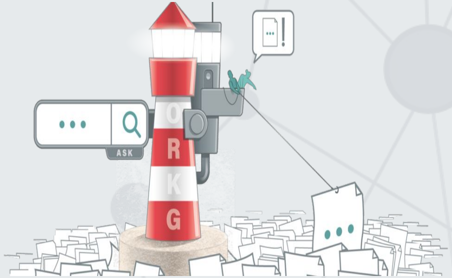
Data Week Leipzig 2025

Neuro-Symbolic AI for Scholarly Research: Enhancing Discovery, Reasoning, and Assistance with LLMs and Knowledge Graphs

Introducing the TIB AIssistant

A platform for AI-supported research



TIB AI ASSISTANT

Gollam Rabby

Slides partly created by Allard Oelen

ORKG TIB

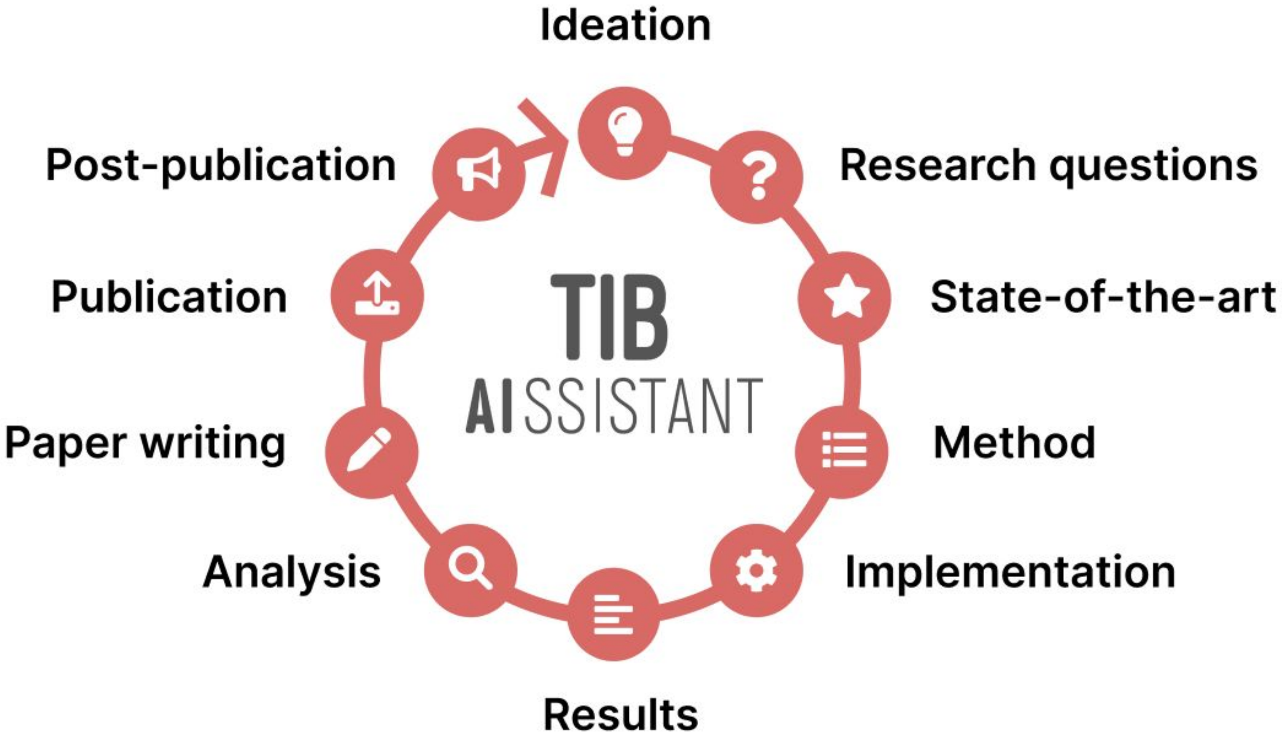
Co-funded by the Horizon 2020 programme of the European Union

L3S Leibniz Universität Hannover

TIB AIssistant

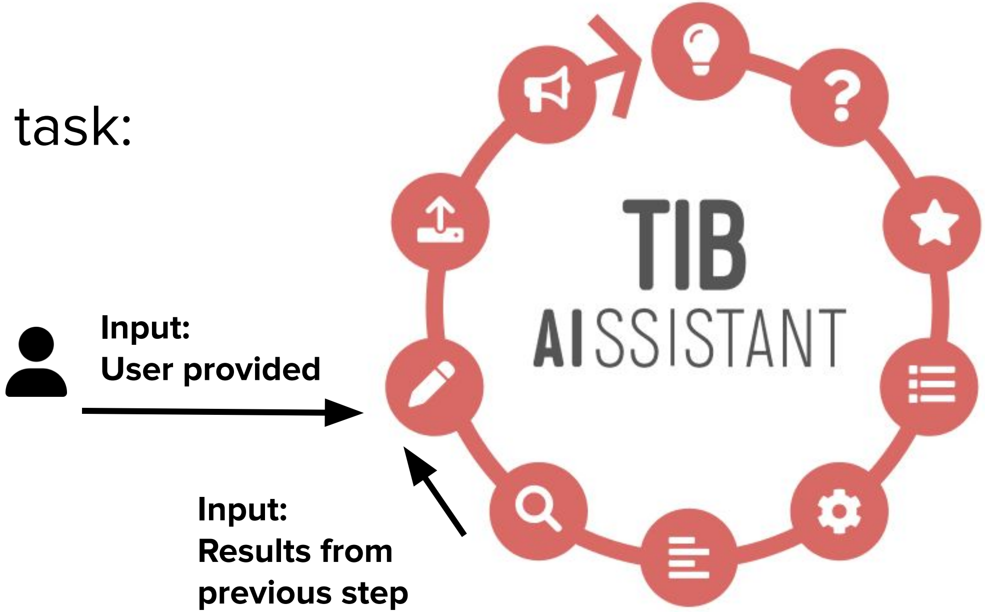
- An AI-supported research assistant helping **throughout the research life cycle**
- Modular, flexible, domain-agnostic or domain-driven (where need)

TIB AIssistant

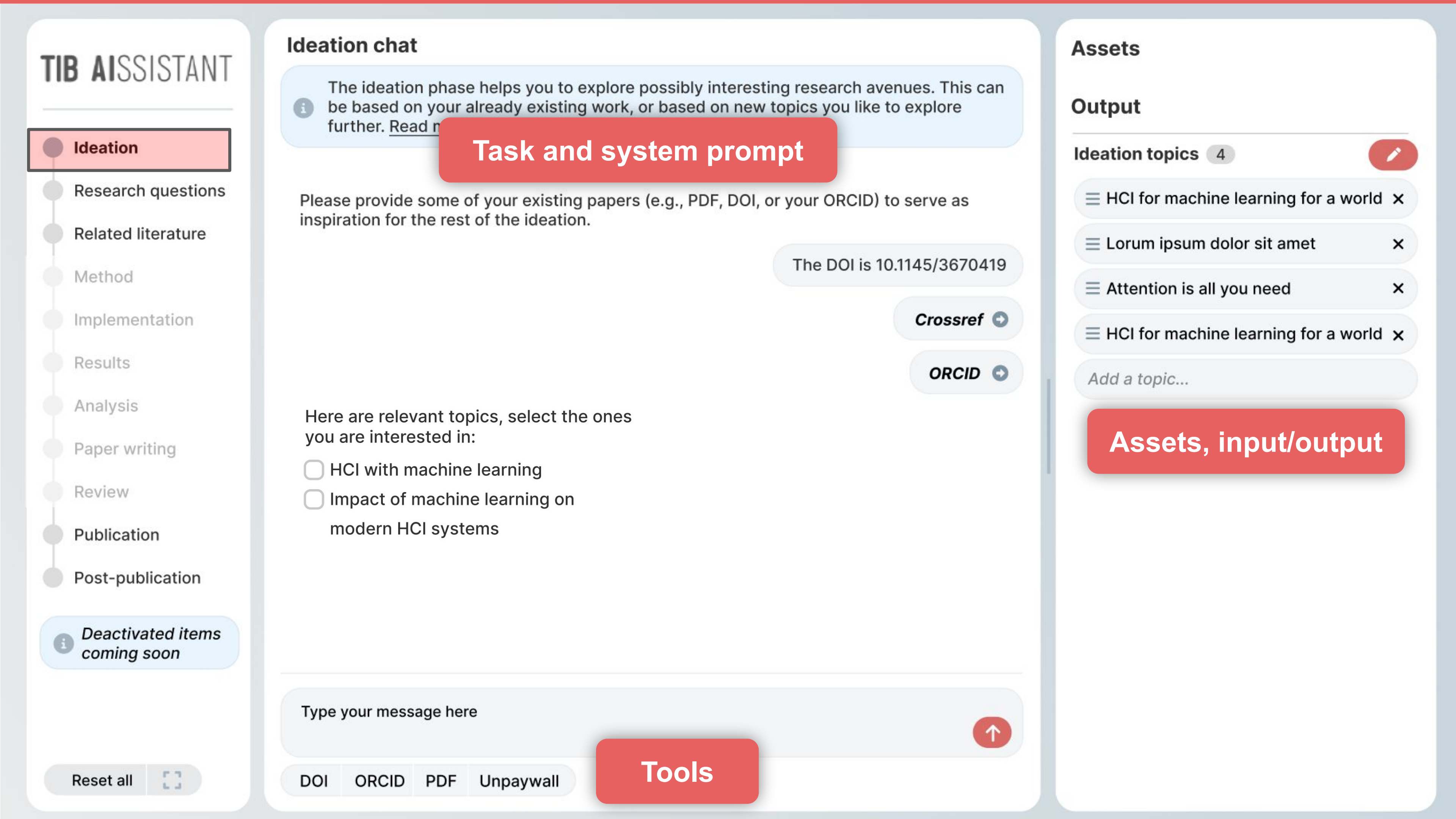


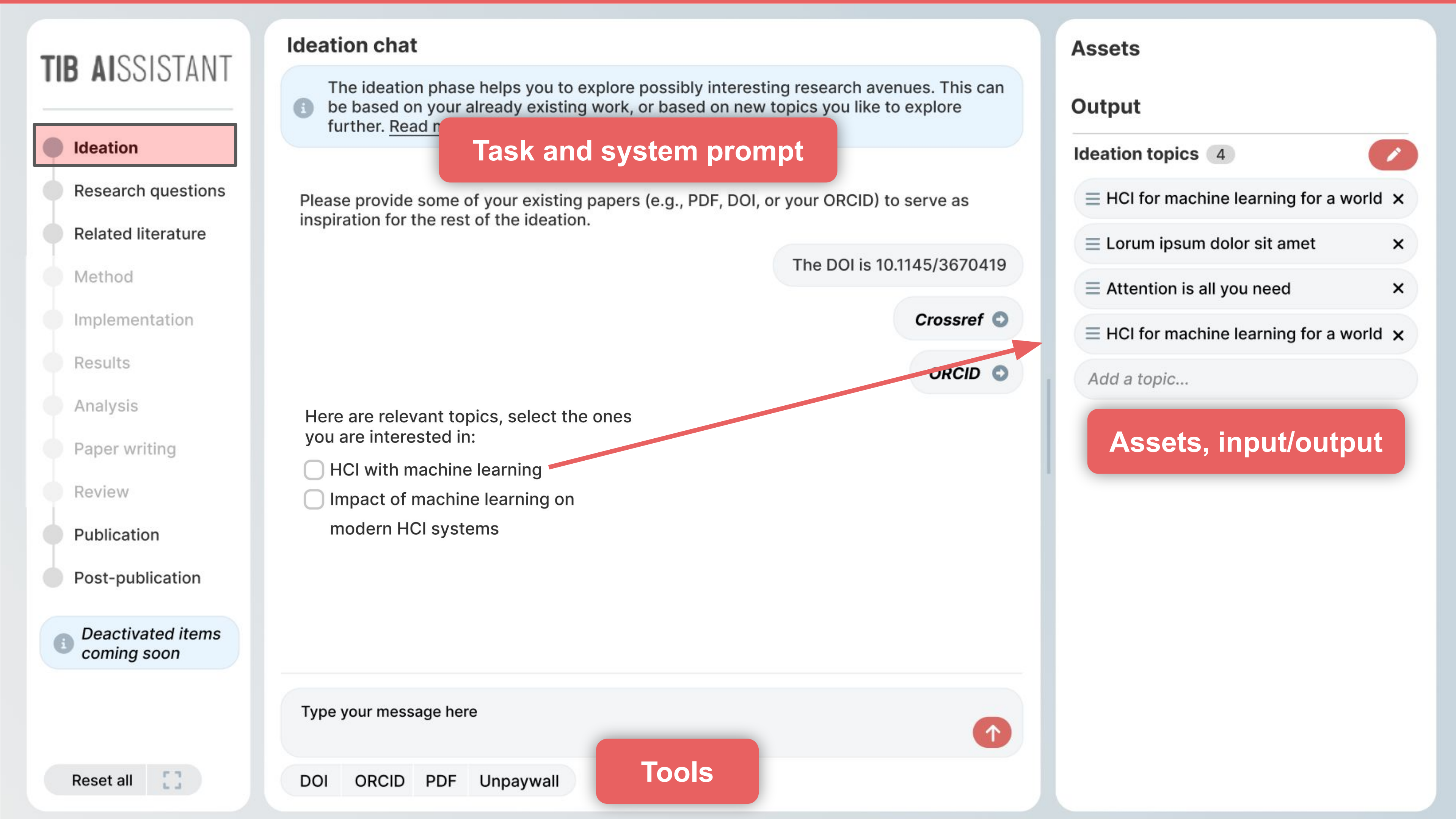
TIB AIssistant

- General user interaction by task:
  a. System prompts
  b. Default set of tools
  c. Assets
     - Input
     - Output



