ACL-IJCNLP 2021

Bringing Structure into Summaries

- A Faceted Summarization Dataset for Long Scientific Documents

Rui Meng, Khushboo Thaker, Lei Zhang, Yue Dong, Xingdi Yuan, Tong Wang, Daqing He

Microsoft® Research

Structures in Writing

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  - Divide document into a linear sequence of subtopics
  - Present ideas and arguments progress in a logical and orderly manner

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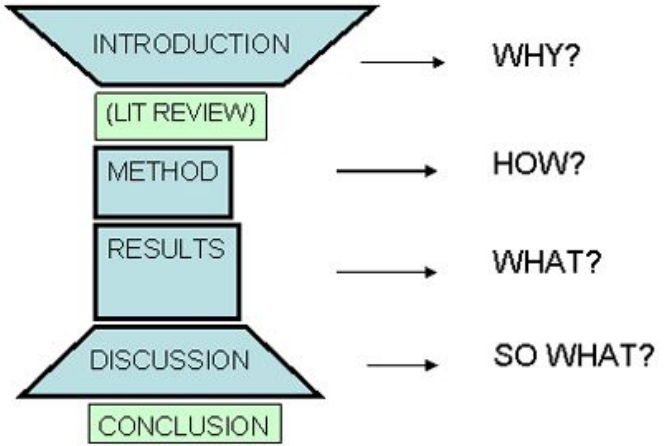

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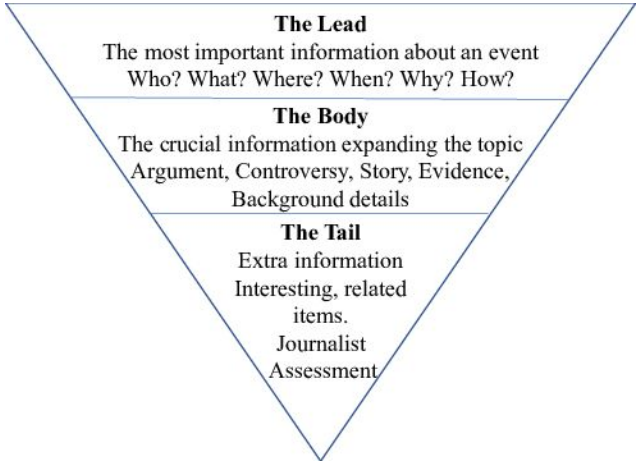

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  - Newspapers: **5W1H**, Inverted Pyramid Style
  - Patient Report: **SOAP** - subjective, objective, assessment, plan

CURRENT CONDITION
COPD/pneumonia

GOALS
1. Pt. will demonstrate productive cough in seated position, 3/4 trials. 2. Pt. will ambulate 150ft with supervision, no assistive device, on level indoor surfaces.

S	Pt. reports not feeling well today, "I'm very tired".
O	Auscultation findings: scattered rhonchi all lung fields. Chest PT was performed in sitting (ant. and post.). Techniques included percussion, vibration, and shaking. Pt. performed a weak combined abdominal and upper costal cough that was nonbronchospastic, congested, and non-productive. The cough/huff was performed with VC. Pectoral stretch/thoracic cage mobilizations performed in seated position. Pt. given towel roll placed in back of seat to open up ant. chest wall. Strengthening exercises in standing - pt. performed hip flexion, extension, and abduction; knee flexion 10 reps x 1 set B. Pt. performs HEP with supervision (in evenings with wife). Pt. instructed to hold tissue over trach when speaking to prevent infection and explained importance of drinking enough water.
A	Pt. continues to present with congestion and limitations in coughing productivity. Pt. has been compliant with evening exercise program, which has results in increased tol to therapeutic exercise regime and an increase in LE strength. Amb. not attempted to 20 to pt. report of fatigue. Pt. should be able to tolerate short distance ambulation within the next few days.
P	Cont. current exercise plan including CPT; emphasize productive coughing techniques; increase strengthening exer reps to 15; attempt amb. again tomorrow.

Summary in Academic Writing

- Traditional abstracts
  - A concise summary of a research paper
  - Single paragraph of approximately 200~300 words in length
  - Highlight key content aspects: purpose/importance of the research, main outcomes etc.

