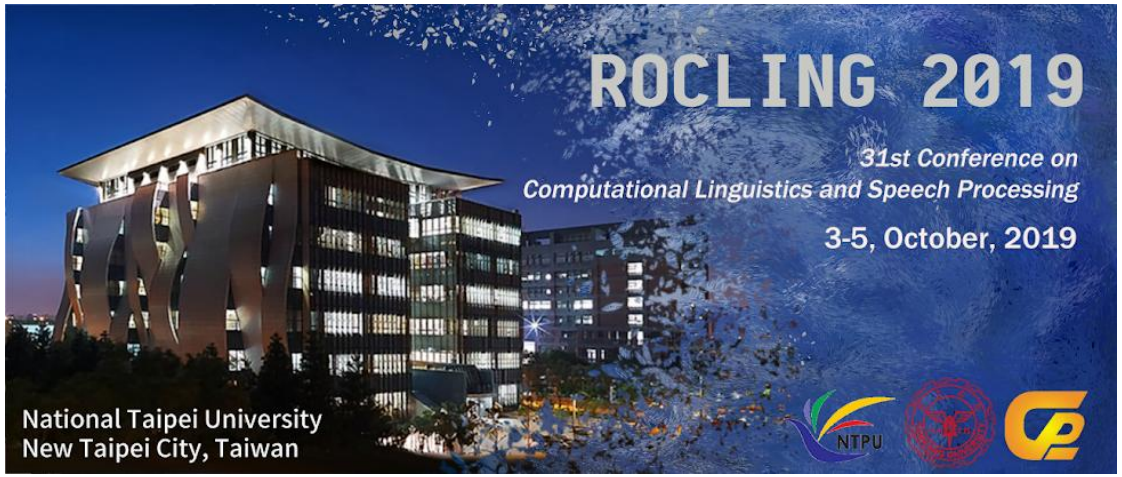
# Information Extraction for Event or Activity Monitoring on Social Media

Prof. Chia-Hui Chang (張嘉惠)
WIDM LAB
National Central University, Taiwan

# About Me

- TAAI President (2019-2020)
- ACLCLP Vice President 2018
  - ACL 2017 Area Co-Chair on IE
  - NAACL 2018 IE Area Co-Chair




# Research Work @ WIDM Lab

- Web Named Entity Recognition (NER)
  - From UGC (user-generated content) on social media
  - Applications
    - PowerPOI: Mining POIs from the Web
    - Damage report monitoring
    - EventGo! Activity Extraction and Retrieval from Social Network
- Web Data Extraction
  - From deep web (template pages, semi-structured)
  - Applications
    - Web ETL API Creator
    - Mobile Web Creator

# Mining POIs from the Web

莊秀敏、張國斌、鄭仲庭、高庭耀、林圓皓

# PowerPOI: POI Extraction & Retrieval



[Download PowerPOI (疾疾店家現身) APP from Google Play]

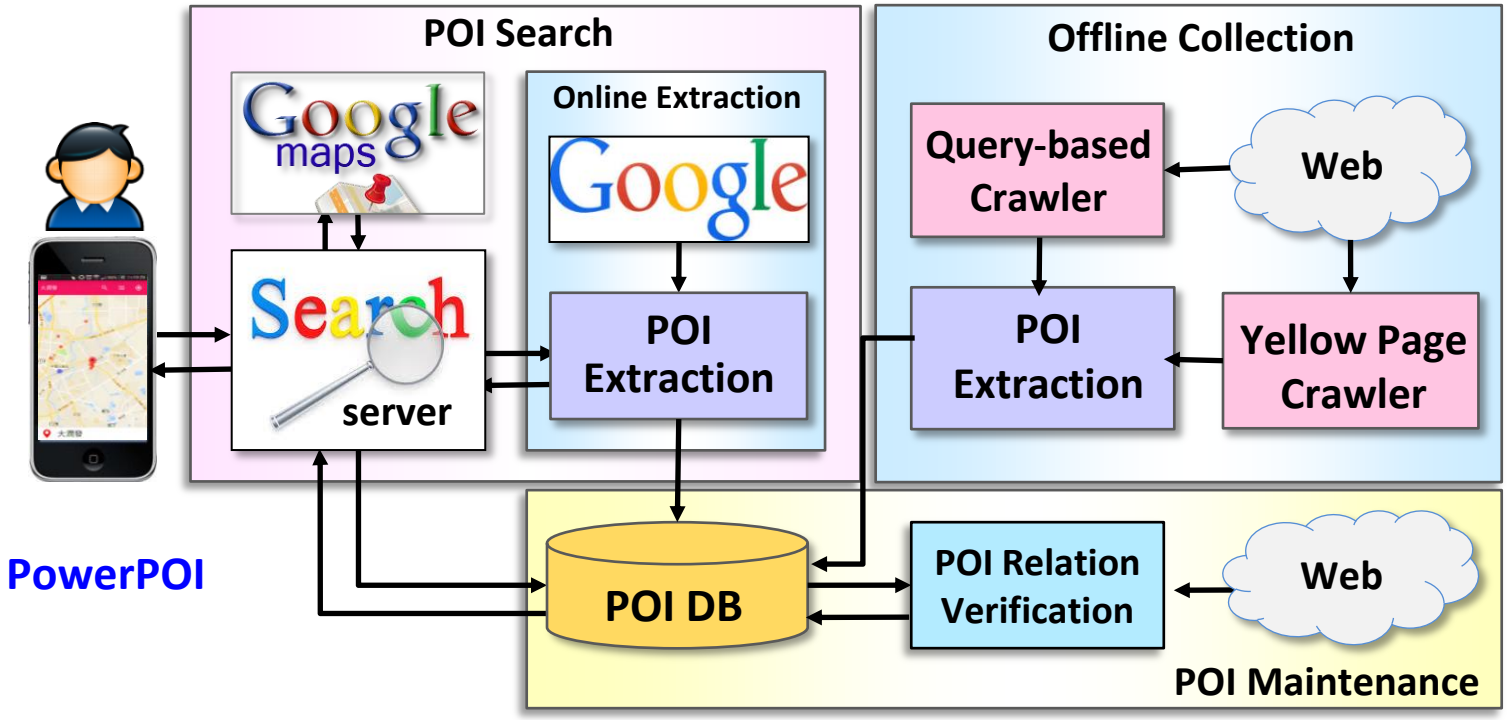

[Download PowerPOI (疾疾店家現身) APP from Apple Store]

# How to Build and Maintain a POI Database

**Goal:** Automatically extract POIs from Web, construct a POI-DB, and verify POI relations to enable POI search on maps

Task Definition

- POI name
- Address
- Business Hour
- Service description




Enabling Maps/Location Searches on Mobile Devices: Constructing a POI Database via Focused Crawling and Information Extraction, IJGIS, 2016

# EventGo Activity Search

林圓皓、程祥恩、莊秀敏

# EventGo! -- Activity Extraction and Retrieval



[Download (Android)]

# EventGO! Find Local Activity for In-depth Journey

- Definition of an activity event
  - Activity name
  - Location/Venue
  - Start/End Date
  - Host: organization name

