Conducting Systematic Literature Reviews: Hands-On Workshop for Researchers

Presented by
Dr. Safwan Mahmood Al-Selwi

The Speaker

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He holds a PhD in Information Technology from UTP (Malaysia), an MSc in Computer Applications from Bangalore University (India), and a BEng in Software Engineering from Taiz University (Yemen).

With over ten years of combined experience in academia and industry, his research interests span Artificial Intelligence, Machine Learning, Deep Learning, Computer Vision, Metaheuristic Algorithms, and Optimization, with additional expertise in Android and web development.

LinkedIn | Google Scholar | Scopus | ResearchGate | Web of Science | ORCID | GitHub | Tutorials

My SLR Journey

1. *Al-Selwi, S. M., Hassan, M. F., Abdulkadir, S. J., Muneer, A., Sumiea, E. H., Alqushaibi, A., & Ragab, M. G. (2024). RNN-LSTM: From Applications to Modeling Techniques and Beyond - Systematic Review. *Journal of King Saud University-Computer and Information Sciences*, 102068. (ISI-indexed Q1 Journal, Impact Factor 6.1)

2. *Sumiea, E. H., Abdulkadir, S. J., Alhussian, H. S., Al-Selwi, S. M., Alqushaibi, A., Ragab, M. G., & Fati, S. M. (2024). Deep Deterministic Policy Gradient Algorithm: A Systematic Review. *Heliyon*. (ISI-indexed Q1 Journal, Impact Factor 3.6)

3. *Ragab, M. G., Abdulkader, S. J., Muneer, A., Alqushaibi, A., Sumiea, E. H., Qureshi, R., Al-Selwi, S. M., & Alhussian, H. (2024). A Comprehensive Systematic Review of YOLO for Medical Object Detection (2018 to 2023). *IEEE Access*. (ISI-indexed Q2 Journal, Impact Factor 3.6)

4. *Hassan, S. U., Abdulkadir, S. J., Zahid, M. S. M., & Al-Selwi, S. M. (2025). Local Interpretable Model-Agnostic Explanation Approach for Medical Imaging Analysis: A Systematic Literature Review. *Computers in Biology and Medicine*, 185, 109569. (ISI-indexed Q1 Journal, Impact Factor 6.3)

5. *Yalli, J. S., Hasan, M. H., Jung, L. T., & Al-Selwi, S. M. (2025). Authentication Schemes for Internet of Things (IoT) Networks: A Systematic Review and Security Assessment. *Internet of Things*, 101469. (ISI-indexed Q1 Journal, Impact Factor 7.6)

6. *Yalli, J. S., Hasan, M. H., Jung, L. T., Yerima, A. I., Aliyu, D. A., Maiwada, U. D., Al-Selwi, S. M., & Shaikh, M. U. R. (2025). A systematic review for evaluating IoT security: A focus on authentication, protocols, and enabling technologies. *IEEE Internet of Things Journal*. (ISI-indexed Q1 Journal, Impact Factor 8.2)

7. *Fayyaz, A., Abdulkadir, S. J., Hassan, S. U., Al-Selwi, S. M., Sumiea, E. H. H., & Talib L. F. (2025). The Role of Advanced Machine Learning in COVID-19 Medical Imaging: A Technical Review. *Results in Engineering*, 105154. (ISI-indexed Q1 Journal, Impact Factor 7.9).

8. Fayyaz, A. M., Abdulkadir, S. J., Talpur, N., Al-Selwi, S. M., Hassan, S. U., & Sumiea, E. H. (2025). Grad-CAM (Gradient-weighted Class Activation Mapping): A systematic literature review. *Computers in Biology and Medicine*, *198*, 111200. (ISI-indexed Q1 Journal, Impact Factor 6.3)

9. *Vikash, M. et al. Machine Learning in Credit Card Fraud Detection: A Systematic Review with Emphasis on Concept Drift. (Under Review).

10. *Ayaz et al. Grain Disease Detection and Classification using Advanced Computer Vision Techniques: A Technical Review. (Under Review)

Agenda

Prerequisites

Introduction

- What, Why, and How do we conduct SLRs?

Methodology

The gap?

The literature study mapping process

Step 1: Preliminary study

Step 2: Screening process

Step 3: Eligibility and quality assessment

Step 4: Data extraction

Extra

Achievements

Prerequisites

Data	Microsoft Office - Excel
Reference manager	EndNote
Bibliometric Mapping	VOSviewer
Code	https://github.com/SafwanAlselwi/RNN-LSTM-SLR
SLR paper to follow	Al-Selwi, S. M., Hassan, M. F., Abdulkadir, S. J., & et al. (2024). RNN-LSTM: From applications to modeling techniques and beyond—Systematic review. *Journal of King Saud University-Computer and Information Sciences*, *36*(5), 102068. https://doi.org/10.1016/j.jksuci.2024.102068

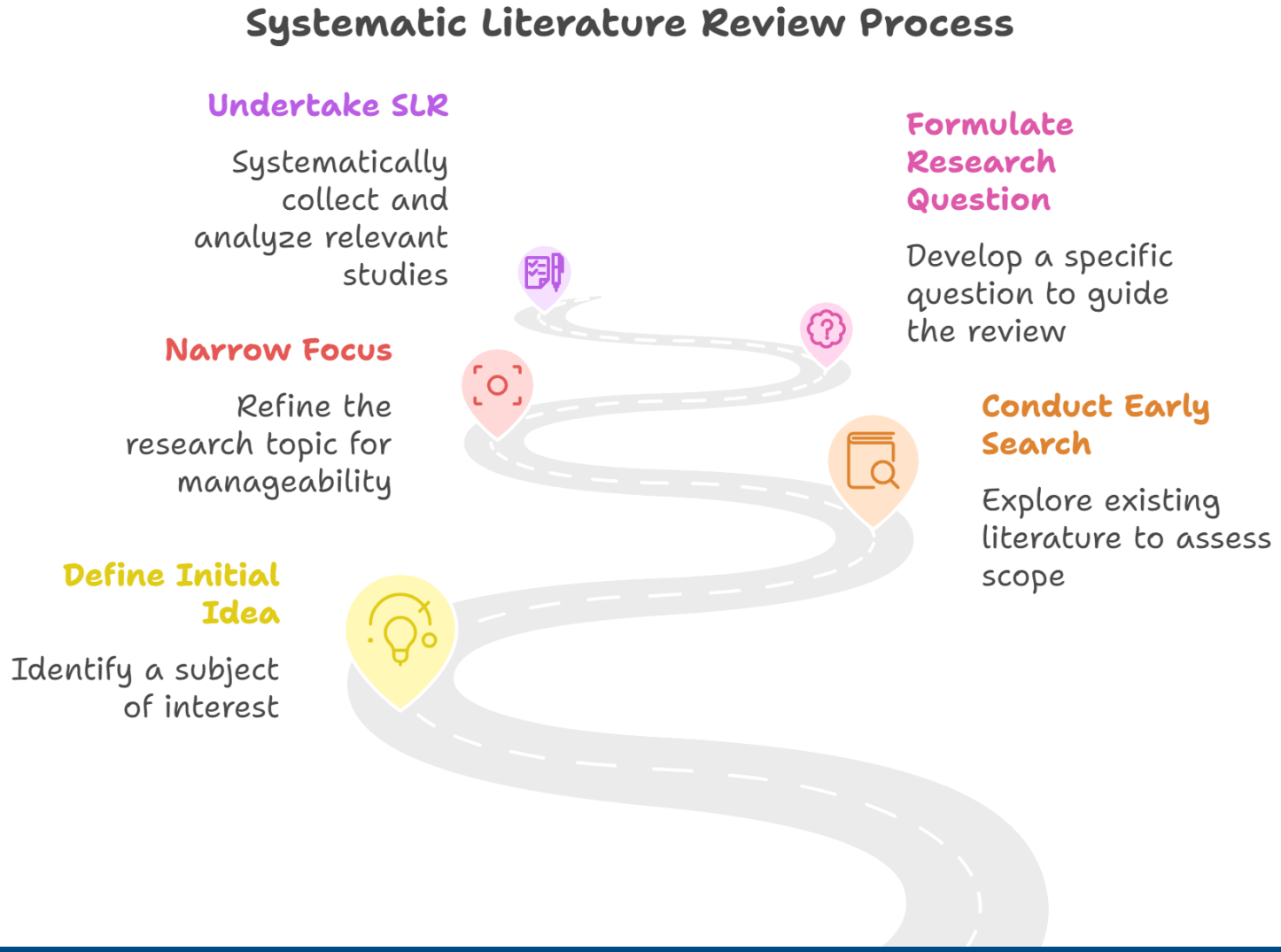
Introduction

Breaking the ice

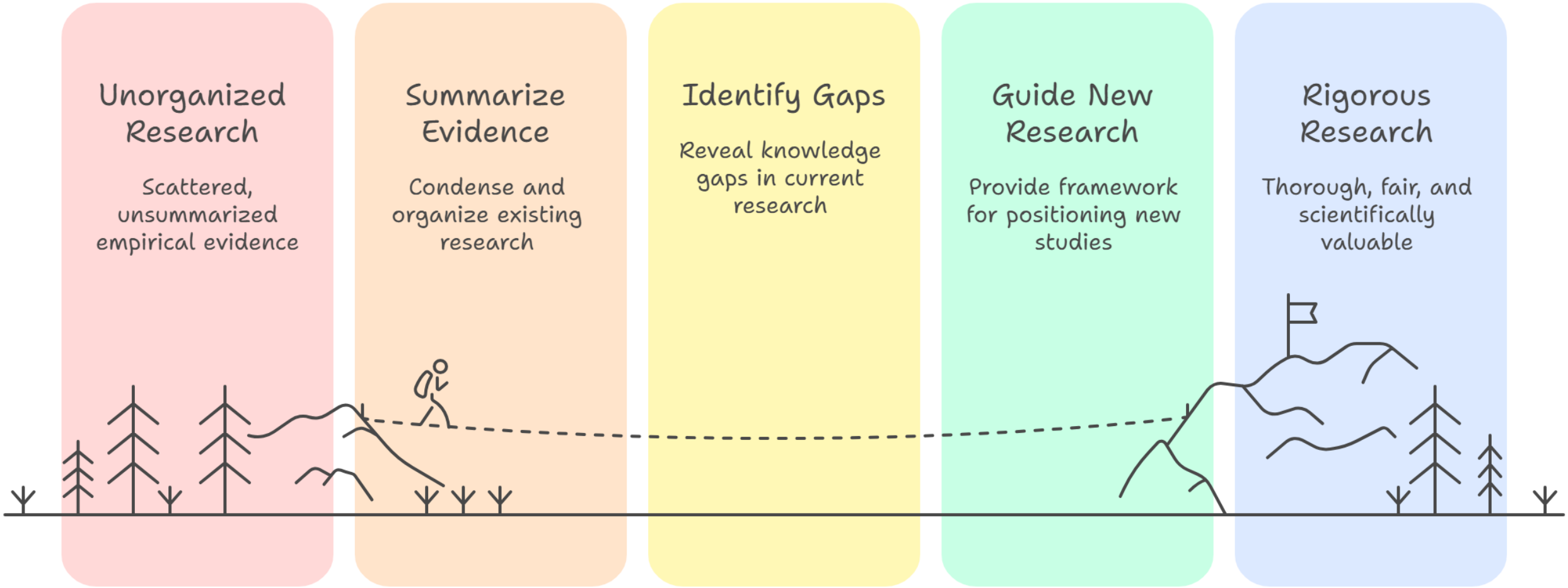
What comes to your mind when you hear *systematic literature review?*

Systematic Literature Review: WHAT

An SLR is a research methodology to collect, identify, and critically analyze the available research studies through a systematic procedure to answer a set of pre-defined research questions.