- Each phase can be used in isolation or in sequence


TIB AISSISTANT
Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
Deactivated items coming soon
Reset all
Ideation chat
The ideation phase helps you to explore possibly interesting research avenues. This can be based on your already existing work, or based on new topics you like to explore further. Read m
Task and system prompt
Please provide some of your existing papers (e.g., PDF, DOI, or your ORCID) to serve as inspiration for the rest of the ideation.
The DOI is 10.1145/3670419
Crossref
ORCID
Here are relevant topics, select the ones you are interested in:
HCI with machine learning
Impact of machine learning on modern HCI systems
Type your message here
DOI
ORCID
PDF
Unpaywall
Tools
Assets
Output
Ideation topics 4
HCI for machine learning for a world
Lorum ipsum dolor sit amet
Attention is all you need
HCI for machine learning for a world
Add a topic...
Assets, input/output



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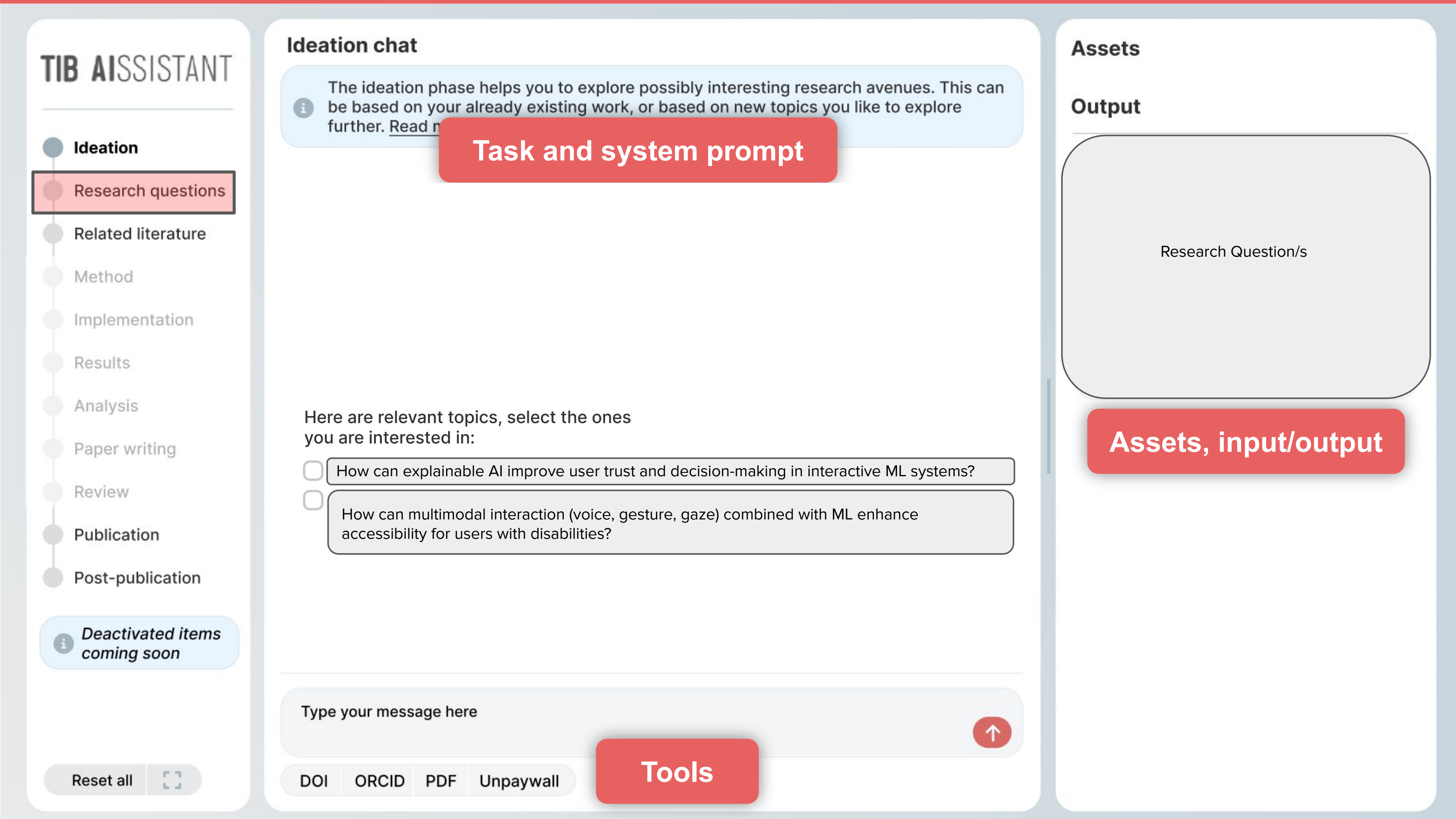
Lorum ipsum dolor sit amet
Attention is all you need
HCI for machine learning for a world
Add a topic...
Assets, input/output

TIB AIssistant

Ideation

Helps researchers with ideas of new topics, research directions, or gaps in the literature.

Input: papers, personal profiles
Output: list of ideas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Results
Analysis
Paper writing
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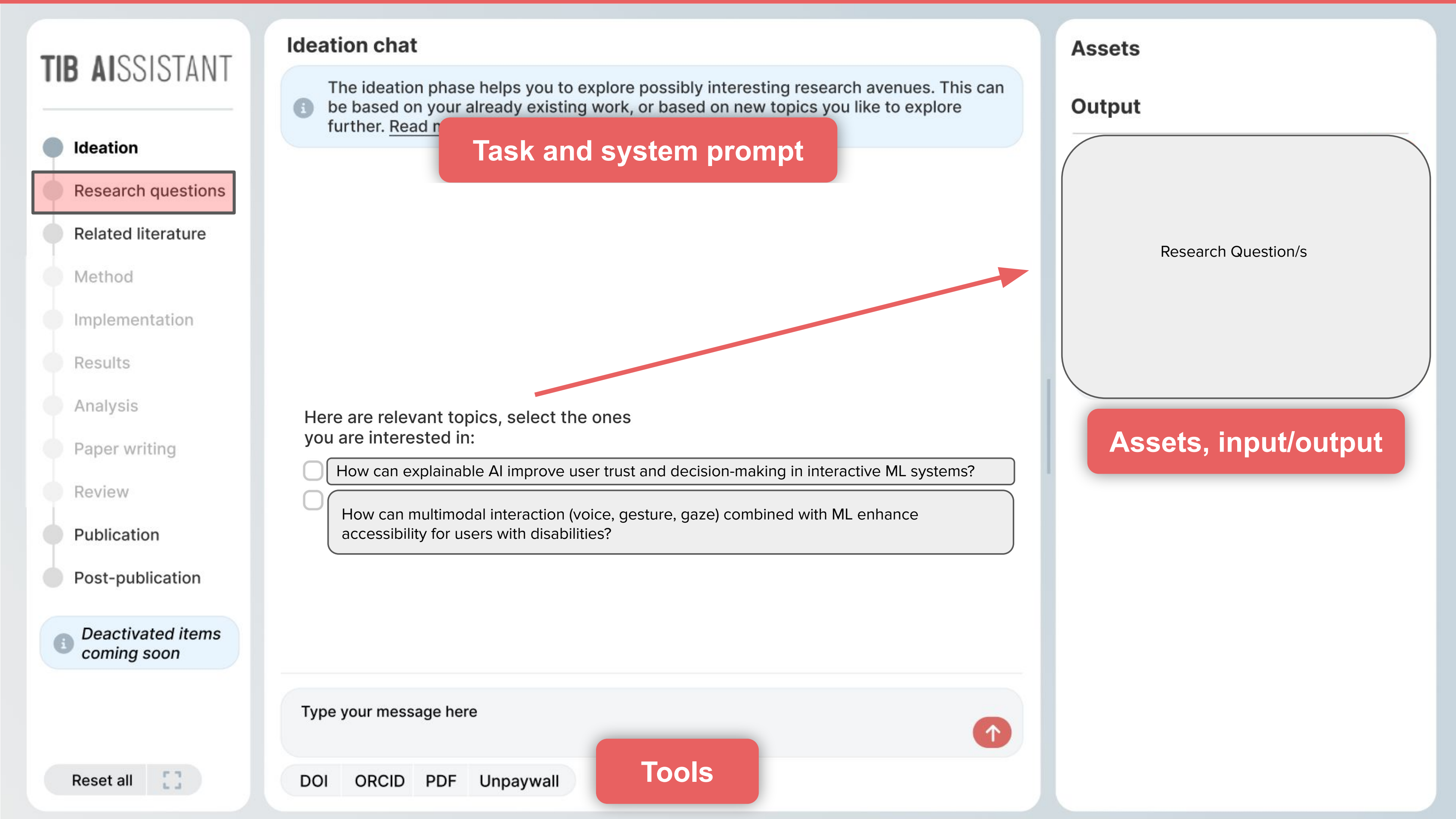
Task and system prompt
Here are relevant topics, select the ones you are interested in:
How can explainable AI improve user trust and decision-making in interactive ML systems?
How can multimodal interaction (voice, gesture, gaze) combined with ML enhance accessibility for users with disabilities?
Type your message here
DOI
ORCID
PDF
Unpaywall
Tools
Assets
Output
Research Question/s
Assets, input/output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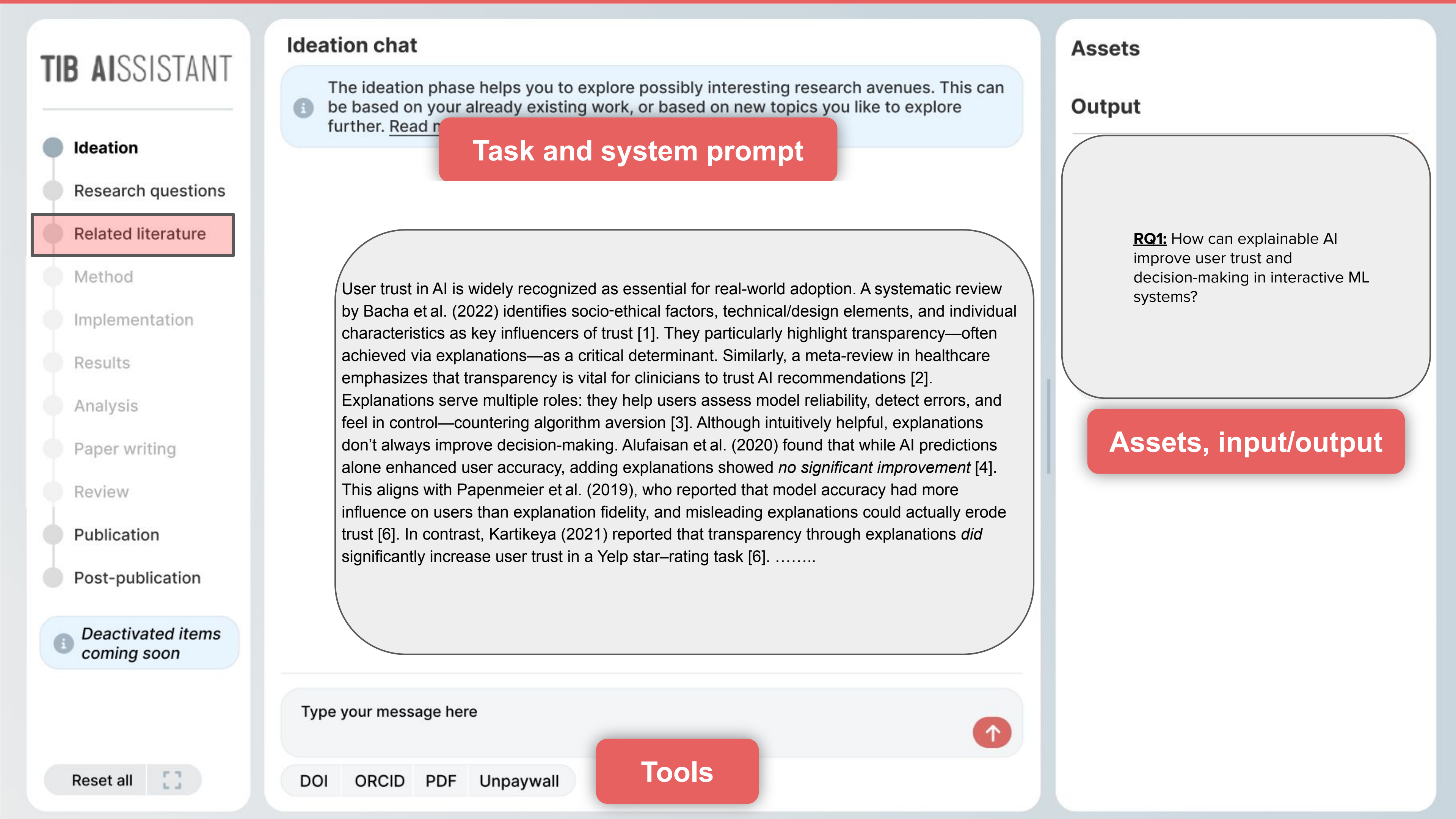
Assets, input/output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Method
Implementation
Results
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Task and system prompt
User trust in AI is widely recognized as essential for real-world adoption. A systematic review by Bacha et al. (2022) identifies socio-ethical factors, technical/design elements, and individual characteristics as key influencers of trust [1]. They particularly highlight transparency—often achieved via explanations—as a critical determinant. Similarly, a meta-review in healthcare emphasizes that transparency is vital for clinicians to trust AI recommendations [2]. Explanations serve multiple roles: they help users assess model reliability, detect errors, and feel in control—countering algorithm aversion [3]. Although intuitively helpful, explanations don't always improve decision-making. Alufaisan et al. (2020) found that while AI predictions alone enhanced user accuracy, adding explanations showed *no significant improvement* [4]. This aligns with Papenmeier et al. (2019), who reported that model accuracy had more influence on users than explanation fidelity, and misleading explanations could actually erode trust [6]. In contrast, Kartikeya (2021) reported that transparency through explanations *did* significantly increase user trust in a Yelp star–rating task [6]. ....
Type your message here
DOI
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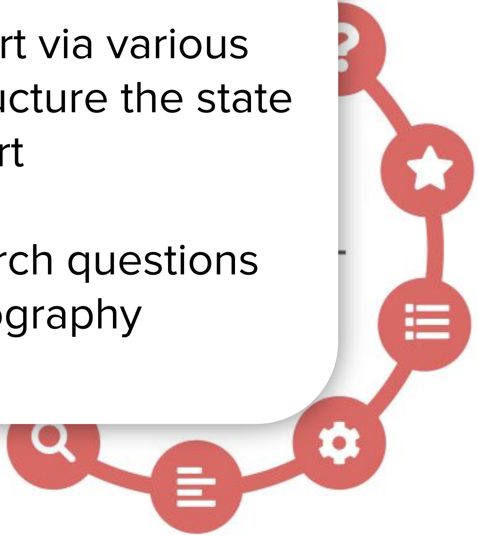
Tools
Assets
Output
RQ1: How can explainable AI improve user trust and decision-making in interactive ML systems?
Assets, input/output

