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GEMv2: Multilingual NLG Benchmarking in a Single Line of Code

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Abstract

Evaluations in machine learning rarely use the latest metrics, datasets, or human evaluation in favor of remaining compatible with prior work. The compatibility, often facilitated through leaderboards, thus leads to outdated but standardized evaluation practices. We pose that the standardization is taking place in the wrong spot. Evaluation infrastructure should enable researchers to use the latest methods and what should be standardized instead is how to incorporate these new evaluation advances. We introduce GEMv2, the new version of the Generation, Evaluation, and Metrics Benchmark which uses a modular infrastructure for dataset, model, and metric developers to benefit from each other’s work. GEMv2 supports 40 documented datasets in 51 languages, ongoing online evaluation for all datasets, and our interactive tools make it easier to add new datasets to the living benchmark.

1 Introduction

The standard evaluation process in natural language processing involves comparisons to prior results in a fixed environment, often facilitated through benchmarks and leaderboards. This process, if executed correctly, can advance reproducibility (Belz et al., 2021) and standardize evaluation choices that

lead to better dataset diversity. But static benchmarks also prevent the adoption of new datasets or metrics (Raji et al., 2021), and many evaluation advancements are thus put aside. That means that the focus on surpassing the best prior reported scores reinforces outdated evaluation designs. Furthermore, this process ignores properties that do not match the leaderboard metric (Ethayarajh and Jurafsky, 2020; Bowman and Dahl, 2021; Dehghani et al., 2021). This issue is particularly pertinent in natural language generation (NLG) since the model quality cannot be estimated using accuracy and instead, NLG relies on automatic and human evaluation approaches that constantly improve (Gehrmann et al., 2022; Kasai et al., 2022).

To bridge the gap between advantages of leaderboards and in-depth and evolving evaluations, the Generation, Evaluation, and Metrics benchmark (GEM, Gehrmann et al., 2021) proposed a “living” benchmark. As such, GEM is participatory in that contributors propose new datasets and expand the selection of metrics. Model developers using GEM retain full agency over the evaluation process but are able to choose from a wider range of tasks and metrics. GEM further introduced evaluation suites (Mille et al., 2021; Dhole et al., 2021) that are compatible with its datasets and test various robustness and fairness aspects of models.

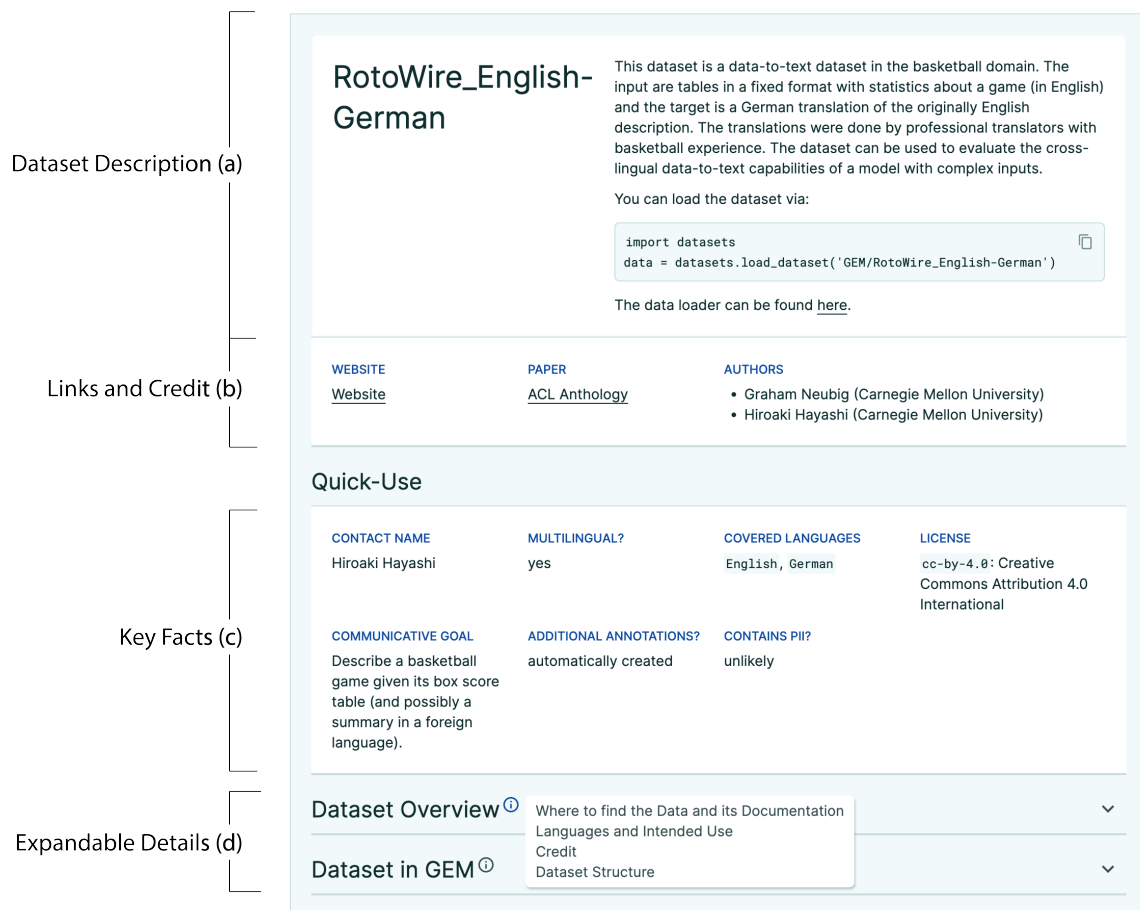


Figure 1: One of the data cards for GEM datasets. (a) shows the header which has the name, a summary, and example code to load it. (b) links to relevant papers and websites, alongside an author list. (c) is the Quick-Use section which summarizes the most important aspect of a dataset, including language(s), PII, and licensing information. (d) is the detailed view which has multiple sections. Each section provides a glance at categories of included questions on hover, and expands to full details on click.