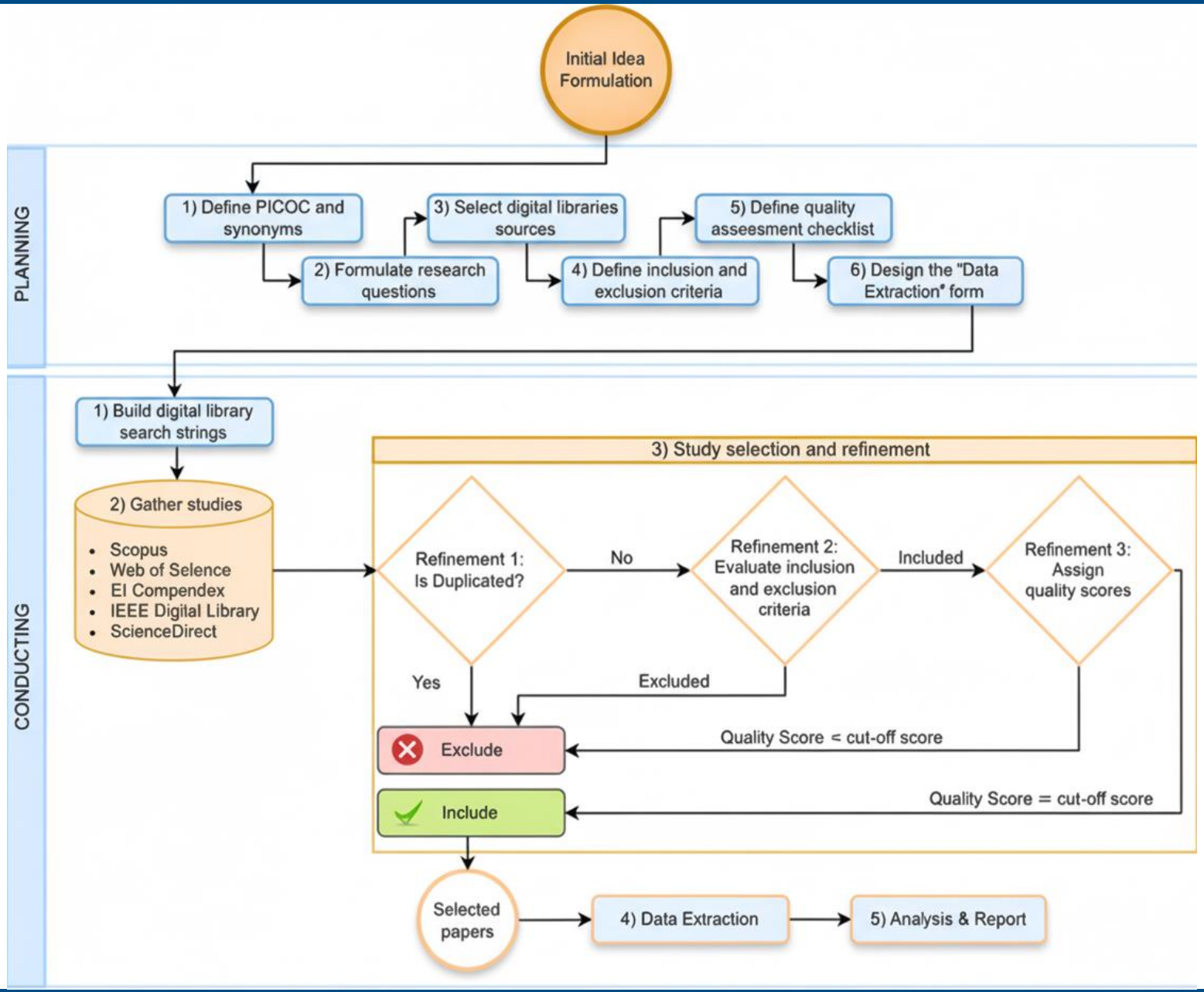


Systematic Literature Review: WHY



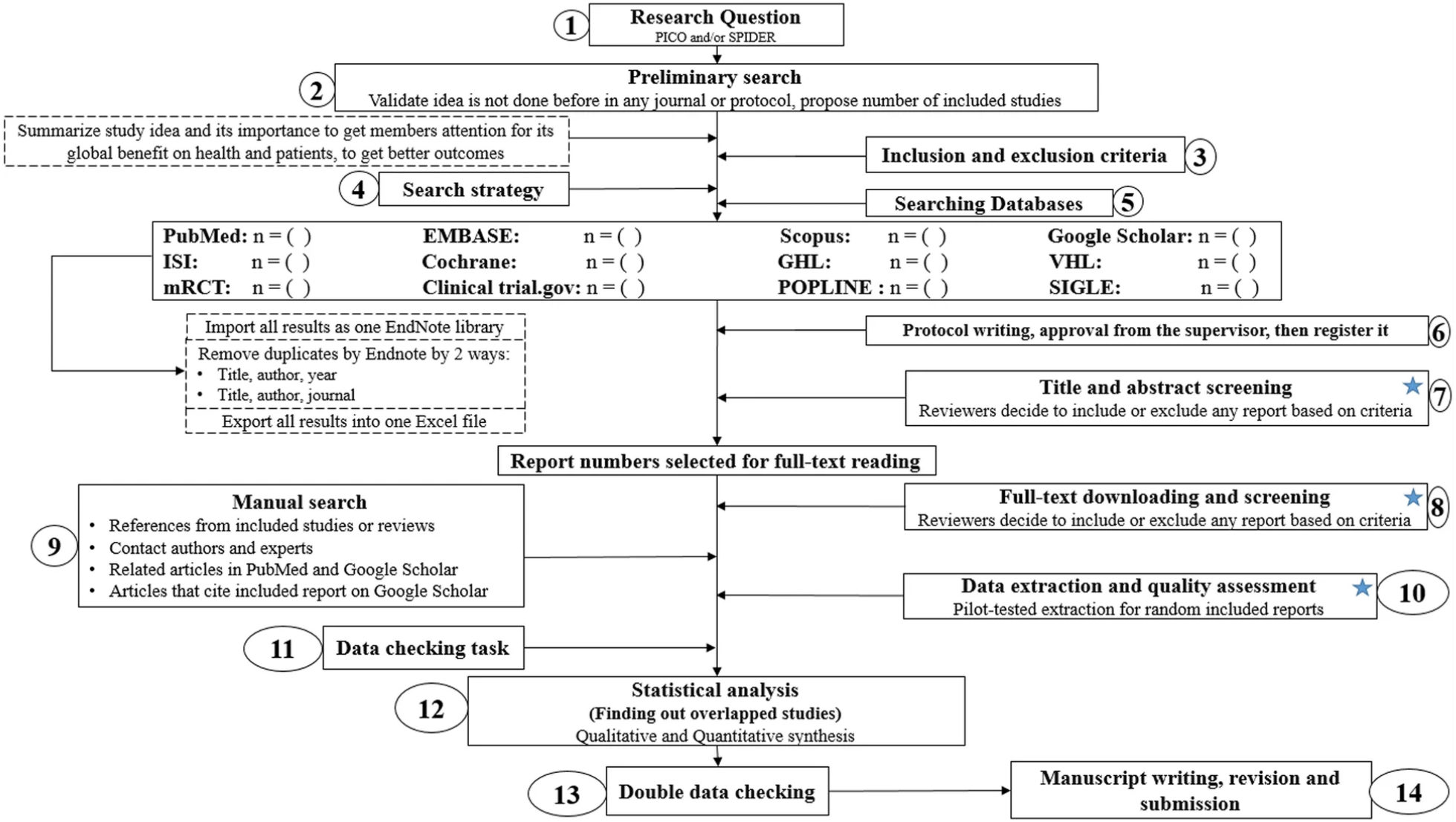
Goal: To **identify gaps in the literature and support these gaps with numerical data** from the conducted SLR.

Systematic Literature Review: HOW



Source: https://doi.org/10.1016/j.mex.2022.101895

Systematic Literature Review: HOW



Methodology

Methodology: The gap?

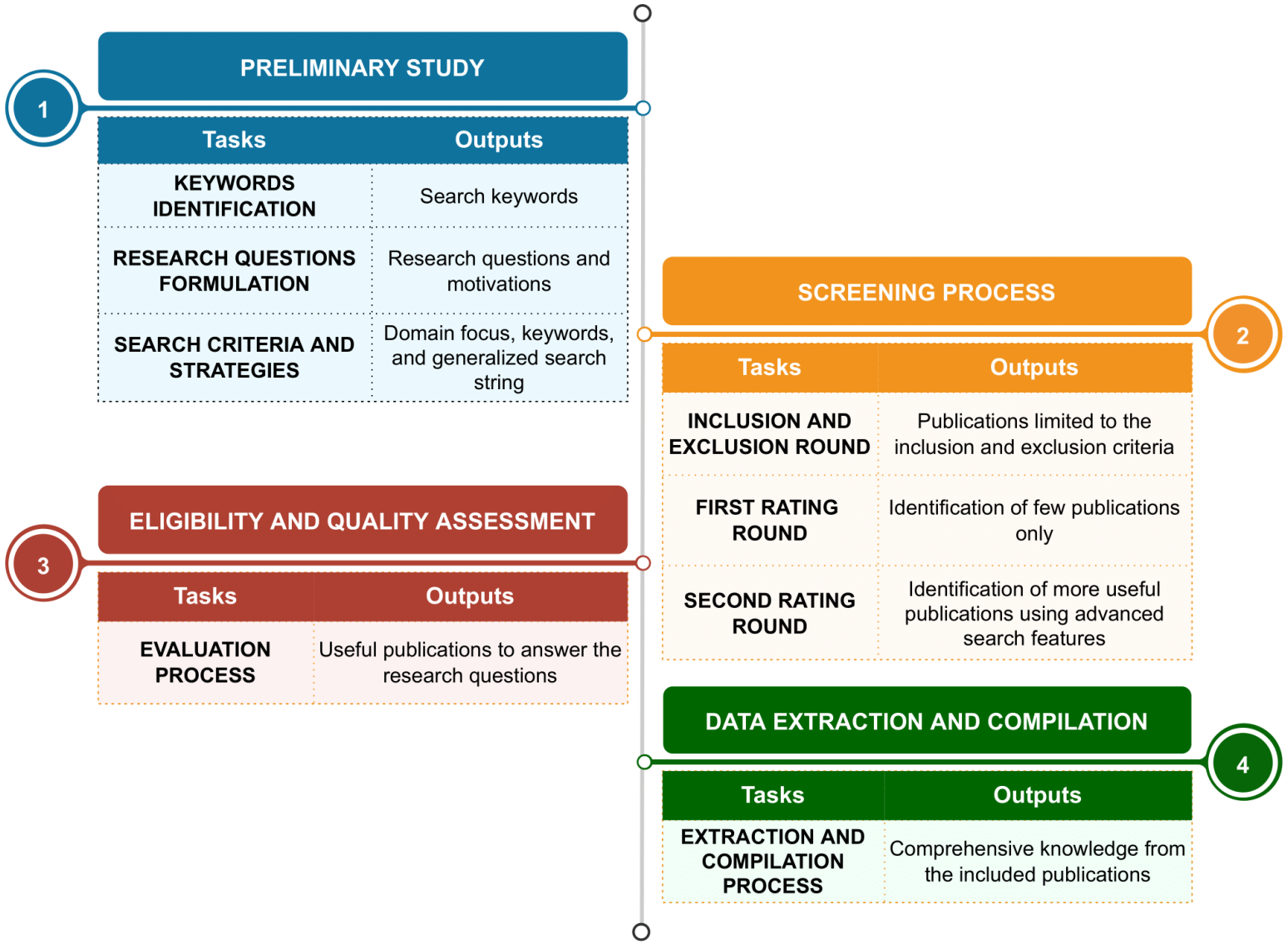
Al-Selwi, S. M., Hassan, M. F., Abdulkadir, S. J., & et al. (2024). RNN-LSTM: From applications to modeling techniques and beyond—Systematic review. *Journal of King Saud University-Computer and Information Sciences*, *36*(5), 102068. https://doi.org/10.1016/j.jksuci.2024.102068

Methodology: The literature study mapping process

The SLR was carried out following the guidelines provided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021).

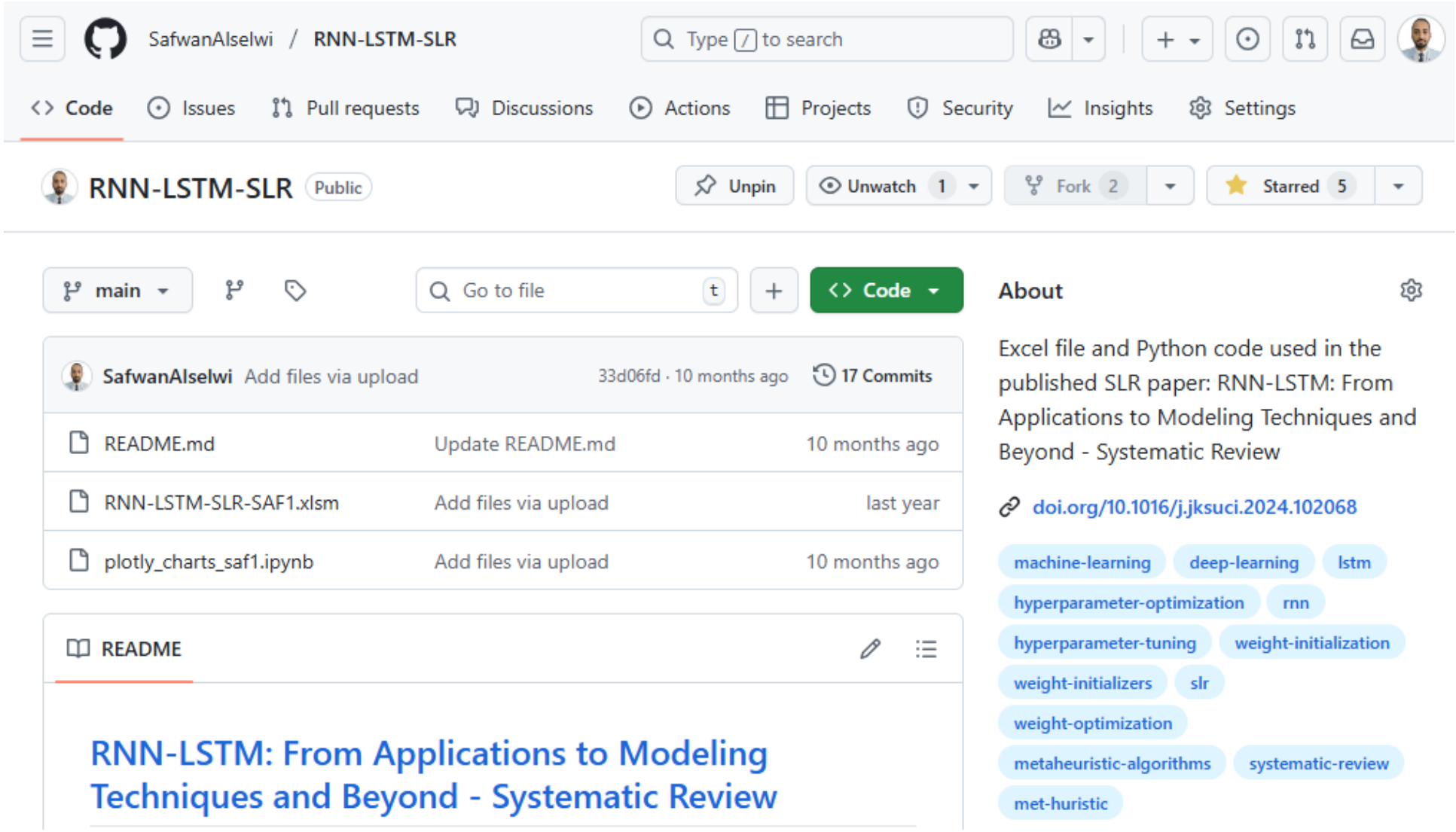
The study also adhered to the standard recommendations proposed by Kitchenham and Charters (2007).

Additionally, to ensure comprehensive reporting, the structure, and approach of previous extensive studies were adopted (Abdullah et al., 2023, Talpur et al., 2023)

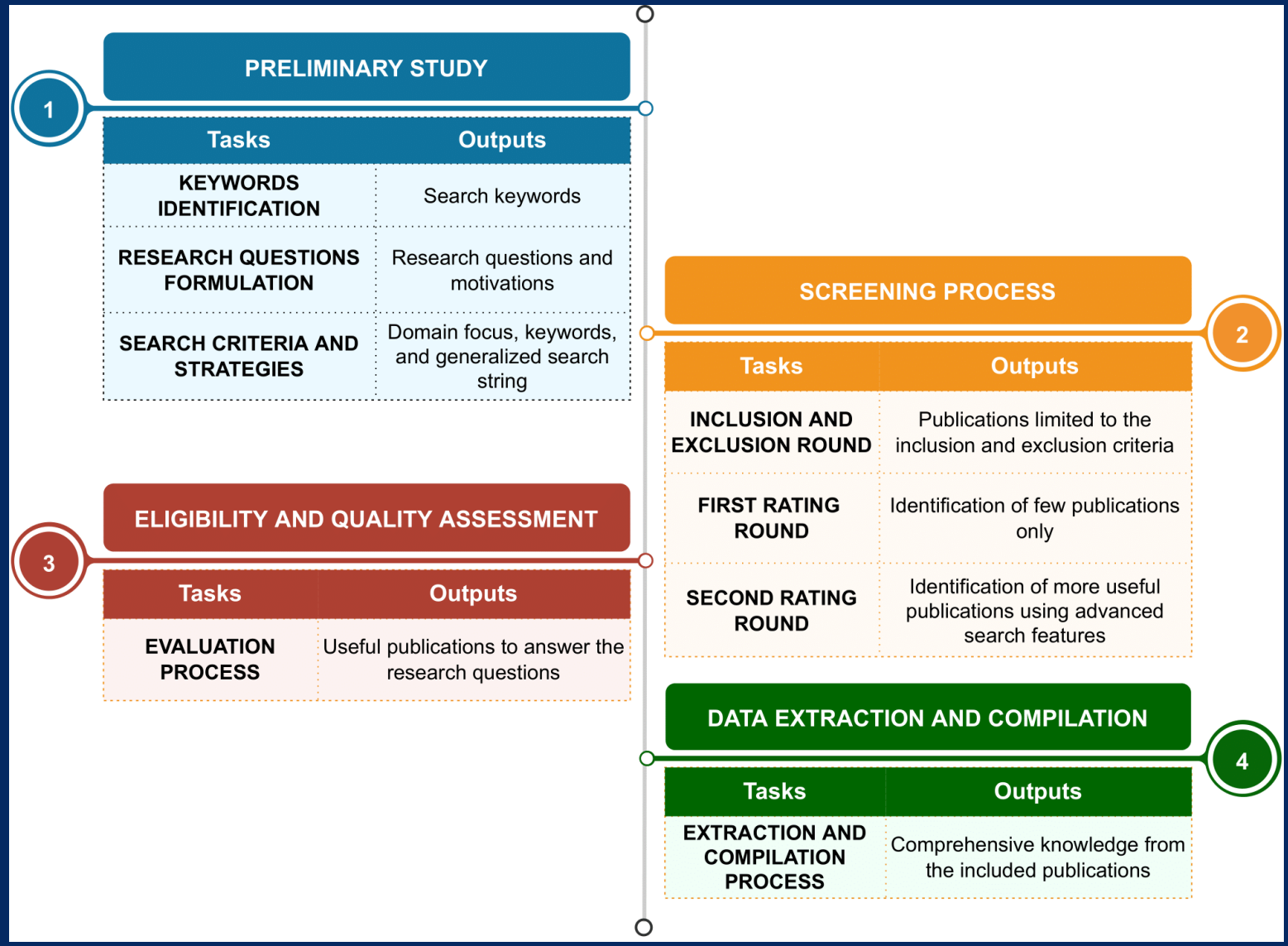


RNN-LSTM-SLR: Shared materials

https://github.com/SafwanAlselwi/RNN-LSTM-SLR

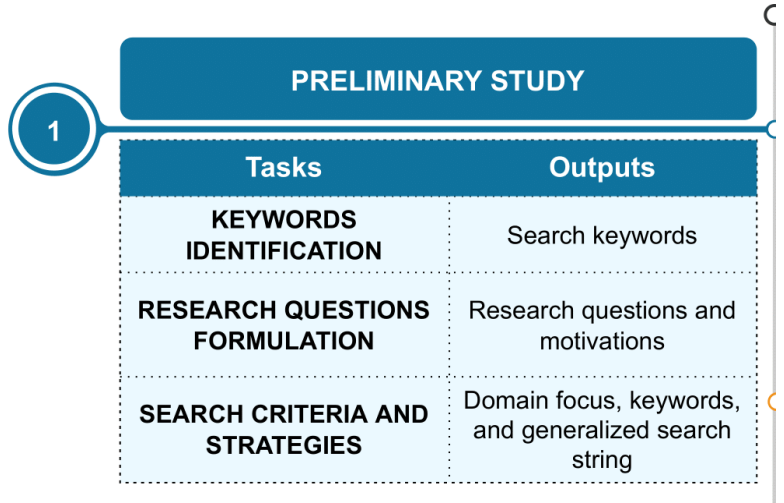


Step 1
Preliminary study



Step 1: Preliminary study

- An initial exploration was performed to gain a deeper understanding of the primary subject matter.
- This step acts as a startup motivation, inspiring authors to identify solid RQs, keywords, and the scopes.
- **Three tasks were undertaken**:
  - The identification of keywords;
  - The formulation of SLR RQs;
  - The identification of the search criteria and strategies.



