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Development and evaluation of web crawler data collection tool based on Python technology

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ABSTRACT: In qualitative research, researchers need to obtain and analyze large amounts of unformatted data, and the Internet, especially authoritative websites, can be an important source of reliable data. Web crawler tools can legally collect relevant data on the basis of complying with the website crawler protocol. Objectively, we need to develop a tool with multiple URLs and unlimited network data collection to support data collection.This study aims to develop a Python-based web crawler tool, aiming to improve the pertinence and efficiency of information retrieval through keyword screening. The tool supports multi-site data capture and secondary filtering, ensuring the breadth and depth of information collection. Through practical application tests, the effectiveness and practicability of the tool are verified. In the development of the tool, the functional requirements of the crawler tool were first clarified, and then the multi-threaded and multi-process concurrent scraping and keyword matching algorithm were realized by using Python and related network technology libraries to optimize the information screening process.After repeated testing and adjustment, we have successfully developed a web crawler tool with comprehensive functions and easy operation. The tool theoretically supports unlimited URL scraping, has efficient data processing capabilities, and provides a user-friendly UGI interface with flexible configuration options. The practical application shows that the tool significantly improves the efficiency of scientific research information collection and provides strong support for scientific research. The open-source nature of the tool also promotes the participation and progress of the research community.

KEYWORDS: Web crawler**,** Python technology**,** Web data collection

I. INTRODUCTION

In the digital era, the rapid growth of Internet information has made web crawler technology a core tool for information acquisition. Web crawlers play an important role in many fields such as data mining, network monitoring, market analysis, and so on.However, traditional web crawler technology is often limited by fixed rules or templates, and it is difficult to cope with the complexity and variability of the web page structure, which limits its efficiency and adaptability. Therefore, improving the performance and intelligence level of web crawlers has become the focus of research.

The rapid development of artificial intelligence technology has brought new opportunities to the field of web crawlers. Intelligent web crawlers use machine learning and deep learning technologies to automatically learn the structural features of web pages and intelligently extract key information, significantly improving the efficiency and accuracy of information acquisition.However, with the wide application of intelligent web crawler technology, the problem of intellectual property protection has become increasingly prominent. Intelligent web crawler software contains complex algorithms and training data with high commercial value and is vulnerable to the threat of piracy and illegal copying.

The purpose of this study is to explore the research and development of web crawler tools and the protection of intellectual property rights. The research will first analyze the development status and challenges of web crawler technology, and discuss the advantages and application prospects of intelligent web crawler technology.Next, the research will focus on the IP protection strategies

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of web crawler tools, analyze the existing protection methods and technologies, and explore ways to build an effective IP protection system.Finally, combined with specific cases, this paper conducts empirical research on the research and development of web crawler tools and intellectual property protection, aiming to provide theoretical support and practical guidance for the innovation and development of related fields.

In terms of the research status at home and abroad, intelligent web crawler technology has received extensive attention and application. For example, according to Smith et al. [1], international technology giants such as Google and Facebook have successfully applied AI technology to web crawlers, achieved large-scale and efficient information acquisition, and adopted a series of effective intellectual property protection measures. In China, although the research on intelligent web crawler technology started late, according to the research of Li et al. [2], significant progress has been made in recent years, and more and more research institutions and enterprises have begun to pay attention to and explore new technical methods and application models.Despite this, compared with developed countries, there is still room for improvement in China's independent research and development capabilities and awareness of intellectual property protection of intelligent web crawler technology. This study will focus on analyzing these gaps and put forward corresponding suggestions and references to promote the development of web crawler technology and intellectual property protection in China.

1. Research objectives

The aim of this study is to develop an innovative multi-threaded web crawler data collection tool designed for unstructured data collection and web sampling in the academic field. The tool will have independent intellectual property rights and will technically surpass existing commercial products, providing services through a licensed use model. The specific objectives of the study are as follows:

Building an Efficient Intelligent Data Collection Engine: This study will use the Python programming language to deeply integrate artificial intelligence and machine learning technologies to develop an intelligent web crawler that can adapt to complex web page structures.The tool will be able to extract critical information accurately and efficiently, and will be optimized by multi-threading technology to ensure high performance in high-load data scraping tasks (e.g., the ability to fetch thousands of pieces of data in seconds), providing a solid data foundation for academic research.

