What Are We Going To Do About Libraries? A Work in Non-Progress Talk

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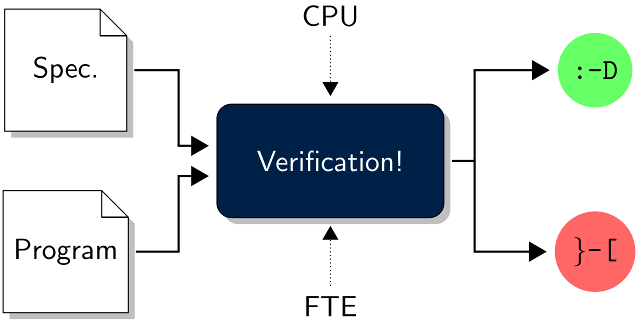
September 18, 2018

A Work in Non-Progress Talk

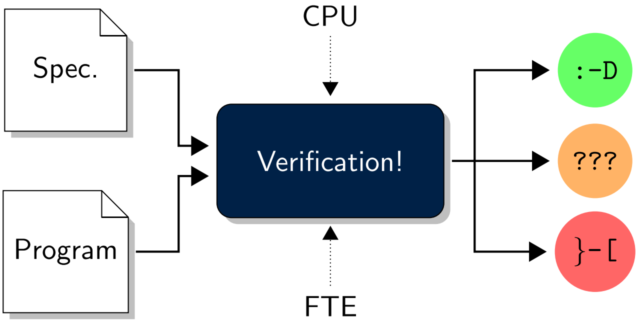
Don't say I didn't warn you...

- No answers; only problems.
- No results; only opinions.

Verification

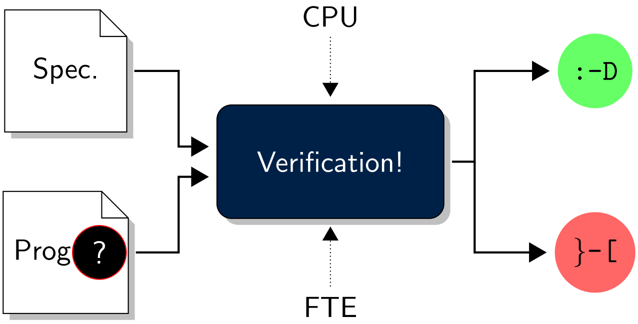


Verification



"The Library Problem"

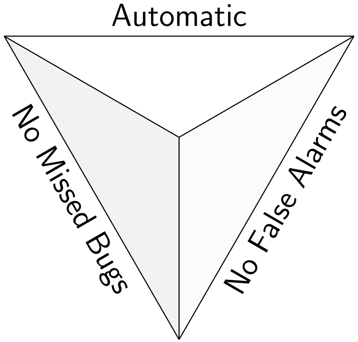
Parts of the program are not available or desireable to analyse



Because. . .

- Source unavailable
- External functionality
- Out of scope
- Platform independence
- Unspecified / imp. def.
- Too complex
- Program not finished
- This *is* the library

The Pyramid Model of Verification



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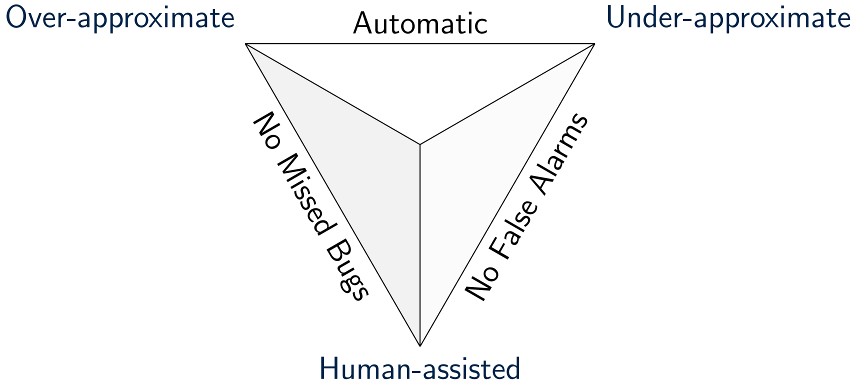

