# Overview of the NTCIR-15 Data Search Task

**Makoto P. Kato (University of Tsukuba)**, Hiroaki Ohshima (University of Hyogo), Ying-Hsang Liu (University of Southern Denmark), Hsin-Liang Chen (Missouri University of Science and Technology)




- **The open data movement is now being accelerated by the expectations for open science and citizen science**
  - Each country strongly encourages the open data movement:
    - Data.gov (United States)
    - Data.gov.uk (United Kingdom)
    - Data.gov.au (Australia)
    - e-Stat (Japan)
- **Besides the governmental portals, there are also thousands of data repositories on the Web**

**Demand for a better data search engine**

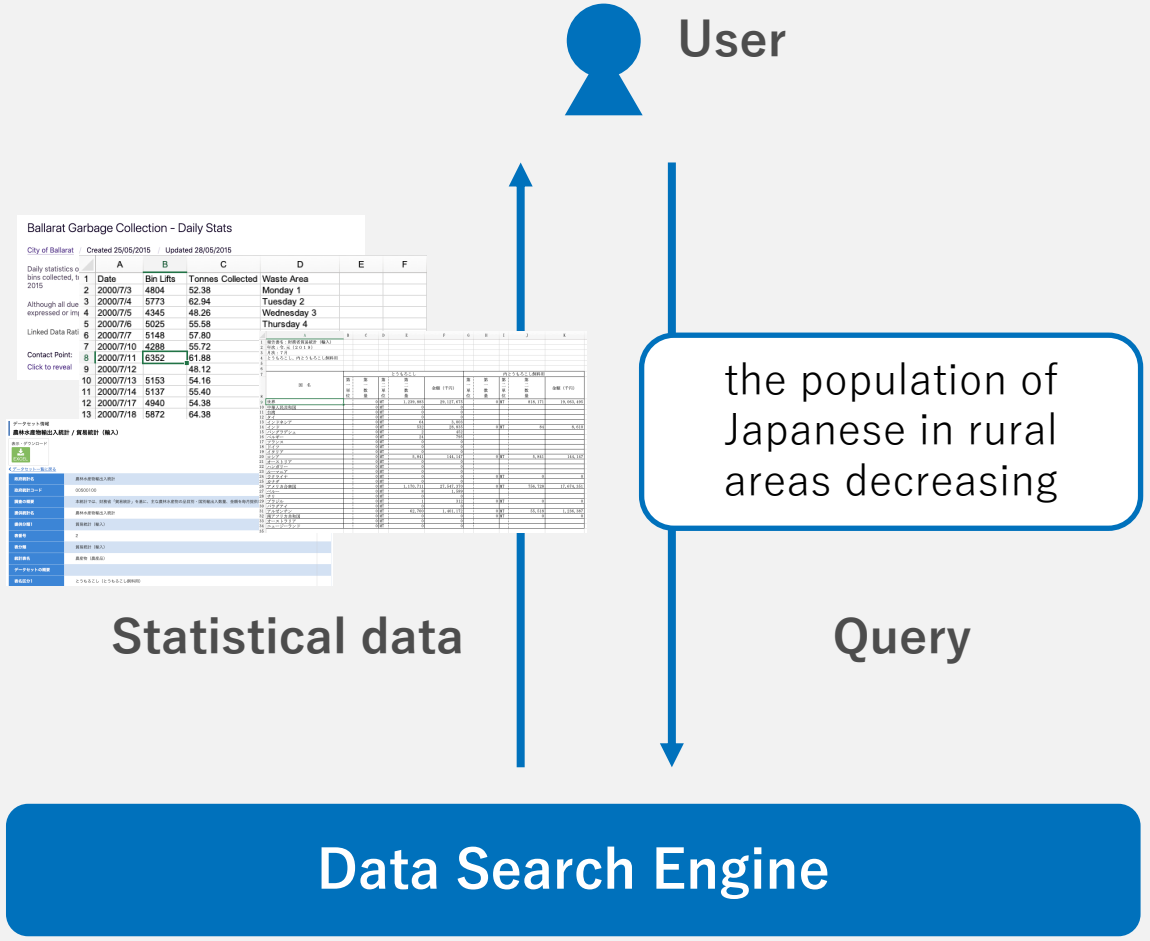
**(e.g. Google Dataset Search)**

# The very first IR evaluation campaign for data search

| | | |
|---|---|---|
| **Japanese** | **Documents (or *datasets*)** | 1,338,402 |
| | **Training queries** | 96 |
| | **Test queries** | 96 |
| | **Relevance judgments for training queries** | 2,035 |
| | **Relevance judgments for test queries** | 5,719 |
| **English** | **Documents (or *datasets*)** | 46,615 |
| | **Training queries** | 96 |
| | **Test queries** | 96 |
| | **Relevance judgments for training queries** | 2,008 |
| | **Relevance judgments for test queries** | 6,240 |

# Ad-hoc retrieval for statistical data

- **Subtasks**
  - English and Japanese
- **Input**
  - 96 queries for each of the subtasks
- **Document (or Dataset) collection**
  - e-Stats for Japanese
  - Data.gov for English
- **Output**
  - Ranked list of datasets for each query



- **Query understanding for data search**
  - Queries for data search include more geographical, temporal, and numerical keywords than those for Web search (Kacprzak+ 2017)
  - The goal of data search can be diverse, e.g. time series analysis and summarization (Koesten+ 2017)
- **Data understanding for data search**
  - Metadata are not always sufficiently informative
  - Data in Excel, CSV, XML, and PDF formats is potentially used with metadata to enrich the index for data search, while interpreting data on the Web is a still challenging problem
- **Retrieval models for data search**
  - Data contains a lot of entities such as locations or products, temporal expressions, and numerical expressions
  - Numerical expressions might require a new model for better rankings

- **Information needs, by which queries are generated and relevance of a dataset is judged, are derived from questions in cQA**
  - Extracted **3,219** Q&As from Yahoo Chiebukuro (Yahoo Japan's cQA) that include links to a Japanese open data portal
  - They were manually assessed, from which we obtained only **192** questions that can be considered as information needs for datasets
  - Japanese-specific entities were transformed into corresponding US-specific ones
    - e.g. Kansai → East coast, Tokyo → New York

| Japanese information needs | English information needs |
|---|---|
| 若者の農業離れが最近騒がれていますが、それを裏付けるデータを探しています。 | I am looking for data proving young people's lack of interest in farming. |
| 関西地方では現在も納豆をあまり食べないのですか？ | Do people in the East Coast dislike oysters? |
| 老人医療費が医療費全体に占める割合が高いのは本当でしょうか？ | Is it true that medical expenses for elderly account for a large percentage of total medical expenses? |