- Sources:
  - 230K FB fanpages in Taiwan
  - Event Post

# Damage Report Monitoring

蔣佳峰、胡育維、林圓皓

# Damage Report Monitoring

作者r32104565 (JJ)看板BigPeitou標題【轉貼】梅鄉受難，心如刀割 時間Fri Aug 14 11:11:17 2009

莫拉克颱風狂掃，惡水淹漫、土石流肆虐。

生我、育我的梅仔坑（嘉義縣梅山鄉）竟淪為嚴重災區。

許多住戶家園全毀，許多鄉親生死不明，連我的二哥也困在瑞里山上，不能回家。

不只是梅山鄉，整個南臺灣災情慘烈，已超過九二一大地震，宛如人間煉獄。

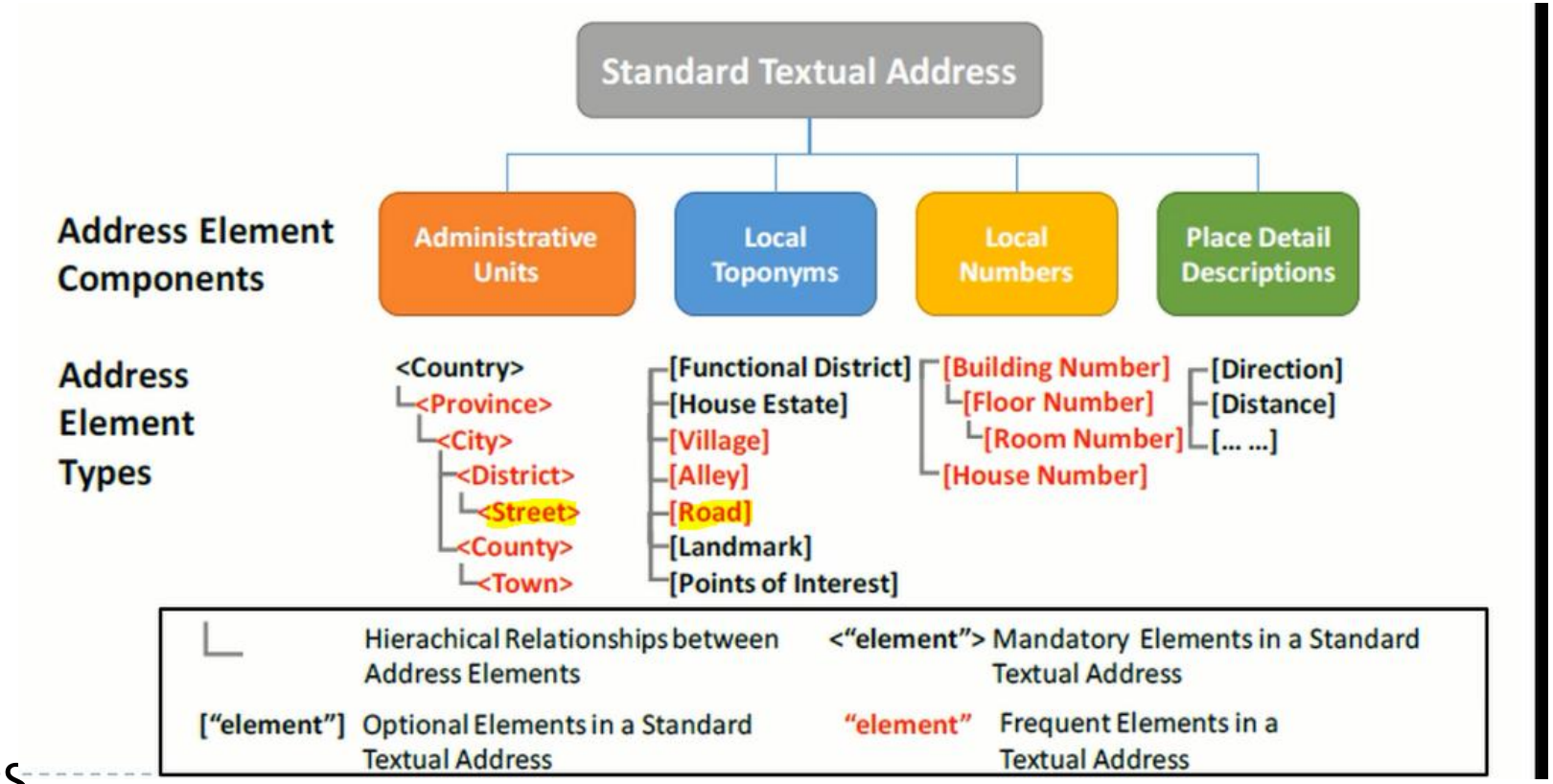
http://tw.myblog.yahoo.com/jw!s3JxrMyRHADOFXJOEBnfG521/article?mid=2884&prev=-1&next=2867

## Information Extraction Tasks

- **Named Entity Recognition**
  - **Damage**
  - **Location name**
  - **Date/Time**
- **Relation coupling**
- **Location Positioning**

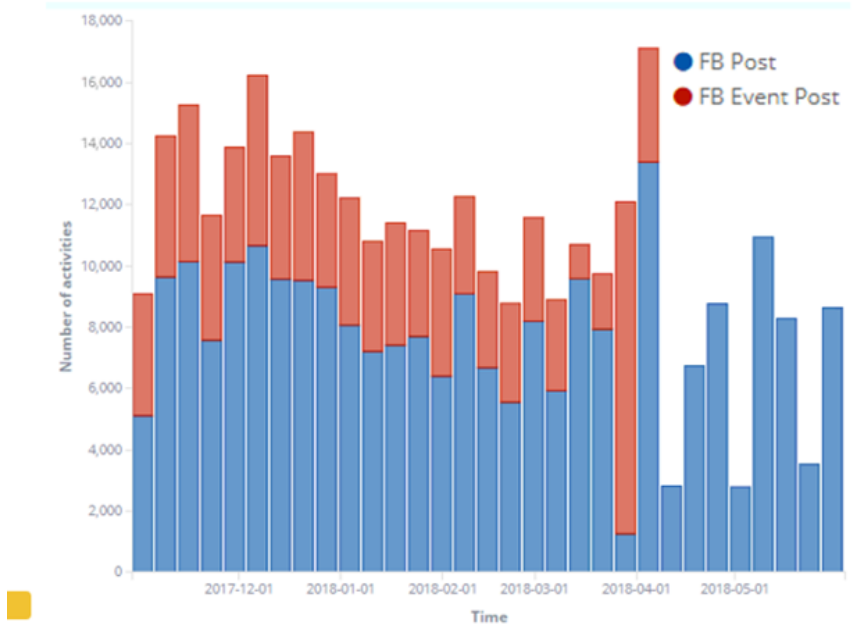
# Location Recognition and Geocoding

- Vocabulary
  - Location
  - Place
  - Venue
  - Toponym
  - Country
  - Address
- Geocoding
  - May not be a single GPS
  - E.g. Central Park



# Activity/Event Monitoring & Visualization

- Temporal-Spatial Activity Extraction
- Visualization




# Behind the story…

## DS4NER: Distant Supervision for Named Entity Recognition

# Named Entity Recognition

- Task: Identifying salient named entities in free text
  - PERSON, PLACE, ORGANIZATION, QUANTITY, DATE/TIME
- EVENT
  - activity name, theorem
- And other **Domain-Specific** fields of interest
  - song, album, drama, movie, book, product names, etc.
- PLACE
  - Location, POI, Toponym, address

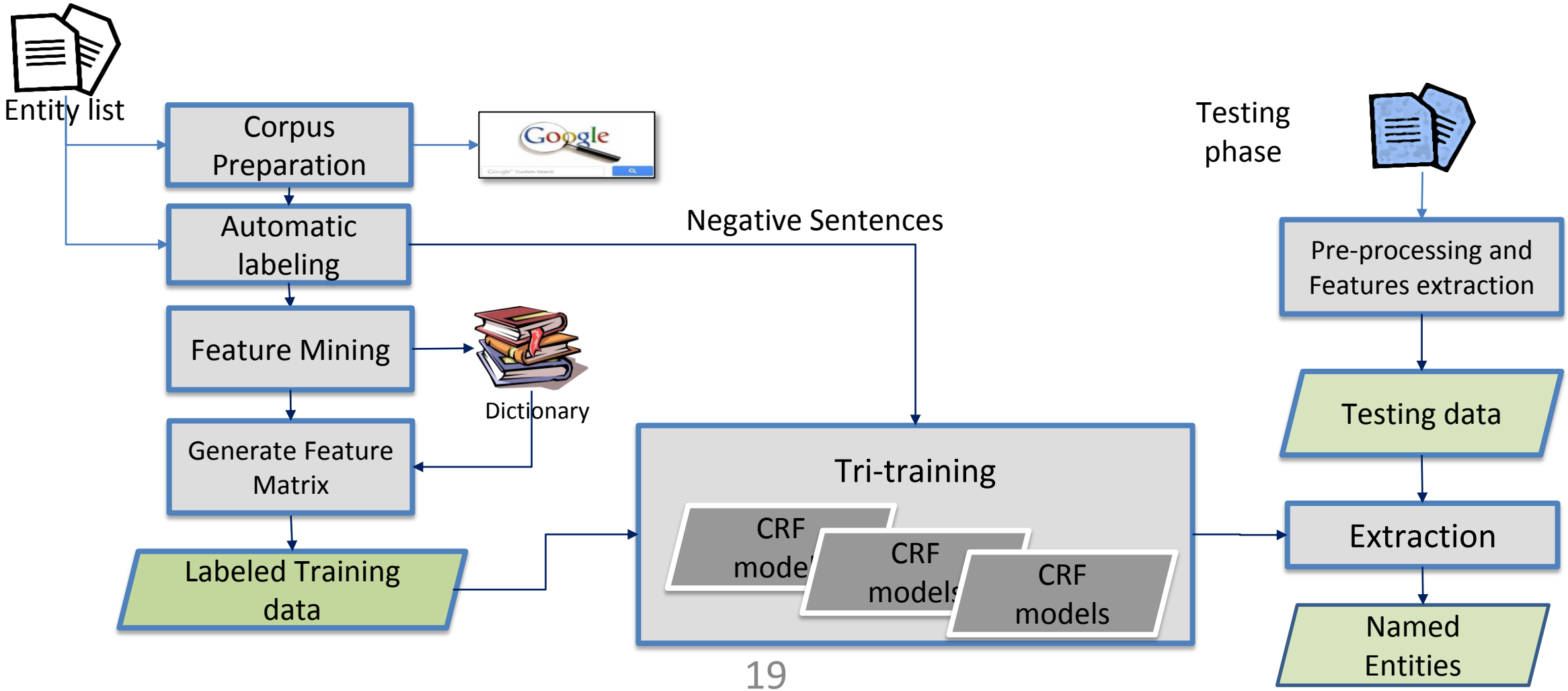
# DS4NER: Training NER models for New Entities

- Issues
  1) How to collect a lot of good quality training data?
  2) How to find features for sequence labeling?
  3) Not enough data? Semi-supervised learning?