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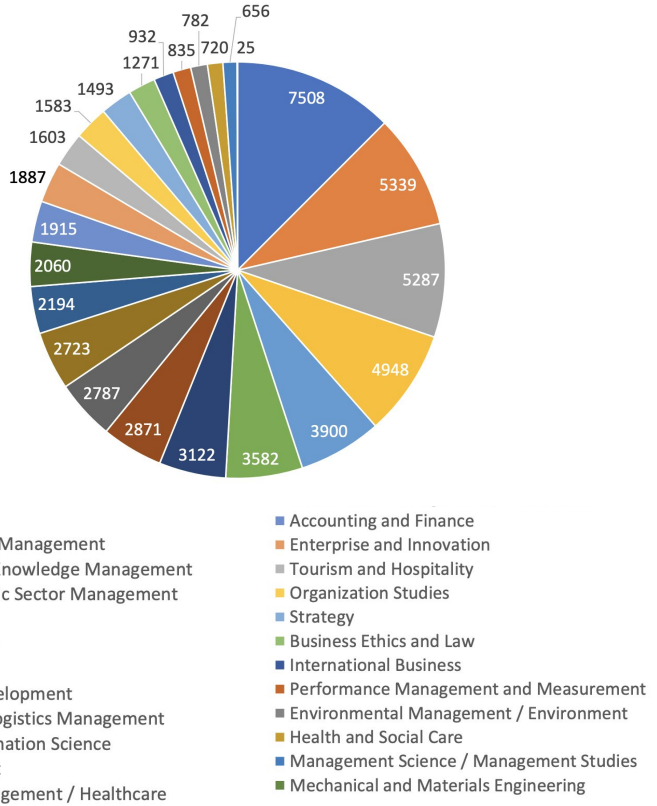
- Can we bring structure into abstracts?
  - Structured abstracts
    - **Emerald (this study)**
    - PubMed (Gidiotis and Tsoumakas,2019)
  - Benefits
    - Faster and easier access by the reader
    - Greater clarity for both reader and writer

Structured Abstract of Emerald

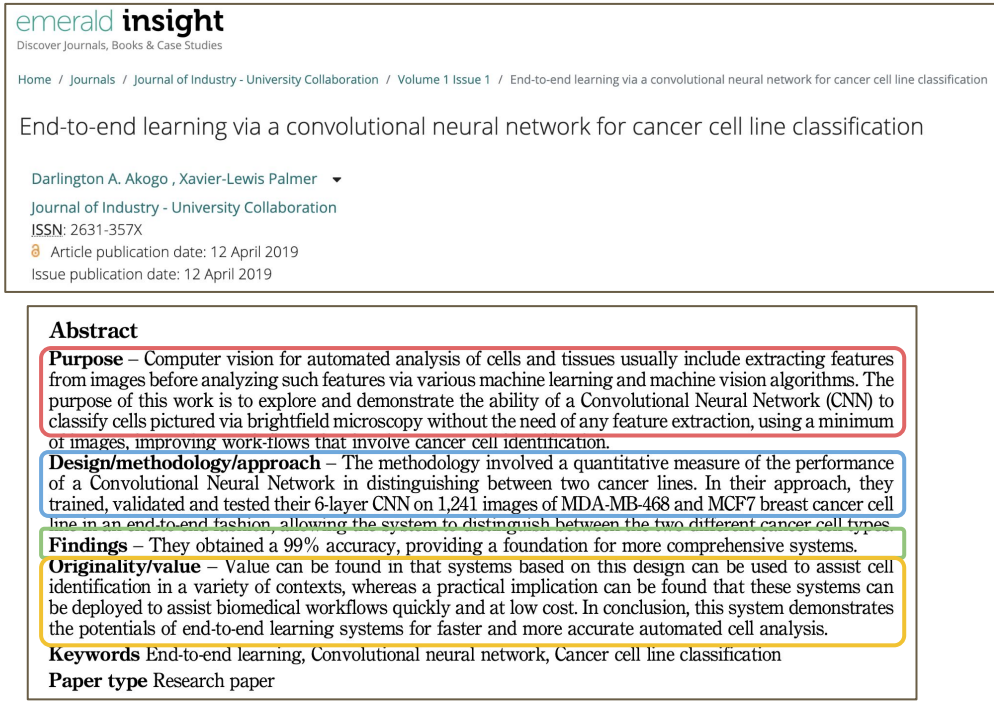
- FacetSum Dataset
  - 60,532 scientific papers w/ fulltext
  - Covering 25 different academic fields

# documents					
Train: 46,289 / Dev: 6,000 / Test: 6,000 / OA-Test: 2,243					
# words in abstracts					
	Full	Purpose	Method	Findings	Value
mean	290.4	54.1	52.0	68.6	47.3
std	±82.8	±28.4	±27.8	±32.4	±24.2
# words in paper sections					
	Full	Intro.	Method	Result	Conc.
recall%	-	84.3%	67.0%	72.4%	79.0%
mean	6,827	885	1,194	2,371	747
std	±2,704	±557	±861	±1,466	±567