TIB AIssistant ❤️ ORKG Ask

[77,368,538 Items with abstracts]

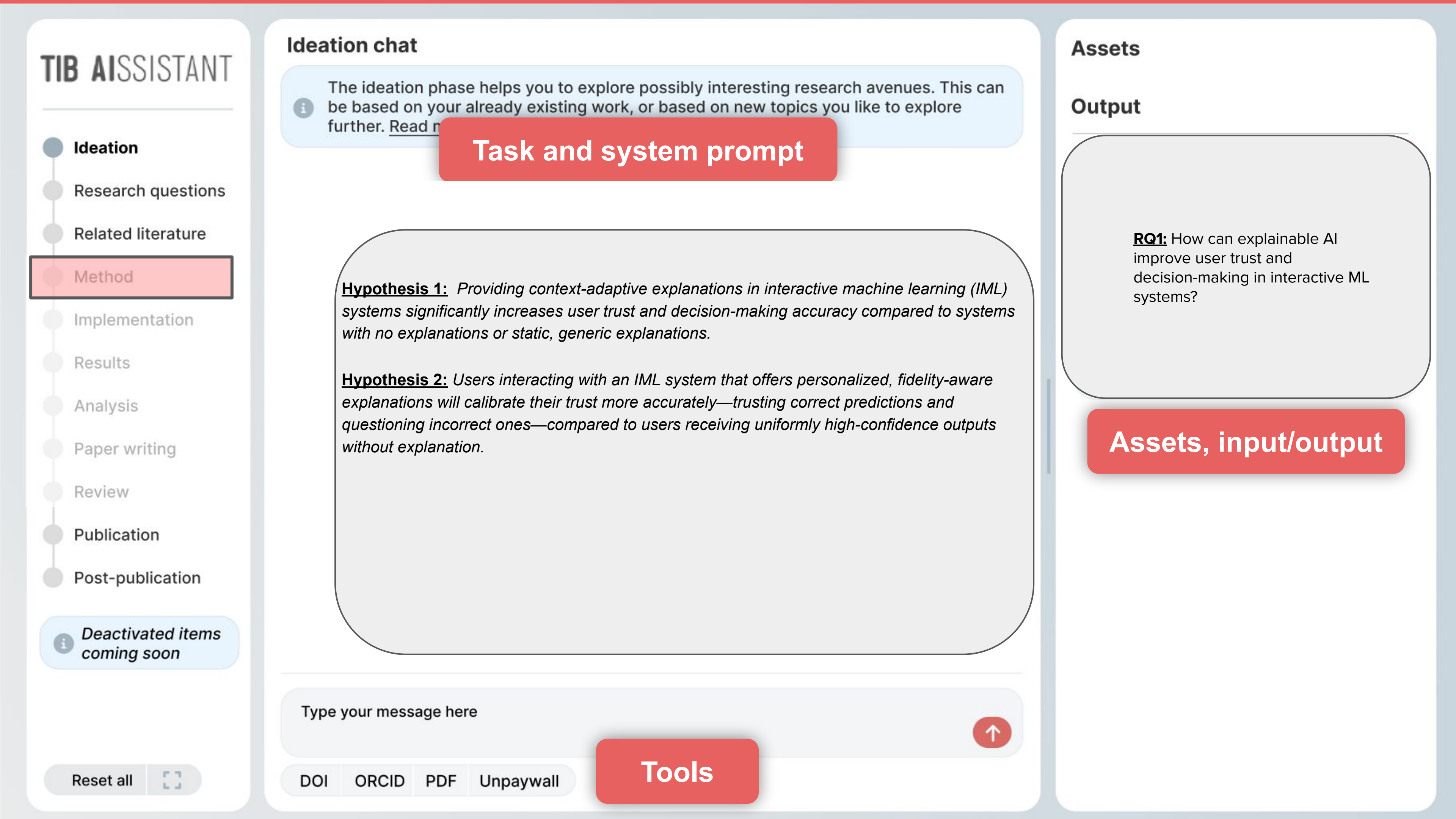
Finds state of the art via various platforms, help to structure the state of the art

Input: topics, research questions
Output: bibliography



State-of-the-art

*@article{schuhmann2025project,
title={Project alexandria: Towards freeing scientific knowledge from copyright burdens via llms},
author={Schuhmann, Christoph and Rabby, Gollam and Prabhu, Ameya and Ahmed, Tawsif and Hochlehnert, Andreas and Nguyen, Huu and Akinci, Nick and Schmidt, Ludwig and Kaczmarczyk, Robert and Auer, Soren and others},
journal={arXiv preprint arXiv:2502.19413},
year={2025}}*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Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
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Task and system prompt
Hypothesis 1: Providing context-adaptive explanations in interactive machine learning (IML) systems significantly increases user trust and decision-making accuracy compared to systems with no explanations or static, generic explanations.
Hypothesis 2: Users interacting with an IML system that offers personalized, fidelity-aware explanations will calibrate their trust more accurately—trusting correct predictions and questioning incorrect ones—compared to users receiving uniformly high-confidence outputs without explanation.
Type your message here
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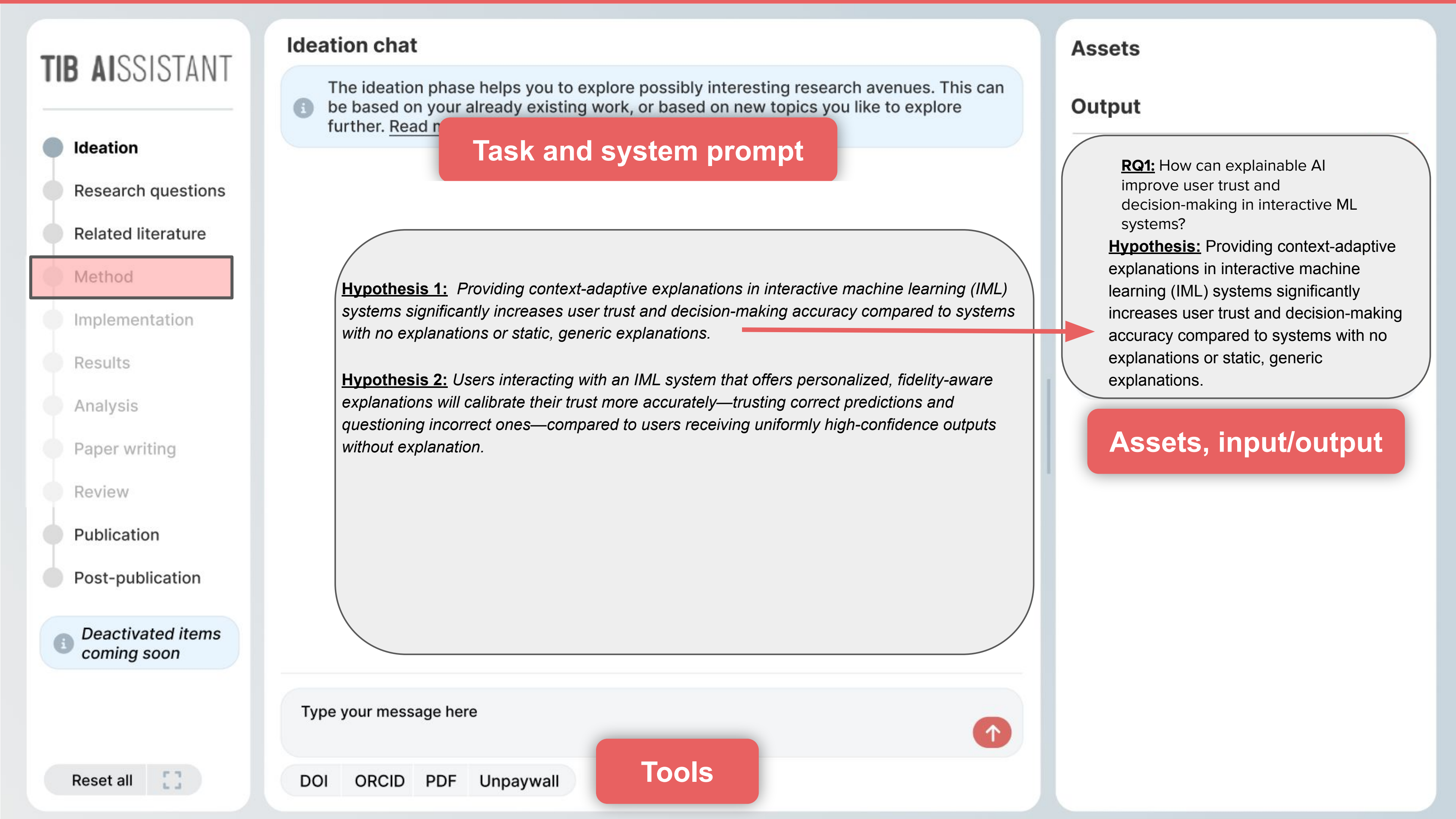
PDF
Unpaywall
Tools
Assets
Output
RQ1: How can explainable AI improve user trust and decision-making in interactive ML systems?
Assets, input/output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Research questions
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Method
Implementation
Results
Analysis
Paper writing
Review
Publication
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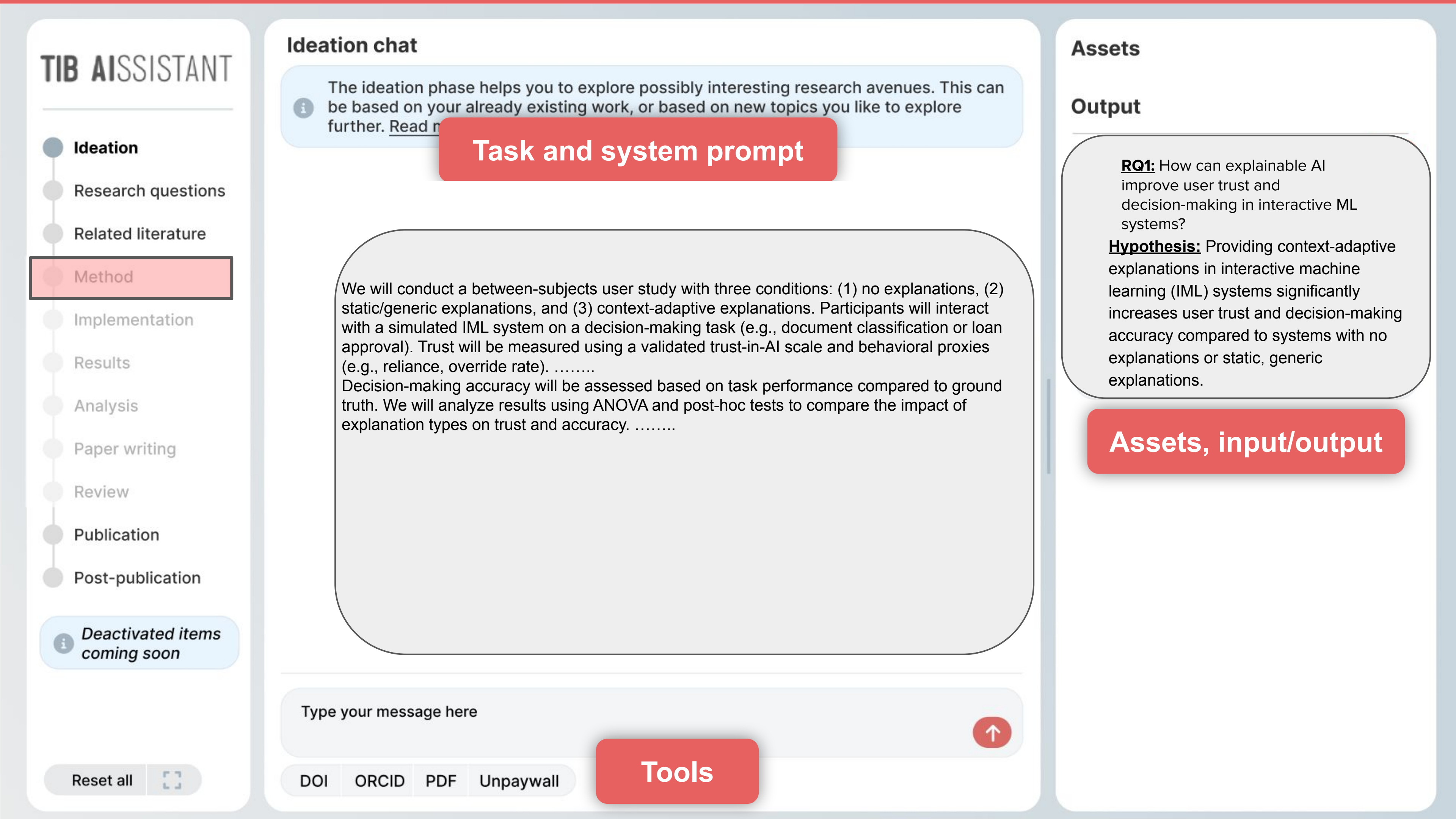