- Use search engine to collect sentences containing known entities
- Automatic Labeling with existing known entities
- Mining dictionary based features
  - Common Before, Common After, Entity Prefix, Entity Suffix
- Tri-Training with 3 sequence labeling models
  - Making use of unlabeled data

https://sites.google.com/site/nculab/projects/ds4ner

# DS4NER Model Generation



# Challenges with Automatic Labeling

- Short seeds
  - Many false positive labeling
- Long seeds
  - False negative labeling with exact match
- Scalability issues
  - 500K seeds against 1M sentences
- Labeling strategy
  - Long seed first?
  - Rank by similarity?
- Avoid nested labeling

Song seeds

希望
背叛
飄

Examples:

【葉婉如／台北報導】李安說：「不<NE>希望</NE>兒子得獎」
今年由黃明志的<NE>飄</NE>向北方拿下冠軍
以<NE>背叛</NE >為主題的電影很多

Activity seed:

國父紀念館館藏展
台灣工藝之家府城聯展

Examples:

今年...五月甫於**國父紀念館**中山國家畫廊，
國寶級木雕大師吳榮賜曾榮獲「**台灣工藝之家**」之尊榮，

# Automatic Labeling: Efficient Labeling with LSH

1) k-shingle
   - Sentence *s* = abcab, *k*-shingle(s, *k*=2) = {ab, bc, ca, ab}
   - Transfer *s* to a long sparse vector format, *v* = {0 0 1 0 0 1 0 1 …}
2) MinHashing
   - Convert *k*-shingle vectors to short signatures vectors of length *L*, while preserving similarity.

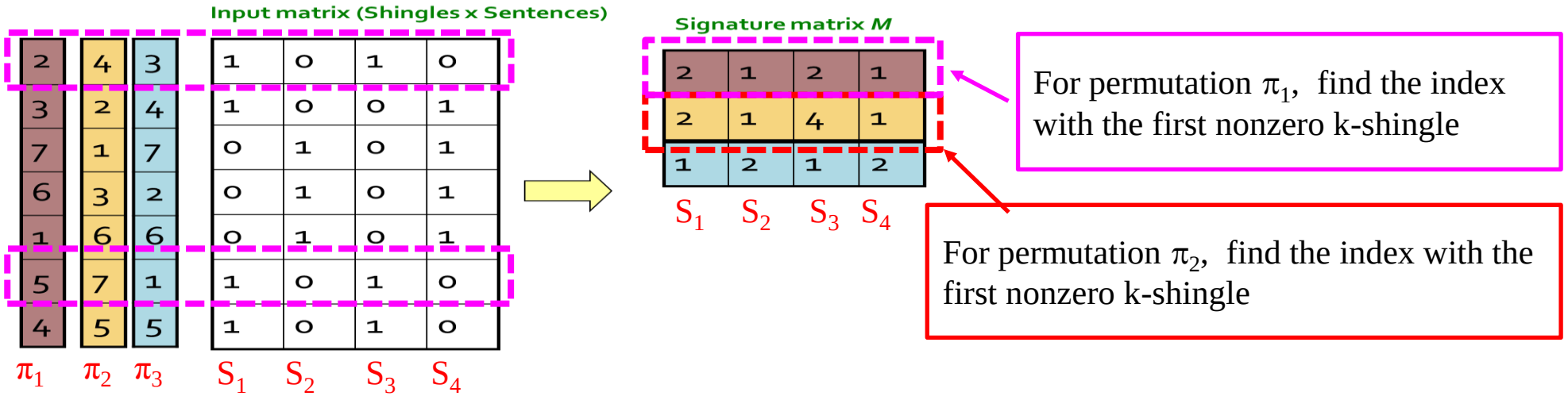





Figure source: Anand Rajaraman et. al., Mining of Massive Datasets Textbook, 2011

# Automatic Labeling: Efficient Labeling with LSH (Cont.)

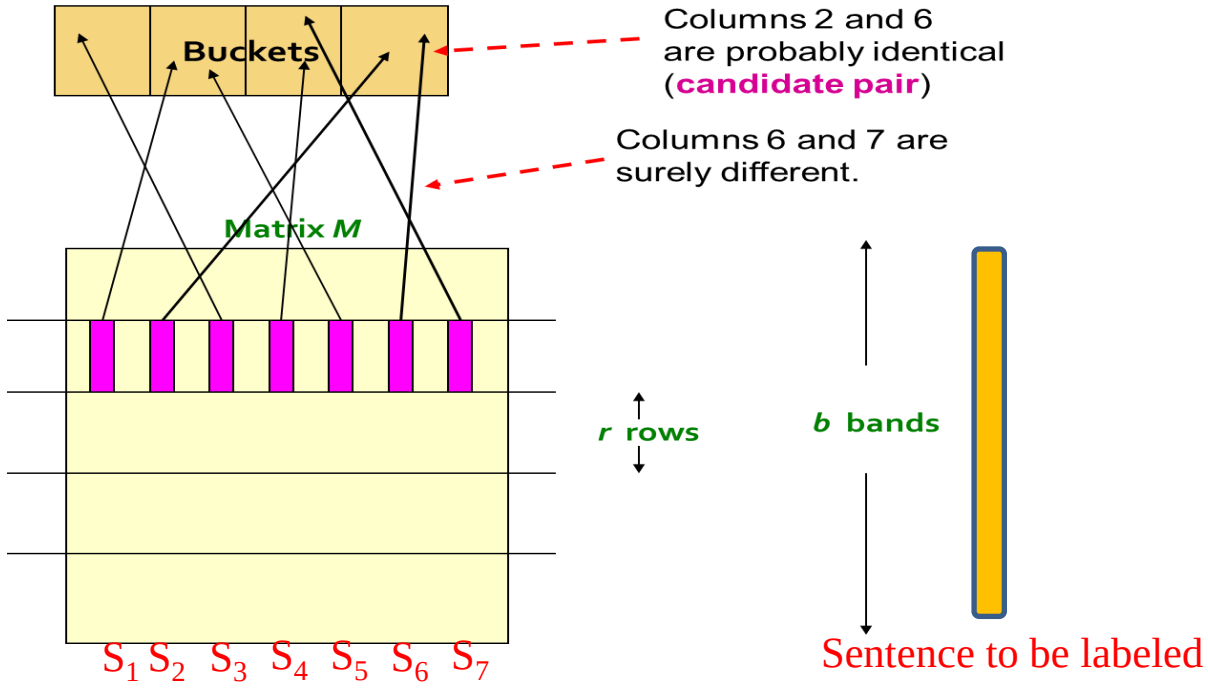
## 3) Locality-Sensitive Hashing

- Each column of signature matrix *M* is divided into *b* bands of *r* rows.
- For each band, hash the code to a table with *k* buckets.
- Each pair of seeds hashed into the same bucket represents a candidate pair.
  - If two sentences are duplicates, they will be hashed to the same bucket for some band

## 4) For each sentence to be labeled

Find candidate seeds from each band using sentence signature

Time 227 days (estimated with 4 threads) → 1d09h (4 threads)



# Automatic Labeling Policy

- Build 3 LSH Based on the length of a seed
  - Short: Length $\leqq$ 2 → ignore/exact labeling + guillemets (option)
  - Medium Seed: 3 $\leqq$ Length $\leqq$ 5 → exact labeling/exact labeling + guillemets (option)
  - Long: Length > 5 → partial labeling with LCS (alignment)
- Labeling Policy 1
  - From long seed labels to short seeds
  - Label the current seed if its similarity > threshold or contain core or last or first then
- Labeling Policy 2
  - Ranking by Similarity
  - Label current seed if the aligned part contain core or first or last of a seed

