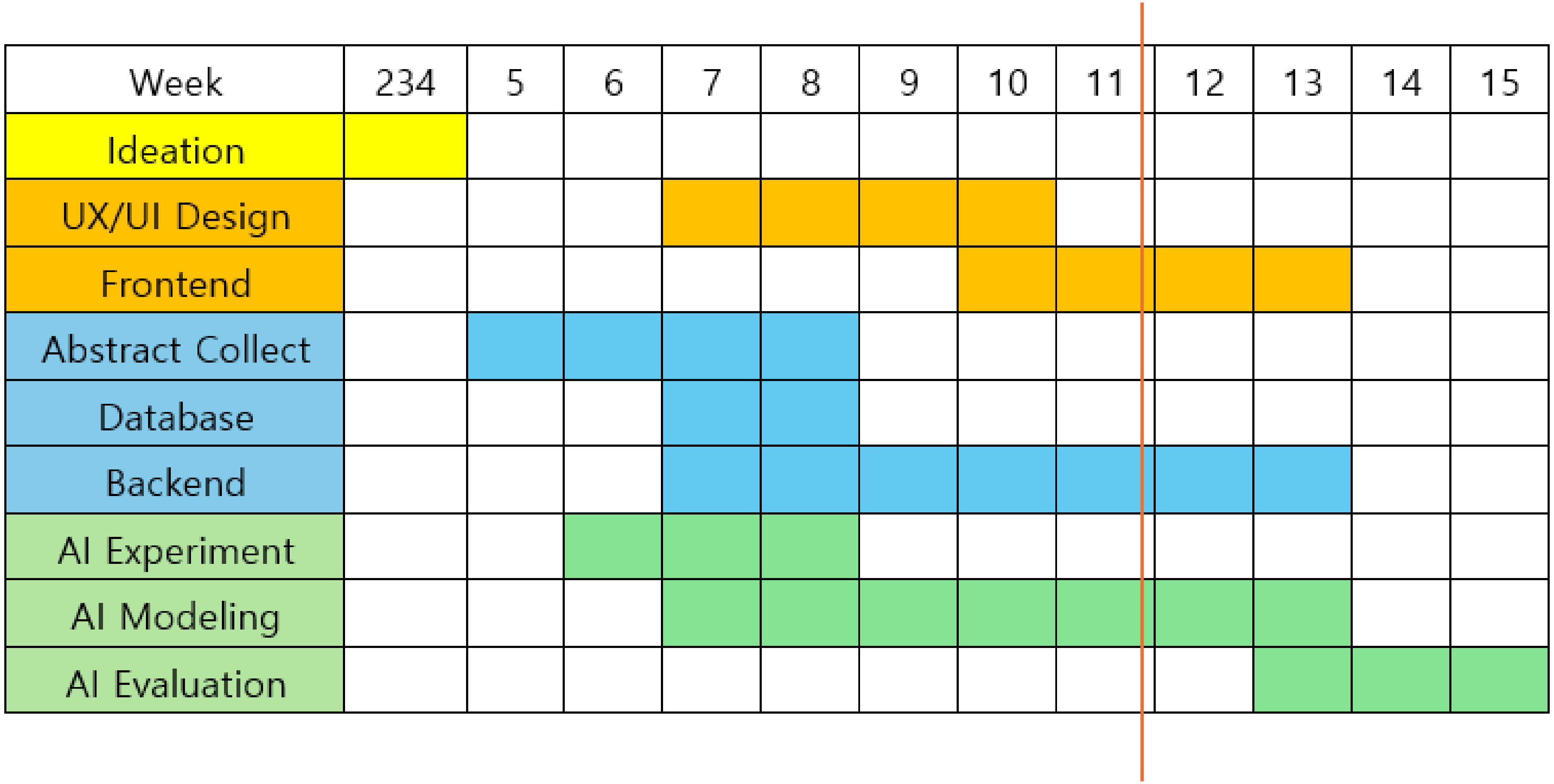
SKKU Lab Recommendation Service : FindMyLab

Team J (Last Lap) 김현진 송민석 장민석 조재희

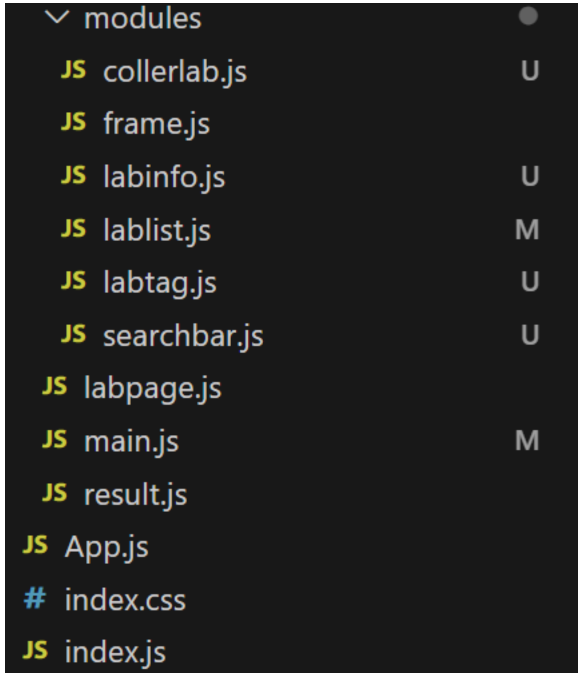
2024-Fall Capstone Design Project

1. Objectives & Milestones

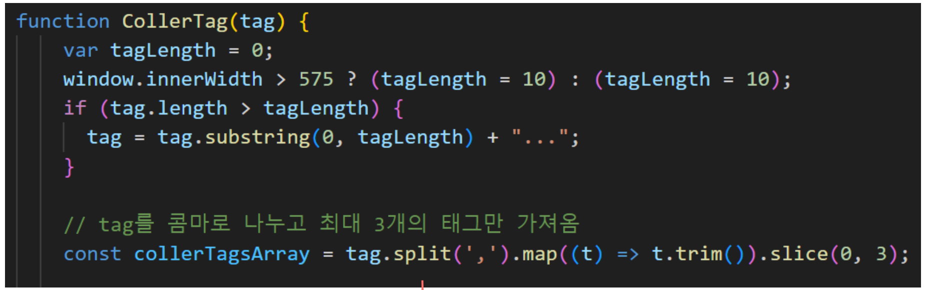


Week	234	5	6	7	8	9	10	11	12	13	14	15
Ideation	🟨											
UX/UI Design				🟧	🟧	🟧	🟧					
Frontend							🟧	🟧	🟧	🟧		
Abstract Collect		🟦	🟦	🟦	🟦							
Database				🟦	🟦							
Backend				🟦	🟦	🟦	🟦	🟦	🟦	🟦		
AI Experiment			🟩	🟩	🟩							
AI Modeling				🟩	🟩	🟩	🟩	🟩	🟩	🟩		
AI Evaluation										🟩	🟩	🟩

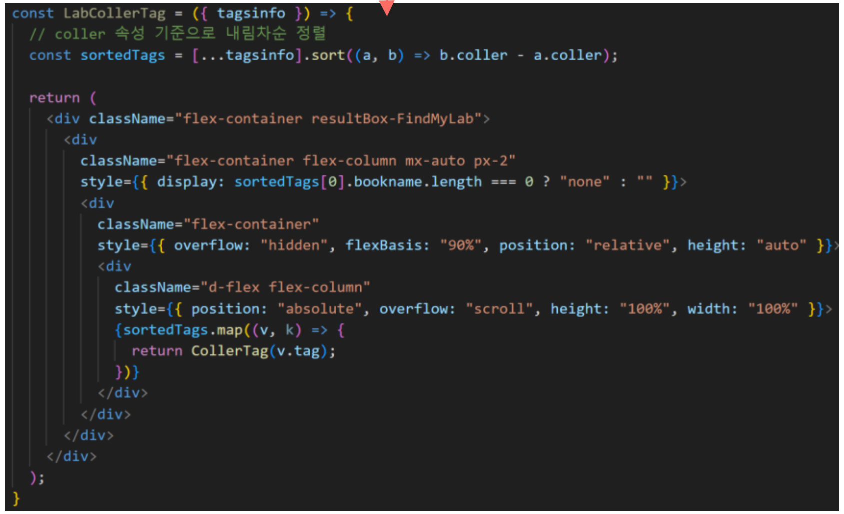
2. Frontend / Component-Based Abstraction



```
∨ modules                ●
    JS collerlab.js      U
    JS frame.js
    JS labinfo.js        U
    JS lablist.js        M
    JS labtag.js         U
    JS searchbar.js      U
  JS labpage.js
  JS main.js             M
  JS result.js
JS App.js
# index.css
JS index.js
```