TIB AISSISTANT
Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
Deactivated items coming soon
Reset all
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Task and system prompt
We will conduct a between-subjects user study with three conditions: (1) no explanations, (2) static/generic explanations, and (3) context-adaptive explanations. Participants will interact with a simulated IML system on a decision-making task (e.g., document classification or loan approval). Trust will be measured using a validated trust-in-AI scale and behavioral proxies (e.g., reliance, override rate). ……..
Decision-making accuracy will be assessed based on task performance compared to ground truth. We will analyze results using ANOVA and post-hoc tests to compare the impact of explanation types on trust and accuracy. ……..
Type your message here
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ORCID
PDF
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Tools
Assets
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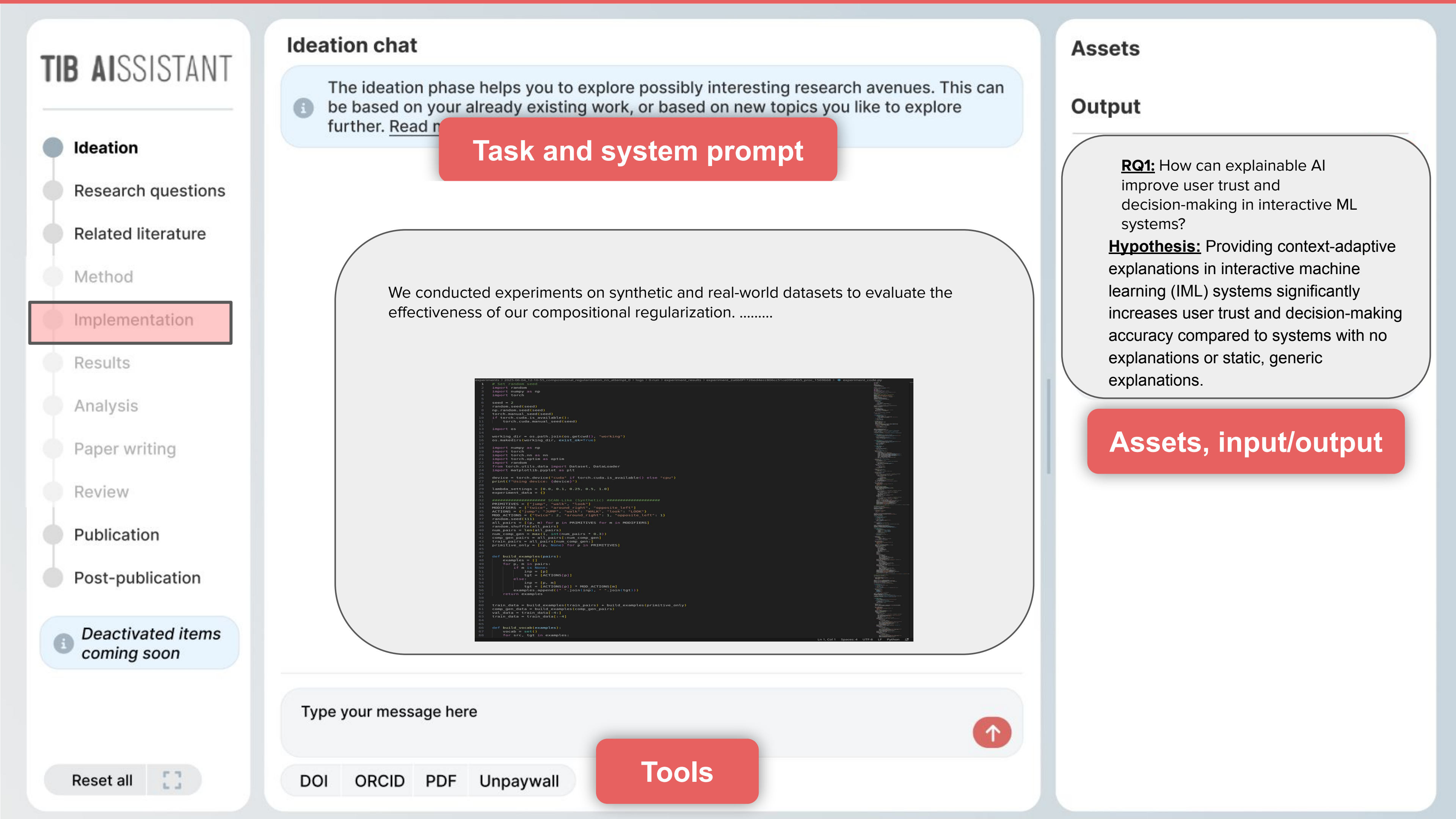
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Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
Deactivated items coming soon
Reset all
Ideation chat
The ideation phase helps you to explore possibly interesting research avenues. This can be based on your already existing work, or based on new topics you like to explore further. Read m
Task and system prompt
We conducted experiments on synthetic and real-world datasets to evaluate the effectiveness of our compositional regularization. ....
Type your message here
DOI
ORCID
PDF
Unpaywall
Tools
Assets
Output
RQ1: How can explainable AI improve user trust and decision-making in interactive ML systems?
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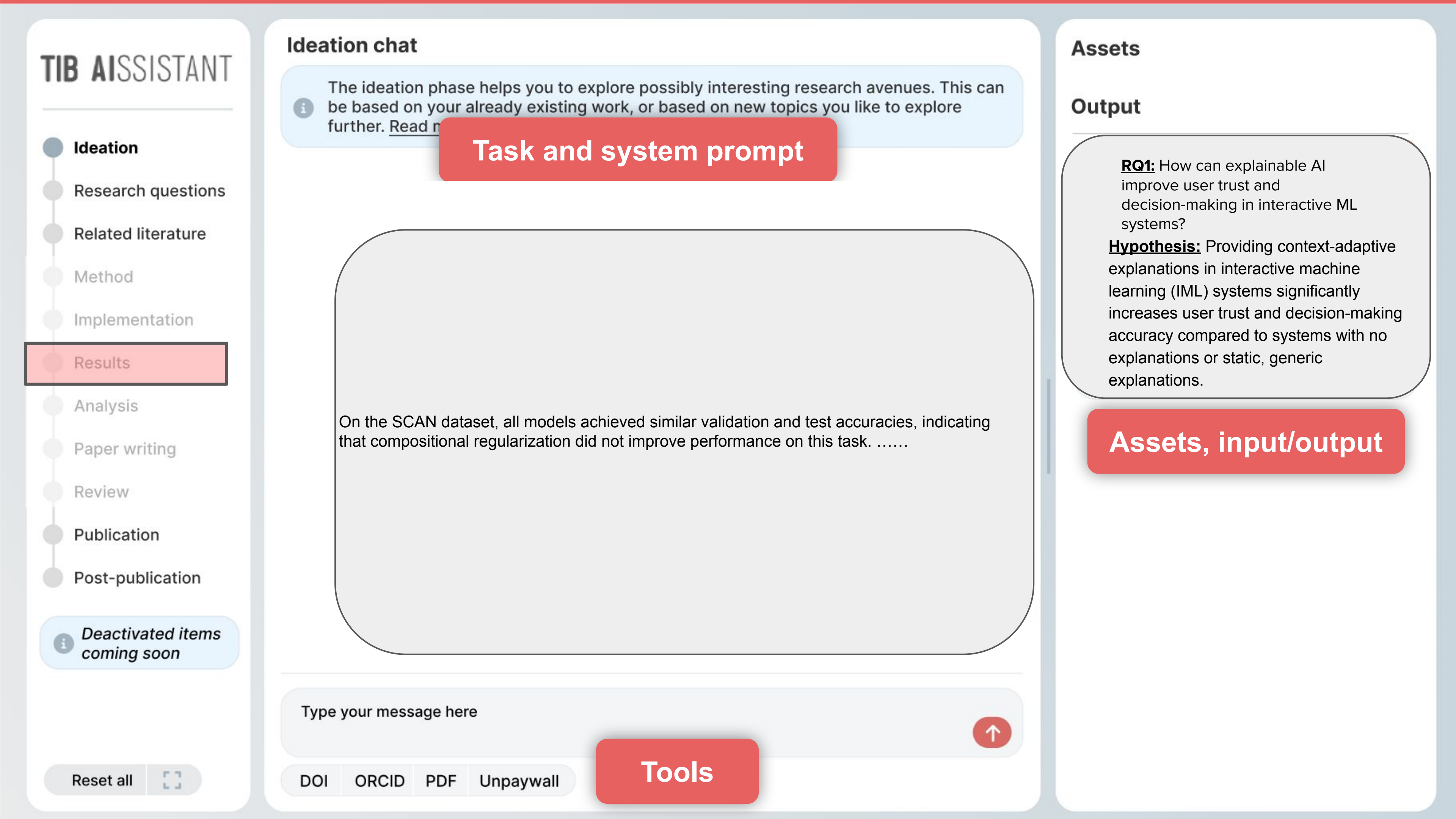

