overview of network security and modern technologies being used to protect computer systems and networks.

KEYWORDS

i523,HID336, Computer Network Security, Big Data Analysis, Deep Learning, Intrusion Detection Systems,

1 INTRODUCTION

Everyday a different computer network is being breached with the intent to cause harm to the system or to steal valuable data. Computer hackers are constantly creating new ways to evade network security and create malicious code that can not be detected by security systems. As malicious technologies continue to advance, the technologies that defend against these technologies need to adapt with these advances. The problem with computer network defence is that the technologies used to breach systems constantly change. Once a solution is created to defend a technology, a new malicious technology could be created the next day. Today many security specialist are using deep learning technologies to monitor network intrusions, and detect malicious code. In order to better understand computer network defense, an overview of modern attacks, network data collection processes, and the technologies used to analyze network data is provided.

2 DATA COLLECTION

2.1 Network Intrusion Data Collection

2.2 Malware Data Collection

3 DEEP LEARNING FOR NETWORK INTRUSIONS

4 DEEP LEARNING ON MALWARE

5 CONCLUSION

ACKNOWLEDGMENTS

The authors would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

REFERENCES

We include an appendix with common issues that we see when students submit papers. One particular important issue is not to use the underscore in bibtex labels. Sharelatex allows this, but the proceedings script we have does not allow this.

When you submit the paper you need to address each of the items in the issues.tex file and verify that you have done them. Please do this only at the end once you have finished writing the paper. To d this cange TODO with DONE. However if you check something on with DONE, but we find you actually have not executed it correcty, you will receive point deductions. Thus it is important to do this correctly and not just 5 minutes before the deadline. It is better to do a late submission than doing the check in haste.

A ISSUES

DONE:

Example of done item: Once you fix an item, change TODO to DONE

A.1 Assignment Submission Issues

Do not make changes to your paper during grading, when your repository should be frozen.

A.2 Uncaught Bibliography Errors

Missing bibliography file generated by JabRef

Bibtex labels cannot have any spaces, _ or & in it

Citations in text showing as [?]: this means either your report.bib is not up-to-date or there is a spelling error in the label of the item you want to cite, either in report.bib or in report.tex

A.3 Formatting

Incorrect number of keywords or HID and i523 not included in the keywords

Other formatting issues

A.4 Writing Errors

Errors in title, e.g. capitalization

Spelling errors

Are you using *a* and *the* properly?

Do not use phrases such as *shown in the Figure below.* Instead, use *as shown in Figure 3*, when referring to the 3rd figure

Do not use the word *I* instead use *we* even if you are the sole author

Do not use the phrase *In this paper/report we show* instead use *We show.* It is not important if this is a paper or a report and does not need to be mentioned

If you want to say *and* do not use *&* but use the word *and*

Use a space after . , :

When using a section command, the section title is not written in all-caps as format does this for you

```
\section{Introduction} and NOT \section{INTRODUCTION}
```

A.5 Citation Issues and Plagiarism

It is your responsibility to make sure no plagiarism occurs. The instructions and resources were given in the class

Claims made without citations provided

Need to paraphrase long quotations (whole sentences or longer)

Need to quote directly cited material

A.6 Character Errors

Erroneous use of quotation marks, i.e. use “quotes” , instead of ” ”

To emphasize a word, use *emphasize* and not “quote”

When using the characters & # % _ put a backslash before them so that they show up correctly

Pasting and copying from the Web often results in non-ASCII characters to be used in your text, please remove them and replace accordingly. This is the case for quotes, dashes and all the other special characters.

If you see a ffigure and not a figure in text you copied from a text that has the fi combined as a single character

A.7 Structural Issues

Acknowledgement section missing

Incorrect README file

In case of a class and if you do a multi-author paper, you need to add an appendix describing who did what in the paper

The paper has less than 2 pages of text, i.e. excluding images, tables and figures

The paper has more than 6 pages of text, i.e. excluding images, tables and figures

Do not artificially inffate your paper if you are below the page limit

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A.8 Details about the Figures and Tables

Capitalization errors in referring to captions, e.g. Figure 1, Table 2

Do use *label* and *ref* to automatically create figure numbers

Wrong placement of figure caption. They should be on the bottom of the figure

Wrong placement of table caption. They should be on the top of the table

Images submitted incorrectly. They should be in native format, e.g. .graffle, .pptx, .png, .jpg

Do not submit eps images. Instead, convert them to PDF

The image files must be in a single directory named ”images”

In case there is a powerpoint in the submission, the image must be exported as PDF

Make the figures large enough so we can read the details. If needed make the figure over two columns

Do not worry about the figure placement if they are at a different location than you think. Figures are allowed to ffoat. For this class, you should place all figures at the end of the report.

In case you copied a figure from another paper you need to ask for copyright permission. In case of a class paper, you must include a reference to the original in the caption

Remove any figure that is not referred to explicitly in the text (As shown in Figure ..)

Do not use textwidth as a parameter for includegraphics

Figures should be reasonably sized and often you just need to add columnwidth

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Big Data Analytics and IoT Smart Refridgerators

Robert W. Gasiewicz
Indiana University
711 N. Park Avenue
Bloomington, IN 47408
rgasiewi@iu.edu

ABSTRACT

The intent of this paper is to explore the rapid growth of IoT Smart Appliances, specifically with regard to refrigerators. As more devices are connected to the internet, to each other, and become readily available to consumers, there are many exciting new possibilities that offer both convenience and to make our lives more efficient. The scope of this paper will begin with a brief history of IoT, then move on to describe the current way in which this technology is being applied, and conclude with exploration and outlook on future development possibilities as well as potential risks.

KEYWORDS

i523, HID316, Big Data, IoT, Refrigerators, Smart Appliances, M2M, Samsung, Innit, Instacart, GrubHub

1 INTRODUCTION

The advent of the Internet of Things (IoT) began at the close of the last millennium when the world began connecting ordinary devices - electronics other than traditional computers - to the internet. With virtually unlimited possibilities, the unthinkable became reality when the concept of putting a wireless network card in a refrigerator went mainstream. Initial features were as simple as a large touchscreen with the news, the weather, and a doodle board.

From there, IoT Smart Refrigerators have evolved to become equipped with cameras, cooking recommendations, and even rudimentary food inventory and spoilage management systems. Now that food delivery services such as Instacart and GrubHub have become popular, there are already plans to integrate these services with smart refrigerators. As IoT has continued to expand throughout the marketplace and the concept of machine-to-machine (M2M) IoT has taken hold, there are now even more possibilities, which means a bright future in the kitchen no matter if you're an aspiring chef, a person trying to efficiently manage a family, or someone with specific health needs. However, along with the rapid advance of new features, there are also significant threats and blind spots with security.

2 EARLY HISTORY OF IOT AND NETWORKED APPLIANCES

Although the internet didn't yet exist in the minds of Hollywood producers in 1985, the opening scene from Back to the Future begins with a room full of ticking clocks, one of which is an alarm clock that rings and sets off a Rube Goldberg machine that has been configured by Doc Brown to automate the preparation of his breakfast. It's not unreasonable to believe that, in his many time travel escapades, Doc would've eventually *discovered* the internet and would've upgraded this rudimentary appliance.

That reality wouldn't come until five years later in 1990 when the first IoT device, a toaster, was turned off and on via the internet. At the October 1989 INTEROP Conference, John Ramkey used a Sunbeam Radiant Control toaster connected to a TCP/IP network to demonstrate that the device could be turned off and on[11]. Not only did Ramkey succeed at turning the toaster on and off, he used SNMP code delivered via his computer's parallel port to a larger relay to control power to the toaster. The SNMP code executed commands for a value, 1 through 10, for the toast's doneness as well as a calculation for the type of item being toasted. For example, while the command for wheat bread would tell the toaster to toast at a level of 2, the command for a frozen bagel would tell the toaster to toast at a level of 5. Additional innovations were later added, such as a Lego robotic arm to insert the bread into the toaster; a sight Doc Brown would've been proud to see.

By 1999, the Salt Lake City Tribune/Deseret News was predicting that household appliances like the refrigerator were going to be part of a future in which "everyone lived like the Jetsons" [12]. "The networked home is on the horizon", the Tribune/Deseret News' Michael Stroh wrote, "with a click, you call up your refrigerator on your office PC to see what's inside (a bar-code reader within the fridge keeps a running inventory). The refrigerator suggests lasagna but warns that you'll need to buy ricotta - and a few other items" [12]. Not surprisingly, it would be at least another decade before this concept became a viable reality.

3 IOT IS BORN

The first time the term *Internet of Things* was used wasn't until nine years later by Kevin Ashton, co-founder of the Auto-ID Center at the Massachusetts Institute of Technology (MIT). The Auto-ID Center was founded with the expressed purpose of creating a formal standard for Radio Frequency Identification (RFID) and other types of networked sensors. In 2009, Kevin wrote[5]: "I could be wrong, but I'm fairly sure the phrase *Internet of Things* started life as the title of a presentation I made at Procter & Gamble (P&G) in 1999. Linking the new idea of RFID in P&G's supply chain to the then-red-hot topic of the Internet was more than just a good way to get executive attention. It summed up an important insight which is still often misunderstood."

Even though Kevin briefly captured the momentary attention of the C-Suite at P&G, it wasn't another full decade until the true concept of IoT caught on in the marketplace. In 2011, the market research company Gartner, included IoT on their hype cycle chart for the very first time. By 2016, IoT was past-peak of inflated expectations was doing the usual nosedive into the trough of disillusionment[7].

[Figure 1 about here.]

4 IOT SMART REFRIGERATORS COME OF AGE

Internet refrigerators, on the other hand were a bit slower catching up. After many failed attempts in the mid-2000s at various gimmicky models, it seemed that the once rosy future painted by Mr. Stroh a decade earlier was simply not going to come to fruition. Hardware and network technology had not yet caught up. By 2014, murmurs of a new wave of internet fridges hit the marketplace and excitement began to build, and by 2016, the IoT Refrigerator was ready for primetime. On January 24, 2016, Samsung launched its Smart Hub Refrigerator complete with a massive 21.5 inch 1080P touchscreen and Android operating system. Another exciting new feature of the Smart Hub fridge was the interior cameras that allowed users to get a real-time look at the contents of their fridge from anywhere[9].

A year later, Samsung debuted version 2.0 of the Smart Hub fridge, this time with improvements such as third-party apps such as Spotify and individualized user profiles for family members. Users are also able to serve photos and other content to the screen as well. Interestingly, Samsung has opted to go with the its own proprietary voice control system called S-Voice, while its only current competitor in the IoT fridge marketplace, LG, will integrate with Amazon's Alexa. Only in Europe, with the LidL supermarket chain, will consumers be able to order groceries through the the fridge. It's a start, but there is much, much more on the horizon[8].

5 THE FUTURE OF IOT SMART REFRIGERATORS

The future of IoT Smart Refrigerators - and kitchen appliances working in concert in general - is brighter than perhaps Doc Brown or even John Ramkey could have ever imagined. Hardware, networking, and most importantly, software, have all caught up to be viable in fulfilling consumer demands and there are fresh new ideas already just beginning to hit the marketplace. The next phase of the IoT Smart Refrigerator will be one that is marked by progress in software. Structurally speaking, refrigerators are designed to last between 14-17 years[2], however, the average consumer might upgrade their personal computer 3 to 4 times during this time span. In other words, an IoT Smart Refrigerator made today, might only be 1/4 to 1/3 of the way through its average lifespan before its computer and networking components become obsolete.

One Silicon Valley company that seems to have a viable solution to this problem is Innit[4]. Innit has come up with the idea of having a cloud-based platform for the kitchen that partners with appliance manufacturers such as Jenn Air and Whirlpool to add their components and integrate their application with existing appliance platforms. The idea is that you can equip your entire kitchen, not just the refrigerator, with technology that can make anyone a culinary master with a bit of guidance[10]. Building upon Samsung's successful Smart Hub fridge platform, Innit takes the camera-in-your-fridge concept a step further by introducing image recognition software that can be used to interface with the cloud to generate recipes based on available ingredients, manage spoilage, and inventory - including placing orders for new food. The technology would also enable other kitchen appliances such as an oven or microwave to interact with one another to create a meal.

Aside from personal convenience, one of the most significant values derived from the advance of this sort of technology is that it could prevent an enormous amount of food waste. The United Nations' Food and Agriculture Organization estimates that up to 1.3 billion tons of food are wasted globally every year[3], which equates to roughly 30 percent of all food produced in the same time-frame. Ultimately, software like Innit's because it is connected to the cloud and utilizing big data to allow consumers to make informed decisions about what they eat, people will live and eat healthier and greener.

6 SMART AND DANGEROUS: AN IOT DOUBLE-EDGED SWORD

Yes - it is true - both today and in the future, your IoT Smart Refrigerator will help you live better, but as Swapnil Bhartiya points out in a recent article on InfoWorld[6], it could also kill you. It sounds ominous, but the rapid growth of IoT comes with a steep price: lack of security. Consumers can never really be sure if their software will be patched properly and for how long. It has been well-documented that hackers have been able to successfully commandeer smart devices and utilize them to aggressively launch DDoS that disabled a sizeable portion of the internet. An even bigger threat is that, once compromised, a vulnerable smart device will work as a Trojan Horse allowing nefarious users to access other devices on your local network. Once you throw Alexa into the mix, all bets are off.

One development that is offsetting this risk is the unification of IoT networks in the cloud. Samsung is now creating a SmartThings cloud in which all of its IoT devices will interact. This centraliztion makes security and big data much easier to manage. This unification is also occurring at the macro level with Cisco and Google's cloud[1] which will hopes to achieve the following goals:

(1) Freedom to access any resource while preserving security and compliance
(2) Ability to extend policy to cloud environments to optimize applications
(3) Extend visibility, threat detection and control across hybrid environments without slowing innovation

7 CONCLUSION

IoT has a very bright future ahead and the rapidly evolving IoT Smart Refrigerator will serve as the centerpiece not only to a smart, connected kitchen, but to a smart, connected, and secure home. While it was hardware and networking that delayed progress in the 1990s and software and implementation that led to stagnation in the 2000s, security serves as the next challenge to be overcome as IoT Smart Refrigerators join the burgeoning global network of IoT smart devices.

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List of Figures

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Figure 1: 2016 Gartner Hype-Cycle Chart.

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Big Data Applications in Virtual Assistants

Jiaan Wang
Indiana University Bloomington
3209 E 10 St
Bloomington, IN 47408
jervwang@indiana.edu

ABSTRACT

This paper provides

KEYWORDS

i523, HID233, Big data, Virtual Assistants, Artificial intelligence

1 INTRODUCTION

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2 FIGURES

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4 CONCLUSION

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ACKNOWLEDGMENTS

The author would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

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We include an appendix with common issues that we see when students submit papers.

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floats 0

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Why Deep Learning matters in IoT Data Analytics?

Murali Cheruvu
Indiana University
3209 E 10th St
Bloomington, Indiana 47408
mcheruvu@iu.edu

ABSTRACT

The Deep Learning is unique in all machine learning algorithms to analyze supervised and unsupervised datasets. Big Data challenges, such as high volumes, multi-dimensionality and feature engineering, are well addressed using Deep Learning algorithms. Deep Leaning, with Edge and distributed Mesh computing, is best suited to handle IoT Analytics from millions of sensors producing petabytes of time-series data.

KEYWORDS

i523, hid306, IoT, Deep Learning, Big Data Analytics

1 INTRODUCTION

Supervised machine learning algorithms: decision trees, linear regression, Support Vector Machines (SVMs), Naive Bayes, neural networks, etc. are popular for classification and regression problems by analyzing labeled training data. K-means clustering algorithms are good for unsupervised datasets to categorize based on the identified patterns in unlabeled data. While there are so many factors - nature of the domain, sample size of the dataset and number of attributes defining characteristics of the data - decide which machine learning algorithm works better, Deep Learning algorithms are, getting greater traction, addressing complex analytics tasks, including high-dimensionality and automatic creation of new features from existing complex hierarchical features, very well.

2 NEURAL NETWORKS

Neural Networks are modeled after human brain, the way they solve complex problems. *Perceptron*, the first generation neural network, created a simple mathematical model, mimicking neuron - the basic unit of the brain, by taking several binary inputs and produced single binary output. *Sigmoid Neuron* improved learning by giving some *weightage* to the input based on importance of the corresponding input to the output so that tiny changes in the output due to the minor adjustments in the input weights (or biases) can be measured effectively. Neural Network is, a *directed graph*, organized by layers and layers are created by number of interconnected neurons (or nodes). Every neuron in a layer is connected with all the neurons from the previous layer; there will no interaction of neurons within a layer. As shown in Figure (1), a typical Neural Network contains three layers: input (left), hidden (middle) and output (right) [3]. The middle layer is called *hidden* only because the neurons of this layer are neither an input nor an output but the actual processing happen in the hidden layer. As data passes through layer by layer, each neuron acts as an *activation function* to process the input. The performance of a Neural Network is measured using *cost or error function* and the dependent input *weight* variables. *Forward-propagation* and *back-propagation* are two techniques, neural network uses repeatedly until all the input variables are adjusted or calibrated to predict accurate output. During, forward-propagation, information moves in forward direction and passes through all the layers by applying certain weights to the input parameters. *Back-propagation* method minimizes the error in the *weights* by applying an algorithm called *gradient descent* at each iteration step.

[Figure 1 about here.]

3 DEEP LEARNING

Deep Learning is an advanced neural network, with multiple hidden layers (thousands or even more deep), that can work well with supervised (labeled) and unsupervised (unlabeled) datasets. Applications, such as speech, image and behavior patterns, having complex relationships in large-set of attributes, are best suited for Deep Learning Neural Networks. Deep Learning vectorizes the input and converts it into output vector space by decomposing complex geometric and polynomial equations into a series of simple transformations. These transformations go through neuron activation functions at each layer parameterized by input weights. For it to be effective, the cost function of the neural network must guarantee two mathematical properties: *continuity* and *differentiability*.

[Figure 2 about here.]

3.1 Feature Engineering

The dataset with too many dimensions, also known as attributes or features, create large sparsity and make it difficult to process. *Curse of dimensionality* is a scenario where the value added by the dimensions is much smaller in comparison to the processing cost. However, in certain applications, such as face recognition and patient electronic medical records, the complexity created by multiple dimensions might add value to the context. *Feature Engineering* is an exploratory analysis to identify the features that collectively contribute to better predictive modeling by removing irrelevant features and creating new features, using the training information to identify the patterns, from existing interrelated features [6]. *Principal Component Analysis* (PCA) is a technique to analyze the interdependency among the features and keep only the principal, most relevant, features with minimum loss in the model. With enough training, Deep Learning makes neurons learn new features themselves, in an unsupervised manner, from existing features distributed in several hidden layers. *Stacked Autoencoder* (AE) is, a Deep Belief Network algorithm, to create advanced predictive models for large datasets having thousands or even millions of dimensions, automatically, with complex hierarchical attributes

in non-linear fashion for simpler computing. Though AE is sophisticated, it is very difficult to understand the algorithm logic and so unable to reuse the learnings from the modeling to other systems.

3.2 Deep Neural Networks

Convolutional Neural Network (CNN), also called multilayer perceptron (MLP), is a deep feedforward network, consists of (1) convolutional layers - to identify the features using weights and biases, followed by (2) fully connected layers - where each neuron is connected from all the neurons of previous layers - to provide non-linearity, sub-sampling or max-pooling, performance and control data overfitting [2]. CNN is used in image and voice recognition applications by effectively using multiples copies of same neuron and reusing group of neurons in several places to make them *modular*. CNNs are constrained by *fixed-size* vectorized inputs and outputs. *Recursive Neural Network* (RNN) is, another type of Deep Learning, that uses same shared feature weights recursively for processing sequential data, emitted by sensors or the way spoken words are processed in natural language processing (NLP), to produce arbitrary size input and output vectors. RNN uses a technique called *loop*, where several copies of the same chunk of network (module), each instance passing a message to the next, to persist the information. Long Short Term Memory (LSTM) is an advanced RNN to learn and remember *longer* sequences by composing series of repeated modules of neural network and a concept called *cell state*, a memory unit, to memorize the learning by adding and removing information using *input*, *output* and *forget* gates, in a regularized fashion while data flows through the layers [9]. The Convolutional and Recursive Neural Networks can complement each other to produce better and effective models where problem space has both - hierarchical features and temporal data. Deep Learning can also work well with related *Reinforcement Learning* algorithms where the focus is on how to maximize the learning based on rewards and punishments.