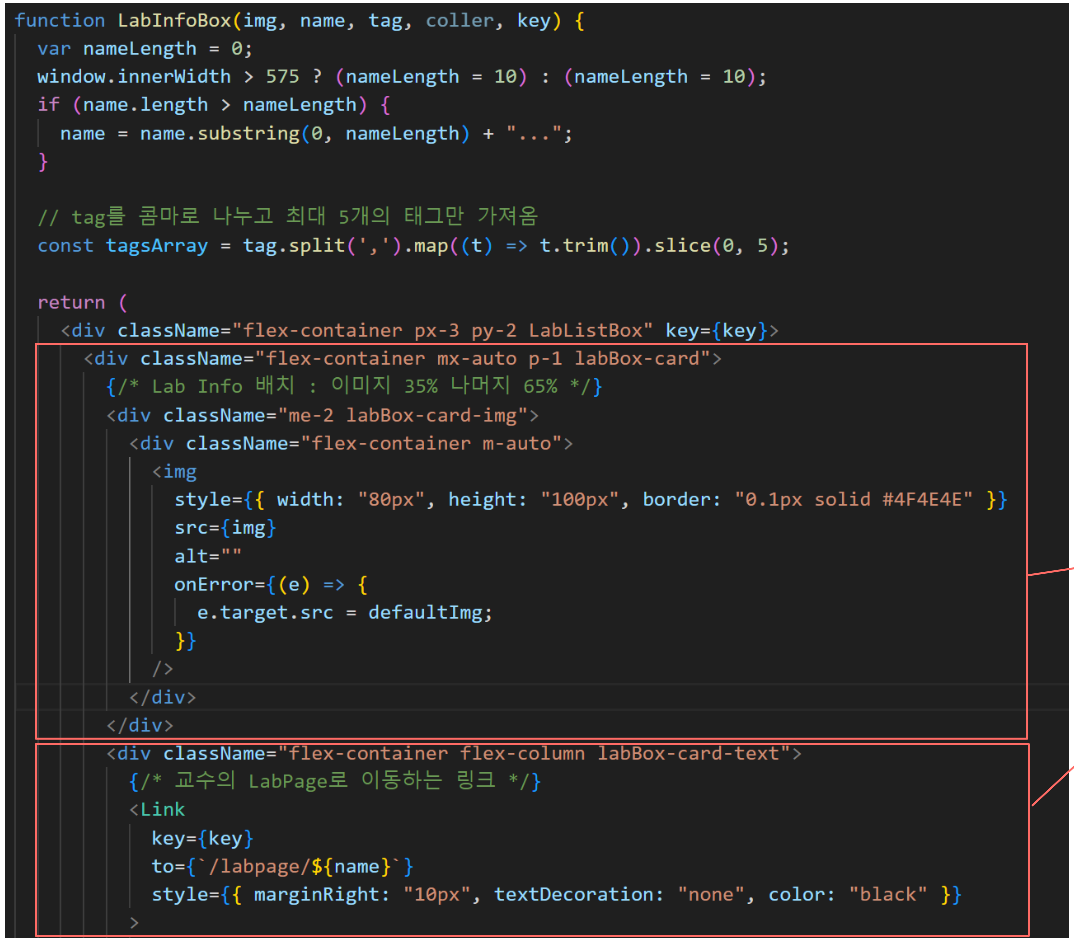


```javascript
function CollerTag(tag) {
    var tagLength = 0;
    window.innerWidth > 575 ? (tagLength = 10) : (tagLength = 10);
    if (tag.length > tagLength) {
      tag = tag.substring(0, tagLength) + "...";
    }

    // tag를 콤마로 나누고 최대 3개의 태그만 가져옴
    const collerTagsArray = tag.split(',').map((t) => t.trim()).slice(0, 3);
```

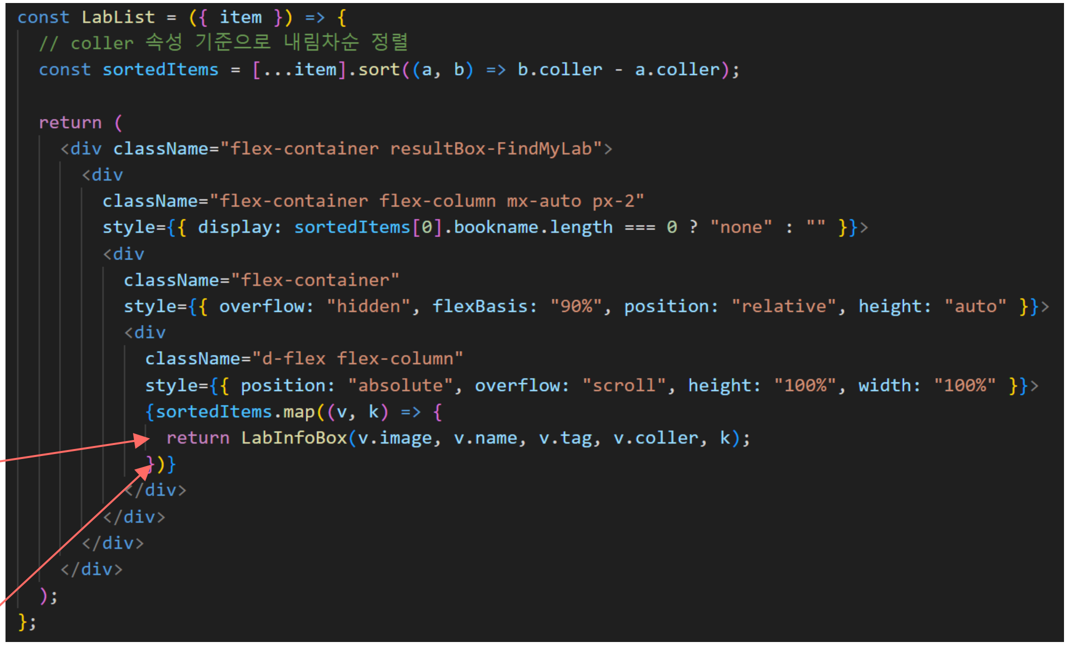


```javascript
const LabCollerTag = ({ tagsinfo }) => {
  // coller 속성 기준으로 내림차순 정렬
  const sortedTags = [...tagsinfo].sort((a, b) => b.coller - a.coller);

  return (
    <div className="flex-container resultBox-FindMyLab">
      <div
        className="flex-container flex-column mx-auto px-2"
        style={{ display: sortedTags[0].bookname.length === 0 ? "none" : "" }}>
        <div
          className="flex-container"
          style={{ overflow: "hidden", flexBasis: "90%", position: "relative", height: "auto" }}>
          <div
            className="d-flex flex-column"
            style={{ position: "absolute", overflow: "scroll", height: "100%", width: "100%" }}>
            {sortedTags.map((v, k) => {
              return CollerTag(v.tag);
            })}
          </div>
        </div>
      </div>
    </div>
  );
}
```

2. Frontend / Parameterization

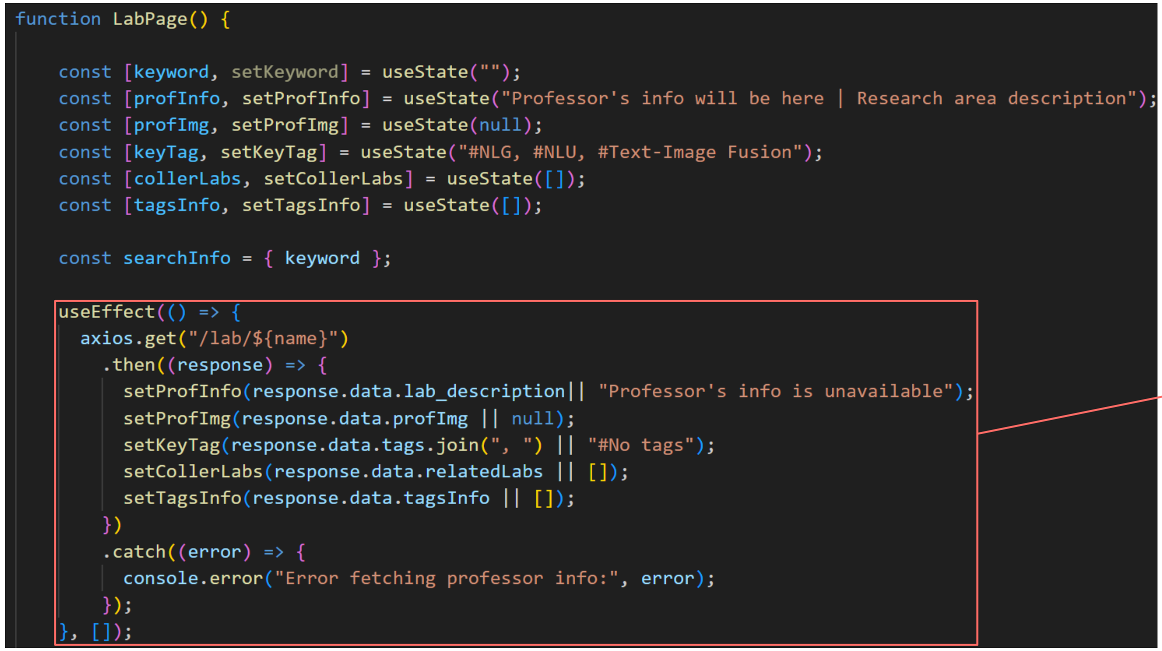


```
function LabInfoBox(img, name, tag, coller, key) {
  var nameLength = 0;
  window.innerWidth > 575 ? (nameLength = 10) : (nameLength = 10);
  if (name.length > nameLength) {
    name = name.substring(0, nameLength) + "...";
  }

  // tag를 콤마로 나누고 최대 5개의 태그만 가져옴
  const tagsArray = tag.split(',').map((t) => t.trim()).slice(0, 5);

  return (
    <div className="flex-container px-3 py-2 LabListBox" key={key}>
      <div className="flex-container mx-auto p-1 labBox-card">
        {/* Lab Info 배치 : 이미지 35% 나머지 65% */}
        <div className="me-2 labBox-card-img">
          <div className="flex-container m-auto">
            <img
              style={{ width: "80px", height: "100px", border: "0.1px solid #4F4E4E" }}
              src={img}
              alt=""
              onError={(e) => {
                e.target.src = defaultImg;
              }}
            />
          </div>
        </div>
        <div className="flex-container flex-column labBox-card-text">
          {/* 교수의 LabPage로 이동하는 링크 */}
          <Link
            key={key}
            to={`/labpage/${name}`}
            style={{ marginRight: "10px", textDecoration: "none", color: "black" }}
          >
```