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Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
Deactivated items coming soon
Reset all
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Task and system prompt
On the SCAN dataset, all models achieved similar validation and test accuracies, indicating that compositional regularization did not improve performance on this task. ……
Type your message here
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ORCID
PDF
Unpaywall
Tools
Assets
Output
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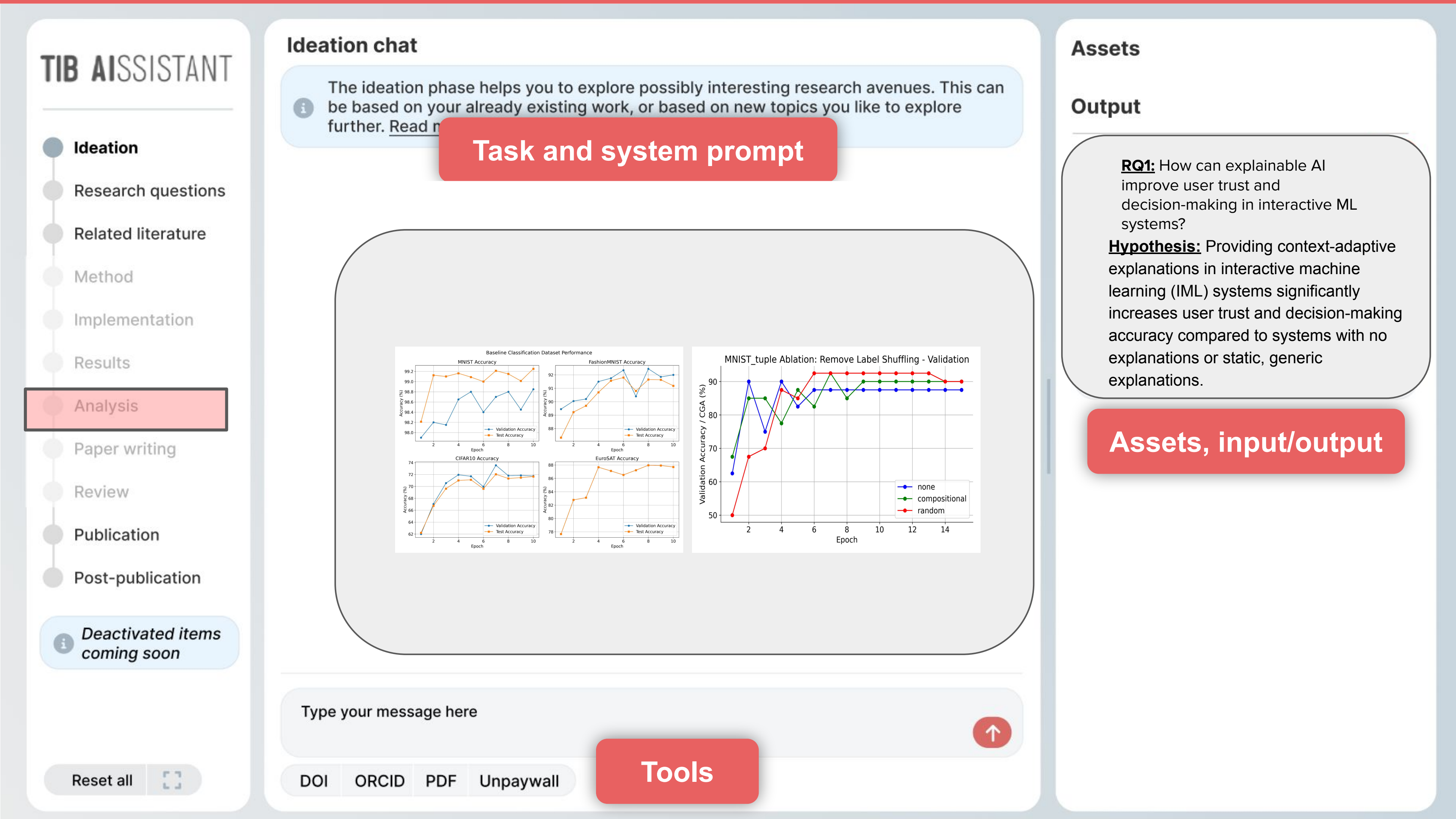
Assets, input/output


TIB AISSISTANT
Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
Deactivated items coming soon
Reset all
Ideation chat
The ideation phase helps you to explore possibly interesting research avenues. This can be based on your already existing work, or based on new topics you like to explore further. Read m
Task and system prompt
Baseline Classification Dataset Performance
MNIST Accuracy
FashionMNIST Accuracy
CIFAR10 Accuracy
EuroSAT Accuracy
Validation Accuracy
Test Accuracy
Epoch
MNIST_tuple Ablation: Remove Label Shuffling - Validation
Validation Accuracy / CGA (%)
Epoch
none
compositional
random
Type your message here
DOI
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PDF
Unpaywall
Tools
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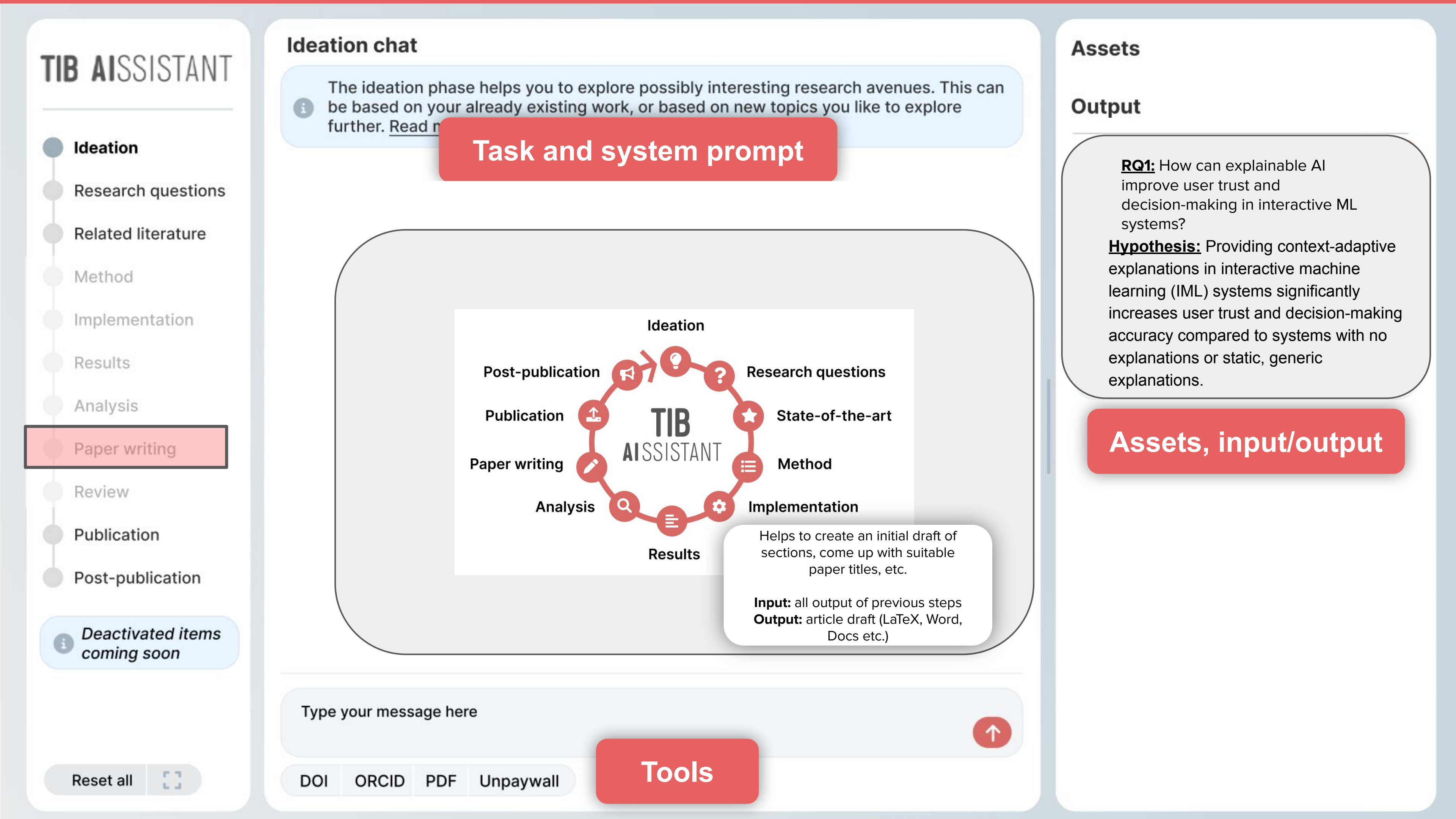
TIB AISSISTANT
Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
Deactivated items coming soon
Reset all
Ideation chat
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Task and system prompt
Ideation
Post-publication
Research questions
Publication
State-of-the-art
TIB AISSISTANT
Paper writing
Method
Analysis
Implementation
Results
Helps to create an initial draft of sections, come up with suitable paper titles, etc.
Input: all output of previous steps
Output: article draft (LaTeX, Word, Docs etc.)
Type your message here
DOI
ORCID
PDF
Unpaywall
Tools
Assets
Output
RQ1: How can explainable AI improve user trust and decision-making in interactive ML systems?
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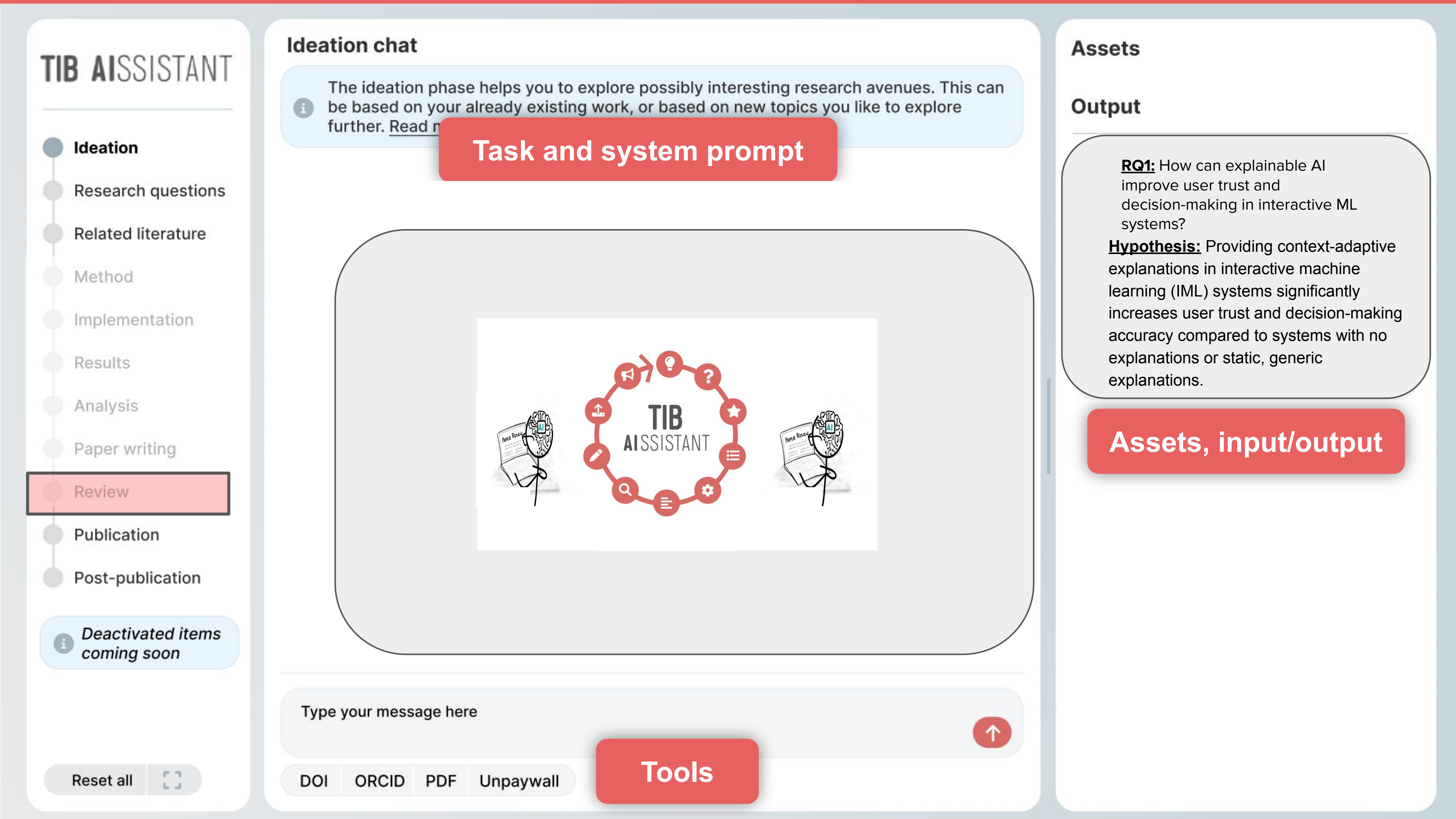
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Ideation
Research questions
Related literature
Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
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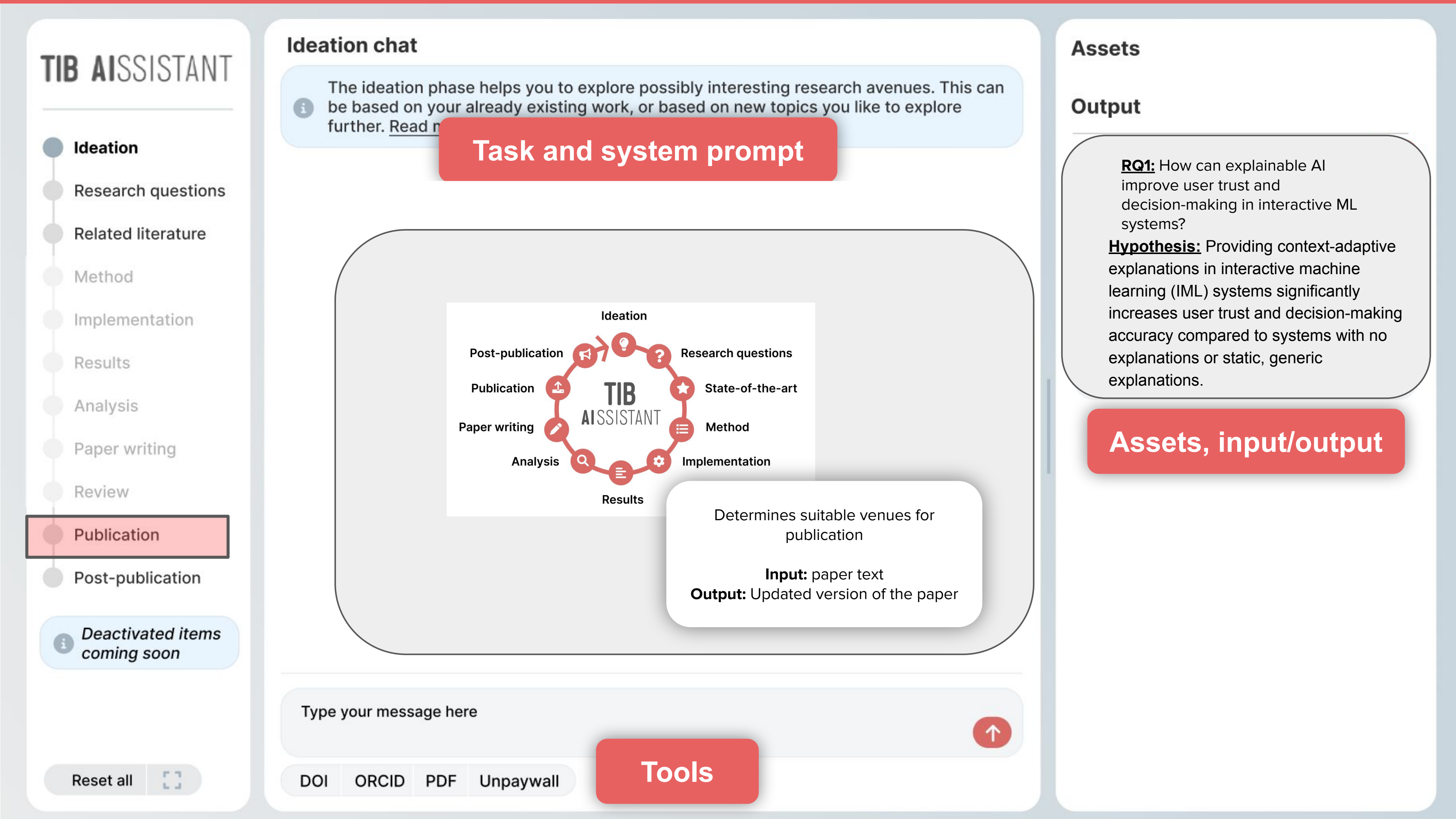
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Method
Implementation
Results
Analysis
Paper writing
Review
Publication
Post-publication
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Task and system prompt
Ideation
Post-publication
Research questions
Publication
State-of-the-art
Paper writing
Method
Analysis
Implementation
Results
TIB AISSISTANT
Determines suitable venues for publication
Input: paper text
Output: Updated version of the paper
Type your message here
DOI
ORCID
PDF
Unpaywall
Tools
Assets
Output
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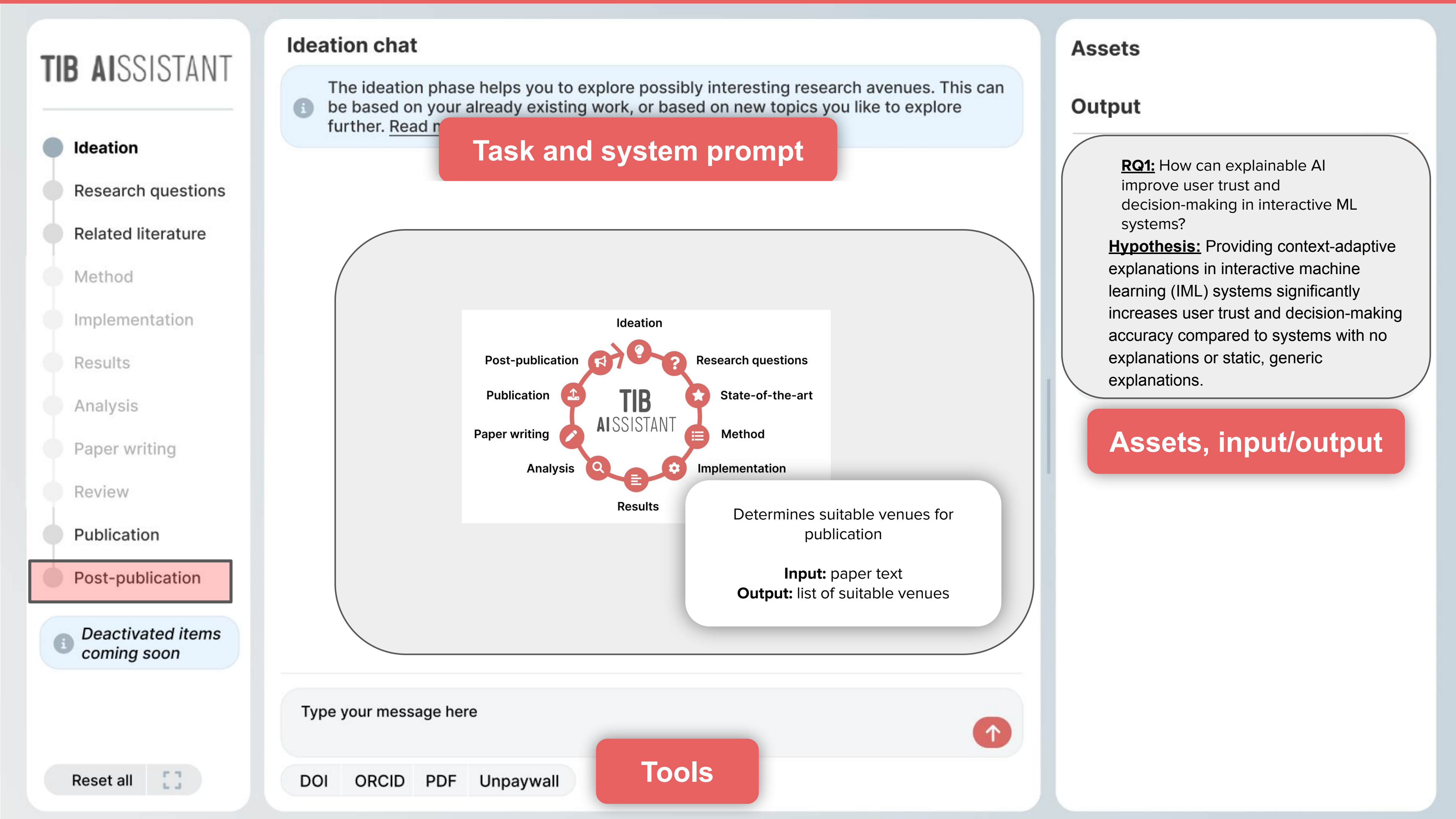
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Method
Implementation
Results
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Review
Publication
Post-publication
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Post-publication
Research questions
Publication
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TIB
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Method
Analysis
Implementation
Results
Determines suitable venues for publication
Input: paper text
Output: list of suitable venues
Type your message here
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ORCID
PDF
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Assets, input/output

