Meaningful Variable Names for Decompiled Code: A Machine Translation Approach

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STRUDEL

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Problem: Obfuscated Variable Names in Code

Minified JavaScript:

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function callback(error, response, body) {
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   var info = JSON.parse(body);
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Decompiled C Code:

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cp = buf;
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  printf(" %02X ", *(cp++));
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v14 = &v15;
asxTab(a2 + 1);
for (v13 = asnContents(a1, &v15, 512LL); v13 > 0; --v13) {
  v9 = (unsignedchar*)(v14++);
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- Use large corpora + machine learning to predict better identifier names.
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- Bavishi et al., Context2Name, 2017
- Vasilescu et al., JSNaughty, 2017
- Raychev et al., JSNice, 2015

Problem: Obfuscated Variable Names in Code

Can we use similar strategies for decompiled code?

Decompiled C Code:

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Statistical Machine Translation (SMT)

- Noisy channel model

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Go do some research!

Va faire de la recherche!

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$$argmax_e \, p(e \mid f)$$

Statistical Machine Translation (SMT)

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$$argmax_e\, p(e \mid f) = argmax_e \frac{p(f \mid e)\, p(e)}{p(f)}$$
$$= argmax_e\, p(f \mid e)\, p(e)$$

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Translation Model: Probability that *f* is a translation of *e*

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Language Model: "Fluency" of *e*

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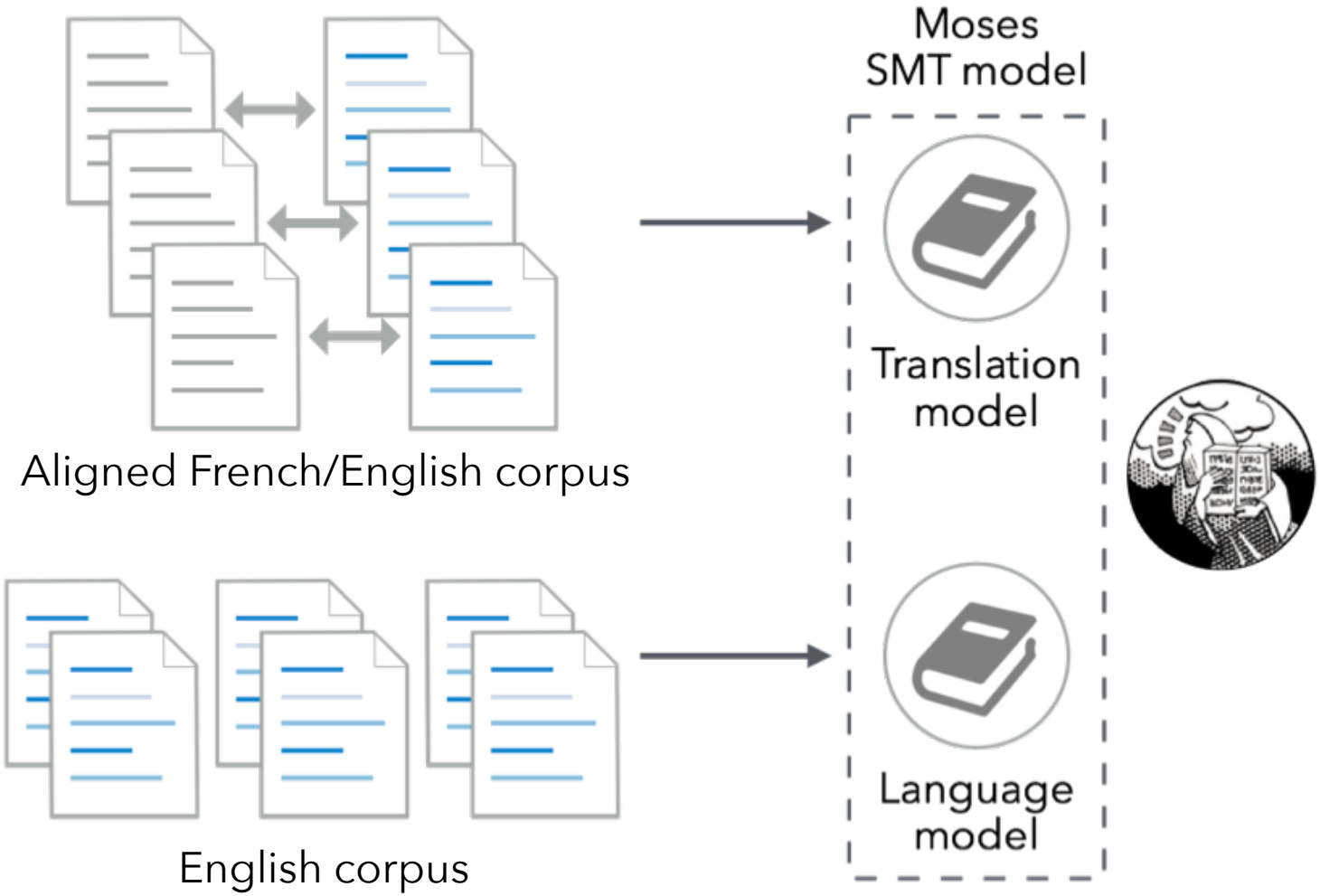
$p(f \mid e)$: Translation Model