# Automatic Labeling: Policy

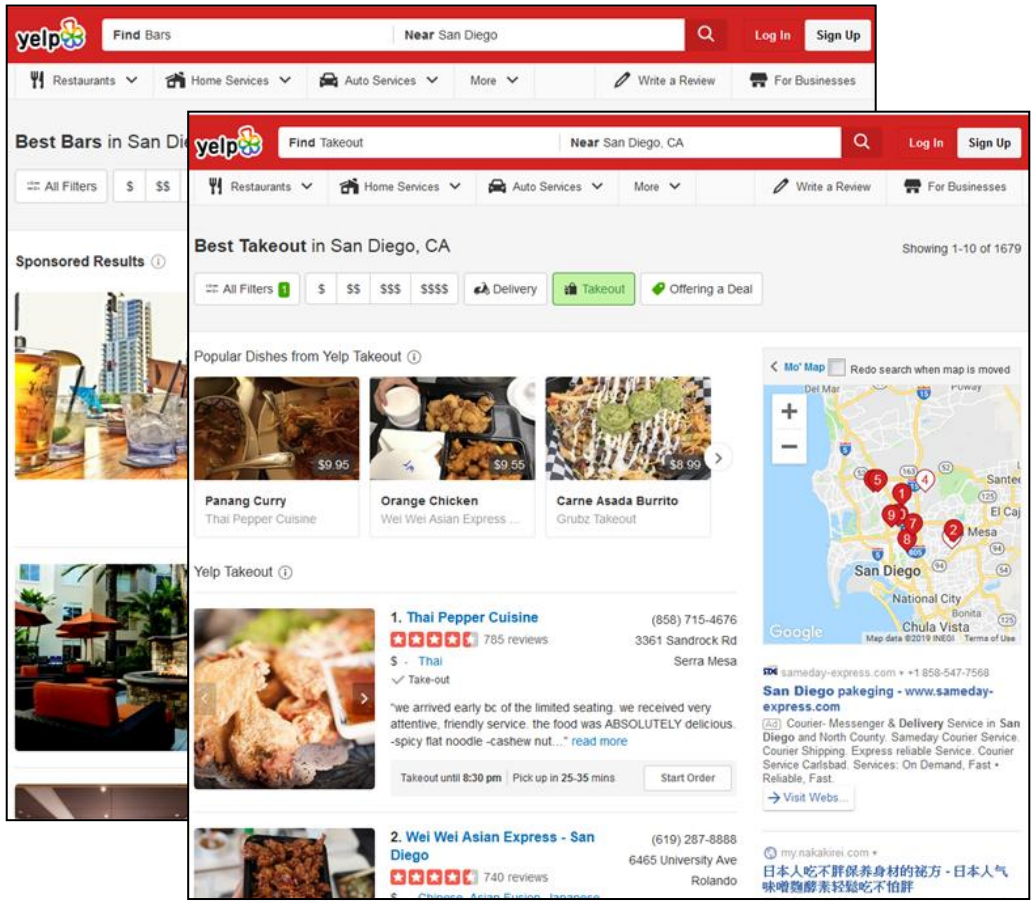
1) Replace matched seed with tags
1) Early stop the internal for loop
2) Filter out negative examples (option)
3) Supports multi-threading technology
4) Supports LSH to improve performance

# How to Obtain Those Seed Entities?

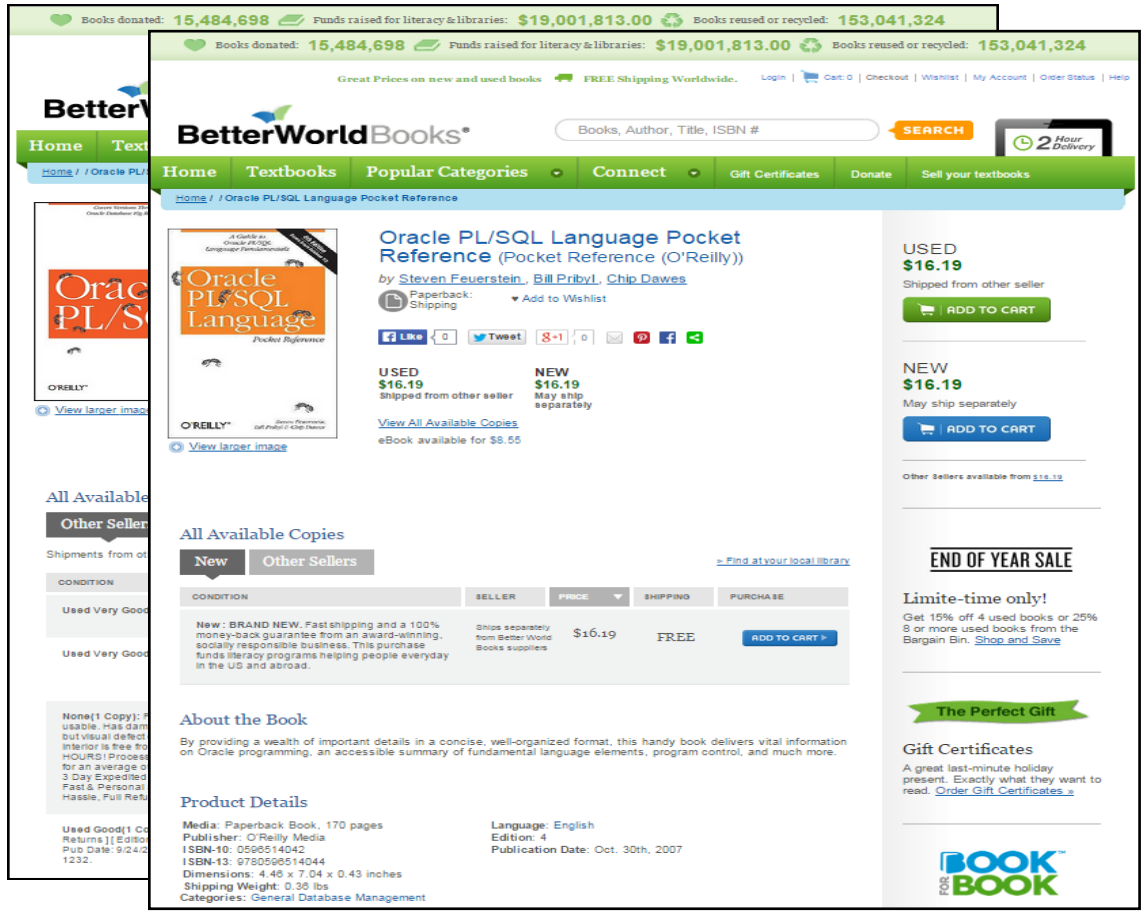
Web Data Extraction

# List vs. Singleton Pages

- Most researches focus on data extraction from **list-pages**.
- The performance is evaluated on the **selected data items**.
- Output: Record-level vs. Page-level (full) schema