Ongoing research

1. Deep Hypothesis and Research Question/s
2. Deep Method and implementation
3. Deep Results and Analysis
4. Scientific Reasoning Models

Iterative Hypothesis Generation for Scientific Discovery with Monte Carlo Nash Equilibrium Self-Refining Trees

Gollam Rabby[1†] (✉), Diyana Muhammed[2†], Prasenjit Mitra[2], and Sören Auer[1,2]

[1] L3S Research Center, Leibniz University Hannover, Hannover, Germany
{gollam.rabby, mitra}@l3s.de
[2] TIB—Leibniz Information Centre for Science and Technology, Hannover, Germany{diyana.muhammed, auer}@tib.eu

Dataset Project Page Codebase

Abstract. Scientific hypothesis generation is a fundamentally challenging task in research, requiring the synthesis of novel and empirically grounded insights. Traditional approaches rely on human intuition and domain expertise, while purely large language model (LLM) based methods often struggle to produce hypotheses that are both innovative and reliable. To address these limitations, we propose the Monte Carlo Nash Equilibrium Self-Refine Tree (MC-NEST), a novel framework that integrates Monte Carlo Tree Search (MCTS) with Nash Equilibrium strategies to iteratively refine and validate hypotheses. MC-NEST dynamically balances exploration and exploitation through adaptive sampling strategies, which prioritize high-potential hypotheses while maintaining diversity in the search space. We demonstrate the effectiveness of MC-NEST through comprehensive experiments across multiple domains, including biomedicine, social science, and computer science. MC-NEST achieves average scores of 2.65, 2.74, and 2.80 (on a 1-3 scale) for novelty, clarity, significance, and verifiability metrics on the social science, computer science, and biomedicine datasets, respectively, outperforming state-of-the-art prompt-based methods, which achieve 2.36, 2.51, and 2.52 on the same datasets. These results underscore MC-NEST's ability to generate high-quality, empirically grounded hypotheses across diverse domains. Furthermore, MC-NEST facilitates structured human-AI collaboration, ensuring that LLMs augment human creativity rather than replace it. By addressing key challenges such as iterative refinement and the exploration-exploitation balance, MC-NEST sets a new benchmark in automated hypothesis generation. The framework provides a robust and adaptable approach that advances the boundaries of scientific discovery. Additionally, MC-NEST's ethical design enables responsible AI use, emphasizing transparency and human supervision in hypothesis generation.

Keywords: Scientific Hypothesis Generation · Monte Carlo Tree Search · Adaptive Sampling Strategies · Hypothesis Refinement.

Ongoing research

1. Deep Hypothesis and Research Question/s
2. Deep Method and implementation
3. Deep Results and Analysis
4. Scientific Reasoning Models

LLM write code

experiments > 2025-06-04_12-10-55_compositional_regularization_nn_attempt_0 > logs > 0-run > experiment_results > experiment_2a6b0f1726ed4ecc806cc51ce09fa4b5_proc_1569668 > experiment_code.py

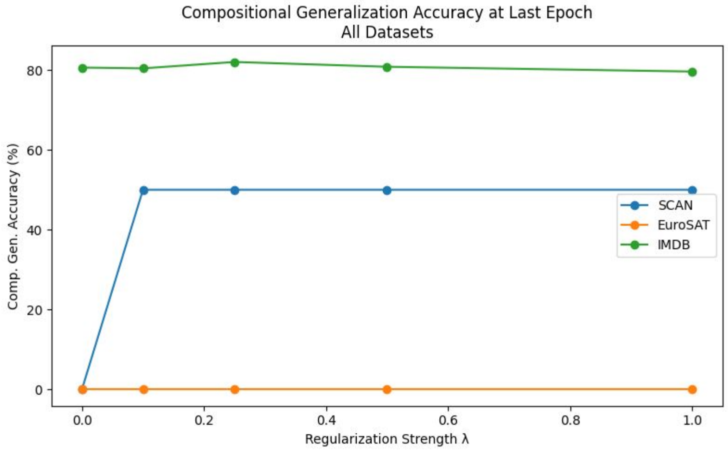
```python
# Set random seed
import random
import numpy as np
import torch

seed = 2
random.seed(seed)
np.random.seed(seed)
torch.manual_seed(seed)
if torch.cuda.is_available():
    torch.cuda.manual_seed(seed)

import os

working_dir = os.path.join(os.getcwd(), "working")
os.makedirs(working_dir, exist_ok=True)

import numpy as np
import torch
import torch.nn as nn
import torch.optim as optim
import random
from torch.utils.data import Dataset, DataLoader
import matplotlib.pyplot as plt

device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
print(f"Using device: {device}")

lambda_settings = [0.0, 0.1, 0.25, 0.5, 1.0]
experiment_data = {}

#################### SCAN-Like (Synthetic) ####################
PRIMITIVES = ["jump", "walk", "look"]
MODIFIERS = ["twice", "around_right", "opposite_left"]
ACTIONS = {"jump": "JUMP", "walk": "WALK", "look": "LOOK"}
MOD_ACTIONS = {"twice": 2, "around_right": 1, "opposite_left": 1}
random.seed(111)
all_pairs = [(p, m) for p in PRIMITIVES for m in MODIFIERS]
random.shuffle(all_pairs)
num_pairs = len(all_pairs)
num_comp_gen = max(1, int(num_pairs * 0.3))
comp_gen_pairs = all_pairs[:num_comp_gen]
train_pairs = all_pairs[num_comp_gen:]
primitive_only = [(p, None) for p in PRIMITIVES]


def build_examples(pairs):
    examples = []
    for p, m in pairs:
        if m is None:
            inp = [p]
            tgt = [ACTIONS[p]]
        else:
            inp = [p, m]
            tgt = [ACTIONS[p]] * MOD_ACTIONS[m]
        examples.append((" ".join(inp), " ".join(tgt)))
    return examples


train_data = build_examples(train_pairs) + build_examples(primitive_only)
comp_gen_data = build_examples(comp_gen_pairs)
val_data = train_data[-4:]
train_data = train_data[:-4]


def build_vocab(examples):
    vocab = set()
    for src, tgt in examples:
```