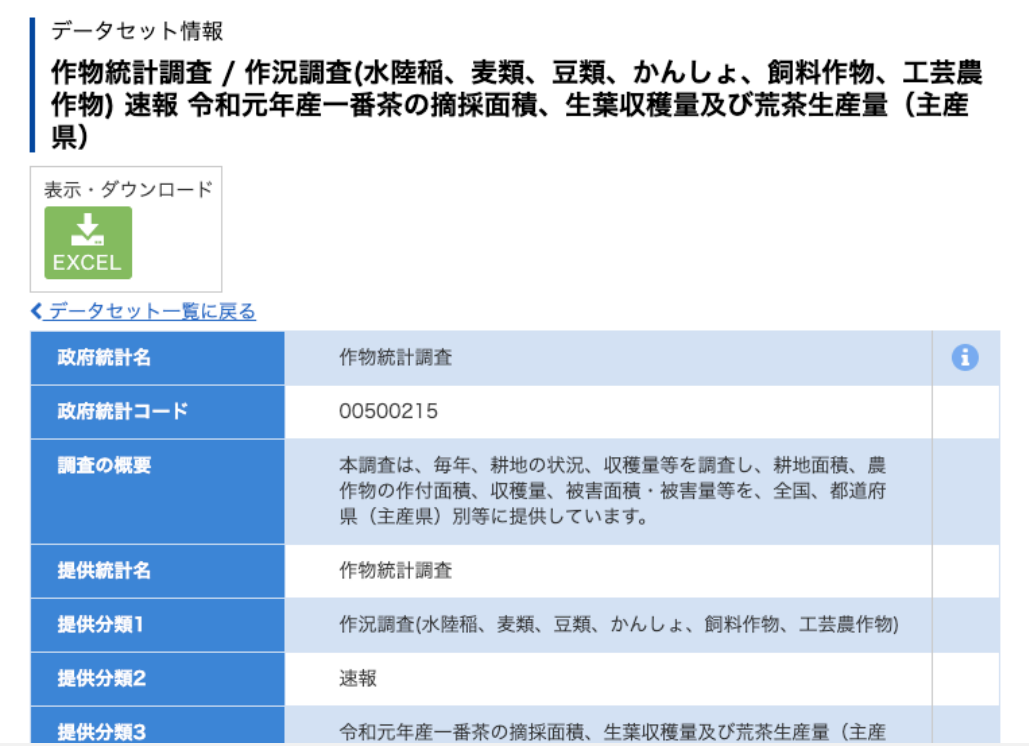
- **Used crowd-sourcing services to convert information needs to queries**
  - Showed a need and asked workers to input a query without looking at the need
    - Tried to simulate a more realistic situation
  - Selected the most "probable" query from 10 workers' queries
    - Built a unigram language model from those queries, and selected the one with the highest perplexity with respect to the language model

# Examples of Topics and Queries

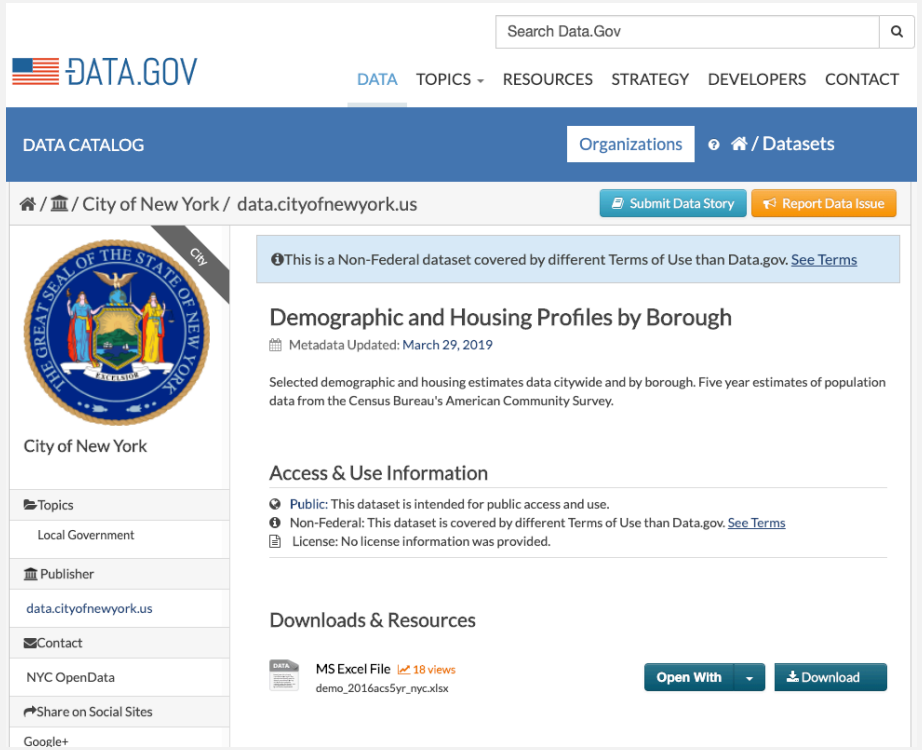


| Topic ID | Topic | Query |
|---|---|---|
| DS1-E-0001 | Do people in the East Coast dislike oysters? | oysters dislike east coast |
| DS1-E-0004 | I am looking for evidences of domestic self-sufficiency rate of salt | domestic self salt rate |
| DS1-E-0007 | Are there many people who can't drive large trailers? | people can't drive large trailers |
| DS1-E-0009 | How many people have a second house? | many people second house |
| DS1-E-0014 | Which city has a population of about 300,000? | city population 300,000 |

- **Japanese**
  - –e-Stat
    - https://www.e-stat.go.jp/
    - 1,338,402 (~100GB)




- **English**
  - –Data.gov
    - https://www.data.gov/
    - 46,615 (~445GB)



# Examples of Datasets



## Ballarat Garbage Collection - Daily Stats

City of Ballarat / Created 25/05/2015 / Updated 28/05/2015

Daily statistics of garbage collection in the City of Ballarat. Includes date, number of garbage bins collected, tonnes of waste collected, area of collection. Date range July 2000 - March 2015

Although all due care has been taken to ensure that these data are correct, no warranty is expressed or implied by the City of Ballarat in their use.

Linked Data Rating: ★★☆☆☆

Contact Point:

Click to reveal

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Date | Bin Lifts | Tonnes Collected | Waste Area | | |
| 2 | 2000/7/3 | 4804 | 52.38 | Monday 1 | | |
| 3 | 2000/7/4 | 5773 | 62.94 | Tuesday 2 | | |
| 4 | 2000/7/5 | 4345 | 48.26 | Wednesday 3 | | |
| 5 | 2000/7/6 | 5025 | 55.58 | Thursday 4 | | |
| 6 | 2000/7/7 | 5148 | 57.80 | Friday 5 | | |
| 7 | 2000/7/10 | 4288 | 55.72 | Monday 1 | | |
| 8 | 2000/7/11 | 6352 | 61.88 | Tuesday 2 | | |
| 9 | 2000/7/12 | | 48.12 | Wednesday 3 | | |
| 10 | 2000/7/13 | 5153 | 54.16 | Thursday 4 | | |
| 11 | 2000/7/14 | 5137 | 55.40 | Friday 5 | | |
| 12 | 2000/7/17 | 4940 | 54.38 | Monday 1 | | |
| 13 | 2000/7/18 | 5872 | 64.38 | Tuesday 2 | | |
| 14 | 2000/7/19 | 4188 | 47.02 | Wednesday 3 | | |
| 15 | 2000/7/20 | 5057 | 54.26 | Thursday 4 | | |
| 16 | 2000/7/21 | 5063 | 54.38 | Friday 5 | | |