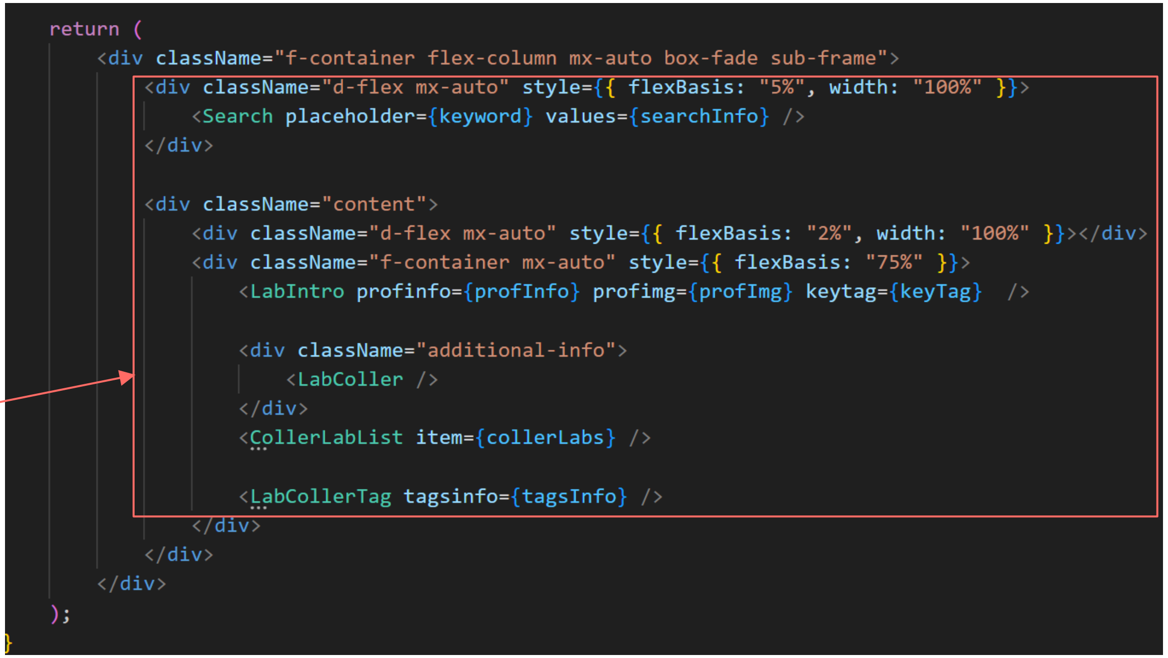


```
const LabList = ({ item }) => {
  // coller 속성 기준으로 내림차순 정렬
  const sortedItems = [...item].sort((a, b) => b.coller - a.coller);

  return (
    <div className="flex-container resultBox-FindMyLab">
      <div
        className="flex-container flex-column mx-auto px-2"
        style={{ display: sortedItems[0].bookname.length === 0 ? "none" : "" }}>
        <div
          className="flex-container"
          style={{ overflow: "hidden", flexBasis: "90%", position: "relative", height: "auto" }}>
          <div
            className="d-flex flex-column"
            style={{ position: "absolute", overflow: "scroll", height: "100%", width: "100%" }}>
            {sortedItems.map((v, k) => {
              return LabInfoBox(v.image, v.name, v.tag, v.coller, k);
            })}
          </div>
        </div>
      </div>
    </div>
  );
};
```

2. Frontend / State-Driven UI

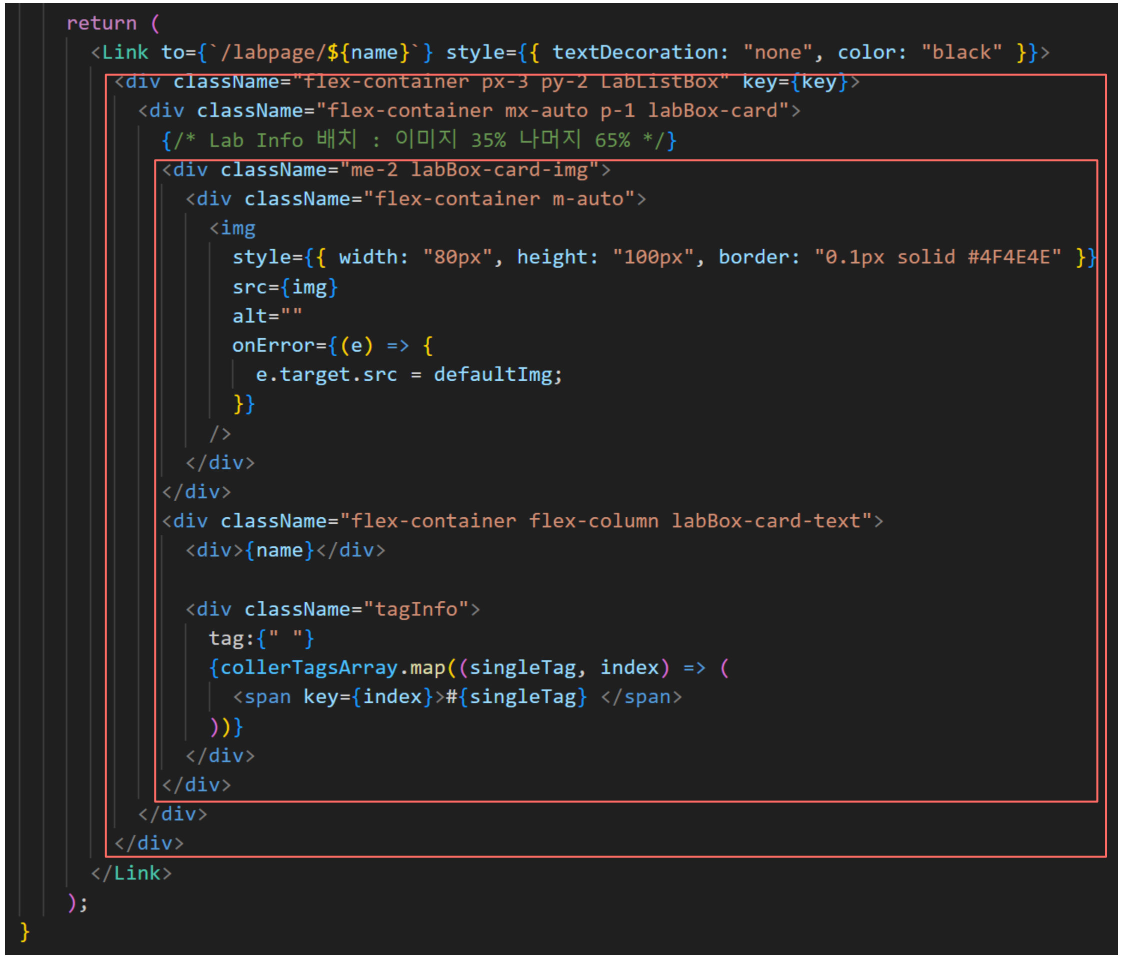


```
function LabPage() {

    const [keyword, setKeyword] = useState("");
    const [profInfo, setProfInfo] = useState("Professor's info will be here | Research area description");
    const [profImg, setProfImg] = useState(null);
    const [keyTag, setKeyTag] = useState("#NLG, #NLU, #Text-Image Fusion");
    const [collerLabs, setCollerLabs] = useState([]);
    const [tagsInfo, setTagsInfo] = useState([]);

    const searchInfo = { keyword };

    useEffect(() => {
      axios.get("/lab/${name}")
        .then((response) => {
          setProfInfo(response.data.lab_description|| "Professor's info is unavailable");
          setProfImg(response.data.profImg || null);
          setKeyTag(response.data.tags.join(", ") || "#No tags");
          setCollerLabs(response.data.relatedLabs || []);
          setTagsInfo(response.data.tagsInfo || []);
        })
        .catch((error) => {
          console.error("Error fetching professor info:", error);
        });
    }, []);
```



```
    return (
        <div className="f-container flex-column mx-auto box-fade sub-frame">
            <div className="d-flex mx-auto" style={{ flexBasis: "5%", width: "100%" }}>
                <Search placeholder={keyword} values={searchInfo} />
            </div>

            <div className="content">
                <div className="d-flex mx-auto" style={{ flexBasis: "2%", width: "100%" }}></div>
                <div className="f-container mx-auto" style={{ flexBasis: "75%" }}>
                    <LabIntro profinfo={profInfo} profimg={profImg} keytag={keyTag}  />

                    <div className="additional-info">
                        <LabColler />
                    </div>
                    <CollerLabList item={collerLabs} />

                    <LabCollerTag tagsinfo={tagsInfo} />
                </div>
            </div>
        </div>
    );
}
```