Hint: First, conduct a deep related literature review to find the gap

Table 1
Summary of the state-of-the-art RNNs-based review papers.

Study	Gradient Descent-Based Optimization	Adaptive Learning Rate Methods	LSTMs-Specific Optimization Techniques	Weight Initialization Strategies	Metaheuristic Algorithms
Vanitha and Jayashree. (2023)	✓	X	✓	X	X
Narkhede et al. (2022)	X	X	✓	✓	✓
Fantin and Hadad (2022)	X	X	X	X	X
Alhumoud and Al Wazrah (2022)	X	X	X	X	X
Boulila et al. (2022)	X	X	X	✓	X
Lalapura et al. (2021)	✓	✓	X	X	X
Zeebaree et al. (2021)	X	X	✓	✓	X
Weerakody et al. (2021)	✓	X	✓	X	X
Abdulrahman et al. (2021)	X	X	✓	X	X
Torres et al. (2021)	✓	✓	✓	X	X
Gallicchio and Scardapane (2020)	X	X	X	✓	X
Van Houdt et al. (2020)	✓	X	✓	X	X
Sezer et al. (2020)	✓	✓	✓	X	X
Surakhi et al. (2020)	✓	✓	✓	X	X
Yu et al. (2019)	X	X	✓	X	X
Bianchi et al. (2017)	✓	✓	✓	✓	X
Salehinejad et al. (2017)	✓	✓	✓	✓	-
Greff et al. (2017)	✓	X	X	X	X
Lipton et al. (2015)	✓	✓	✓	X	X
Lukosevicius and Jaeger (2009)	✓	X	✓	✓	X
Prokhorov et al. (2002)	X	✓	X	X	X
This Study	✓	✓	✓	✓	✓

Paper:
RNN-LSTM: From applications to modeling techniques and beyond—Systematic review - ScienceDirect

Hint: First, conduct a deep related literature review to find the gap

Table 1
Comparison of this work with existing healthcare explainability survey: Legends, X: Not discussed, ✓: discussed, ≈: partially discussed, DL: DL explanation techniques applied in medical health, ML: ML explanation techniques applied in medical health.

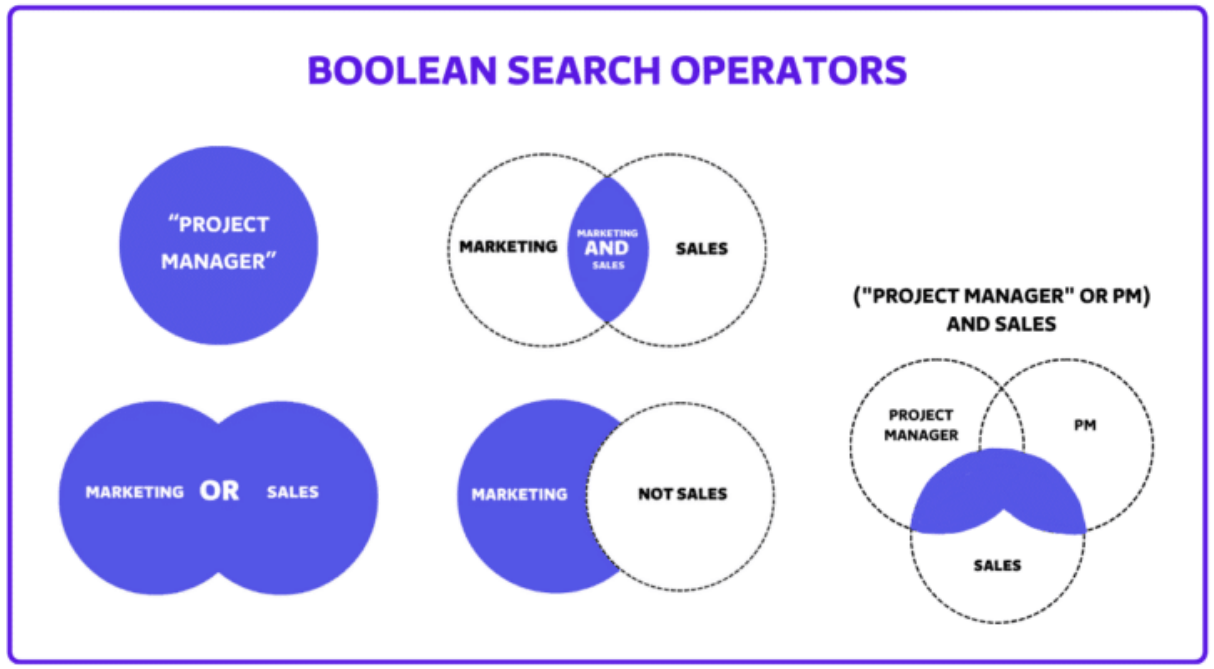
Ref.	Year	Focused applications	ML	DL	Datasets	Metrics	LIME in medical imaging	Challenges	Future direction
Holzinger et al. [69]	2017	Medical image and omic data segmentation	X	✓	X	X	X	X	≈
Adadi and Berrada [66]	2018	Current trends in explainable methods	✓	≈	X	X	≈	✓	≈
Mathews [68]	2019	Explainable AI uses in NLP, biomedicine, and malware categorization	✓	✓	X	X	✓	X	≈
Tjoa and Guan [64]	2020	Classification of XAI techniques and a brief discussion of their use in medicine	≈	≈	≈	X	≈	✓	✓
Singh et al. [24]	2020	Medical imaging for disease identification and prediction	X	✓	≈	X	X	≈	≈
Char et al. [67]	2020	Identifying moral issues for use in the field of healthcare	✓	≈	X	X	X	✓	✓
Adadi and Berrada [70]	2020	Transforming black boxes into interpretable models	✓	≈	X	X	≈	X	✓
Vilone and Longo [71]	2021	Concepts related to explainability and methods for assessing explainable AI	✓	≈	≈	✓	X	X	≈
Rasheed et al. [72]	2022	ML for healthcare that is comprehensible and reliable	✓	✓	≈	X	≈	✓	✓
Borys et al. [73]	2023	Saliency-based XAI method for clinical practitioners in medical imaging	X	✓	✓	X	X	X	✓
This study	2024	Model-Agnostic approaches in XAI for medical imaging analysis	✓	✓	✓	✓	✓	✓	✓

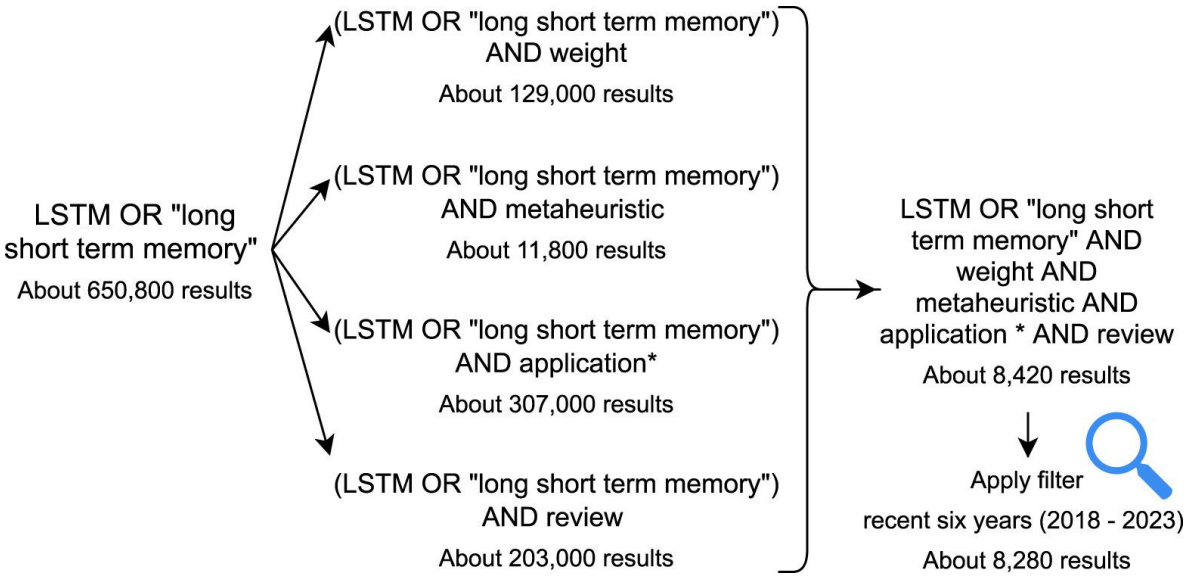
Paper: Local interpretable model-agnostic explanation approach for medical imaging analysis: A systematic literature review - ScienceDirect

Step 1.1: Keywords identification & Boolean operators

Keywords identification

- A search in Google Scholar was conducted with given keywords to explore the available papers on this subject.
- Related variations and additional keywords were identified to refine the search further.
- Relevant papers were screened to aid in addressing the SLR.
- These retrieved papers assisted in identifying more relevant keywords and providing a broad understanding of the search scope.
- Finally, the keywords were analyzed to identify the most suitable combinations that would yield the most relevant papers related to LSTM or “long short-term memory”.





Step 1.2: Research questions formulation

Enable Meaningful Synthesis

Findings are organized around RQs, ensuring clarity.

Enable Reproducibility

Clear RQs allow others to replicate and validate the review.

Guide Entire Process

RQs drive every step from search design to data extraction.

Define Scope & Direction

RQs set boundaries and ensure focus on the intended problem.

Step 1.2: Research questions formulation

Research questions formulation

RQ1: What are the current applications and domains into which LSTM networks are used?

Motivation: To investigate the different usages of RNN-LSTM and how its learning ability impacts several domains and becomes state-of-the-art in numerous fields.

RQ2: What are the current modeling techniques and tools used to build the LSTM models?

Motivation: To explore the current modeling techniques and tools available for RNN-LSTM development including the programming languages, frameworks, libraries, and evaluation metrics.

RQ3: What are the weights initialization techniques used in LSTM networks?

Motivation: Weights initialization directly affects the network convergence. Thus, it is a crucial step before the training of LSTM models.

RQ4: What are the weights optimization techniques used in LSTM networks?

Motivation: To gain a comprehensive understanding of the most effective weight optimization techniques for RNN-LSTM networks.

RQ5: What is the intensity of publications related to LSTM?

Motivation: To investigate the frequency and volume of publications and the prevailing research trends concerning RNN-LSTM and suggest potential future directions.

Hint: Highlight your contribution based on the RQs

This SLR examines the literature published over the past six years (2018–2023) and identifies the following as the most significant contributions:

- Presenting a systematic literature review with an **in-depth four-step approach** to methodically include studies concerning the initialization and optimization of LSTM weights (shown in Fig. 3).
- Conducting an extensive discussion on the **current domains and applications into which LSTM is used**, including their architectures, datasets, evaluation metrics, strengths, limitations, and their contribution to the field (Section 5.1).
- Identification of the **current dominated techniques and tools used to build the LSTM models**, including the preferred and most used programming languages (Section 5.2.1) and the most used evaluation metrics in regression and classification problems (Section 5.2.2).
- Providing an **extensive analysis of various weight initialization techniques** specifically designed for RNN-LSTM networks (Section 5.3). These techniques include among others, *random* initialization with uniform or Gaussian distributions, *Xavier/Glorot* initialization, and *He* initialization. The review examines the effects of different weight initialization techniques on the performance and convergence of LSTM networks in different applications.
- Comprehensively **summarizing numerous optimization algorithms used in optimizing LSTM networks** (Section 5.4). These algorithms have been classified into five main groups: *adaptive learning rate, gradient descent-based, metaheuristic, boosting, and other algorithms*. The characteristics, advantages, and disadvantages of each one of these algorithms have been compared in multiple tables of comparisons to give the researchers a full understanding of these techniques.
- Illustrating and **emphasizing key insights from the synthesized data** via a methodical mapping strategy to illustrate research intensity in the covered field (Section 5.5).

Step 1.3: Search criteria and strategies – The Boundaries

Databases Selected:	Scopus, IEEE Xplore, Web of Science, ScienceDirect, ACM Digital Library
Publication Types:	Journals, conference proceedings, book chapters
Timeframe:	2018–2023
Search Fields:	Title, abstract, and keywords
Keywords:	LSTM, “long short-term memory”, weight
Boolean Operators:	Used AND/OR and wildcards to refine search strings
Generalized Search String:	(*LSTM* OR “long short term memory”) AND weight
Date of Latest Search:	06/04/2023
Duplicates Removal:	Using EndNote 20.5 and Excel
Screening & Reporting:	Applied PRISMA standards, flowchart created via PRISMA tool

Step 1.3: Search criteria and strategies - **Scopus Hands-On Example**

How can I best use the Advanced search? - Scopus Support Center

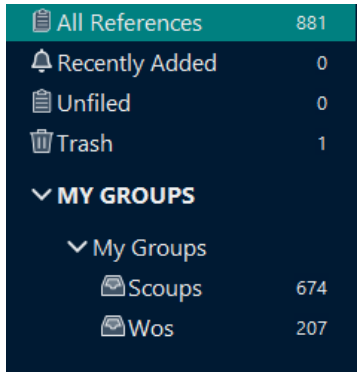
Basic Search	Search for these two keywords *LSTM* or *weight* in the title, abstract, and keywords. *How many results do you get?*
Adding Synonyms	Expand your search to include the synonym *long short term memory*. *How many results now?*
Using Wildcards	Replace lstm with *lstm. *What difference do you observe in the number of results?*
Adding new Term	Add the keyword group optim*. *How many results now?*
Year Filter	Restrict your query to papers published from 2018 onwards. *How many results remain?*
Document Type Filter	Limit your results to articles or conference papers: *How many results now?*
Domain Restriction	Add a subject filter to restrict results to Computer Science. *How many final results do you get?*
Download:	Download the finalized EndNote RIS

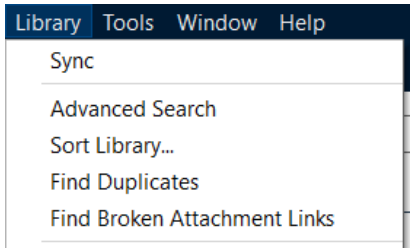
Step 1.3: Search criteria and strategies - Databases Search

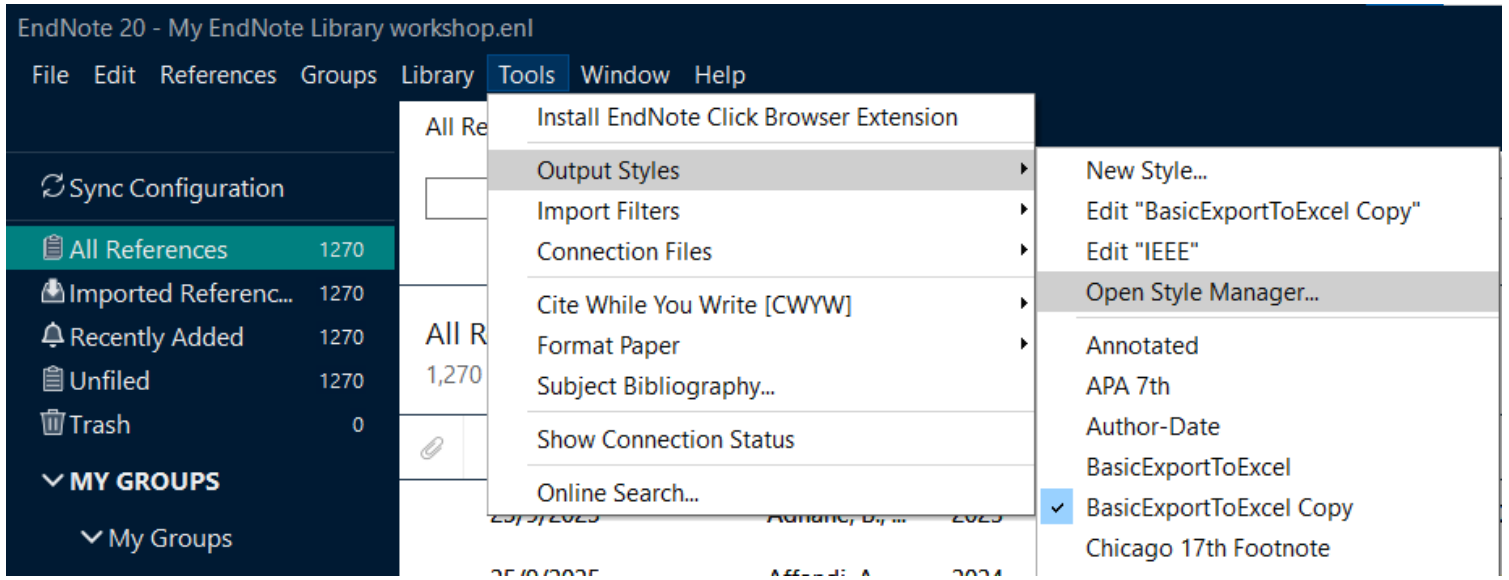
Source	URL	Search string
Scopus	https://bit.ly/lstm_slr_scopus	(TITLE(*LSTM* OR "long short term memory") AND TITLE-ABS-KEY(weight)) AND PUBYEAR > 2017 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE,"cp") OR LIMIT-TO (DOCTYPE,"ch")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (SUBJAREA,"COMP") OR LIMIT-TO (SUBJAREA,"ENGI")) AND (LIMIT-TO (PUBSTAGE ,"final"))
IEEE Xplore	https://bit.ly/lstm_slr_ieeexplore	("Document Title":*LSTM* OR "Document Title":“long short term memory”) AND ("All Metadata":weight), Filters Applied (Type: Conferences or Journals, Years: 2018 – 2023)
Web of Science	https://bit.ly/lstm_slr_wos	*LSTM* OR "long short term memory" (Title) and weight (Topic), Refined by (Document Type: Article and Proceeding Paper, Language: English, Research Area: Computer Science or Engineering, Open Access)
Science Direct	https://bit.ly/lstm_slr_sciencedirect	Title: LSTM OR "long short term memory", Title, abstract, keywords: weight, Filters Applied (Type: Research articles and book chapters, Years: 2018 – 2023, Subject area: Computer Science and Engineering)
ACM Digital Library	https://bit.ly/lstm_slr_acmdl	[[Title: *LSTM*] OR [Title: "long short term memory"]] AND [Abstract: weight] AND [E-Publication Date: (01/01/2018 TO 12/31/2023)]