[Figure 3 about here.]

[Figure 4 about here.]

4 IOT DATA ANALYTICS

Internet of Things (IoT) is getting lots of traction, due to the massive volumes of data, making it *Big Data*; however, business needs to convert this data into *information* whether to monitor and control the devices or to analyze the sensor data for betterment. Time series data has non-stationary time aspects collected at certain intervals over a short period of time and correlate this sequence of data with past or future sequences. Stock prices and IoT sensor data are examples of time series data. *InfluxDB*, an open source time series database, is offering high write performance, data compaction through down-sampling and automatic deletion of expired old time series data, to address IoT data storage challenges [5].

4.1 Complexity

Unique traits of IoT data, such as noise, high dimensionality and high streaming of time-series data in real-time, make it challenging to process using traditional machine learning algorithms [10]. Autoregressive Moving Average Model (ARIMA), converts time-series from non-stationary into stationary, but only for short-time predictions. Deep Learning, using LSTM, can detect anomalies in the IoT Data and train time series data very well. Deep Learning algorithms involve complex mathematics - geometry, matrix algebra, differential calculus, statistics and probability, and intensive distributed computing to train the massive amounts of sensor data.

4.2 Scalability

Deep Learning, by design, allows parallel programming, as each module - with all the dependencies among neurons - can run independently and parallelly from other modules within the network. Using Graphics Process Unit (GPU), module networks can achieve parallel programming without needing much of Central Processing Unit (CPU) allocation. Though GPU is intended for graphical processing, it works efficiently to run thousands of small mathematical functions, such as matrix multiplications, in parallel. Cloud computing and Edge Analytics offer flexible scale out options, using virtualization and containerization, for distributed processing. Sophisticated algorithms and distributed computing make Deep Learning scale and perform well to process huge datasets.

4.3 Case Study

Hewlett Packard (HP) Labs has given a presentation of their experiments to check how effectively Deep Learning algorithms can be applied for IoT Sensor Data Analytics. Sample data - vision, speech, text and sensor data such as signals, have been collected from scripted video and accelerometer from 52 subjects on average 20 minutes of activity recognition per subject - 12,000 measurements per minute per person with 16 classifications, such as walk to bed, enter bed, lie down, roll left, roll right and speak. They have analyzed and trained the sample data using various supervised learning algorithms including SVMs, Decision Trees and traditional Neural Networks; compared the results with Recurrent, Deep Learning, Neural Network. Deep Learning showed 95% or more accuracy in various scenarios, performed much better than all the other algorithms, without sophisticated feature engineering. However, Deep Learning algorithms were slow and expensive for results to converge as the sample dataset is huge with lots of instances (10^6-10^9) and very large number of features ($>10^6$). They have concluded the presentation with scale-out hardware options using CPU/GPU clusters and futuristic Edge Analytics and distributed Mesh Computing alternatives for better scalability and performance [11].

5 CONCLUSION

In contrast to traditional machine learning solutions, Deep Learning not only scales well with high volumes of input data but also facilitates in automatic decomposition of complex data representations of unsupervised and uncategorized data. Automatic discovery of new features, from convolutional or recurrent neural networks, makes Deep Learning predominant among all machine learning algorithms. It is very difficult to understand fuzzy and complex logic of Deep Learning, perhaps, more adoption helps getting better handle at them. Deep Learning algorithms need deep research in validating the process of advanced Big Data Analytics tasks, such as IoT sensor time-series data, semantic learning, scalability, data tagging and reliability of the predictive models without extreme generalization.

ACKNOWLEDGMENTS

The author would like to thank Dr. Gregor von Laszewski and the Teaching Assistants for their support and valuable suggestions.

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[11] Natalia Vassilieva. 2016. *Sense Making in an IOT World: Sensor Data Analysis with Deep Learning*. Technical Report. Hewlett Packard Labs. http://on-demand.gputechconf.com/gtc/2016/presentation/s6773-natalia-vassilieva-sensor-data-analysis.pdf

List of Figures

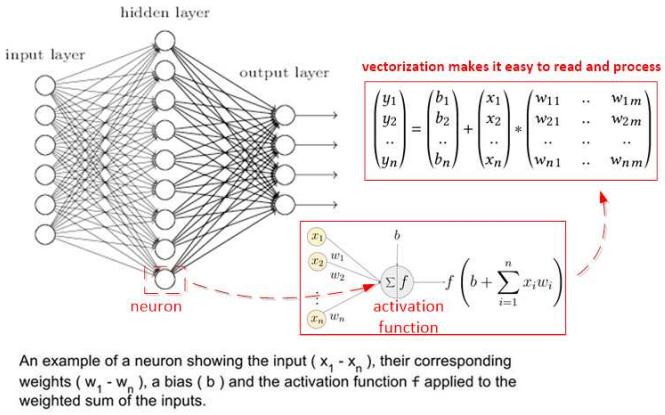

Figure 1: Simple Neural Network [3, 4].

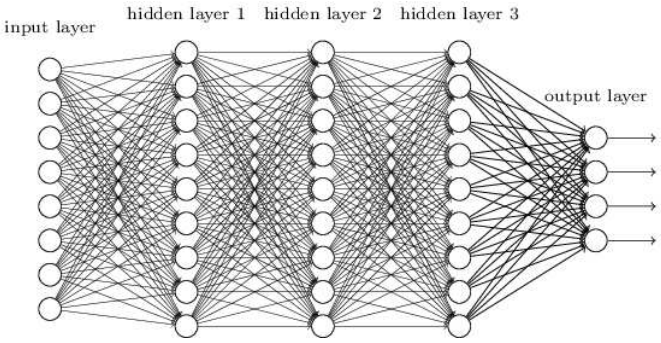

Figure 2: Deep Neural Network with three hidden layers [3].

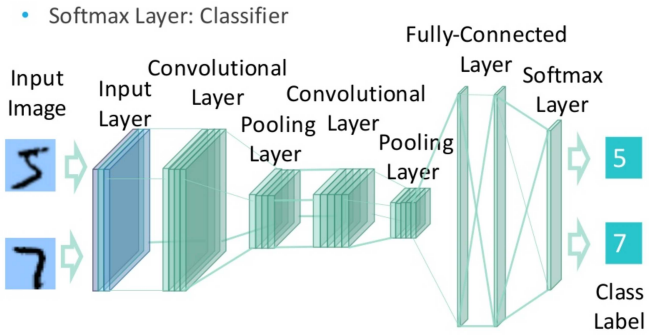

Figure 3: Sample Convolutional Neural Network [1].

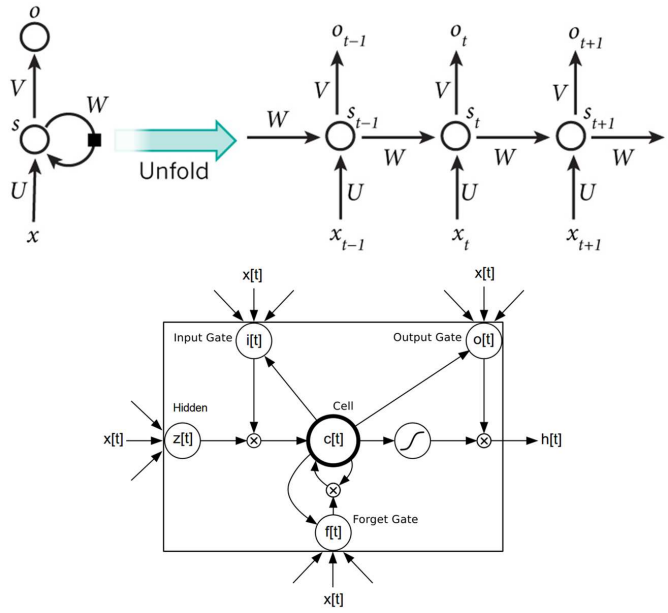

Figure 4: Recursive Neural Network Loop and LSTM Cell State [7, 8].

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paper2: 85%

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wc 306 paper2 6 273 report.bib

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79:                 \includegraphics[width=0.5\textwidth]{images/rnn}
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Big Data for Edge Computing

Ben Trovato
Institute for Clarity in Documentation
P.O. Box 1212
Dublin, Ohio 43017-6221
trovato@corporation.com

G.K.M. Tobin
Institute for Clarity in Documentation
P.O. Box 1212
Dublin, Ohio 43017-6221
webmaster@marysville-ohio.com

Gregor von Laszewski
Indiana University
Smith Research Center
Bloomington, IN 47408, USA
laszewski@gmail.com

ABSTRACT

This paper provides a sample of a LaTeX document which conforms, somewhat loosely, to the formatting guidelines for ACM SIG Proceedings.

KEYWORDS

Big Data, Edge Computing i523

1 INTRODUCTION

Put here an introduction about your topic. We just need one sample refernce so the paper compiles in LaTeX so we put it here [**?**].

2 FIGURES

In Figure 1 we show a fly. Please note that because we use just columwidth that the size of the figure will change to the columnwidth of the paper once we change the layout to final. CHnaging the layout to final should not be done by you. All figures will be listed at the end.

[Figure 1 about here.]

When copying the example, please do not check in the images from the examples into your images directory as you will not need them for your paper. Instead use images that you like to include. If you do not have any images, do not dreate the images folder.

3 TABLES

In case you need to create tables, you can do this with online tools (if you do not mind sharing your data) such as https://www.tablesgenerator.com/ or other such tools (please google for them). They even allow you to manage tables as CSV.

or generate them by hand while using the provided template in Table**??**. Not ethat the caption is before the tabular environment.

[Table 1 about here.]

4 LONG EXAMPLE

If you like to see a more elaborate example, please look at report-long.tex.

5 CONCLUSION

Put here an conclusion. Conlcusions and abstracts must not have any citations in the section.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

REFERENCES

We include an appendix with common issues that we see when students submit papers. One particular important issue is not to use the underscore in bibtex labels. Sharelatex allows this, but the proceedings script we have does not allow this.

When you submit the paper you need to address each of the items in the issues.tex file and verify that you have done them. Please do this only at the end once you have finished writing the paper. To d this cange TODO with DONE. However if you check something on with DONE, but we find you actually have not executed it correcty, you will receive point deductions. Thus it is important to do this correctly and not just 5 minutes before the deadline. It is better to do a late submission than doing the check in haste.

A ISSUES

DONE:

Example of done item: Once you fix an item, change TODO to DONE

A.1 Assignment Submission Issues

Do not make changes to your paper during grading, when your repository should be frozen.

A.2 Uncaught Bibliography Errors

Missing bibliography file generated by JabRef

Bibtex labels cannot have any spaces, _ or & in it

Citations in text showing as [?]: this means either your report.bib is not up-to-date or there is a spelling error in the label of the item you want to cite, either in report.bib or in report.tex

A.3 Formatting

Incorrect number of keywords or HID and i523 not included in the keywords

Other formatting issues

A.4 Writing Errors

Errors in title, e.g. capitalization

Spelling errors

Are you using *a* and *the* properly?

Do not use phrases such as *shown in the Figure below.* Instead, use *as shown in Figure 3*, when referring to the 3rd figure

Do not use the word *I* instead use *we* even if you are the sole author

Do not use the phrase *In this paper/report we show* instead use *We show.* It is not important if this is a paper or a report and does not need to be mentioned

If you want to say *and* do not use *&* but use the word *and*

Use a space after . , :

When using a section command, the section title is not written in all-caps as format does this for you

`\section{Introduction}` and NOT `\section{INTRODUCTION}`

A.5 Citation Issues and Plagiarism

It is your responsibility to make sure no plagiarism occurs. The instructions and resources were given in the class

Claims made without citations provided

Need to paraphrase long quotations (whole sentences or longer)

Need to quote directly cited material

A.6 Character Errors

Erroneous use of quotation marks, i.e. use “quotes” , instead of ” ”

To emphasize a word, use *emphasize* and not “quote”

When using the characters & # % _ put a backslash before them so that they show up correctly

Pasting and copying from the Web often results in non-ASCII characters to be used in your text, please remove them and replace accordingly. This is the case for quotes, dashes and all the other special characters.

If you see a ffigure and not a figure in text you copied from a text that has the fi combined as a single character

A.7 Structural Issues

Acknowledgement section missing

Incorrect README file

In case of a class and if you do a multi-author paper, you need to add an appendix describing who did what in the paper

The paper has less than 2 pages of text, i.e. excluding images, tables and figures

The paper has more than 6 pages of text, i.e. excluding images, tables and figures

Do not artificially inflate your paper if you are below the page limit

A.8 Details about the Figures and Tables

Capitalization errors in referring to captions, e.g. Figure 1, Table 2

Do use *label* and *ref* to automatically create figure numbers

Wrong placement of figure caption. They should be on the bottom of the figure

Wrong placement of table caption. They should be on the top of the table

Images submitted incorrectly. They should be in native format, e.g. .graffle, .pptx, .png, .jpg

Do not submit eps images. Instead, convert them to PDF

The image files must be in a single directory named ”images”

In case there is a powerpoint in the submission, the image must be exported as PDF

Make the figures large enough so we can read the details. If needed make the figure over two columns

Do not worry about the figure placement if they are at a different location than you think. Figures are allowed to ffloat. For this class, you should place all figures at the end of the report.

In case you copied a figure from another paper you need to ask for copyright permission. In case of a class paper, you must include a reference to the original in the caption

Remove any figure that is not referred to explicitly in the text (As shown in Figure ..)

Do not use textwidth as a parameter for includegraphics

Figures should be reasonably sized and often you just need to add columnwidth

e.g.

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[2]

List of Figures

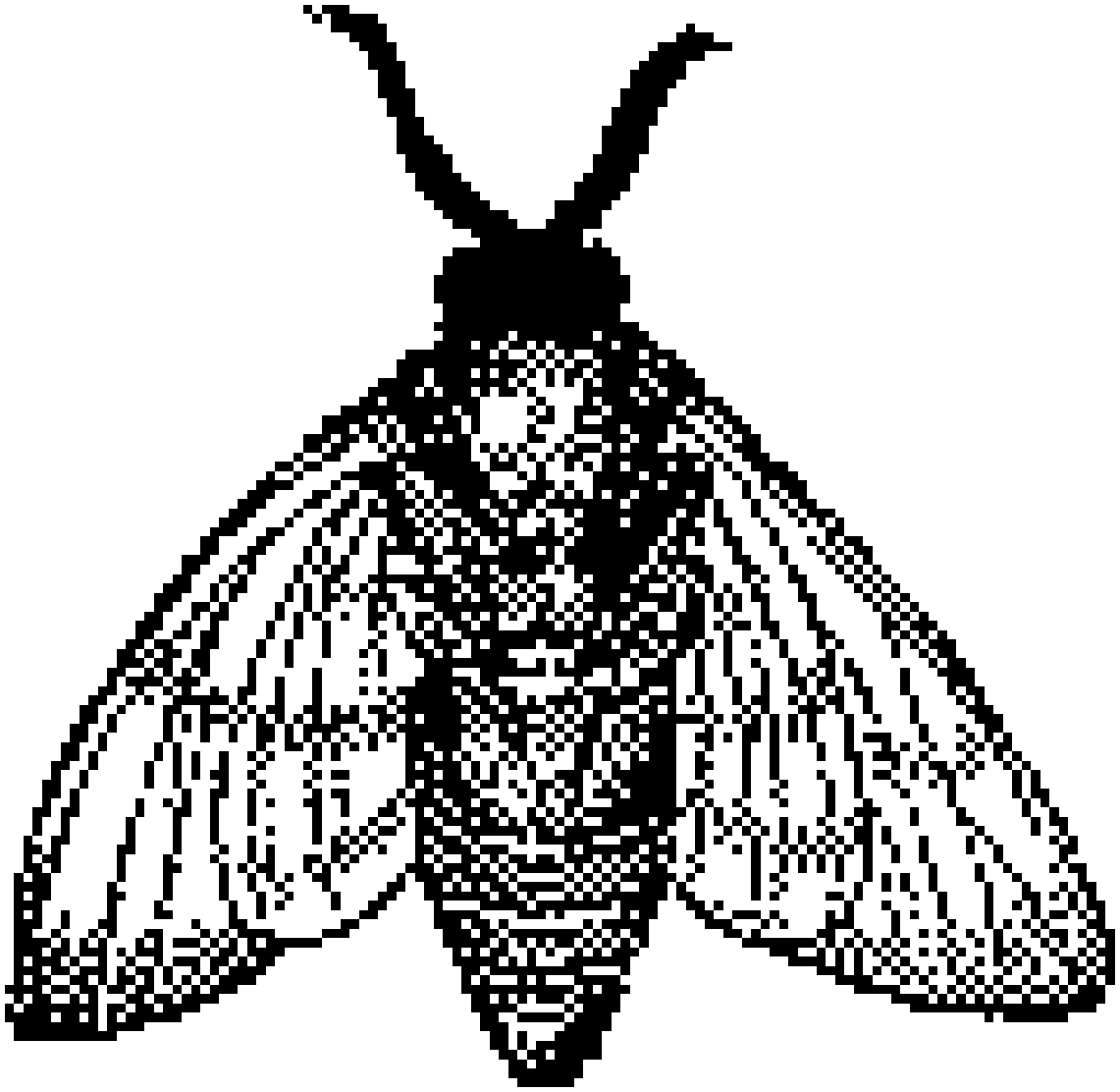

Figure 1: Example caption

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List of Tables

Table 1: My caption

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51:81     error    line too long (87 > 80 characters)  (line-length)
51:87     error    trailing spaces  (trailing-spaces)
52:81     error    line too long (87 > 80 characters)  (line-length)
53:81     error    line too long (91 > 80 characters)  (line-length)
53:91     error    trailing spaces  (trailing-spaces)
54:81     error    line too long (88 > 80 characters)  (line-length)
55:81     error    line too long (88 > 80 characters)  (line-length)
55:88     error    trailing spaces  (trailing-spaces)
56:66     error    trailing spaces  (trailing-spaces)
63:24     error    trailing spaces  (trailing-spaces)
```

```
Compliance Report
================================================================================

name: Shiqi Shen
hid:  109
paper1: 100% Oct 27th
paper2: in progress 50%
project: in progress

yamlcheck
================================================================================

wordcount
================================================================================
6
wc 109 paper2 6 518 report.tex
wc 109 paper2 6 1163 report.pdf
wc 109 paper2 6 50 report.bib

find "
================================================================================
passed: True

find footnote
================================================================================
passed: True

find input{format/i523}
================================================================================
4: \input{format/i523}

passed: True

floats
================================================================================
67: In Figure \ref{f:fly} we show a fly. Please note that because we use
73: \begin{figure}[!ht]
74:   \centering\includegraphics[width=\columnwidth]{images/fly.pdf}
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figures 1
tables 1
includegraphics 1
```

```
labels 2
refs 2
floats 2

True : ref check passed: (refs >= figures + tables)
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True : include graphics passed: (figures >= includegraphics)