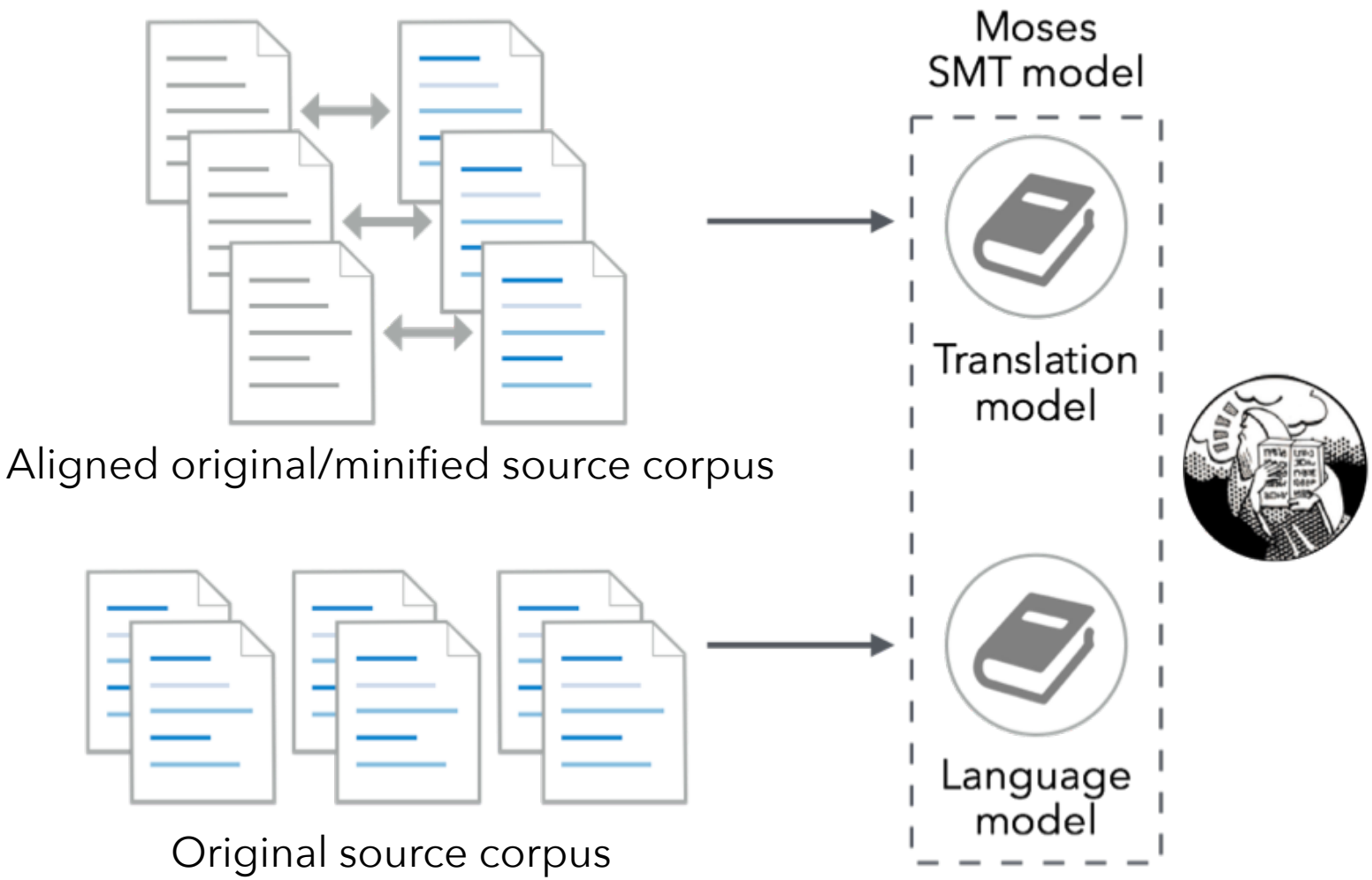
$p(e)$: Language Model

MOSES SMT:

SMT Model for Natural Language



SMT Model for Minified JavaScript



Problem: Obfuscated Identifiers in Code

Can we use SMT for decompiled code?