データセット情報

## 農林水産物輸出入統計 / 貿易統計（輸入）

表示・ダウンロード

EXCEL

データセット一覧に戻る

| | |
|---|---|
| 政府統計名 | 農林水産物輸出入統計 |
| 政府統計コード | 00500100 |
| 調査の概要 | 本統計では、財務省「貿易統計」を基に、主な農林水産物の品目別・国別輸出入数量、金額を毎月提供しています。 |
| 提供統計名 | 農林水産物輸出入統計 |
| 提供分類1 | 貿易統計（輸入） |
| 表番号 | 2 |
| 表分類 | 貿易統計（輸入） |
| 統計表名 | 農産物（農産品） |
| データセットの概要 | |
| 表名区分1 | とうもろこし（とうもろこし飼料用） |

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 報告書名：財務省貿易統計（輸入） | | | | | | | | | | |
| 2 | 年次：令.元（２０１９） | | | | | | | | | | |
| 3 | 月次：７月 | | | | | | | | | | |
| 4 | とうもろこし、内とうもろこし飼料用 | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | とうもろこし | | | | | 内とうもろこし飼料用 | | | | |
| 8 | 国　名 | 第一単位 | 第一数量 | 第二単位 | 第二数量 | 金額（千円） | 第一単位 | 第一数量 | 第二単位 | 第二数量 | 金額（千円） |
| 9 | 世界 | | 0 | MT | 1,239,883 | 29,127,675 | | 0 | MT | 818,171 | 19,063,495 |
| 10 | 中華人民共和国 | | 0 | MT | 0 | 0 | | | | | |
| 11 | 台湾 | | 0 | MT | 0 | 0 | | | | | |
| 12 | タイ | | 0 | MT | 0 | 0 | | | | | |
| 13 | インドネシア | | 0 | MT | 64 | 3,003 | | | | | |
| 14 | インド | | 0 | MT | 532 | 28,835 | | 0 | MT | 84 | 8,610 |
| 15 | バングラデシュ | | 0 | MT | 2 | 452 | | | | | |
| 16 | ベルギー | | 0 | MT | 24 | 795 | | | | | |
| 17 | フランス | | 0 | MT | 0 | 0 | | | | | |
| 18 | ドイツ | | 0 | MT | 0 | 0 | | | | | |
| 19 | イタリア | | 0 | MT | 0 | 0 | | | | | |
| 20 | ロシア | | 0 | MT | 5,841 | 144,147 | | 0 | MT | 5,841 | 144,147 |
| 21 | オーストリア | | 0 | MT | 0 | 0 | | | | | |
| 22 | ハンガリー | | 0 | MT | 0 | 0 | | | | | |
| 23 | ルーマニア | | 0 | MT | 0 | 0 | | | | | |
| 24 | ウクライナ | | 0 | MT | 0 | 0 | | 0 | MT | 0 | 0 |
| 25 | カナダ | | 0 | MT | 0 | 0 | | | | | |
| 26 | アメリカ合衆国 | | 0 | MT | 1,170,711 | 27,547,370 | | 0 | MT | 756,728 | 17,674,351 |
| 27 | ペルー | | 0 | MT | 8 | 1,589 | | | | | |
| 28 | チリ | | 0 | MT | 0 | 0 | | | | | |
| 29 | ブラジル | | 0 | MT | 1 | 312 | | 0 | MT | 0 | 0 |
| 30 | パラグアイ | | 0 | MT | 0 | 0 | | | | | |
| 31 | アルゼンチン | | 0 | MT | 62,700 | 1,401,172 | | 0 | MT | 55,518 | 1,236,387 |
| 32 | 南アフリカ共和国 | | 0 | MT | 0 | 0 | | 0 | MT | 0 | 0 |
| 33 | オーストラリア | | 0 | MT | 0 | 0 | | | | | |
| 34 | ニュージーランド | | 0 | MT | 0 | 0 | | | | | |
| 35 | | | | | | | | | | | |

# • "Dataset" is a unit of retrieval in Data Search

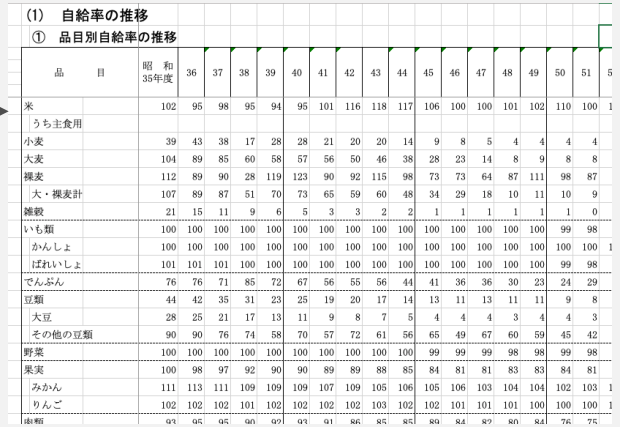
– Consists of metadata and multiple data files