2. Frontend / Hierarchical Structure

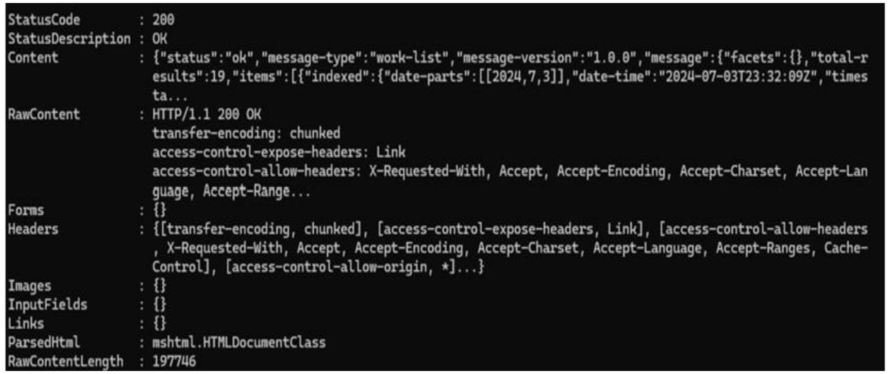


```
    return (
      <Link to={`/labpage/${name}`} style={{ textDecoration: "none", color: "black" }}>
        <div className="flex-container px-3 py-2 LabListBox" key={key}>
          <div className="flex-container mx-auto p-1 labBox-card">
            {/* Lab Info 배치 : 이미지 35% 나머지 65% */}
            <div className="me-2 labBox-card-img">
              <div className="flex-container m-auto">
                <img
                  style={{ width: "80px", height: "100px", border: "0.1px solid #4F4E4E" }}
                  src={img}
                  alt=""
                  onError={(e) => {
                    e.target.src = defaultImg;
                  }}
                />
              </div>
            </div>
            <div className="flex-container flex-column labBox-card-text">
              <div>{name}</div>

              <div className="tagInfo">
                tag:{" "}
                {collerTagsArray.map((singleTag, index) => (
                  <span key={index}>#{singleTag} </span>
                ))}
              </div>
            </div>
          </div>
        </div>
      </Link>
    );
}
```

3. Backend / Abstract Extract - previous algorithm

ORCID

Connecting Research
and Researchers

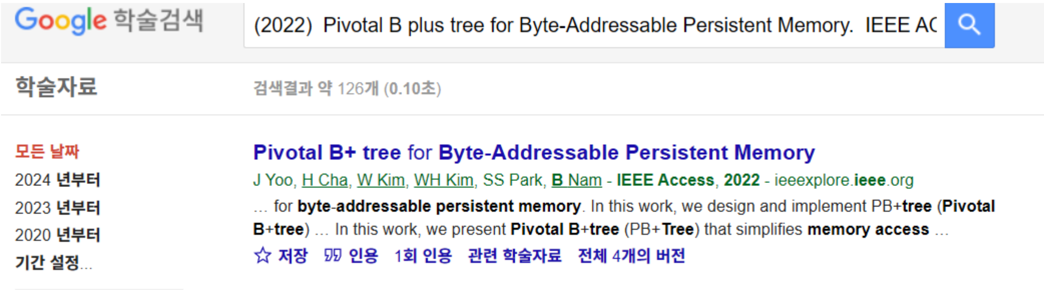


```
StatusCode        : 200
StatusDescription : OK
Content           : {"status":"ok","message-type":"work-list","message-version":"1.0.0","message":{"facets":{},"total-r
                    esults":19,"items":[{"indexed":{"date-parts":[[2024,7,3]],"date-time":"2024-07-03T23:32:09Z","times
                    ta...
RawContent        : HTTP/1.1 200 OK
                    transfer-encoding: chunked
                    access-control-expose-headers: Link
                    access-control-allow-headers: X-Requested-With, Accept, Accept-Encoding, Accept-Charset, Accept-Lan
                    guage, Accept-Range...
Forms             : {}
Headers           : {[transfer-encoding, chunked], [access-control-expose-headers, Link], [access-control-allow-headers
                    , X-Requested-With, Accept, Accept-Encoding, Accept-Charset, Accept-Language, Accept-Ranges, Cache-
                    Control], [access-control-allow-origin, *]...}
Images            : {}
InputFields       : {}
Links             : {}
ParsedHtml        : mshtml.HTMLDocumentClass
RawContentLength  : 197746
```

[Crossref API]

학술지 논문

- (2022) Pivotal B plus tree for Byte-Addressable Persistent Memory. IEEE ACCESS. 10, -
- (2021) Failure-Atomic Byte-Addressable R-tree for Persistent Memory. IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS. 32, 3
- (2021) Failure-Atomic Byte-Addressable R-tree for Persistent Memory. IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS. 32, 3
- (2020) B-3-Tree: Byte-Addressable Binary B-Tree for Persistent Memory. ACM TRANSACTIONS ON STORAGE. 16, 3



(2022) Pivotal B plus tree for Byte-Addressable Persistent Memory. IEEE AC

학술자료

검색결과 약 126개 (0.10초)

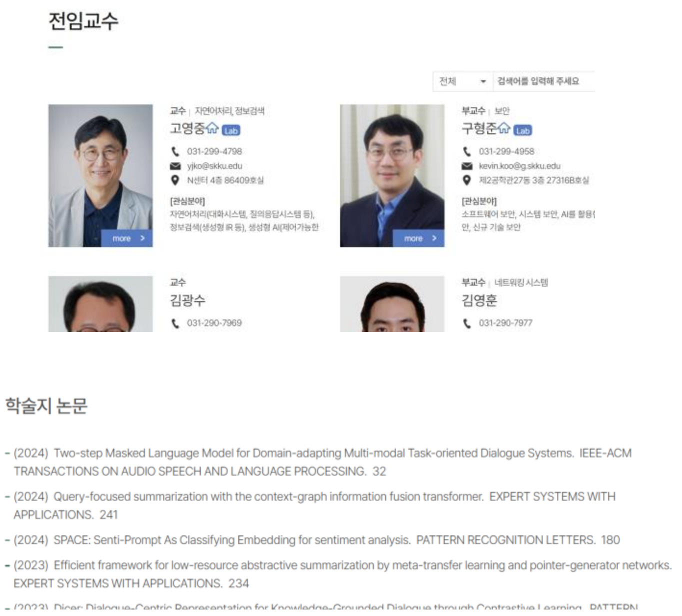
모든 날짜
2024 년부터
2023 년부터
2020 년부터
기간 설정...

Pivotal B+ tree for Byte-Addressable Persistent Memory

J Yoo, H Cha, W Kim, WH Kim, SS Park, B Nam - **IEEE Access**, **2022** - ieeexplore.**ieee**.org

... for **byte-addressable persistent memory**. In this work, we design and implement PB+**tree** (**Pivotal B**+**tree**) ... In this work, we present **Pivotal B**+**tree** (PB+**Tree**) that simplifies **memory access** ...

3. Backend / Abstract Extract - SKKU Web Crawling



전임교수

전체 ▾ | 검색어를 입력해 주세요

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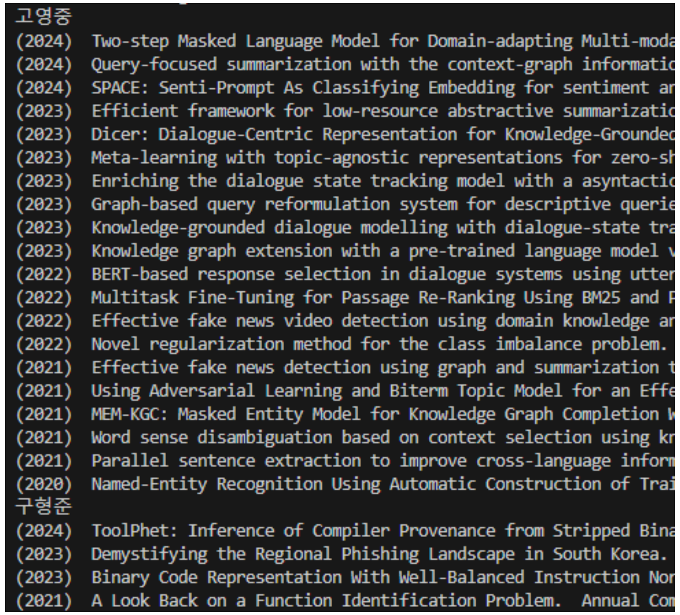
학술지 논문

- (2024) Two-step Masked Language Model for Domain-adapting Multi-modal Task-oriented Dialogue Systems. IEEE-ACM TRANSACTIONS ON AUDIO SPEECH AND LANGUAGE PROCESSING. 32
- (2024) Query-focused summarization with the context-graph information fusion transformer. EXPERT SYSTEMS WITH APPLICATIONS. 241
- (2024) SPACE: Senti-Prompt As Classifying Embedding for sentiment analysis. PATTERN RECOGNITION LETTERS. 180
- (2023) Efficient framework for low-resource abstractive summarization by meta-transfer learning and pointer-generator networks. EXPERT SYSTEMS WITH APPLICATIONS. 234
- (2023) Dicer: Dialogue-Centric Representation for Knowledge-Grounded Dialogue through Contrastive Learning. PATTERN

[SKKU Computer Science Web Site]