Decompiled C Code:

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cp = buf;
(void)asxTab(level + 1);
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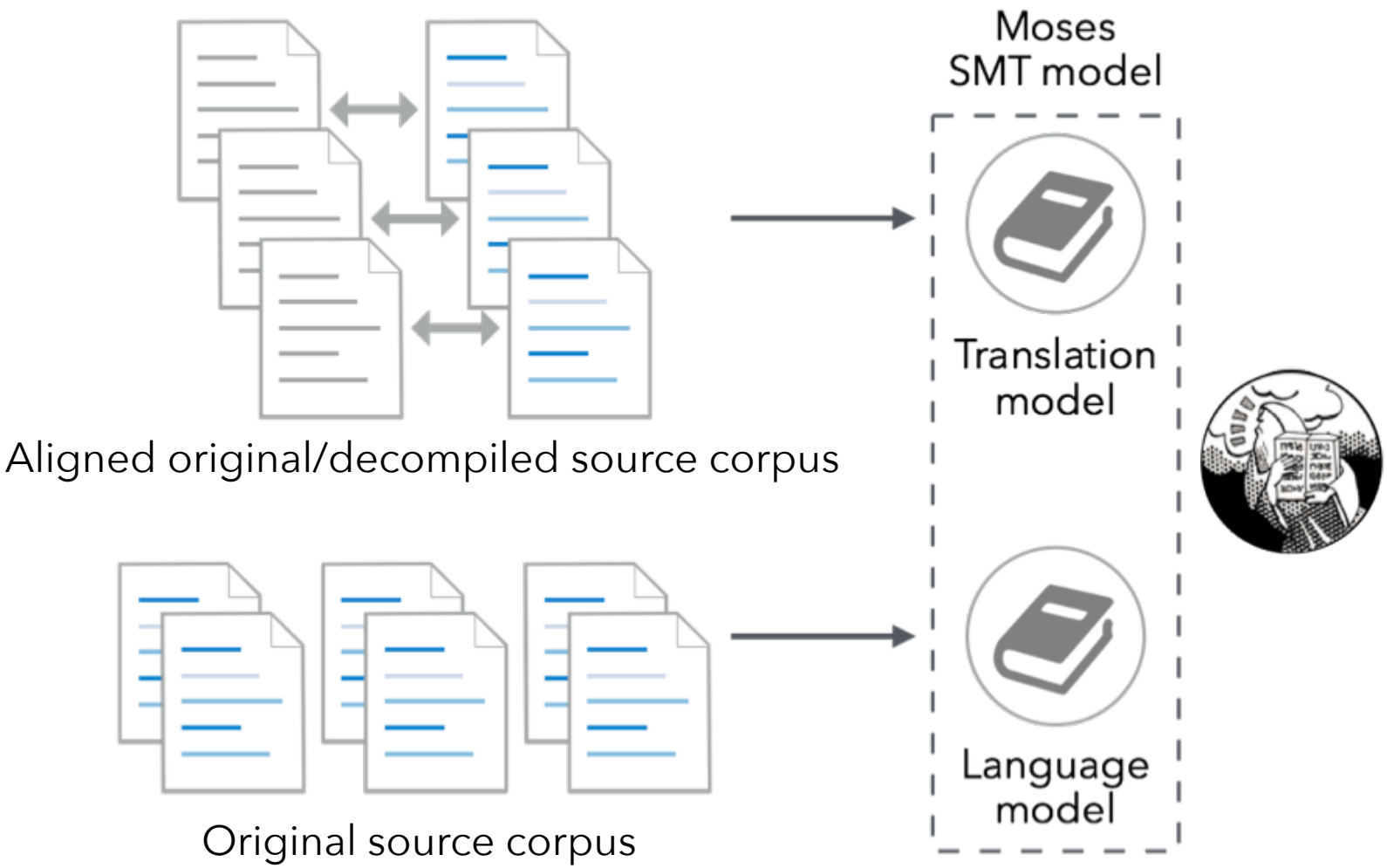
SMT Model for Decompiled Code?