Step 1.3: Search criteria and strategies - **Export to EndNote and Excel**

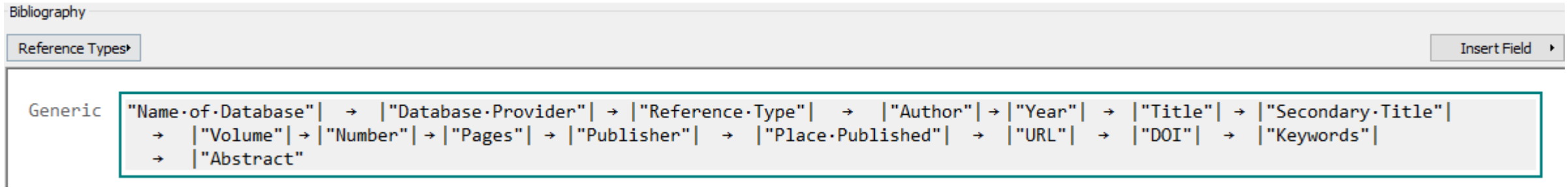
1. From the previous exercise, export all your results to EndNote RIS file, create custom group for each import, then remove duplicates:







2. Add this output style using EndNote style manager (Tools, output styles, open style manager, new style):



Step 1.3: Search criteria and strategies - **Export to EndNote and Excel**

3. Select all your finalized non-duplicated results in EndNote using **CTL+A, CTRL+K, then CTL+V** in Excel.
Put all your identified papers in the first Excel's sheet "1 Identification".

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Name of	Database	Reference	Author	Year	Secondary	Volume	Number	Pages	Publisher	Place	Keywords	Title	Abstract	DOI	URL
2	ACM DL		Conferenc	J. Shen; X.	2021	Proceeding			209–215	Associatio	Beijing,	Attention	Cough-		10.1145/35	https://doi
3	ACM DL		Conferenc	P. Rong-O;	2020	Proceeding			Article 20	Associatio	Bangkok,	PM2.5	The Impact		10.1145/34	https://doi
4	ACM DL		Conferenc	C. Huang;	2019	Proceeding			53–57	Associatio	Nanchang,	Chinese	Attention-		10.1145/33	https://doi
5	ACM DL		Conferenc	A. ElSaid;	2018	Proceeding			13–20	Associatio	Kyoto,	ant colony	Using ant		10.1145/32	https://doi
6	ACM DL		Conferenc	T. Dang; H.	2020	Proceeding			Article 38	Associatio	Bangkok,		DeepVix:		10.1145/34	https://doi
7	ACM DL		Journal	M. Bi; Q.	2021	ACM Trans.	20	5	Article 77			BLSTM	Bi-		10.1145/34	https://doi
8	ACM DL		Journal	R. P.	2022	Acm	21	4		Associatio		Computati	Q-Learning	Tree-LSTM	10.1145/34	https://ww
9	IEEE Xplore		Journal	X. Ma; H.	2021	IEEE	Mar-00			Institute of		Brain	A New	This	10.1109/TI	https://ww
10	IEEE Xplore		Conferenc	Y. Yang; W.	2022	2022 4th			1-Jul			Load	Research	On the	10.1109/CE	
11	IEEE Xplore		Conferenc	L. Yang; J.	2022	2022 23rd			1-Jun			Location	MicroMILT	Driven by	10.23919/A	
12	IEEE Xplore		Conferenc	G. Yang; H.	2022	2022			1-Aug			Visualizati	Named	As a type	10.1109/IJC	
13	IEEE Xplore		Conferenc	M. Xu; S.	2021	2020 25th			2089-2096			Convolutio	ACCLVOS:	Semi-	10.1109/IC	
14	IEEE Xplore		Conferenc	N. T. H.	2022	2022 11th			522-528			Measurem	Multiple	Improving	10.1109/IC	
15	IEEE Xplore		Conferenc	M.	2022	2022 Sixth			95-102			Adaptation	External	Online	10.1109/IR	
16	IEEE Xplore		Conferenc	N. Regev;	2021	2021			1-Aug			Query	Approxima	Despite	10.1109/IJC	
17	IEEE Xplore		Conferenc	V. T.	2022	2022 IEEE			1-Jun			Training	BILLNET: A	Long Short-	10.1109/Si	
18	IEEE Xplore		Journal	M. T. Khan;	2023	IEEE	70	1	266-279			Computer	Architectur	This paper	10.1109/TC	
19	IEEE Xplore		Conferenc	D.	2019	2019 Amity			228-234			Artificial	Compariso	The	10.1109/AI	
20	IEEE Xplore		Journal	M. Fazil; S.	2023	IEEE Access	11-Jan		16801-			Hate	Attentiona	Online	10.1109/AC	
21	IEEE Xplore		Conferenc	J. S.	2018	2018 15th			222-229			Videos	Context-	We	10.1109/CR	

< > ... # Reference Type | # Setup | #Metrics | # E&QA | # Publisher | # Techniques | 4 Included | 3 Eligibility | 2 Screening | 1 Identification +

Step 1.3: Search criteria and strategies - PRISMA

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

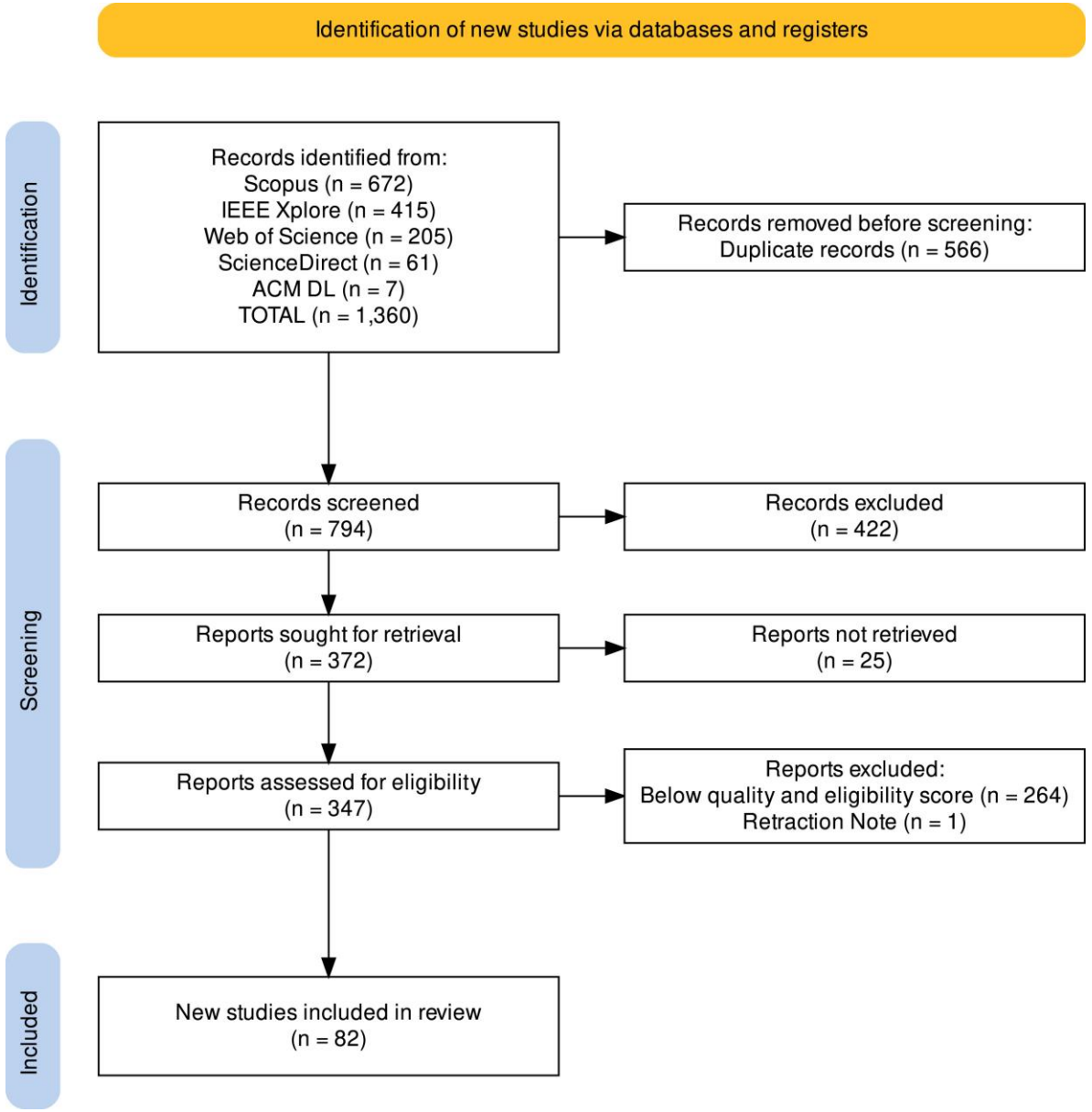
PRISMA flow diagram depicts the flow of information through the different phases of a systematic review.

It maps out the number of records identified, included and excluded, and the reasons for exclusions.
https://www.prisma-statement.org/prisma-2020-flow-diagram

Read more: Abstracts — PRISMA statement

Read more: Scoping — PRISMA statement

Online PRISMA Flow Diagram Tool by Haddaway et al.
https://estech.shinyapps.io/prisma_flowdiagram/



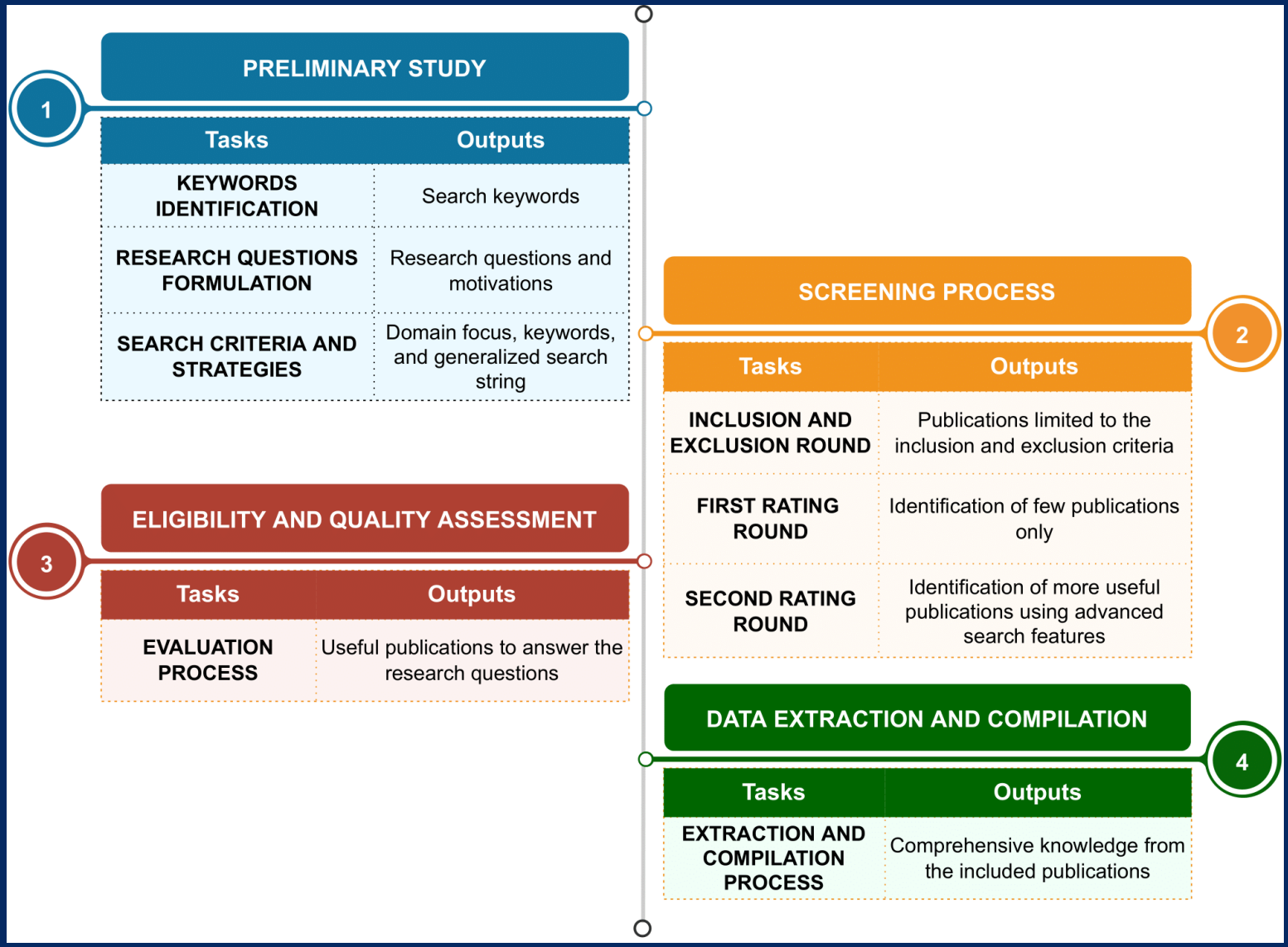
PRISMA flowchart of the systematic literature process

PRISMA 2020 checklist

Table 23
PRISMA 2020 checklist.

Topic	Item	Location
Title	1	Title
Abstract	2	Abstract
Introduction	3	Section 1
	4	Section 4.1.2
Methods	5	Section 4.3
	6	Section 4.1.3, Table 5
	7	Sections 4.1.3, 4.2.1
	8	Section 4.1.3
	9	Section 4.4
	10–15	Not applicable
Results	16a	Flowchart 5
	16b	Not applicable
	17	Section 5.1
	18–22	Not applicable
Other Information	24	Not applicable
	25	Acknowledgment
	26	Declaration of competing interest
	27	Data availability

Step 2
Screening process

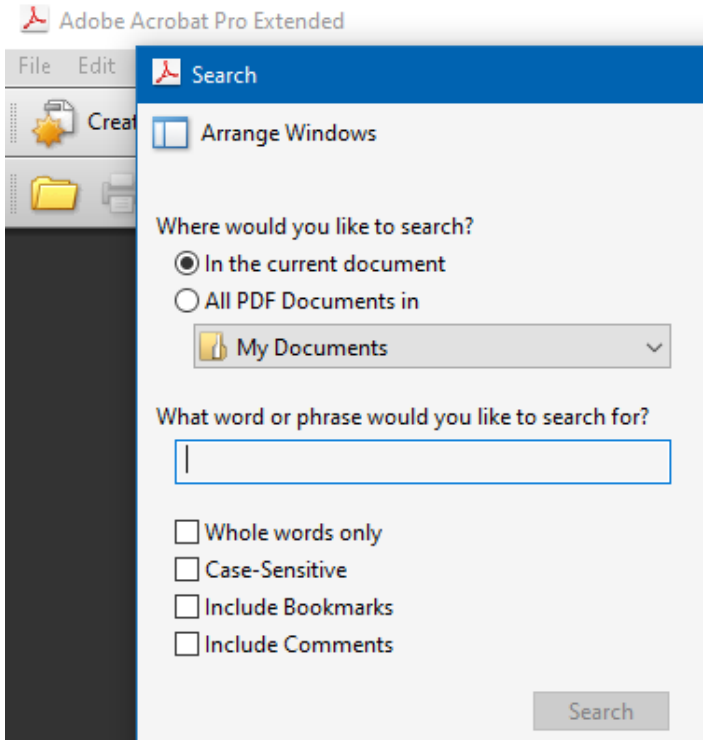


Step 2: Screening process

You can use advance search tools in Adobe Acrobat or EndNote to find some insights

Table 3
Inclusion and exclusion criteria for search screening.

