

P2P File Sharing Application Report

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1 Introduction

This peer-to-peer (P2P) file-sharing application lets users (peers) on a network discover each other, search for files shared by other peers, and download files directly from them in a decentralized way. The implementation was inspired from the BitTorrent protocol and has chunked file transfers.

2 Features

The app includes:

- **Peer Discovery:** Manual connection between peers using IP address and port
- **File Indexing:** Each node indexes files periodically (15 seconds)
- **File Searching:** Peers can search for files across the network of connected peers. Results show the filename, size, and the peer hosting the file
- **Chunked File Transfer:** Files are downloaded in fixed-size chunks (64KB)
- **File Integrity Verification:** SHA-256 hashing is used to verify that downloaded files match the original
- **Concurrent Connections:** Uses threading to handle multiple connections plus background tasks at the same time

3 Implementation

Each instance is acting as both a client and a server, and communication between peers uses TCP sockets. Requests and responses are JSON strings.

- **node.py:** The main class that has the node's logic (peer connections, indexing, request handling, and downloads)

- `cli.py`: Handles user interaction
- `main.py`: Starts the processes
- `utils.py`: Has a helper function (had more initially)

3.1 File Indexing

index_files scans the shared directory, calculates the size, number of chunks, and the hash for each file, storing the metadata in memory (separate thread)

3.2 Chunk Transfer

When downloading the node requests file info, then iterates through the chunks, requesting each one.

3.3 Concurrency

start_server runs the main loop in a thread. Each incoming connection is handled by making a new thread. Indexing also runs its own thread.

4 Use

4.1 Starting a Node

A node is started by specifying the directory to share:

```
python main.py --dir ./directory_path
```

```
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1  ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared1

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 1 files

> Listening on port 60744
Indexed 1 files
Indexed 1 files
Indexed 1 files
connect 127.0.0.1 60771
Added peer: 127.0.0.1:60771
Connected to: 127.0.0.1:60771

> Indexed 1 files
█

~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1  x  ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2  +
Last login: Sun Apr 13 19:26:03 on ttys072
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
█
```

Figure 1: Starting P2P nodes

4.2 Connecting Peers

Connecting uses the *connect* command in the CLI, followed by the target peer's IP and port:

```
connect ip_address port
```

```
x ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1 +
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
Last login: Sun Apr 13 19:26:03 on ttys072
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
Indexed 0 files
list

Local files:
> █

x ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1 +
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared1

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 1 files

> Listening on port 60744
Indexed 1 files
Indexed 1 files
Indexed 1 files
connect 127.0.0.1 60771
Added peer: 127.0.0.1:60771
Connected to: 127.0.0.1:60771

> Indexed 1 files
Indexed 1 files
Indexed 1 files
list

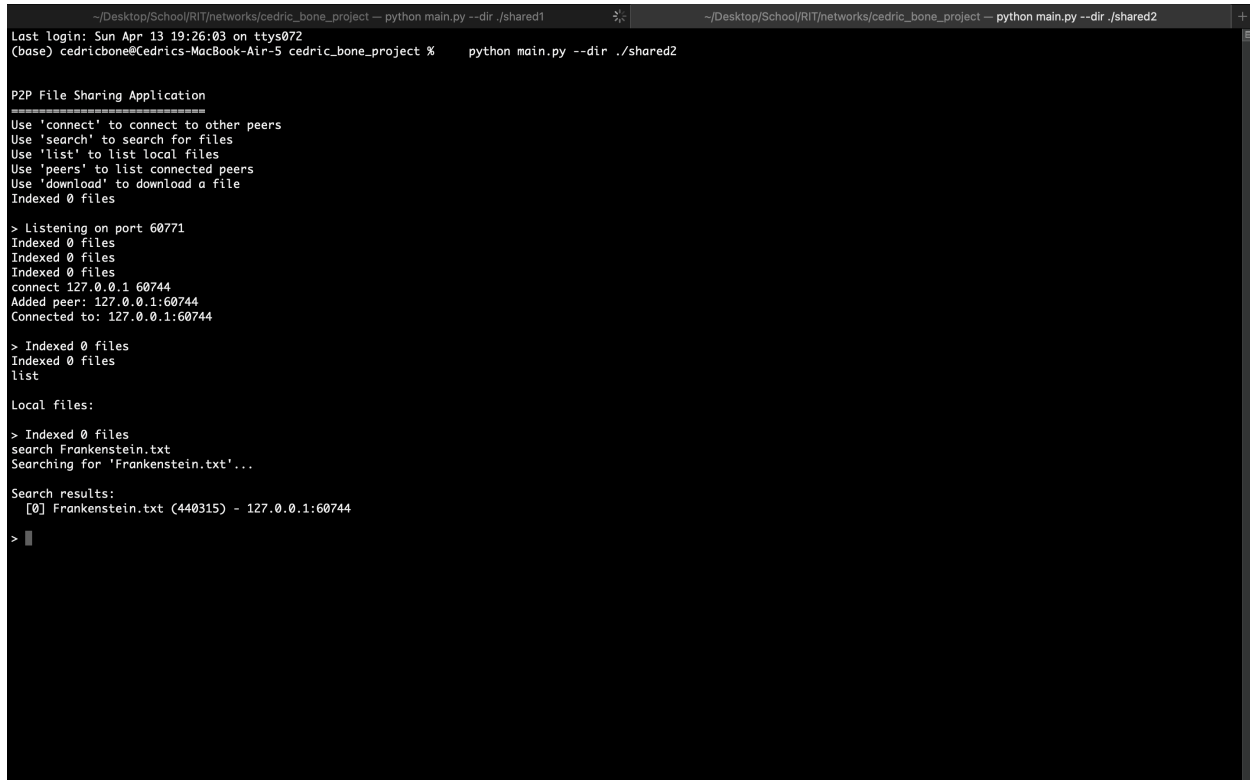
Local files:
  Frankenstein.txt (440315)
> █
```

Figure 2: Connecting Nodes

4.3 Searching for Files

Use the *search* command:

```
search filename_or_query
```



```
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
Last login: Sun Apr 13 19:26:03 on ttys072
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
Indexed 0 files
list

Local files:

> Indexed 0 files
search Frankenstein.txt
Searching for 'Frankenstein.txt'...

Search results:
[0] Frankenstein.txt (440315) - 127.0.0.1:60744

> █
```

Figure 3: Searching for Frankenstein

4.4 Downloading Files

Use the *download* command with the index number from the search results:

```
download index_number
```

```
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
Indexed 0 files
list

Local files:

> Indexed 0 files
search Frankenstein.txt
Searching for 'Frankenstein.txt'...

Search results:
[0] Frankenstein.txt (440315) - 127.0.0.1:60744

> Indexed 0 files
download 0
Downloading 'Frankenstein.txt' from 127.0.0.1:60744...

> Downloading chunk 1/7 (14.285714285714285%)...
Downloading chunk 2/7 (28.57142857142857%)...
Downloading chunk 3/7 (42.857142857142854%)...
Downloading chunk 4/7 (57.14285714285714%)...
Downloading chunk 5/7 (71.42857142857143%)...
Downloading chunk 6/7 (85.71428571428571%)...
Downloading chunk 7/7 (100.0%)...

calc hash: f497cabfcd2fa811c58d313a96cf1171c835b8b317a29afaf3ced224101618e2 expected hash: f497cabfcd2fa811c58d313a96cf1171c835b8b317a29afaf3ced224101618e2
Indexed 1 files

Downloaded Frankenstein.txt
```

Figure 4: Downloading a file, showing chunk progress (Frankenstein was downloaded from Project Gutenberg)