We uncovered several shortcomings in GEMv1 that hindered its scaling and adoption: (1) Centralized data management made adding new datasets too complex. (2) Computing all metrics in a single framework led to dependency issues and was challenging for those with limited compute resources. (3) Participants needed more guidance in our dataset documentation process (McMillan-Major et al., 2021) to guarantee data card quality.

We introduce GEMv2, a modular and extendable NLG evaluation infrastructure which allows for continuous integration of newly developed datasets. We release a data card collection and rendering tool that makes it easier to follow for both card creators and readers. These improvements led to an expansion of GEM from 13 to 40 tasks and from 18 to 51 supported languages. We also introduce an online evaluation process that collects model outputs and computes metrics for all datasets.

2 Features and Functionality

Since evaluation practices evolve, we focus on modularity and maintainability to ensure that new dataset and metrics are compatible with all other features. Model developers are able to use new datasets and metrics without any changes to their existing setup. In this section, we describe the supported user [J]ourneys for various stakeholders in generation research.

J1 - Document a Dataset Every GEM dataset is documented using the data card template by McMillan-Major et al. (2021), which we revised using the Data Card Playbook (Pushkarna et al., 2022). A new card can be filled out or an existing one updated via an interactive form that provides detailed instructions for each field.¹

J2 - Choose a Dataset The data card viewer

¹huggingface.co/spaces/GEM/DatasetCardForm

presents information at multiple detail levels in separate columns. Anyone can quickly get a high-level overview of a dataset or read extended information on a documentation category (see Figure 1).

J3 - Create a Data Loader Each dataset has a separate repository at huggingface.co/GEM, with a loader using the Datasets library (Lhoest et al., 2021).² Through this, all supported datasets can be loaded via the same code,

```
from datasets import load_dataset
data = load_dataset(
    'GEM/$dataset_name',
    '$config_name')
```

where `$config_name` is the (optional) specification of the dataset configuration to use. To stratify how datasets are accessed, they are implemented according to the following conventions:

- `linearized_input`: Linearization processes convert structured input to a string. For reproducibility, we implement linearization schemes from prior work (e.g., Saleh et al., 2019; Kale and Rastogi, 2020).
- `target` and `references`: String targets and List[string] references ensure compatibility with existing training and eval scripts.
- `gem_id`: A unique example ID is used to track data points regardless of shuffling.

J4 - Evaluate a Model Model outputs can be evaluated locally using the `gem-metrics` library or online which will add the outputs to our result overview (J6).³ Both methods require a standardized input format that specifies the dataset and split and which allows us to evaluate all 100+ data splits via the call `gem_metrics outputs.json`.

J5 - Add a new Metric In `gem-metrics`, each metric implements a `compute()` function and our library handles caching, parallelism, tokenization, etc. To avoid dependency conflicts, a metric can optionally specify a docker environment, as suggested by Deutsch and Roth (2022).

```
from .texts import Predictions
from .texts import References
from .metric import ReferencedMetric

class NewMetric(ReferencedMetric):
    def _initialize(self):
        """Load models and artifacts."""
        pass
```

²Documentation on how to add new datasets can be found at gem-benchmark.com/tutorials.

³huggingface.co/spaces/GEM/submission-form

```
def compute(
    self,
    cache,
    predictions: Predictions,
    references: References) -> Dict:
    """Compute the metric."""
    pass
```

J6 - Use Prior Results Comparisons to prior work often only copy reported numbers which could be computed using different evaluation parameters, and a lack of released model outputs frequently prevents a fair side-by-side comparison outside of leaderboards (Gehrmann et al., 2022).⁴ To improve comparability, we add every online submission to a growing corpus of model outputs which evaluation researchers can use to develop better metrics or to conduct analyses.

3 Dataset Selection and Loading

To identify candidate datasets, continued to follow the SuperGLUE process (Wang et al., 2019) by soliciting tasks to be included from the research community. Our request to suggest multilingual, challenging, and/or interesting NLG tasks led to 40 submissions. To avoid quality judgments, we imposed only three requirements for selection: (1) consent from dataset authors, (2) availability under a permissive license, (3) the task needs to be able to be cast as a text-to-text problem. 27 tasks were selected in addition to the 13 existing ones (Gehrmann et al., 2021). Three datasets are simplification evaluation sets added to the Wiki-Auto loader (Jiang et al., 2020), while all others have independent data loaders.⁵ All data loaders and cards were produced as part of a month-long hackathon, and we invited the dataset authors and GEM participants to contribute to one or more of the datasets. Afterwards, the organizers managed the ongoing maintenance. New datasets can be added on an ongoing basis, subject to the three requirements. GEMv2 currently supports 40 datasets, listed in Appendix A and described in this section.

Figure 2 shows the distributions of training example count, task types, and their input and target lengths. Data-to-text and summarization are most common, followed by response generation. While data-to-text tasks are spread across resource availability categories, summarization datasets tend to

⁴Marie (2022) discusses how this practice leads to harmful claims using a translation example (Costa-jussà et al., 2022).

⁵Changes to datasets are documented in the appendix.

