

# Binary Decompile to LLVM IR

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## Motivation and Goals

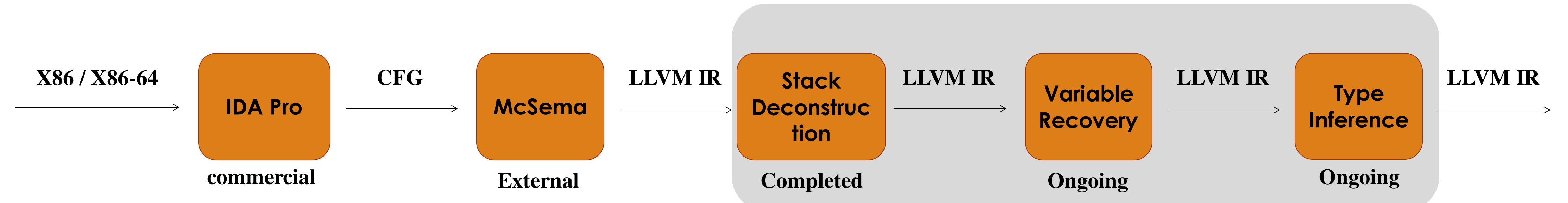
ALLVM: Represent *all* software components as LLVM IR, which provides new opportunities for analysis and optimization.

What about the software components which are in binary?

### Goals

- Translate binary to “rich” LLVM IR where richness includes
  - Variable and type recovery
  - Per procedure stack frame recovery
  - Function signature recovery

## Our Approach



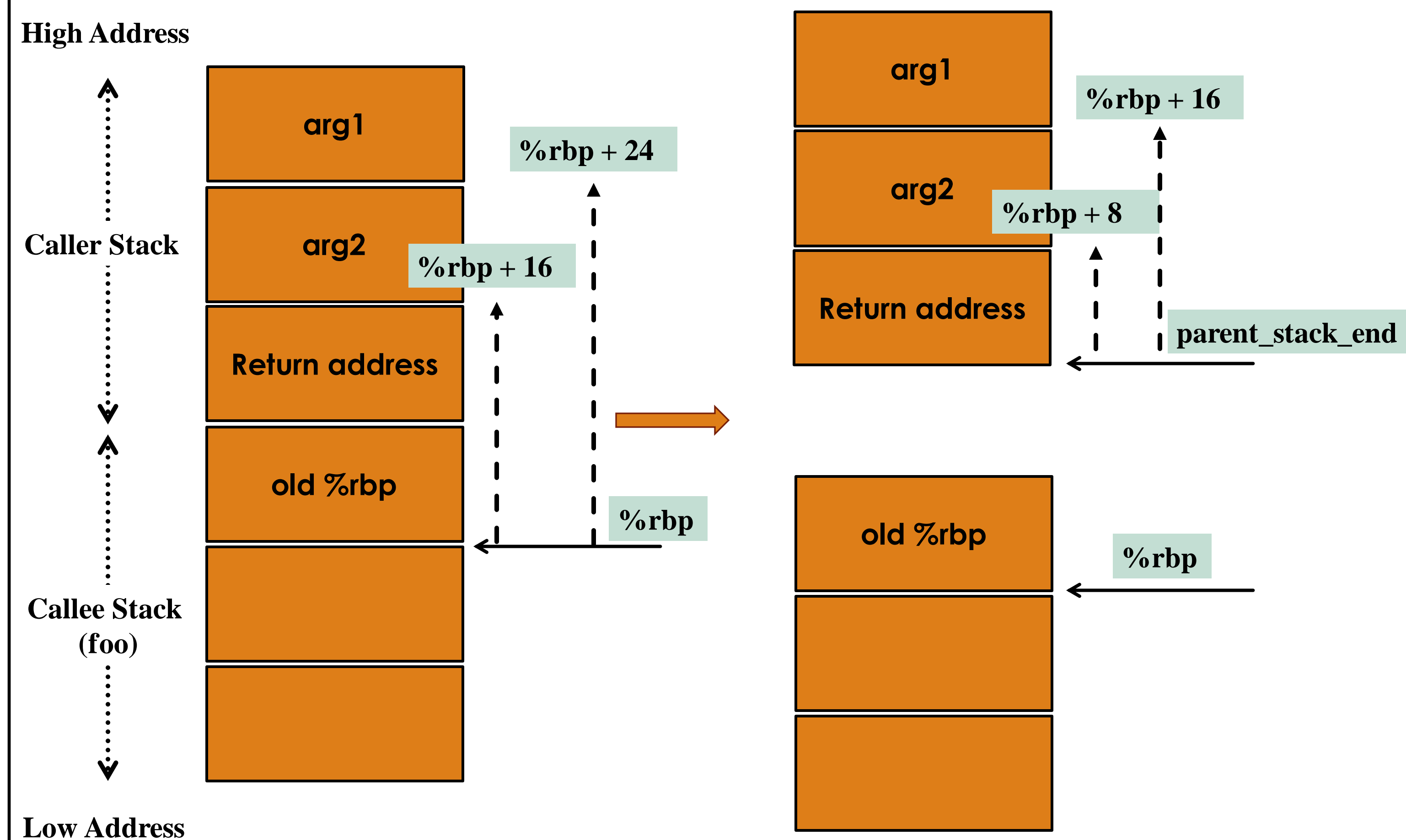
### McSema Features

- Open Sourced
- Fully functional Output IR
- Plug & play CFG recovery

### McSema Limitations

- Hardware registers not distinguishable from memory
- Process stack represented as flat array
- Variables not identified.
- No usable type information