Criteria	Inclusion Criteria	Exclusion Criteria
Publication year	2018–2023	Not between 2018–2023
Article Type	Journal papers, conference proceedings, and book chapters	Review papers, tutorials, seminars, interviews, letters, or blogs
Language	English	Non-English
Availability	Studies available in full text	Studies not available in full text (less than 5 pages)
Relevance	Relevant to the RQs	Not relevant to the RQs
Area	Studies in Computer Science and Engineering areas only	Publications not in Computer Science and Engineering areas
Publication Stage	Final (Published)	Not published yet (Articles in press)
Access Type	Open access	Not open access



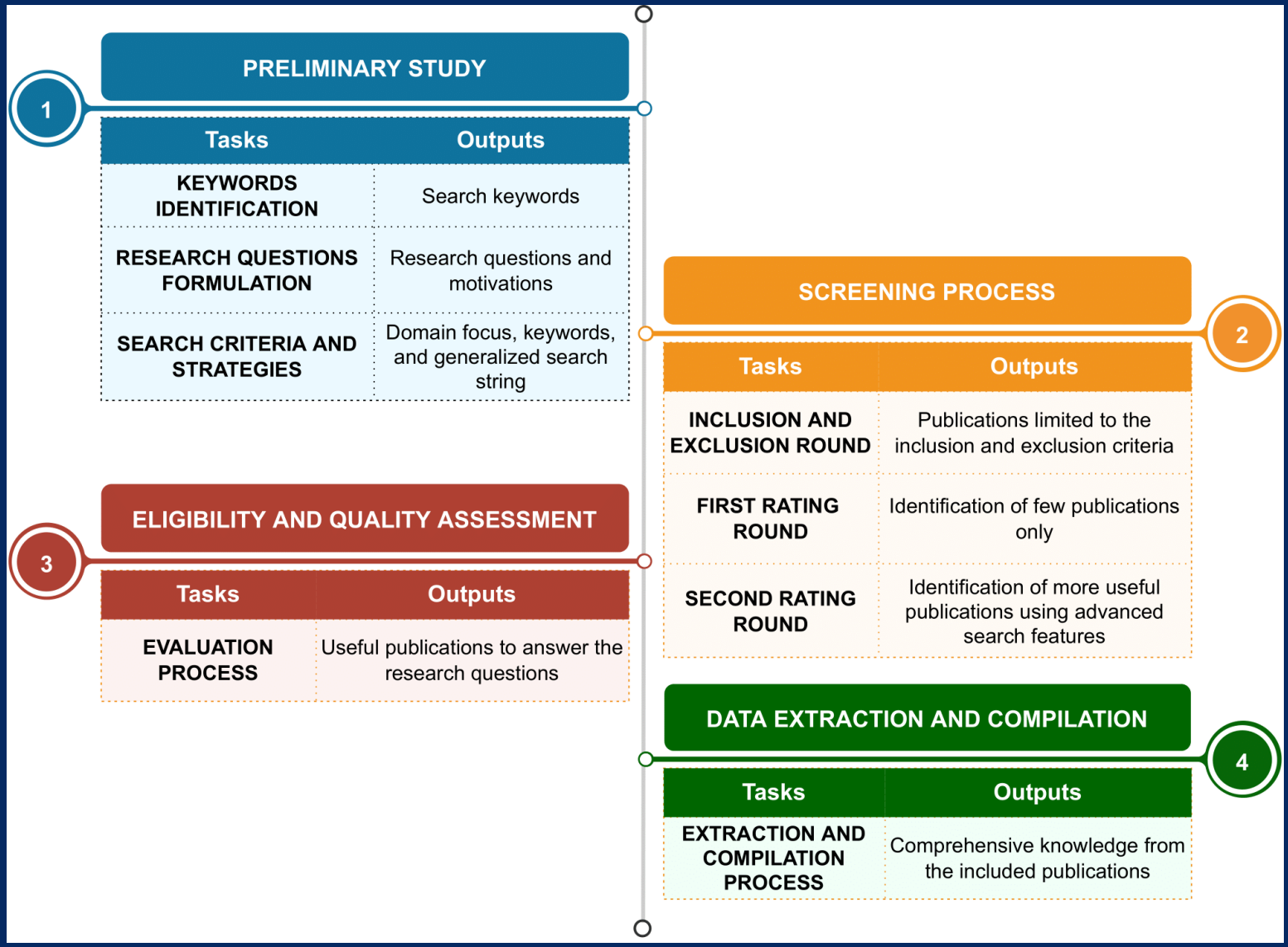
Step 2: Screening process

In Excel's sheet "2 Screening", start the screening process by reading title and abstract and then determine if paper will be further included or not.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Name of Databas	Database Provide	Reference Type	Author	Year	Volume	Number	Pages	Publisher	Secondary Title	Place Publishe	Keywords	Title	Abstract	DOI	URL	Rating 1st Round	Rating 2nd Round	Final Rating	Note	Application	Methodology
2	ACM DL		Journal	Zhang; M.	2021	20	5		n for	Transactio		term	Bi-	The	.org/10.114	w.scopus.c	☆ 0	☆ 1	☆ 1		Question	BLSTM-
3	ACM DL		Conferenc	Zhang; W.	2021			209–215	n for	s Of The	China	mechanis	Cough-	Cough-	.org/10.114	.org/10.114	☆ 0	☆ 1	☆ 1		Cough-	
4	ACM DL		Conferenc	N.	2020			Article 20	n for	s Of The	Thailand	forecasting	The Impact	The last	.org/10.114	.org/10.114	☆ 0	☆ 1	☆ 1		PM2.5	
5	ACM DL		Conferenc	F. E. Jamiy;	2018			13-20	n for	-		optimizati	Using ant	This work	.org/10.114	w.scopus.c	☆ 1		☆ 1		prediction	ACO-LSTM
6	ACM DL		Conferenc	Y. Chen; Q.	2019			53-57	n for	Internation		term	Attention-	Named	.org/10.114	w.scopus.c	☆ 0	☆ 0	☆ 0		Chinese	AM-BiLSTM
7	ACM DL		Conferenc	Van; H.	2020				n for	Internation		Science	DeepVix:	Machine	.org/10.114	w.scopus.c	☆ 0	☆ 0	☆ 0			
8	ACM DL		Journal	Hastuti; Y.	2022	21	4		n for	Transactio		onal	Q-Learning	Tree-LSTM	.org/10.114	w.scopus.c	☆ 0	☆ 0	☆ 0			
9	IEEE Xplore		Conferenc	K. M. Lim;	2021				Electrical	Internation		Convolutio	1D	Human	.org/10.110	w.scopus.c	☆ 0	☆ 1	☆ 1		Human	
10	IEEE Xplore		Journal	Xu; Q. Pan	2021	22	11	7242-7255		Transactio		Forestry	4-D Flight	The	.org/10.110	explore.ie	☆ 0	☆ 1	☆ 1		Flight	
11	IEEE Xplore		Journal	A. R. Zaidi;	2021	70		1-Sep		Transactio		extraction	A CNN-	Convolutio	.org/10.110	explore.ie	☆ 0	☆ 1	☆ 1		Wrist	
12	IEEE Xplore		Journal	Zhao; Y.	2022	10		88654	Electrical	IEEE Access		Forecastin	A	Multivariat	.org/10.110	w.scopus.c	☆ 0	☆ 1	☆ 1		Multivariat	MLP-
13	IEEE Xplore		Journal	Tawhid; S.	2022	71		1-Nov		Transactio		modeling	A	Epilepsy	.org/10.110	explore.ie	☆ 0	☆ 1	☆ 1		Epilepsy	
14	IEEE Xplore		Conferenc	Zhu; Y.	2020			1316-1321	Electrical	s - 2020		on (of	A Double	The CNN-	.org/10.110	w.scopus.c	☆ 0	☆ 1	☆ 1		Text	
15	IEEE Xplore		Conferenc	Zhang; Y.	2021			273-277	Electrical	Internation		g	A Dual-	As an	.org/10.110	w.scopus.c	☆ 0	☆ 1	☆ 1		Remaining	
16	IEEE Xplore		Journal	Yang; K.	2021	9		32822	Electrical	IEEE Access		gation	A feature-	Forecastin	.org/10.110	w.scopus.c	☆ 0	☆ 1	☆ 1		tourists	
17	IEEE Xplore		Journal	S. Kuenzel;	2022	71		1-Oct		Transactio		models	A Hybrid	In a	.org/10.110	explore.ie	☆ 0	☆ 1	☆ 1		Combating	
18	IEEE Xplore		Journal	F. Lin; X.	2021	22	11	6910-6920	Electrical	Transactio		g	A Hybrid	Accurate	.org/10.110	w.scopus.c	☆ 0	☆ 1	☆ 1		short-	AM Conv-

Reference Type | # Setup | #Metrics | # E&QA | # Publisher | # Techniques | 4 Included | 3 Eligibility | 2 Screening | 1 Identification

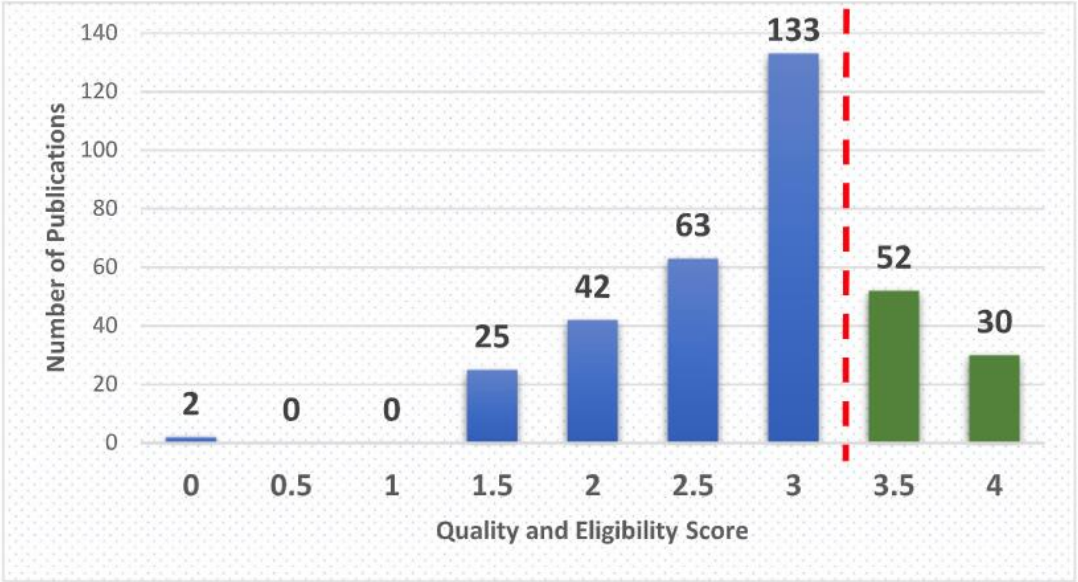
Step 3
Eligibility and quality assessment



Step 3: Eligibility and quality assessment

Table 4. Criteria for scoring the eligibility and quality assessment.

Criteria	Score	Description
Well-defined objectives?	1	Indeed, the paper clearly outlines its objectives and goals.
	0.5	The paper outlines its objectives, though the goals are not explicitly defined.
	0	No, the paper does not have well-defined objectives.
Well-explained methodology?	1	Yes, the paper showcases a comprehensive, and well-documented methodology.
	0.5	Partially documented methodology that needs more details.
	0	No, the paper fails to provide a well-explained methodology.
Declared limitations?	1	Yes, the limitations are mentioned within the paper.
	0.5	The limitations are not in full detail.
	0	No, no declared limitations in this paper.
Clear research findings?	1	Indeed, the study provides clear findings with appropriate visualizations.
	0.5	The study does present its findings, but not in clear statements or visualizations.
	0	The study's research findings are unclear, and lacking elaboration.



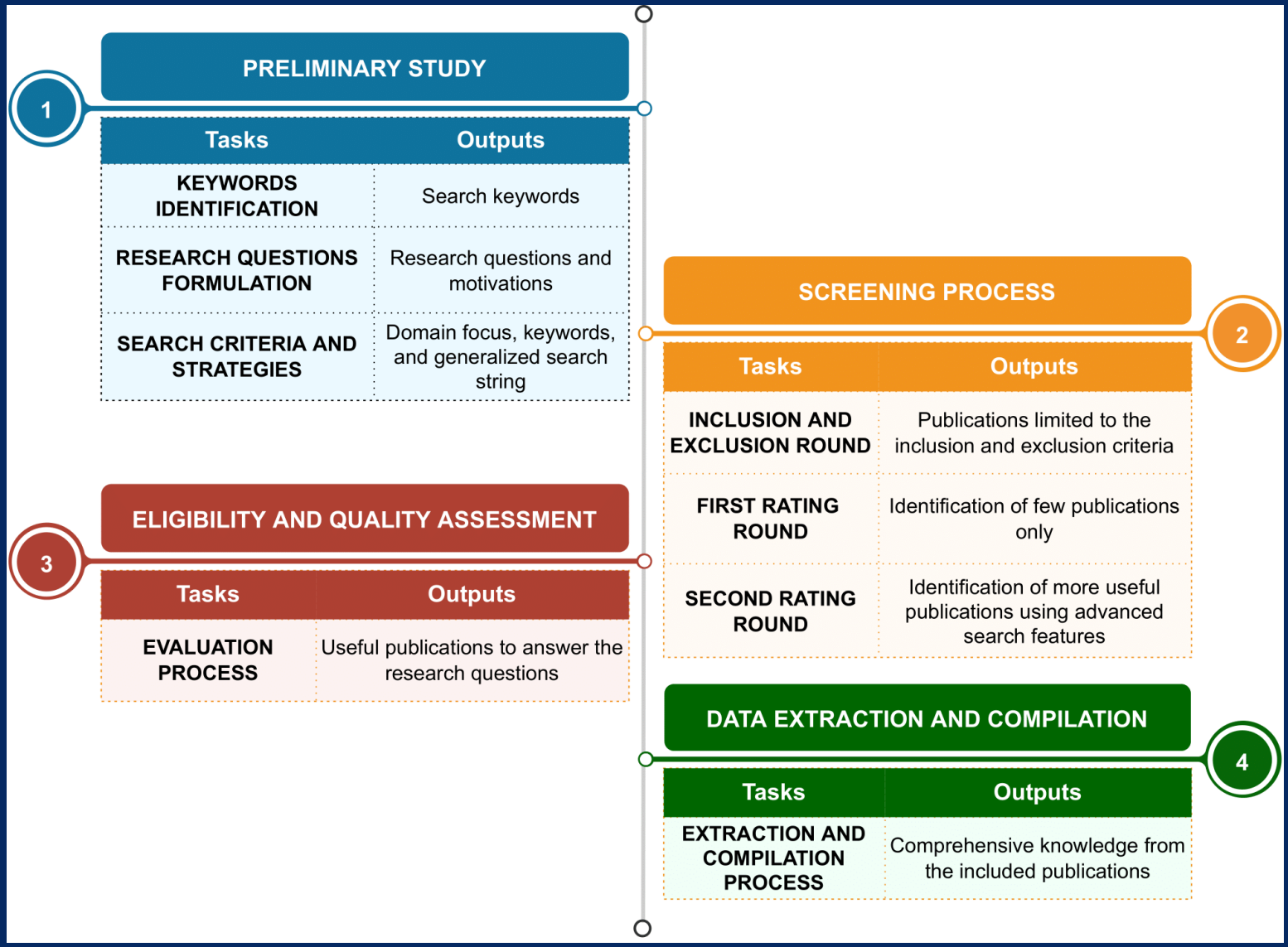
Step 3: Eligibility and quality assessment

