OIM3640 - Problem Solving and Software Design

Web Scraping*

* *based on ZenRows-What is Web Scraping? In-Depth Guide*

What is Web Scraping?

- Web Scraping is the process of automatically collecting web data with specialized software.
- also called "crawling", or "spidering".

Why not API

- API is more convenient to communicate with other systems.
- Unfortunately, many services don't provide an API.
- Some APIs only allow limited functionality.

What is Web Scraping Used For?

- Price Monitoring
  - E-commerce: tracking competition prices and availability.
  - Financial services: detect stock price changes, volume activity, anomalies, etc.
- Lead Generation
  - Extract contact information: names, email addresses, phones, or job titles.
  - Identify new opportunities, i.e., in Yelp, YellowPages, Crunchbase, etc.

What is Web Scraping Used For?

- Market Research
  - Real Estate: supply/demand analysis, market opportunities, trending areas, etc.
  - Automotive/Cars: dealers distribution, most popular models, best deals, etc.
  - Travel and Accommodation: available rooms, hottest areas, best discounts, prices by season, etc.
  - Job Postings: most demanded jobs. Industries on the rise. Biggest employers. Supply by sector, etc.
  - Social Media: brand presence and growing influencers tracking. New acquisition channels, audience targeting, etc.
  - City Discovery: track new restaurants, shops, trending areas, etc.

What is Web Scraping Used For?

- Aggregation: i.e. news from many sources.
- Inventory and Product Tracking
  - Collect product details and specs.
  - New products.
- SEO (Search Engine Optimization): Keywords' relevance and performance. Competition tracking, brand relevance, new players' rank.
- ML/AI/Data Science: Collect massive amounts of data to train machine learning models; image recognition, predictive modeling, NLP.
- Bulk downloads: PDFs or massive Image extraction at scale.

Web Scraping Process

- Just like a standard **HTTP** client-server communication.
    - The browser (client) connects to a website (server) and **requests** the content.
    - The server then returns HTML content, a markup language both sides understand.
    - The browser is responsible for **rendering** HTML to a graphical interface.

Request - made by the browser

- URL: the specific address on the website.
- Method:
  - GET to retrieve data.
  - POST to submit data (usually forms).
- Headers:
  - User-Agent, Cookies, Browser Language, etc
  - Tricky parts of communication. Websites strongly focus on this data to determine whether a request comes from a human or a bot.
- Body: commonly user-generated input. Used when submitting forms.