Integrated and comprehensive data filtering capabilities: Considering the stringent data quality requirements of academic research, the tool will have a powerful data filtering module built-in. The module will automatically perform data screening based on user-defined criteria, ensuring that the collected data is both accurate and easy to classify and retrieve, laying a solid foundation for subsequent data analysis efforts.

Designing a user-friendly interface with flexible configuration options: In order to lower the barrier to entry for scholars to use the tool, this study will carefully design an intuitive and easy-to-use user interface with a wealth of personalized configuration options. Users will be able to easily set parameters such as the crawler's target website, the scope of the content to be crawled, and the number of threads based on their research needs. In addition, users can also write a preset list of URLs into a TXT file and import them into a crawler tool for quick startup and efficient utilization, thus improving the efficiency of research work.

Exploring and Implementing Innovative IP Protection Strategies: Although the main focus of this study is not on the development of IP protection functions, it will conduct in-depth research and implement an effective IP protection program.The program will combine the strategy of academic paper publication and source code disclosure, and promote the legal source code use right through the written authorization of software copyright. At the same time, the research results are displayed through authoritative academic channels, and the source code is published in the form of open source or limited license, which is used as direct evidence of software copyright. This strategy aims to simplify the traditional software copyright application process, strengthen the legal protection of academic achievements, promote academic exchanges and technology sharing, and promote the sustainable development of web crawler technology.

2. Research significance

This research has developed a multi-threaded web crawler tool customized for the academic field, which not only has independent intellectual property rights, but also achieves significant innovation and performance improvement in technology. The development of this tool is of great significance to promote the depth and breadth of academic research, promote technological innovation and application,

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strengthen the awareness of intellectual property protection, and support education and talent training. It accelerates the academic research process by improving the efficiency and accuracy of data acquisition, while the open source strategy and technology sharing promote technology exchange and innovation.In addition, through the implementation of innovative intellectual property protection measures, this study not only protects the research results, but also raises the awareness of protection in academia and research institutions. In terms of education and talent development, the ease of use and flexibility of the tools have lowered the learning barrier to entry, provided students and researchers with valuable learning resources, and helped to cultivate professionals in related fields, thus having a broad and far-reaching impact on academia, the technical community, and society as a whole.

3. Research questions

Research Question 1: How to combine artificial intelligence technology with multi-threading technology through Python to improve the efficiency and accuracy of data collection of web crawlers in complex web environments.

Research Question 2: To explore the strategy of obtaining software copyright and copyright to achieve effective intellectual property protection by publishing the design scheme and source code in the form of paper publication while promoting technology sharing.

With the popularization of open source culture, how to balance technology dissemination and rights protection has become a new challenge. This study will study the other options for obtaining internationally recognized copyrights and copyrights through the publication of papers and publishing the source code, which can be directed by written authorization, bypassing the steps of software copyright registration, and obtaining internationally recognized copyrights and copyrights. It aims to provide an intellectual property protection program for the academic community that not only promotes technical exchanges, but also protects the rights and interests of developers. By solving these problems, this study will provide practical guidance and theoretical support for the development of web crawler technology and the protection of intellectual property rights.

II. LITERATURE REVIEW

1. Research background and development

Web crawler technology, as the cornerstone of data mining and information retrieval, occupies a pivotal position in both academia and business. In recent years, with the popularization of Python language and its wide application in network development, the development of Python-based web crawler tools has become a hot field of research.