Label/ref check
passed: True

bibtex
================================================================================

label errors


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Database file #1: report.bib
Warning--I didn't find a database entry for "editor00"
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bibtex_empty_fields
================================================================================

entries in general should not be empty in bibtex


find ""
================================================================================
15: note            = "",

passed: False

ascii
================================================================================
```

Big Data for Edge Computing

Ben Trovato
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P.O. Box 1212
Dublin, Ohio 43017-6221
trovato@corporation.com

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re

2

List of Figures

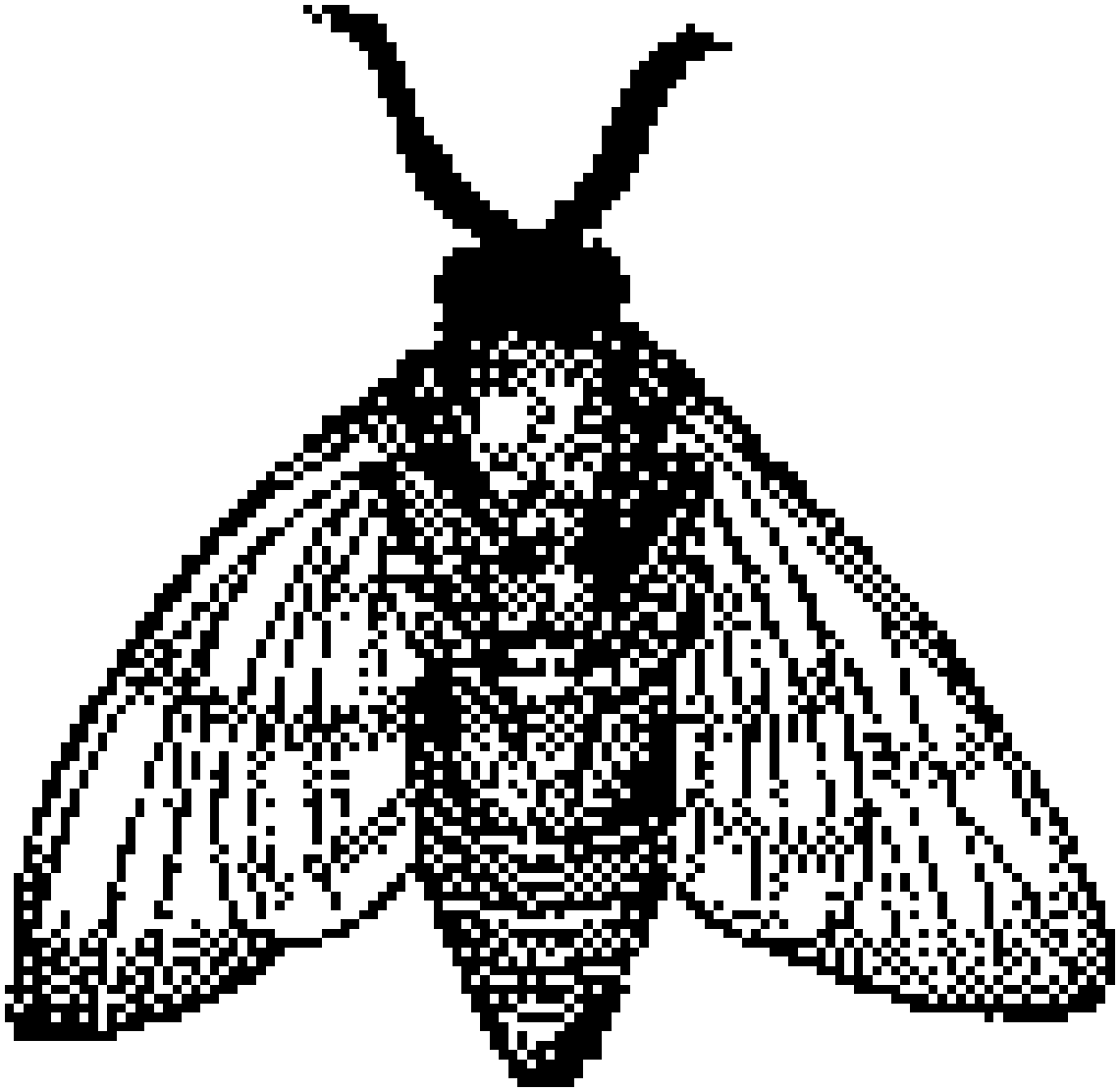

Figure 1: Example caption

4

List of Tables

Table 1: My caption

1	2	3
4	5	6
7	8	9

```
bibtext report
==========================================

This is BibTeX, Version 0.99d (TeX Live 2016)
The top-level auxiliary file: report.aux
The style file: ACM-Reference-Format.bst
Database file #1: report.bib
Warning--I didn't find a database entry for "editor00"
(There was 1 warning)

bibtext _ label error
==========================================


bibtext space label error
==========================================


bibtext comma label error
==========================================


latex report
==========================================

        [2017-11-03 08.16.31] pdflatex report.tex
This is pdfTeX, Version 3.14159265-2.6-1.40.17 (TeX Live 2016) (preloaded format=pdflate
p.1   L62   : [editor00] undefined
p.1   L89   : 't:mytable' undefined
Empty `thebibliography' environment.
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
There were undefined citations.
bookmark level for unknown  defaults to 0.
The anchor of a bookmark and its parent's must not be the same. Added a new anchor.
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There were undefined references.
Typesetting of "report.tex" completed in 1.2s.
../README.yml
  9:81      error    line too long (83 > 80 characters)  (line-length)
  10:81     error    line too long (81 > 80 characters)  (line-length)
```

```
  11:81     error    line too long (82 > 80 characters)  (line-length)
  12:81     error    line too long (81 > 80 characters)  (line-length)
  13:81     error    line too long (81 > 80 characters)  (line-length)

Compliance Report
================================================================================

name: Arnav, Arnav
hid:  201
paper1: 20th Oct 2017 100%
paper2: not started
project: not started

yamlcheck
================================================================================

wordcount
================================================================================
6
wc 201 paper2 6 518 report.tex
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figures 1
tables 1
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Big Data for Edge Computing

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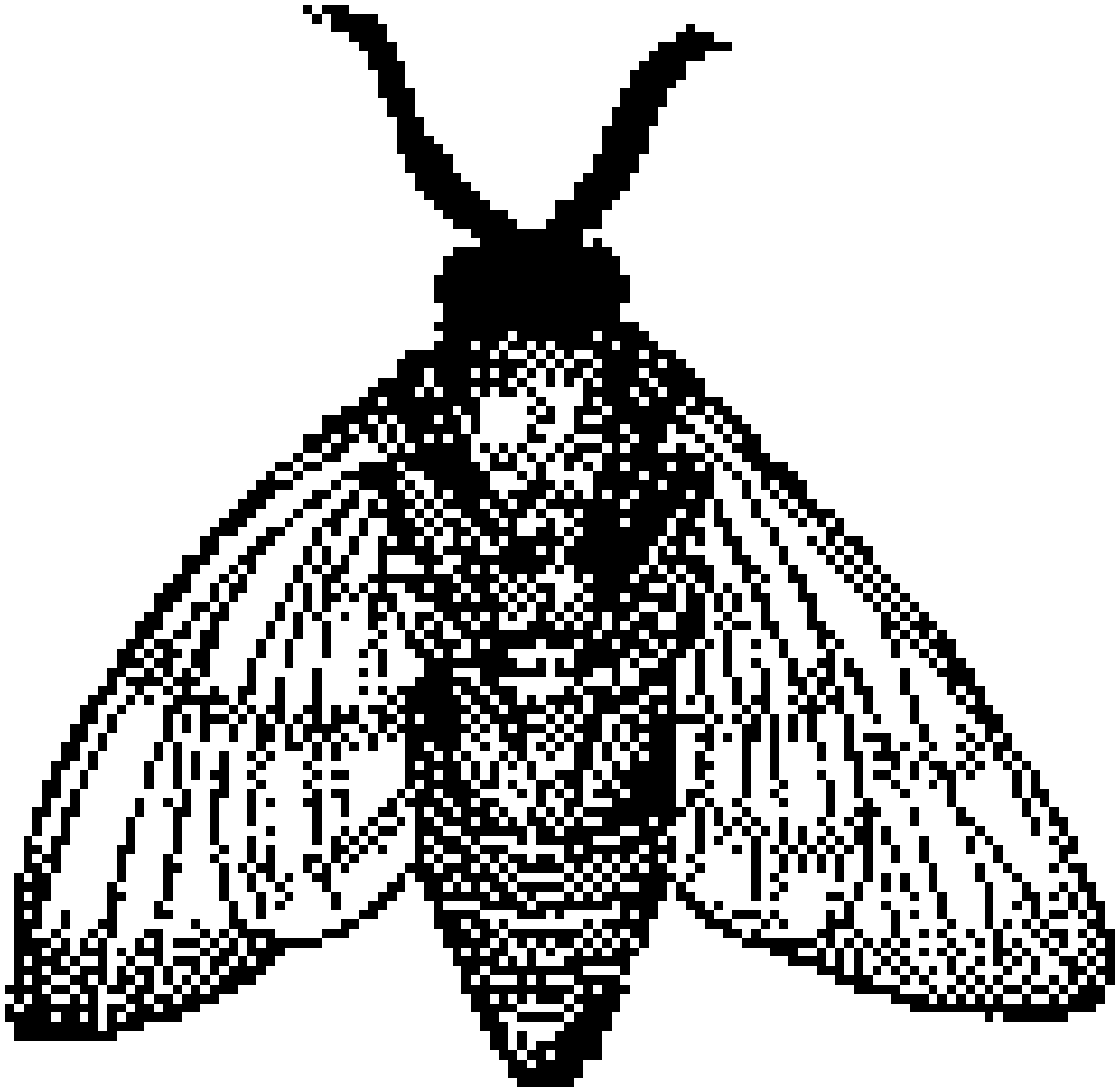

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==========================================

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Compliance Report
================================================================================

name: Niu, Geng
hid:  218
paper1: 100%
paper2: in progress

yamlcheck
================================================================================

wordcount
================================================================================
(null)
wc 218 paper2 (null) 518 report.tex
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e.g.

`/includegraphics[width=\columnwidth]{images/myimage.pdf}`

re

List of Figures

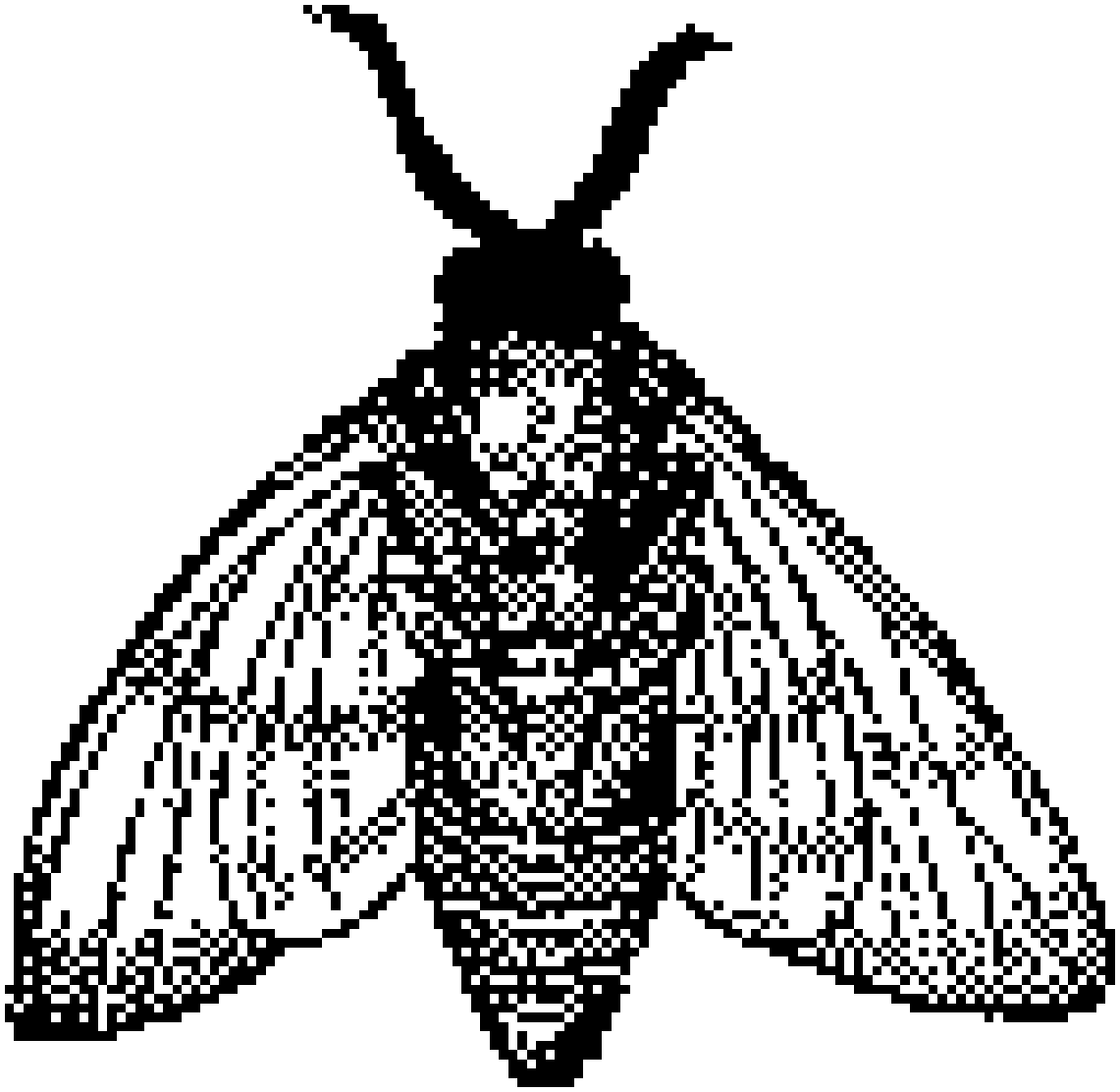

Figure 1: Example caption

4

List of Tables

Table 1: My caption

1	2	3
4	5	6
7	8	9

Big Data Applications in Aviation Industry

Swargam, Prashanth
Indiana University Bloomington
107 S Indiana Ave
Bloomington, Indiana 47408
pswargam@iu.edu

ABSTRACT

Data generated by aviation industry is being increased enormously. The data generated by all the components of aviation industry can be analysed for reducing the operational costs, predict customer behaviour, analyse customer satisfaction. These applications of big data in aviation industry makes it a prominent player. Hence, collecting this data, storing and processing them for desired results can help the aviation industry in boosting their profits and improve customer satisfaction.Various applications of Big data, their challenges and models are discussed here.

KEYWORDS

HID228, I523, Big Data, Aviation Industry,Analytics ,

```
bibtext report
=========================================

This is BibTeX, Version 0.99d (TeX Live 2016)
The top-level auxiliary file: report.aux
I found no \citation commands---while reading file report.aux
I found no \bibstyle command---while reading file report.aux
(There were 2 error messages)
make[2]: *** [bibtex] Error 2

latex report
=========================================

        [2017-11-03 08.16.47] pdflatex report.tex
This is pdfTeX, Version 3.14159265-2.6-1.40.17 (TeX Live 2016) (preloaded format=pdflate
Typesetting of "report.tex" completed in 0.8s.
../README.yml
  8:81      error    line too long (133 > 80 characters)  (line-length)
  9:81      error    line too long (110 > 80 characters)  (line-length)
  9:110     error    trailing spaces  (trailing-spaces)
  10:81     error    line too long (87 > 80 characters)  (line-length)
  10:87     error    trailing spaces  (trailing-spaces)
  11:81     error    line too long (114 > 80 characters)  (line-length)
  11:114    error    trailing spaces  (trailing-spaces)
  12:81     error    line too long (114 > 80 characters)  (line-length)
  13:81     error    line too long (169 > 80 characters)  (line-length)
  13:169    error    trailing spaces  (trailing-spaces)
  14:81     error    line too long (155 > 80 characters)  (line-length)

Compliance Report
=========================================================================

name: Swargam, Prashanth
hid:  228
paper1: Oct 20 17  100%
paper2: in progress

yamlcheck
=========================================================================

wordcount
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1
wc 228 paper2 1 570 report.tex
wc 228 paper2 1 504 report.pdf
```

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wc 228 paper2 1 261 report.bib

find "
================================================================================
passed: True

find footnote
================================================================================
13: \renewcommand\footnotetextcopyrightpermission[1]{} % removes
    footnote with conference information in first column

passed: False

find input{format/i523}
================================================================================
4: \input{format/i523}

passed: True

floats
================================================================================

figures 0
tables 0
includegraphics 0
labels 0
refs 0
floats 0

True : ref check passed: (refs >= figures + tables)
True : label check passed: (refs >= figures + tables)
True : include graphics passed: (figures >= includegraphics)

Label/ref check
passed: True

bibtex
================================================================================

label errors


bibtex errors

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bibtex_empty_fields
================================================================================

entries in general should not be empty in bibtex


find ""
================================================================================
passed: True

ascii
================================================================================
```

Big Data for Edge Computing

Ben Trovato
Institute for Clarity in Documentation
P.O. Box 1212
Dublin, Ohio 43017-6221
trovato@corporation.com

G.K.M. Tobin
Institute for Clarity in Documentation
P.O. Box 1212
Dublin, Ohio 43017-6221
webmaster@marysville-ohio.com

Gregor von Laszewski
Indiana University
Smith Research Center
Bloomington, IN 47408, USA
laszewski@gmail.com

ABSTRACT

This paper provides a sample of a LaTeX document which conforms, somewhat loosely, to the formatting guidelines for ACM SIG Proceedings.

KEYWORDS

Big Data, Edge Computing i523

1 INTRODUCTION

Put here an introduction about your topic. We just need one sample refernce so the paper compiles in LaTeX so we put it here [**?**].

2 FIGURES

In Figure 1 we show a fly. Please note that because we use just columwidth that the size of the figure will change to the columnwidth of the paper once we change the layout to final. CHnaging the layout to final should not be done by you. All figures will be listed at the end.

[Figure 1 about here.]

When copying the example, please do not check in the images from the examples into your images directory as you will not need them for your paper. Instead use images that you like to include. If you do not have any images, do not dreate the images folder.

3 TABLES

In case you need to create tables, you can do this with online tools (if you do not mind sharing your data) such as https://www.tablesgenerator.com/ or other such tools (please google for them). They even allow you to manage tables as CSV.

or generate them by hand while using the provided template in Table**??**. Not ethat the caption is before the tabular environment.

[Table 1 about here.]

4 LONG EXAMPLE

If you like to see a more elaborate example, please look at report-long.tex.

5 CONCLUSION

Put here an conclusion. Conlcusions and abstracts must not have any citations in the section.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

REFERENCES

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A ISSUES

DONE:

Example of done item: Once you fix an item, change TODO to DONE

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Missing bibliography file generated by JabRef

Bibtex labels cannot have any spaces, _ or & in it

Citations in text showing as [?]: this means either your report.bib is not up-to-date or there is a spelling error in the label of the item you want to cite, either in report.bib or in report.tex

A.3 Formatting

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Other formatting issues

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Use a space after . , :

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`\section{Introduction}` and NOT `\section{INTRODUCTION}`

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Need to paraphrase long quotations (whole sentences or longer)

Need to quote directly cited material

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A.7 Structural Issues

Acknowledgement section missing

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The paper has more than 6 pages of text, i.e. excluding images, tables and figures

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Wrong placement of table caption. They should be on the top of the table

Images submitted incorrectly. They should be in native format, e.g. .graffle, .pptx, .png, .jpg

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e.g.

`/includegraphics[width=\columnwidth]{images/myimage.pdf}`

re

[2]

List of Figures

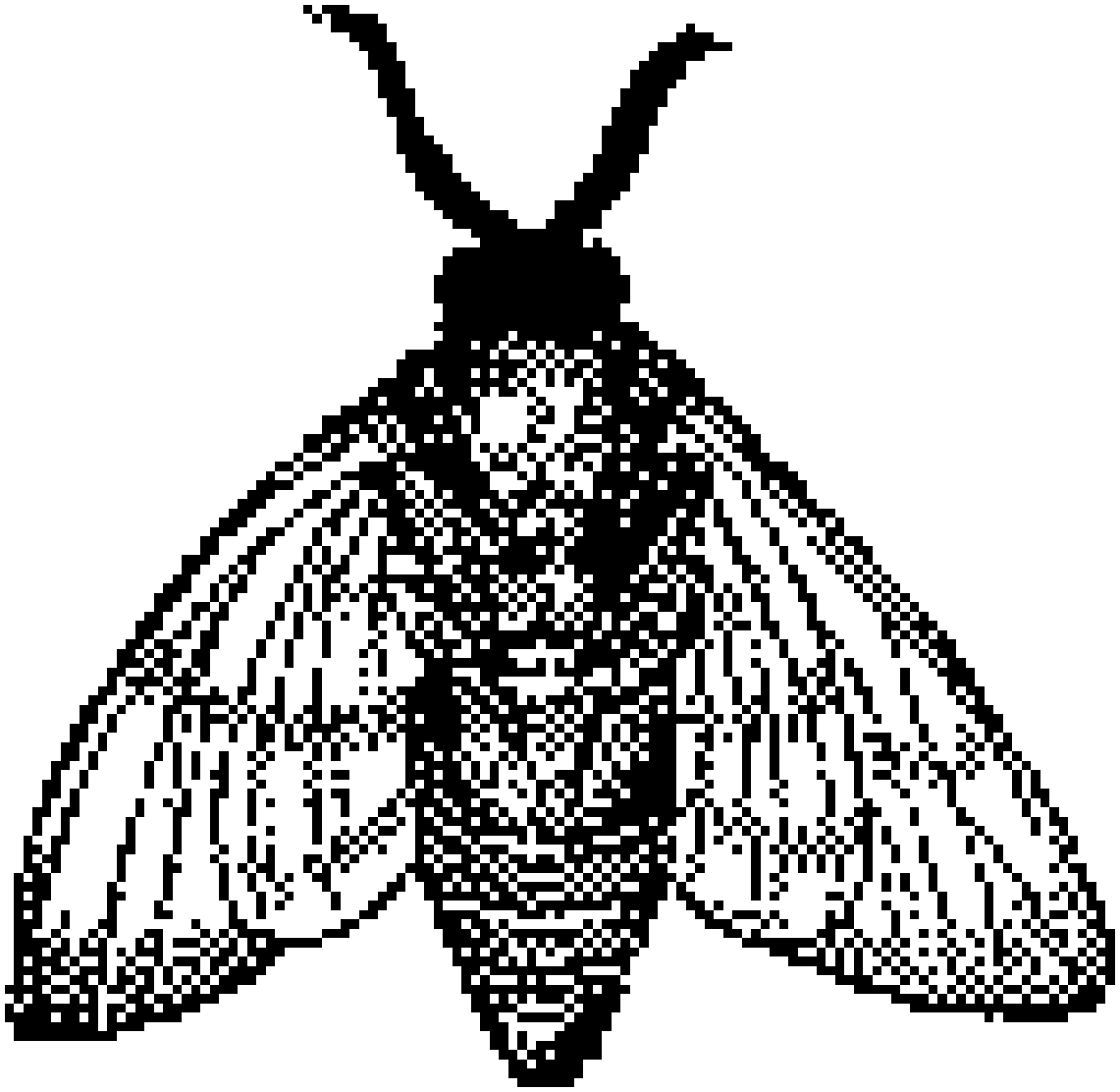

Figure 1: Example caption

4

List of Tables

Table 1: My caption

1	2	3
4	5	6
7	8	9

