Research Methods
in computer science
Spring 2020

Lecture 5

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January 29, 2020

Agenda

Research Paper Anatomy

Assignment

Anatomy of a Research Paper

Abstract

Introduction

Related Work

Design and Implementation

Evaluation

Conclusion

Some of the contents in the next few slides from Jennifer Widom's notes on Writing Technical Papers.

Abstract

Summary of motivation, state of the art, your algorithm or system, and results each in 1-3 sentences.

Abstract MadLibs!!

This paper presents a _____ method for _____
(synonym for *new*)   (sciencey verb)

the _____. Using _____, the
(noun few people have heard of)   (something you didn't invent)

_____ was measured to be _____ +/- _____
(property)   (number)   (number)

_____. Results show _____ agreement with
(units)   (sexy adjective)

theoretical predictions and significant improvement over

previous efforts by _____, et al. The work presented
(Loser)

here has profound implications for future studies of

_____ and may one day help solve the problem of
(buzzword)

_____.
(supreme sociological concern)

Keywords: _____, _____, _____
(buzzword)   (buzzword)   (buzzword)

Introduction

What is the problem?

Why is it interesting and important?

Why is it hard? (E.g., why do naive approaches fail?)

Why hasn't it been solved before? (Or, what's wrong with previous proposed solutions? How does mine differ?)

What are the key components of my approach and results? Also include any specific limitations.

Summary of results and contributions.

Related Work

You want to give a sense of the old and new work in this area.

Where to look for these?

Organized is better than not organized

Organizing Related Work

Lists

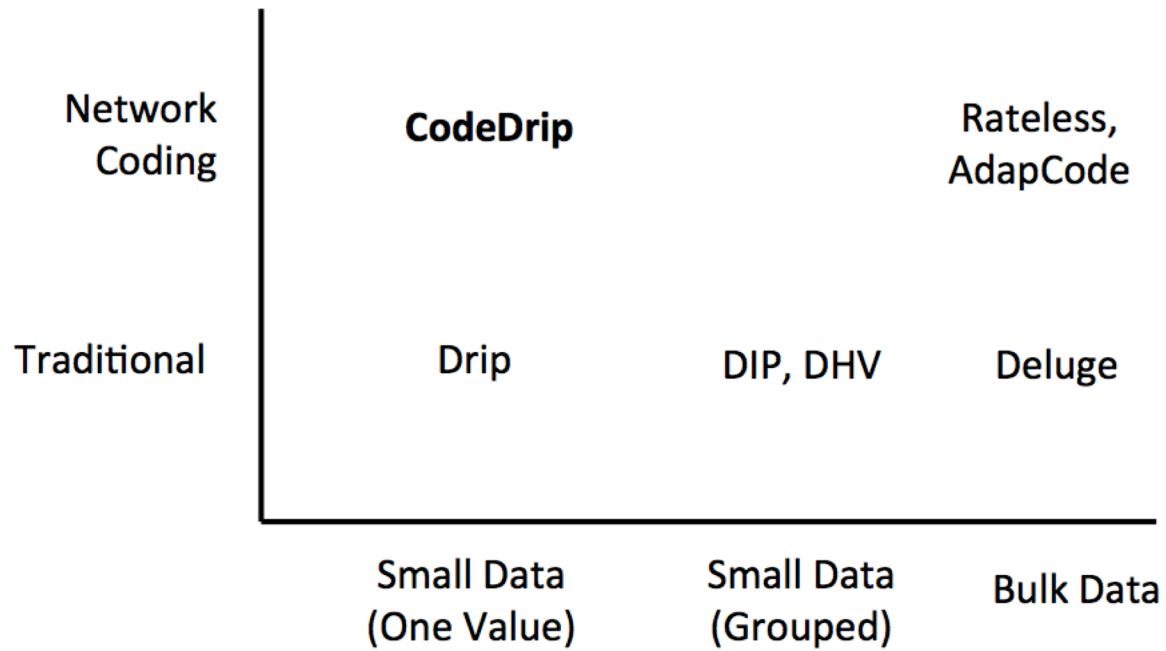Figures

Diagrams

Tables

Sub-sections

Competition table

Fig. 1. Selected classes of dissemination protocols in sensor network. CodeDrip uses network coding to make dissemination of small data efficient and fast.

Table 1: Comparison of different non-intrusive people identification methods.

Paper	Sensor	Accuracy (%)	population
Hnat et al. [6]	Ultrasonic	94	5
Pan et al. [18]	Geophone	96	5
Zeng et al. [24]	Wi-Fi	93	4
Jenkins et al. [9]	Pressure	80	15
Khalil et al. [13]	Ultrasonic	95	20

Table I: State of the Art People Counting Solutions

Solution	Application	Cost ($)	Privacy Preserving Level	Scalability	Real Time	Flexibility
Break Beam Sensors	Counting	≤ 10	High	Yes	Yes	No
PIR Sensors	Presence	≤ 10	High	Yes	Yes	Yes
Ultrasonic Sensor	Counting	≤ 100	Moderate	No	Training Required	No
RGB Cameras	Counting	≤ 100	Low	Yes	Yes	No
IR Imager	Counting	≤ 25	High	Yes	Training Required	No
Our Solution	Counting	≤ 25	High	Yes	Yes	Yes

Table 1. Performance for state-of-the-art embedded VLC.