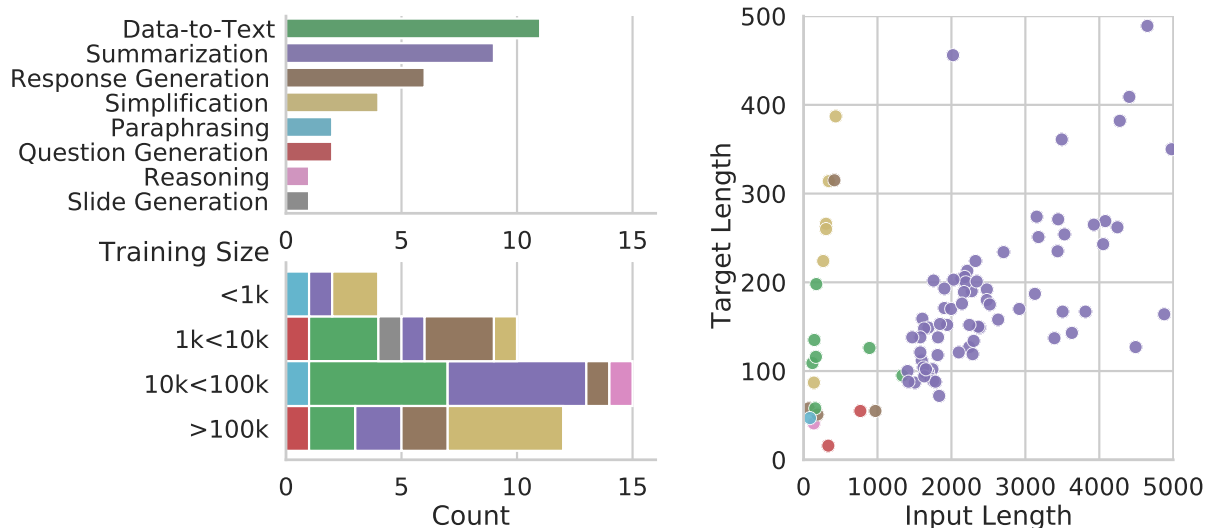


Figure 2: An overview of the properties of the currently supported datasets in GEM. (Top left) A histogram of the supported task types. The most represented tasks are Data-to-Text, followed by Summarization, Response Generation, and Simplification. (Bottom Left) The frequency of different training corpus sizes for dataset configurations, broken down by their task types. While some task types are represented across all resource availability levels, some are concentrated on high resource. (Right) An overview of input and target lengths of different dataset configurations according to the mT5 tokenizer (Xue et al., 2021). Summarization tasks have input lengths of over 1,000 while all other tasks remain under 1,000 tokens. There is a lot more between-task variance in output length. Four dataset configurations are hidden due to the axis truncation.

be larger. While datasets vary in target length, the median input length tends to remain under 500 tokens, likely motivated by modeling limitations. Exceptions to this are summarization, with input lengths beyond what is supported by most models (e.g., WikiCatSum (Perez-Beltrachini et al., 2019) and XLSum (Hasan et al., 2021)), and a class of data-to-text datasets with the communicative goal to generate game summaries from large sports statistic tables (e.g., Hayashi et al., 2019; Thomson et al., 2020; Puduppully et al., 2019a).

We put an emphasis on language diversity, as prior work has found that fewer than 30% of NLG publications (even counting evaluations on machine translation) evaluate on non-English tasks (Gehrmann et al., 2022). While a lot of this focus on English can be traced to a lack of multilingual resources, many non-English NLG datasets have been released in recent years (e.g., Hasan et al., 2021; Ladhak et al., 2020; Mille et al., 2020; Cahyawijaya et al., 2021). As shown in Table 2, we support languages across all resource classes in the taxonomy by Joshi et al. (2020). However, the focus on English is still apparent in the number of datasets supporting a particular language, shown in Table 1, where English is far above all other languages. Moreover, most of the language diversity

stems from the three highly multilingual datasets XLSum (Hasan et al., 2021), WikiLingua (Ladhak et al., 2020), and data from the surface realization shared task '20 (Mille et al., 2020). Excluding those, there are 13 datasets supporting non-English languages, 9 of which are exclusively non-English.

Of the 40 datasets, 14 have multiple configurations which can differ in task setup, languages, their encoding in romanized or original script, or domain. For example, we modified WikiLingua (Ladhak et al., 2020) to have splits from and to any of the 18 supported languages, enabling better cross-lingual evaluations. Seventeen datasets have challenge splits, many of which were created for GEM. For example, the challenge set for the conversational weather dataset (Balakrishnan et al., 2019) selects examples from the original test split with complex discourse relations.

4 Data Cards

Each dataset is accompanied by documentation about how it was created, who created it, how it should be used, and the risks in using it (Bender and Friedman, 2018; Gebru et al., 2018). Our original data documentation process (McMillan-Major et al., 2021) required filling out a markdown template following instructions in a separate guide. We

Count	Languages
1	Amharic, Azerbaijani, Bengali, Burmese, Dutch, Gujarati, Hausa, Igbo, Javanese, Kirundi, Kyrgyz, Marathi, Nepali, Oromo, Pashto, Persian, Pidgin, Punjabi, Scottish Gaelic, Serbian, Sinhala, Somali, Sundanese, Swahili, Swedish, Tamil, Telugu, Tigrinya, Ukrainian, Urdu, Uzbek, Welsh, Yoruba
2	Czech, Italian, Thai, Turkish, Vietnamese
3	Arabic, Finnish, Hindi, Japanese, Korean, Portuguese
4	Indonesian
6	Chinese, German, Russian, Spanish
8	French
28	English

Table 1: The languages supported in GEMv2 and in how many of its datasets they appear.

analyzed the existing template and the resulting data cards under the dimensions provided in the data card playbook (Pushkarna et al., 2022) and identified the following improvements:

- **Accountability:** It needs to be clear who will maintain and extend the data cards when a dataset changes, when limitations of a dataset are found, or when it is deprecated (Corry et al., 2021).
- **Utility:** The recommended evaluation process for a dataset should be prominently shown.
- **Quality:** We need a process to validate data card completeness and quality.
- **Impact & Consequences:** It needs to be clear that we are curators, not editors, and that critiques reflect on the data, not the creators.
- **Risk & Recommendations I:** We need to expand the documentation of potential PII issues.
- **Risk & Recommendations II:** To help decide whether to use a dataset, the card needs to discuss differences from other datasets with similar communicative goals.