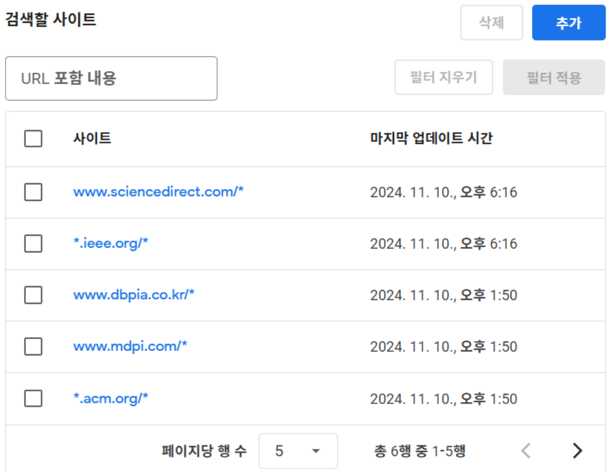


```
고영중
(2024)  Two-step Masked Language Model for Domain-adapting Multi-moda
(2024)  Query-focused summarization with the context-graph informatio
(2024)  SPACE: Senti-Prompt As Classifying Embedding for sentiment ar
(2023)  Efficient framework for low-resource abstractive summarizatio
(2023)  Dicer: Dialogue-Centric Representation for Knowledge-Grounded
(2023)  Meta-learning with topic-agnostic representations for zero-sh
(2023)  Enriching the dialogue state tracking model with a asyntactic
(2023)  Graph-based query reformulation system for descriptive querie
(2023)  Knowledge-grounded dialogue modelling with dialogue-state tra
(2023)  Knowledge graph extension with a pre-trained language model v
(2022)  BERT-based response selection in dialogue systems using utter
(2022)  Multitask Fine-Tuning for Passage Re-Ranking Using BM25 and P
(2022)  Effective fake news video detection using domain knowledge ar
(2022)  Novel regularization method for the class imbalance problem.
(2021)  Effective fake news detection using graph and summarization t
(2021)  Using Adversarial Learning and Biterm Topic Model for an Effe
(2021)  MEM-KGC: Masked Entity Model for Knowledge Graph Completion W
(2021)  Word sense disambiguation based on context selection using kn
(2021)  Parallel sentence extraction to improve cross-language inform
(2020)  Named-Entity Recognition Using Automatic Construction of Trai
구형준
(2024)  ToolPhet: Inference of Compiler Provenance from Stripped Bina
(2023)  Demystifying the Regional Phishing Landscape in South Korea.
(2023)  Binary Code Representation With Well-Balanced Instruction Nor
(2021)  A Look Back on a Function Identification Problem.  Annual Com
```

[Crawling Data]

3. Backend / Abstract Extract - Custom Search API

Custom Search API

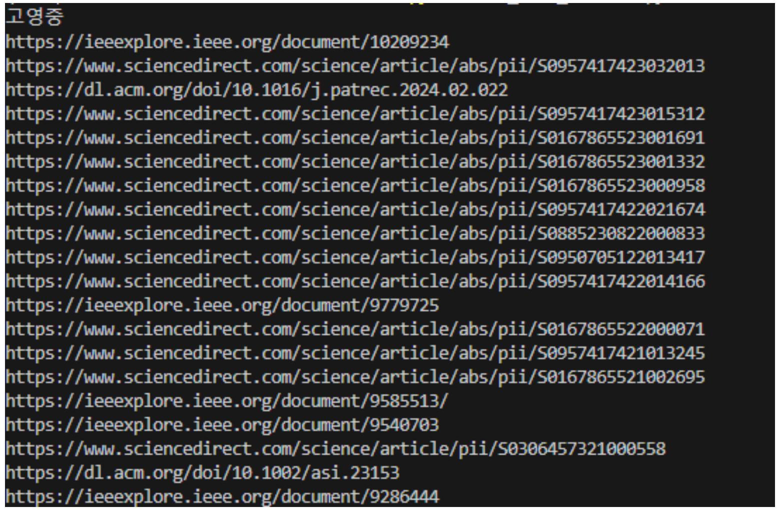


검색할 사이트

☐	사이트	마지막 업데이트 시간
☐	www.sciencedirect.com/*	2024. 11. 10., 오후 6:16
☐	*.ieee.org/*	2024. 11. 10., 오후 6:16
☐	www.dbpia.co.kr/*	2024. 11. 10., 오후 1:50
☐	www.mdpi.com/*	2024. 11. 10., 오후 1:50
☐	*.acm.org/*	2024. 11. 10., 오후 1:50

페이지당 행 수 5 총 6행 중 1-5행

[Custom Search Engine]



```
고영중
https://ieeexplore.ieee.org/document/10209234
https://www.sciencedirect.com/science/article/abs/pii/S0957417423032013
https://dl.acm.org/doi/10.1016/j.patrec.2024.02.022
https://www.sciencedirect.com/science/article/abs/pii/S0957417423015312
https://www.sciencedirect.com/science/article/abs/pii/S0167865523001691
https://www.sciencedirect.com/science/article/abs/pii/S0167865523001332
https://www.sciencedirect.com/science/article/abs/pii/S0167865523000958
https://www.sciencedirect.com/science/article/abs/pii/S0957417422021674
https://www.sciencedirect.com/science/article/abs/pii/S0885230822000833
https://www.sciencedirect.com/science/article/abs/pii/S0950705122013417
https://www.sciencedirect.com/science/article/abs/pii/S0957417422014166
https://ieeexplore.ieee.org/document/9779725
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https://www.sciencedirect.com/science/article/abs/pii/S0167865521002695
https://ieeexplore.ieee.org/document/9585513/
https://ieeexplore.ieee.org/document/9540703
https://www.sciencedirect.com/science/article/pii/S0306457321000558
https://dl.acm.org/doi/10.1002/asi.23153
https://ieeexplore.ieee.org/document/9286444
```
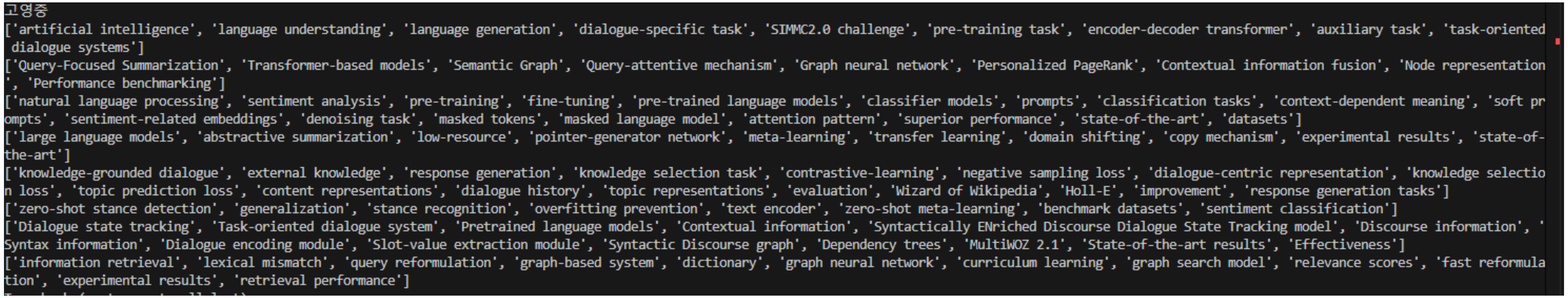

[URI Data]