System	Dietz et al. [13]	Schmid et al. [24]	Klaver et al.[19]	Wang et al. [31]	Hewage et al. [15]	Li et al. [21]	Our Work
Data Rate	250 bps	800 bps	1 kbps	16 kbps	1 mbps	1-10 kbps	100 kbps
Distance	~10cm	~2m	~1m	~5m	NA	~20cm	6m
Multi-hop	No	No	Yes	No	No	No	Yes
Full-Duplex	No	No	No	No	No	No	Yes
Parallel Channels	No	No	No	No	No	No	Yes
Implementation	MCU	MCU	MCU	ARM	FPGA+MCU	MCU	ARM + PRU
Antenna	LED-to-LED	LED-to-LED	LED-to-PD	LED-to-LED/PD	LED-to-PD	RGB-to-RGB	RGB/LED-to-LED/PD

IV. RELATED WORK

In this section, we overview the types of tools the networking community has built to evaluate network protocols.

Link Emulation: Single link emulation can be done on hardware (using channel emulators) or on software (using tools such as Netem). Prior work has shown that when correctly configured, Netem provides a realistic estimation of impaired network conditions and is sufficient for most networking experiments [15].

Network Emulation: Mininet [4] [5] uses light-weight virtualization by isolating certain OS resources, thus allowing emulation of large networks in a single machine. However, scalability becomes an issue when we want to emulate larger networks than can be tested in a single physical machine. Emulab [16] light-weight virtualization technique, FreeBSD jails, to setup multiple virtual interfaces per process group, similar to Mininet and CloudNet. CloudNet provides better resource isolation across the emulated nodes than Emulab and shows how we can use it on the commodity clouds. There is some prior work in data centers to optimize VM placement and routing [17]. CloudNet uses the concept of placement groups in Amazon EC2 where the virtual machines are placed as close to each other so that we can efficiently use the resources.

Network Emulation Timing: Time-Warp [18] explores the possibility of using time dilation in network emulation experiments. Future version of CloudNet may use this technique to offer added consistency in performance for emulations that requires very high-bandwidth. Slicetime is another effort to provide scalable and accurate network emulation [19]. Slicetime makes the simulations independent of real time constraint thus allowing simulation of complex and high performance networks when we have limited physical resources.

Competition

AFFORDABLE

CS CouchSurfing

craigslist

BedandBreakfast.com

AirBed&Breakfast

Hostels.com
Every Hostel, Everywhere!

OFFLINE TRANSACTION

ONLINE TRANSACTION

Rent Smart!
rentobi.com
furnished, unfurnished & vacation rentals

VRBO
Vacation Rentals
by owner

hotels.com

EXPENSIVE

Template by **PitchDeckCoach**.com

Competition

$90M raised on concept of SMB loyalty in 2011 and 2012…
LevelUp, FiveStars, BellyCard, Mogl, Shopkick, etc.

Loyalty in nightlife is wide open!

	Flowtab	GOPAGO	coaster	Tabbedout	bartab
Bars & Nightclubs	✔		✔	✔	✔
Multiple Cities	✔	✔		✔	✔
0% CC Processing	✔				
Distribution Partner	✔	✔			
Table Ordering	✔				
POS Integration				✔	

Related work variations

Merged with Introduction

Inter-mingled with relevant sections

Placement of Related Work

The Body of the paper

Depending on the area of work may describe the proposed algorithm, proofs, systems, implementations

Evaluation

Description of experiments and metrics

Results of experiments

Implications of those results

More applicable to the applied areas of computer science.

Conclusions

Not the same as abstract

Short summary of what you did in the project and the implications of the results

Can include lessons learnt and future directions

Quick Exercise

Look through three research papers

Identify the sections we discussed so far

Share with the class any variations

Slightly different take from other disciplines

Anatomy of a Science Paper

Describe the Problem Is there a hypothesis? What is the central question?

Relevance-Why solve it?

Describe existing theories and how this investigation will add to knowledge or distinguish between theories

Introduction

Approach: How will you use data to solve this problem?

Where will data come from and what is it's accuracy?

Experimental apparatus and data acquisition methodology.

References to data sources and relevant publications.

Methods

! Convince the reader that the data can be believed.

The Scientific Investigation

? How do the observations agree with predictions made by the model?

? How do the observations disagree with predictions made by the model?

What are the relationships between different observations and/or "features"? Are there patterns?

What is the relationship between the theoretical model and the data?

How do these findings fit with other studies or models?

How could this study be improved if better or additional data were available?

Discussion

Description of observations, which may include charts, graphs or other representations.