We modified our template following these insights and to be in line with the playbook approach of dividing between *telescope*, *periscope*, and *microscope* questions based on the length of the expected answer. We implemented this template in an [interactive collection tool](#) that can create new cards or load and update existing ones. The tool shows progress bars for the overall answer status and a breakdown for each of the subsections to indicate where more content should be added. The tool further improves the user experience by conditionally rendering questions based on prior answers, e.g., *Is there a risk of PII?* → *What kind of PII?*

The output of the tool is a structured json file that

Tax.	Languages
0	West African Pidgin English, Sinhala
1	Azerbaijani, Burmese, Gujarati, Igbo, Javanese, Kirundi, Kyrgyz, Nepali, Oromo, Pashto, Scottish Gaelic, Somali, Sundanese, Telugu, Welsh
2	Amharic, Hausa, Marathi, Punjabi, Swahili, Tigrinya, Yoruba
3	Bengali, Indonesian, Tamil, Thai, Ukrainian, Urdu, Uzbek
4	Czech, Dutch, Finnish, Hindi, Italian, Korean, Persian, Portuguese, Russian, Serbian, Swedish, Turkish, Vietnamese
5	Arabic, Chinese, English, French, German, Japanese, Spanish

Table 2: Supported languages categorized into the resource taxonomy by Joshi et al. (2020).

we convert into a simple markdown file for the data loader and an optimized web viewer and embedded in our website (Figure 1). The viewer presents important information at the top and splits the detailed rendering into three columns, corresponding to the telescope, periscope, and microscope split. This enables an easy navigation since high-level information can be found by focusing on the left column, moving toward the right for additional details.

The structured format enables us to study trends in dataset construction practices beyond those shown in Section 3.⁶ For example, 66% of the data cards report that PII is unlikely or definitely not included, while it is likely or definitely included in 33%. In the free-text explanations, we find four types of justifications for absent PII: The majority (7) stated that the data format or domain was restricted to avoid PII. Two stated that the data is in the public domain (e.g., Wikipedia) and another two used fully simulated data. One response described that crowd raters were instructed to avoid mentioning PII. We found that multiple of the PII-likely datasets only use public domain data, indicating that there is confusion about PII definitions.

Another typically hidden aspect is the data sourcing. Our datasets present an almost even split between automatically-, crowdworker-, and expert-created datasets, with crowdworker-created ones being slightly more common, possibly confounded if experts were hired through crowdworking platforms, as was done for SQuality (Wang et al., 2022). It may thus also possible to compare which of these collection methods leads to more insightful modeling results. We follow up by asking

⁶We encourage others to use the publicly available files for additional investigations.

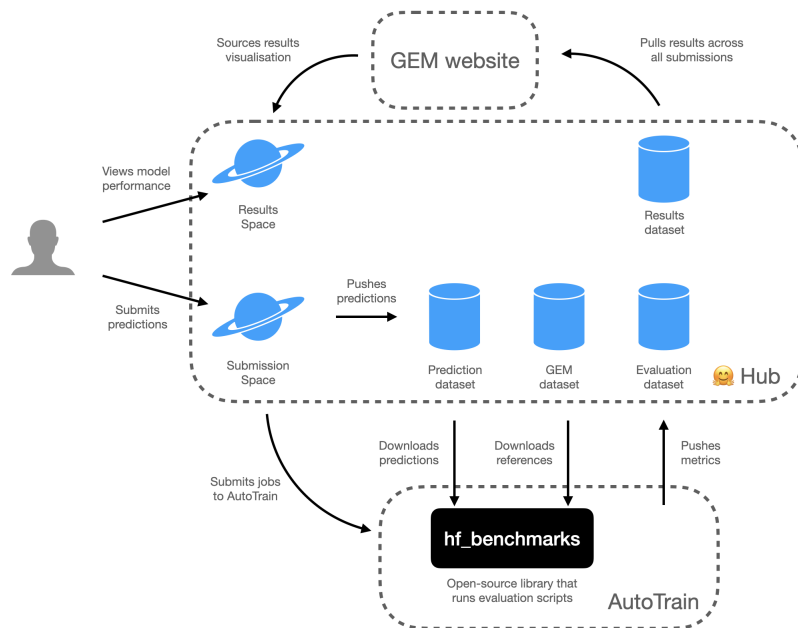


Figure 3: System architecture for hosting GEM on the Hugging Face Hub

which crowdworking platform was used and unsurprisingly, Amazon Mechanical Turk was the most frequent answer, followed by participatory experiments and other non-specified platforms.

5 System Design

To support the automatic evaluation of outputs, we use the Hugging Face Hub to integrate datasets, metrics, and user interfaces for GEM users to submit their outputs. The system architecture is shown in Figure 3, and consists of five main components: **Spaces** We host Streamlit applications on Spaces⁷ for the submission of predictions, downloading of results, and visualization of model performance.

Datasets Dataset repositories are used to host the datasets, submissions, evaluations, and results.