3. Backend - Abstract Extract - GPT prompting

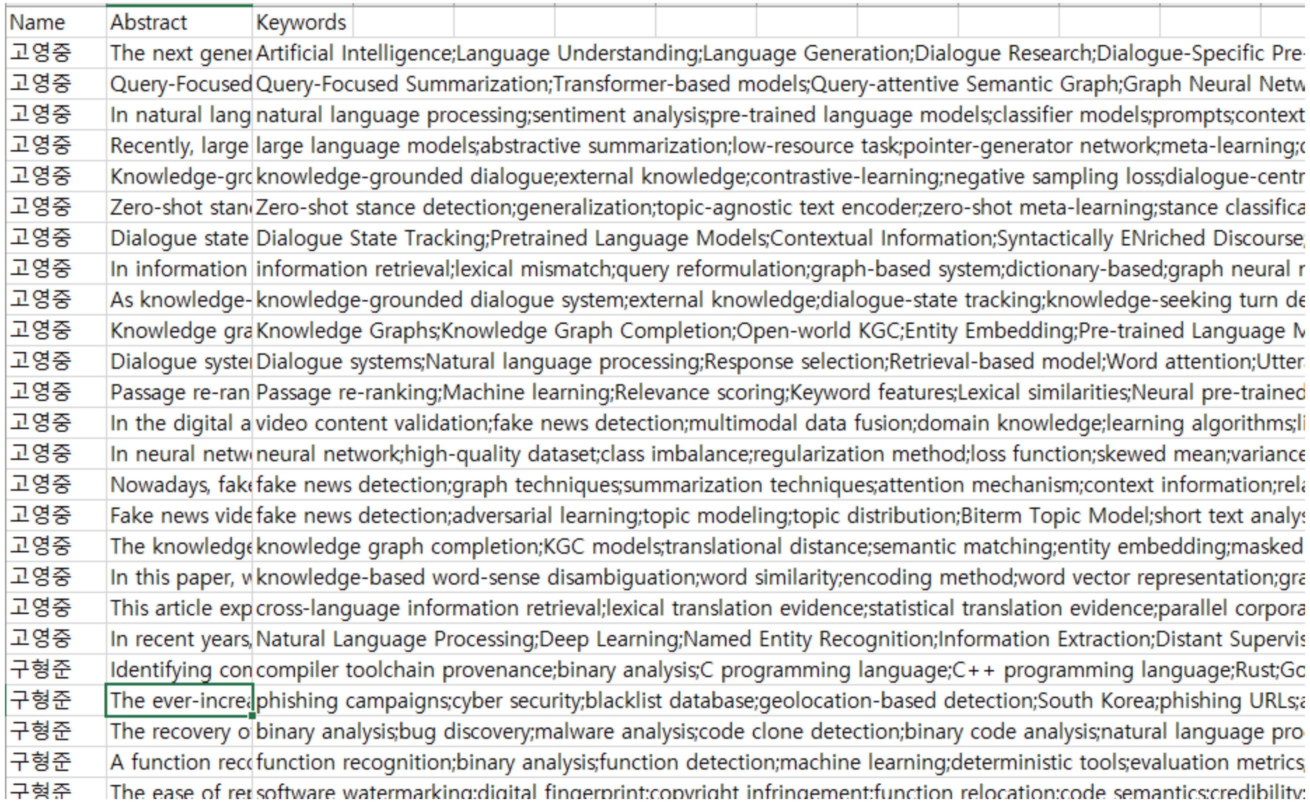
Prompt

Read the abstract of the provided research paper and return the {field} core technology and classification in a list format. Provide only concise keywords or phrases for each response item without full sentences.Read the abstract of the provided research paper and return the core technology and classification as a single, combined list of keywords in array format, without any headings or categorization



```
고영중
['artificial intelligence', 'language understanding', 'language generation', 'dialogue-specific task', 'SIMMC2.0 challenge', 'pre-training task', 'encoder-decoder transformer', 'auxiliary task', 'task-oriented
 dialogue systems']
['Query-Focused Summarization', 'Transformer-based models', 'Semantic Graph', 'Query-attentive mechanism', 'Graph neural network', 'Personalized PageRank', 'Contextual information fusion', 'Node representation
', 'Performance benchmarking']
['natural language processing', 'sentiment analysis', 'pre-training', 'fine-tuning', 'pre-trained language models', 'classifier models', 'prompts', 'classification tasks', 'context-dependent meaning', 'soft pr
ompts', 'sentiment-related embeddings', 'denoising task', 'masked tokens', 'masked language model', 'attention pattern', 'superior performance', 'state-of-the-art', 'datasets']
['large language models', 'abstractive summarization', 'low-resource', 'pointer-generator network', 'meta-learning', 'transfer learning', 'domain shifting', 'copy mechanism', 'experimental results', 'state-of-
the-art']
['knowledge-grounded dialogue', 'external knowledge', 'response generation', 'knowledge selection task', 'contrastive-learning', 'negative sampling loss', 'dialogue-centric representation', 'knowledge selectio
n loss', 'topic prediction loss', 'content representations', 'dialogue history', 'topic representations', 'evaluation', 'Wizard of Wikipedia', 'Holl-E', 'improvement', 'response generation tasks']
['zero-shot stance detection', 'generalization', 'stance recognition', 'overfitting prevention', 'text encoder', 'zero-shot meta-learning', 'benchmark datasets', 'sentiment classification']
['Dialogue state tracking', 'Task-oriented dialogue system', 'Pretrained language models', 'Contextual information', 'Syntactically ENriched Discourse Dialogue State Tracking model', 'Discourse information', '
Syntax information', 'Dialogue encoding module', 'Slot-value extraction module', 'Syntactic Discourse graph', 'Dependency trees', 'MultiWOZ 2.1', 'State-of-the-art results', 'Effectiveness']
['information retrieval', 'lexical mismatch', 'query reformulation', 'graph-based system', 'dictionary', 'graph neural network', 'curriculum learning', 'graph search model', 'relevance scores', 'fast reformula
tion', 'experimental results', 'retrieval performance']
```

3. Backend - Abstract Extract - GPT prompting

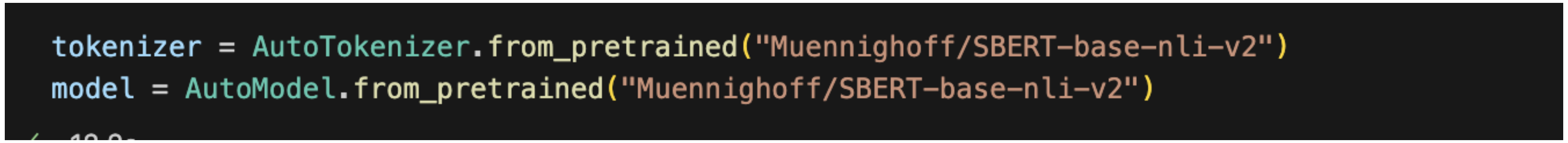


Name	Abstract	Keywords
고영중	The next gener	Artificial Intelligence;Language Understanding;Language Generation;Dialogue Research;Dialogue-Specific Pre-
고영중	Query-Focused	Query-Focused Summarization;Transformer-based models;Query-attentive Semantic Graph;Graph Neural Netw
고영중	In natural lang	natural language processing;sentiment analysis;pre-trained language models;classifier models;prompts;context
고영중	Recently, large	large language models;abstractive summarization;low-resource task;pointer-generator network;meta-learning;c
고영중	Knowledge-grc	knowledge-grounded dialogue;external knowledge;contrastive-learning;negative sampling loss;dialogue-centr
고영중	Zero-shot stan	Zero-shot stance detection;generalization;topic-agnostic text encoder;zero-shot meta-learning;stance classifica
고영중	Dialogue state	Dialogue State Tracking;Pretrained Language Models;Contextual Information;Syntactically ENriched Discourse;
고영중	In information	information retrieval;lexical mismatch;query reformulation;graph-based system;dictionary-based;graph neural r
고영중	As knowledge-	knowledge-grounded dialogue system;external knowledge;dialogue-state tracking;knowledge-seeking turn de
고영중	Knowledge gra	Knowledge Graphs;Knowledge Graph Completion;Open-world KGC;Entity Embedding;Pre-trained Language M
고영중	Dialogue syste	Dialogue systems;Natural language processing;Response selection;Retrieval-based model;Word attention;Utter
고영중	Passage re-ran	Passage re-ranking;Machine learning;Relevance scoring;Keyword features;Lexical similarities;Neural pre-trained
고영중	In the digital a	video content validation;fake news detection;multimodal data fusion;domain knowledge;learning algorithms;li
고영중	In neural netw	neural network;high-quality dataset;class imbalance;regularization method;loss function;skewed mean;variance
고영중	Nowadays, fak	fake news detection;graph techniques;summarization techniques;attention mechanism;context information;rela
고영중	Fake news vide	fake news detection;adversarial learning;topic modeling;topic distribution;Biterm Topic Model;short text analys
고영중	The knowledge	knowledge graph completion;KGC models;translational distance;semantic matching;entity embedding;masked
고영중	In this paper, w	knowledge-based word-sense disambiguation;word similarity;encoding method;word vector representation;gra
고영중	This article exp	cross-language information retrieval;lexical translation evidence;statistical translation evidence;parallel corpora
고영중	In recent years,	Natural Language Processing;Deep Learning;Named Entity Recognition;Information Extraction;Distant Supervis
구형준	Identifying con	compiler toolchain provenance;binary analysis;C programming language;C++ programming language;Rust;Go
구형준	The ever-increa	phishing campaigns;cyber security;blacklist database;geolocation-based detection;South Korea;phishing URLs;a
구형준	The recovery o	binary analysis;bug discovery;malware analysis;code clone detection;binary code analysis;natural language pro
구형준	A function reco	function recognition;binary analysis;function detection;machine learning;deterministic tools;evaluation metrics;
구형준	The ease of rei	software watermarking;digital fingerprint;copyright infringement;function relocation;code semantics;credibility;

4. AI / Search Algorithm

Model

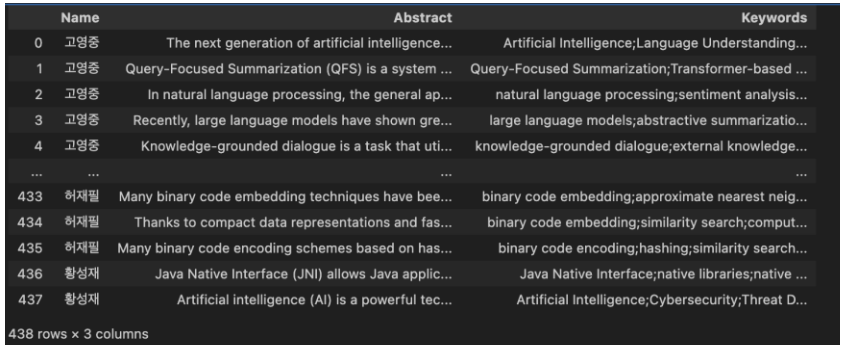
SBERT - nil pretrained model



```
tokenizer = AutoTokenizer.from_pretrained("Muennighoff/SBERT-base-nli-v2")
model = AutoModel.from_pretrained("Muennighoff/SBERT-base-nli-v2")
```

Data

NAME	Abstract	Keywords
고영중	The next generation..	Artificial intelligence, Language ..
고영중	Query-Focused Summarization is a system…	Transformer-based..
..		
…		
황성재	Java Native Interface allows Java…	Native libraries, Java Native interface



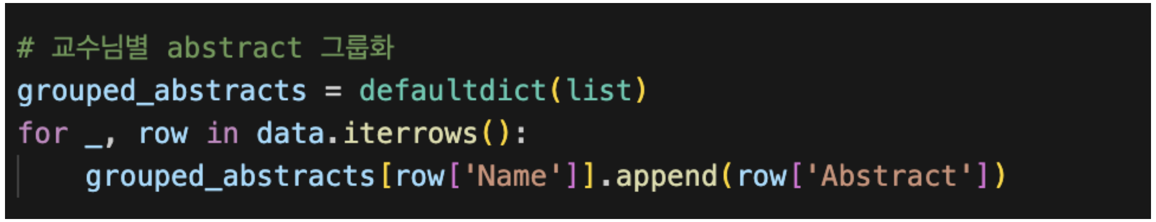
	Name	Abstract	Keywords
0	고영중	The next generation of artificial intelligence...	Artificial Intelligence;Language Understanding...
1	고영중	Query-Focused Summarization (QFS) is a system ...	Query-Focused Summarization;Transformer-based ...
2	고영중	In natural language processing, the general ap...	natural language processing;sentiment analysis...
3	고영중	Recently, large language models have shown gre...	large language models;abstractive summarizatio...
4	고영중	Knowledge-grounded dialogue is a task that uti...	knowledge-grounded dialogue;external knowledge...
...	...	...	...
433	허재필	Many binary code embedding techniques have bee...	binary code embedding;approximate nearest neig...
434	허재필	Thanks to compact data representations and fas...	binary code embedding;similarity search;comput...
435	허재필	Many binary code encoding schemes based on has...	binary code encoding;hashing;similarity search...
436	황성재	Java Native Interface (JNI) allows Java applic...	Java Native Interface;native libraries;native ...
437	황성재	Artificial intelligence (AI) is a powerful tec...	Artificial Intelligence;Cybersecurity;Threat D...