In Excel's sheet "3 Eligibility", determine if paper will be further included or not based on your eligibility score.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Name of Databas	Database Provide	Reference Type	Author	Year	Volume	Number	Pages	Publisher	Secondary Title	Place Publishe	Keywords	Title	Abstract	DOI	URL	Application	Architecture	Objectives	Methodology	Limitations	Findings	Total
2	ACM DL		Article	Zhang; M.	2021	20	5		n for	Transactio		term	Bi-	The intellig	https://doi.	https://ww	Question	BLSTM-SRLP	✓ 1	✓ 1	! 0.5	✓ 1	3.5
3	ACM DL		e Paper	Zhang; W.	2021			209–215	n for	s Of The	China	mechanis	Cough-	Cough-base	https://doi.	https://doi	Cough-		! 0.5	! 0.5	✗ 0	! 0.5	1.5
4	ACM DL		e Paper	N.	2020			Article 20	n for	s Of The	Thailand	forecasting	The Impact	The last few	https://doi.	https://doi	PM2.5		✓ 1	✓ 1	✗ 0	✓ 1	3
5	ACM DL		e	F. E. Jamiy;	2018			13-20	n for	-		optimizati	Using ant	This work e	https://doi.	https://ww	prediction	ACO-LSTM	✓ 1	✓ 1	✗ 0	✓ 1	3
6	IEEE Xplore		e	K. M. Lim;	2021				Electrical	Internation		Convolutio	1D	Human activ	https://doi.	https://ww	Human		✓ 1	! 0.5	✗ 0	✓ 1	2.5
7	IEEE Xplore		Article	Xu; Q. Pan	2021	22	11	7242-7255		Transactio		Forestry	4-D Flight	The increasi	https://doi.	https://iee	Flight		✓ 1	✓ 1	✓ 1	✓ 1	4
8	IEEE Xplore		Article	A. R. Zaidi;	2021	70		45170		Transactio		extraction	A CNN-	Convolutior	https://doi.	https://iee	Wrist		✓ 1	✓ 1	✓ 1	✓ 1	4
9	IEEE Xplore		Article	Zhao; Y.	2022	10		88654	Electrical	IEEE Access		Forecastin	A	Multivariate	https://doi.	https://ww	Multivariate	MLP-	! 0.5	✓ 1	! 0.5	✓ 1	3
10	IEEE Xplore		Article	Tawhid; S.	2022	71		45231		Transactio		modeling	A	Epilepsy (EF	https://doi.	https://iee	Epilepsy		! 0.5	✓ 1	! 0.5	✓ 1	3
11	IEEE Xplore		e	Zhu; Y.	2020			1316-1321	Electrical	s - 2020		on (of	A Double	The CNN-LS	https://doi.	https://ww	Text		! 0.5	! 0.5	! 0.5	! 0.5	2
12	IEEE Xplore		e	Zhang; Y.	2021			273-277	Electrical	Internation		g	A Dual-	As an indisp	https://doi.	https://ww	Remaining		! 0.5	! 0.5	✗ 0	✓ 1	2
13	IEEE Xplore		Article	Yang; K.	2021	9		32822	Electrical	IEEE Access		gation	A feature-	Forecasting	https://doi.	https://ww	tourists		✓ 1	! 0.5	! 0.5	! 0.5	2.5
14	IEEE Xplore		Article	S. Kuenzel;	2022	71		45200		Transactio		models	A Hybrid	In a convent	https://doi.	https://iee	Combating		✓ 1	✓ 1	✗ 0	✓ 1	3
15	IEEE Xplore		Article	F. Lin; X.	2021	22	11	6910-6920	Electrical	Transactio		g	A Hybrid	Accurate sh	https://doi.	https://ww	short-Time	AM Conv-	! 0.5	✓ 1	! 0.5	✓ 1	3
16	IEEE Xplore		Article	Kim	2022	10		34754	Electrical	IEEE Access		Commerce	A Hybrid	Accurate pr	https://doi.	https://ww	Stock		✓ 1	✓ 1	✗ 0	✓ 1	3
17	IEEE Xplore		Article	S. F. Gau;	2020	14	2	299-311	Electrical	Journal On		dataset	A	The heterog	https://doi.	https://ww	Classifying		✓ 1	✓ 1	! 0.5	✓ 1	3.5
18	IEEE Xplore		Article	Y. Chen; W.	2020	8		11		Journal Of		bidirection	A Multi-	Background	https://doi.	<Go to	Electrocardi		✓ 1	! 0.5	✗ 0	✓ 1	2.5
19	IEEE Xplore		Article	Hu; Y.	2021	70			Electrical	Transactio		Forecastin	A New	This researc	https://doi.	https://ww	Transformer	IDRSN-	✓ 1	✓ 1	✓ 1	✓ 1	4
20	IEEE Xplore		Article	Zhang; P.	2020	8		7295-7302	Electrical	IEEE Access		Iterative	A Novel	In this pape	https://doi.	https://ww	CSI	CNN-AM-	✓ 1	! 0.5	✗ 0	! 0.5	2
21	IEEE Xplore		Article	C. Liew; L.	2021	9		23671	Electrical	IEEE Access		Commerce	A Novel	Stock marke	https://doi.	https://ww	Stock	IPSO-LSTM	✓ 1	✓ 1	✓ 1	✓ 1	4
22	IEEE Xplore		Article	J. Fan; T.	2020	8		155440	Electrical	IEEE Access		us vehicles	A Novel	Long short-t	https://doi.	https://ww	Decision-	GOA-LSTM	✓ 1	✓ 1	✓ 1	✓ 1	4
23	IEEE Xplore		e	Zhu; M.	2019			100-105	Electrical	s - 2019 6Th		g	A	Short-term	https://doi.	https://ww	Traffic flow	Regularized	! 0.5	! 0.5	✗ 0	! 0.5	1.5
24	IEEE Xplore		e	Chen; H.	2021			2854-2859	Electrical	Conferenc		forecasting	A Robust	The general	https://doi.	https://ww	Wind Power		! 0.5	! 0.5	✗ 0	! 0.5	1.5
25	IEEE Xplore		e	Ruan	2021			249-253		Internation		learning	A	As a hot top	https://doi.	https://iee	sentiment		✓ 1	! 0.5	✗ 0	! 0.5	2
26	IEEE Xplore		Article	Ling; Y.	2020	8		66866	Electrical	IEEE Access		Complex	A Sparse	The develo	https://doi.	https://ww	Time Series	sparse	✓ 1	! 0.5	! 0.5	✓ 1	3

Reference Type | # Setup | #Metrics | # E&QA | # Publisher | # Techniques | 4 Included | 3 Eligibility | 2 Screening | 1 Identification

Step 4 Data extraction



Data extraction and compilation of included studies

In Excel's sheet "4 Included", extract the data you need from the finalized included papers.

Name of Database	Main Publisher	Publisher	Secondary Title	Volume	Number	Pages	Place Published	Keywords	Reference Type	Authors	Year	Title	Abstract	DOI	URL	Weights 1st Round	Weights 2nd Round	Application	Domain	Architecture	Objectives	Motivation	Advantages	Limitations	Dataset	Evaluation Metric	Experiment Setup	Analysed
ACM DL	ACM	Associati	Acm	20	5			Long	Journal	M. Bi; Q.	2021	Bi-	The	https://d	https://		ADADELTA	Question	Natural	BLSTM-	To	Existing	Improved	Model	Food	|MRR|,	Python	Ebrahim
IEEE	IEEE	Institute	2021 IEEE			808-812		Data	Confere	R. Ying;	2021	Predictio	How to	https://d	https://	ADABOOS		Predictio	Stock	LSTM-	To	The	The LSTM-	The model	Historical	|RMSE|,	-	Safwan
IEEE	IEEE	Institute	2021					Brain	Confere	Z. C.	2021	Two-	Predictiv	https://d	https://	SDAGD		Predictive	Prognosti	SDAGD-	To	The	The	Susceptib	Machiner	|MSE|	-	Safwan
IEEE	IEEE	Institute	IEEE	9		23660-		Brain	Journal	Y. Ji; A.	2021	A Novel	Stock	https://d	https://	IPSO		Stock	Stock	IPSO-	To	Predicting	Updating	It is not	S&P/ASX2	|RMSE|,	Python	Safwan
IEEE	IEEE	Institute	IEEE	8		155429-		Autono	Journal	Y. Shi; Y.	2020	A Novel	Long	https://d	https://	GOA		Decision-	Computer	GOA-LSTM	To	To	Extract	The	NGSIM	Accuracy	Python,	Ebrahim
IEEE	IEEE		IEEE	9		7701-		Task	Journal	A. Onan;	2021	A Term	Sarcasm	https://d	<Go to		BO	Sarcasm	Natural	Three-	To	Sarcasm	The	The	Three	Accuracy	Java,	Ebrahim
IEEE	IEEE	Institute	IEEE	9		47252-		Brain	Journal	J. Bian; L.	2021	Abnorm	In the	https://d	https://	PSO		Abnormal	Energy	PSO-AM-	To	To	The	The model	The	|RMSE|,	MATLAB	Ebrahim
IEEE	IEEE		IEEE	9		30636-		Fire	Journal	Z. Y. Xu;	2021	Advance	Fire	https://d	<Go to		ADAM	Fire	Safety	LSTM-VAE	To	To	Improve	The lack	69 real-	Fire	-	Ebrahim
IEEE	IEEE		IEEE	11		16194-		Social	Journal	X. Wang;	2023	Adverse	Drug	https://d	https://i	AM	SGD	Adverse	Safety	Quantum	To	Leveragin	The QBi-	The need	TwiMed,	Precision,	Python,	Ebrahim
IEEE	IEEE		IEEE	11		16801-		Hate	Journal	M. Fazil;	2023	Attentio	Online	https://d	https://i	AM	ADAM	Hate	Speech	Multi-	To	Addressin	The	The model	Three	Accuracy,	Python	Ebrahim
IEEE	IEEE		IEEE	9		5332-		Emotion	Journal	H. Y.	2021	Attentio	Speech	https://d	<Go to		RMSprop	Speech	Speech	SCBAMM	To	Speech	SCBAMM	The study	EMO-DB	Accuracy,	Python,	Ebrahim
IEEE	IEEE	Institute	IEEE	7		155130-		Bayesian	Journal	Y. Liu; G.	2019	Deep	In recent	https://d	https://		SGD	Lithium-	Prognosti	BMA-	To	To	It	It is	CALCE	|ERUL|	|R|	Ebrahim
IEEE	IEEE	Institute	IEEE	7		73627-		Brain	Journal	H. Wei;	2019	Named	Biomedi	https://d	https://	AM	ADAM	Biomedic	Natural	AM-	To	Previous	The	The	JNLPBA	Precision,	-	Safwan
IEEE	IEEE	Institute	IEEE	8		165849-		Electric	Journal	L. Wang;	2020	Short-	Because	https://d	https://	IPSO		Short-	Energy	OVMD-	To	To	The	It takes	The PV	$\|R^2\|$,	Python	Safwan
IEEE	IEEE		IEEE	7		107897-		Air	Journal	J. Ma; Y.	2019	Spatiote	As air	https://d	<Go to		MBSGD	Pm2.5	Environm	IDW-	To predict	Deep	The	The study	Historical	|RMSE|,	-	Safwan
IEEE	IEEE	Institute	IEEE	9		59860-		Backpro	Journal	L. Yang;	2021	Speech	In recent	https://d	https://	PSO		Speech	Speech	PSO-GA-	To	Tradition	Proposed	Truncatio	Two	Accuracy,	Python	Safwan
IEEE	IEEE		IEEE	11		18245-		Credit	Journal	J. Eom; J.	2023	Time-	One of	https://d	https://i		ADAM	Predicting	Stock	Time-	To	By	The	The model	Three	Precision,	-	Safwan
IEEE	IEEE	Institute	IEEE	9		146082-		Errors	Journal	X. Liu; Q.	2021	Using	Enhancin	https://d	https://	AHMPSO		Predicting	Environm	AHMPSO-	To predict	Tradition	The	The	396 data	|RMSE|,	Python	Safwan
IEEE	IEEE	Institute	IEEE	14	2	299-311		Large	Journal	Y. S. Lin;	2020	A	The	https://d	https://		ADAMAX	Classifyin	Healthcar	Multimod	To	To	The	The	ADOS	unweighte	Python,	Ebrahim
IEEE	IEEE	Institute	IEEE	22	6	6052-		Authenti	Journal	D.	2022	An ECG	The	https://d	https://	AM	SGD	An ECG	Healthcar	Hierarchi	To design	To	Low	The	PTB ECG,	Accuracy,	Python,	Ebrahim
IEEE	IEEE	Institute	IEEE	20	9	4868-		Indoor	Journal	Y. Zhang;	2020	An	In recent	https://d	https://		SGD	Indoor	Communi	LSTM	To	The	The	The	Raw CSI	|MSE|,|M	Python,	Ebrahim
IEEE	IEEE	Institute	IEEE	20	23	14302-		Deep	Journal	J. Torres-	2020	Improvin	Entities	https://d	https://		ADADELTA	Detection	Safety	LeNet5-	To create	Detecting	The	the	A	Accuracy		
IEEE	IEEE		IEEE	11	4	473-482		Anomaly	Journal	B. Yang;	2019	Anomalo	We	https://d	https://i		ADAGRAD	Anomalou	Computer	WCAE-	To	To	the	The	CUHK	|AUC|,		
IEEE	IEEE	IEEE	IEEE	69	3	441-452		Brain	Journal	X. Dai; H	2020	Grow	Long	https://d	https://		RANDOM	Image	Computer	Hidden-	To	LSTMs are	The	Requires	MSCOCO,	CIDEr-D	PyTorch,	Safwan

Not shared

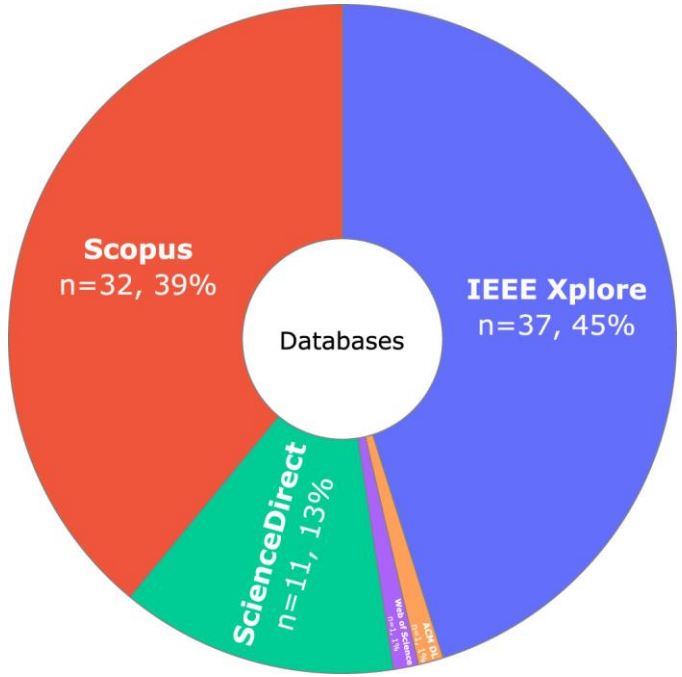
Reference Type | # Setup | #Metrics | # E&QA | # Publisher | # Techniques | 4 Included | 3 Eligibility | 2 Screening | 1 Identification

Data extraction and compilation of included studies

Finally, it is time to condense the information extracted from the included studies into visual aids and provide answers to the previously posed RQs.