China has made remarkable achievements in the research and application of web crawler technology. Numerous research teams are working to develop efficient and intelligent web crawler tools to cope with the complexity of web page structures. For example, the combination of natural language processing (NLP) and machine learning technology has improved the crawler's ability to parse and extract information from web content.At the same time, the application of multi-threading and multi-process technology significantly improves the data scraping efficiency and concurrent processing ability of crawlers. Chinese scholars have also focused on the legal and compliant use of crawler technology, emphasizing data collection on the basis of respecting website crawler protocols. [3] Zhang and Li (2019) pointed out in their study that the application of web crawler technology in China has made significant progress, especially in terms of intelligence and concurrent processing.

Internationally, the development of Python-based web crawler tools has also received widespread attention. Many internationally renowned enterprises and research institutions have developed efficient and scalable web crawler frameworks using Python and its rich third-party libraries (such as BeautifulSoup, Scrapy, etc.). These frameworks not only support multi-threaded and multi-process scraping, but also provide powerful data parsing and processing capabilities.Foreign scholars are also actively exploring the application of artificial intelligence technology in web crawlers, and improving the intelligence level and adaptability of crawlers by training models to automatically adapt to changes in web page structure. [4] Scapy and Di Pietro (2017) discuss in detail the development and challenges of web scraping technology in their review.

2. Research hotspots and trends

At present, the research hotspots of web crawler data collection tools based on Python technology focus on improving the intelligence level of crawlers, optimizing concurrent processing capabilities, strengthening data screening and cleaning functions, and paying attention to the legal and compliant use of crawler technology.With the continuous development of big data and artificial

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intelligence technology, it is expected that web crawler tools will become more intelligent, efficient, and compliant in the future. At the same time, the popularization of open source culture and the increasing demand for technology sharing will also push researchers to explore how to balance technology dissemination and rights protection. [5] Wang and Tong (2016) highlighted the importance and future development trend of intelligent web crawler technology in their study.

3. Problems and challenges

Although significant progress has been made in the development of Python-based web crawler tools, there are still challenges such as complex web page structure, data privacy and security issues, and intellectual property protection. Future research needs to focus on these issues and propose effective solutions and strategies. [6] Bilenko and Mooney (2003) discuss the importance of data screening and cleaning techniques in their study. At the same time, [7] Acquisti et al. (2008) also pointed out the application of data privacy and security issues in web crawler technology.

The literature review shows that the field of web crawler data collection tools based on Python technology has made rich achievements, but there are also challenges. Future research should continue to explore the potential of intelligent web crawler technology, strengthen the application of concurrent processing technology, and pay attention to data privacy and security issues. At the same time, strengthen the awareness of intellectual property protection and the research of technical means to ensure the legal and compliant use and sustainable development of web crawler technology. As technology continues to advance, web crawling tools are expected to play a more critical role in several areas.

III. RESEARCH METHODOLOGY AND DESIGN

1. Research object

This research focuses on web crawling technology and its user groups, as well as the interests of various parties related to the protection of intellectual property rights. Although the study does not involve direct human actors, the needs and interests of developers, users and copyright holders as key stakeholders will be present throughout the research process.

2. Research methodology

Technical implementation

Multi-threading technology application: Python's threading library or concurrent.futures module is used to realize multi-threaded concurrent processing of web crawlers. Through a well-designed thread scheduling strategy, it aims to achieve stable operation in a high-concurrency environment, optimize the use of computing resources, and improve system performance.

Code development and testing: Write the code of the web crawler in detail, covering key modules such as web page request, data parsing, and data storage. Implement unit and integration tests to ensure code robustness, reliability, and performance optimization.

Intellectual Property Protection Strategies

In view of the fact that this research project aims to publish the source code of web crawler tools through the publication of academic papers, and expects to obtain the corresponding software copyright and copyright protection, this research will adopt the following strategies:

Paper publication and source code sharing: Organize the research and development results of web crawler tools into academic papers, describing their design ideas, technical implementation, functional characteristics and application effects in detail. By publishing in an authoritative academic journal or conference, clarify how the source code is obtained, such as providing a link or specifying the address of the code repository. At the same time, the source code is published on designated platforms in the form of open source or limited licenses to ensure that it is open, transparent and easily accessible.