Structured Abstract of Emerald

- Summarize each study in four facets
  - Purpose
  - Design/methodology/approach
  - Findings
  - Originality/value



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End-to-end learning via a convolutional neural network for cancer cell line classification

Darlington A. Akogo , Xavier-Lewis Palmer

Journal of Industry - University Collaboration
ISSN: 2631-357X
Article publication date: 12 April 2019
Issue publication date: 12 April 2019

Abstract

Purpose – Computer vision for automated analysis of cells and tissues usually include extracting features from images before analyzing such features via various machine learning and machine vision algorithms. The purpose of this work is to explore and demonstrate the ability of a Convolutional Neural Network (CNN) to classify cells pictured via brightfield microscopy without the need of any feature extraction, using a minimum of images, improving work-flows that involve cancer cell identification.

Design/methodology/approach – The methodology involved a quantitative measure of the performance of a Convolutional Neural Network in distinguishing between two cancer lines. In their approach, they trained, validated and tested their 6-layer CNN on 1,241 images of MDA-MB-468 and MCF7 breast cancer cell line in an end-to-end fashion, allowing the system to distinguish between the two different cancer cell types.

Findings – They obtained a 99% accuracy, providing a foundation for more comprehensive systems.

Originality/value – Value can be found in that systems based on this design can be used to assist cell identification in a variety of contexts, whereas a practical implication can be found that these systems can be deployed to assist biomedical workflows quickly and at low cost. In conclusion, this system demonstrates the potentials of end-to-end learning systems for faster and more accurate automated cell analysis.

Keywords End-to-end learning, Convolutional neural network, Cancer cell line classification

Paper type Research paper

Structured Abstract of PubMed

- Five facets
  - Introduction
  - Objections
  - Methods
  - Results
  - Conclusion
- Dataset
  - 19.7m+ scientific papers, 2.8m w/ fulltext
  - #unstructured : #structured = 4.5m : 15.1m

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed | 24792780[uid]

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Clin Toxicol (Phila). 2014 Jun;52(5):525-30. doi: 10.3109/15563650.2014.913175. Epub 2014 May 5.

Evaluation of dexmedetomidine therapy for sedation in patients with toxicological events at an academic medical center.

Mohorn PL[1], Vakkalanka JP, Rushton W, Hardison L, Woloszyn A, Holstege C, Corbett SM.

Author information

Abstract

INTRODUCTION: Although clinical use of dexmedetomidine (DEX), an alpha2-adrenergic receptor agonist, has increased, its role in patients admitted to intensive care units secondary to toxicological sequelae has not been well established.

OBJECTIVES: The primary objective of this study was to describe clinical and adverse effects observed in poisoned patients receiving DEX for sedation.

METHODS: This was an observational case series with retrospective chart review of poisoned patients who received DEX for sedation at an academic medical center. The primary endpoint was incidence of adverse effects of DEX therapy including bradycardia, hypotension, seizures, and arrhythmias. For comparison, vital signs were collected hourly for the 5 h preceding the DEX therapy and every hour during DEX therapy until the therapy ended. Additional endpoints included therapy duration; time within target Richmond Agitation Sedation Score (RASS); and concomitant sedation, analgesia, and vasopressor requirements.