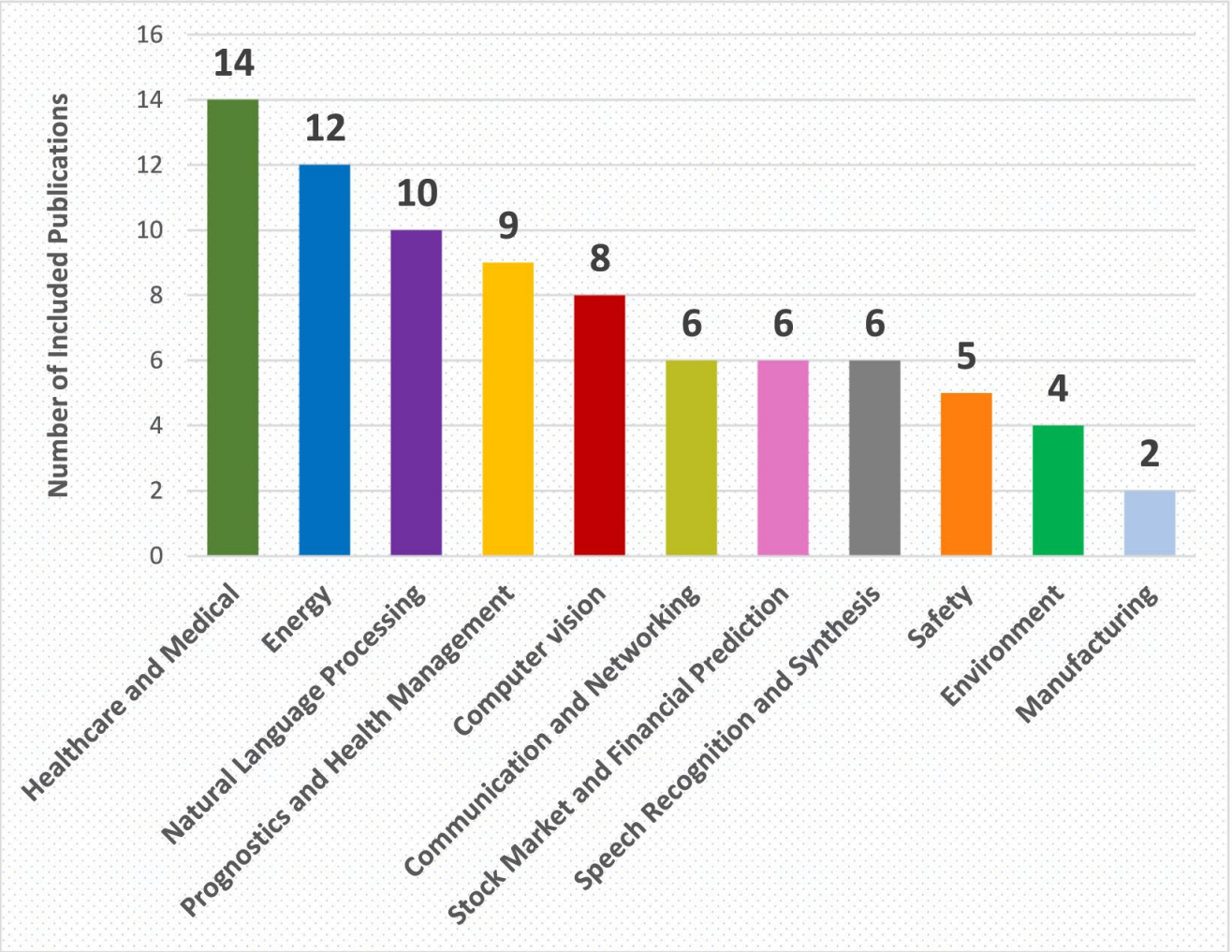
Table 5. Studies retrieved in each step of the systematic literature process.

Source	Identified	Unique	Screened	Pass E&QA	Included
IEEE Xplore	415	394	194	37	37
Scopus	672	307	100	32	32
Science Direct	61	57	40	11	11
Web of Science	205	29	9	1	1
ACM DL	7	7	4	1	1
Total	1360	794	347	82	82



Distribution of included studies by scientific databases and venues.

RQ1: What are the current applications and domains into which LSTM networks are used?

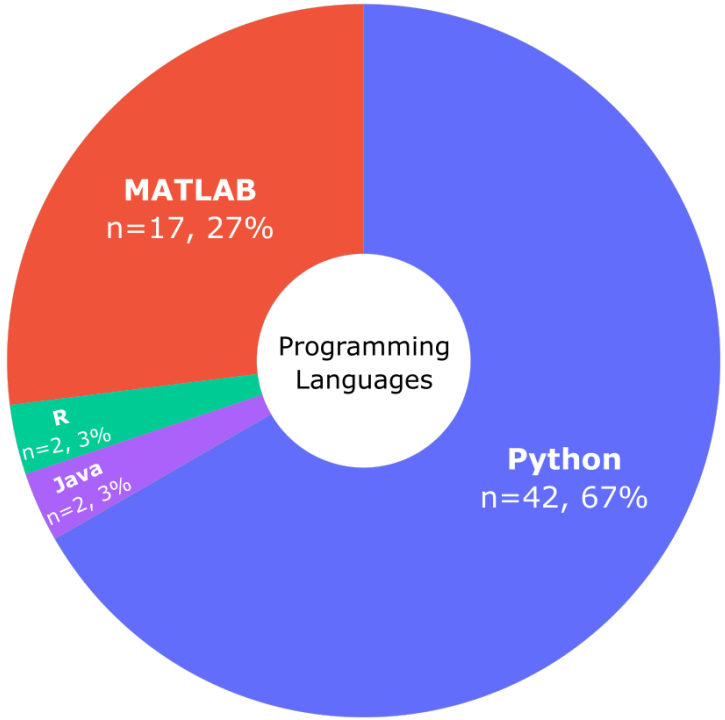


Synthesis of data and analysis

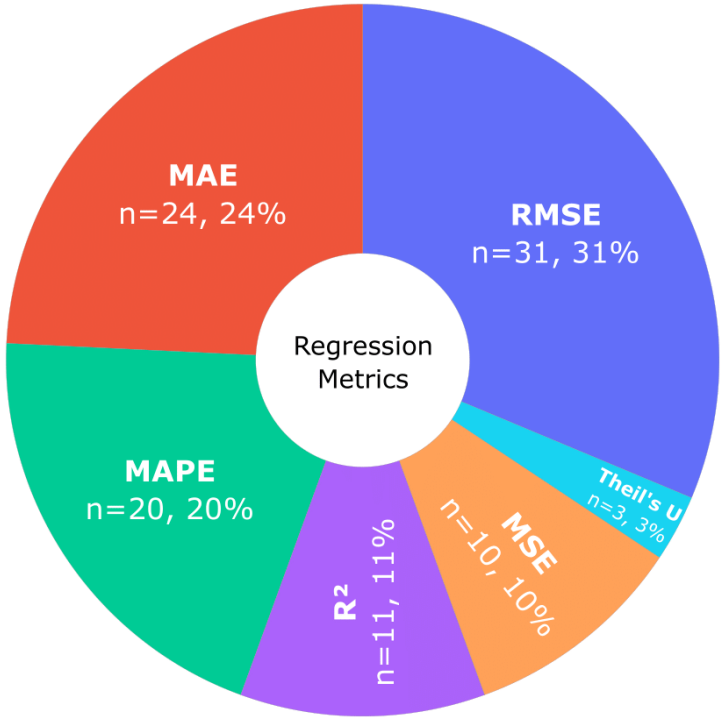
RQ2: What are the current modeling techniques and tools used to build the LSTM models?

Source: https://github.com/SafwanAlselwi/RNN-LSTM-SLR/blob/main/plotly_charts_saf1.ipynb

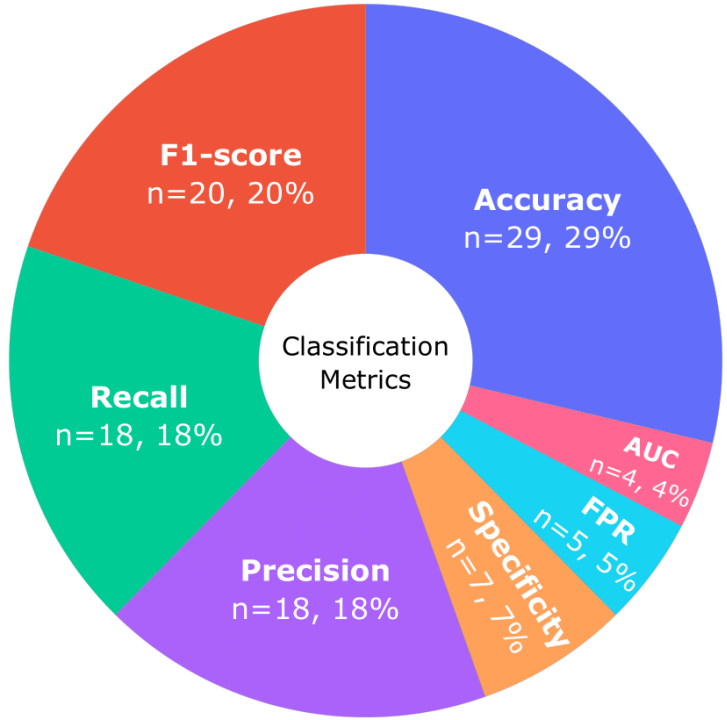
Generated using my Python's Plotly (Single Donut Chart)



Preferred programming languages for LSTM development

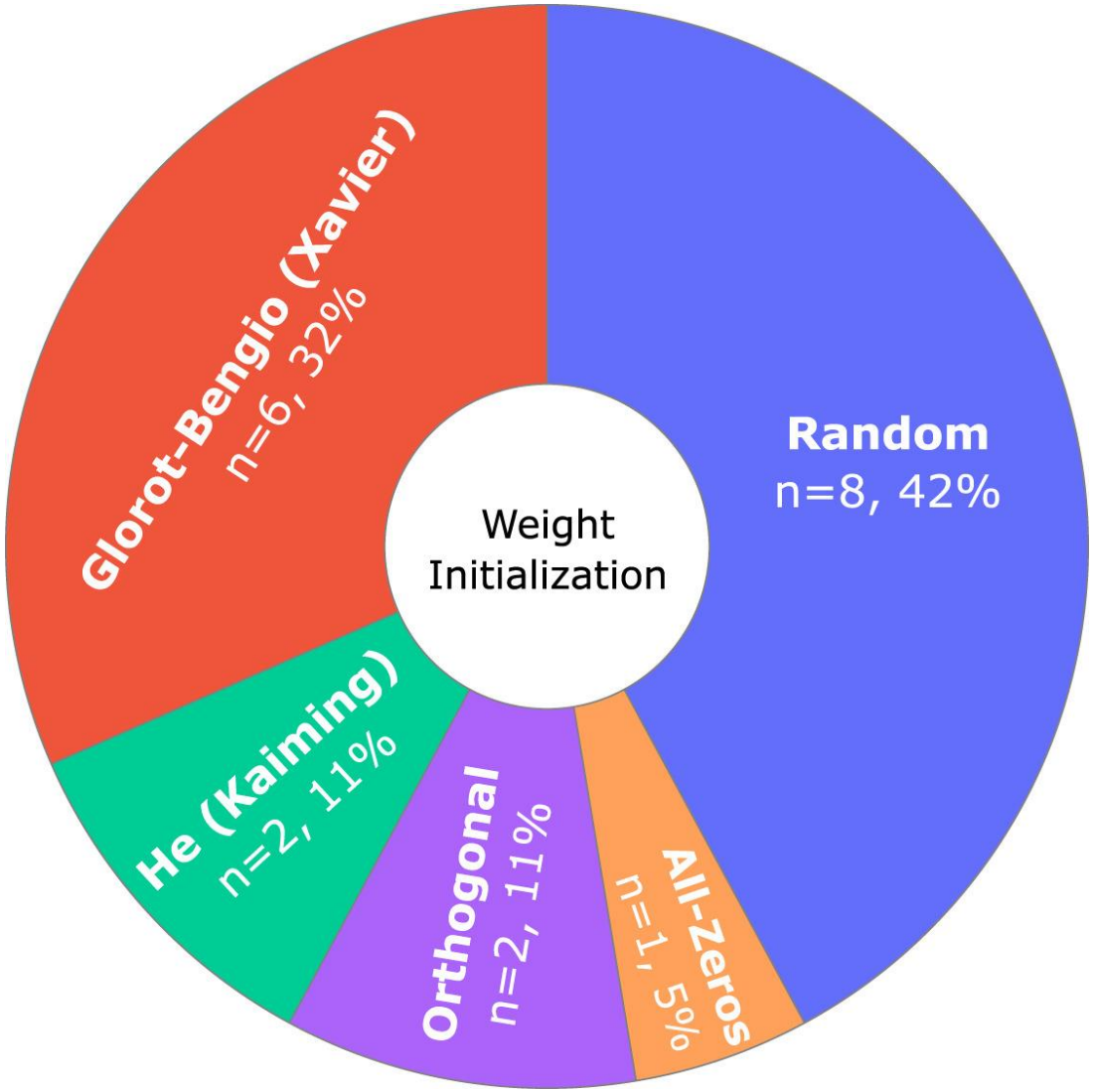


Most used evaluation metrics in regression problems

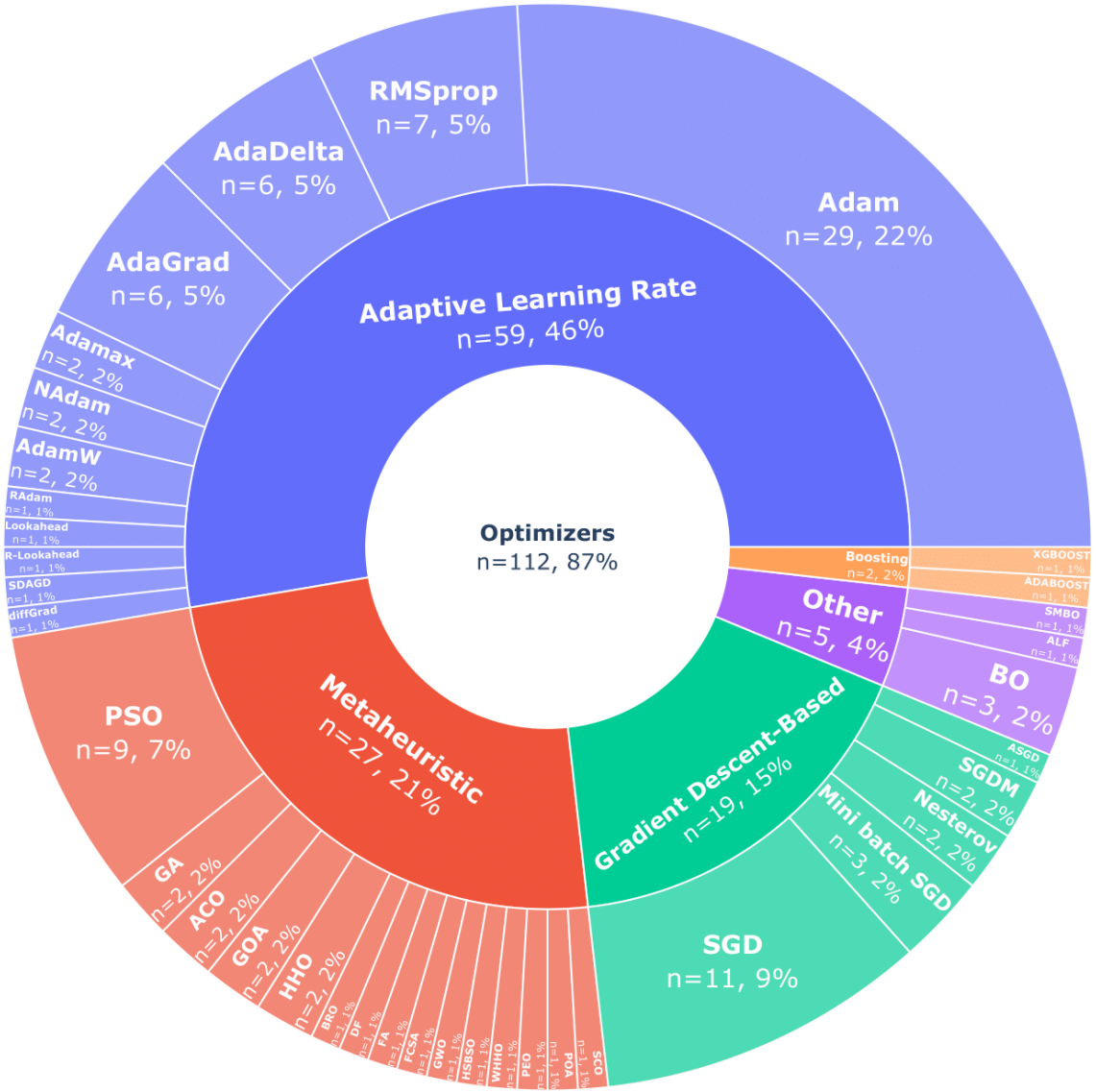


Most used evaluation metrics in classification problems

RQ3: What are the weights initialization techniques used in LSTM networks?