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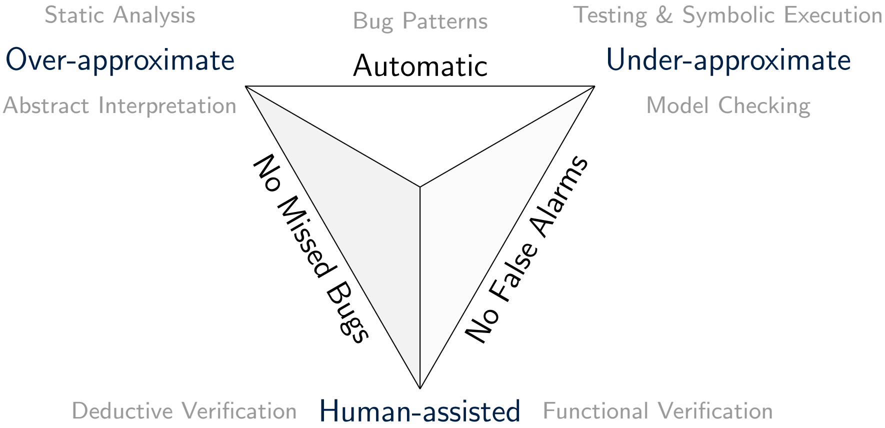
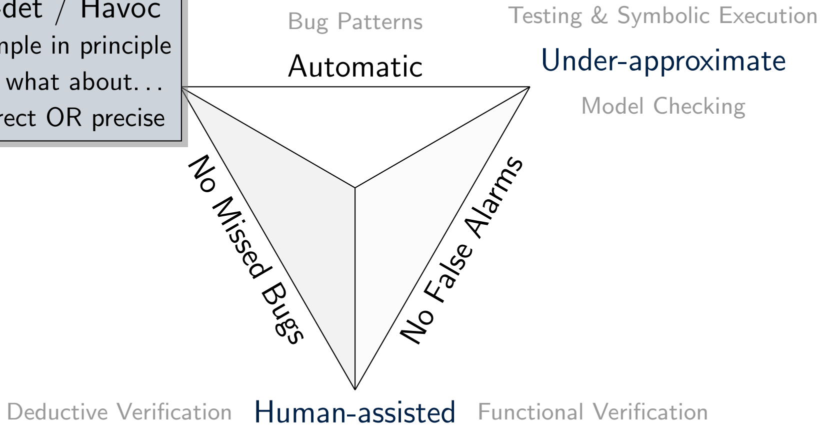


The Over-approximate Solution : Just Over-approximate

Non-det / Havoc
+ Simple in principle
- But what about…
- Correct OR precise



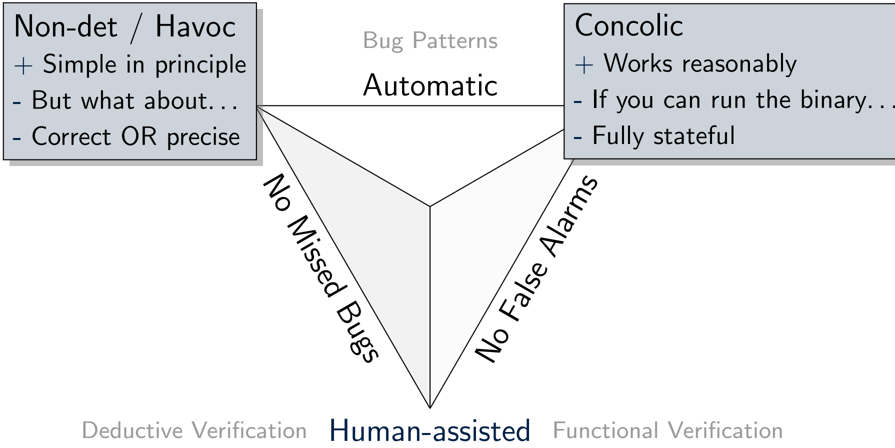
The Over-approximate Solution : Just Over-approximate

```
size_t f00(void*, size_t, size_t, struct s *)
```

The Over-approximate Solution : Just Over-approximate

```
size_t fread(void*, size_t, size_t, FILE *)
```

The Under-approximate Solution : "Concolic"



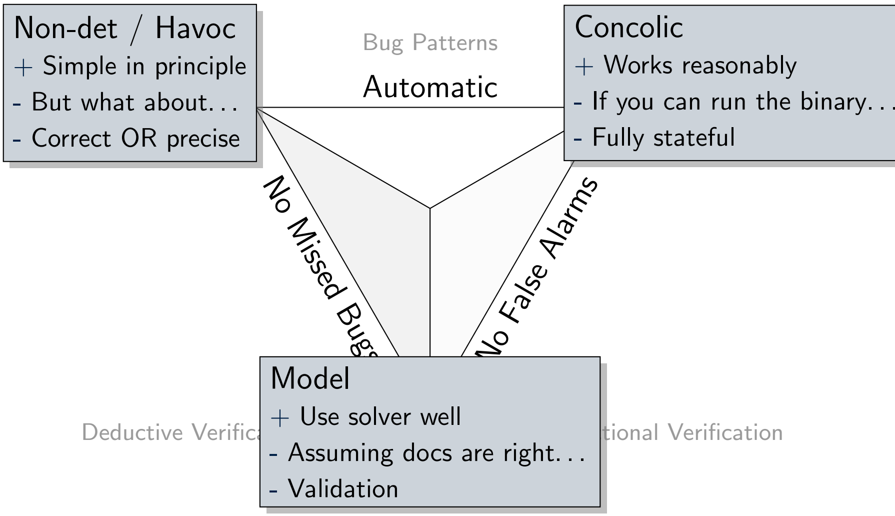
The Under-approximate Solution : “Concolic”

```
ssize_t f01(int, const void*, size_t, int,
        const struct t*, size_t)
```