## • e-Stat

– A data file for each metadata

### Metadata

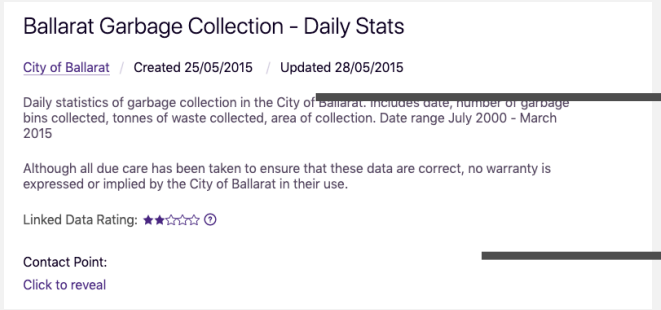

### Data file



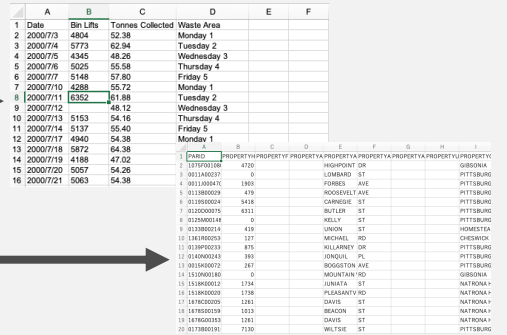

## • Data.gov

– Multiple data files for each metadata

### Metadata




### Data files

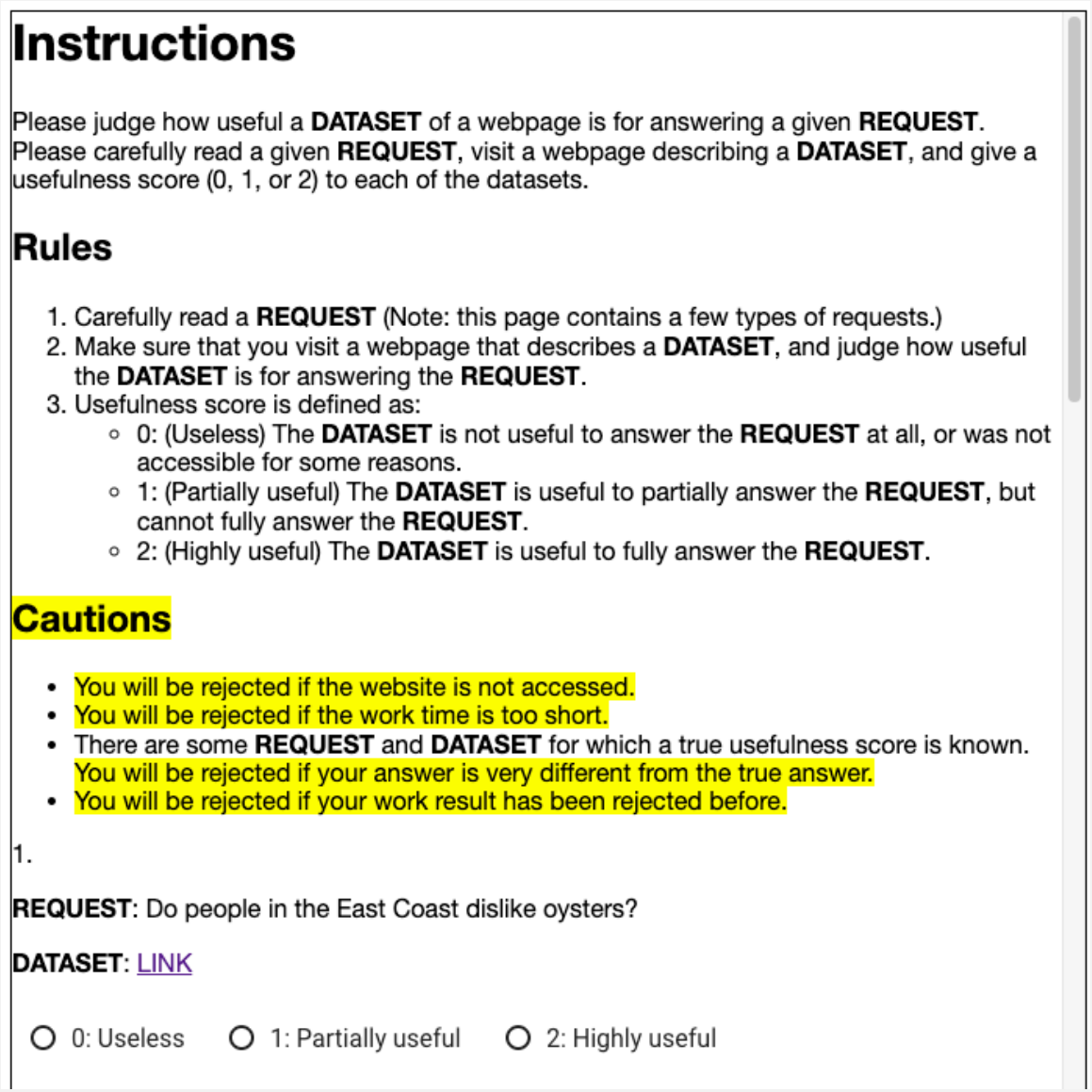


- **e-Stats**
  - Distributed under a license compatible to CC BY, which allows redistribution and modification
- **Data.gov**
  - Used only the datasets that can be redistributed, i.e. U.S. Government Work, CC BY, etc.

- **The Data Search test collection is freely available from our website**
  - https://ntcir.datasearch.jp/

- **The relevance of each dataset for a given query is judged by crowd-sourcing workers**
  - 0: Not-relevant
  - 1: Partially relevant
  - 2: Highly relevant

- **Inter-rater agreement**
  - Japanese: 0.495
  - English: 0.462
    (Not high, but not low in IR evaluation)



## Instructions

Please judge how useful a **DATASET** of a webpage is for answering a given **REQUEST**. Please carefully read a given **REQUEST**, visit a webpage describing a **DATASET**, and give a usefulness score (0, 1, or 2) to each of the datasets.

### Rules

1. Carefully read a **REQUEST** (Note: this page contains a few types of requests.)
2. Make sure that you visit a webpage that describes a **DATASET**, and judge how useful the **DATASET** is for answering the **REQUEST**.
3. Usefulness score is defined as:
   - 0: (Useless) The **DATASET** is not useful to answer the **REQUEST** at all, or was not accessible for some reasons.
   - 1: (Partially useful) The **DATASET** is useful to partially answer the **REQUEST**, but cannot fully answer the **REQUEST**.
   - 2: (Highly useful) The **DATASET** is useful to fully answer the **REQUEST**.

### Cautions

- You will be rejected if the website is not accessed.
- You will be rejected if the work time is too short.
- There are some **REQUEST** and **DATASET** for which a true usefulness score is known. You will be rejected if your answer is very different from the true answer.
- You will be rejected if your work result has been rejected before.

1.

**REQUEST**: Do people in the East Coast dislike oysters?

**DATASET**: LINK

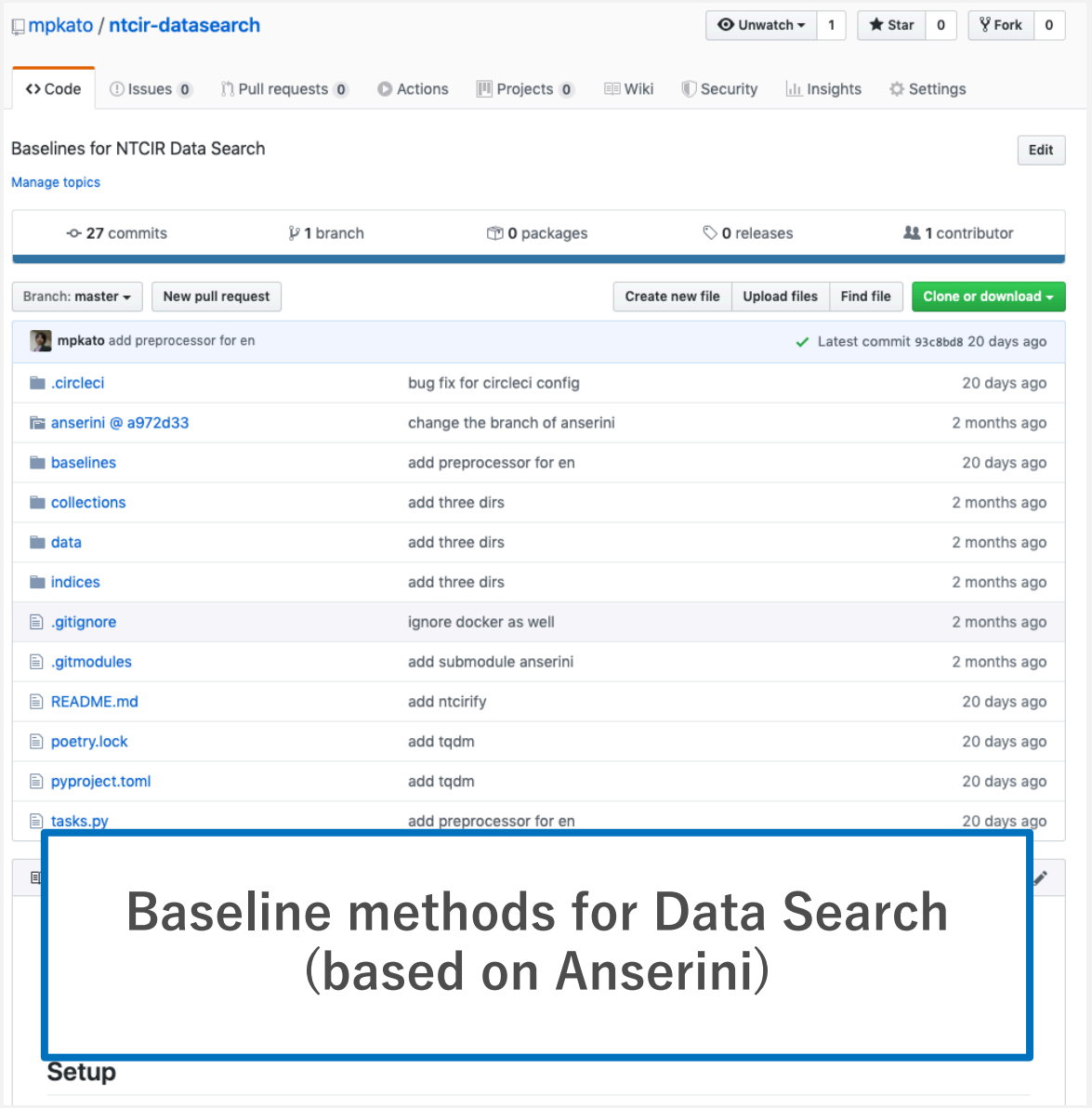
○ 0: Useless ○ 1: Partially useful ○ 2: Highly useful