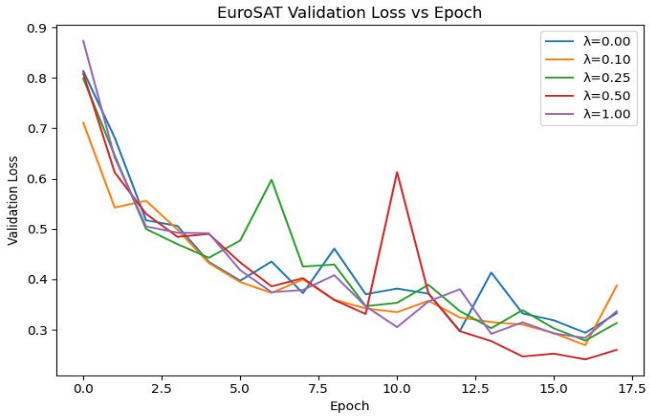
Ln 1, Col 1   Spaces: 4   UTF-8   LF   Python

Ongoing research

1. Deep Hypothesis and Research Question/s
2. Deep Method and implementation
3. Deep Results and Analysis
4. Scientific Reasoning Models

LLM write code and compiles





Ongoing research

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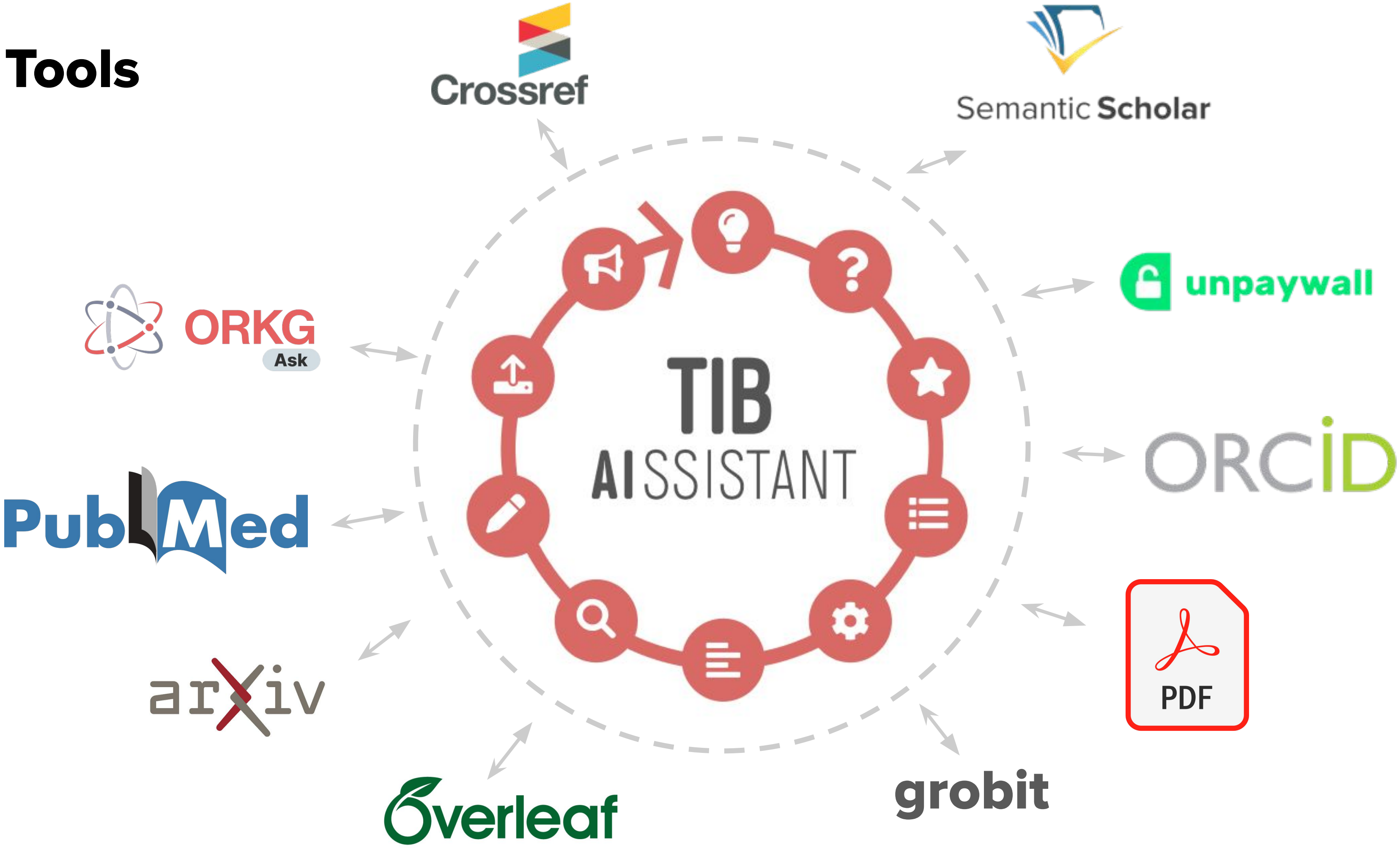
Tools



Crossref
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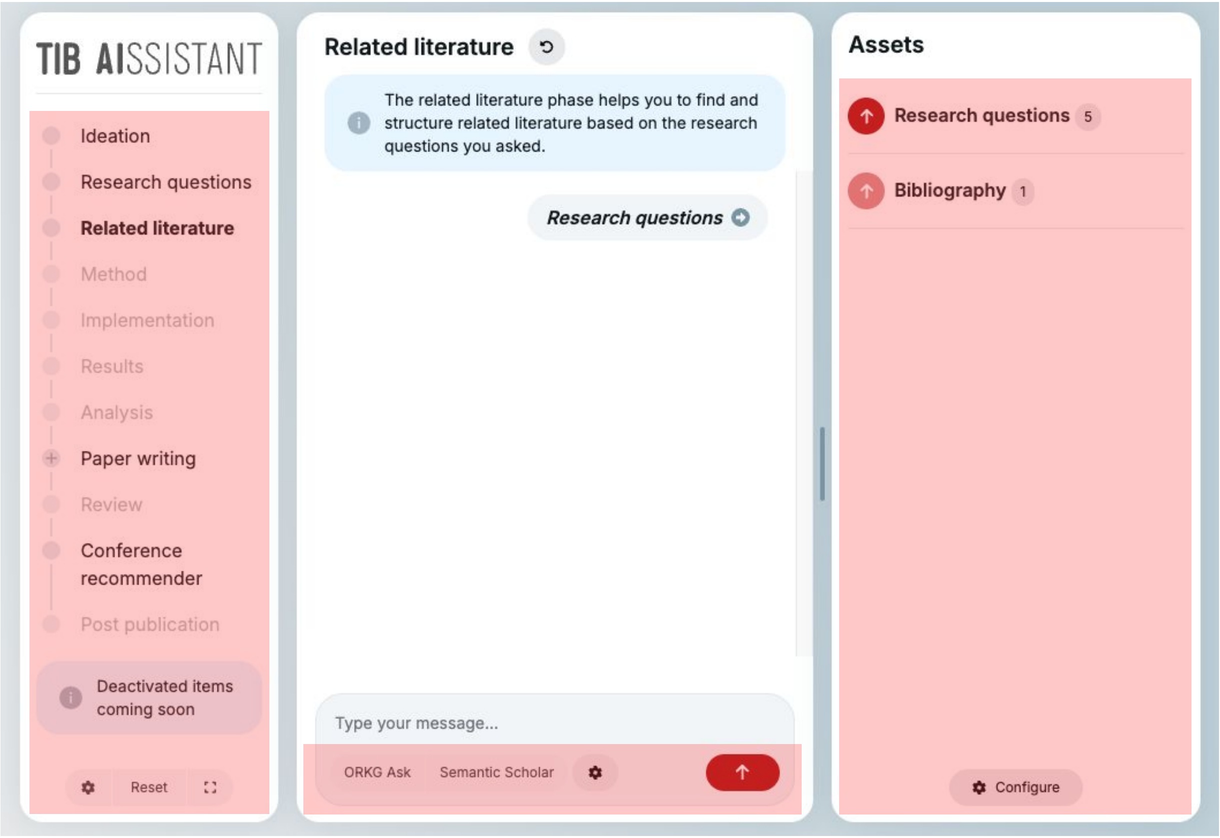
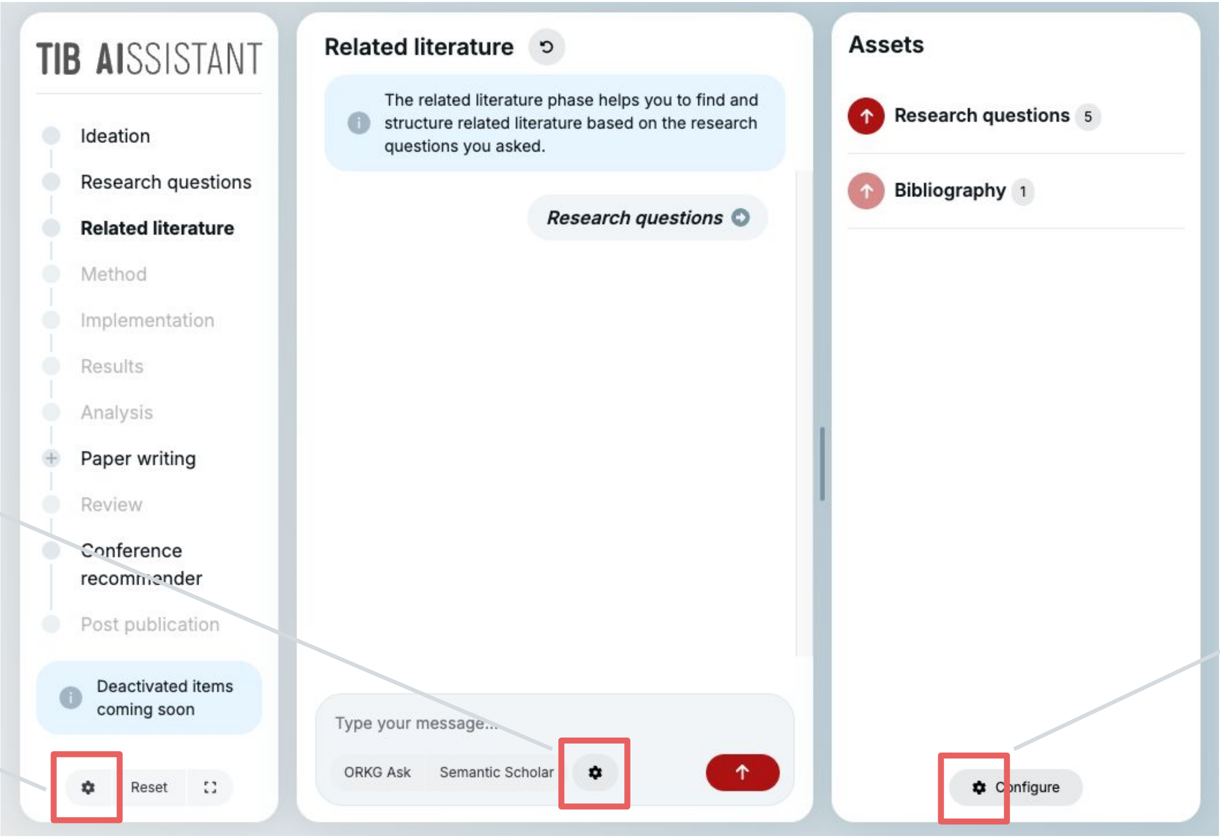
grobit