```
bibtext report
==========================================

This is BibTeX, Version 0.99d (TeX Live 2016)
The top-level auxiliary file: report.aux
The style file: ACM-Reference-Format.bst
Database file #1: report.bib
Warning--I didn't find a database entry for "editor00"
(There was 1 warning)

bibtext _ label error
==========================================


bibtext space label error
==========================================


bibtext comma label error
==========================================


latex report
==========================================

        [2017-11-03 08.17.05] pdflatex report.tex
This is pdfTeX, Version 3.14159265-2.6-1.40.17 (TeX Live 2016) (preloaded format=pdflate
p.1   L62   : [editor00] undefined
p.1   L89   : 't:mytable' undefined
Empty `thebibliography' environment.
Missing character: ""
Missing character: ""
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Missing character: ""
Missing character: ""
Missing character: ""
There were undefined citations.
bookmark level for unknown  defaults to 0.
The anchor of a bookmark and its parent's must not be the same. Added a new anchor.
The anchor of a bookmark and its parent's must not be the same. Added a new anchor.
There were undefined references.
Typesetting of "report.tex" completed in 1.2s.
../README.yml
  9:81      error    line too long (86 > 80 characters)  (line-length)
  19:1      error    trailing spaces  (trailing-spaces)
```

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  22:81     error    line too long (89 > 80 characters)  (line-length)
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  34:1      error    trailing spaces  (trailing-spaces)
  37:81     error    line too long (88 > 80 characters)  (line-length)
  37:88     error    trailing spaces  (trailing-spaces)
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  38:87     error    trailing spaces  (trailing-spaces)
  39:49     error    trailing spaces  (trailing-spaces)
  46:9      error    trailing spaces  (trailing-spaces)

Compliance Report
================================================================================

name: Wu, Yujie
hid:  235
paper1: 100%, 10/27/2017
paper2: in progress

yamlcheck
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wordcount
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wc 235 paper2 6 518 report.tex
wc 235 paper2 6 1163 report.pdf
wc 235 paper2 6 50 report.bib

find "
================================================================================
passed: True

find footnote
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passed: True

find input{format/i523}
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4: \input{format/i523}
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passed: True

floats
================================================================================
67: In Figure \ref{f:fly} we show a fly. Please note that because we use
73: \begin{figure}[!ht]
74:   \centering\includegraphics[width=\columnwidth]{images/fly.pdf}
75:   \caption{Example caption}\label{f:fly}
90: or generate them by hand while using the provided template in Table\ref{t:mytable}.
93: \begin{table}[htb]
96: \label{t:mytabble}

figures 1
tables 1
includegraphics 1
labels 2
refs 2
floats 2

True : ref check passed: (refs >= figures + tables)
True : label check passed: (refs >= figures + tables)
True : include graphics passed: (figures >= includegraphics)

Label/ref check
passed: True

bibtex
================================================================================

label errors


bibtex errors

Database file #1: report.bib
Warning--I didn't find a database entry for "editor00"
(There was 1 warning)

bibtex_empty_fields
================================================================================

entries in general should not be empty in bibtex


find ""
================================================================================
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15: note            = "",

passed: False

ascii
================================================================================
```

Hadoop and MongoDB in support of Big Data Applications and Analytics

Sushant Athaley
Indiana University
sathaley@iu.edu

ABSTRACT

Big data processing is beyond capability of traditional tool. It requires specialized tools like Hadoop and MongoDB. We will explore Haddop and MongoDB technically as a tool and how they provide support/help in big data analysis. TBD

KEYWORDS

i523, hid302, big data, Hadoop, MongoDB

1 INTRODUCTION

Describe about big data, hadoop and mongodb. Describe what this paper will do. Papers organization.

2 BIG DATA

Big Data is defined in lot many different ways but one of the interesting ways it has been defined is in terms of three V's which are Volume, Velocity, and Variety. Big data is generated in great *volume* typically in the gigabyte or more which makes data processing difficult. Data *velocity* has been increased due to the real-time data streaming from various applications like social media or different type of sensors recording data continuously. Big data comes in *variety* of format like structured or unstructured data. Data varies in various format like text, pictures, audio, videos, 3D, social media and so on. These big data characteristics pose challenges in terms of overall data lifecycle management. Some of the examples of big data usage are the recommendation service, predictive analytics, data analytics, pattern identification, and machine learning. Traditional systems are good for small or medium data processing but unable to provide support for the big data. Big data need specialized technologies and tools to handle its characteristics. The technologies which can solve big data problem should have capabilities like distributed computing system, massively parallel processing, NoSQL, and analytical database [1, Ch. 1, p. 4]. Can Hadoop or MongoDB be those technologies who can provide that support?

3 HADOOP

introduce hadoop, architecture, support to big data, real life examples Apache foundation describes Hadoop as "The Apache Hadoop software library is a framework that allows for the distributed processing of large data sets across clusters of computers using simple programming models. It is designed to scale up from single servers to thousands of machines, each offering local computation and storage. Rather than rely on hardware to deliver high-availability, the library itself is designed to detect and handle failures at the application layer, so delivering a highly-available service on top of a cluster of computers, each of which may be prone to failures" [2]. In other words, Hadoop provides a framework to store data in the distributed manner and provides the capability to run data analysis in the distributed way.

"Currently Hadoop project includes following modules:

- **Hadoop Common**: The common utilities that support the other Hadoop modules.
- **Hadoop Distributed File System (HDFS)**: A distributed file system that provides high-throughput access to application data.
- **Hadoop YARN**: A framework for job scheduling and cluster resource management.
- **Hadoop MapReduce**: A YARN-based system for parallel processing of large data sets" [2].

3.1 Hadoop Common

3.2 Hadoop Distributed File System (HDFS)

Hadoop Distributed File System (HDFS) is the default distributed file system provided by the Hadoop. HDFS serves as storage mechanism in the Hadoop framework. HDFC specifically designed to process large data set and run on low cost hardware. It is high fault tolerant which contains mechanism for quick fault detection and auto recovery. HDFS is designed to port across heterogeneous hardware and software platform. It does data computation on same node instead of moving data to the server which is faster as well as avoid network congestion. It provides scalability by adding or removing nodes in the HDFS cluster and can support hundreds of nodes in single cluster [3]. Figure 1 shows HDFS architecture.

[Figure 1 about here.]

HDFS is based on master/slave architecture where NameNode is the master server and DataNodes are the slave nodes. There can be only one NameNode server which manages file system name space and all read write requests. NameNode doesn't store any data but contains all the meta-data about files and DataNodes. DataNode contains actual data and they can be multiple in numbers usually one per node. DataNodes are responsible for the create, delete, replicate of the datablocks on the node as per the instruction by the NameNode. It also sends heartbeat message to NameNode which helps in identifing the failure nodes. If heartbeat is not received by NameNode in specified interval then that DataNode is marked as dead and NameNode usage different DataNode.

3.3 Hadoop YARN

3.4 Hadoop MapReduce

3.5 Big Data Support

4 MONGODB

5 TABLES

In case you need to create tables, you can do this with online tools (if you do not mind sharing your data) such as https://www.tablesgenerator.com/ or other such tools (please google for them). They even allow you to manage tables as CSV.

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[Table 1 about here.]

6 LONG EXAMPLE

If you like to see a more elaborate example, please look at report-long.tex.

7 CONCLUSION

Put here an conclusion. Conlcusions and abstracts must not have any citations in the section.

ACKNOWLEDGMENTS

The authors would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

REFERENCES

[1] Shiva Achari. 2015. *Hadoop Essentials.* Packt Publishing, Birmingham.
[2] Apache. [n. d.]. Apache Hadoop. ([n. d.]). http://hadoop.apache.org/
[3] Apache. 2017. HDFS Architecture. web. (2017). http://hadoop.apache.org/docs/current/hadoop-project-dist/hadoop-hdfs/HdfsDesign.html

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```
\section{Introduction} and NOT \section{INTRODUCTION}
```

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e.g.

```
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```

re

[3]

List of Figures

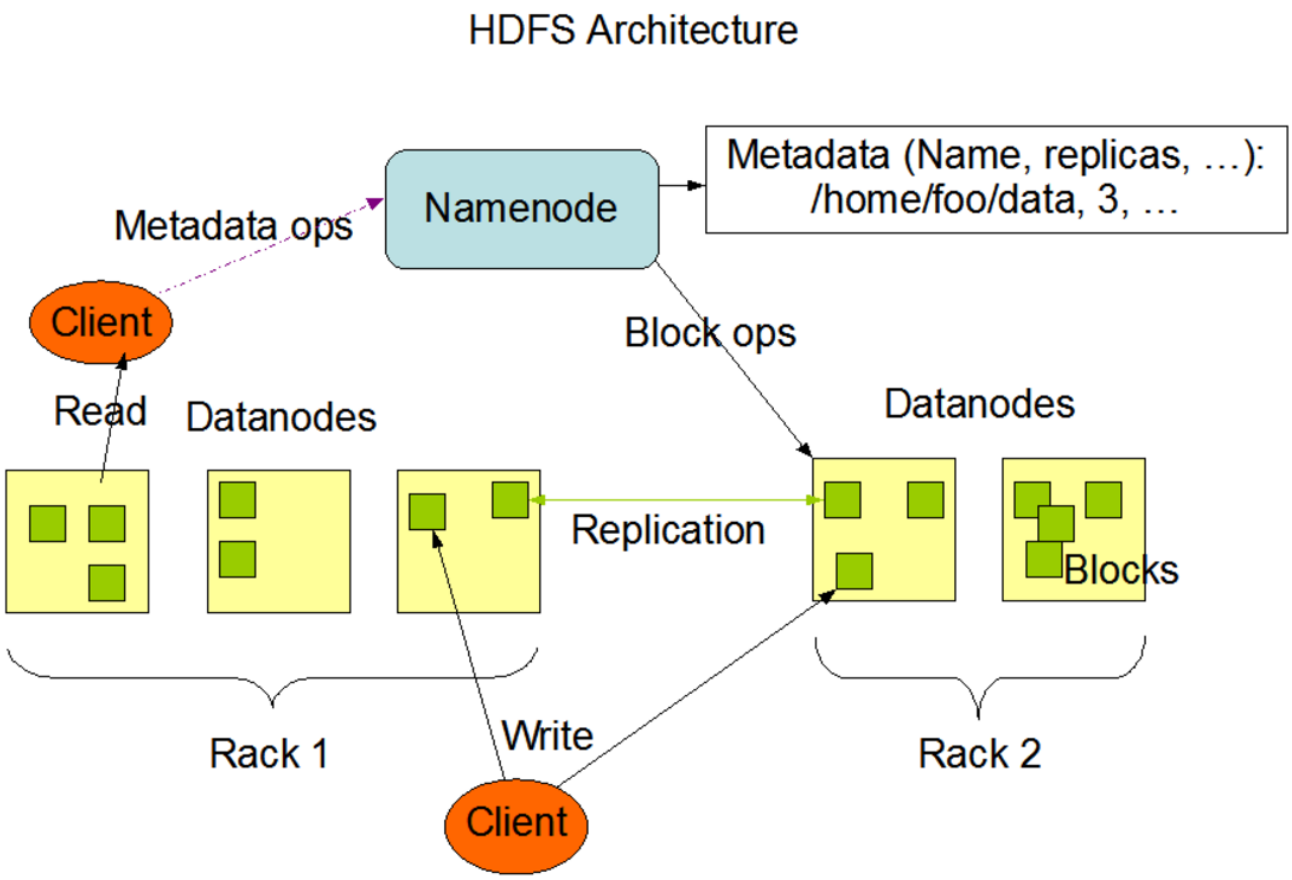

Figure 1: HDFS Architecture [3]

5

List of Tables

Table 1: My caption

1	2	3
4	5	6
7	8	9

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bibtext report
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This is BibTeX, Version 0.99d (TeX Live 2016)
The top-level auxiliary file: report.aux
The style file: ACM-Reference-Format.bst
Database file #1: report.bib
Warning--empty year in www-hadoop
(There was 1 warning)

bibtext _ label error
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bibtext space label error
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bibtext comma label error
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latex report
=========================================

        [2017-11-03 08.17.11] pdflatex report.tex
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p.2   L77   : 't:mytable' undefined
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
bookmark level for unknown  defaults to 0.
The anchor of a bookmark and its parent's must not be the same. Added a new anchor.
The anchor of a bookmark and its parent's must not be the same. Added a new anchor.
There were undefined references.
Typesetting of "report.tex" completed in 1.3s.
Compliance Report
=============================================================================

name: Sushant Athaley
hid:  302
paper1: Nov 3 2017 100%
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paper2: 30%

yamlcheck
================================================================================

wordcount
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7
wc 302 paper2 7 1042 report.tex
wc 302 paper2 7 1701 report.pdf
wc 302 paper2 7 195 report.bib

find "
================================================================================
passed: True

find footnote
================================================================================
passed: True

find input{format/i523}
================================================================================
4: \input{format/i523}

passed: True

floats
================================================================================
54: Hadoop Distributed File System (HDFS) is the default distributed file system provide
55: \begin{figure}[!ht]
56:   \centering\includegraphics[width=\columnwidth]{images/hdfsArch.PNG}
57:   \caption{HDFS Architecture \cite{www-hdfs-arch}}\label{f:hdfs-arch}
78: or generate them by hand while using the provided template in Table\ref{t:mytable}.
81: \begin{table}[htb]
84: \label{t:mytabble}