- **Applied standard retrieval models to only the metadata**

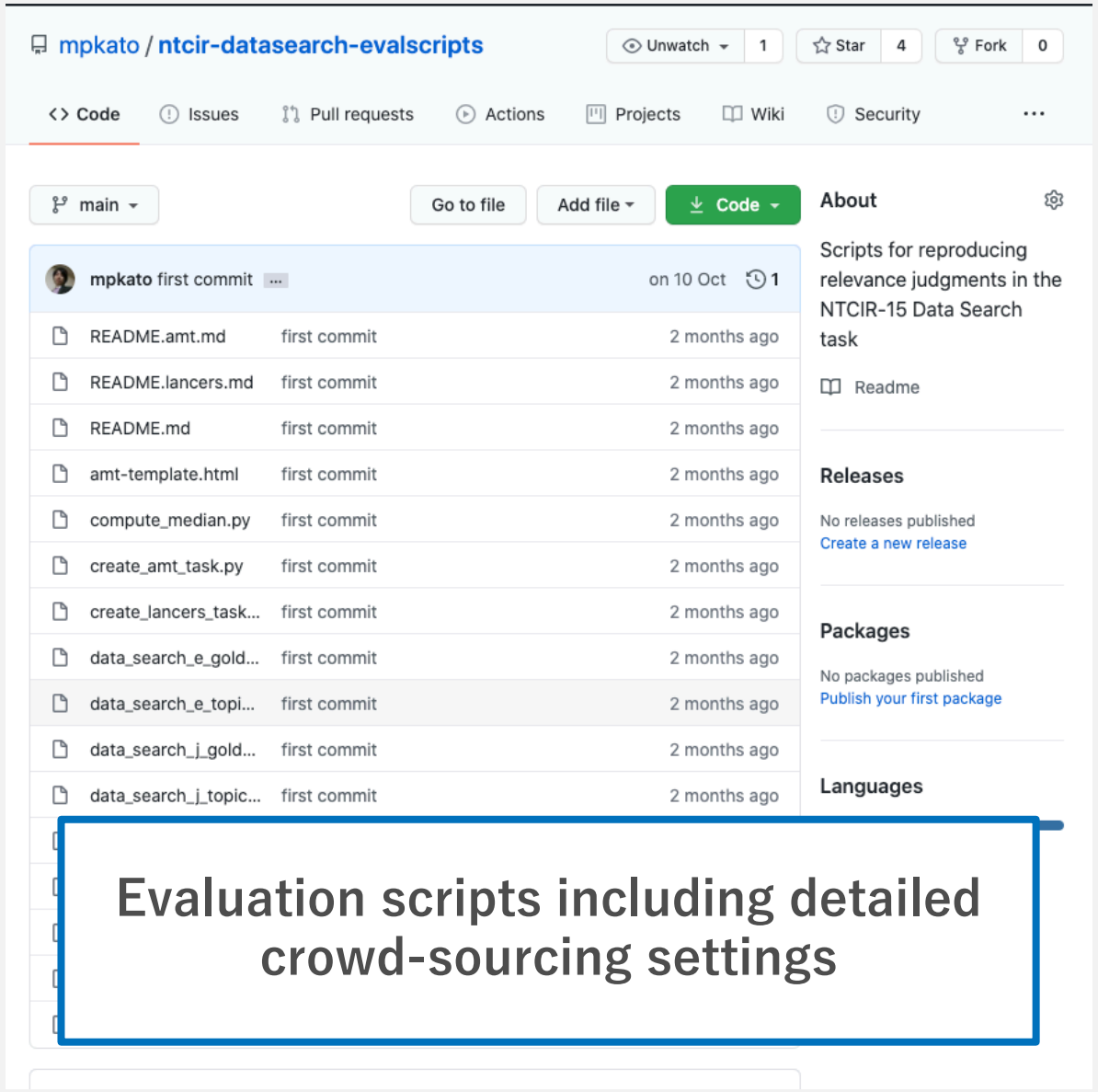

- **Baseline retrieval models**
  - BM25, BM25 + RM3, BM25 + SDM, BM25 + BM25PRF
  - Query Likelihood, Query Likelihood + RM3, Query Likelihood + SDM

# Tools developed for Data Search






**Baseline methods for Data Search (based on Anserini)**




**Evaluation scripts including detailed crowd-sourcing settings**

- **NTCIR-15 Data Search attracted six research groups and received 54 systems' results in total**
  - 17 for Japanese and 37 for English

- **Overall, the evaluation results showed that**
  - **1. Much room for improvement for data search algorithms**
  - **2. No single system significantly outperformed the others**

- STIS : Politeknik Statistika
- NII: National Institute of Informatics
- Uhai: University of Hyogo
- KSU: Kyoto Sangyo University

# Participants' Runs (Japanese subtask)



| Team | Run | Description |
|---|---|---|
| KSU | KSU-J-1 | category search, **QA categories** and BM25 and **table headers** |
| KSU | KSU-J-3 | **Birch** and **table headers** |
| KSU | KSU-J-5 | category search, **QA categories** and BM25 |
| KSU | KSU-J-7 | **Birch** |
| uhai | uhai-J-6 | Query Fixing + L2R + **Bert** |
| uhai | uhai-J-7 | Query Fixing + L2R |
| uhai | uhai-J-8 | L2R |
| uhai | uhai-J-9 | L2R + **Bert** |
| uhai | uhai-J-10 | Query Fixing + bm25 |

