The Vault: A Comprehensive Multilingual Dataset for Advancing Code Understanding and Generation

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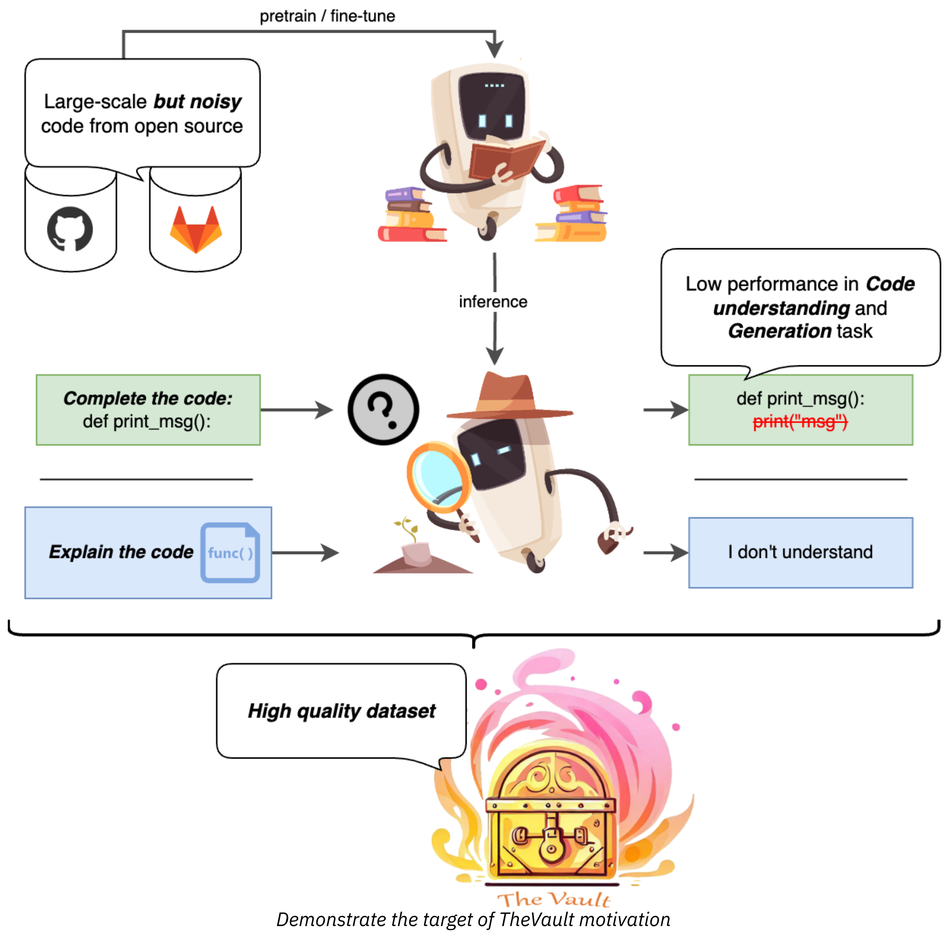
MOTIVATION



Demonstrate the target of TheVault motivation

MAIN CONTRIBUTIONS

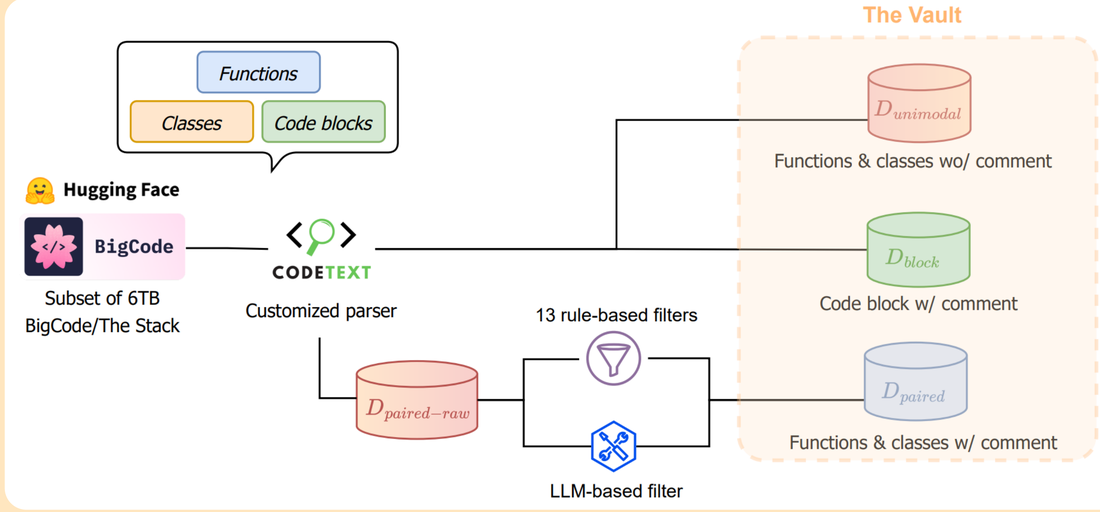
- We release a dataset with **43 million samples of high-quality code-text pairs**, 243 million uni-modal samples, and 69 million pairs of line comments with context from 10 popular programming languages.
- Well-known CodeLLMs (CodeGen, CodeT5, PLBART) **fine-tuned on The Vault outperform their original models** significantly on wide range of tasks, including code generation, code search and code summarization.
- We propose a **novel pipeline for obtaining high-quality pairs** of code from large, noisy corpora.
- We publish an open-source toolkit used for **converting raw source code into code-text pairs** and filtering noisy samples in various programming languages.