438 rows × 3 columns

4. AI / Search Algorithm

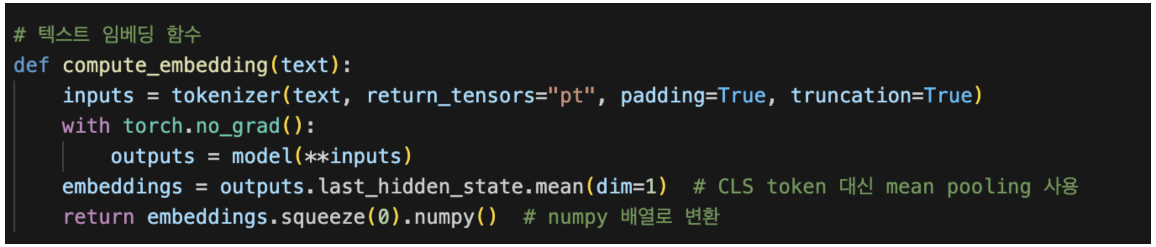
Prof’s feature

1) grouping abstract → Organized by professor



```
# 교수님별 abstract 그룹화
grouped_abstracts = defaultdict(list)
for _, row in data.iterrows():
    grouped_abstracts[row['Name']].append(row['Abstract'])
```

2) mean pooling

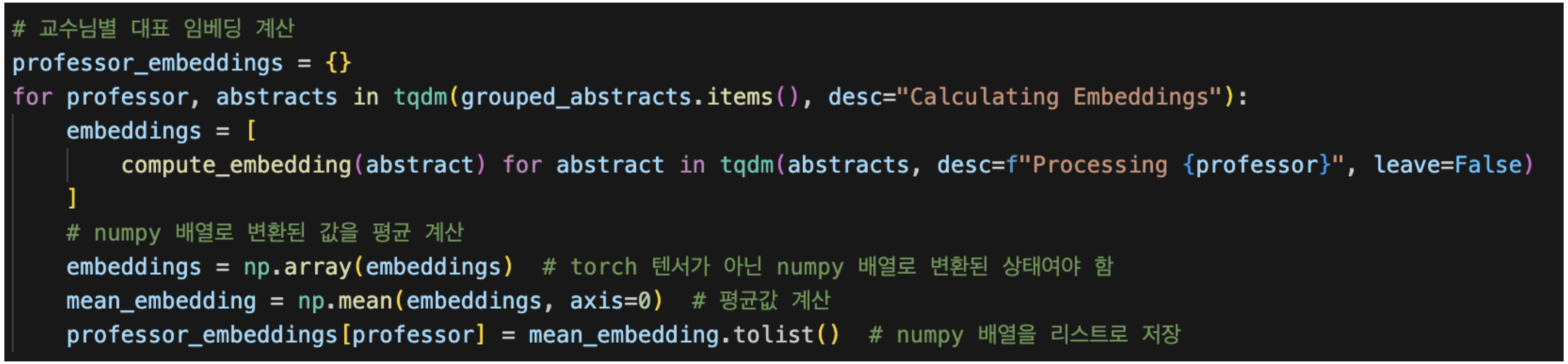


```
# 텍스트 임베딩 함수
def compute_embedding(text):
    inputs = tokenizer(text, return_tensors="pt", padding=True, truncation=True)
    with torch.no_grad():
        outputs = model(**inputs)
    embeddings = outputs.last_hidden_state.mean(dim=1)  # CLS token 대신 mean pooling 사용
    return embeddings.squeeze(0).numpy()  # numpy 배열로 변환
```

4. AI / Search Algorithm

Prof’s feature

3) call the function : Calculating representative embeddings for each professor



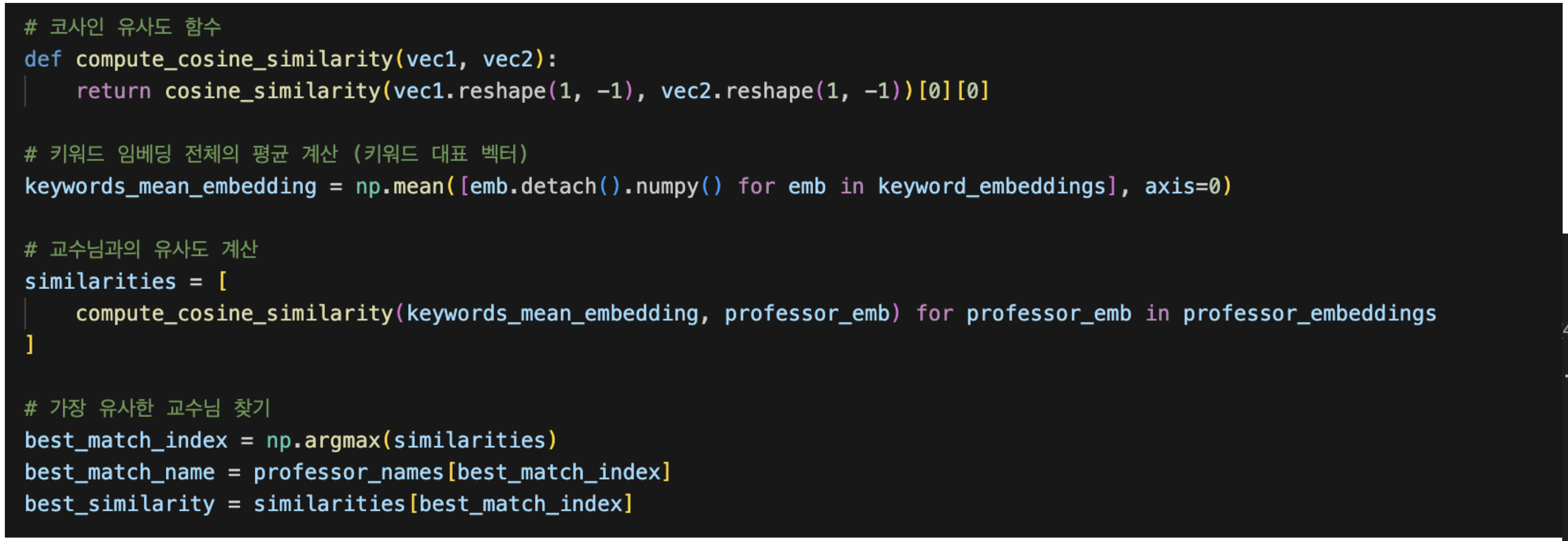
```
# 교수님별 대표 임베딩 계산
professor_embeddings = {}
for professor, abstracts in tqdm(grouped_abstracts.items(), desc="Calculating Embeddings"):
    embeddings = [
        compute_embedding(abstract) for abstract in tqdm(abstracts, desc=f"Processing {professor}", leave=False)
    ]
    # numpy 배열로 변환된 값을 평균 계산
    embeddings = np.array(embeddings)  # torch 텐서가 아닌 numpy 배열로 변환된 상태여야 함
    mean_embedding = np.mean(embeddings, axis=0)  # 평균값 계산
    professor_embeddings[professor] = mean_embedding.tolist()  # numpy 배열을 리스트로 저장
```

time cost: # of 438 abstract, # of 34 prof => about 10minutes

4. AI / Search Algorithm

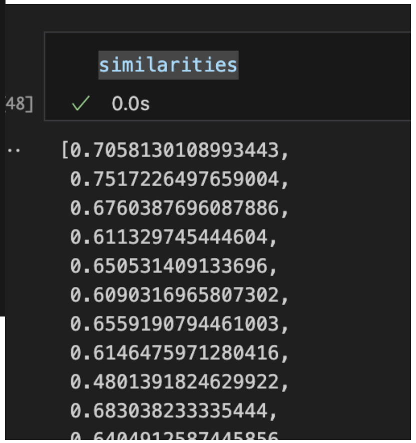
Search

calculate cosine similarity between search keywords and professor embedding



```python
# 코사인 유사도 함수
def compute_cosine_similarity(vec1, vec2):
    return cosine_similarity(vec1.reshape(1, -1), vec2.reshape(1, -1))[0][0]

# 키워드 임베딩 전체의 평균 계산 (키워드 대표 벡터)
keywords_mean_embedding = np.mean([emb.detach().numpy() for emb in keyword_embeddings], axis=0)

# 교수님과의 유사도 계산
similarities = [
    compute_cosine_similarity(keywords_mean_embedding, professor_emb) for professor_emb in professor_embeddings
]

# 가장 유사한 교수님 찾기
best_match_index = np.argmax(similarities)
best_match_name = professor_names[best_match_index]
best_similarity = similarities[best_match_index]
```