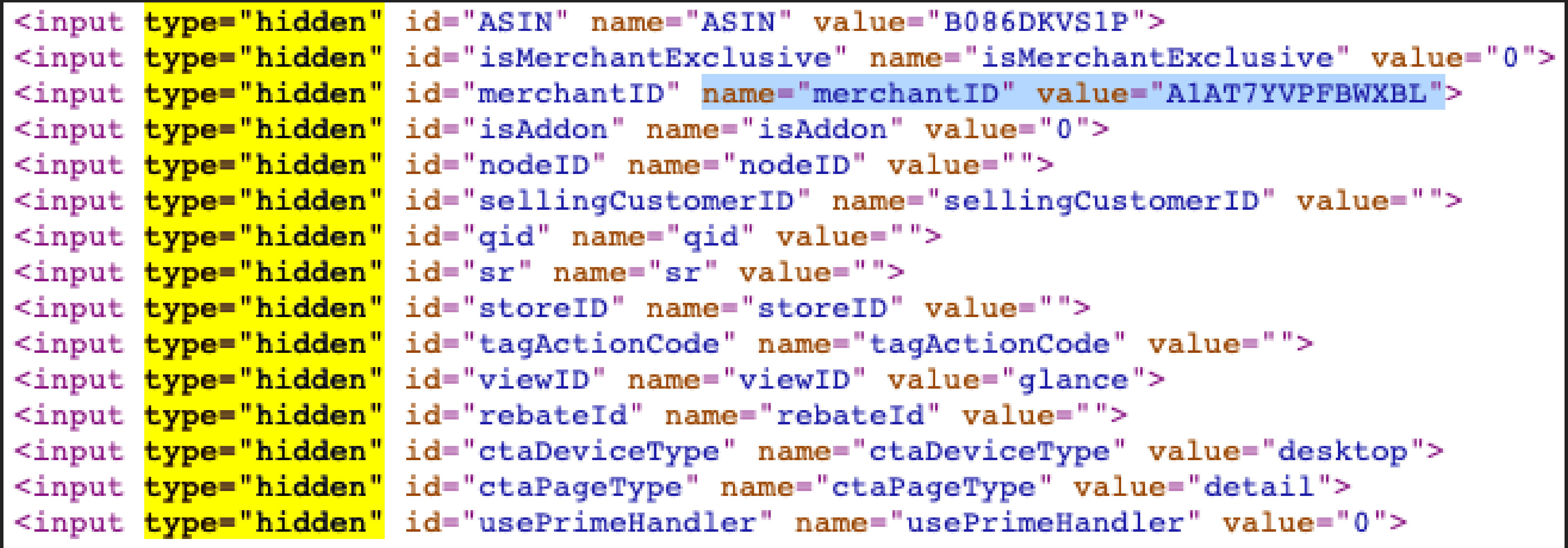
Response - returned by the server

- HTTP Code: a number indicating the status of the request.
  - 200 means everything went OK.
  - The infamous 404 means URL not found.
  - 500 is an internal server error.
- The content:
  - HTML: responsible for rendering the website.
  - Auxiliary content types: CSS, images, JSON, JS scripts, etc.
- Headers:
  - Just like Request Headers, these play a crucial role in communication.
  - One important part is instructing browser to "Set-Cookie"s.

Data Extraction - Parsing

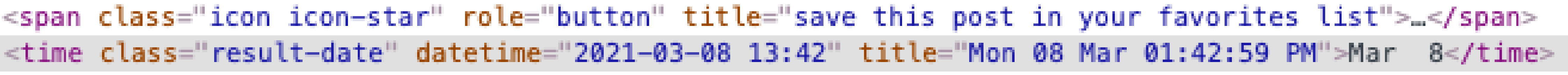
- We want to obtain specific data from the HTML
- Parsing is the process of extracting selected data and organizing it into a well-defined structure.
  - Technically, HTML is a **tree structure** - DOM.
  - The extraction process begins by **analyzing** a website