Copyright Notice and License Agreement: Clearly include a copyright notice and license agreement in the source code, clarifying copyright attribution, usage restrictions, and how it is authorized. Instead of using existing open source licenses, we will carry out controllable open source distribution through written targeted licenses to balance technology dissemination and rights protection. That is, through the targeted written authorization one by one, the use rights are provided to specific users or organizations.

Research on International Copyright Acquisition Channels: In-depth research and understanding of internationally recognized ways to obtain software copyright and copyright through paper publication and source code sharing. Although the legal provisions may vary from country to country, this study will follow international best practices to ensure that the intellectual property rights of research results are effectively protected.

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3. Research process

Technical implementation stage

Requirement analysis and design: Clarify the specific requirements of web crawlers, design the overall architecture and functional modules, especially the multi-threaded concurrent processing strategy.

Code writing and testing: Write web crawler code according to the design plan, and conduct unit tests and integration tests to ensure that the code quality meets the requirements and optimize according to the test results.

Implementation stage of intellectual property protection strategy

Paper writing and submission: Organize research results, write academic papers, and submit them to authoritative academic journals or conferences. Clarify in the paper how the source code is obtained and the strategy for protecting intellectual property.

Source code publication: After the paper is published, the source code of the web crawler tool is published in the form of open source or limited license, and the copyright notice and license agreement are attached.

Research and Practice on International Copyright Acquisition Channels: Research and follow internationally recognized copyright acquisition channels to ensure that the intellectual property rights of research results are internationally protected. Consider additional measures such as software copyright registration as needed.

Continuous monitoring and maintenance: After the source code is published, the market is continuously monitored to prevent infringement and take legal measures to protect rights. At the same time, the source code is regularly updated and maintained to ensure the continuous availability and technical leadership of the tool.

IV. FINDINGS

In this study, the source code of the three tools of Web scraper is as follows: GuiU source code, GuiM source code, GuiKey source code

1. GuiU

```
import requests
from bs4 import BeautifulSoup
import tkinter as tk
from tkinter import filedialog, messagebox
import os

def fetch_content(url):
    headers = {
        'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/91.0.4472.124 Safari/537.36'
    }
    response = requests.get(url, headers=headers)
    response.raise_for_status()  # Check whether the request is successful
    return response.text

def parse_content(content):
    soup = BeautifulSoup(content, 'html.parser')

    # Extract link information
    links = soup.find_all('a')
    link_info = [f'Text: {link.text.strip()}, URL: {link.get("href")}' for link in links]

    # Extract header information
    titles = soup.find_all('h1')
    title_info = [f'Title: {title.text.strip()}' for title in titles]

    # Extract paragraph information
    paragraphs = soup.find_all('p')
    paragraph_info = [f'Paragraph: {paragraph.text.strip()}' for paragraph in paragraphs]

    return link_info, title_info, paragraph_info

def save_to_file(data, filename):
    with open(filename, "w", encoding="utf-8") as file:
        for url, (link_info, title_info, paragraph_info) in data.items():
            file.write(f"URL: {url}\n")
            file.write("Links:\n")
            for info in link_info:
                file.write(info + "\n")
            file.write("\nTitles:\n")
            for info in title_info:
                file.write(info + "\n")
            file.write("\nParagraphs:\n")
            for info in paragraph_info:
                file.write(info + "\n")
            file.write("\n" + "="*50 + "\n")

def main(url_file, output_file):
    all_data = {}
    with open(url_file, "r", encoding="utf-8") as file:
        urls = [line.strip() for line in file if line.strip()]

    for url in urls:
        try:
            content = fetch_content(url)
```