All charts and graphs are mentioned

Interpretations

Observations

Classification of observations as "features".

Summarize the findings of the study

What did you "prove" and what needs more study?

What are important questions that were not answered by this study? Directions for future research?
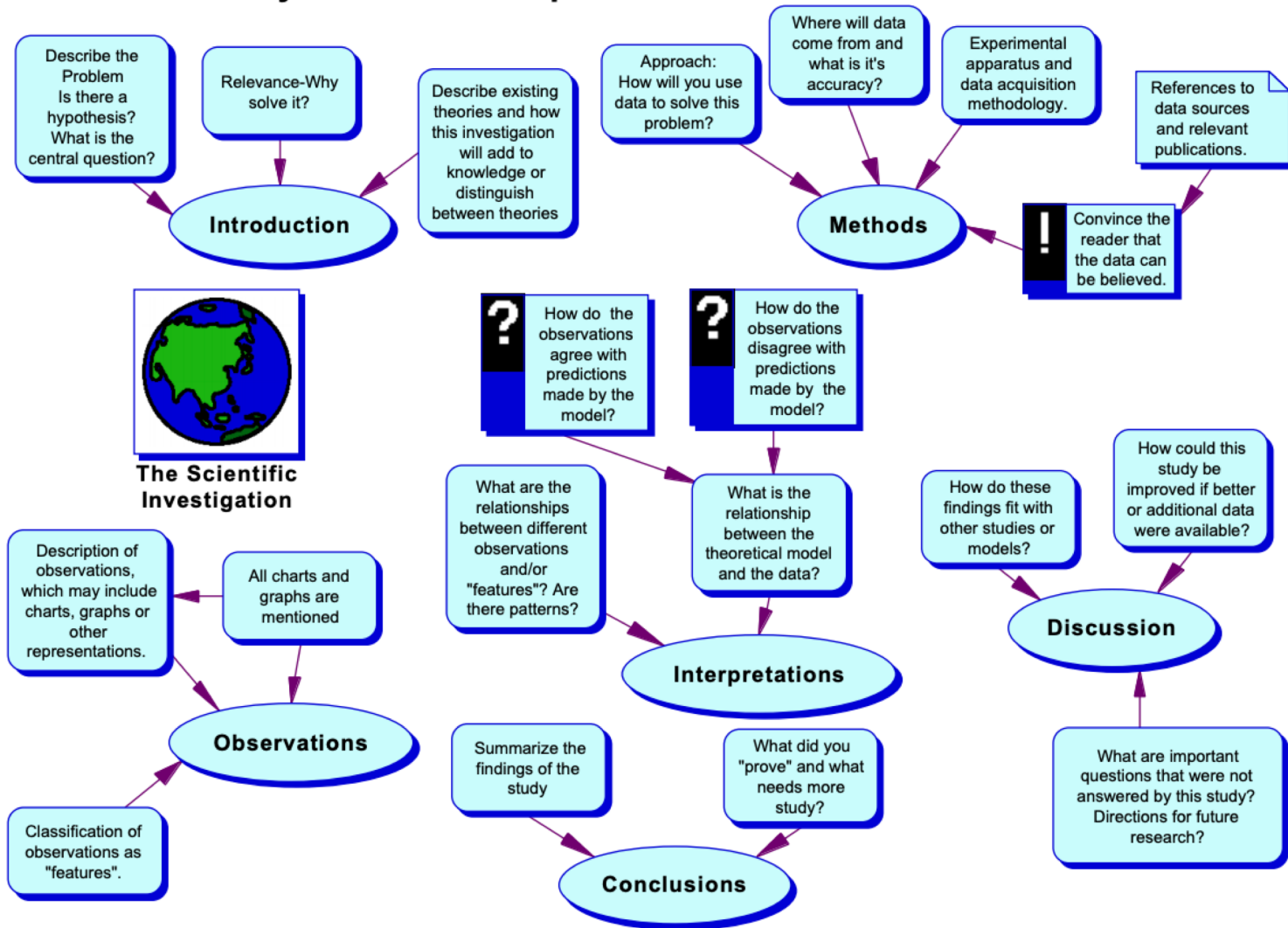
Conclusions

Figure 3.1. This diagram shows the headings that must be used for this science paper. Please pay careful attention to the boxes with arrows pointing at each elliptical heading box. These boxes are reminders of the content that belongs with each heading.

https://earthweb.ess.washington.edu/creager//ess202/Ch3.Anatomy.pdf

How do the answers map to these questions to the different parts of a paper?

HW2 - Research Formulation

What are you trying to do? Articulate your objectives using absolutely no jargon.

How is it done today, and what are the limits of current practice?

What's new in your approach and why do you think it will be successful?

Who cares?

Heilmeier

HW2 - Research Formulation

If you're successful, what difference will it make?

What are the risks and the payoffs?

How much will it cost?

How long will it take?

What are the midterm and final "exams" to check for success?

Heilmeier