figures 1
tables 1
includegraphics 1
labels 2
refs 2
floats 2

True : ref check passed: (refs >= figures + tables)
True : label check passed: (refs >= figures + tables)
True : include graphics passed: (figures >= includegraphics)
```

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passed: True

bibtex
================================================================================

label errors


bibtex errors

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Big Data Applications in Historical Studies

Neil Eliason
Indiana Unversity
Anderson, Indiana

ABSTRACT

KEYWORDS

i523, HID 312, Big Data, History

1 INTRODUCTION

1.1 Big Data

Big data attention and success stories. Driven by More's Law.

Big data to date can claim numerous victories in a variety of fields, and promises more. Businesses such as Facebook and Netflix have built corporate empires off of the insights gathered from their big data, and physicists and biologists are learning what makes up the universe and ourselves via big data [1].

Despite all this, the concept itself is rather nebulously defined. A rough description of is data with quantitative factors that require specialized techniques to utilize. The most commonly referenced big data factors are volume (amount of data), variety (number of data source types), and velocity (rate of data collection or input) known as the three vs. While this definition is generally accepted, its application varies based upon the industry or field of study and often changes with developments in information technology [5].

The focus on big data arises partially from the phenomenon of data storage capabilities growing at a faster rate than data processing. This creates a situation where data can be economically stored, but not as economically processed, requiring specialized analytic techniques. As big data progresses through the storage, cleaning, analysis, and interpretation stages of the data life cycle, specialized approaches are required [1].

DIKW Data lifecycle

1.2 History of History

The historian's labor has involved interacting with voluminous and varied data for centuries. Before computers, this process involved searching physical archives for relevant data, and manually copying and organizing it into useful information to be analyzed. Though this method can deliver deep insights, some data sets are too big to be studied in a manual fashion [7].

Around the mid-twentieth century, computers had become sufficiently powerful and usable for historians to begin using them to process larger amounts of information. This facilitated a change towards a more quantitative approach and a focus by some from tracing the rise and fall of political or ideological forces, to developing a more complete understanding of mundane topics, such as the family or economics.

Now as archives become digitized and accessible via the internet, the quantity of data available leads to the appeal to big data analytic methods [4]. The potential of unlocking significant connections and developing big picture historical insights at the scale of the growing digital archives of the world is alluring. This hope has driven the labor of many researchers towards developing more big data informed research methods and has directed funds of many institutions towards investments in data infrastructure. However, many are also concerned that the promises of big data are at best optimistic, and at worst hiding potential pitfalls to the historical process [7].

1.3 Thesis

Big Data Analytics have the potential to provide new insights to the field of historical studies. However, their application will differ due to the nature of historical data, and they will serve as an additional tool for the historian, rather than the only tool.

2 BIG DATA IN HISTORICAL STUDIES

2.1 Data Sources

Source types

Methods to get information from data

Methods different from streaming data It could be argued that the seeds of big data history have long laid dormant in archives and libraries, waiting to be germinated by sufficient computational capabilities to process them. As big data analytics mature, pressure develops to make more data available for analysis by digitizing more archival material. This is evidenced not only by the familiar repositories of e-books, but also by archives containing millions of pages from newspapers [7] centuries of letters [4], and

Sources for big data research consist not only of the content of documents in an archive, but also the bibliographical records.While originally designed to allow individual works to be located in an archive, historians have began to study the bibliographical data themselves, an approach called distant reading. By looking at the data about a document, rather than the document's content, societal or intellectual trends can be identified across large scale factors such as time or geography in a more comprehensive way. This approach has elicited some criticism that collections of bibliographical data are not complete enough to derive such large-scale conclusions. Still, considerable interest exist in targeting these data sets for historical analysis [10].

However, the data from these sources differs from that of other fields which utilize big data analytics. Historical data is not streaming the way that social media or smartphone sensors are. It is data which has already been collected, organized, and often times analyzed for a purpose defined by people from a different time and different needs/constraints from ourselves. This creates data sets which are difficult to compare and often require considerable cleaning and reworking to be used in a larger framework. [4].

2.2 Analytics for Big Historical Data

Analytic Techniques

Due to the natural reliance on documents in historical studies, text analytic techniques are the primary set of big data approach utilized by historians. Text analytics is broad category of related algorithms and statistical techniques, such as artificial intelligence, machine learning, and natural language processing that attempt to extract specific information from the text and identify patterns and relationships within the body of data [7].

Artificial intelligence is "the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings"[2]. In the context of historical research, this would include tasks such as extracting relevant content from sources, identifying relationships within the data. A specific type of artificial intelligence is machine learning, which consists of programs which change their actions autonomously in response external input. Their ability to adapt allows them to do decision-making tasks, and thus can search through data sources in a more intelligent way to find relevant data [1]. Natural language processing is another artificial intelligence technique, which aims to create programs that can take human language, and make it machine readable [9]. Historians can use such programs connect archival documents to more complex analytic algorithms.

In order to interpret the results of big data analysis, visualization is critical. This is a challenge, as the large scale of the data makes striking a balance between a sufficiently big picture perspective without losing relevant details difficult. Many approaches attempt to utilize high resolution approaches to avoid losing important information [1]. This process is especially challenging in historical studies, as the data is often incomplete and may have inconsistencies which prevent assuming a uniform set of data. For this reason, historians often use visualizations to identify qualitative, rather than quantitative relationships in the data, to inform further inquiry [4].

2.3 Software Packages and Resources for Big Data History

A variety of software packages have been utilized to assist the process of translating raw data into historical insights, such as such as Tableau, Gephi, R, and ArcGIS. However, a limitation of these tools is their their quantitative focus, which tends to exclude more qualitative approaches [4].

Some software has been developed to provide a more qualitative visualization tool set for researchers.For example Stanford University developed a software package called Palladio, designed to visualize connections in large scale historical data. Their approach focused on visualizations that encouraged exploring data, rather than creating statistical statements about it. Examples of this would be mapping connections between historical actors over geography or creating a visualization of the social network of a particular figure in history. They do not create statistical arguments, rather they give a framework for understanding how the data are connected [6].

Another tool with a qualitative visualization focus is WAHSP. It was developed to extract data from the National Library of the Netherlands' newspaper archive, but has been utilized on a number of other databases as well. It provides a number of useful analyses, such as word frequency cloud visualizations, detecting positive or negative sentiment related to certain terms, and Named Entity Recognition, which can identify people, places, events, etc. and then connect them into a relational or geographical framework. It also provides an interactive histogram where the resolution of the data can be adjusted to quickly move between a big picture and detailed data perspective. A derivative project is BILAND, which is a program that can perform many of the analyses of WAHSP, but applies them across two languages, Dutch and German for comparative cultural studies [7].

Along with these data intensive tools specifically designed for historical studies, there are also resources to help the historian learn some of these methods. For example, The Programming Historian website provides a wide range of tutorials and lessons on how to use digital tools in historical studies. At the time of this writing there were 67 lessons available organized by their target stage of research, including lessons on using R, Python, Java, and GitHub [8].

2.4 Insights from Big Historical Data

A number of studies have used these techniques to approach historical research from a big data perspective. Stanford's Mapping of the Republic of Letters project sought to map the social network of Enlightenment thinkers who actively corresponded with each other. This was accomplished by utilizing big data analytics on the metadata of these letters to see how these thinkers related temporally, geographically, socially. Through the research process, the need for more qualitative approaches to visualization was recognized, and eventually led to the development of the Palladio tool set.

Their analysis revealed a number of interesting points. By mapping the social network of John Locke, they supported previous scholarly contentions that the Enlightenment culture was not homogeneously connected, but was made up of a number of subcultures which had thin social connections. Also, by analyzing Benjamin Franklin's letters, they noted that despite his reputation as cross cultural traveler, the main hub of his correspondence was between Philadelphia and London, which were major centers of British culture. [4] .

The WAHSP tool has also been used to analyze large data-sets. One researcher used the tool to study attitudes found towards drugs in the early 20th century newspapers. It found by using the word cloud analysis tool, that before 1924 that drugs such as heroin and opium were used in the context of health, but after 1924 they were associated with crime.

The related tool BILAND was used to study

3 POTENTIAL ISSUES

Opportunistic research: Data driven, not question driven [3], [4] Over-hyped Gaps in data sources Improperly formated data[4]

4 CONCLUSION

ACKNOWLEDGMENTS

The authors would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

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5 ISSUES

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5.1 Assignment Submission Issues

Do not make changes to your paper during grading, when your repository should be frozen.

5.2 Uncaught Bibliography Errors

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Bibtex labels cannot have any spaces, _ or & in it

Citations in text showing as [?]: this means either your report.bib is not up-to-date or there is a spelling error in the label of the item you want to cite, either in report.bib or in report.tex

5.3 Formatting

Incorrect number of keywords or HID and i523 not included in the keywords

Other formatting issues

5.4 Writing Errors

Errors in title, e.g. capitalization

Spelling errors

Are you using *a* and *the* properly?

Do not use phrases such as *shown in the Figure below.* Instead, use *as shown in Figure 3*, when referring to the 3rd figure

Do not use the word *I* instead use *we* even if you are the sole author

Do not use the phrase *In this paper/report we show* instead use *We show.* It is not important if this is a paper or a report and does not need to be mentioned

If you want to say *and* do not use *&* but use the word *and*

Use a space after . , :

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5.5 Citation Issues and Plagiarism

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Claims made without citations provided

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Need to quote directly cited material

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5.8 Details about the Figures and Tables

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Do use *label* and *ref* to automatically create figure numbers

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Images submitted incorrectly. They should be in native format, e.g. .graffle, .pptx, .png, .jpg

Do not submit eps images. Instead, convert them to PDF

The image files must be in a single directory named ”images”

In case there is a powerpoint in the submission, the image must be exported as PDF

Make the figures large enough so we can read the details. If needed make the figure over two columns

Do not worry about the figure placement if they are at a different location than you think. Figures are allowed to ffoat. For this class, you should place all figures at the end of the report.

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Big Health Data from Wearable Electronic Sensors (WES) and the Treatment of Opioid Addiction

Sean M. Shiverick
Indiana University Bloomington
smshiver@indiana.edu

ABSTRACT

Wearable electronic sensors (WES) generate to collect vital health data in the treatment of opioid addiction.

KEYWORDS

Big Data Applications, Health Analytics, Wearable Sensors, i535, HID335

1 INTRODUCTION

In the increasingly connected digital age, personal electronic devices are generating huge volumes of data with important applications for health analytics. Wearable electronic sensors (i.e., *wearables*) and fitness monitors (e.g, FitBit, iWatch) can record our movements and vital physiological measures such as heart rate, temperature, and blood pressure [**?**]. Consumers are using wearables to self-monitor stress and hypertension, and wearable sensors can be used to help track recovery following medical procedures such as surgery [**?**]. The development of personalized health care models are also enabling individuals to self-monitor and manage their own health in partnership with care providers. This paper explores approaches to using personal electronic devices and wearable sensors for the treatment of addiction disorders and the prevention of drug overdose. Past research has shown that *Mobile Health* platforms have been used to address prescription medication abuse in several ways: (a) monitor patient health conditions at any time and remotely, (b) monitor medication consumption, and (c) connect patients with health care providers and treatment services [**?**]. The following review of the literature shows that wireless digital technologies and smartphone applications are effective at providing health data in real time and can assist patients in recovery to resist physical cravings, prevent relapse, and access treatment support. Mobile applications can play an important role in addressing the opioid epideic by supplementing traditional approaches to addiction treatment and recovery.

1.1 The Opioid Epidemic: Medication Abuse and Addiction

