



# Case Study

# AlphaCode

Creating software with LLMs

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# AlphaCode - Problem

## Coding contests



A problem description is given. Alongside it a few example test cases (2-3) with expected outputs are given.

The set  $[1, 2, 3, \dots, n]$  contains a total of  $n!$  unique permutations. By listing and labeling all of the permutations in order, we get the following sequence for  $n = 3$ : ["123", "132", "213", "231", "312", "321"]. Given  $n$  and  $k$ , return the  $k$ th permutation sequence.

**Example 1:**

Input:  $n = 3, k = 3$

Output: "213"

**Example 2:**

Input:  $n = 4, k = 9$

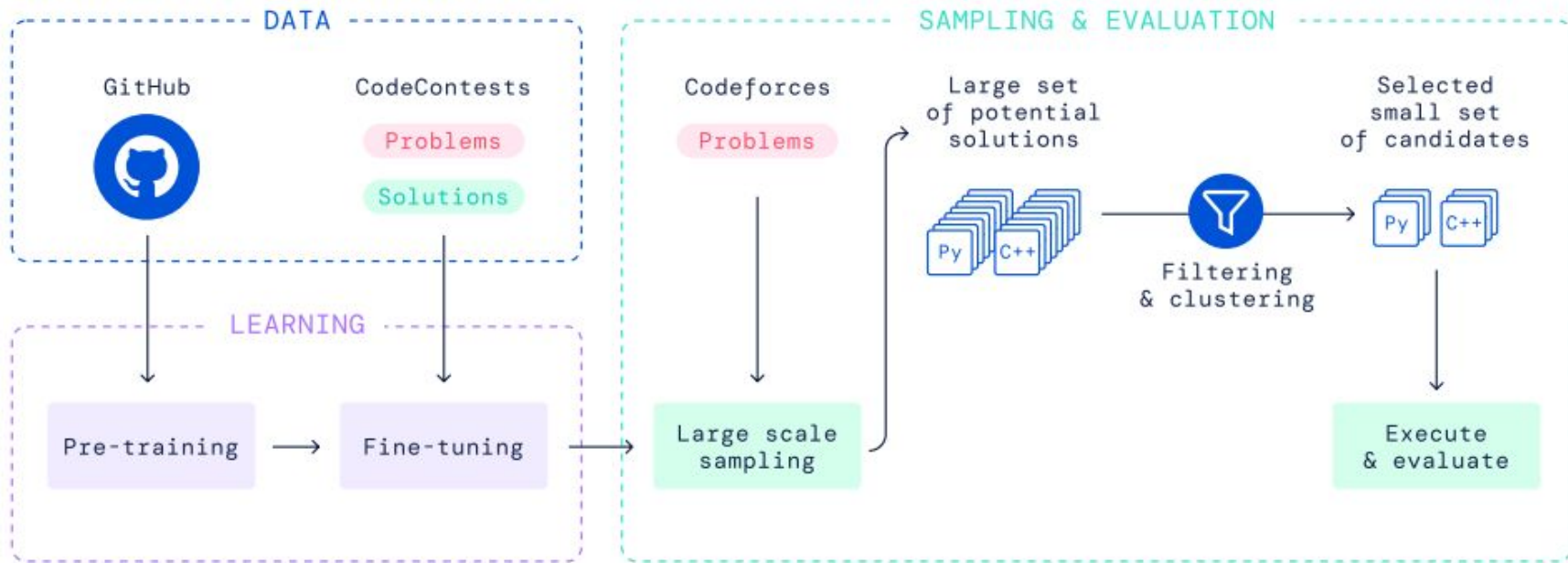
Output: "2314"

**Example 3:**

Input:  $n = 3, k = 1$

Output: "123"

# AlphaCode - Overview



LLM



Pre-train (GitHub)

Fine-tune  
(specialized)

Sample

Cluster

Test case model

Filter (input)

