Distributed Computing

A-11. BitTorrent

What BitTorrent Is

- A **file distribution system**
  - Basically, an alternative to HTTP (or FTP if you're old) for transferring sizeable files
- **File search** is **not a feature**
- Reference: the delightfully simple paper at P2PECON 2003

Architecture

Torrent File

- A `.torrent` file contains metadata about your file
  - Name
  - Size
  - Hashing information
  - The URL of a **tracker**
    - Or, if you're using the DHT (introduced in 2005), nothing :)

The BitTorrent Swarm

- **Tracker**: a machine that helps node discover each other
  - Made not necessary by the DHT
- **Seed**: a node with a full copy of the file, just uploading
- **Downloaders**: nodes that have not finished downloading the file
- When downloaders complete a download, they can stay and seed

Pieces

- Files are cut in **pieces** (256KB by default)
- Hashes of each piece are included in the `.torrent` file
- A node doesn’t report having a piece until it verifies the hash
- Nodes contact each other, asking which pieces they have

Piece Selection

- Which piece to select?
- **Rarest first**: always try to get the rarest piece in the system first
  - It will be the one that will be most difficult to find later
  - Guarantees that copies will stay around
- Exception: **random first piece**, to get something to upload ASAP

Incentives to Cooperation

Tit for Tat

- I behave with you as you did with me
  - “Pan per focaccia”, for the Italian speakers
- Among all the uploads open, most are *choked*—i.e., uploaders don’t send data through them
  - By default, 4 connections are unchoked
  - **Optimistic unchoke**: every 30s, give an upload slot to a random node
  - The others go to the peers that are sending data faster
- Result: to get fast downloads, you need to **upload fast**

The Evolution of Cooperation

- Tit for Tat was probably inspired by a book on game theory
- In some cases, when rational entities have multiple reciprocal interactions ("iterated prisoner's dilemma"), cooperation emerges as a successful strategy
- Tit-for-Tat is a bare-bone version of the concept of reputation: if you have a good reputation, I'll be more friendly to you