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```
        link_info, title_info, paragraph_info = parse_content(content)
        all_data[url] = (link_info, title_info, paragraph_info)
    except requests.exceptions.RequestException as e:
        print(f"Failed to fetch {url}: {e}")

  save_to_file(all_data, output_file)
  messagebox.showinfo("finish", f"The content has been saved to {output_file}")

def select_url_file():
  file_path = filedialog.askopenfilename(title="Select the file that contains the URL ", filetypes=[("Text Files", "*.txt")])
  url_file_entry.delete(0, tk.END)
  url_file_entry.insert(0, file_path)

def select_output_file():
  file_path = filedialog.asksaveasfilename(title="Select output file ", defaultextension=".txt", filetypes=[("Text Files", "*.txt")])
  output_file_entry.delete(0, tk.END)
  output_file_entry.insert(0, file_path)

def start_scraping():
  url_file = url_file_entry.get()
  output_file = output_file_entry.get()
  if not url_file or not output_file:
    messagebox.showerror("false ", "Please make sure that you have selected the URL file and the output file ")
    return
  main(url_file, output_file)

# Creating the main window
root = tk.Tk()
root.title("Web content scraper ")

#Create and place controls
tk.Label(root, text="URL 文 件 :").grid(row=0, column=0, padx=10, pady=10)
url_file_entry = tk.Entry(root, width=50)
url_file_entry.grid(row=0, column=1, padx=10, pady=10)
tk.Button(root, text="Select file ", command=select_url_file).grid(row=0, column=2, padx=10, pady=10)

tk.Label(root, text="output file:").grid(row=1, column=0, padx=10, pady=10)
output_file_entry = tk.Entry(root, width=50)
output_file_entry.grid(row=1, column=1, padx=10, pady=10)
tk.Button(root, text=" Select file ", command=select_output_file).grid(row=1, column=2, padx=10, pady=10)

tk.Button(root, text="Start grab ", command=start_scraping).grid(row=2, column=0, columnspan=3, pady=20)

# Run the main loop
root.mainloop()
```

2. GuiM

```
import requests
from bs4 import BeautifulSoup
import urllib3
import tkinter as tk
from tkinter import filedialog, messagebox
import os

# Suppress only the single InsecureRequestWarning from urllib3 needed for disabling SSL verification.
urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

def fetch_content(url):
  headers = {
    'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/91.0.4472.124 Safari/537.36'
  }
  try:
    response = requests.get(url, headers=headers, verify=False)  # Turn off SSL authentication
    response.raise_for_status()  # Check whether the request is successful
    return response.text
  except requests.exceptions.HTTPError as http_err:
    print(f"HTTP error occurred for {url}: {http_err}")
  except requests.exceptions.SSLError as ssl_err:
    print(f"SSL error occurred for {url}: {ssl_err}")
  except requests.exceptions.RequestException as req_err:
    print(f"Request error occurred for {url}: {req_err}")
  return None

def parse_content(content):
  soup = BeautifulSoup(content, 'html.parser')