Example: Hidden Inputs on Amazon Products

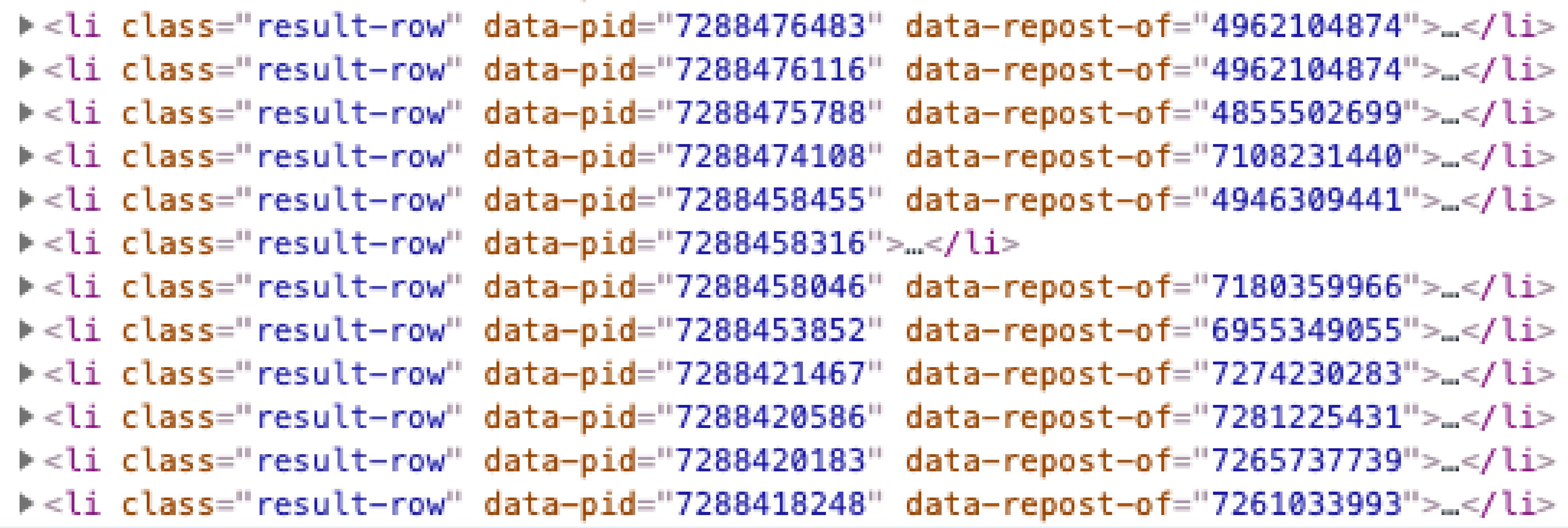


```
<input type="hidden" id="ASIN" name="ASIN" value="B086DKVS1P">
<input type="hidden" id="isMerchantExclusive" name="isMerchantExclusive" value="0">
<input type="hidden" id="merchantID" name="merchantID" value="A1AT7YVPFBWXBL">
<input type="hidden" id="isAddon" name="isAddon" value="0">
<input type="hidden" id="nodeID" name="nodeID" value="">
<input type="hidden" id="sellingCustomerID" name="sellingCustomerID" value="">
<input type="hidden" id="qid" name="qid" value="">
<input type="hidden" id="sr" name="sr" value="">
<input type="hidden" id="storeID" name="storeID" value="">
<input type="hidden" id="tagActionCode" name="tagActionCode" value="">
<input type="hidden" id="viewID" name="viewID" value="glance">
<input type="hidden" id="rebateId" name="rebateId" value="">
<input type="hidden" id="ctaDeviceType" name="ctaDeviceType" value="desktop">
<input type="hidden" id="ctaPageType" name="ctaPageType" value="detail">
<input type="hidden" id="usePrimeHandler" name="usePrimeHandler" value="0">
```

Example: HTML Attributes on Craiglist



```
<span class="icon icon-star" role="button" title="save this post in your favorites list">…</span>
<time class="result-date" datetime="2021-03-08 13:42" title="Mon 08 Mar 01:42:59 PM">Mar  8</time>
```



```
▶<li class="result-row" data-pid="7288476483" data-repost-of="4962104874">…</li>
▶<li class="result-row" data-pid="7288476116" data-repost-of="4962104874">…</li>
▶<li class="result-row" data-pid="7288475788" data-repost-of="4855502699">…</li>
▶<li class="result-row" data-pid="7288474108" data-repost-of="7108231440">…</li>
▶<li class="result-row" data-pid="7288458455" data-repost-of="4946309441">…</li>
▶<li class="result-row" data-pid="7288458316">…</li>
▶<li class="result-row" data-pid="7288458046" data-repost-of="7180359966">…</li>
▶<li class="result-row" data-pid="7288453852" data-repost-of="6955349055">…</li>
▶<li class="result-row" data-pid="7288421467" data-repost-of="7274230283">…</li>
▶<li class="result-row" data-pid="7288420586" data-repost-of="7281225431">…</li>
▶<li class="result-row" data-pid="7288420183" data-repost-of="7265737739">…</li>
▶<li class="result-row" data-pid="7288418248" data-repost-of="7261033993">…</li>
```

Web Scraping Challenges

- Legal Issues:
  - still a gray area, YMMV
- Technical challenges:
  - IP Rate Limit
  - Rotating Proxies
  - Headers/Cookies validation
  - Reverse Engineering Headers / Cookies generation
  - Javascript Execution
  - Headless Browsers
  - Captcha / reCAPTCHA (Developed by Google)
  - Pattern Recognition

Web Scraping - Example

- Install *Beautiful Soup*

  -
    ```
    python -m pip install beautifulsoup4
    ```
- Download imdb_top250.py
- Try with Yahoo Finance Trending Stocks