DATASET COMPARISON

Dataset	#PL	#Function w/ docstring	#Function w/o docstring
PyMT5 [Clement et al., 2020]	1	≈ 7,700,000	-
CoDesc [Hasan et al., 2021]	1	4,211,516	-
CodeSearchNet [Husain et al., 2019]	6	2,326,976	4,125,470
CodeXGLUE CSN [Lu et al., 2021]	6	1,005,474	-
Deepcom [Hu et al., 2020]	1	424,028	-
CONCODE [Iyer et al., 2018b]	1	2,184,310	-
Funcom [LeClair et al., 2019]	1	2,149,121	-
CodeT5 [Wang et al., 2021]	8	3,158,313	5,189,321
THEVAULT	**10**	**34,098,775**	**205,151,985**

A comparison between programming language of current available parallel dataset on function level

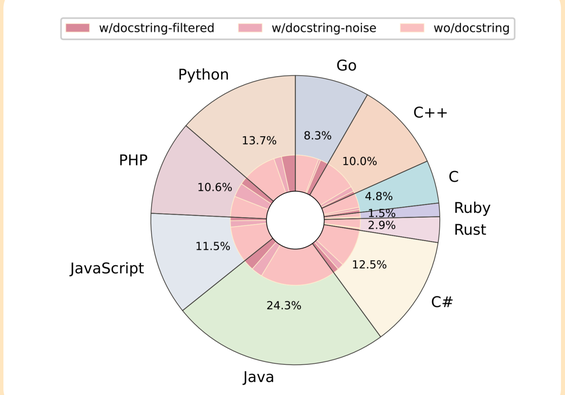
DATA CREATION



Pipeline to create datasets of code blocks with comments D_{block}, unimodal code $D_{unimodal}$, and code-textpairs D_{paired} from raw source code

The Vault's construction process consist of 4 steps:

- ***Step 1:*** Sampling a subset of 6TB The Stack, that contains permissible source code, in 10 most popular programming languages.
- ***Step 2:*** Apply CodeText, our customized tree-sitter parsers, to parse the code snippets into AST and extract *functions*, *classes*, *arbitrary code blocks*, with their associated *natural language comments* to obtain preliminary datasets.
- ***Step 3:*** We employ both rule-based filters and neural-based filter on $D_{paired-raw}$ dataset to select high quality samples for D_{paired}.
- ***Step 4:*** Consolidate $D_{unimodal}$, D_{block} and D_{paired} to create The Vault.



Distribution and the number of functions by the presence of docstrings.

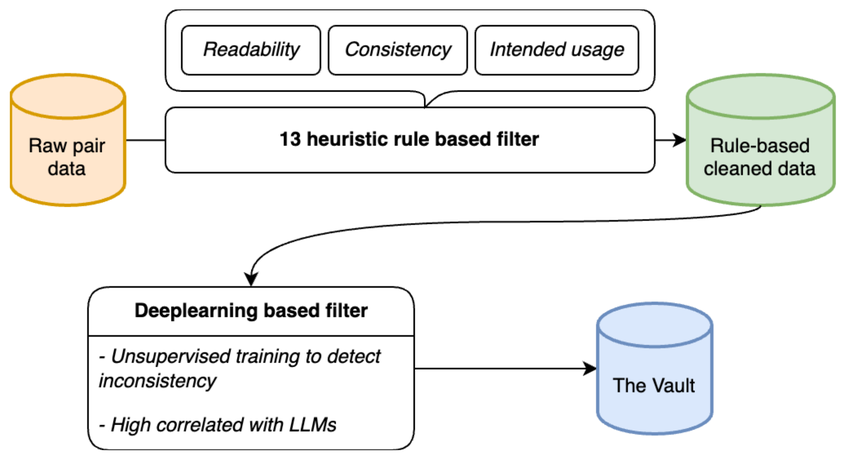
Sample of Inconsistent pairs

```
// we do not need Buffer pollyfill for now
function(str){
    var ret = new Array(str.length), len = str.length;
    while(len--) ret[len] = str.charCodeAt(len);
    return Uint8Array.from(ret);
}
```

```
// Handy for templates.
def has_urls(self):
    if self.isbn_uk or self.isbn_us:
        return True
    else:
        return False
```

Inconsistent pair of code-text examples filtered by rule-based and neural-based filters.

DATA CLEANING



Demonstrate cleaning pipeline using both rule-based and deep learning-based

EXPERIMENTS

We observe significantly better performances in CodeLLMs when fine-tuned using The Vault, compared to the current SOTA CodeSearchNet.

Model	Fine-tune dataset	pass@1	pass@10	pass@100
	HUMANEVAL			
CodeGen 350M	-	6.67	10.61	16.84
	Py/CodeSearchNet	2.76	8.76	14.72
	(250K) Py/TheVault	3.74	10.57	16.26
	raw/PyTheStack	6.64	15.42	24.80
	Py/TheVault	**8.14**	**18.12**	**30.07**
CodeGen 2B	-	**14.51**	24.67	38.56
	Py/TheVault	14.00	**25.74**	**41.72**
	MBPP			
CodeGen 350M	-	7.46	24.18	46.37
	Py/TheVault	**10.13**	**33.96**	**53.20**
CodeGen 2B	-	18.06	45.80	**65.34**
	Py/TheVault	**27.82**	**50.06**	65.06

Code generation benchmarks running on CodeGen Multi model.

- CodeT5 and PLBART fine-tuned on (similar size) The Vault significantly better performance (≈17.6% average) than on CodeSearchNet on task ***Code Summarization***.
- On ***Code Search***, superior results (≈28% average) are observed in most languages when using (similar size) The Vault than on CodeSearchNet when fine-tuning CodeBERT, RoBERTa, UniXCoder.

Check our Github repository