AutoTrain We use AutoTrain⁸, Hugging Face’s AutoML platform, to run all evaluation jobs using **Hugging Face Benchmarks**, a library that defines how metrics are computed within AutoTrain.⁹

Metrics We use `GEM-metrics` to perform the metric computations. In addition to supporting common metrics like BLEU (Papineni et al., 2002) and ROUGE (Lin, 2004), the Docker integration simplifies the calculation of multiple model-based metrics like BLEURT (Sellam et al., 2020).

On submission, a dataset repository with the model outputs is created under the

`GEM-submissions` organisation on the Hugging Face Hub. In parallel, an evaluation job is triggered in AutoTrain which downloads the submission from the Hub, along with all the reference splits of the GEM datasets. These references are used to compute a wide variety of NLG metrics via `GEM-metrics`. The resulting metrics are then pushed to a dataset repository on the Hub, and used to source the visualization of results on the GEM website¹⁰ and Space.¹¹

6 Conclusion

We introduce GEMv2 which unifies infrastructure for generation research. We propose a consistent workflow from documenting and choosing datasets to loading and evaluating on them while keeping all supported datasets and metrics compatible with each other. We demonstrate the scalability by releasing the initial version with support for 40 datasets in 51 languages. Of the supported datasets, 23 are improved through configurations, filtering, and re-splitting processes and 17 datasets have challenge sets. We release a submission tool that computes metrics and makes model outputs available to download for evaluation researchers. Researchers who are interested in integrating their dataset are welcome to contact us for support.

⁷huggingface.co/spaces

⁸huggingface.co/autotrain

⁹github.com/huggingface/hf_benchmarks

¹⁰gem-benchmark.com

¹¹huggingface.co/spaces/GEM/results

7 Broader Impact

As discussed in the main part of the paper, GEMv2 aims to avoid any explicit curation decisions about inclusion and exclusion of datasets beyond licensing and consent. This is a change from the originally set out strict inclusion criteria based on dataset quality. The reason for this is that the entire research community should be the authority to decide whether a dataset is useful and what it is useful for. For example, a dataset with noisy outputs may still be useful to study hallucination avoidance methods. However, this change has implications on how dataset deprecation needs to be handled, in particular for datasets with newly found issues or datasets with better alternatives. Documenting issues and alternatives using the data cards is thus becoming more important in GEMv2 and we encourage researchers to update data cards. Another side effect of positioning GEMv2 as infrastructure that support dataset creators is a decreased risk of erasure. All our documentation and dataset loaders center the work of the creators to encourage users to cite the datasets they use.

Another open issue that we have been working on is the interplay between multilingualism and metrics. We now support multiple languages for which no NLG metrics have been tested, and for which our tokenization schemes may be inappropriate. The freedom to combine every dataset with every metric may lead to more flawed evaluations in those cases. In addition, some datasets were released with specific metrics that we do not support yet.

A final issue we want to point out is the lack of discussion of human evaluation in this overview paper which we omitted for brevity. Human evaluation does not scale and every task requires its own evaluation approach, especially when the goal is to deploy a system to real users. We have thus taken the approach to develop better human evaluation for only a subset of tasks, solving issues pointed out by Tang et al. (2022), Howcroft et al. (2020), and van der Lee et al. (2019), and we will release detailed instructions separately. However, these instructions will not replace a better understanding of the users of deployed systems.

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A Dataset Overviews

We provide a detailed overview of all the supported datasets in Table 3. Input and output lengths are reported in number of tokens according to the mT5 tokenizer (Xue et al., 2021). When multiple configurations for a dataset are available, we report the median of the sizes and lengths.

B Changes to Datasets

B.1 BiSECT

The original released *BiSECT* (Kim et al., 2021a) training, validation, and test splits are maintained to ensure a fair comparison. Note that the original BiSECT test set was created by manually selecting 583 high-quality Split and Rephrase instances from 1000 random source-target pairs sampled from the EMEA and JRC-Acquis corpora from the OPUS parallel corpus (Tiedemann and Nygaard, 2004).

As the first challenge set, we include the *HSPLIT-Wiki* test set, containing 359 pairs (Sulem et al., 2018). For each complex sentence, there are four reference splits; To ensure replicability, as reference splits, we again follow the original *BiSECT* paper and present only the references from *HSplit2-full*. In addition to the two evaluation sets used in the original BiSECT paper, we also introduce a second challenge set. For this, we initially consider all 7,293 pairs from the EMEA and JRC-Acquis corpora. From there, we classify each pair using the classification algorithm from Section 4.2 of the original BiSECT paper. The three classes are as follows:

1. **Direct Insertion**: when a long sentence l contains two independent clauses and requires only minor changes in order to make a fluent and meaning-preserving split s .
2. **Changes near Split**, when l contains one independent and one dependent clause, but modifications are restricted to the region where l is split.
3. **Changes across Sentences**, where major changes are required throughout l in order to create a fluent split s .

We keep only pairs labeled as Type 3, and after filtering out pairs with significant length differences (signaling potential content addition/deletion), we present a second challenge set of 1,798 pairs.