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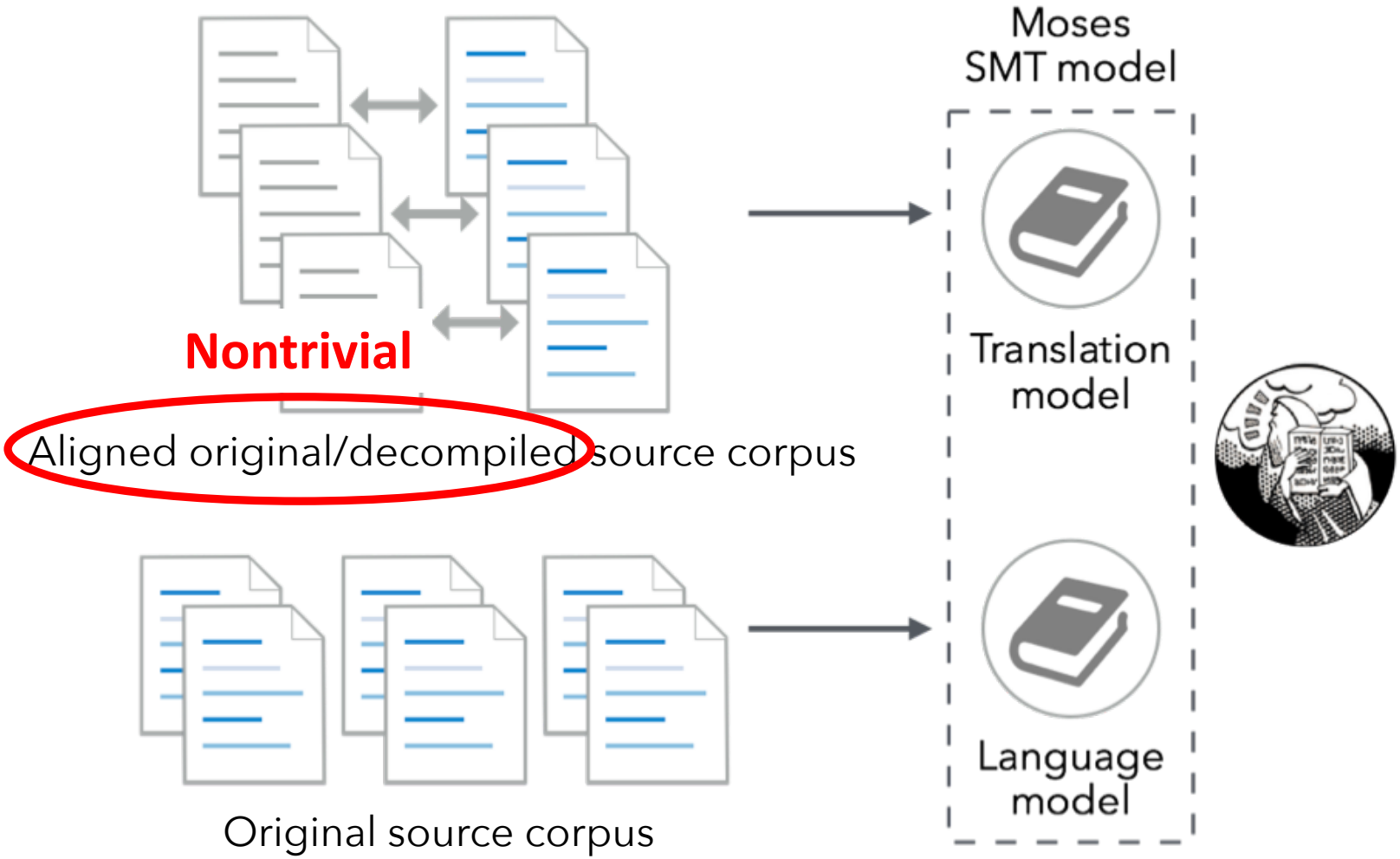