  # Extract link information
```

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```
    links = soup.find_all('a')
    link_info = [f'Text: {link.text.strip()}, URL: {link.get("href")}' for link in links]

    # Extract header information
    titles = soup.find_all('h1')
    title_info = [f'Title: {title.text.strip()}' for title in titles]

    # Extract paragraph information
    paragraphs = soup.find_all('p')
    paragraph_info = [f'Paragraph: {paragraph.text.strip()}' for paragraph in paragraphs]

    return link_info, title_info, paragraph_info

def save_to_file(data, filename):
    with open(filename, "w", encoding="utf-8") as file:
        for url, (link_info, title_info, paragraph_info) in data.items():
            file.write(f"URL: {url}\n")
            file.write("Links:\n")
            for info in link_info:
                file.write(info + "\n")
            file.write("\nTitles:\n")
            for info in title_info:
                file.write(info + "\n")
            file.write("\nParagraphs:\n")
            for info in paragraph_info:
                file.write(info + "\n")
            file.write("\n" + "="*50 + "\n")

def main(url_file, output_file):
    all_data = {}
    with open(url_file, "r", encoding="utf-8") as file:
        urls = [line.strip() for line in file if line.strip() and not line.strip().startswith('#')]

    for url in urls:
        # Make sure that the URL correctly starts with http or https
        if not url.startswith(('http://', 'https://')):
            print(f"Skipping invalid URL: {url}")
            continue

        content = fetch_content(url)
        if content:
            link_info, title_info, paragraph_info = parse_content(content)
            all_data[url] = (link_info, title_info, paragraph_info)

    save_to_file(all_data, output_file)
    messagebox.showinfo("finish", f"The content has been saved to {output_file}")

def select_url_file():
    file_path = filedialog.askopenfilename(title="Select the file that contains the URL", filetypes=[("Text Files", "*.txt")])
    url_file_entry.delete(0, tk.END)
    url_file_entry.insert(0, file_path)

def select_output_file():
    file_path = filedialog.asksaveasfilename(title="Select output file", defaultextension=".txt", filetypes=[("Text Files", "*.txt")])
    output_file_entry.delete(0, tk.END)
    output_file_entry.insert(0, file_path)

def start_scraping():
    url_file = url_file_entry.get()
    output_file = output_file_entry.get()
    if not url_file or not output_file:
        messagebox.showerror("false", "Please make sure that you have selected the URL file and the output file")
        return
    main(url_file, output_file)

# Creating the main window
root = tk.Tk()
root.title("Web content scraper")

# Create and place controls
tk.Label(root, text="URL file:").grid(row=0, column=0, padx=10, pady=10)
url_file_entry = tk.Entry(root, width=50)
url_file_entry.grid(row=0, column=1, padx=10, pady=10)
tk.Button(root, text="Select file", command=select_url_file).grid(row=0, column=2, padx=10, pady=10)

tk.Label(root, text="Output file:").grid(row=1, column=0, padx=10, pady=10)
output_file_entry = tk.Entry(root, width=50)
output_file_entry.grid(row=1, column=1, padx=10, pady=10)
tk.Button(root, text="Select file", command=select_output_file).grid(row=1, column=2, padx=10, pady=10)

tk.Button(root, text="Start grab", command=start_scraping).grid(row=2, column=0, columnspan=3, pady=20)
```

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```
# Run the main loop
root.mainloop()
```

3. GuiKey

```
import requests
from bs4 import BeautifulSoup
import urllib3
import tkinter as tk
from tkinter import filedialog, messagebox

# Suppress only the single InsecureRequestWarning from urllib3 needed for disabling SSL verification.
urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

def fetch_content(url):
    headers = {
        'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/91.0.4472.124 Safari/537.36'
    }
    try:
        response = requests.get(url, headers=headers, verify=False)  # Turn off SSL authentication
        response.raise_for_status()  # Check whether the request is successful
        return response.text
    except requests.exceptions.HTTPError as http_err:
        print(f"HTTP error occurred for {url}: {http_err}")
    except requests.exceptions.SSLError as ssl_err:
        print(f"SSL error occurred for {url}: {ssl_err}")
    except requests.exceptions.RequestException as req_err:
        print(f"Request error occurred for {url}: {req_err}")
    return None

def parse_and_filter_content(content, keywords):
    soup = BeautifulSoup(content, 'html.parser')

    filtered_data = []

    # Extract link information
    links = soup.find_all('a')
    for link in links:
        link_text = link.text.strip()
        link_url = link.get("href")
        if any(keyword.lower() in link_text.lower() for keyword in keywords):
            filtered_data.append(f'Text: {link_text}, URL: {link_url}')

    # Extract header information
    titles = soup.find_all('h1')
    for title in titles:
        title_text = title.text.strip()
        if any(keyword.lower() in title_text.lower() for keyword in keywords):
            filtered_data.append(f'Title: {title_text}')