# Participants' Runs (English subtask) 1/2



| Team | Run | Description |
|---|---|---|
| KSU | KSU-E-2 | category search, **QA categories**, BM25 and **table headers** |
| KSU | KSU-E-4 | **Birch** and **table headers** |
| KSU | KSU-E-6 | category search, **QA categories** and BM25 |
| KSU | KSU-E-8 | **Birch** |
| NIITableLinker | NIITableLinker-E-1 | BM25 [fine-tune] |
| NIITableLinker | NIITableLinker-E-2 | BM25+PRF [default] |
| NIITableLinker | NIITableLinker-E-3 | BM25+PRF [fine-tune] |
| NIITableLinker | NIITableLinker-E-4 | R2+**BERT** |
| NIITableLinker | NIITableLinker-E-5 | R3+**BERT** |
| NIITableLinker | NIITableLinker-E-6 | **Entity** + **Noun phrase** + BM25+PRF |
| NIITableLinker | NIITableLinker-E-7 | DATE LOC |
| NIITableLinker | NIITableLinker-E-8 | metadata attributes + BM25+PRF |
| NIITableLinker | NIITableLinker-E-9 | cluster |
| NIITableLinker | NIITableLinker-E-10 | R3+**BERT**+Top100 |

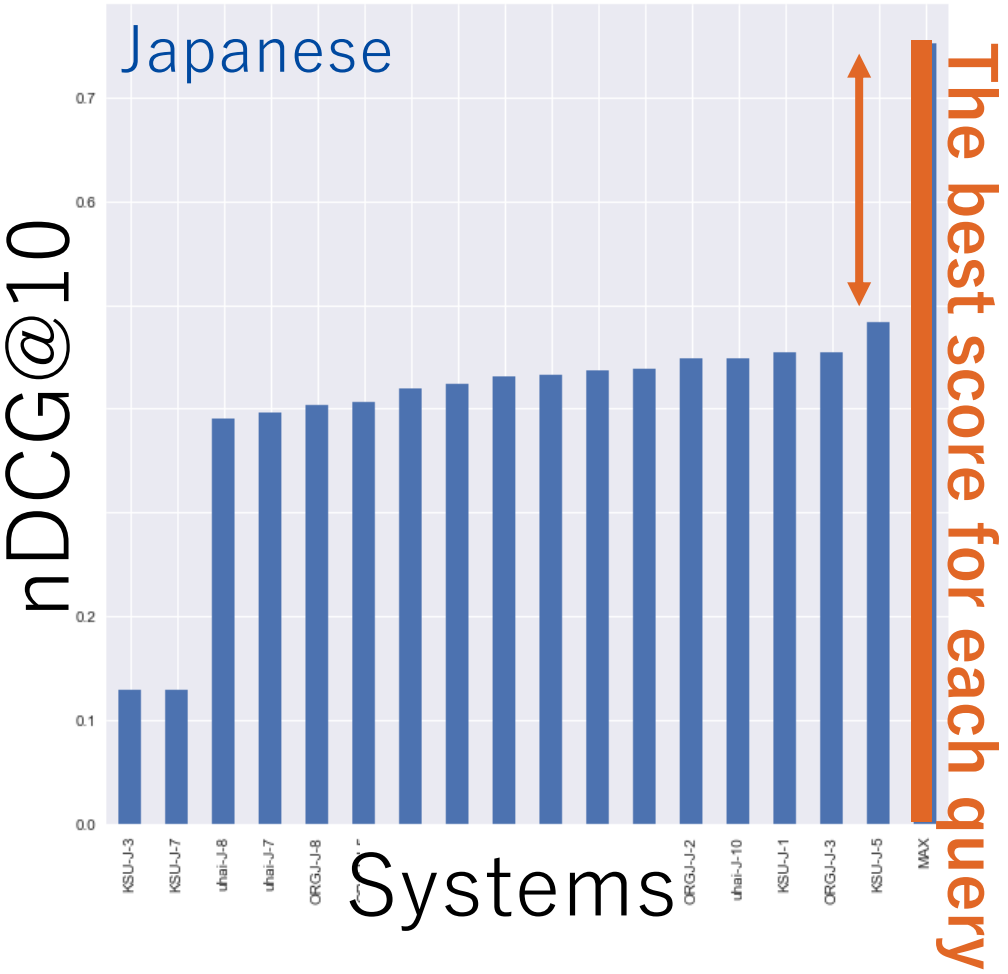
# Participants' Runs (English subtask) 2/2

