

# Research Methods in computer science

Spring 2023

Lecture 6

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February 6, 2023

# Agenda

Anatomy of Research Papers

HW3

Recap

# 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.

# 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.

# Why do we need related work?

Justify that the proposed work is needed

Hopefully, an objective justification

Recap from HW2

Demonstrate mastery over area

Reviewers want to know if they can trust you

Relationship to other scientific areas

Connect the dots

Sometimes helps non-expert reviewers

# Related Work



# What work is related?

Relation could be

Similar problems

Similar methods

Applications

Datasets

Don't go too broad

“Computer” not a related work in ML papers

# 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

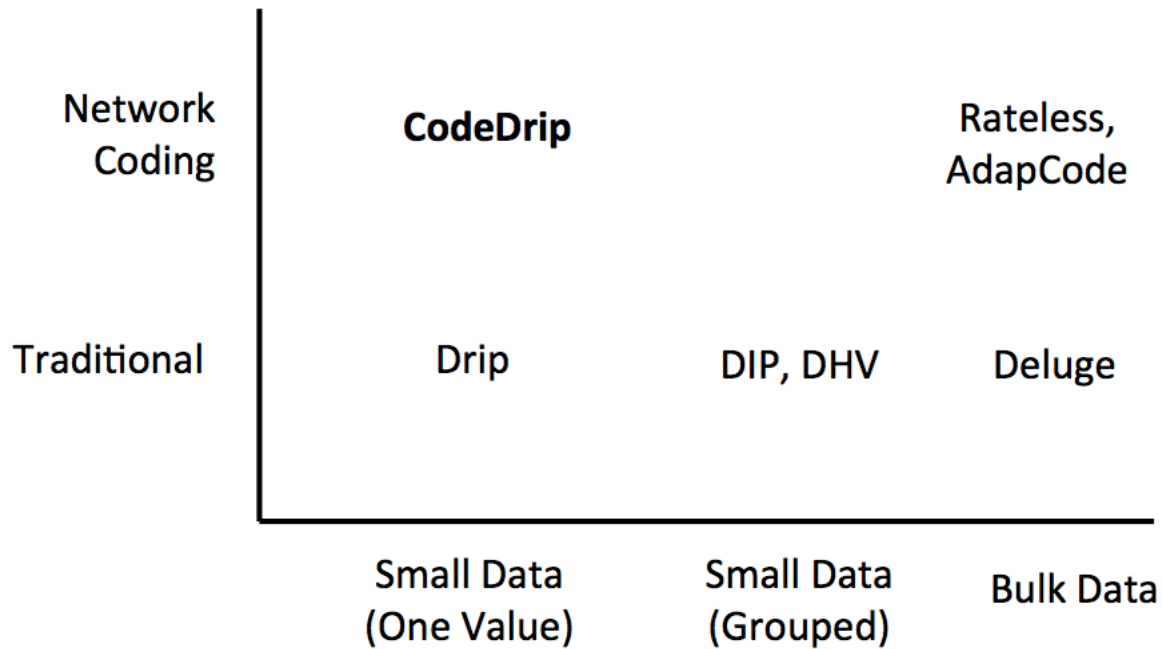
Figures

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.**

<b>Paper</b>	<b>Sensor</b>	<b>Accuracy (%)</b>	<b>population</b>
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	$\leq 10$	High	Yes	Yes	No
PIR Sensors	Presence	$\leq 10$	High	Yes	Yes	Yes
Ultrasonic Sensor	Counting	$\leq 100$	Moderate	No	Training Required	No
RGB Cameras	Counting	$\leq 100$	Low	Yes	Yes	No
IR Imager	Counting	$\leq 25$	High	Yes	Training Required	No
Our Solution	Counting	$\leq 25$	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
<b>Data Rate</b>	250 bps	800 bps	1 kbps	16 kbps	1 mbps	1-10 kbps	100 kbps
<b>Distance</b>	~10cm	~2m	~1m	~5m	NA	~20cm	6m
<b>Multi-hop</b>	No	No	Yes	No	No	No	Yes
<b>Full-Duplex</b>	No	No	No	No	No	No	Yes
<b>Parallel Channels</b>	No	No	No	No	No	No	Yes
<b>Implementation</b>	MCU	MCU	MCU	ARM	FPGA+MCU	MCU	ARM + PRU
<b>Antenna</b>	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

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# Competition

\$90M raised on concept of SMB loyalty in 2011 and 2012...

LevelUp, FiveStars, BellyCard, Mogl, Shopkick, etc.