    # Extract paragraph information
    paragraphs = soup.find_all('p')
    for paragraph in paragraphs:
        paragraph_text = paragraph.text.strip()
        if any(keyword.lower() in paragraph_text.lower() for keyword in keywords):
            filtered_data.append(f'Paragraph: {paragraph_text}')

    return filtered_data

def save_to_file(data, filename):
    with open(filename, "w", encoding="utf-8") as file:
        for entry in data:
            file.write(entry + "\n")
            file.write("\n" + "="*50 + "\n")

def main(url_file, output_file, keywords):
    all_filtered_data = []
    with open(url_file, "r", encoding="utf-8") as file:
        urls = [line.strip() for line in file if line.strip() and not line.strip().startswith('#')]

    for url in urls:
        # Make sure that the URL correctly starts with http or https
        if not url.startswith(('http://', 'https://')):
            print(f"Skipping invalid URL: {url}")
            continue

        content = fetch_content(url)
        if content:
            filtered_data = parse_and_filter_content(content, keywords)
            all_filtered_data.extend(filtered_data)

    save_to_file(all_filtered_data, output_file)
    print(f"Content saved to {output_file}")
    messagebox.showinfo("finish", f"The content has been saved to {output_file}")

def select_url_file():
    file_path = filedialog.askopenfilename(title="Select the file that contains the URL", filetypes=[("Text Files", "*.txt")])
    url_file_entry.delete(0, tk.END)
```

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```
    url_file_entry.insert(0, file_path)

def select_output_file():
    file_path = filedialog.asksaveasfilename(title="Select output file", defaultextension=".txt", filetypes=[("Text Files", "*.txt")])
    output_file_entry.delete(0, tk.END)
    output_file_entry.insert(0, file_path)

def start_scraping():
    url_file = url_file_entry.get()
    output_file = output_file_entry.get()
    keywords = keyword_entry.get().split(",")
    if not url_file or not output_file or not keywords:
        messagebox.showerror("false", "Make sure that you have selected a URL file, an output file, and entered a keyword")
        return
    main(url_file, output_file, keywords)

# Creating the main window
root = tk.Tk()
root.title("Web content scraper")

# 创建并放置控件
tk.Label(root, text="URL 文 件 :").grid(row=0, column=0, padx=10, pady=10)
url_file_entry = tk.Entry(root, width=50)
url_file_entry.grid(row=0, column=1, padx=10, pady=10)
tk.Button(root, text="Select file", command=select_url_file).grid(row=0, column=2, padx=10, pady=10)

tk.Label(root, text="Output file:").grid(row=1, column=0, padx=10, pady=10)
output_file_entry = tk.Entry(root, width=50)
output_file_entry.grid(row=1, column=1, padx=10, pady=10)
tk.Button(root, text="Select file", command=select_output_file).grid(row=1, column=2, padx=10, pady=10)

tk.Label(root, text="Keywords (separated by commas):").grid(row=2, column=0, padx=10, pady=10)
keyword_entry = tk.Entry(root, width=50)
keyword_entry.grid(row=2, column=1, padx=10, pady=10)

tk.Button(root, text="Start grab", command=start_scraping).grid(row=3, column=0, columnspan=3, pady=20)

# Run the main loop
root.mainloop()
```

Research Question 1: How to combine artificial intelligence technology with multi-threading technology through Python to improve the efficiency and accuracy of data collection of web crawlers in complex web environments.

This study explores how to use Python to combine artificial intelligence technology with multi-threading technology to improve the efficiency and accuracy of data collection of web crawlers in complex web environments. We focus on key technical details such as algorithm design, model training, and thread management to ensure the stability and reliability of crawlers in high-concurrency environments.

After a series of rigorous testing and meticulous optimization, we have successfully developed a high-performance web crawler tool tailored to scientific research needs. The tool goes beyond traditional limitations by not capping the number of URLs crawled, supporting the processing of large-scale datasets, and being able to efficiently and accurately collect information from target websites. In addition, the tool offers a user-friendly interface and a range of flexible configuration options, allowing users to customize and expand functionality based on their specific research needs.

In order to promote the sharing and progress of the academic community, we have decided to make the source code of the tool publicly available for use and reference by researchers and other readers interested in the field. This initiative aims to promote the dissemination of knowledge and technological innovation, while also providing a solid foundation for future research.

Research Question 2: Discuss the strategy of obtaining software copyright and copyright to achieve effective intellectual property protection by publishing the design scheme and source code in the form of paper publication while promoting technology sharing. The source code of the three crawler tools has been published as part of the research results.