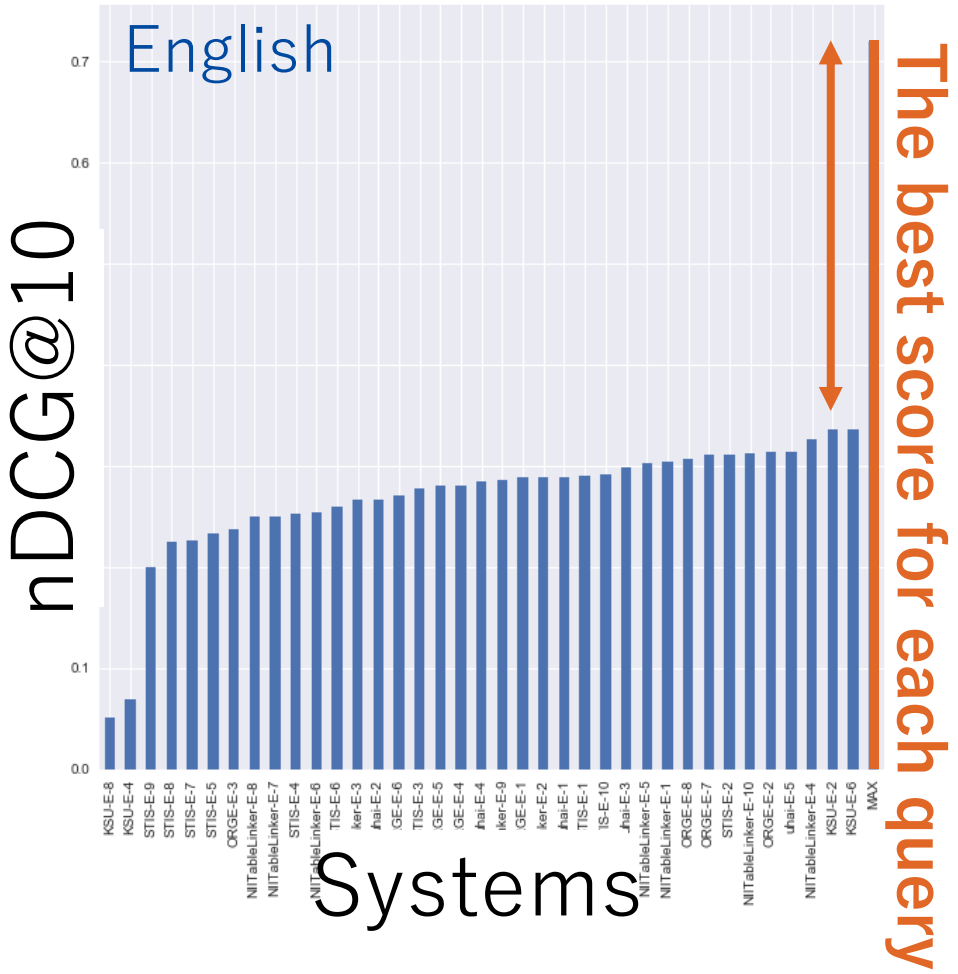


| Team | Run | Description |
|---|---|---|
| STIS | STIS-E-1 | RM3+BM25 AND FINETUNED **BERT** BERT-BASE-UNCASED |
| STIS | STIS-E-2 | RM3+BM25 AND FINETUNED **BERT** BERT-BASE-UNCASED |
| STIS | STIS-E-3 | RM3+BM25 AND FINETUNED **BERT** BERT-LARGE-UNCASED |
| STIS | STIS-E-4 | RM3+BM25 AND FINETUNED **BERT** BERT-LARGE-UNCASED |
| STIS | STIS-E-5 | RM3+BM25 AND FINETUNED **ROBERTA** ROBERTA-BASE |
| STIS | STIS-E-6 | RM3+BM25 AND FINETUNED **ROBERTA** ROBERTA-BASE |
| STIS | STIS-E-7 | RM3+BM25 AND ENCODER CONCAT **GLOVE** |
| STIS | STIS-E-8 | RM3+BM25 AND ENCODER CONCAT **GLOVE** |
| STIS | STIS-E-9 | RM3+BM25 AND ENCODER CONCAT **GLOVE** |
| STIS | STIS-E-10 | RM3+BM25 AND FINETUNED **BERT** BERT-BASE-UNCASED |
| uhai | uhai-E-1 | Query Fixing + L2R + **Bert** |
| uhai | uhai-E-2 | Query Fixing + L2R |
| uhai | uhai-E-3 | L2R + **Bert** |
| uhai | uhai-E-4 | L2R |
| uhai | uhai-E-5 | Query Fixing + bm25 |

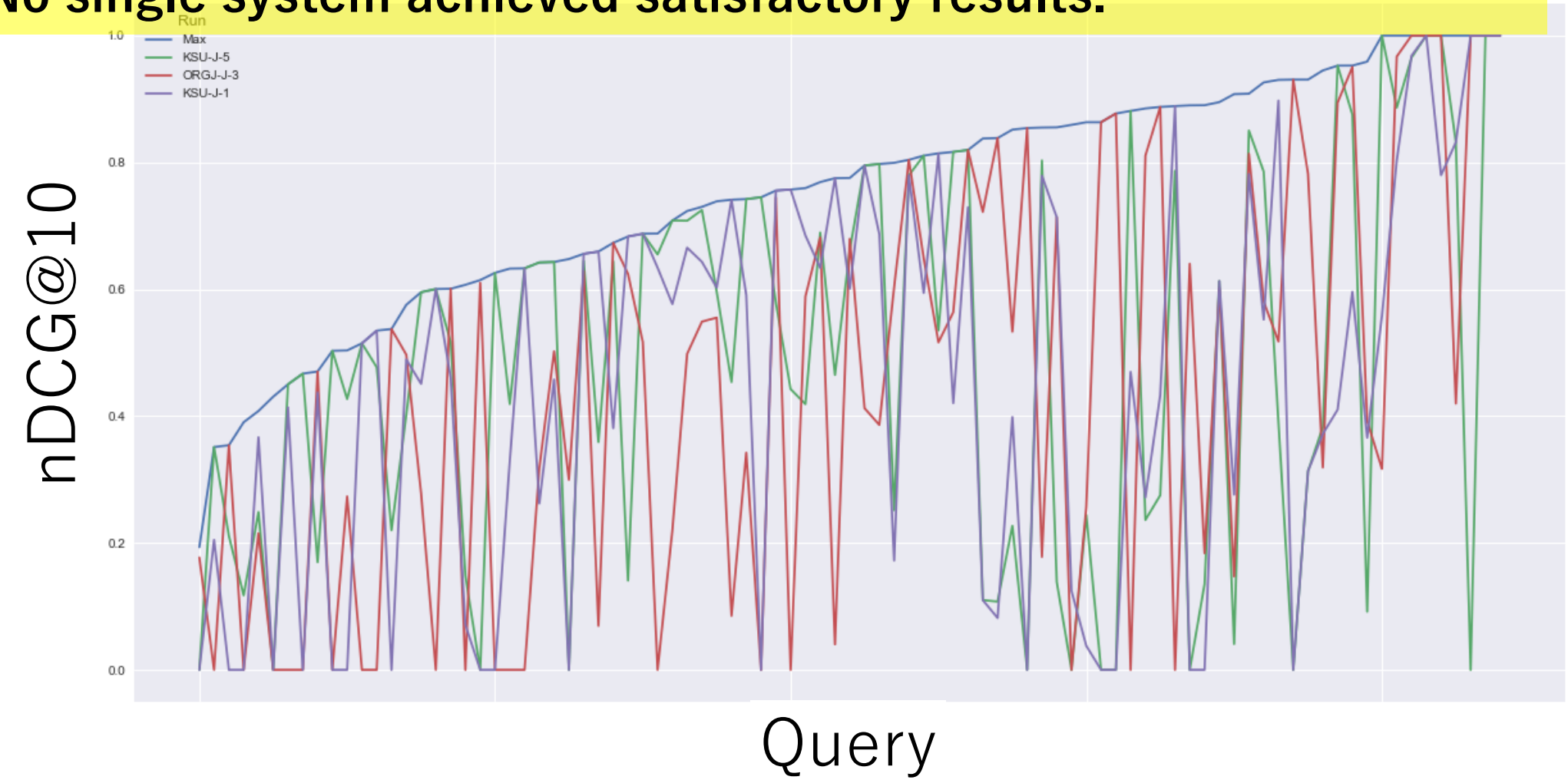
# Overall Results: 1. Much Room for Improvement