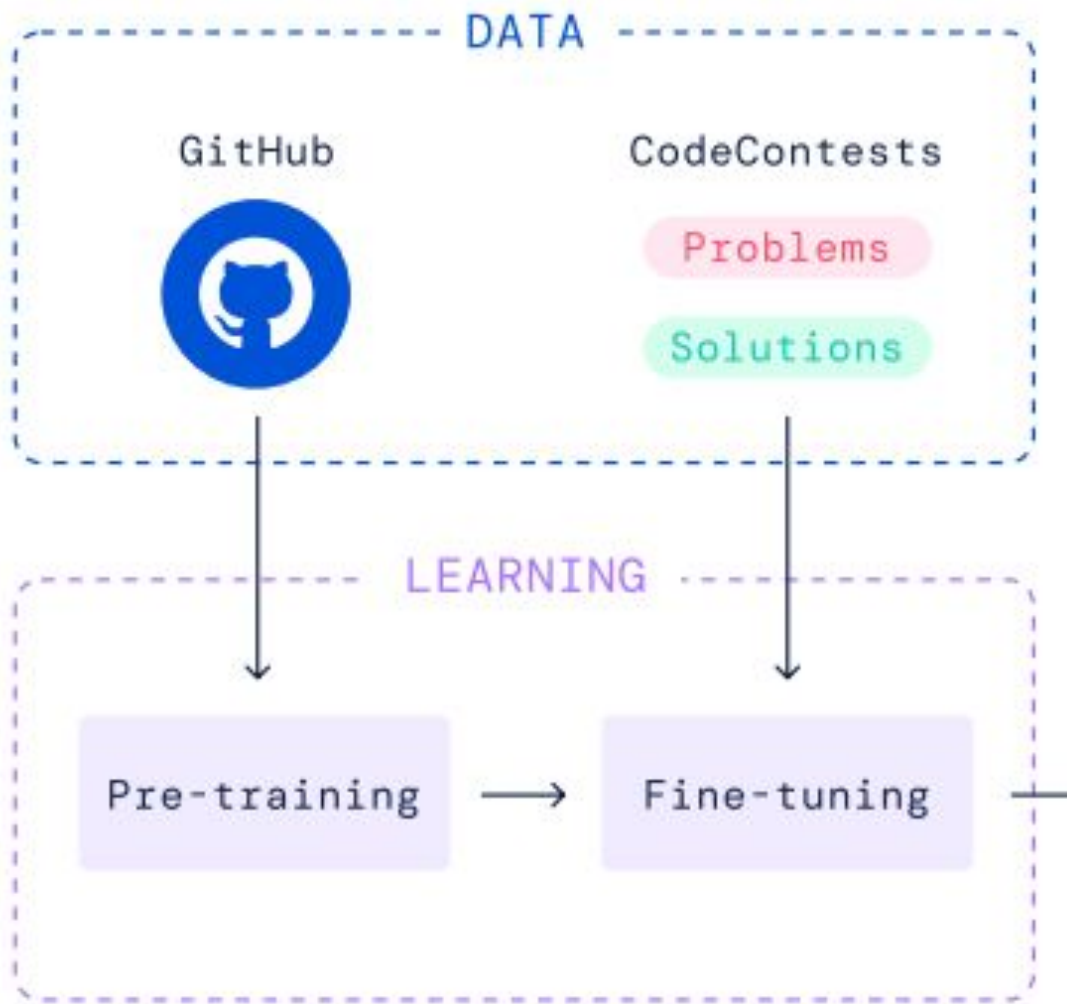
Sample from cluster

Execute and  
evaluate

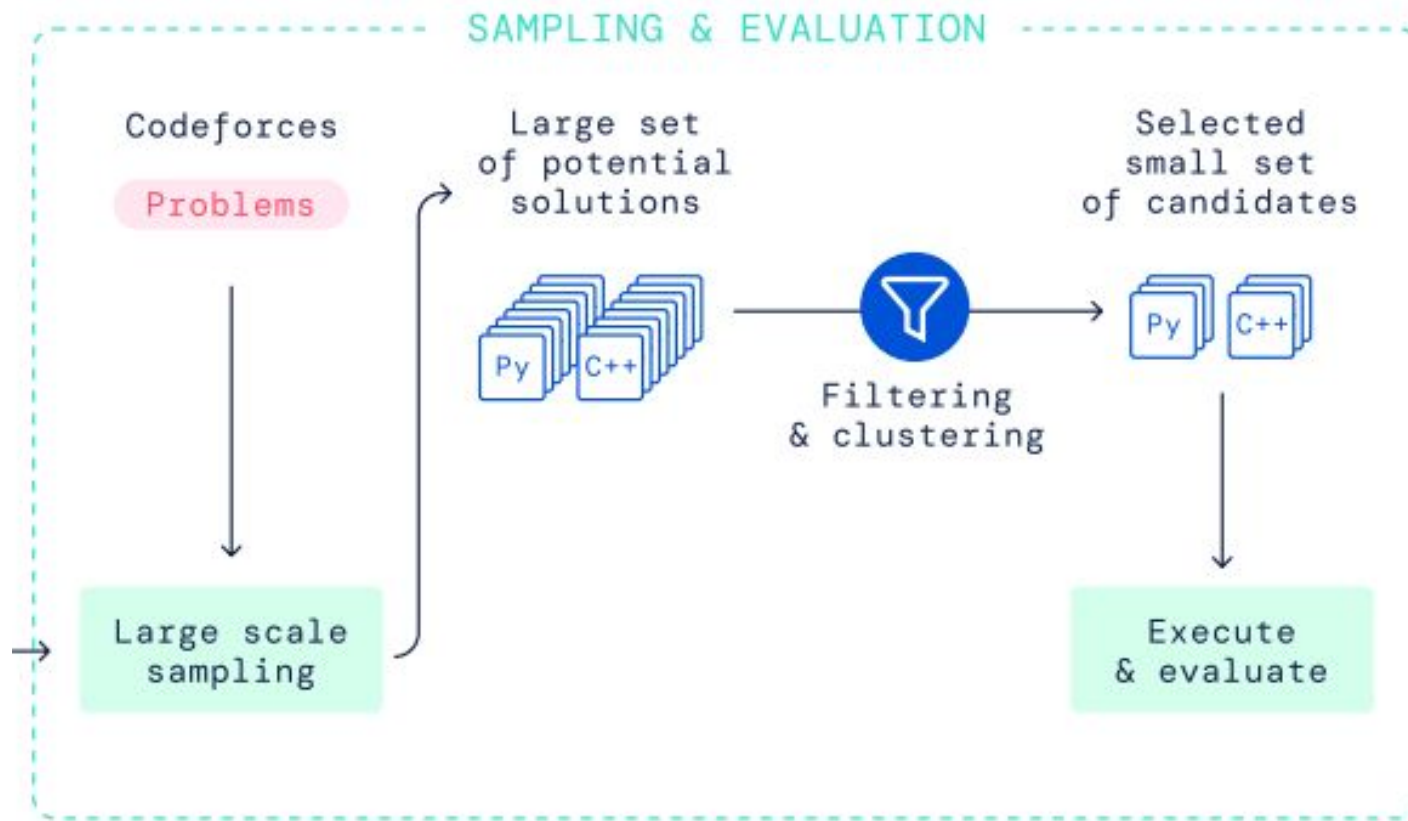
Pipeline



# AlphaCode - LLM



# AlphaCode - Generation



**Passes  
provided test  
cases.**

2



3

**Diverse output  
in generated  
test cases.**

1

**LLM Samples.**



# Filtering and clustering



1 - Does it pass input test cases?