The abuse of prescription opioid medication in the U.S. has become a major health crisis that the Department of Health and Human Services (HHS) has described as an epidemic [**?**]. Approximately 2 million Americans were dependent on or abused prescription opioids (e.g., oxycodone, hydrocodone) in 2014 [**?**]. Overdose deaths from prescription opioids has quadrupled since 1999, resulting in more than 180,000 deaths between 1999 to 2015. Figure 1 shows that the dramatic increase in overdose deaths in the U.S. between 2000 and 2016 are from synthetic opioids (other than methadone), natural and semi-synthetic opioids, and heroin [**?**]. Of the estimated 64,000 drug overdose deaths in 2015, over 20,000 were from fentanyl and other synthetic opioid analogs. Public health agencies are implementing comprehensive efforts to address four major risk areas of prescription opioid abuse, overdoses, and deaths: (i) Increasing knowledge of opioid abuse and improving decisions among medication prescribers, (ii) Reducing inappropriate access to opioids, (iii) Increasing effective overdose treatment, (iv) Providing substance-abuse treatment to persons addicted to opioids. The nature of the opioid epidemic is complex, and to understand how technological interventions can play a role in mitigating the crisis, it is necessary to consider the nature of addiction and approaches to treatment.

[Figure 1 about here.]

1.1.1 Drug Addiction and Treatment. For millions of people struggling with substance abuse and dependency in the U.S., addiction and relapse are chronic health conditions [**?**]. Drug addiction has many similar characteristics to other chronic medical illnesses; however, there are unique challenges to the treatment of addiction illnesses. For example, drug addicted patients undergo intense detoxification in rehabilitation treatment programs, but then are released back into the same environment associated with their drug use. The lack of continuity in the treatment of addiction disorders, leaves addicts in recovery at high risk for relapse into substance use and abuse. Second, individuals with addiction disorders present for care to emergency rooms after acute intoxication, often following law enforcement interventions. Emergency personal and very capable at crisis intervention for drug overdose, but lack resources to evaluate severe addiction disorders or provide follow-up. Furthermore, addicted individuals seeking treatment often relapse at night or on weekends when treatment centers are not open. Various theories of addiction and relapse have been proposed. According to the classical conditioning model, situational cues or events can elicit a motivational state underlying relapse to drug use. A slightly more complex model suggests that addictive behavior can be reinstated after extinction of dependency by exposure to drugs, drug-related cues, or environmental stressors [**?**]. Understanding that a user‘s affective response to cues in the environmental can lead to relapse and drug use are key to developing strategies for prevention and treatment.

1.2 Technology-Based Interventions for Addiction Treatment

Technology-based interventions have been used for drug addiction assessment, treatment, prevention and recovery [**?**]. In terms of assessment, data about individuals substance use can be obtained from mobile cell phone reporting outside of treatment settings.

Web-based approaches to treatment have been implemented online to improve behavioral and psychosocial functioning for addicted individuals in recovery [**?**]. For example, the Therapeutic Education System (TES) is a self-directed, web-based interactive treatment program consisted of 65 training modules that focuses cognitive-behavioral skills, psychosocial functioning (family/social relations). This online approach helped to increase access to treatment for individuals in rural areas, and included an optional contingency management module. A computer based Training in Cognitive Behavioral Therapy (CBT) program was found to enhance treatment outcomes when provided in conjunction with traditional substance abuse treatment, and helped improve coping skills and decision-making skills [**?**]. In evaluating the effectiveness of mobile applications for addiction treatment, several questions remain to be answered: First, if mobile applications primarily are regarded primarily as supplements to traditional therapeutic treatment, can their effectiveness be measured independently from the approach used in treatment? Second, over what time period period can the benefits of mobile applications be observed? Research evidence suggests that the benefits of mobile interventions may be limited to 12 or 15 weeks [**?**]. However, it is unclear whether individuals struggling from addiction would continue to use mobile treatment applications in the long terms, beyond a limited course of treatment.

1.2.1 Mobile-Based Applications. Mobile based applications have been used for monitoring and treatment of substance abuse and addiction disorders for several decades [**?**]. Early applications included the use of electronic pagers (i.e., beepers) for experience sampling with paper-based assessments that generated data about daily life behavior and experiences [**?**]. In the 1990s, programmable personal digital assistants (e.g., palm-pilot) enabled collection of data electronically, and subsequent mobile research tools facilitated the collection of information about psychological factors (e.g., daily stressors, emotional states, thoughts) and other variables related to addiction (e.g., craving, contextual cues, actual substance use). Assessments performed several times throughout the day (commonly, every 2 to 4 hours) allowed for analysis of the daily fluctuations of these symptoms and features. Historically, addiction research has faced some unique challenges that the use of mobile technologies may help to overcome. Methodological aspects of traditional research using retrospective, cross-sectional, or longitudinal assessments (over periods of weeks, months, or years) have been problematic for investigating risk factors including behaviors and symptoms (severe physiological cravings, withdrawal, and substance use) that can span a relatively short time. An additional factor is the co-morbidity, or co-occurence, of substance use disorders (SUDs) with other psychological disorders, such as anxiety and mood disorders. For example, the "self-medicationfifi model has commonly been used to explain the association between alcohol abuse is used as an effort by an individual to reduce or cope with a high degree of anxiety (or depression). It has also been challenging for researchers to capture the role of environmental or contextual cues (e.g., people, places, things) associated with substance abuse and addiction, which can trigger relapse for individuals in recovery.

Smartphone Applications. Continued care is an important ingredient for recovery from addiction that involves monitoring, outreach, planning, case management, and social support [**?**]. Smartphone applications can help individuals in recovery to monitor cravings at critical points in daily life, track contextual cues associated with substance use, and provide outreach to support services. A team of researchers at the University of Wisconsin evaluated the effectiveness of a smartphone application called Addiction Comprehensive Health Enhancement Support System (A-CHESS), designed to provide recovery support patients leaving residential alcohol treatment center [**?**]. A-CHESS provided anytime, anywhere access to support services in audio-visual format, GPS monitoring and warnings for risky locations, and communication with counselors. Over an 8-month period and 4 month follow-up, patients who used the A-CHESS intervention reported fewer risky drinking days, on average, per month than patients in a comparable control group. The findings provide evidence that the smartphone intervention was effective at treating a critical behavioral measure for treatment of alcohol use disorder (AUD). The methods described in this study could be extended by re-purposing built-in smartphone sensors to record physiological measures related to opioid usage, and communicate data to health care providers or treatment specialists to initiate interventions for opioid addiction [**?**].

[Figure 2 about here.]

1.3 Medication Adherence and Abuse Monitoring System

Mobile health applications can be used as an advanced warning system for medication adherence and potential abuse of prescription medication [**?**]. Medication abuse can consist of higher dosages or rapid escalation of a prescribed medication dosage, and the general goal of such a prediction model is to analyze patient data for sudden changes in medication consumption. Figure 2 illustrates several steps in a process and decision support structure for a medication monitoring system, with adjustable parameters, such as the threshold for abuse (e.g., greater than N doses in X hours) [**?**]. A major challenge for measuring medication abuse is obtaining reliable information from potentially addicted individuals based on self report data. Ideally, information on medication consumption and adherence can be obtained from multiple sources. Addiction is a complex behavior that involves a variety of factors, including: demographics (e.g., age, gender), past history, comorbidity with other disorders, family support, social influence, employment status, and patient motivation. Figure 3 shows a model architecture of a system for monitoring potential abuse where dose information is provided via a smartphone application, relayed via wireless cellular network to analytic models that measure changes in medication consumption, relays reports to support treatment services for possible interventions, and to a smart medication dispenser box. In order to function successfully a medication abuse monitoring system depends on the collection of reliable information, including data from wearable sensors that can directly measure physiological changes (e.g., heartrate, blood pressure, respiration, temperature) related to changes in medication usage. n the context of prescription opioid abuse, such as medication monitoring system could be very beneficial in anticipating opioid addiction and preventing overdose death.

[Figure 3 about here.]

1.4 Mobile Detection with Wearable Biosensors

Portable biosensors can provide a continuous stream of data on the timing, location, context, and duration of drug use by individuals in treatment. In a small pilot study, an Affectiva Q sensor was used to continuously measure electrodermal activity (EDA), skin temperature, and acceleration (8 recordings per second), in a sample of N = 4 patients during the administration of opioid medication in an emergency room setting [**?**]. Table 1 provides a summary of the participant characteristics. The Q biosensor was worn on the wrist and was similar in size and dimensions to a wristwatch or fitbit health monitor. The results showed an increase in EDA associated with intravenous opioid injection that was detected by the biosensors. In addition, there was some indication that the physiological response to opioids varies according to an individualfis drug tolerance. The findings provide evidence to support the use of wearable biodensors to detect drug use in real time, though in a relatively controlled environment. An important limitation of the study is the small sample size, which reduces the generalizability of the findings to a broader population. The authors also acknowledged that psychological or physiological stress can produce alterations in EDA, skin temperature, and acceleration, and therefore this could not be ruled out as an alternative explanation for the findings. The results are promising, however, and encourage future efforts to explore the effectiveness of wearable biosensors in the context of environments that individuals in recovery associate with drug use where relapse can occur.

[Table 1 about here.]

1.5 Emerging Sensor Technologies

Wearable wireless sensors have been used to study physiological responses, activity, and social behavior in non-human primates, in the form of a fitted vest, and using a mobile phone with blue tooth protocol to collect data in real time. Figure 4 shows sample ambulatory data from a rhesus macaque recorded from a wearable wireless sensor for 11 hours inside a large group primate cage [**?**]. Data was recorded on a custom Android software application, which captured measures of EDA, heart rate (HR), temperature, and acceleration. The goals of this study were to measure associations between physiological measures and social behavior in primates; however, this practical application of sensor technology demonstrated a system that was relatively low-cost, highly portable, scalable, and simple to use. Future research could explore the development of a similar system modified for use with humans to collect data on physiological measures from addicted individuals in naturalistic settings.

[Figure 4 about here.]

1.5.1 LoRa Backscatter: Enabling Ubiquitous Connectivity.

[Figure 5 about here.]

[Figure 6 about here.]

[Figure 7 about here.]

1.5.2 Graphene Electronic Tattoo sensors. [**?**]

[Figure 8 about here.]

1.6 Can Emerging Technologies Reduce Opioid Addiction in U.S.

2 TABLES

In case you need to create tables, you can do this with online tools (if you do not mind sharing your data) such as google for them). They even allow you to manage tables as CSV.

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3 CONCLUSION

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ACKNOWLEDGMENTS

The author would like to thank Dr. Gregor von Laszewski for providing the LaTex template and instructions, many comments, helpful feedback, edits, and fixes on paper 1. Thanks also to the Assistant Instructors who were also very helpful in this learning process.

REFERENCES

REFERENCES

When you submit the paper you need to address each of the items in the issues.tex file and verify that you have done them. Please do this only at the end once you have finished writing the paper. To d this cange TODO with DONE. However if you check something on with DONE, but we find you actually have not executed it correctly, you will receive point deductions. Thus it is important to do this correctly and not just 5 minutes before the deadline. It is better to do a late submission than doing the check in haste.

List of Figures

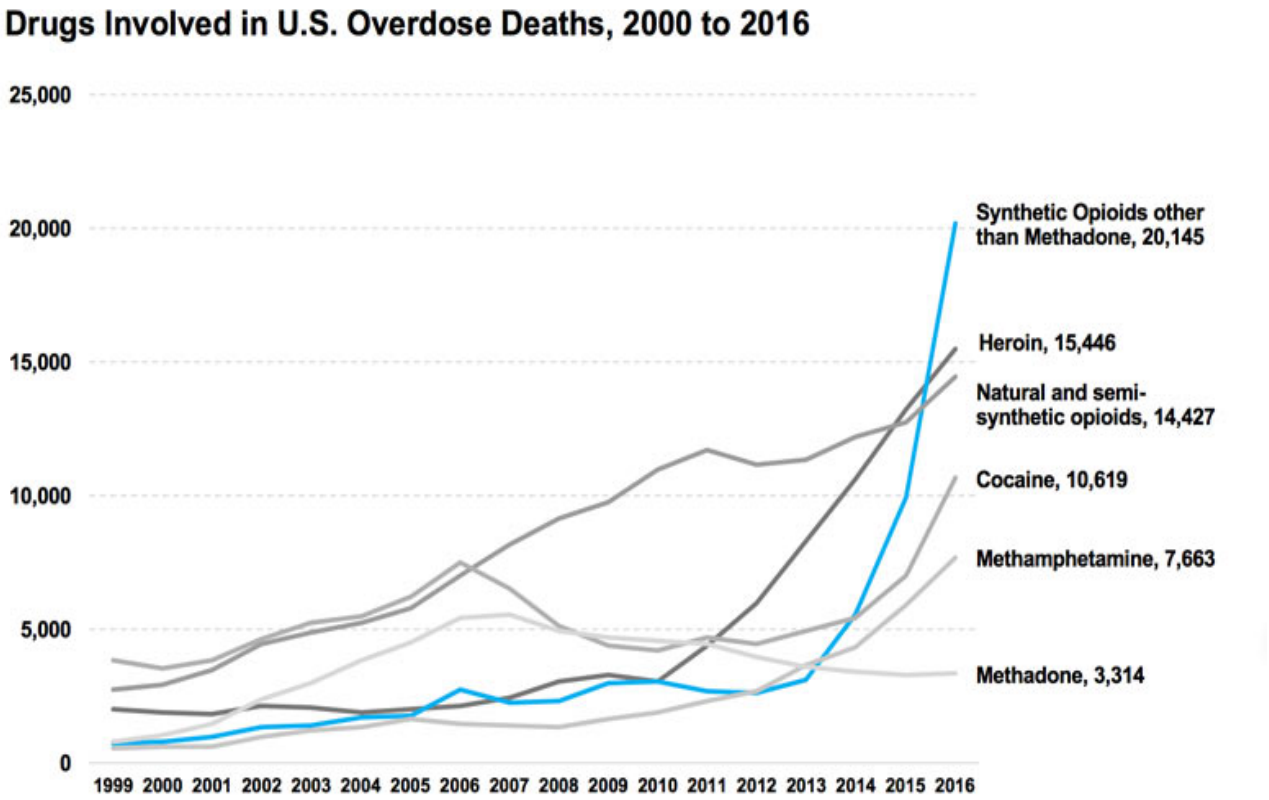

Figure 1: Drugs Involved in U.S. Overdose Deaths from 2000 to 2016, National Institute on Drug Addiction (NIDS) [?]

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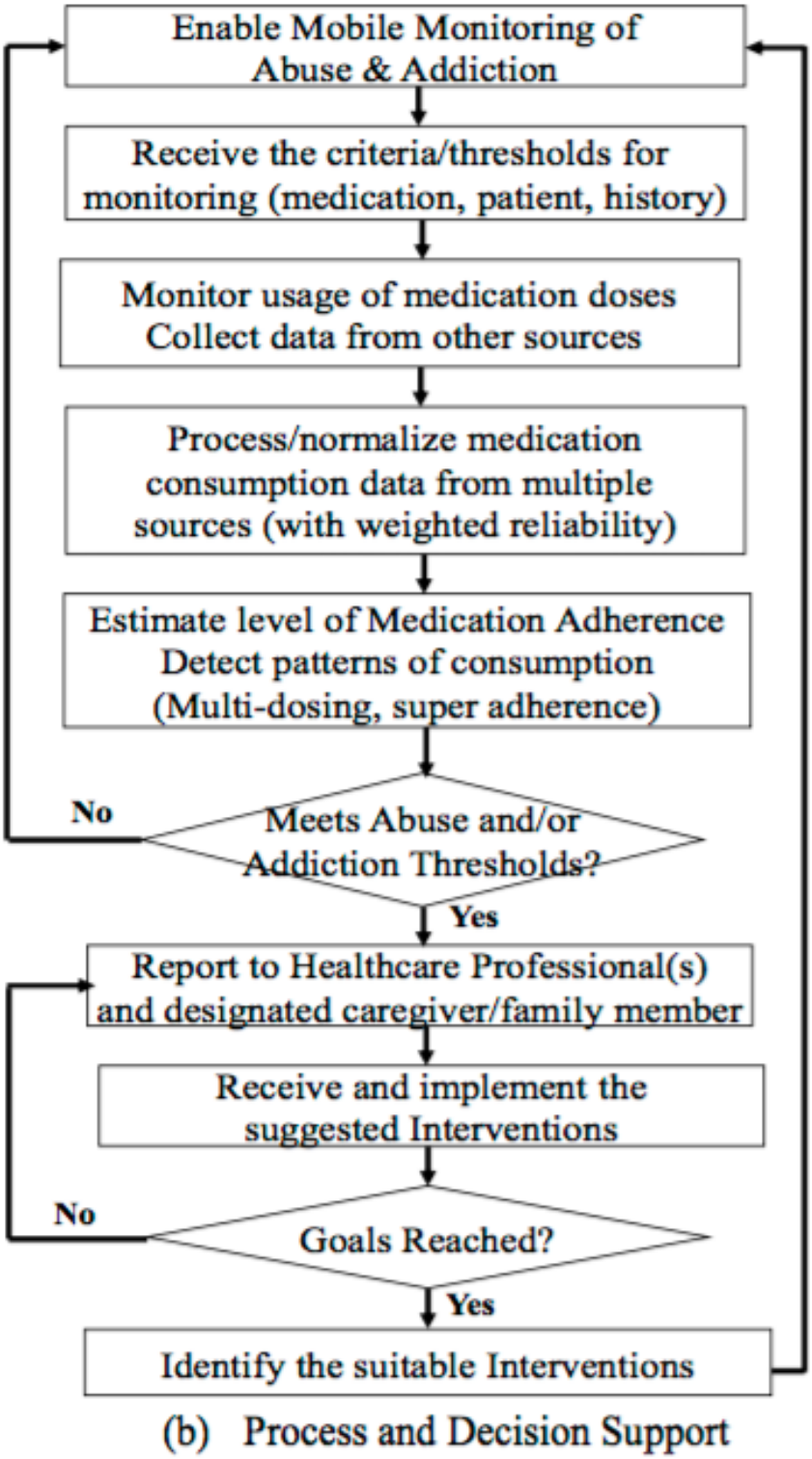
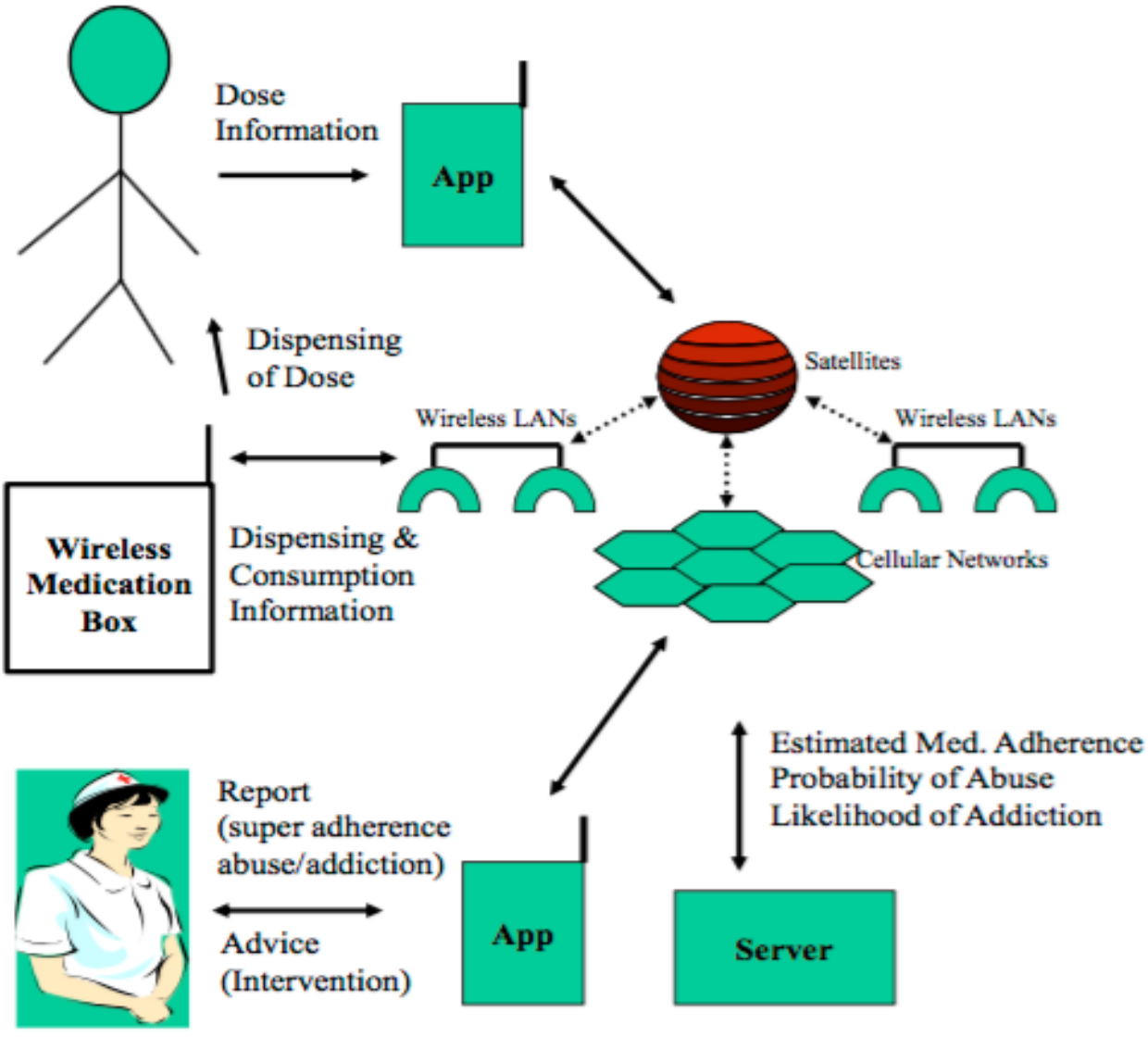


Figure 2: Process and Decision Support for Abuse Monitoring System [?]



(a) Architecture of the Abuse Monitoring System

Figure 3: Architecture for Abuse Monitoring System [?]

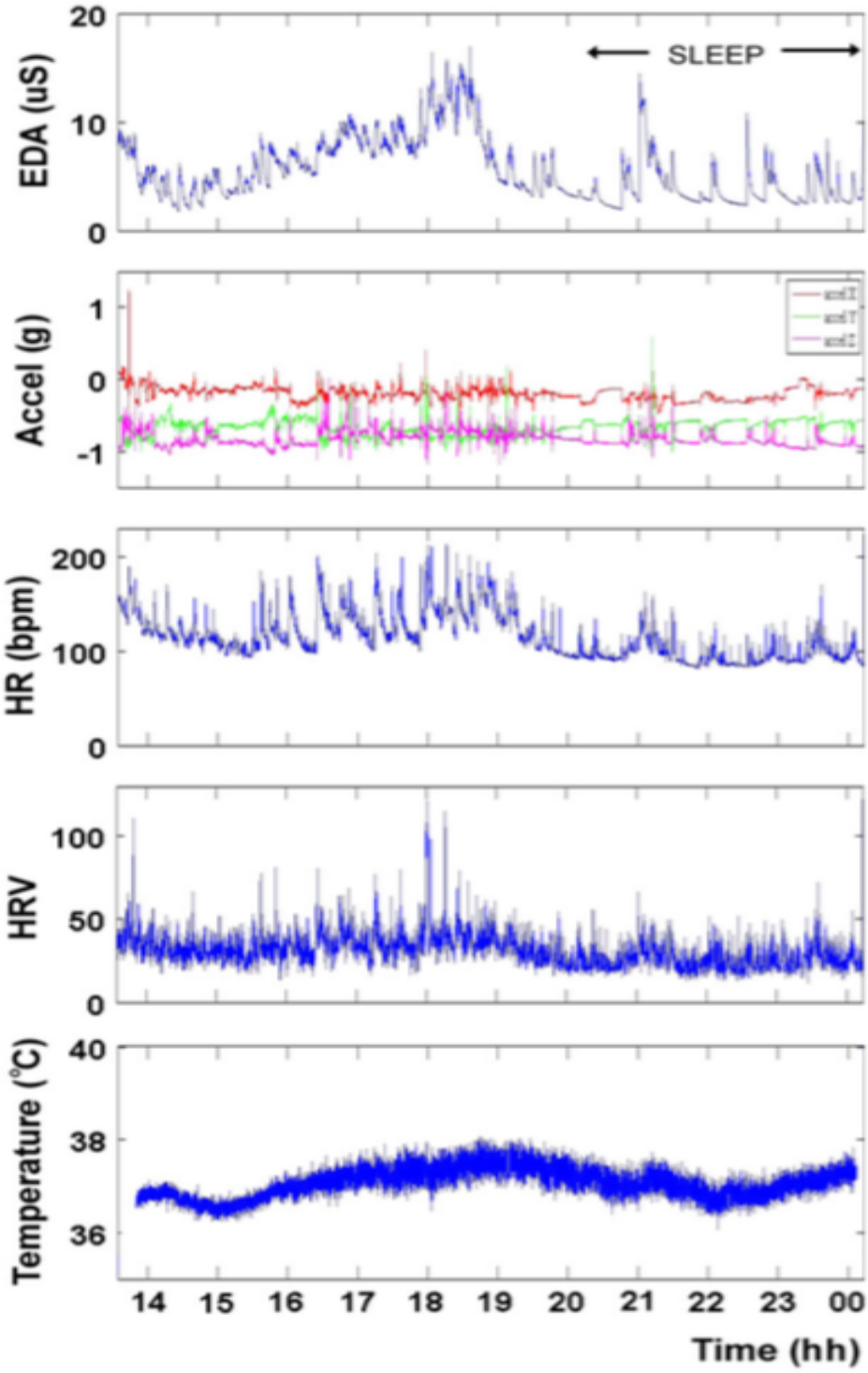


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Figure 4: Sample Ambulatory Data from Rhesus Macaque Recorded on Wearable Sensor for 11+ hours Inside Large Primate Cage Facility [?]

Figure 5: LoRa Backscatter Epidermal Patch [?]

[9]

Technology	Sensitivity	Data Rate	Whole Home Coverage	Button Cell	Tiny Solar Cell	Printed Battery
Wi-Fi (802.11 b/g)	-95 dBm	1-54 Mbps	✓	✗	✗	✗
LoRa	-149 dBm	18 bps–37.5 kbps	✓	✗	✗	✗
Bluetooth	-97 dBm	1-2 Mbps	✗	✗	✗	✗
Sigfox	-126 dBm	100 bps	✓	✗	✗	✗
ZigBee	-100 dBm	250 kbps	✓	✗	✗	✗
Passive Wi-Fi	-95 dBm	1-11 Mbps	✗	✓	✓	✓
RFID	-85 dBm	40–640 kbps	✗	✓	✓	✓
LoRa Backscatter	-149 dBm	18 bps–37.5 kbps	✓	✓	✓	✓

Figure 6: Comparison of Wireless Communication Technologies [?]

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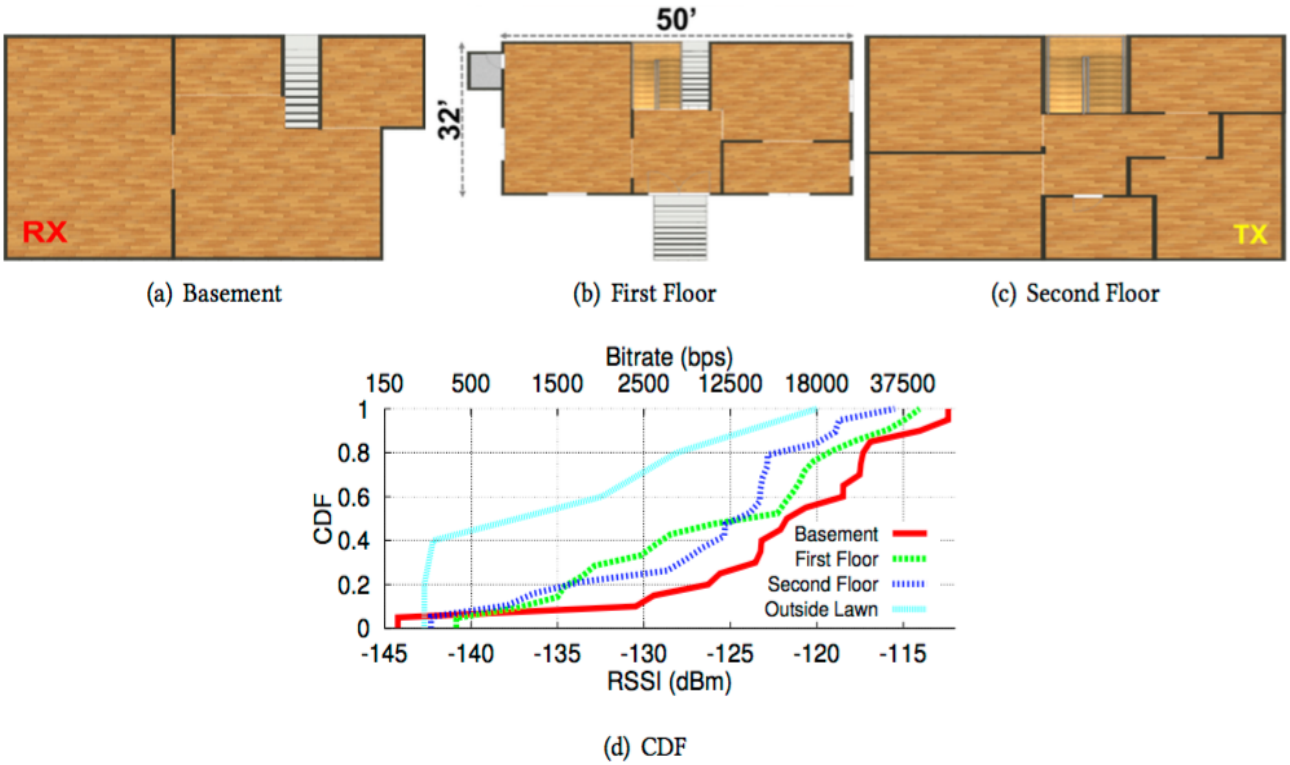

Figure 7: Home Deployment of LoRa backscatter pakcets across 4,800 sq. ft. House Apread Across Three Floors [?]

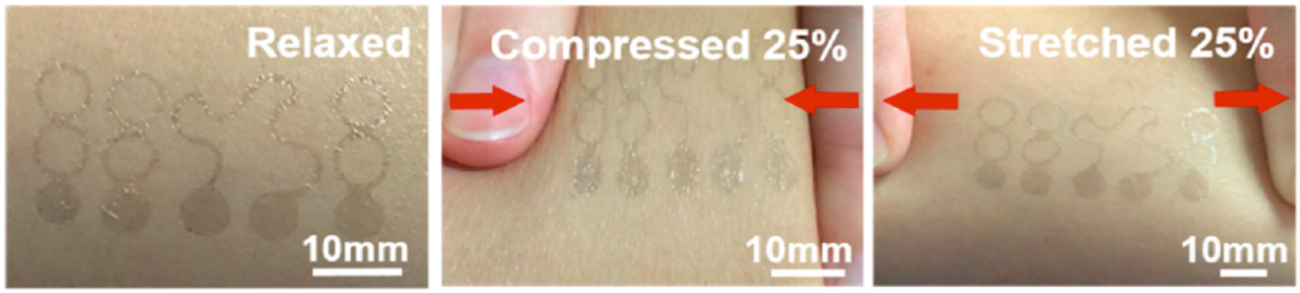

Figure 8: Graphene Electronic Tatoo Biosensor [?]

List of Tables

Table 1: Summary of Participant Characteristics in Pilot study [?]

Patient	Age	Gender	History of Use	Intervention	Pre-EDA	Post-EDA
1	82	Male	Opioid naive	4 mg morphine	4.5	60.0
2	47	Male	Recent short-term	1 mg hydromorphone	3.4	12.2
3	43	Female	Chronic opioid use	1 mg hydromorphone	0.2	0.2
4	72	Male	Chronic opioid use	4 mg morphine	0.9	1.6