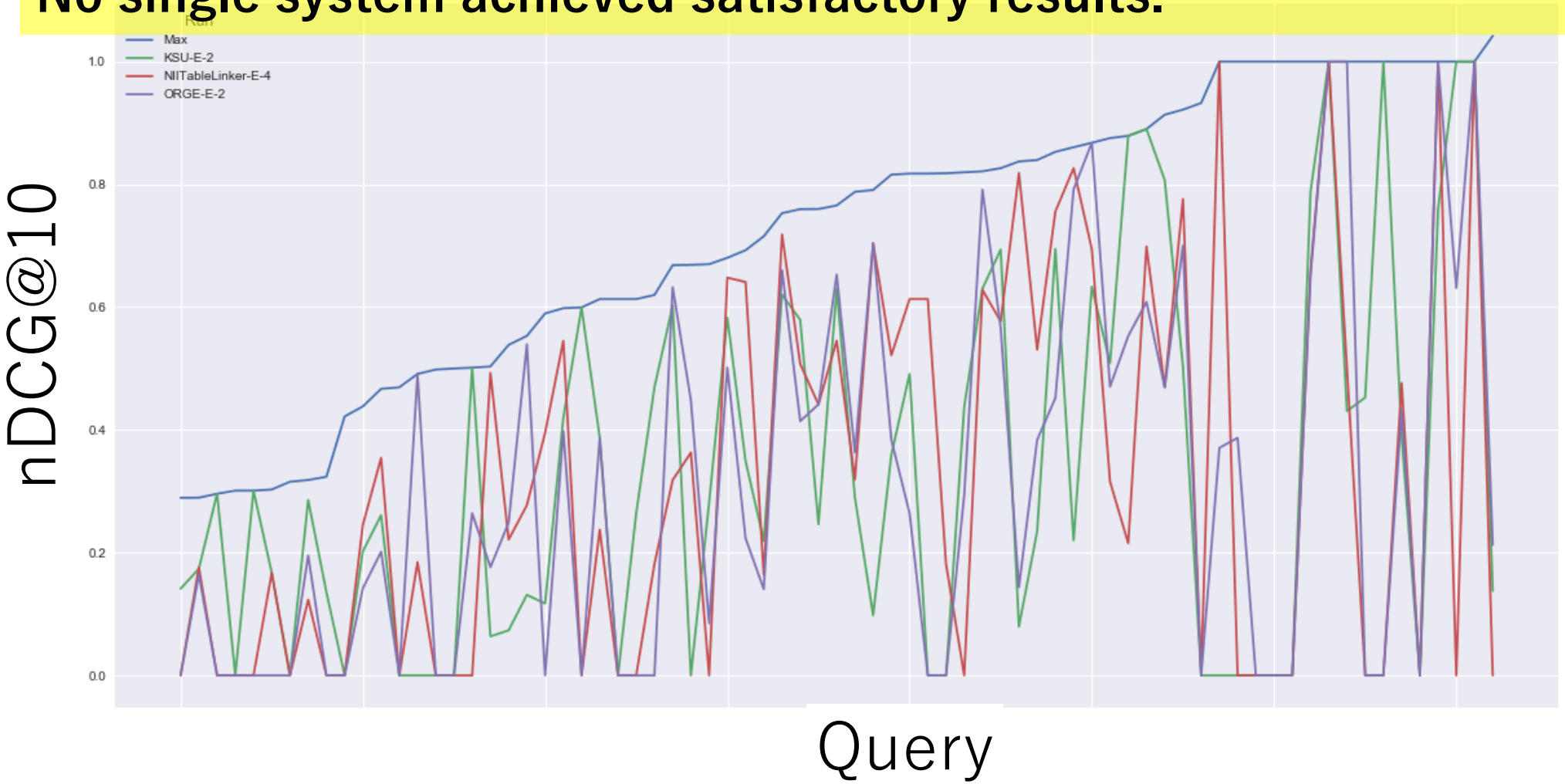


The blue line indicate the maximum score for each query.
Each of the other lines indicates one of the top 3 runs.
**No single system achieved satisfactory results.**



The blue line indicate the maximum score for each query.
Each of the other lines indicates one of the top 3 runs.
**No single system achieved satisfactory results.**



# Which Team was Successful?



## Japanese

| | nDCG@3 | nDCG@5 | nDCG@10 | nERR@3 | nERR@5 | nERR@10 | Q | Note |
|---|---|---|---|---|---|---|---|---|
| KSU-J-5 | 0.388 | 0.403 | 0.448 | 0.283 | 0.448 | 0.477 | 0.498 | BM25 + **Category classification** |
| KSU-J-1 | 0.362 | 0.381 | 0.421 | 0.295 | 0.423 | 0.453 | 0.473 | BM25 + Table header + **Category classification** |
| ORGJ-J-3 | 0.407 | 0.413 | 0.421 | 0.325 | 0.450 | 0.47 | 0.484 | BM25 |
| uhai-J-10 | 0.403 | 0.406 | 0.415 | 0.312 | 0.447 | 0.466 | 0.484 | BM25 + Query modification |
| ORGJ-J-2 | 0.402 | 0.405 | 0.415 | 0.328 | 0.447 | 0.467 | 0.483 | BM25 (lucene) |
| ORGJ-J-6 | 0.379 | 0.386 | 0.406 | 0.321 | 0.423 | | | |
| ORGJ-J-1 | 0.382 | 0.396 | 0.405 | 0.308 | 0.426 | | | |
| ORGJ-J-7 | 0.380 | 0.386 | 0.401 | 0.323 | 0.430 | | | |
| ORGJ-J-4 | 0.365 | 0.377 | 0.400 | 0.318 | 0.409 | | | |

**KSU (Kyoto Sangyo University) is the top performer in both subtasks**

## English

| | nDCG@3 | nDCG@5 | nDCG@10 | nERR@3 | nERR@5 | nERR@10 | Q | Note |
|---|---|---|---|---|---|---|---|---|
| KSU-E-2 | 0.204 | 0.231 | 0.255 | 0.238 | 0.229 | 0.257 | 0.276 | BM25 + Table header + **Category classification** |
| KSU-E-6 | 0.204 | 0.231 | 0.255 | 0.238 | 0.229 | 0.257 | 0.276 | BM25 + **Category classification** |
| NIITableLinker-E-4 | 0.233 | 0.237 | 0.248 | 0.251 | 0.251 | 0.264 | 0.278 | BM25 + PRF + **BERT Reranking** |
| ORGE-E-2 | 0.219 | 0.225 | 0.238 | 0.240 | 0.235 | 0.250 | 0.264 | BM25 (lucene) |
| uhai-E-5 | 0.219 | 0.225 | 0.238 | 0.240 | 0.235 | 0.250 | 0.264 | BM25 + Query modification |
| NIITableLinker-E-10 | 0.221 | 0.226 | 0.237 | 0.238 | 0.235 | 0.248 | 0.264 | BM25 + PRF + **BERT Reranking** |
| STIS-E-2 | 0.23 | 0.228 | 0.237 | 0.217 | 0.248 | 0.255 | 0.264 | BM25 + RM3 + **BERT Reranking** |
| ORGE-E-7 | 0.216 | 0.220 | 0.236 | 0.237 | 0.228 | 0.242 | 0.256 | BM25 + Sequential dependency model |
| ORGE-E-8 | 0.224 | 0.230 | 0.233 | 0.238 | 0.244 | 0.255 | 0.264 | Query likelihood + RM3 |

## Not very conclusive yet, but

- **Category classifier (used by KSU)**
  - Train a category classifier by cQA datasets and applied it to queries and documents
  - A document is considered relevant if its category is the same as that of a query
  - A simple, but effective technique that can be seen in production systems
- **Dataset header (used by KSU and NII)**
  - The headers of datasets were also used as a part of documents
  - Possibly effective but may need more exploration
- **BERT (used by all the teams)**
  - A successful technique often used in NLP tasks
  - Not conclusive again, probably due to lack of large training data

- **The very first IR evaluation campaign for data search**
- **Ad-hoc retrieval for statistical data**
- **Evaluation results suggested that**
  - 1. Much room for improvement for data search algorithms
  - 2. No single system significantly outperformed the others
- **NTCIR-16 Data Search 2 (if accepted)**
  - Ad hoc retrieval task
  - Question answering
  - Search interface