2 - Arrange in buckets based on output of generated tests.

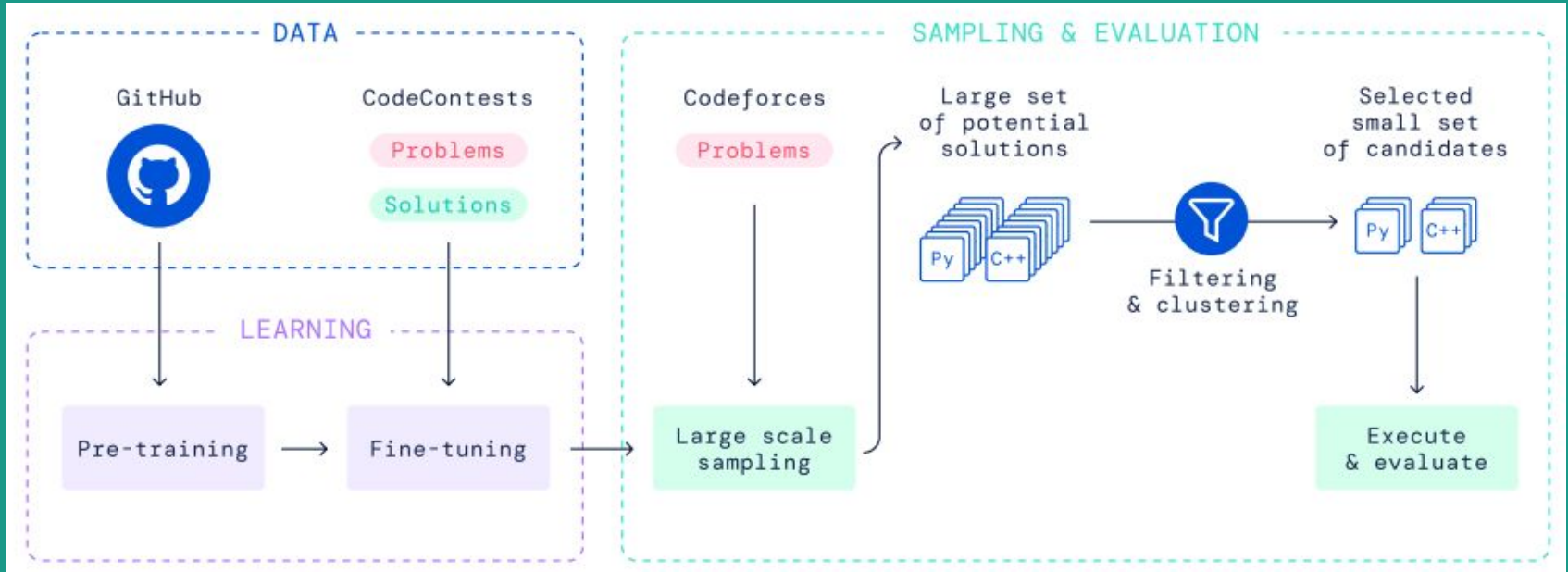
*(most programs are the same)*

[Test case model - LLM]

3 - Sample from buckets. Evaluate.



# Conclusion



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LLMs alone are not enough for critical applications.