Dataset	Citation	Task	Language(s)	Taxonomy	Size	Input Length	Output Length
ART	(Bhagavatula et al., 2020)	Reasoning	en	5	50k	138	41
BiSECT	(Kim et al., 2021a)	Simplification	en, de, es, fr	5	200k–1M	266–434	224–387
Cochrane	(Devaraj et al., 2021)	Simplification	en	5	3.5k		
CommonGen	(Lin et al., 2020)	Data-to-Text	en	5	70k	80	
Conversational Weather	(Balakrishnan et al., 2019)	Response Generation	en	5	25k	417	315
CrossWOZ	(Zhu et al., 2020)	Response Generation	zh	5	5k		
CS Restaurants	(Dušek and Jurčiček, 2019)	Response Generation	cs	4	3.5k	70	58
DART	(Nan et al., 2021)	Data-to-Text	en	5	60k		
DSTC 10	(Kim et al., 2021b)	Data-to-Text	en	5	20k	1337	95
E2E NLG	(Novikova et al., 2017; Dušek et al., 2020; Dušek et al., 2019)	Data-to-Text	en	5	35k	146	135
FairytaleQA	(Xu et al., 2022)	Question Generation	en	5	8.5k	335	15.9
IndoNLG	(Cahyawijaya et al., 2021)	Summarization	id, jv, su	1–3	14k–200k	2021	456
MLB	(Puduppully et al., 2019a)	Data-to-Text	en	5	23k	24665	2580
MLSum	(Scialom et al., 2020)	Summarization	es, de	5	220k–250k	4152	147
Opusparcus	(Creutz, 2018)	Paraphrasing	de, en, fi, fr, ru, sv	4–5	0–35M		
OrangeSum	(Kamal Eddine et al., 2021)	Summarization	fr	5	21k–30k	1984	138
RiSAWOZ	(Quan et al., 2020)	Response Generation	zh	5	10k		
RotoWire En-De	(Wiseman et al., 2017; Hayashi et al., 2019)	Data-to-Text	en, de	5	242		
Schema-Guided Dialog	(Rastogi et al., 2020)	Response Generation	en	5	165k	188	51
SciDuet	(Sun et al., 2021)	Slide Generation	en	5	2k		
SIMPITIKI	(Tonelli et al., 2016)	Simplification	it	4	815		
SportSett	(Thomson et al., 2020)	Data-to-Text	en	5	3.7k	5990	1620
Squad V2	(Rajpurkar et al., 2016)	Question Generation	en	5	120k	768	55
SQuALITY v1.1	(Wang et al., 2022)	Summarization	en		2500	5000	227
Surface Realization ST 2020	(Mille et al., 2020)	Data-to-Text	ar, en, es, fr, hi, in ko, ja, pt, ru, zh	3–5	250k	892	126
TaskMaster	(Byrne et al., 2019)	Response Generation	en	5	190k	972	55
ToTTo	(Parikh et al., 2020)	Data-to-Text	en	5	120k	357	
Turku Hockey	(Kanerva et al., 2019)	Data-to-Text	fi	4	2.7k–6.1k	158	58
Turku Paraphrase	(Kanerva et al., 2021)	Paraphrasing	fi	4	81k–170k	87	47
ViGGo	(Juraska et al., 2019)	Data-to-Text	en	5	5.1k	120	109
WebNLG	(Gardent et al., 2017a,b)	Data-to-Text	en, ru	4–5	14k–35k	169.5	157
WikiAuto							
+ASSET/TURK/Split&Rephrase	(Jiang et al., 2020; Alva-Manchego et al., 2020; Xu et al., 2016; Zhang et al., 2020)	Simplification	en	5	480k		
WikiCatSum	(Perez-Beltrachini et al., 2019)	Summarization	en	5	48k	43527	256
WikiLingua	(Ladhak et al., 2020)	Summarization	ar, cs, de, en, es, fr, hi, id, it, ja, ko, nl, pt, ru, th, tr, vi, zh	3–5	5k–3.8M	1607–4650	159–489
XLSum	(Hasan et al., 2021)	Summarization	om, fr, am, ar, az, bn, cy, en, es, gd, fa, gu, ha, hi, ig, id, ja, ko, ky, mr, my, ne, ps, pcm, pt, pa, m, ru, sr, si, so, sw, ta, te, th, ti, tr, uk, ur, uz, vi, yo, zh-CN, zh-TW	0–5	1.3k–300k	1470–9924	200.5 137–614
XSum	(Narayan et al., 2018)	Summarization	en	5	23k	3486.5	237
XWikis	(Perez-Beltrachini and Lapata, 2021)	Summarization	en, de, fr, cs	4–5	44k–461k	1845 1743	153 102

Table 3: Detailed information about all the datasets currently supported in GEM. We present the name of the dataset, the paper(s) in which the dataset was introduced, the NLG task it performs, the languages the dataset caters to and their resourcedness taxonomy class, the size of the training set (rounded), and the lengths of input and output.

B.2 FairytaleQA

The original release of FairytaleQA (Xu et al., 2022) used separate files to store the fairytale story content and experts-labeled QA-pairs. It provided baseline benchmarks on both Question Answering and Question Generation tasks. In GEMv2, we re-organize the data to be specifically prepared for the Question Generation task. The original dataset contains 2 answers created by different annotators in the evaluation and test splits, but we only take the first answer into consideration for the Question Generation task. The input for this task would be the concatenation of each answer labeled by human experts and the related story section(s), and the output target would be the corresponding question labeled by human experts.

B.3 MLB Data to Text

We follow the serialization format introduced in (Puduppully and Lapata, 2021) for the linearized_input field. Specifically, we serialize the home team records, the visiting team records, and the player records. We next serialize the records of the innings in chronological order.

B.4 Opusparcus

Compared to the original release of Opusparcus (Creutz, 2018), available through the Language Bank of Finland,¹² the GEMv2 release contains a few additions to facilitate the use of this resource:

The validation and test sets now come in two versions, the so-called *regular* validation and test sets and the *full* sets. The regular sets only contain

¹²<https://www.kielipankki.fi/corpora/opusparcus/>

sentence pairs that qualify as paraphrases. The full sets are the original sets from the original release, which contain all sentence pairs successfully annotated by the annotators, including the sentence pairs that were rejected as paraphrases. The validation sets were called development sets in the original release.