<similarity result>

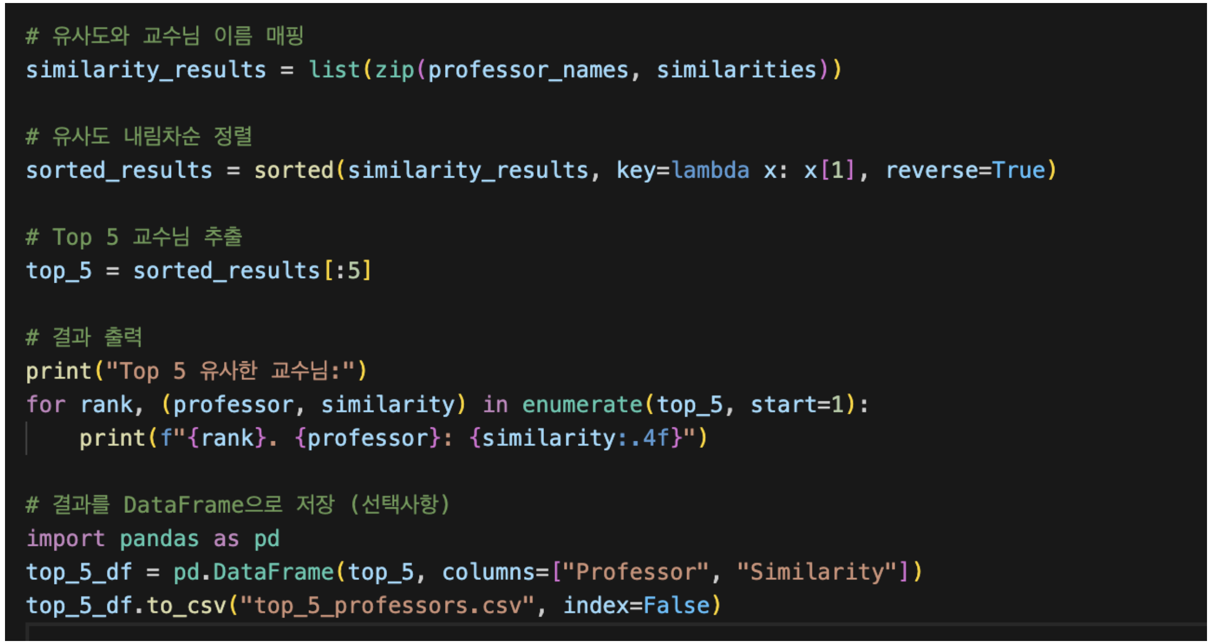


```
    similarities
48]  ✓  0.0s

..  [0.7058130108993443,
     0.7517226497659004,
     0.6760387696087886,
     0.611329745444604,
     0.650531409133696,
     0.6090316965807302,
     0.6559190794461003,
     0.6146475971280416,
     0.4801391824629922,
     0.683038233335444,
     0.6404912587445856
```

4. AI / Search Algorithm

Search top 5

The extracted similarity list is obtained by sorting in descending order.

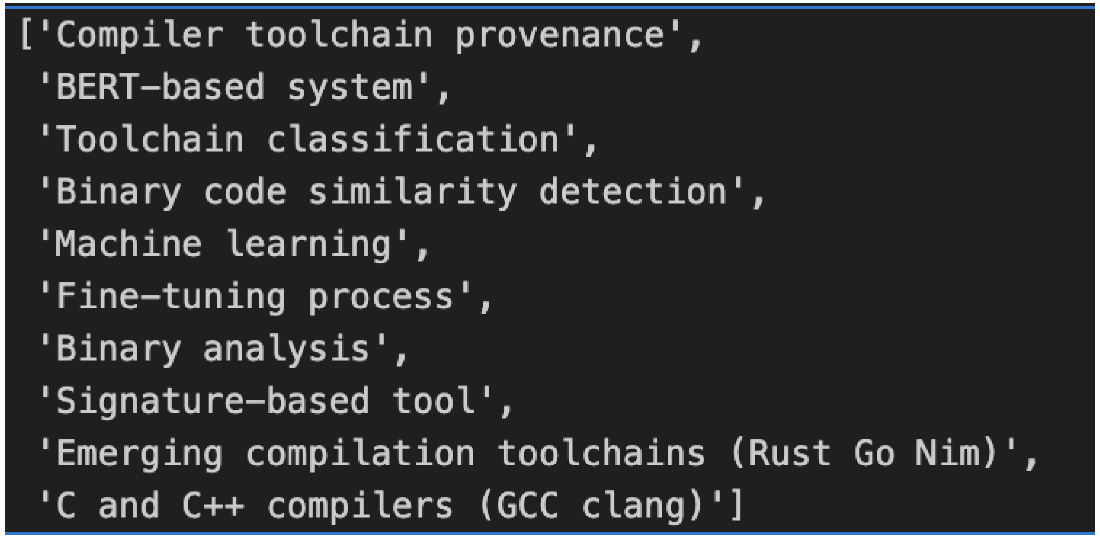


```
# 유사도와 교수님 이름 매핑
similarity_results = list(zip(professor_names, similarities))

# 유사도 내림차순 정렬
sorted_results = sorted(similarity_results, key=lambda x: x[1], reverse=True)

# Top 5 교수님 추출
top_5 = sorted_results[:5]

# 결과 출력
print("Top 5 유사한 교수님:")
for rank, (professor, similarity) in enumerate(top_5, start=1):
    print(f"{rank}. {professor}: {similarity:.4f}")

# 결과를 DataFrame으로 저장 (선택사항)
import pandas as pd
top_5_df = pd.DataFrame(top_5, columns=["Professor", "Similarity"])
top_5_df.to_csv("top_5_professors.csv", index=False)
```

4. AI / Search Algorithm

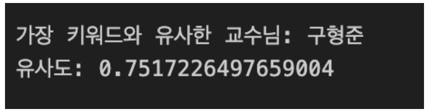
Example

search keywords



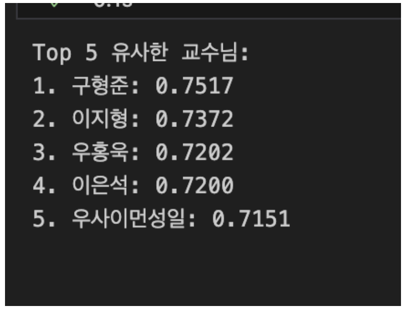
```
['Compiler toolchain provenance',
 'BERT-based system',
 'Toolchain classification',
 'Binary code similarity detection',
 'Machine learning',
 'Fine-tuning process',
 'Binary analysis',
 'Signature-based tool',
 'Emerging compilation toolchains (Rust Go Nim)',
 'C and C++ compilers (GCC clang)']
```

<search result>



```
가장 키워드와 유사한 교수님: 구형준
유사도: 0.7517226497659004
```

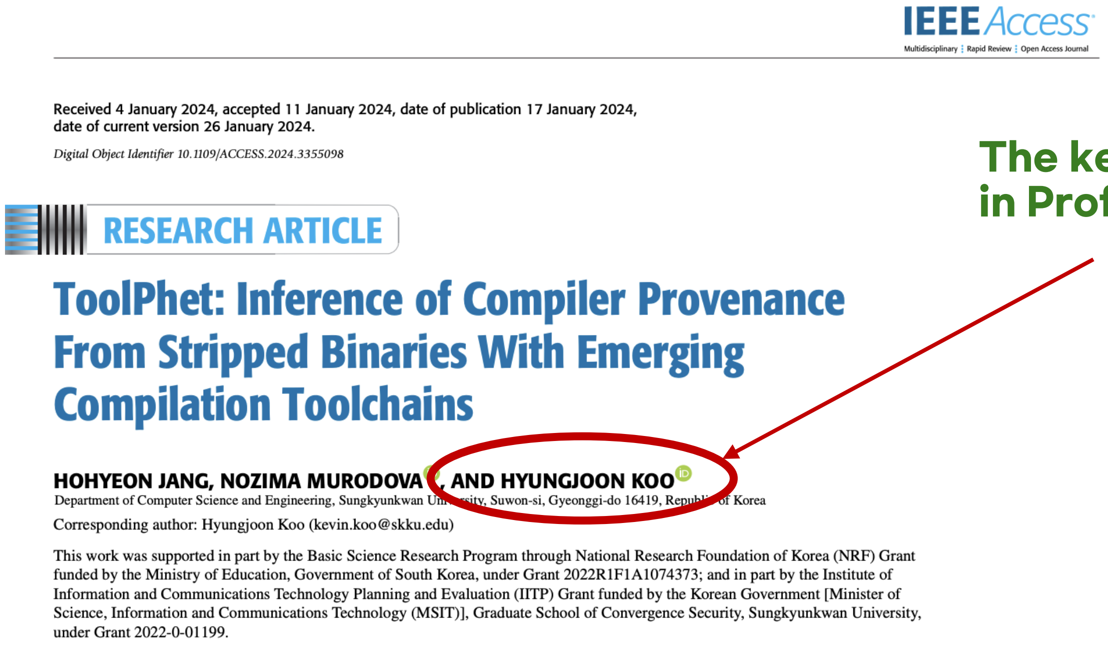
<top 5 search result>



```
Top 5 유사한 교수님:
1. 구형준: 0.7517
2. 이지형: 0.7372
3. 우홍욱: 0.7202
4. 이은석: 0.7200
5. 우사이먼성일: 0.7151
```

4. AI / Search Algorithm

Example



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RESEARCH ARTICLE

ToolPhet: Inference of Compiler Provenance From Stripped Binaries With Emerging Compilation Toolchains

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The keywords are highly similar to those used in Professor Koo Hyungjun's actual research papers

Q & A