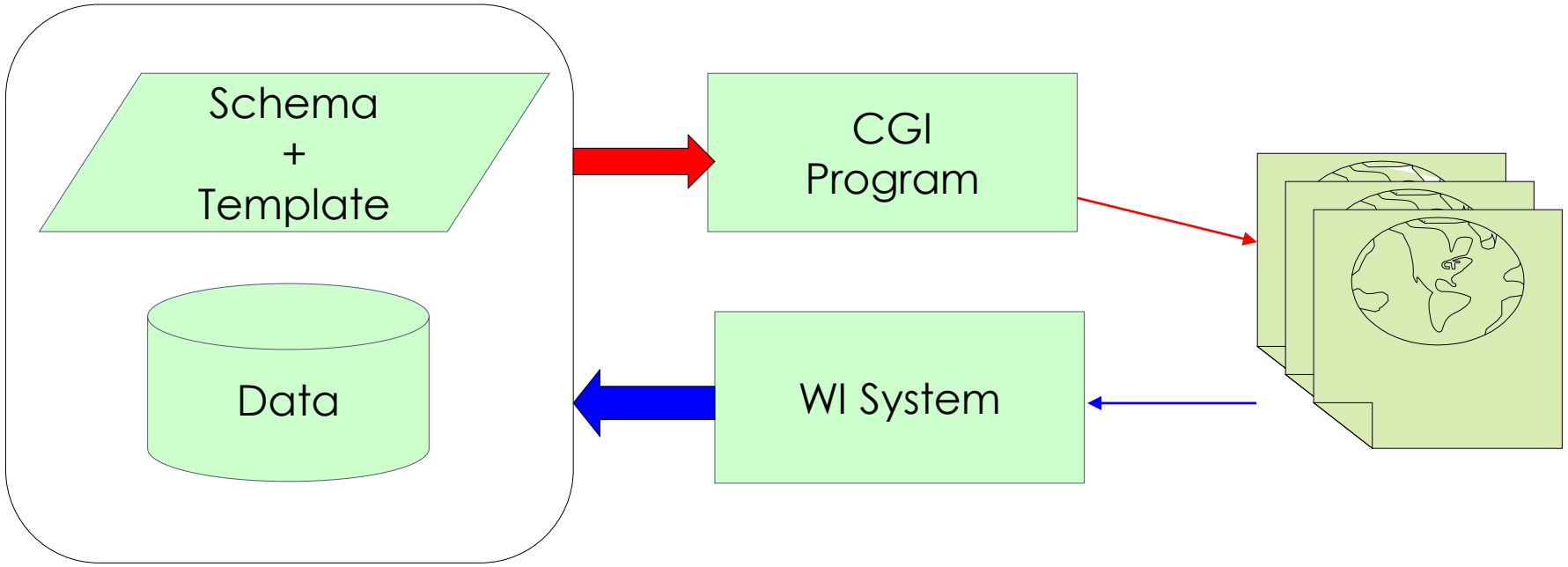



List Pages




SingletonPages

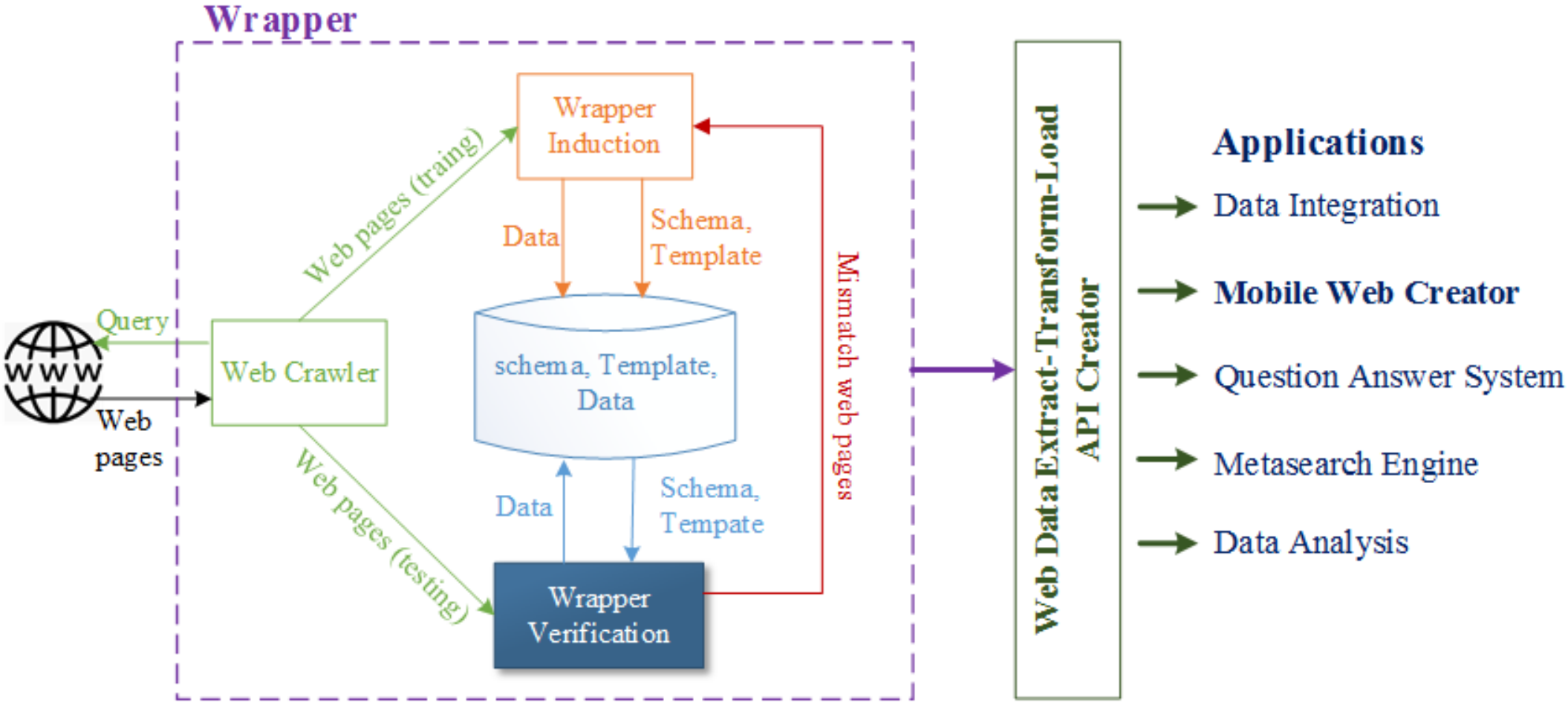
# Core Technique: Deep Web Wrapper Induction – Reverse Engineering




⇒ CGI programs generate HTML pages based on schema+template and data.

⇐ WI systems infer the schema+template and data from Html pages.

# DeXaR Project
# Data Extraction and Reuse



# APPLICATIONS OF DEEP WEB DATA EXTRACTION

- Web ETL API Creator
- Mobile Web Creator

Extract-Transform-Load Web data from

Create a Mobile Web site from existing web servers (reuse of existing system)

# Web Data ETL API Creator

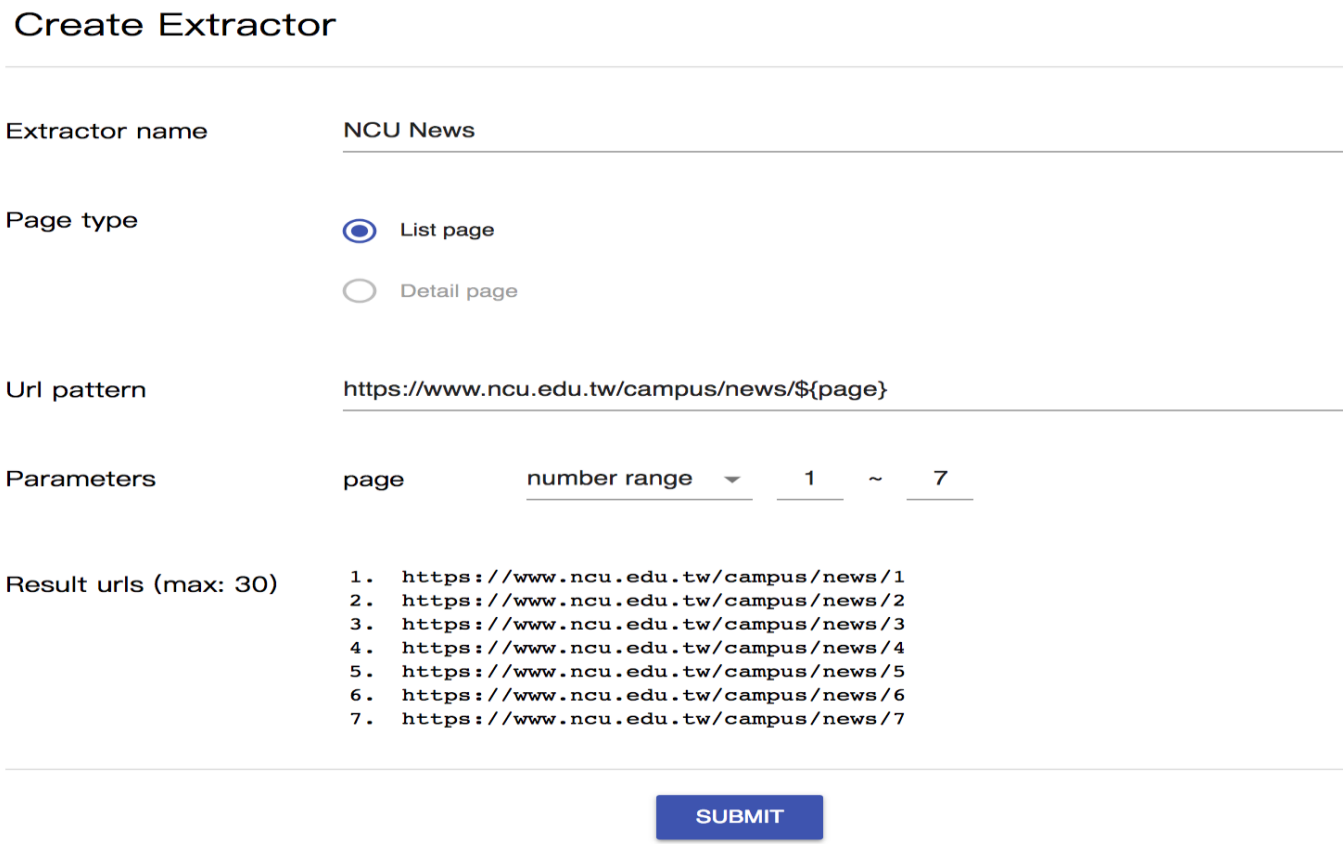
**Goal: A tool for creating data API endpoint**