The training sets are orders of magnitudes larger than the validation and test sets. Therefore the training sets have not been annotated manually and the true paraphrase status of each entry is unknown. In the original release, each training set entry is accompanied by an automatically calculated ranking score, which reflects how likely that entry contains a true paraphrase pair. The entries are ordered in the data, best first, worst last. If you use the original release, you need to control yourself how large and how clean a portion of the training data you will use.

In the GEMv2 release, the training sets come in predefined subsets. Using the so-called *quality* parameter, the user can control for the estimated proportion (in percent) of true paraphrases in the retrieved training subset. Allowed quality values range between 60 and 100, in increments of 5 (60, 65, 70, ..., 100). A value of 60 means that 60% of the sentence pairs in the training set are estimated to be true paraphrases (and the remaining 40% are not). A higher value produces a smaller but cleaner set. The smaller sets are subsets of the larger sets, such that the quality=95 set is a subset of quality=90, which is a subset of quality=85, and so on. Depending on this parameter, the dataset can fall into all resourcedness categories in Figure 2.

B.5 ROTOWIRE_English-German

We introduce a field `linearized_input`, which serializes the input table into a string. We follow a serialization format similar to that of Saleh et al. (2019). More specifically, we serialize all the records of the home team followed by that of the visiting team. We next serialize the records of the players of the home team followed by that of the visiting team. We rank the players by points in descending order. In addition, we add information about the relative rank of a player within a team following Puduppully et al. (2019b).

B.6 SciDuet

The original released *SciDuet* (Sun et al., 2021) uses two json files to store paper information and slide information, respectively. In GEMv2, we

merge these two files and reorganize the structure so that each data instance contains the complete input (i.e., paper title/abstract/section headers/section content, as well as slide title) and output (i.e., slide text content). In addition, we introduce a new challenging dataset in GEMv2 by removing slides if their titles match with any section headers from the corresponding paper.

B.7 SIMPITIKI

The original release of SIMPITIKI (Tonelli et al., 2016) includes two xml files, corresponding to the version 1 and version 2 respectively. The second version has better sentence boundaries. However, no training, validation and test splits were officially proposed for both release. In GEM, we randomly and independently split both xml files into training, validation and test sets. Note that version 1 and version 2 have different splits. We also generated challenge sets where some simplification transformations in the test set are not part of the training set and thus unseen in the training phase. Then, as SIMPITIKI leverages data from Wikipedia and the Municipality of Trento corpora, we further propose splits based on the respective data source.

B.8 SportSett Basketball

Similar to MLB Data-to-Text, SportSett also follows the serialization format introduced in (Puduppully and Lapata, 2021) for the `linearized_input` field. The serialisation starts with current game’s information such as date and venue of the game. This is followed with both team’s information (line-scores) including their next game’s information as well. Finally, the players’ information (box-scores) is serialised, starting with home team’s players and then visiting team’s players.

B.9 squad_v2

SQuAD2.0 (Rajpurkar et al., 2016) combines the 100,000 questions in SQuAD1.1 with over 50,000 unanswerable questions written adversarially by crowdworkers to look similar to answerable ones. The original SQuAD2.0 dataset has only training and dev (validation) splits. A new test split is created from the train split and added as part of the `squad_v2` dataset.

B.10 Taskmaster-3

According to Byrne et al. (2021), the Taskmaster-3 (also called TicketTalk) dataset consists of 23,789 movie ticketing dialogs, where the customer’s goal

is to purchase tickets after deciding on theater, time, movie name, number of tickets, and date, or opt out of the transaction. This collection was created using the "self-dialog" method, i.e., a single, crowd-sourced worker is paid to create a conversation writing turns for both speakers- the customer and the ticketing agent.

B.11 Turku Hockey

To ease the use of the data, in addition to the game-level structuring as used in the original Turku Hockey data release (Kanerva et al., 2019), we provide a simplified event-level structuring. In the event-level generation, the structured input data is linearized to string representation separately for each game event, and the task objective is thus to generate the description separately for each game event directly using the linearized input representation. In comparison, the objective of the game-level generation is to process the structured data for the entire game at once, and generate descriptions for all relevant events. The linearized event inputs are produced using similar approach as described in the original paper.

B.12 Turku Paraphrase

In GEMv2, the Turku Paraphrase data can be loaded with three different configurations, *plain*, *classification*, and *generation*. While the *plain* configuration models the data similarly to the original release, the two other options directly applies several transformations beneficial for the named task. In *classification* each example is provided using both $(text1, text2, label)$ and $(text2, text1, label)$ ordering, as paraphrase classification does not depend on the order of the given statements. In cases with a directionality annotation in the paraphrase pair, the label is flipped accordingly when creating the additional examples. In generation, on the other hand, the data is pre-processed to include only examples suitable for the paraphrase generation task, therefore discarding, e.g., negative and highly context dependent examples, which does not fit the generation task as such. In addition, the examples with annotated directionality (one statements being more detailed than the other, for instance one mentioning *a woman* while the other *a person*), the example is always provided using ordering where the input is more detailed and the output more general in order to prevent model hallucination (model learning to generate facts not present in the input). For more details about the annotated labels and the

directionality, see Kanerva et al. (2020).