The Under-approximate Solution : “Concolic”

```
ssize_t sendto(int, const void*, size_t, int,
        const struct sockaddr*, socklen_t)
```

The Human-assisted Solution : Write Models



The Human-assisted Solution : Write Models

```
void * realloc(void *ptr, size_t size)
```

Should we model...

- When is `size` too much?
- Return `NULL`?
- Return `NULL` is sticky?
- Alignment of result?
- When does it return `ptr`?
- `errno` set?

Possible Approaches

1. Isn’t this what game semantics is supposed to fix?

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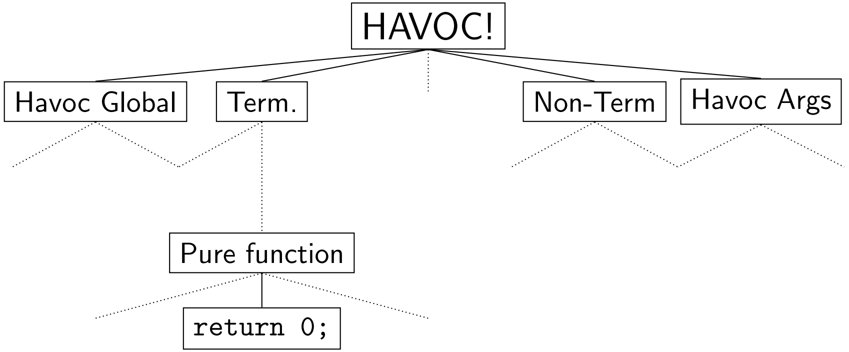

Possible Approaches

1. Isn't this what game semantics is supposed to fix?
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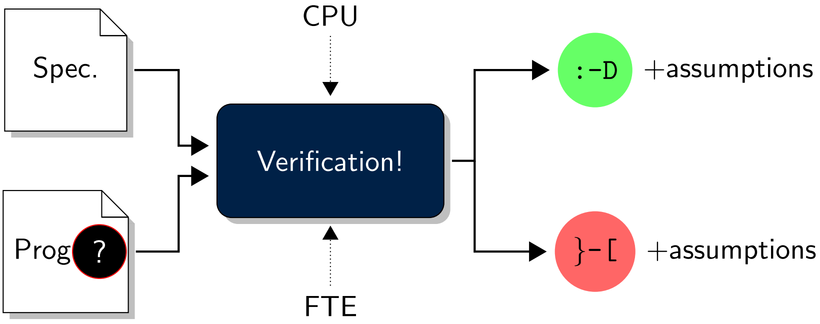

Possible Approaches

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3. What is "the answer" anyway?
4. Opaque handles $\longrightarrow$ automata?

```
FILE *fopen(const char *pathname, const char *mode);
size_t fread(void *ptr, size_t size, size_t nmemb, FILE *stream)
size_t fwrite(const void *ptr, size_t size, size_t nmemb, FILE *
int feof(FILE *stream);
int ferror(FILE *stream);
int fclose(FILE *stream);
```

Possible Approaches

1. Isn't this what game semantics is supposed to fix?
2. Lattice-based (formula) abstraction refinement
3. What is "the answer" anyway?
4. Opaque handles $\longrightarrow$ automata?
5. The spec is in the caller!

```
struct dirent *d =
  readdir(root);

if (d == NULL) {
  perror("Directory empty");
  return errno;
} else {
  ...
```

```
do {
  struct dirent *d =
    readdir(tmp);

  if (strcmp(d->d_name, "vmlinuz")
    ...
```

Possible Approaches

1. Isn't this what game semantics is supposed to fix?
2. Lattice-based (formula) abstraction refinement
3. What is "the answer" anyway?
4. Opaque handles $\longrightarrow$ automata?
5. The spec is in the caller!
6. Is modular symbolic execution impossible? Prove it!

Assuming independence is an (the only?) over-approximation. . .

Conclusions

1. The library problem is the pressing problem for practical application of verification tools
(that can be solved by theoretical advances).
2. Current approaches are not practical / cost-effective.
3. Your solution here?

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Thank you for your time and attention.

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