**Features:**

- **Web data crawling and extraction without programming**
- **Two Backend Wrapper Induction Methods :**
  - **Single list page extraction**
  - **Multiple page extraction: DCA [Applied Intelligence 2018]**

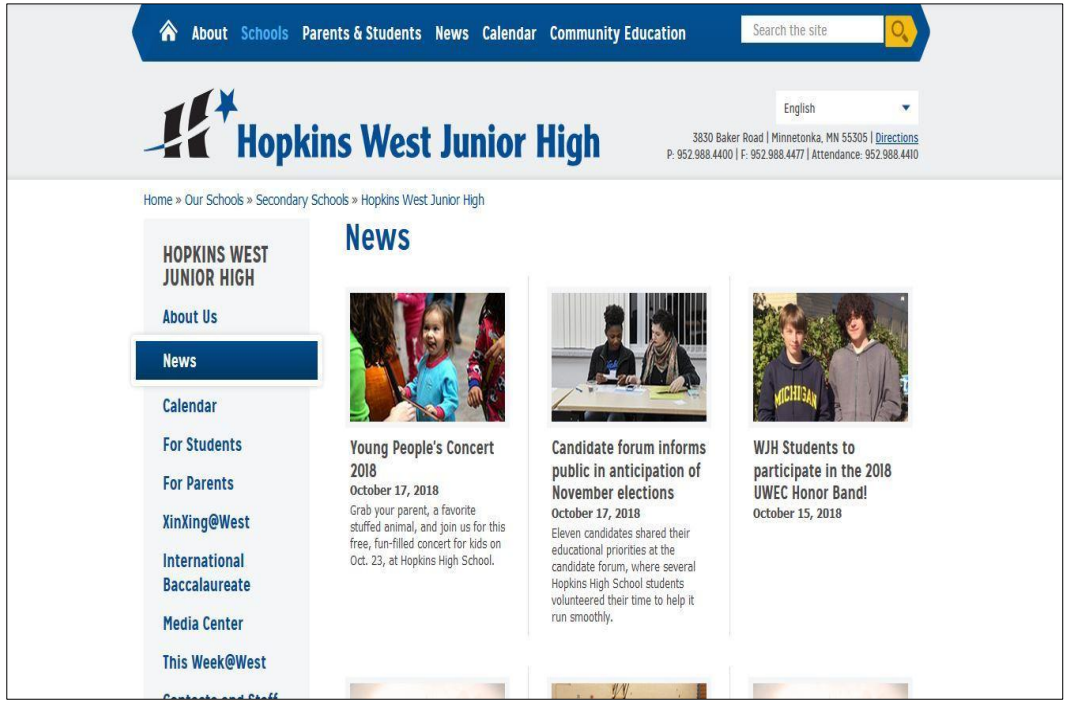
# How to create a Data ETL API?

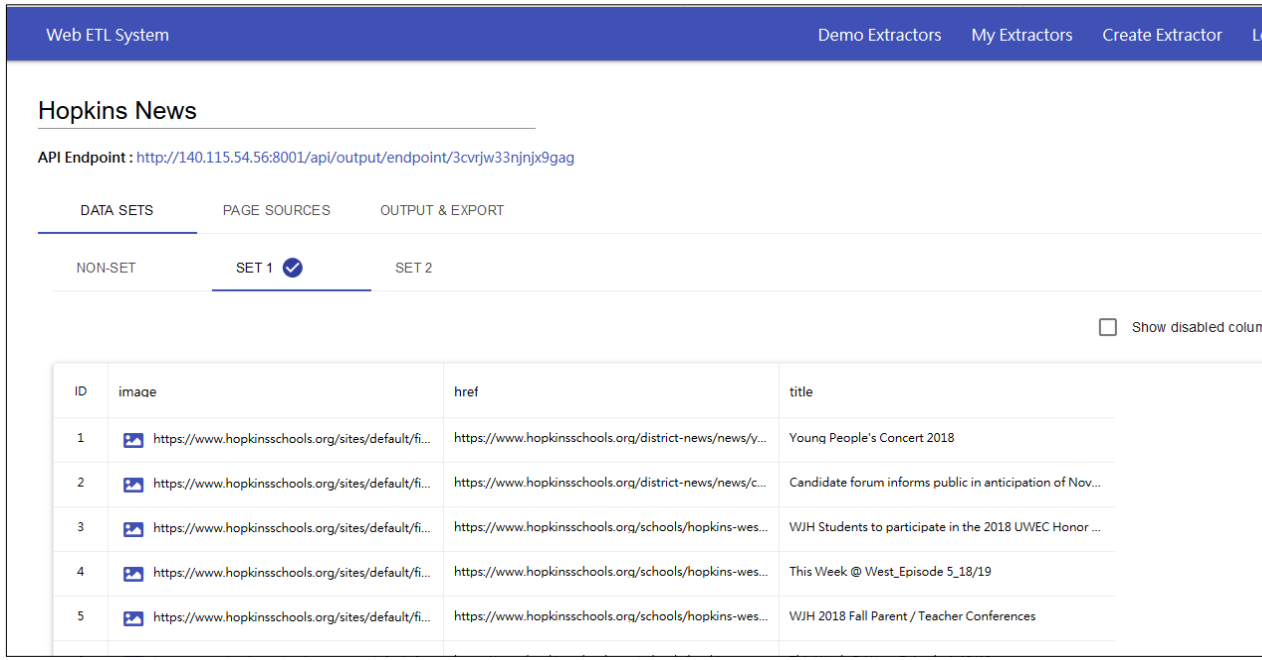
1. **Create extractor: Input url pattern and parameters to generate url list.**
2. **Setup extractor: Enable/Disable/Merge columns**
3. **Checkout API endpoint result**