Configurability



Configurability

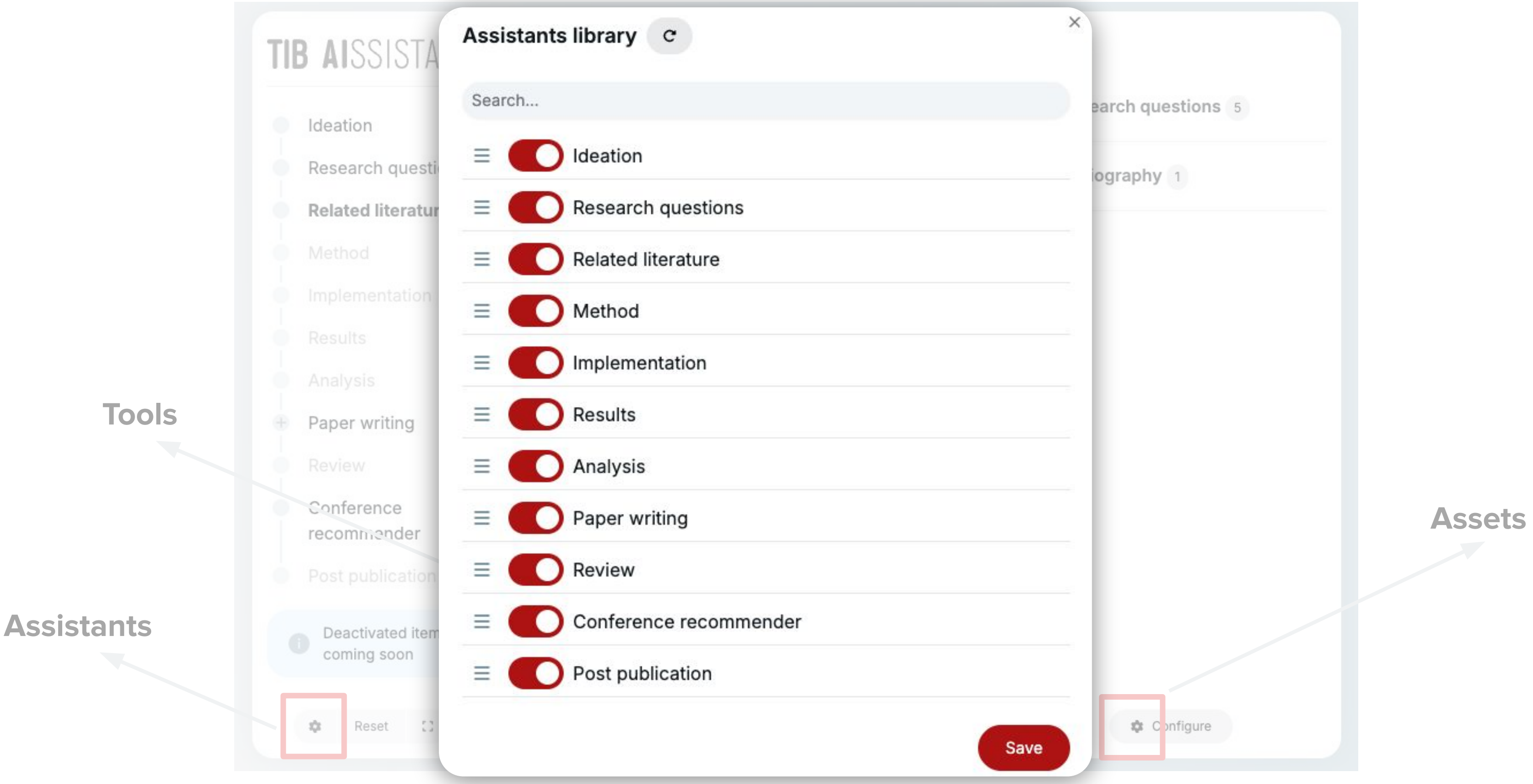


Tools

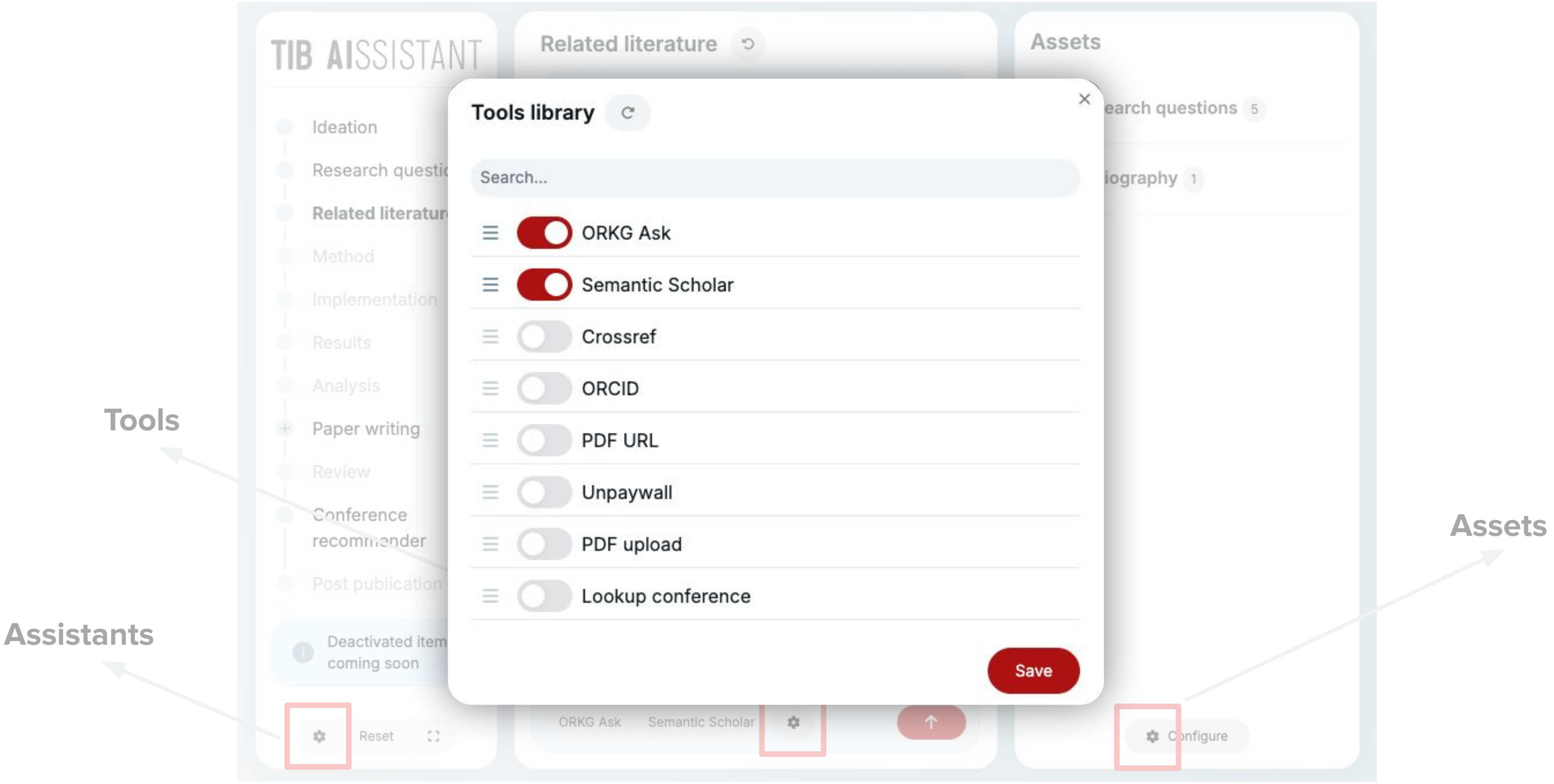
Assistants

Assets

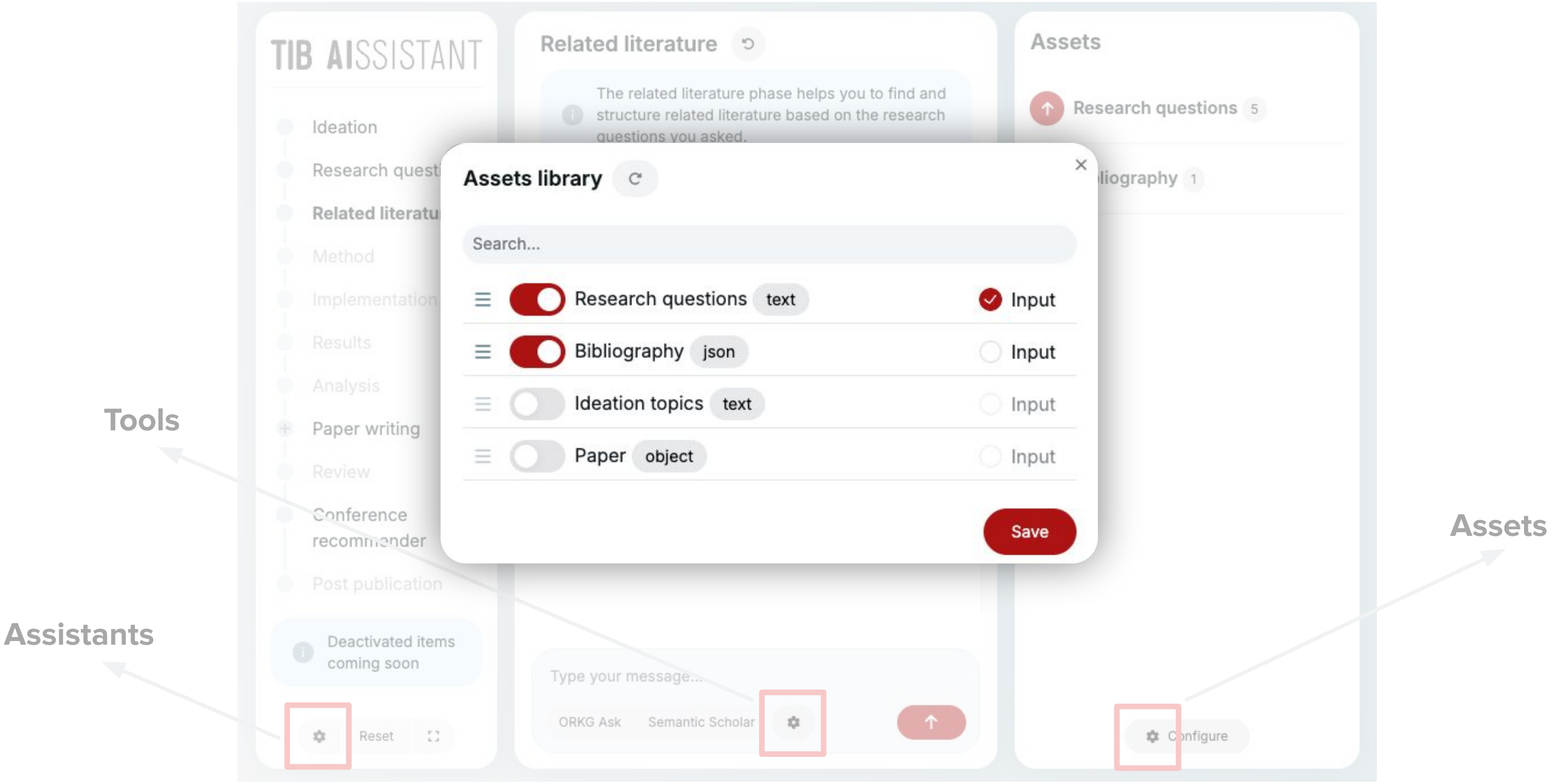
Configurability



Configurability

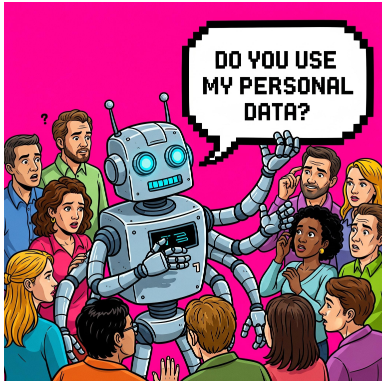


Configurability



Ethical Considerations

1. **Transparency:** Clearly disclose when and how AI contributes to scientific research to maintain trust and accountability.
2. **Peer Review Integrity**: Prevent misuse of AI to manipulate publication metrics or game the peer-review process.
3. **Ethical Oversight**: Ensure research involving AI-generated work is conducted with proper approvals and institutional cooperation.
4. **Community Standards**: Collaborate with the scientific community to develop norms and guidelines for responsible AI use in research.
5. **Avoiding Bias**: Balance transparency with fair evaluation by addressing concerns about bias in reviewing AI-assisted research.



Publications

1. Farhana Keya, Gollam Rabby, Prasenjit Mitra, Sahar Vahdati, Sören Auer, and Yaser Jaradeh. "**SCI-IDEA: Context-Aware Scientific Ideation Using Token and Sentence Embeddings.**" *arXiv preprint arXiv:2503.19257* (2025).
2. Gollam Rabby, Diyana Muhammed, Prasenjit Mitra, and Sören Auer. "**Iterative hypothesis generation for scientific discovery with monte carlo self-refining trees.**" *arXiv preprint arXiv:2503.19309* (2025).
3. Christoph Schuhmann, Gollam Rabby, Ameya Prabhu, Tawsif Ahmed, Andreas Hochlehnert, Huu Nguyen, Nick Akinci et al. "**Project alexandria: Towards freeing scientific knowledge from copyright burdens via llms.**" *arXiv preprint arXiv:2502.19413* (2025).
4. Diyana Muhammed, Gollam Rabby, and Sören Auer. "**SelfCheckAgent: Zero-Resource Hallucination Detection in Generative Large Language Models.**" *arXiv preprint arXiv:2502.01812* (2025).
5. Gollam Rabby, Farhana Keya and Sören Auer. "**MC-NEST--Enhancing Mathematical Reasoning in Large Language Models with a Monte Carlo Self-Refine Tree.**" *arXiv preprint arXiv:2411.15645* (2024).

Resources

Repository:
https://gitlab.com/TIBHannover/orkg/tib
-aissistant/web-app

Developer documentation:
https://tibhannover.gitlab.io/orkg/tib-aissis
tant/web-app/storybook/?path=/docs/intro
duction--docs

Thank you!
Any Questions?

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Meet the team:
https://orkg.org/about/9/Team

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