*Loyalty in nightlife is wide open!*

	<i>Flowtab</i> <sup>®</sup>	 GOPAGO	 easter	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

# Signs of poor related work

Laundry list of summaries

No explicit relation to the proposed work

Lack of organization

Putting one's work in the context of the field

Other symptoms

- Old papers

- Papers from limited number of sources

# 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

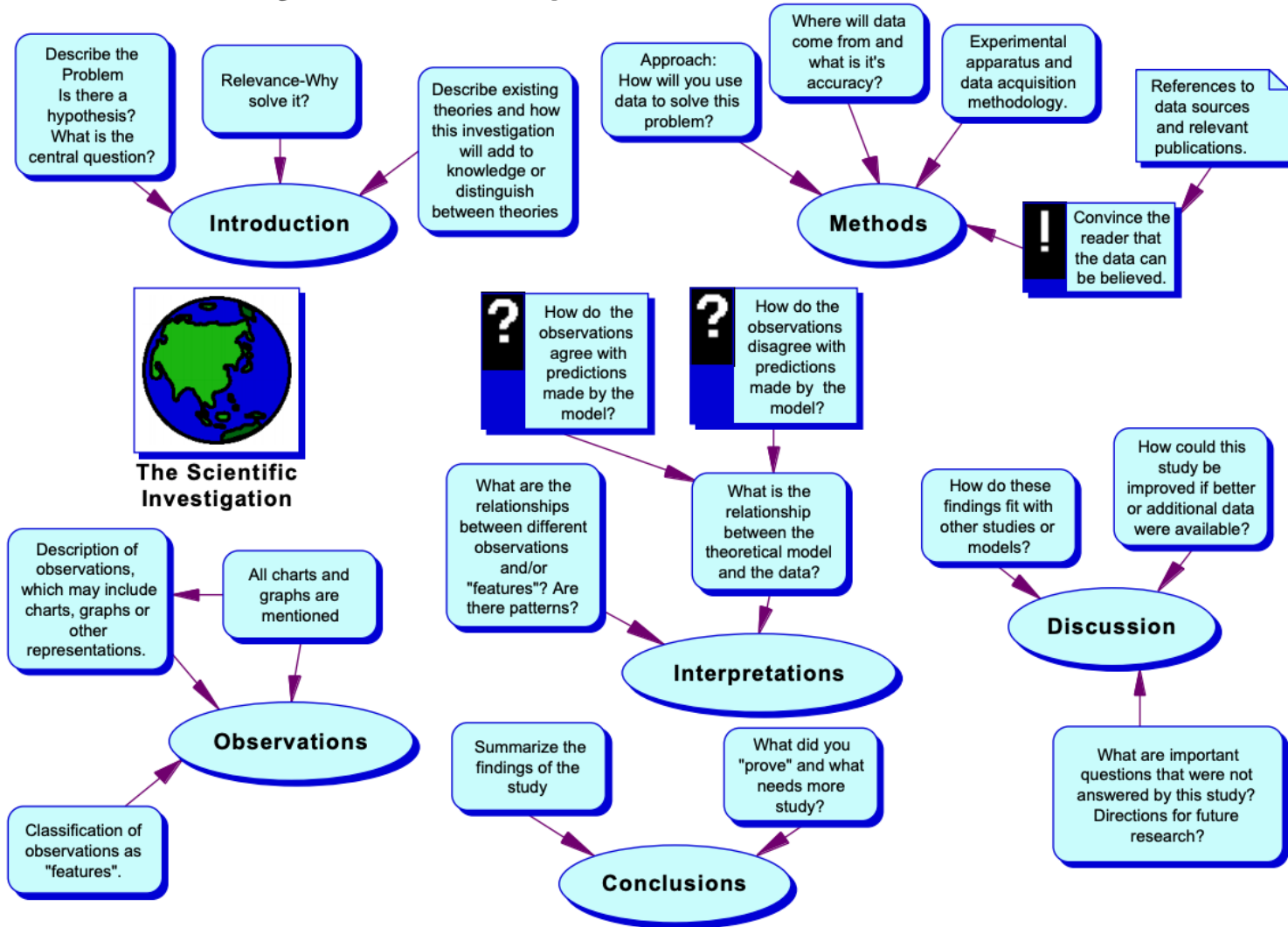


Figure 3.1. This diagram shows the headings that must be used for this science paper. Please pay careful attention to the boxes with arrows pointing at each elliptical heading box. These boxes are reminders of the content that belongs with each heading.

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

# HW3

Pick ten papers related to your research

Summarize each paper in 2-3 sentences

Why is it important?

Contributions? Strengths? Weaknesses?

Improve related work organization for one of the papers.