Difficulty: Decompilation Changes Structure

Original Source

```c
#include <stdio.h>
int main() {
 int cur = 0;
 while (cur <= 9) {
   printf("%d\n", cur);
   ++cur;
 }
 return 0;
}
```

Decompiled Code

```c
#include <stdio.h>
int main() {
 int v1 = 0;
 int v2;
 for (v2 = 0; v2 < 10; ++v2)
   printf("%d\n", v2);
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}
```

Difficulty: Decompilation Changes Structure

9 Lines Original Source

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8 Lines Decompiled Code

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- Different line count.

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Decompiled Code Corpus Generation

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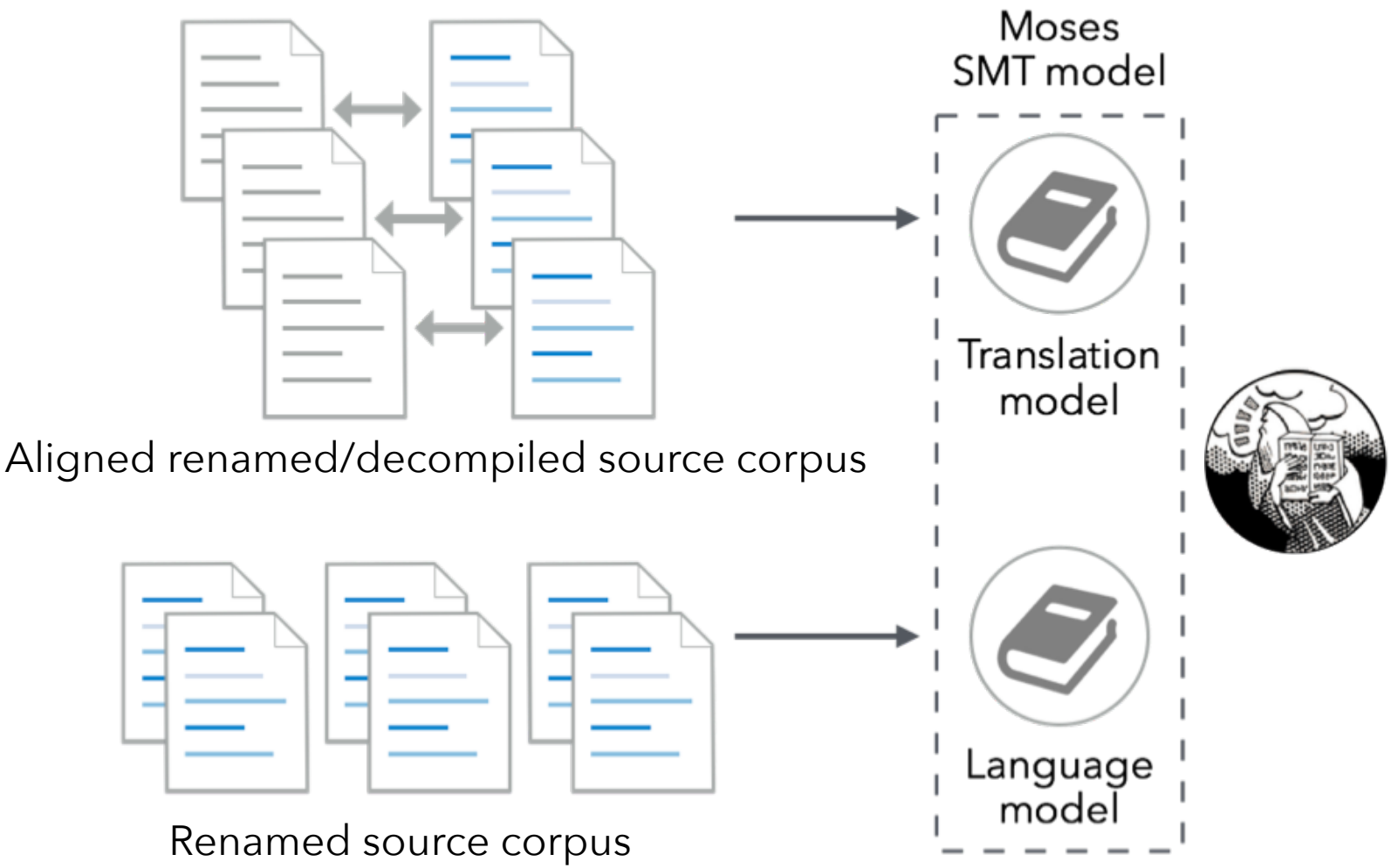
Renamed Decompiled Code