# Web ETL API Creator

http://140.115.54.44:8001/



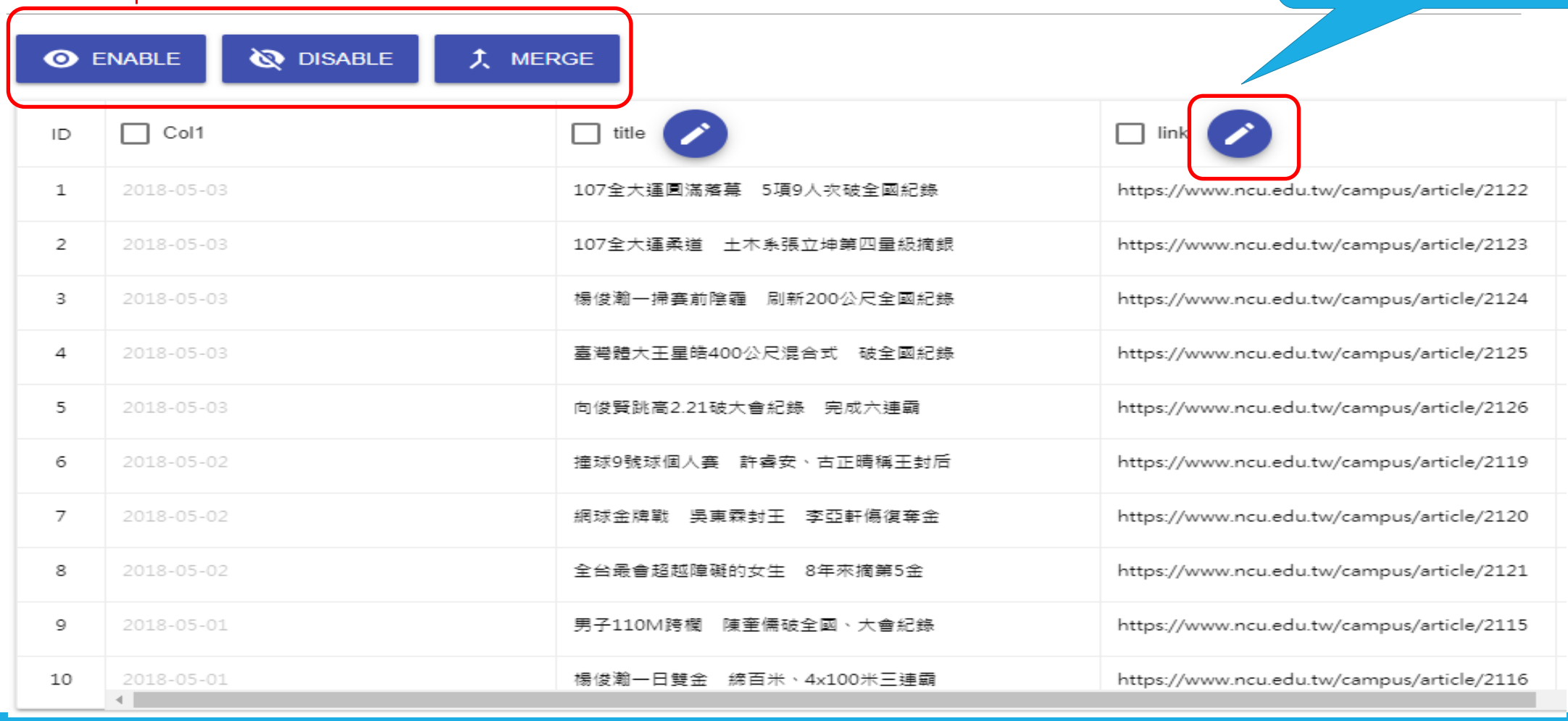

HWJH website
recent news page

Structure (Table-like) output

# Web Data ETL API Creator

2. Setup extractor: Enable or disable the selected columns.

Edit column name




| ID | Col1 | title | link |
|---|---|---|---|
| 1 | 2018-05-03 | 107全大運圓滿落幕　5項9人次破全國紀錄 | https://www.ncu.edu.tw/campus/article/2122 |
| 2 | 2018-05-03 | 107全大運柔道　土木系張立坤第四量級摘銀 | https://www.ncu.edu.tw/campus/article/2123 |
| 3 | 2018-05-03 | 楊俊瀚一掃賽前陰霾　刷新200公尺全國紀錄 | https://www.ncu.edu.tw/campus/article/2124 |
| 4 | 2018-05-03 | 臺灣體大王星皓400公尺混合式　破全國紀錄 | https://www.ncu.edu.tw/campus/article/2125 |
| 5 | 2018-05-03 | 向俊賢跳高2.21破大會紀錄　完成六連霸 | https://www.ncu.edu.tw/campus/article/2126 |
| 6 | 2018-05-02 | 撞球9號球個人賽　許睿安、古正晴稱王封后 | https://www.ncu.edu.tw/campus/article/2119 |
| 7 | 2018-05-02 | 網球金牌戰　吳東霖封王　李亞軒傷復奪金 | https://www.ncu.edu.tw/campus/article/2120 |
| 8 | 2018-05-02 | 全台最會超越障礙的女生　8年來摘第5金 | https://www.ncu.edu.tw/campus/article/2121 |
| 9 | 2018-05-01 | 男子110M跨欄　陳奎儒破全國、大會紀錄 | https://www.ncu.edu.tw/campus/article/2115 |
| 10 | 2018-05-01 | 楊俊瀚一日雙金　續百米、4x100米三連霸 | https://www.ncu.edu.tw/campus/article/2116 |

# Web Data ETL API Creator

## 2. Setup extractor：Rename the column name


# Web Data ETL API Creator

2. Setup extractor：Merge multiple columns into one column.

| Col5 | Col6 | Col7 |
|---|---|---|
| 2019/12/31 23:00(+0800) | | |
| 2019/05/18 09:30(+0800) | ~16:00 | |
| 2019/04/13 09:30(+0800) | ~ | 2019/04/20 16:00(+0800) |
| 2019/03/16 09:30(+0800) | ~ | 2019/03/23 16:00(+0800) |
| 2019/02/16 09:30(+0800) | ~ | 2019/02/23 16:00(+0800) |
| 2019/01/19 09:30(+0800) | ~ | 2019/01/26 16:00(+0800) |
| 2018/12/31 17:40(+0800) | | |
| 2018/12/15 09:30(+0800) | ~16:00 | |

Merge

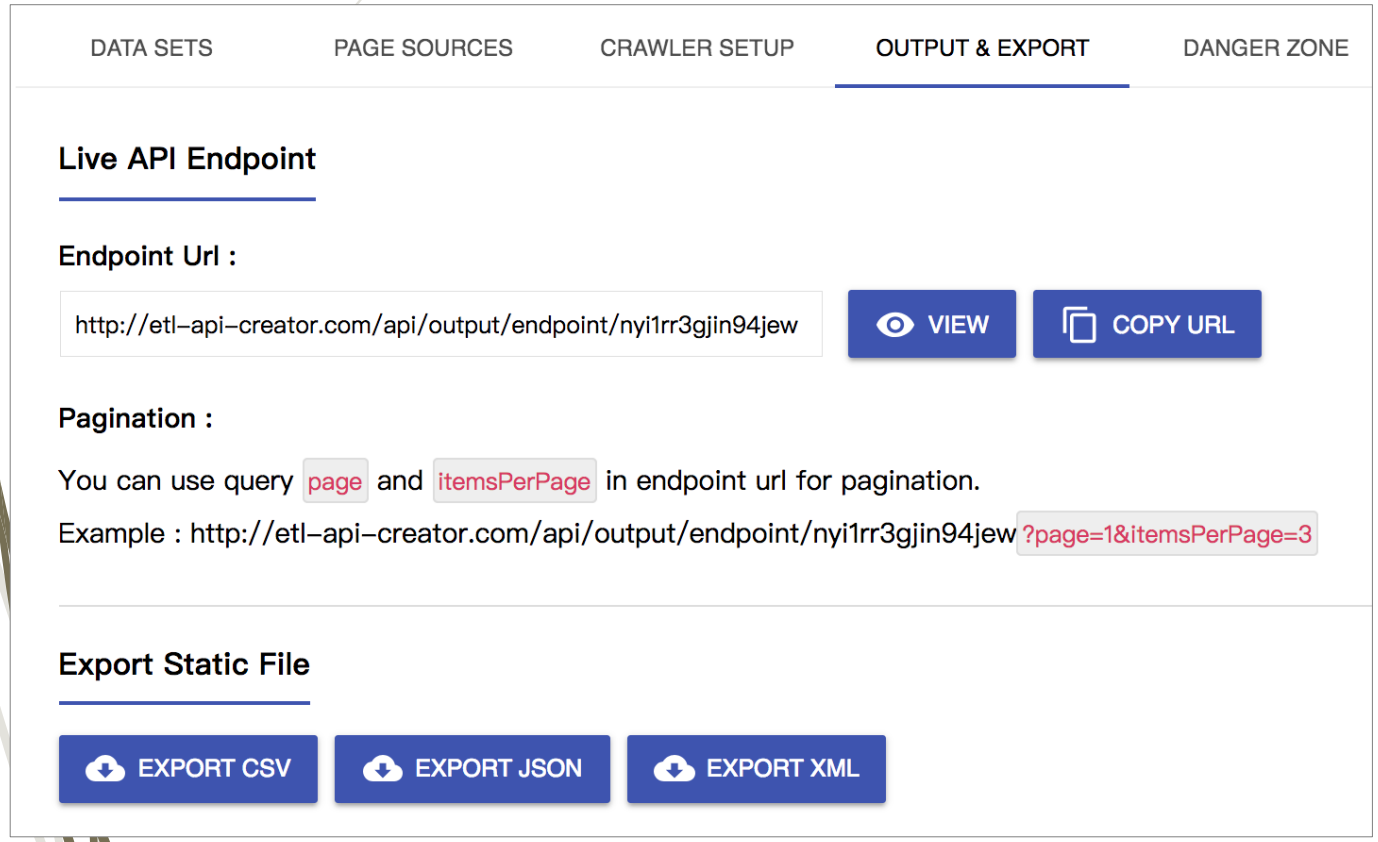
| Col5+Col6+Col7 |
|---|
| 2019/12/31 23:00(+0800) |
| 2019/05/18 09:30(+0800)~16:00 |
| 2019/04/13 09:30(+0800)~2019/04/20 16:00(+0800) |
| 2019/03/16 09:30(+0800)~2019/03/23 16:00(+0800) |
| 2019/02/16 09:30(+0800)~2019/02/23 16:00(+0800) |
| 2019/01/19 09:30(+0800)~2019/01/26 16:00(+0800) |
| 2018/12/31 17:40(+0800) |
| 2018/12/15 09:30(+0800)~16:00 |