```
bibtext report
=======================================

This is BibTeX, Version 0.99d (TeX Live 2016)
The top-level auxiliary file: report.aux
The style file: ACM-Reference-Format.bst
Database file #1: report.bib
"}" immediately follows an entry type---line 13 of file report.bib
 : \email{smshiver@indiana.edu
 :                            }
I'm skipping whatever remains of this entry
Warning--I didn't find a database entry for "metcalf16"
Warning--I didn't find a database entry for "atallah11"
Warning--I didn't find a database entry for "Varshney14"
Warning--I didn't find a database entry for "volkow14"
Warning--I didn't find a database entry for "cdc17"
Warning--I didn't find a database entry for "nida17"
Warning--I didn't find a database entry for "boyer10"
Warning--I didn't find a database entry for "shaham03"
Warning--I didn't find a database entry for "marsch12"
Warning--I didn't find a database entry for "marschdallery2012"
Warning--I didn't find a database entry for "carroll08"
Warning--I didn't find a database entry for "swedenson16"
Warning--I didn't find a database entry for "johnson11"
Warning--I didn't find a database entry for "gustafson14"
Warning--I didn't find a database entry for "varshney13"
Warning--I didn't find a database entry for "carreiro15"
Warning--I didn't find a database entry for "fletcher12"
Warning--I didn't find a database entry for "ameri17"
Warning--I didn't find a database entry for "talla17"
d is an illegal style-file command---line 3241 of file ACM-Reference-Format.bst
 : execute {end.bib}d
 :                    Murray",
Illegal, another entry command---line 3397 of file ACM-Reference-Format.bst
 : entry
 :
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 :                          before.all mid.sentence after.sentence after.block }
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 :                                } % initialized below in begin.bib
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 :                    namesleft numnames }
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 :                        }
len is already a type "integer-global-variable" function name
---line 3452 of file ACM-Reference-Format.bst
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 :               }
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---line 3454 of file ACM-Reference-Format.bst
 : integers { last.extra.num
 :                           }
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---line 3456 of file ACM-Reference-Format.bst
 : strings { s
 :             t t.org u }
last.label is already a type "string-global-variable" function name
---line 3458 of file ACM-Reference-Format.bst
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 :                       next.extra }
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---line 3460 of file ACM-Reference-Format.bst
 : strings { p1
 :              p2 p3 page.count }
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---line 3467 of file ACM-Reference-Format.bst
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---line 3475 of file ACM-Reference-Format.bst
 : function { empty.or.unknown
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duplicate is an illegal style-file command---line 3497 of file ACM-Reference-Format.bst
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 :            $ empty$
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---line 3503 of file ACM-Reference-Format.bst
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 :                    }
```

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 :   write
 :        $               % output top-of-stack string
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---line 3554 of file ACM-Reference-Format.bst
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 :                              }
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---line 3562 of file ACM-Reference-Format.bst
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---line 3592 of file ACM-Reference-Format.bst
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---line 3621 of file ACM-Reference-Format.bst
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---line 3650 of file ACM-Reference-Format.bst
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 :                             }
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---line 3703 of file ACM-Reference-Format.bst
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 :                         }
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---line 3712 of file ACM-Reference-Format.bst
 : function { bibinfo.output.check
 :                                 }
output.check.dot.space is already a type "wizard-defined" function name
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 :                                  }
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 :                         }
fin.sentence is already a type "wizard-defined" function name
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 : function { fin.sentence
 :                         }
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---line 3764 of file ACM-Reference-Format.bst
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 :                     }
output.coden is already a type "wizard-defined" function name
---line 3772 of file ACM-Reference-Format.bst
 : function { output.coden
 :                         }       % UTAH
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 :                             }
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---line 3794 of file ACM-Reference-Format.bst
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 :                         }
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---line 3806 of file ACM-Reference-Format.bst
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 :                             }
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---line 3824 of file ACM-Reference-Format.bst
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 :                                  }     % UTAH
output.day.month.year is already a type "wizard-defined" function name
---line 3836 of file ACM-Reference-Format.bst
 : function { output.day.month.year
 :                                  }     % UTAH
strip.doi is already a type "wizard-defined" function name
```

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 :                      } % UTAH
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 :             "INTERNAL STYLE-FILE ERROR" 's :=
(Error may have been on previous line)
"{" can't start a style-file command---line 3871 of file ACM-Reference-Format.bst
 :
 :             { t text.length$ }
(Error may have been on previous line)
s is an illegal style-file command---line 3888 of file ACM-Reference-Format.bst
 :             s
 :               #1 #3 substring$ "10." =
s is an illegal style-file command---line 3893 of file ACM-Reference-Format.bst
 :             s
 :                 % push the stripped DOI on the output stack
"}" can't start a style-file command---line 3895 of file ACM-Reference-Format.bst
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 :         }
(Error may have been on previous line)
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---line 3908 of file ACM-Reference-Format.bst
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 :                       } % UTAH
output.isbn is already a type "wizard-defined" function name
---line 3925 of file ACM-Reference-Format.bst
 : function { output.isbn
 :                         }                % UTAH
output.issn is already a type "wizard-defined" function name
---line 3962 of file ACM-Reference-Format.bst
 : function { output.issn
 :                         } % UTAH
output.issue is already a type "wizard-defined" function name
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 : function { output.issue
 :                          }
output.lccn is already a type "wizard-defined" function name
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 : function { output.lccn
 :                         } % UTAH
output.note is already a type "wizard-defined" function name
---line 3986 of file ACM-Reference-Format.bst
 : function { output.note
 :                         } % UTAH
output.note.check is already a type "wizard-defined" function name
```

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---line 3994 of file ACM-Reference-Format.bst
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 :                               } % UTAH
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---line 4002 of file ACM-Reference-Format.bst
 : function { output.eprint
 :                           } %
output.url is already a type "wizard-defined" function name
---line 4027 of file ACM-Reference-Format.bst
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 :                       } % UTAH
""" can't start a style-file command---line 4055 of file ACM-Reference-Format.bst
 :
 :           "\url{" *
(Error may have been on previous line)
url is an illegal style-file command---line 4057 of file ACM-Reference-Format.bst
 :           url
 :               't :=                       % get modifiable copy of URL list
"{" can't start a style-file command---line 4059 of file ACM-Reference-Format.bst
 :
 :           { t text.length$ }
(Error may have been on previous line)
t is an illegal style-file command---line 4074 of file ACM-Reference-Format.bst
 :             t
 :               #2 t text.length$ #1 - substring$ 't :=
""" can't start a style-file command---line 4078 of file ACM-Reference-Format.bst
 :
 :           "}}" * writeln
(Error may have been on previous line)
output.year.check is already a type "wizard-defined" function name
---line 4086 of file ACM-Reference-Format.bst
 : function { output.year.check
 :                               }
not is already a type "wizard-defined" function name
---line 4098 of file ACM-Reference-Format.bst
 : function { not
 :               }
and is already a type "wizard-defined" function name
---line 4105 of file ACM-Reference-Format.bst
 : function { and
 :               }
or is already a type "wizard-defined" function name
---line 4112 of file ACM-Reference-Format.bst
 : function { or
 :              }
le is already a type "wizard-defined" function name
```

```
---line 4119 of file ACM-Reference-Format.bst
 : function { le
 :               }
">" can't start a style-file command---line 4126 of file ACM-Reference-Format.bst
 :
 :   > { #0 } { #1 } if$
(Error may have been on previous line)
ge is already a type "wizard-defined" function name
---line 4129 of file ACM-Reference-Format.bst
 : function { ge
 :               }
"<" can't start a style-file command---line 4136 of file ACM-Reference-Format.bst
 :
 :   < { #0 } { #1 } if$
(Error may have been on previous line)
is.leading.digit is already a type "wizard-defined" function name
---line 4139 of file ACM-Reference-Format.bst
 : function { is.leading.digit
 :                             }
"#" can't start a style-file command---line 4145 of file ACM-Reference-Format.bst
 :
 :   #1 #1 substring$                      % replace string by string[1:1]
(Error may have been on previous line)
skip.digits is already a type "wizard-defined" function name
---line 4155 of file ACM-Reference-Format.bst
 : function { skip.digits
 :                         }
duplicate is an illegal style-file command---line 4165 of file ACM-Reference-Format.bst
 :   duplicate
 :            $
"{" can't start a style-file command---line 4170 of file ACM-Reference-Format.bst
 :
 :   { t text.length$ }
(Error may have been on previous line)
u is an illegal style-file command---line 4184 of file ACM-Reference-Format.bst
 :   u
 :                                                                  % rest of string
"}" can't start a style-file command---line 4193 of file ACM-Reference-Format.bst
 :
 : }
(Error may have been on previous line)
skip.nondigits is already a type "wizard-defined" function name
---line 4195 of file ACM-Reference-Format.bst
 : function { skip.nondigits
 :                           }
"'" can't start a style-file command---line 4203 of file ACM-Reference-Format.bst
```

```
 :
 :   't :=
(Error may have been on previous line)
"{" can't start a style-file command---line 4206 of file ACM-Reference-Format.bst
 :
 :   { t text.length$ }
(Error may have been on previous line)
u is an illegal style-file command---line 4220 of file ACM-Reference-Format.bst
 :   u
 :                          % rest of string
"}" can't start a style-file command---line 4224 of file ACM-Reference-Format.bst
 :
 : }
(Error may have been on previous line)
parse.next.number is already a type "wizard-defined" function name
---line 4226 of file ACM-Reference-Format.bst
 : function { parse.next.number
 :                                }
"'" can't start a style-file command---line 4234 of file ACM-Reference-Format.bst
 :
 :   's :=
(Error may have been on previous line)
reduce.pages.to.page.count is already a type "wizard-defined" function name
---line 4239 of file ACM-Reference-Format.bst
 : function { reduce.pages.to.page.count
 :                                        }
pages is an illegal style-file command---line 4266 of file ACM-Reference-Format.bst
 :   pages
 :
duplicate is an illegal style-file command---line 4272 of file ACM-Reference-Format.bst
 :   duplicate
 :            $
pop is an illegal style-file command---line 4285 of file ACM-Reference-Format.bst
 :   pop
 :      $
p is an illegal style-file command---line 4294 of file ACM-Reference-Format.bst
 :   p
 :    1 p3 =   p2 "1" =   and   numpages empty.or.unknown   and
p is an illegal style-file command---line 4305 of file ACM-Reference-Format.bst
 :   p
 :    1 "1" =   p3 empty.or.unknown   and   numpages empty.or.unknown   and
"}" can't start a style-file command---line 4320 of file ACM-Reference-Format.bst
 :
 : }
(Error may have been on previous line)
new.block.checkb is already a type "wizard-defined" function name
```

```
---line 4322 of file ACM-Reference-Format.bst
 : function { new.block.checkb
 :                             }
field.or.null is already a type "wizard-defined" function name
---line 4332 of file ACM-Reference-Format.bst
 : function { field.or.null
 :                           }
emphasize is already a type "wizard-defined" function name
---line 4340 of file ACM-Reference-Format.bst
 : function { emphasize
 :                       }
emphasize.with.italic.correction is already a type "wizard-defined" function name
---line 4348 of file ACM-Reference-Format.bst
 : function { emphasize.with.italic.correction
 :                                             }
comma is already a type "wizard-defined" function name
---line 4356 of file ACM-Reference-Format.bst
 : function { comma
 :                  }
format.names is already a type "wizard-defined" function name
---line 4364 of file ACM-Reference-Format.bst
 : function { format.names
 :                          }
"'" can't start a style-file command---line 4370 of file ACM-Reference-Format.bst
 :
 :   's :=
(Error may have been on previous line)
my.full.label is already a type "wizard-defined" function name
---line 4405 of file ACM-Reference-Format.bst
 : function { my.full.label
 :                           }
"{" can't start a style-file command---line 4413 of file ACM-Reference-Format.bst
 :
 :     { s nameptr "{vv~}{ll}" format.name$ 't :=  % get the next name
(Error may have been on previous line)
"}" can't start a style-file command---line 4437 of file ACM-Reference-Format.bst
 :
 : }
(Error may have been on previous line)
format.names.fml is already a type "wizard-defined" function name
---line 4439 of file ACM-Reference-Format.bst
 : function { format.names.fml
 :                             }
"'" can't start a style-file command---line 4445 of file ACM-Reference-Format.bst
 :
 :   's :=
```

```
(Error may have been on previous line)
"{" can't start a style-file command---line 4451 of file ACM-Reference-Format.bst
 :
 :     {
(Error may have been on previous line)
nameptr is an illegal style-file command---line 4454 of file ACM-Reference-Format.bst
 :       nameptr
 :               #1 >
format.authors is already a type "wizard-defined" function name
---line 4478 of file ACM-Reference-Format.bst
 : function { format.authors
 :                           }
format.key is already a type "wizard-defined" function name
---line 4488 of file ACM-Reference-Format.bst
 : function { format.key
 :                       }
format.no.key is already a type "wizard-defined" function name
---line 4496 of file ACM-Reference-Format.bst
 : function { format.no.key
 :                          }
format.editors.fml is already a type "wizard-defined" function name
---line 4504 of file ACM-Reference-Format.bst
 : function { format.editors.fml
 :                                }
editor is an illegal style-file command---line 4511 of file ACM-Reference-Format.bst
 :   editor
 :          empty.or.unknown
format.editors is already a type "wizard-defined" function name
---line 4525 of file ACM-Reference-Format.bst
 : function { format.editors
 :                           }
format.articletitle is already a type "wizard-defined" function name
---line 4541 of file ACM-Reference-Format.bst
 : function { format.articletitle
 :                                 }
format.title is already a type "wizard-defined" function name
---line 4552 of file ACM-Reference-Format.bst
 : function { format.title
 :                         }
n.dashify is already a type "wizard-defined" function name
---line 4563 of file ACM-Reference-Format.bst
 : function { n.dashify
 :                     }
format.btitle is already a type "wizard-defined" function name
---line 4594 of file ACM-Reference-Format.bst
 : function { format.btitle
```

```
 :                          }
format.emphasize.booktitle is already a type "wizard-defined" function name
---line 4609 of file ACM-Reference-Format.bst
 : function { format.emphasize.booktitle
 :                                     }
format.city is already a type "wizard-defined" function name
---line 4624 of file ACM-Reference-Format.bst
 : function { format.city
 :                         }
duplicate is an illegal style-file command---line 4630 of file ACM-Reference-Format.bst
 :   duplicate
 :            $ empty.or.unknown
tie.or.space.connect is already a type "wizard-defined" function name
---line 4651 of file ACM-Reference-Format.bst
 : function { tie.or.space.connect
 :                                 }
either.or.check is already a type "wizard-defined" function name
---line 4660 of file ACM-Reference-Format.bst
 : function { either.or.check
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format.bvolume is already a type "wizard-defined" function name
---line 4668 of file ACM-Reference-Format.bst
 : function { format.bvolume
 :                           }
volume is an illegal style-file command---line 4673 of file ACM-Reference-Format.bst
 :   volume
 :          empty.or.unknown
format.bvolume.noseries is already a type "wizard-defined" function name
---line 4686 of file ACM-Reference-Format.bst
 : function { format.bvolume.noseries
 :                                   }
format.series is already a type "wizard-defined" function name
---line 4696 of file ACM-Reference-Format.bst
 : function { format.series
 :                          }
format.number.series is already a type "wizard-defined" function name
---line 4704 of file ACM-Reference-Format.bst
 : function { format.number.series
 :                                 }
multi.page.check is already a type "wizard-defined" function name
---line 4738 of file ACM-Reference-Format.bst
 : function { multi.page.check
 :                            }
format.pages is already a type "wizard-defined" function name
---line 4759 of file ACM-Reference-Format.bst
 : function { format.pages
```

```
 :                         }
format.pages.check.without.articleno is already a type "wizard-defined" function name
---line 4773 of file ACM-Reference-Format.bst
 : function { format.pages.check.without.articleno
 :                                                 }
articleno is an illegal style-file command---line 4781 of file ACM-Reference-Format.bst
 :   articleno
 :             empty.or.unknown
format.pages.check is already a type "wizard-defined" function name
---line 4792 of file ACM-Reference-Format.bst
 : function { format.pages.check
 :                               }
format.bookpages is already a type "wizard-defined" function name
---line 4800 of file ACM-Reference-Format.bst
 : function { format.bookpages
 :                             }
format.named.pages is already a type "wizard-defined" function name
---line 4808 of file ACM-Reference-Format.bst
 : function { format.named.pages
 :                               }
format.page.count is already a type "wizard-defined" function name
---line 4822 of file ACM-Reference-Format.bst
 : function { format.page.count
 :                             }
format.articleno.numpages is already a type "wizard-defined" function name
---line 4836 of file ACM-Reference-Format.bst
 : function { format.articleno.numpages
 :                                     }
articleno is an illegal style-file command---line 4854 of file ACM-Reference-Format.bst
 :   articleno
 :             empty.or.unknown
format is an illegal style-file command---line 4880 of file ACM-Reference-Format.bst
 :       format
 :             .page.count
format.journal.volume.number.day.month.year is already a type "wizard-defined" function
---line 4885 of file ACM-Reference-Format.bst
 : function { format.journal.volume.number.day.month.year
 :                                                       }
number is an illegal style-file command---line 5317 of file ACM-Reference-Format.bst
 :   number
 :          empty.or.unknown
format is an illegal style-file command---line 5336 of file ACM-Reference-Format.bst
 :   format
 :         .day.month.year *
format.chapter.pages is already a type "wizard-defined" function name
---line 5339 of file ACM-Reference-Format.bst
```

```
 : function { format.chapter.pages
 :                                 }
format.in.emphasize.booktitle is already a type "wizard-defined" function name
---line 5356 of file ACM-Reference-Format.bst
 : function { format.in.emphasize.booktitle
 :                                         }
format.in.booktitle is already a type "wizard-defined" function name
---line 5364 of file ACM-Reference-Format.bst
 : function { format.in.booktitle
 :                                }
format.in.ed.booktitle is already a type "wizard-defined" function name
---line 5372 of file ACM-Reference-Format.bst
 : function { format.in.ed.booktitle
 :                                    }
format.thesis.type is already a type "wizard-defined" function name
---line 5385 of file ACM-Reference-Format.bst
 : function { format.thesis.type
 :                                  }
format.tr.number is already a type "wizard-defined" function name
---line 5397 of file ACM-Reference-Format.bst
 : function { format.tr.number
 :                               }
format.advisor is already a type "wizard-defined" function name
---line 5413 of file ACM-Reference-Format.bst
 : function { format.advisor
 :                             }
format.article.crossref is already a type "wizard-defined" function name
---line 5421 of file ACM-Reference-Format.bst
 : function { format.article.crossref
 :                                     }
format.crossref.editor is already a type "wizard-defined" function name
---line 5426 of file ACM-Reference-Format.bst
 : function { format.crossref.editor
 :                                    }
format.book.crossref is already a type "wizard-defined" function name
---line 5444 of file ACM-Reference-Format.bst
 : function { format.book.crossref
 :                                  }
format.incoll.inproc.crossref is already a type "wizard-defined" function name
---line 5474 of file ACM-Reference-Format.bst
 : function { format.incoll.inproc.crossref
 :                                         }
format.lab.names is already a type "wizard-defined" function name
---line 5479 of file ACM-Reference-Format.bst
 : function { format.lab.names
 :                              }
```

```
"'" can't start a style-file command---line 5493 of file ACM-Reference-Format.bst
 :
 :   's :=
(Error may have been on previous line)
author.key.label is already a type "wizard-defined" function name
---line 5519 of file ACM-Reference-Format.bst
 : function { author.key.label
 :                              }
editor.key.organization.label is already a type "wizard-defined" function name
---line 5549 of file ACM-Reference-Format.bst
 : function { editor.key.organization.label
 :                                          }
author.editor.key.label is already a type "wizard-defined" function name
---line 5566 of file ACM-Reference-Format.bst
 : function { author.editor.key.label
 :                                    }
calc.label is already a type "wizard-defined" function name
---line 5583 of file ACM-Reference-Format.bst
 : function { calc.label
 :                        }
type is an illegal style-file command---line 5591 of file ACM-Reference-Format.bst
 :   type
 :       $ "book" =
author is an illegal style-file command---line 5608 of file ACM-Reference-Format.bst
 :   author
 :          empty.or.unknown  % generate the full label citation information.
""" can't start a style-file command---line 5633 of file ACM-Reference-Format.bst
 :
 :   "}{" * swap$ * "}{" *
(Error may have been on previous line)
output.bibitem is already a type "wizard-defined" function name
---line 5643 of file ACM-Reference-Format.bst
 : function { output.bibitem
 :                           }
output.issue.doi.coden.isxn.lccn.url.eprint is already a type "wizard-defined" function
---line 5658 of file ACM-Reference-Format.bst
 : function { output.issue.doi.coden.isxn.lccn.url.eprint
 :                                                       }
""" can't start a style-file command---line 5679 of file ACM-Reference-Format.bst
 :
 :   "\newblock" writeln
(Error may have been on previous line)
output is an illegal style-file command---line 5682 of file ACM-Reference-Format.bst
 :   output
 :         .issue
output.issue.doi.coden.isxn.lccn.url.eprint.note is already a type "wizard-defined" func
```

```
---line 5692 of file ACM-Reference-Format.bst
 : function { output.issue.doi.coden.isxn.lccn.url.eprint.note
 :                                                          }
output.issue.doi.coden.isxn.lccn.url.eprint.note.check is already a type "wizard-defined
---line 5705 of file ACM-Reference-Format.bst
 : function { output.issue.doi.coden.isxn.lccn.url.eprint.note.check
 :                                                                 }
article is already a type "wizard-defined" function name
---line 5718 of file ACM-Reference-Format.bst
 : function { article
 :                    }
author is an illegal style-file command---line 5722 of file ACM-Reference-Format.bst
 :   author
 :          empty.or.unknown
author is an illegal style-file command---line 5732 of file ACM-Reference-Format.bst
 :   author
 :          format.no.key output       % added
crossref is an illegal style-file command---line 5742 of file ACM-Reference-Format.bst
 :   crossref
 :            missing$
format is an illegal style-file command---line 5751 of file ACM-Reference-Format.bst
 :   format
 :         .pages.check.without.articleno output
book is already a type "wizard-defined" function name
---line 5758 of file ACM-Reference-Format.bst
 : function { book
 :                }
booklet is already a type "wizard-defined" function name
---line 5797 of file ACM-Reference-Format.bst
 : function { booklet
 :                    }
inbook is already a type "wizard-defined" function name
---line 5816 of file ACM-Reference-Format.bst
 : function { inbook
 :                  }
incollection is already a type "wizard-defined" function name
---line 5857 of file ACM-Reference-Format.bst
 : function { incollection
 :                         }
inproceedings is already a type "wizard-defined" function name
---line 5889 of file ACM-Reference-Format.bst
 : function { inproceedings
 :                          }
conference is already a type "wizard-defined" function name
---line 5936 of file ACM-Reference-Format.bst
 : function { conference
```

```
 :                       } { inproceedings }
manual is already a type "wizard-defined" function name
---line 5938 of file ACM-Reference-Format.bst
 : function { manual
 :                   }
masterstthesis is already a type "wizard-defined" function name
---line 5962 of file ACM-Reference-Format.bst
 : function { masterstthesis
 :                           }
misc is already a type "wizard-defined" function name
---line 5985 of file ACM-Reference-Format.bst
 : function { misc
 :                 }
online is already a type "wizard-defined" function name
---line 6005 of file ACM-Reference-Format.bst
 : function { online
 :                   } { misc }
game is already a type "wizard-defined" function name
---line 6007 of file ACM-Reference-Format.bst
 : function { game
 :                 } { misc }
phdthesis is already a type "wizard-defined" function name
---line 6010 of file ACM-Reference-Format.bst
 : function { phdthesis
 :                     }
format.date is already a type "wizard-defined" function name
---line 6033 of file ACM-Reference-Format.bst
 : function {format.date
 :                     }
new.block.checka is already a type "wizard-defined" function name
---line 6073 of file ACM-Reference-Format.bst
 : function {new.block.checka
 :                            }
periodical is already a type "wizard-defined" function name
---line 6081 of file ACM-Reference-Format.bst
 : function { periodical
 :                       }
proceedings is already a type "wizard-defined" function name
---line 6096 of file ACM-Reference-Format.bst
 : function { proceedings
 :                         }
techreport is already a type "wizard-defined" function name
---line 6128 of file ACM-Reference-Format.bst
 : function { techreport
 :                       }
unpublished is already a type "wizard-defined" function name
```

```
---line 6153 of file ACM-Reference-Format.bst
 : function { unpublished
 :                         }
default.type is already a type "wizard-defined" function name
---line 6169 of file ACM-Reference-Format.bst
 : function { default.type
 :                          } { misc }
Illegal, macro command after read command---line 6174 of file ACM-Reference-Format.bst
 : macro
 :       {jan}              {"Jan."}
Illegal, macro command after read command---line 6176 of file ACM-Reference-Format.bst
 : macro
 :       {feb}              {"Feb."}
Illegal, macro command after read command---line 6178 of file ACM-Reference-Format.bst
 : macro
 :       {mar}              {"March"}
Illegal, macro command after read command---line 6180 of file ACM-Reference-Format.bst
 : macro
 :       {apr}              {"April"}
Illegal, macro command after read command---line 6182 of file ACM-Reference-Format.bst
 : macro
 :       {may}              {"May"}
Illegal, macro command after read command---line 6184 of file ACM-Reference-Format.bst
 : macro
 :       {jun}              {"June"}
Illegal, macro command after read command---line 6186 of file ACM-Reference-Format.bst
 : macro
 :       {jul}              {"July"}
Illegal, macro command after read command---line 6188 of file ACM-Reference-Format.bst
 : macro
 :       {aug}              {"Aug."}
Illegal, macro command after read command---line 6190 of file ACM-Reference-Format.bst
 : macro
 :       {sep}              {"Sept."}
Illegal, macro command after read command---line 6192 of file ACM-Reference-Format.bst
 : macro
 :       {oct}              {"Oct."}
Illegal, macro command after read command---line 6194 of file ACM-Reference-Format.bst
 : macro
 :       {nov}              {"Nov."}
Illegal, macro command after read command---line 6196 of file ACM-Reference-Format.bst
 : macro
 :       {dec}              {"Dec."}
Illegal, another read command---line 6326 of file ACM-Reference-Format.bst
 : read
 :
```

```
sortify is already a type "wizard-defined" function name
---line 6328 of file ACM-Reference-Format.bst
 : function { sortify
 :                    }
chop.word is already a type "wizard-defined" function name
---line 6334 of file ACM-Reference-Format.bst
 : function { chop.word
 :                      }
sort.format.names is already a type "wizard-defined" function name
---line 6344 of file ACM-Reference-Format.bst
 : function { sort.format.names
 :                               }
sort.format.title is already a type "wizard-defined" function name
---line 6368 of file ACM-Reference-Format.bst
 : function { sort.format.title
 :                               }
author.sort is already a type "wizard-defined" function name
---line 6380 of file ACM-Reference-Format.bst
 : function { author.sort
 :                         }
author.editor.sort is already a type "wizard-defined" function name
---line 6393 of file ACM-Reference-Format.bst
 : function { author.editor.sort
 :                                }
editor.organization.sort is already a type "wizard-defined" function name
---line 6434 of file ACM-Reference-Format.bst
 : function { editor.organization.sort
 :                                      }
editor is an illegal style-file command---line 6439 of file ACM-Reference-Format.bst
 :   editor
 :          empty.or.unknown
presort is already a type "wizard-defined" function name
---line 6455 of file ACM-Reference-Format.bst
 : function { presort
 :                    }
calc is an illegal style-file command---line 6462 of file ACM-Reference-Format.bst
 :   calc
 :       .label sortify % recalculate bibitem label
initialize.extra.label.stuff is already a type "wizard-defined" function name
---line 6497 of file ACM-Reference-Format.bst
 : function { initialize.extra.label.stuff
 :                                        }
forward.pass is already a type "wizard-defined" function name
---line 6503 of file ACM-Reference-Format.bst
 : function { forward.pass
 :                         }
```

```
last is an illegal style-file command---line 6509 of file ACM-Reference-Format.bst
 :   last
 :       .label
reverse.pass is already a type "wizard-defined" function name
---line 6527 of file ACM-Reference-Format.bst
 : function { reverse.pass
 :                          }
bib.sort.order is already a type "wizard-defined" function name
---line 6543 of file ACM-Reference-Format.bst
 : function { bib.sort.order
 :                            }
begin.bib is already a type "wizard-defined" function name
---line 6563 of file ACM-Reference-Format.bst
 : function { begin.bib
 :                        }
""" can't start a style-file command---line 6569 of file ACM-Reference-Format.bst
 :
 :   "%%% -*-BibTeX-*-" writeln
(Error may have been on previous line)
preamble is an illegal style-file command---line 6574 of file ACM-Reference-Format.bst
 :   preamble
 :           $ empty.or.unknown
""" can't start a style-file command---line 6614 of file ACM-Reference-Format.bst
 :
 :   "\ifx \showCODEN    \undefined \def \showCODEN     #1{\unskip}     \fi" writeln
(Error may have been on previous line)
end.bib is already a type "wizard-defined" function name
---line 6639 of file ACM-Reference-Format.bst
 : function { end.bib
 :                    }
(There were 220 error messages)
make[2]: *** [bibtex] Error 2

latex report
============================================

        [2017-11-03 08.17.40] pdflatex report.tex
This is pdfTeX, Version 3.14159265-2.6-1.40.17 (TeX Live 2016) (preloaded format=pdflate
p.1   L34   : [metcalf16] undefined
p.1   L37   : [atallah11] undefined
p.1   L45   : [Varshney14] undefined
p.1   L57   : [volkow14] undefined
p.1   L58   : [cdc17] undefined
p.1   L63   : [nida17] undefined
p.1   L84   : [boyer10] undefined
p.1   L102  : [shaham03] undefined
```

```
p.1   L110  : [marsch12] undefined
p.1   L114  : [marschdallery2012] undefined
p.1   L122  : [carroll08] undefined
p.1   L129  : [swedenson16] undefined
p.2   L138  : [boyer10] undefined
p.2   L141  : [swedenson16] undefined
p.2   L170  : [johnson11] undefined
p.2   L176  : [gustafson14] undefined
p.2   L187  : [johnson11] undefined
p.2   L201  : [varshney13] undefined
p.2   L207  : [Varshney14] undefined
p.2   L238  : [carreiro15] undefined
p.3   L279  : [fletcher12] undefined
p.3   L324  : [ameri17] undefined
p.4   L1    : [nida17] undefined
p.4   L2    : [Varshney14] undefined
p.4   L3    : [Varshney14] undefined
p.4   L4    : [fletcher12] undefined
p.4   L5    : [talla17] undefined
p.4   L6    : [talla17] undefined
p.4   L7    : [talla17] undefined
p.4   L8    : [ameri17] undefined
p.5   L5    : [nida17] undefined
p.5   L5    : [nida17] undefined
p.5   L13   : [Varshney14] undefined
p.5   L13   : [Varshney14] undefined
p.5   L20   : [Varshney14] undefined
p.5   L20   : [Varshney14] undefined
p.5   L28   : [fletcher12] undefined
p.5   L28   : [fletcher12] undefined
p.5   L36   : [talla17] undefined
p.5   L36   : [talla17] undefined
p.5   L43   : [talla17] undefined
p.5   L43   : [talla17] undefined
p.5   L51   : [talla17] undefined
p.5   L51   : [talla17] undefined
p.5   L58   : [ameri17] undefined
p.5   L58   : [ameri17] undefined
p.12  L1    : [carreiro15] undefined
p.13  L2    : [carreiro15] undefined
p.13  L2    : [carreiro15] undefined
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
```

```
Missing character: ""
Empty ‘thebibliography’ environment.
Empty ‘thebibliography’ environment.
There were undefined citations.
bookmark level for unknown  defaults to 0.
The anchor of a bookmark and its parent’s must not be the same. Added a new anchor.
Float too large for page by 51.24545pt.
Float too large for page by 51.24545pt.
Float too large for page by 62.24545pt.
The anchor of a bookmark and its parent’s must not be the same. Added a new anchor.
Typesetting of "report.tex" completed in 1.0s.
../README.yml
  13:5      error    wrong indentation: expected 8 but found 4  (indentation)
  15:5      error    wrong indentation: expected 8 but found 4  (indentation)
  37:5      error    wrong indentation: expected 8 but found 4  (indentation)
  39:5      error    wrong indentation: expected 8 but found 4  (indentation)
  52:4      error    wrong indentation: expected 4 but found 3  (indentation)
  52:17     error    trailing spaces  (trailing-spaces)
  54:4      error    wrong indentation: expected 7 but found 3  (indentation)
  56:4      error    wrong indentation: expected 7 but found 3  (indentation)
  73:70     error    trailing spaces  (trailing-spaces)
  77:33     error    trailing spaces  (trailing-spaces)
  79:81     error    line too long (91 > 80 characters)  (line-length)

Compliance Report
================================================================================

name: Sean Shiverick
hid:  335
paper1: 10/25/17 100%
paper2: 65%
project: in progress

yamlcheck
================================================================================

wordcount
================================================================================
13
wc 335 paper2 13 2602 report.tex
wc 335 paper2 13 2615 report.pdf
wc 335 paper2 13 2602 report.bib

find "
================================================================================
passed: True
```

```
find footnote
================================================================================
passed: True

find input{format/i523}
================================================================================
4: \input{format/i523}

passed: True

floats
================================================================================
74: \begin{figure}[!ht]
75:   \centering\includegraphics[width=\columnwidth]{images/Figure1.pdf}
78:   }\label{f:Figure1}
190: \begin{figure}[!ht]
191:   \centering\includegraphics[width=\columnwidth]{images/Figure2.pdf}
194:   }\label{f:Figure2}
225: \begin{figure}[!ht]
226:   \centering\includegraphics[width=\columnwidth]{images/Figure3.pdf}
228:   }\label{f:Figure3}
257: \begin{table}
259:   \label{tab:freq}
290: \begin{figure}[!ht]
291:   \centering\includegraphics[width=\columnwidth]{images/Figure4.pdf}
295:   \label{f:Figure4}
303: \begin{figure}[!ht]
304:   \centering\includegraphics[width=\columnwidth]{images/Figure5.pdf}
306:   }\label{f:Figure5}
309: \begin{figure}[!ht]
310:   \centering\includegraphics[width=\columnwidth]{images/Figure6.pdf}
312:   }\label{f:Figure6}
315: \begin{figure}[!ht]
316:   \centering\includegraphics[width=\columnwidth]{images/Figure7.pdf}
319:   }\label{f:Figure7}
327: \begin{figure}[!ht]
328:   \centering\includegraphics[width=\columnwidth]{images/Figure8.pdf}
330:   }\label{f:Figure8}
356: %Table\ref{t:mytable}.
359: %\begin{table}[htb]
362: %\label{t:mytabble}

figures 8
tables 2
includegraphics 8
```

```
labels 10
refs 1
floats 10

True : ref check passed: (refs >= figures + tables)
True : label check passed: (refs >= figures + tables)
True : include graphics passed: (figures >= includegraphics)

Label/ref check
60: more than 180,000 deaths between 1999 to 2015. Figure 1 shows that the dramatic

204: medication consumption. Figure 2 illustrates several steps in a process and

213: status, and patient motivation. Figure 3 shows a model architecture of a system

238: medication in an emergency room setting \cite{carreiro15}. Table 1 provides a

277: in real time. Figure 4 shows sample ambulatory data from a rhesus macaque

passed: False -> labels or refs used wrong

bibtex
================================================================================

label errors


bibtex errors

m
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```
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-
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o

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x
i
t

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a
t
u
s

2
.

bibtex_empty_fields
================================================================================

entries in general should not be empty in bibtex


find ""
================================================================================
passed: True
```

```
ascii
================================================================================
non ascii found 8217
non ascii found 8217
non ascii found 8217
```