B.13 WikiLingua

The original release of WikiLingua (Ladhak et al., 2020) released a dataset of article-summary pairs in 18 languages, but had only created train/val/test splits for 4 language pairs (es-en, tr-en, ru-en, vi-en), for the purposes of crosslingual evaluation. As part of GEMv1, we created train/val/test splits for all 18 languages. To further facilitate building multilingual and crosslingual models for all 18 languages, the GEMv2 release contains the following changes to the GEMv1 release:

In the original WikiLingua release, each document-summary pair in any of the 17 non-English languages has a corresponding parallel document-summary pair in English. A given English document-summary pair can have parallel document-summary pairs in multiple languages. In order to facilitate crosslingual experiments across all language pairs, for the GEMv2 release, we align document-summary pairs across the other 17 languages via English. For example, if a given document-summary pair in English has corresponding parallel pairs in Turkish and Vietnamese, we can then align these to get Turkish-Vietnamese parallel pairs. As a result, in addition to supporting all the functionality in GEMv1, the v2 loader allows the user to specify and load crosslingual data for any language pair in the dataset.

In addition to the original evaluation sets (val and test), we also have sub-sampled versions in order to facilitate faster development cycles. To create the sub-sampled versions, for each evaluation set, we randomly sample 3,000 instances.¹³

We further clean the dataset by removing payloads for thumbnails that were scraped into the document and summary texts and we filter out all instances with a summary length longer than 60% of the input document length. This removes around 5% of the data.

C Contribution Statements

Organizing GEM would not be possible without community contributions and the mutual goal of improving NLG and its evaluation. To give proper credit to all contributors, this section lists the involvements of all co-authors. Besides the detailed list, everyone contributed to discussion sessions,

¹³Evaluation sets that have fewer than 3,000 instances were not sub-sampled.

made dataset suggestions, and participated in proof reading the final paper.

Dataset Loaders The new data loaders and associated data cards were created by the following people:

ART: Chandra Bhagavatula, Nico Daheim, Aman Madaan

BiSect: Jenny Chim, Reno Kriz

Conversational Weather: Vipul Raheja, Michael White

CrossWOZ: Qi Zhu

DSTC10: Nico Daheim, Di Jin, Alexandros Papangelis

FairyTaleQA: Bingsheng Yao

IndoNLG: Bryan Wilie, Samuel Cahyawijaya, Genta Indra Winata

MLB: Ratish Puduppully

Opusparcus: Mathias Creutz

OrangeSum: Moussa Kamal Eddine

RiSAWOZ: Tianhao Shen, Deyi Xiong, Chaobin You

RotoWire En-De: Hiroaki Hayashi, Ratish Puduppully

SciDuet: Yufang Hou, Dakuo Wang

SIMPITIKI: Sebastien Montella, Vipul Raheja

Split and Rephrase: Cristina Garbacea, Reno Kriz, Li Zhang

SportSett: Craig Thomson, Ashish Upadhyay

Squad V2: Abinaya Mahendiran

SQUALITY: Alex Wang

Surface Realisation ST: Bernd Bohnet, Simon Mille

TaskMaster: Tosin Adewumi

ToTTo (port): Abinaya Mahendiran

Turku Hockey: Filip Ginter, Jenna Kanerva

Turku Paraphrase: Filip Ginter, Jenna Kanerva

ViGGo: Juraj Juraska, Aman Madaan

WikiCatSum: Ronald Cardenas Acosta, Laura Perez-Beltrachini

WikiLingua (port): Jenny Chim, Faisal Ladhak

XLSum: Abhik Bhattacharjee, Tahmid Hasan, Rifat Shahriyar

XSum (port): Abinaya Mahendiran

XWikis: Ronald Cardenas Acosta, Laura Perez-Beltrachini

Lewis Tunstall designed and implemented the infrastructure to host GEMv2 on the Hugging Face Hub. Sebastian Gehrmann addressed the remaining loader issues and ported the remaining GEMv1 datasets. Anna Shvets developed dataset-agnostic

bias detection filters. Simon Mille coordinated progress during the hackathon.

Documentation The updated tutorials for using GEM and adding new data loaders were developed and tested by Jenny Chim, Paul Pu Liang, and Anna Shvets.

Data Cards The questions in the revised data card template were created during sessions led by Mahima Pushkarna with the help of Yacine Jernite, Angelina McMillan-Major, Nishant Subramani, Pawan Sasanka Ammanamanchi, and Sebastian Gehrmann. The collection tool was implemented by Yacine Jernite and Sebastian Gehrmann. The data card rendering tool was developed by Vivian Tsai and Mahima Pushkarna.

Human Evaluation The human evaluation working group is led by João Sedoc. Its members include Jenny Chim, Elizabeth Clark, Daniel Deutsch, Kaustubh Dhole, Khyathi Raghavi Chandu, Sebastian Gehrmann, Yufang Hou, Yixin Liu, Saad Mahamood, Simon Mille, Vitaly Nikolaev, Salomey Osei, Dragomir Radev, Yisi Sang, and Alex Wang.

Metrics The metrics library, originally developed for GEMv1, was extended by Jordan Clive, Nico Daheim, Daniel Deutsch, Ondrej Dusek, Sebastian Gehrmann, Aman Madaan, Joshua Maynez, Vikas Raunak, Leonardo F. R. Ribeiro, and Anna Shvets.

Paper Writing and Analyses Sebastian Gehrmann led the writing of the paper. Abinaya Mahendiran and Jekaterina Novikova contributed analyses that were used to create Figure 2 and Table 3.

Submission Infrastructure Lewis Tunstall led the development of the submission infrastructure. Hendrik Strobelt led the extension of the result visualization tool to ensure compatibility with the new submission system.

Baselines Additional baseline results were provided by Tosin Adewumi, Mihir Sanjay Kale, Joshua Maynez, and Leonardo F. R. Ribeiro.