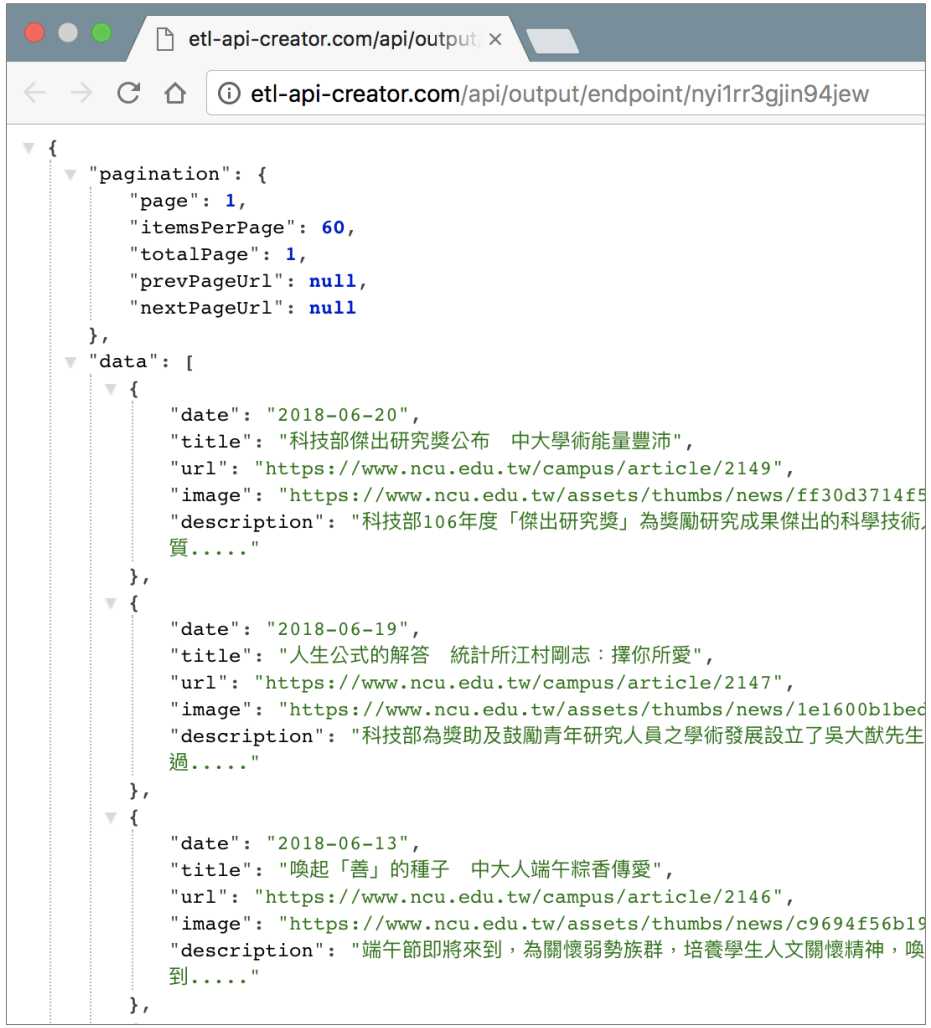
# Web Data ETL API Creator

## 3. Checkout API endpoint result

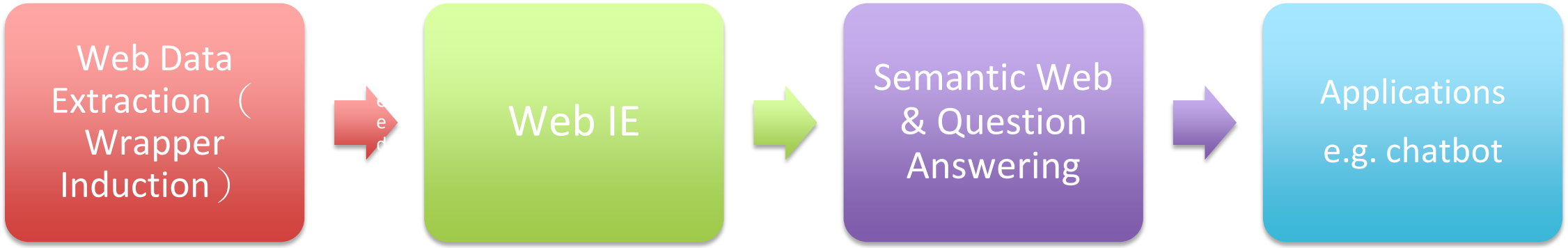
# Web Data ETL API Creator

## 3. Output API endpoint result



# Roadmap for Message Understanding and Information Management




- Single/Multiple page input
- Record/Page Level extraction

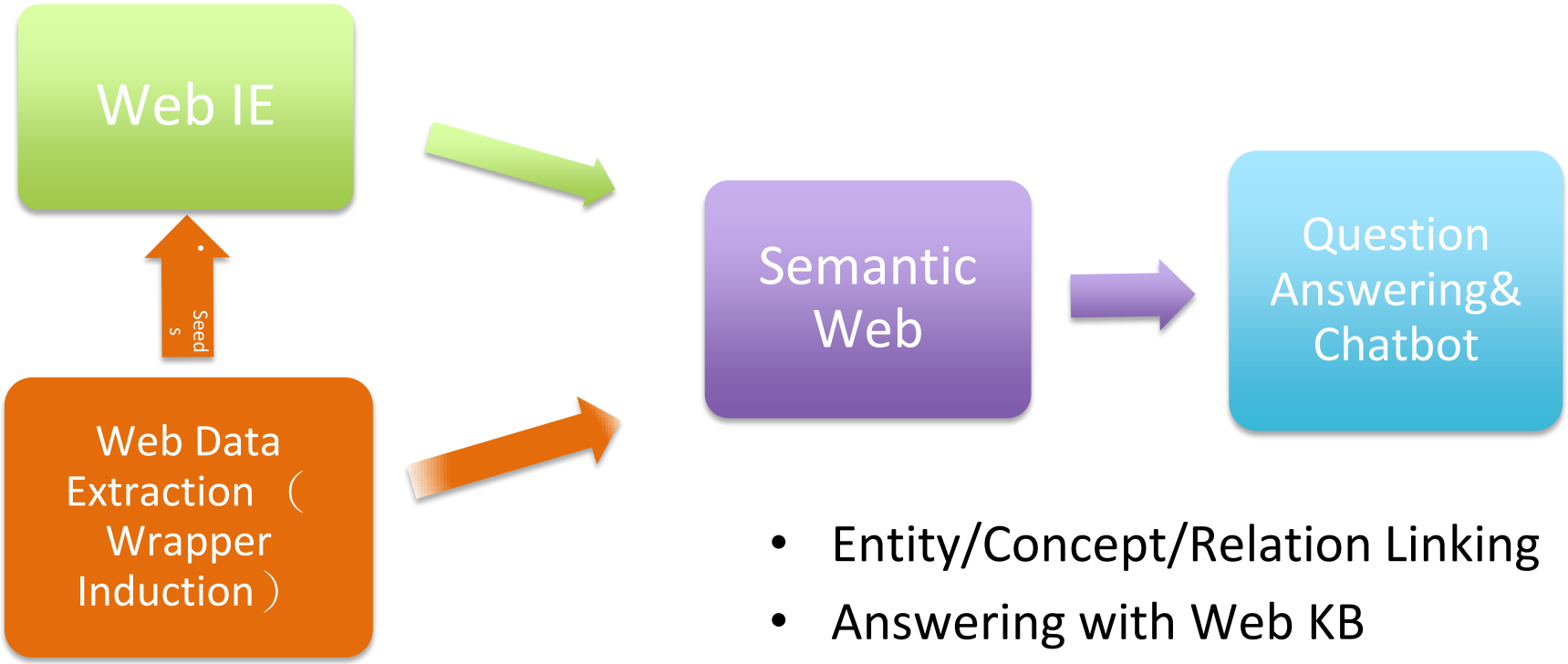
- NER
- Relation Extraction
- Coreference Resolution

- Entity/Concept/Relation Linking
- Answering with Web KB
- NTCIR Short Text Conversation (STC)
- Reading comprehension

**Co-Learning with Computers via Distant Supervision**

- NER,
- Coreference Resolution
- Relation Extraction

- Single/Multiple page input
- Record/Page Level extraction




- Entity/Concept/Relation Linking
- Answering with Web KB
- NTCIR Short Text Conversation
- Taiwan AI Grand Challenge

**Co-Learning with Computers via Distant Supervision**

# Conclusions

- Deep Web Data Extraction
  - Web data reuse and integration
  - Enhance Web KB for better question answering
- NER & Relation Extraction
  - Question answering
  - Damage report monitoring, Activity search, POI search, etc.
  - Call center client service