Natural Language Processing (NLP) to analyze human speech data

Ashok Reddy Singam
Indiana University
711 N Park Ave
Bloomington, Indiana 47408
asingam@iu.edu

Anil Ravi
Indiana University
711 N Park Ave
Bloomington, Indiana 47408
anilravi@iu.edu

ABSTRACT

Extracting meaningful information from large volumes of unstructured human language is a challenging big data problem. Automatic speech recognition (ASR) and natural language processing (NLP) based intelligent system can be used in several human machine interface applications both in consumer and industrial sector. Here describing the architecture, building blocks, performance and applications for such system that would use pre-developed ASR and NLP APIs.

KEYWORDS

i523, HID333, HID337, Natural Language Processing

1 INTRODUCTION

As voice becoming a common user interface, the need for accurate and intelligent speech recognition technologies is growing. In speech processing technology there are two main subtasks

- Speaker Recognition
- Speech Recognition

Although the performance of current speaker and speech recognition systems is far from perfect, these systems have already proven their usefulness for certain applications.

2 SPEAKER RECOGNITION

Speaker identification is one of the important task in speech processing. Each person has a voice that is different from everyone elsefis.Speaker recognition is the process of identifying who is speaking by using acoustic features of speech.Speaker recognition has been applied mostly in security applications to control access. Current speaker recognition systems are not very accurate for large speaker populations.

3 NLP FOR SPEECH RECOGNITION

Speech recognition is the ability to identify spoken words. It is the process of converting speech into text. This process prepares the input data (speech) to be appropriate for Natural Language Processing(NLP). NLP is the processing of the text to understand the meaning of the text. It comes as the next step of speech recognition.

Analyzing language for its meaning is a complex task. Modern speech recognition research began in the late 1950s with the advent of the digital computer. The 1960s saw advances in the automatic segmentation of speech into units of linguistic relevance like phonemes, syllables. And now with advancements in the field of Artificial Intelligence, neural networks have been used in many aspects of speech recognition such as phoneme classification,isolated word recognition,audiovisual speech recognition, audiovisual speaker recognition and speaker adaptation. In the context of Speech Recognition, NLP involves 4 basic steps

- Morphological Analysis
- Syntactic Analysis
- Semantic Analysis
- Pragmatic Analysis

3.1 Morphological Analysis

Morphological analysis is the identification, analysis, and description of the structure of a given languagefis root words, word boundaries, affixes, parts of speech, etc. There are two typical problems in this area, which includes word segmentation and part-of-speech (POS) tagging. Word segmentation is the problem of finding word boundaries in a corpus.

3.2 Syntactic Analysis

Syntactic analysis or parsing is the process of analyzing a string of symbols, either in natural language or in computer languages, conforming to the rules of a formal grammar.

3.3 Semantic Analysis

Semantic analysis is the process of relating syntactic structures, from the levels of phrases, clauses, sentences and paragraphs to the level of the writing as a whole, to their language-independent meanings.

3.4 Pragmatic Analysis

Pragmatic Analysis is how sentences are used in different situations and how use affects the interpretation of the sentence. Means what was said is reinterpreted as what it actually means.

4 CONCLUSION

ACKNOWLEDGMENTS

The authors would like to thank Dr. Gregor von Laszewski for his support and suggestions to write this paper.

REFERENCES

```
bibtext report
=========================================

This is BibTeX, Version 0.99d (TeX Live 2016)
The top-level auxiliary file: report.aux
The style file: ACM-Reference-Format.bst
I found no \citation commands---while reading file report.aux
Database file #1: report.bib
(There was 1 error message)
make[2]: *** [bibtex] Error 2

latex report
=========================================

        [2017-11-03 08.17.51] pdflatex report.tex
This is pdfTeX, Version 3.14159265-2.6-1.40.17 (TeX Live 2016) (preloaded format=pdflate
Missing character: ""
Missing character: ""
Missing character: ""
Missing character: ""
Empty ‘thebibliography’ environment.
Typesetting of "report.tex" completed in 0.8s.
../README.yml
  16:16     error    trailing spaces  (trailing-spaces)

Compliance Report
=================================================================================

name: Ashok Reddy Singam
hid:  337
paper1: Nov 01 17 100%
paper2: In Progress
project: not started

yamlcheck
=================================================================================

wordcount
=================================================================================
1
wc 337 paper2 1 575 report.tex
wc 337 paper2 1 537 report.pdf
wc 337 paper2 1 66 report.bib

find "
```

```
================================================================================
passed: True

find footnote
================================================================================
passed: True

find input{format/i523}
================================================================================
4: \input{format/i523}

passed: True

floats
================================================================================

figures 0
tables 0
includegraphics 0
labels 0
refs 0
floats 0

True : ref check passed: (refs >= figures + tables)
True : label check passed: (refs >= figures + tables)
True : include graphics passed: (figures >= includegraphics)

Label/ref check
passed: True

bibtex
================================================================================

label errors


bibtex errors

m
a
n
d

,
b
i
```

bibtex report, returned non-zero exit status 2.

```
bibtex_empty_fields
================================================================================

entries in general should not be empty in bibtex


find ""
================================================================================
passed: True

ascii
================================================================================
non ascii found 8217
non ascii found 8217
```