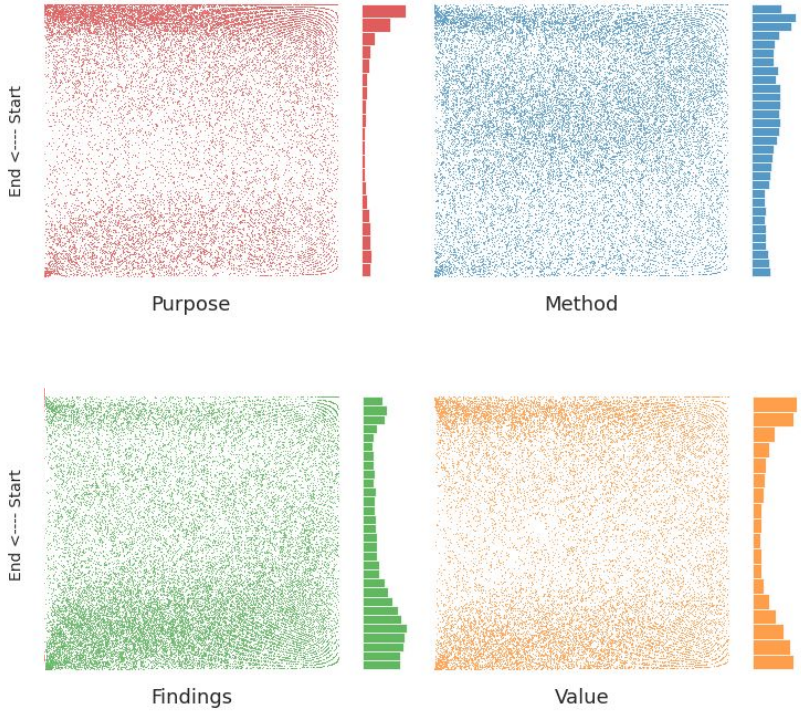
RESULTS: Twenty-two patients were included. Median initial and median DEX infusion rates were similar to the commonly used rates for sedation. Median heart rate was lower during the therapy (82 vs. 93 beats/minute, $p < 0.05$). Median systolic blood pressure before and during therapy was similar (111 vs. 109 mmHg, $p = 0.745$). Five patients experienced an adverse effect per study definitions during therapy. No additional adverse effects were noted. Median time within target RASS and duration of therapy was 6.5 and 44.5 h, respectively. Seventeen patients (77%) had concomitant use of other sedation and/or analgesia with four (23%) of these patients requiring additional agents after DEX initiation. Seven patients (32%) had concomitant vasopressor support with four (57%) of these patients requiring vasopressor support after DEX initiation.

CONCLUSION: Common adverse effects of DEX were noted in this study. The requirement for vasopressor support during therapy warrants further investigation into the safety of DEX in poisoned patients. Larger, comparative studies need to be performed before the use of DEX can be routinely recommended in poisoned patients.

PMID: 24792780 [PubMed - indexed for MEDLINE]

Analysis 1 - Sentence Position Distribution

- Find best-match sentences (extractive oracle) in source texts by Rouge-1
- Plot the relative position of each oracle sentence
  - **Purpose** is clearly skewed towards the beginning
  - **Method** distribution is generally uniform
  - **Findings** are mostly positioned towards the end
  - **Value** is located at the beginning and end



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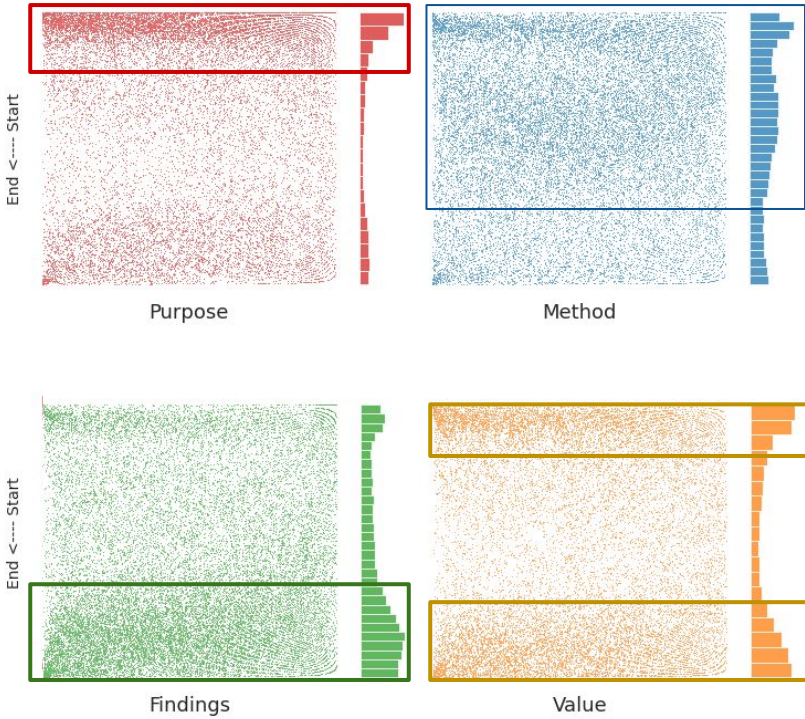


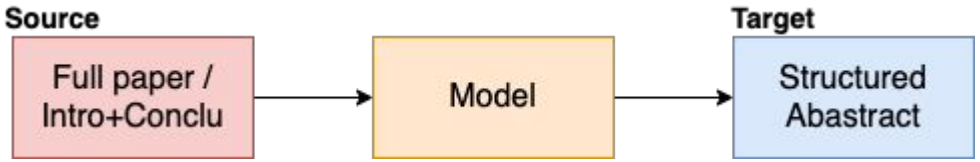
Analysis 2 - Section Alignment

- How different abstract facets align with different sections in an article
- Categorize paper sections by keyword matching of section titles
  - **Introduction**: intro, purpose
  - **Method**: design, method, approach
  - **Result**: result, find, discuss, analy
  - **Conclusion**: conclu, future
- Oracle scores show a strong correlation between summary facets and sections