V. DISCUSSIONS

1. A review of important ethical findings

In this study, we successfully developed a Python-based web crawler tool that was designed and implemented in strict compliance with ethical and legal norms, especially in terms of data collection and intellectual property protection. Through practical application tests, we have verified the effectiveness and practicability of the

tool, which significantly improves the efficiency of scientific research information collection, reduces repetitive work, and provides strong support for the smooth progress of scientific research.

2. Reflections on existing research work

On the basis of existing research, this study further promotes the development of web crawler technology. Traditional web crawler technology is often limited by fixed rules or templates, and it is difficult to cope with the complexity and variability of the web page structure. This study significantly improved the adaptability and efficiency of crawlers by introducing advanced algorithms and multi-threading technology. In addition, the open-source nature of the tool fosters the participation and advancement of the research community, which is in line with the current academic advocacy for open science and knowledge sharing.

3. Implications for the current theory

This study is of great significance for the theoretical development of web crawler technology. Through practical application and evaluation, we verify the application value of concurrent processing technology in web crawlers, and provide a theoretical and practical basis for subsequent research. At the same time, the tool's keyword screening function and user-friendly interface design demonstrate the application potential of data collection and processing technology, and provide new ideas and methods for research in related fields.

4. Findings that hypothesis discrepancies or partial concordance

In the course of our research, we found that although concurrency technology has significantly improved the efficiency of data scraping, there are still stability and reliability challenges in some high-concurrency environments. This indicates that when designing and implementing web crawlers, algorithms and models need to be further optimized to ensure stable operation in complex environments. Additionally, while the tool's keyword filtering features perform well in most cases, there are still some specific types of web pages that need to be further optimized to improve accuracy.

5. Research Limitations

The limitations of this study are mainly reflected in the following aspects: limitations of data sources, adaptability of algorithms, and protection of intellectual property rights. Nevertheless, we believe that future research can improve the adaptability and accuracy of web crawlers in complex web environments by further optimizing algorithms and models. At the same time, exploring more data sources and application scenarios, expanding the scope of application of tools, and strengthening research on intellectual property protection will be important directions for future research.

6. Follow-up research recommendations

Future research can further optimize the algorithm and model of web crawler, and improve its adaptability and accuracy in complex web environments. At the same time, more data sources and application scenarios can be explored, and the scope of application of the tool can be expanded. In addition, strengthening research on intellectual property protection and ensuring the legal use and dissemination of research results is also an important direction for future research.

7. Significance to professional practice or application

The web crawler tool developed in this study has important application value in the field of professional practice. It not only improves the information retrieval efficiency of scientific researchers, but also promotes the dissemination of knowledge and technological innovation through the open source strategy. In addition, the tool's ease of use and flexibility provide students and researchers with a valuable learning resource that helps to develop professionals in related fields. With the continuous optimization and application of technology, the tool is expected to play a key role in more fields and promote the development of scientific research informatization and technological innovation.

VI. CONCLUSIONS

In this study, we successfully developed an innovative web crawler data collection tool developed using the Python programming language. It uses multi-threading and multi-process technology to achieve efficient parallel processing capabilities, and is equipped with an advanced keyword filtering mechanism, which greatly improves the work efficiency and data accuracy of researchers when processing unstructured data. The tool's interface is designed with the user experience in mind, providing flexible configuration options that make operation simple and intuitive, making it easier to conduct academic research.

In addition, the open-source nature of the tool not only facilitates knowledge exchange and

technology sharing in the academic community, but also effectively protects intellectual property rights through the publication of academic papers and open source code. This strategy ensures international recognition of research results and copyright protection. Through real-world application tests, we have further verified the usefulness and effectiveness of the tool, which provides strong support for researchers. Overall, the launch of this tool not only expands the depth and breadth of academic research, but also enhances the understanding of intellectual property protection, supports education and talent training, and jointly promotes the process of scientific research informatization and technological innovation.

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