High-Fidelity C Interoperability in Hylo

1. Contributions

- design goals for a high-fidelity C interoperability
- novel, simple architectural design for capturing memory layout of C into Hylo
- specification for mapping C constructs to Hylo

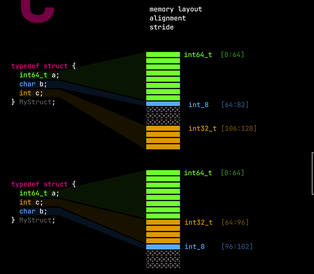
2. Methodology

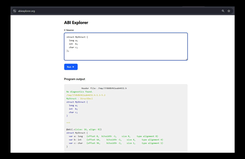
- Understand C and Hylo well
- Industry review - Rust Bindgen, Swift, Zig
- Academic literature review (scopus, Undermind)
- Personal interviews with PL experts and interop tooling developers
- Prototypes:
  - ABI explorer - abiexplorer.org
  - Explicit conversions from/to C integers
  - mapping prototypes: bit-fields, unions, flexible array members

3. Required for Interop

ABI: Abstract Binary Interface

Two hard things:
- function calling conventions
- memory layout of passed data

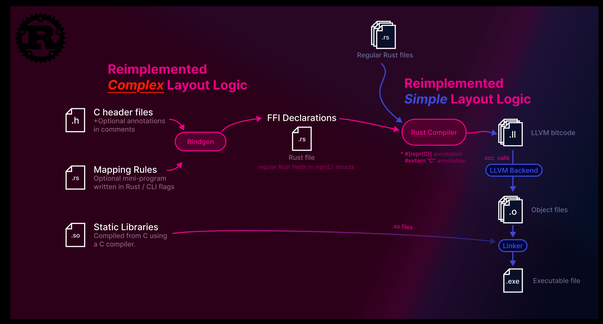


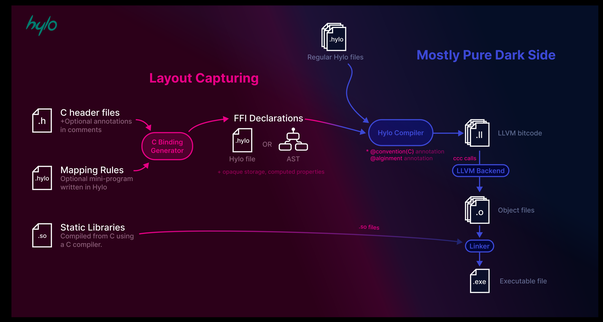


4. Other Requirements

- High coverage of C constructs
- Flexible and portable use (dialects)
- Maintainable and robust interop tooling
- Control and customizability
- Cross-Language LSP support
- Build system integration

Architecture





Type Mapping: Integers

// C Declaration	*// C Meaning*
`char x;`	"size = 1 byte, at least 8 bit, either signed or unsigned"
`int x;`	"signed, at least 16 bit sizeof(short) ⩽ sizeof(int) ⩽ sizeof(long)"

- avoid conversions when not needed
- preserve values
  - guarantee at compile-time or runtime
- encourage maximal portability - no reliance on accidentally matching types

```
int x;
```

```
#if target == x86-64
  UInt32 x;
#else
  CInt x;
#endif
```

```
let x1 = UInt32(truncating_if_needed: x)

let x2 = UInt32(trap_on_loss: x)

let x3 = UInt32(non_narrowing: x)
```

Future Work

- macro translation
- full implementation
- design and implement the customization library details