Abstract \ Paper Section	Full	I+C	Introduction	Method	Result	Conclusion
Full	62.09	56.47	48.47	43.32	49.73	50.42
Purpose	49.76	47.06	44.23	30.12	33.87	36.23
Method	45.36	34.23	30.82	37.53	29.07	28.46
Findings	52.09	45.28	33.65	29.49	42.80	42.35
Value	45.98	42.37	35.29	26.68	32.52	36.85

Automatic Faceted Summarization

- Method
  - Utilize a pre-trained encoder-decoder model - BART
  - Fine-tune it on Emerald paper data
    - Input: (1) **full paper** (2) **I+C** (introduction+conclusion)



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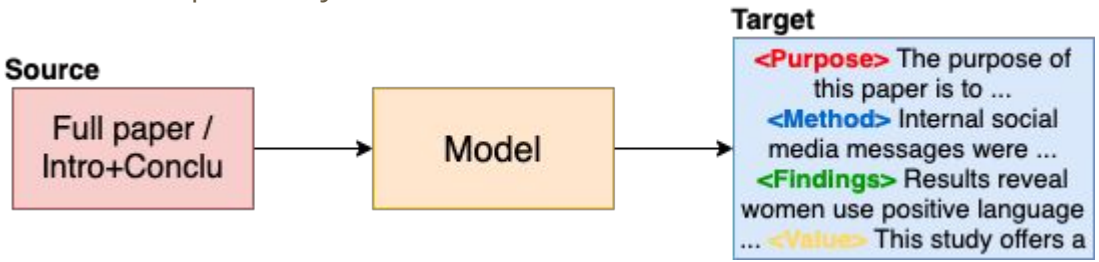
    - Output:
      - (1) **BART-CAT:** a long summary by concatenating all facets
        - Pros: simple to implement
        - Cons: target text might be very long, model can have difficulty handling long-distance dependency



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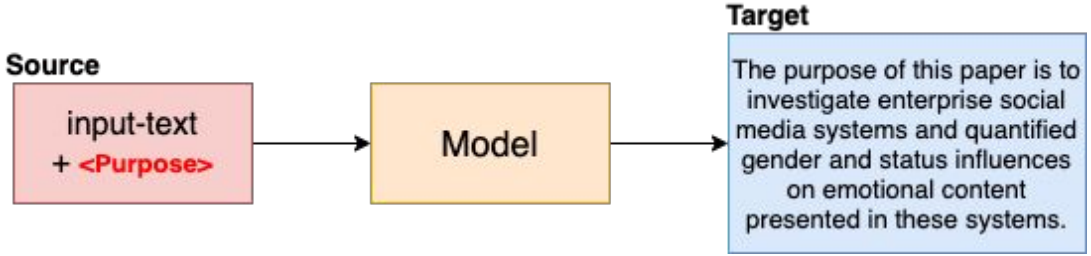
    - Output:
      - (1) **BART-CAT**
      - (1) **BART-FACET:** use a control token in input specifying the facet to summarize
        - Pros: shorter output sequence
        - Cons: may output duplicate information among multiple facets



Results

- Results
  - BART-CAT << BART-Facet
    - The quality of outputs deteriorates rapidly as the decoding proceeds

Model	Source Text	Full	Purpose	Method	Findings	Value
BART (Lewis et al., 2020)	I+C	44.36	41.14	20.75	14.72	5.85
BART-Facet	I+C	**47.09**	**43.47**	**29.07**	**30.97**	**28.90**
BART	full paper	42.74	41.21	20.53	14.33	5.07
BART-Facet	full paper	45.76	42.55	28.07	28.98	28.70

Results

- Results
  - BART-CAT << BART-Facet
    - The quality of outputs deteriorates rapidly as the decoding proceeds
  - I+C > full paper
    - Difficulty in handling long inputs (avg 6.8k tokens).

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Future Work

- Incorporating methods for long-document processing
  - Reducing input length by first extracting key sentences or segments
  - Architectures for long text, such as Longformer, BigBird
- Automatically structuring traditional abstracts

Thank You!

Email: rui.meng@pitt.edu

arXiv: arxiv.org/pdf/2106.00130.pdf

Data & Code: https://github.com/hfthair/emerald_crawler

- Crawler for Emerald data
- Paper links and dataset splits