

Improving Debugging For Optimized Rust Code

Master Thesis

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Overview

1. Introduction
2. DWARF
3. Implementation
4. Evaluation and Discussion
5. Conclusion

What is debugging

- The process of finding and resolving errors, flaws, or faults.
- Debugging techniques:
 - Back tracking
 - Testing
 - Control flow analysis
 - And more
- Debugging is very useful for embedded systems.

What is a Debugger

- A Debugger is a debugging tool.
- Control over the debugged computer program.
- Some of the most common control features:
 - Continue/Start/Run
 - Stop/Halt
 - Restart
 - Step
 - Set and remove breakpoint.

What is a Debugger

- Visualisation of the debugged target state.
- Some of the most common visualisation features:
 - Evaluate variables
 - Stacktrace, unwinding call stack
 - Show machine and Assembly code
 - Show relevant source code.

Unoptimized Vs Optimized

- Unoptimized:
 - All variables stored in memory.
- Optimized:
 - Most variables stored in registry.

Motivation

- Lorem ipsum dolor sit amet, consectetur adipiscing elit

Problem definition

- Lorem ipsum dolor sit amet, consectetur adipiscing elit
- Aliquam blandit faucibus nisi, sit amet dapibus enim tempus eu
- Nulla commodo, erat quis gravida posuere, elit lacus lobortis est, quis porttitor odio mauris at libero
- Nam cursus est eget velit posuere pellentesque
- Vestibulum faucibus velit a augue condimentum quis convallis nulla gravida

Motivation

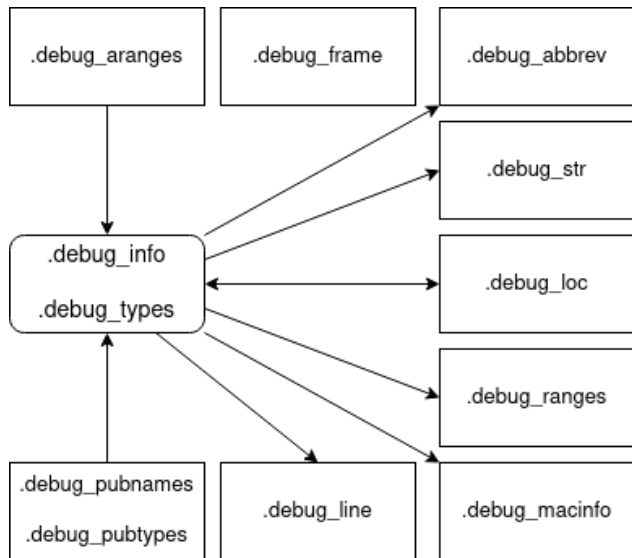
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Deliminations

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DWARF Sections



DWARF Unit and DIE

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Evaluating a variable

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Evaluating the location of a variable

```
<2><4321>: Abbrev Number: 16 (DW_TAG_subprogram)
  <4322>   DW_AT_low_pc      : 0x8000fca
  <4326>   DW_AT_high_pc     : 0x2c
  <432a>   DW_AT_frame_base  : 1 byte block: 57          (DW_OP_reg7 (r7))
  <432c>   DW_AT_linkage_name: (indirect string, offset: 0x473b8): _ZN24nucleo_r
  <4330>   DW_AT_name        : (indirect string, offset: 0x64a52): my_function
  <4334>   DW_AT_decl_file   : 1
  <4335>   DW_AT_decl_line   : 194
  <4336>   DW_AT_type        : <0x6233>
<3><433a>: Abbrev Number: 17 (DW_TAG_formal_parameter)
  <433b>   DW_AT_location    : 2 byte block: 91 7e      (DW_OP_fbreg: -2)
  <433e>   DW_AT_name        : (indirect string, offset: 0x11d94): val
  <4342>   DW_AT_decl_file   : 1
  <4343>   DW_AT_decl_line   : 194
  <4344>   DW_AT_type        : <0x6233>
```

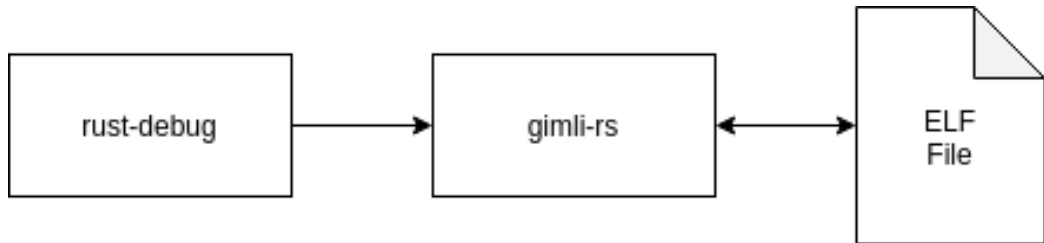
Parsing the type of a variable

```
<1><6233>: Abbrev Number: 34 (DW_TAG_base_type)
  <6234>   DW_AT_name      : (indirect string, offset: 0x2a125): i16
  <6238>   DW_AT_encoding   : 5      (signed)
  <6239>   DW_AT_byte_size  : 2
```


Virtually Unwinding Call Stack

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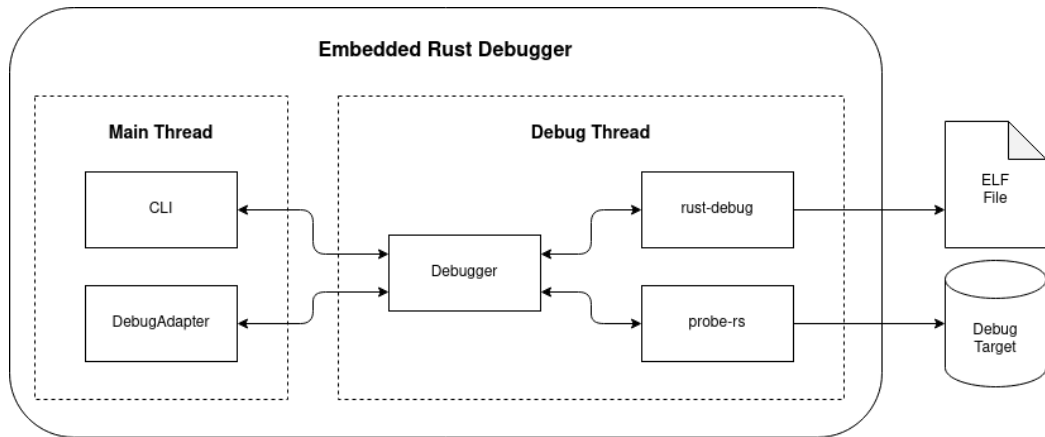
Debugging library rust-debug



Debugging library rust-debug

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Embedded Rust Debugger(ERD)



VSCode Extension

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Debugger settings

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Evaluating Rust enums

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Conclution

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Demo

References



John Smith (2012)

Title of the publication

Journal Name 12(3), 45 – 678.

Thank you for listening

Bullet Points

- Lorem ipsum dolor sit amet, consectetur adipiscing elit
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Blocks of Highlighted Text

In this slide, some important text will be **highlighted** because it's important. Please, don't abuse it.

Block

Sample text

Alertblock

Sample text in red box

Examples

Sample text in green box. The title of the block is "Examples".

Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table: Table caption

Theorem

Theorem (Mass–energy equivalence)

$$E = mc^2$$

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References



John Smith (2012)

Title of the publication

Journal Name 12(3), 45 – 678.

The End