Better SMT Model for Decompiled Code



Choosing Renamings

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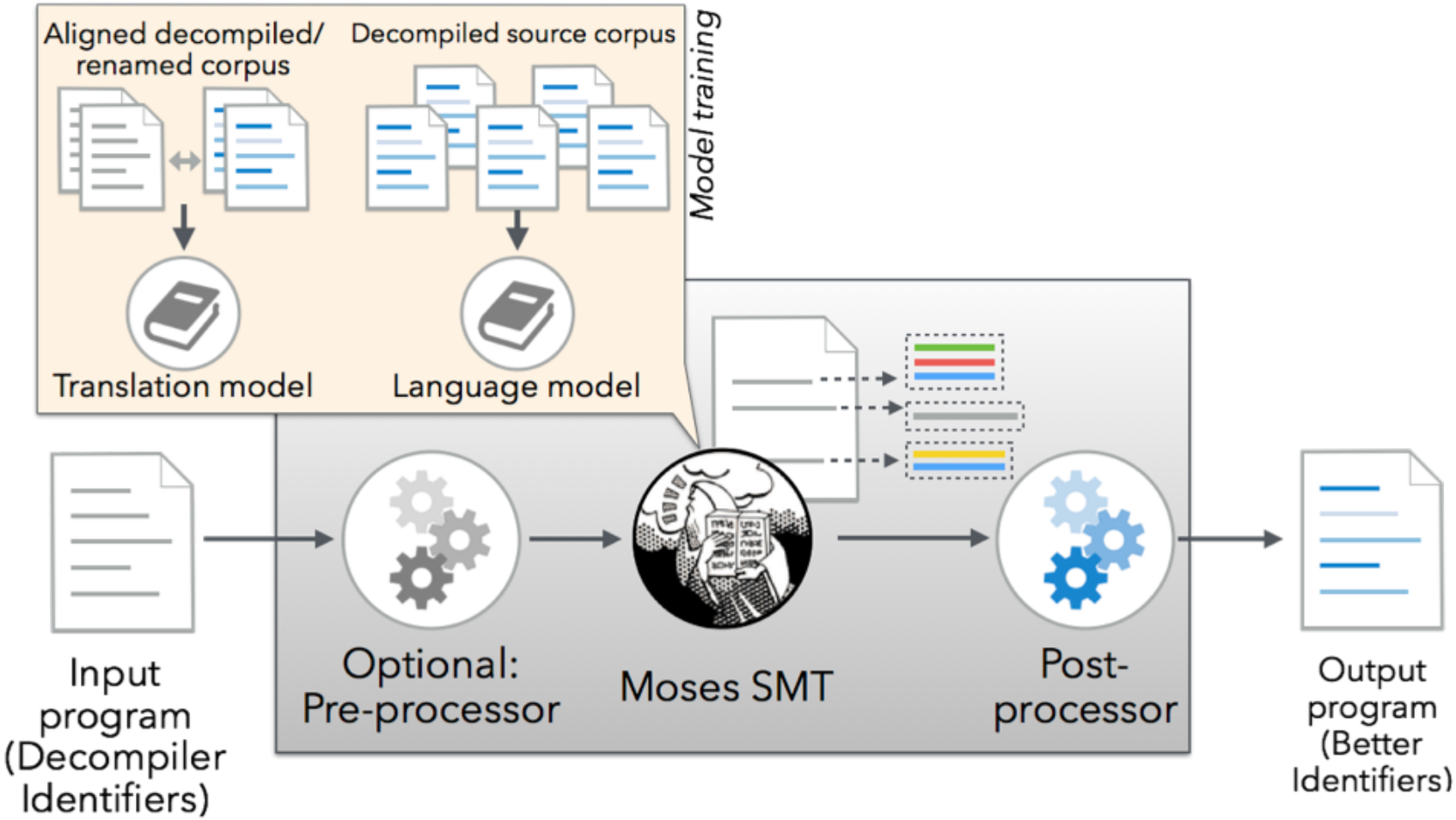
System Architecture