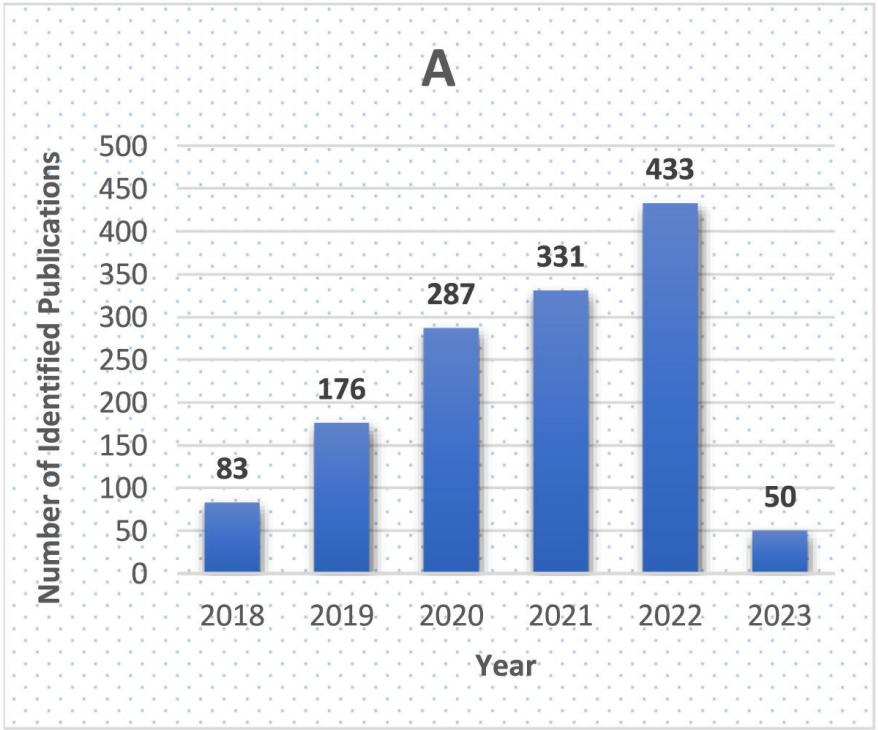


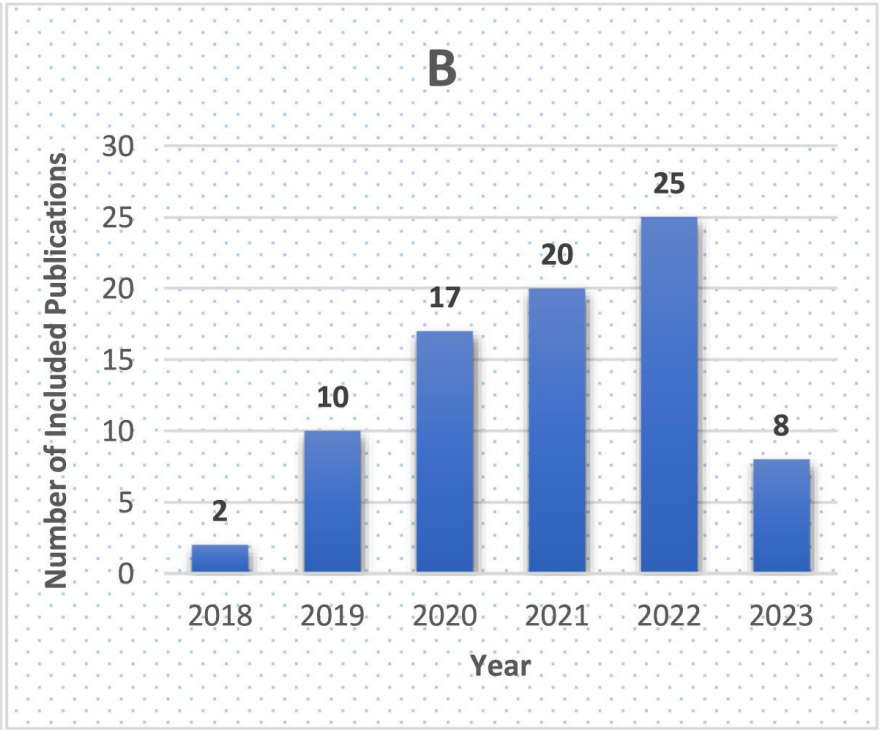
RQ4: What are the weights optimization techniques used in LSTM networks?

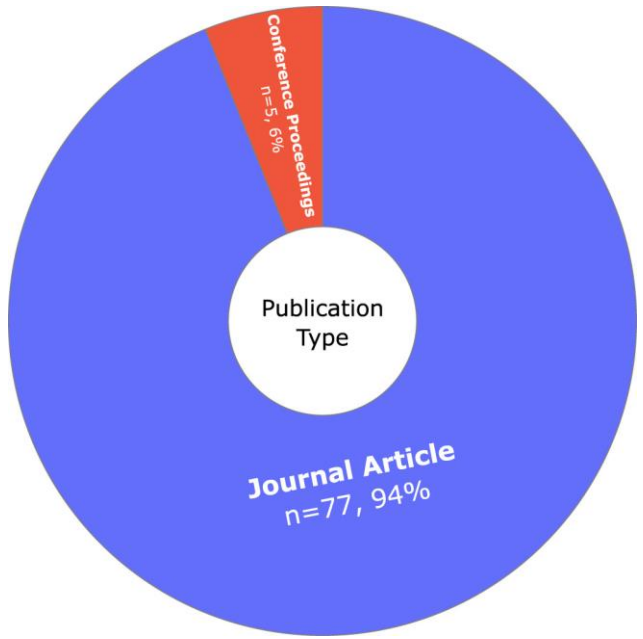


RQ5: What is the intensity of publications related to LSTM?

1. Distribution of included studies by year
2. Distribution of included studies by publication type.
3. Distribution of included studies by publisher.
4. Distribution of included studies by journal.







Extra

Extra: Bibliometric Mapping with VOSviewer

VOSviewer - Visualizing scientific landscapes

What is VOSviewer?

- A software tool for constructing and visualizing **bibliometric networks** (e.g., co-authorship networks, keyword co-occurrence, citation networks) from your set of references.
- It helps reveal patterns like which keywords cluster together or which authors often collaborate, in your collected literature.

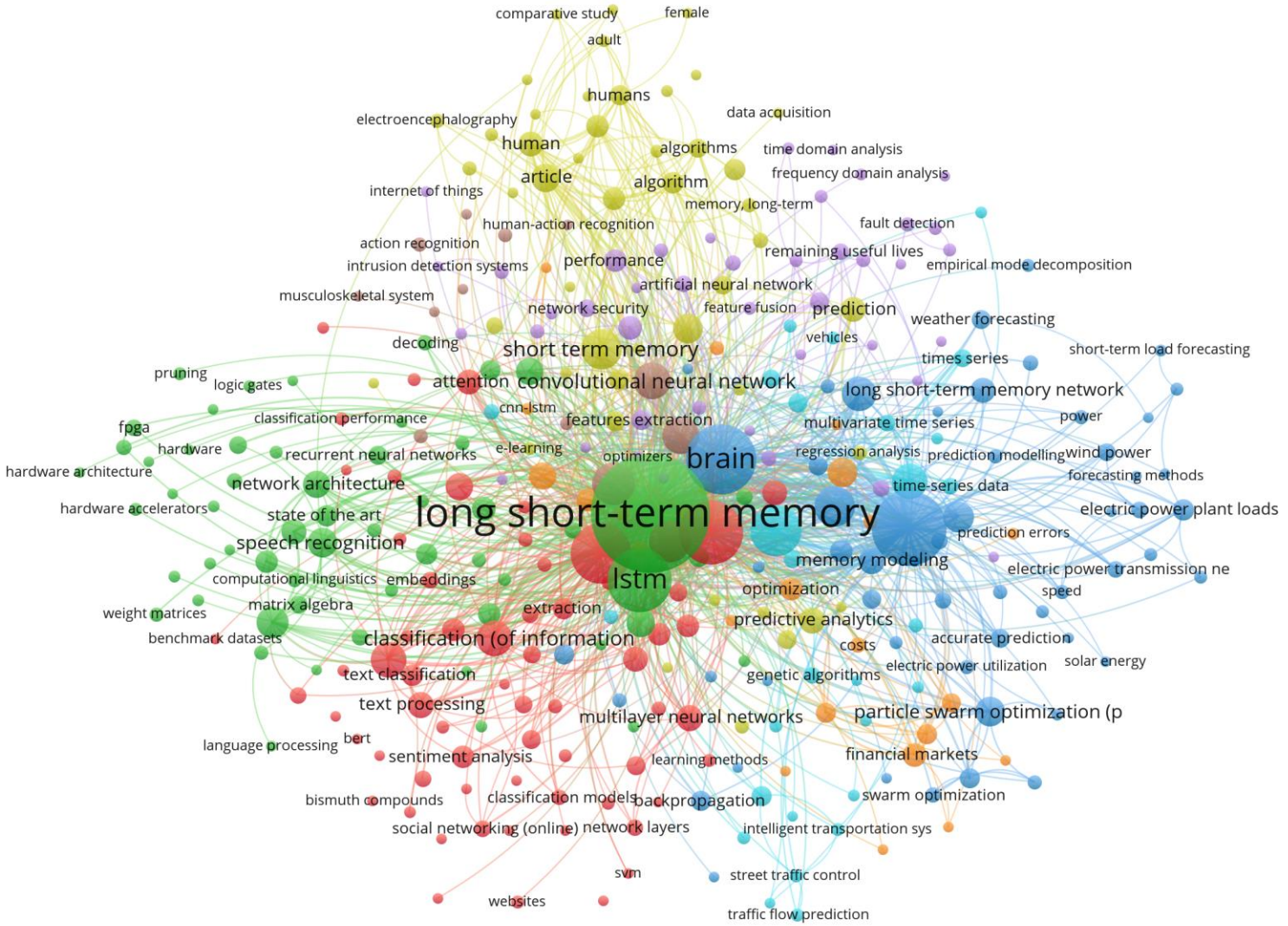
Using VOSviewer:

- You can input your final set of included papers (from a RIS/BibTeX file) into VOSviewer.

Common analyses include

- *Keyword co-occurrence map:* shows clusters of terms that frequently appear together in titles/abstracts, indicating major themes.
- *Co-authorship map:* shows collaboration networks among authors or institutions in the field.
- *Citation or Co-citation map:* reveals how studies cite each other or share references, showing influential works.

VOSviewer – LSTM papers from Scopus



VOSviewer

https://app.napkin.ai

What is Napkin.ai?

- An AI tool that transforms input text (paragraphs, bullet points, descriptions) into visually-rich diagrams, flowcharts, infographics, and concept maps.

- Example: See Fig. 4 and Table 3 in this paper:
  - Authentication schemes for Internet of Things (IoT) networks: A systematic review and security assessment - ScienceDirect

References

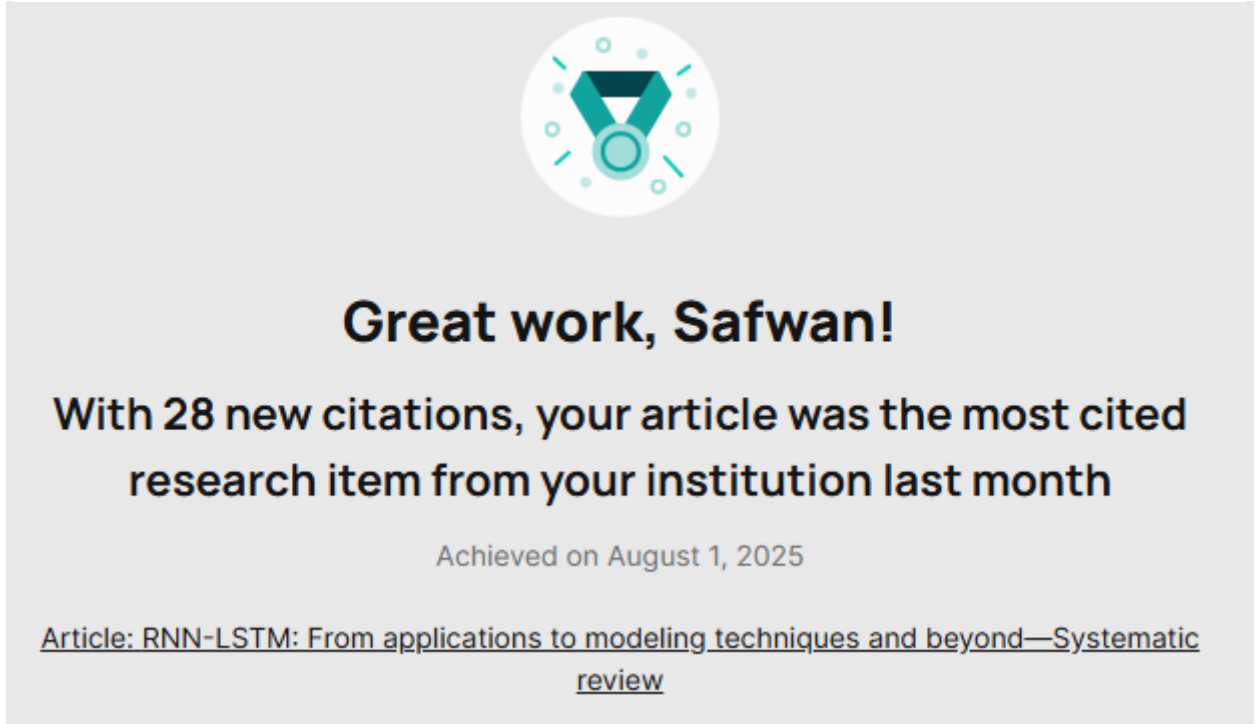
- Al-Selwi, S. M., Hassan, M. F., Abdulkadir, S. J., Muneer, A., Sumiea, E. H., Alqushaibi, A., & Ragab, M. G. (2024). RNN-LSTM: From applications to modeling techniques and beyond—Systematic review. *Journal of King Saud University-Computer and Information Sciences*, *36*(5), 102068. https://doi.org/10.1016/j.jksuci.2024.102068

- https://github.com/SafwanAlselwi/RNN-LSTM-SLR

Achievements

Achievements

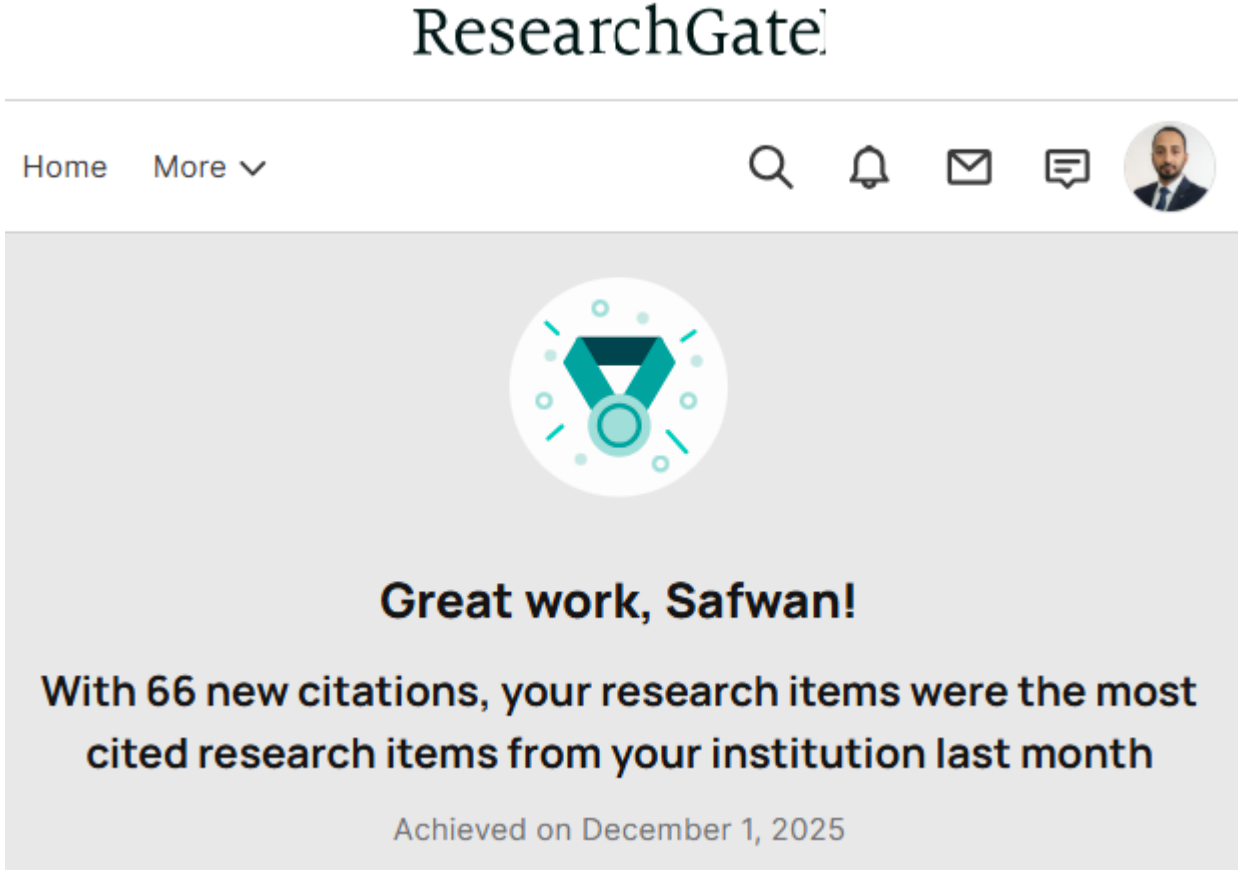
ResearchGate



Please **recommend** my SLR in ResearchGate and **cite** it if you use the given methodology:

(PDF) RNN-LSTM: From applications to modeling techniques and beyond—Systematic review

Achievements



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THANK
YOU
Dr. SAFWAN AL-SELWI