Results and Evaluation

Original

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                   size_t buffer_size)
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Results and Evaluation

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Decompiled

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Results and Evaluation

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Renamed Decompiled

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Renamed Decompiled

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Results and Evaluation

Original

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my_rc base2_string(base2_handle base2_h, char* buffer,
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```

Exact

Renamed Decompiled

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my_rc base2_string(base2_handle base2_h, char* buf,
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```

Results and Evaluation

Original

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my_rc base2_string(base2_handle base2_h, char* buffer,
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```

Approx

Renamed Decompiled

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my_rc base2_string(base2_handle base2_h, char* buf,
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Results and Evaluation

Original

```
my_rc base2_string(base2_handle base2_h, char* buffer,
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```

Not a match

Renamed Decompiled

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Results and Evaluation

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Renamed Decompiled

```
my_rc base2_string(base2_handle base2_h, char* buf,
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- 12.7% Exact
- 16.2% Exact + Approx

Results and Evaluation

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Preliminary Investigation: Human Study

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1 int x = 1;
2 int y = 0;
3 while (x <= 5) {
4   y += 2;
5   x += 1;
6 }
7 printf("%d", y);
```

- What is the value of the variable y on line 7?

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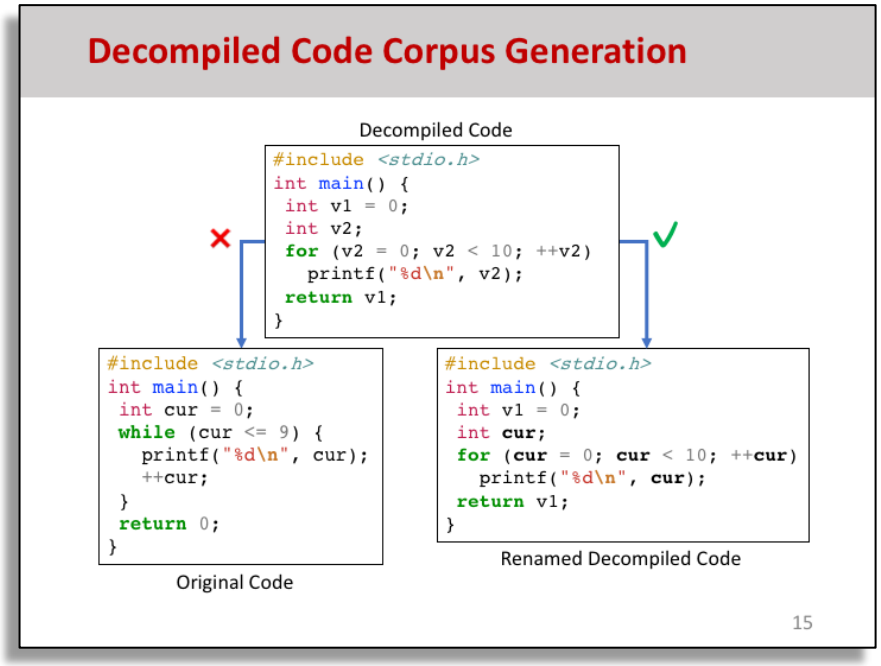
- What is the value of the variable y on line 7?

- For correct answers, the time to answer using our renamings was statistically significantly lower than when using the decompiler names.

Conclusion



- Questions?
- Suggestions?