## Stack Deconstruction



```
foo:
push %rbp
mov %rsp, %rbp
mov 16(%rbp), %rax
mov 24(%rbp), %r10
```

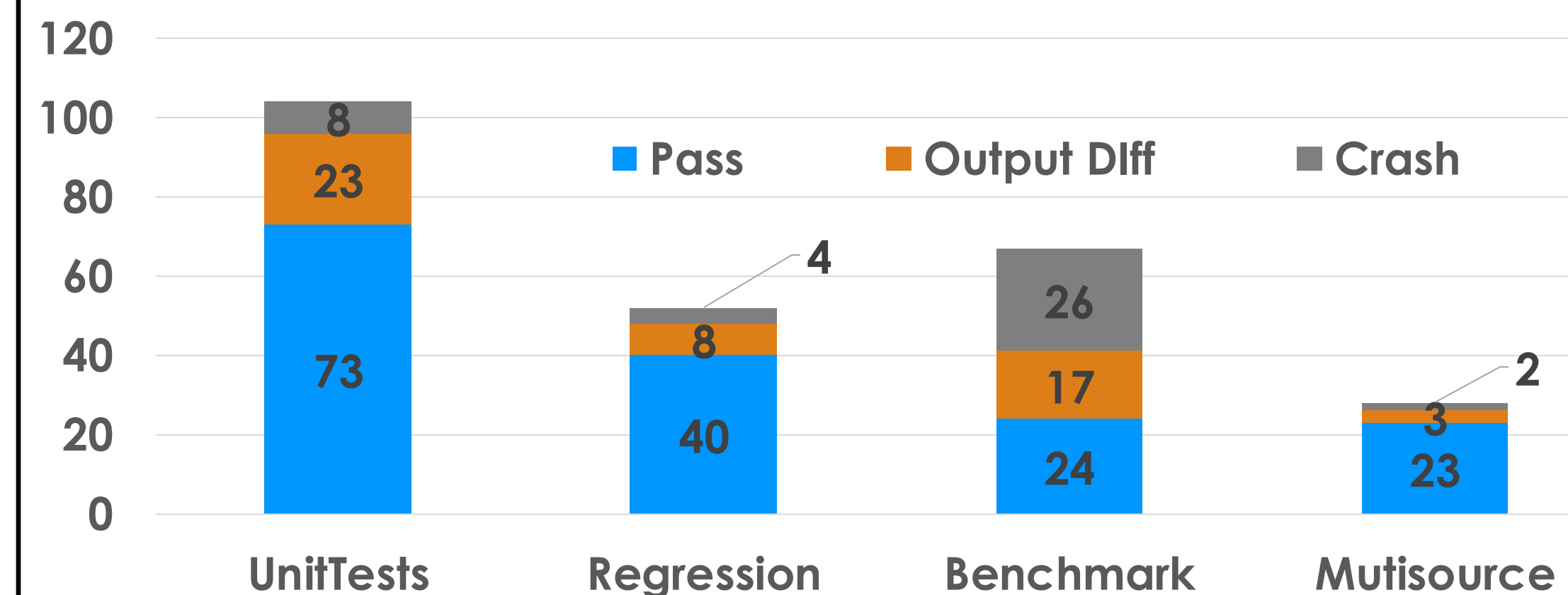
Before

```
foo (parent_rbp, parent_stack_end):
push %parent_rbp
mov %rsp, %rbp
mov 8(%parent_stack_end), %rax
mov 16(%parent_stack_end), %r10
```

After

## Evaluation

Evaluation on LLVM testsuite



- Some cases, not shown here, are unsupported by McSema.
- For unsupported cases, planning to include the inline assembly in the IR.

## Lessons

- McSema generated IR is not amenable to pointer analysis due to `ptrtoint` or `inttoptr` casts and conservativeness of the available pointer analysis.
- Transformed the IR based on type information and using available analysis into more succinct form which can assist pointer analysis to some degree.

## Related Work

	Devine	Retypd	Hex-Rays	BAP	TIE	BitBlaze	Second-Write	RevGen	Rev.ng	McSema	Allin
LLVM IR	×	×	×	×	×	×	✓	✓	✓	✓	✓
Open Sourced	×	×	×	✓	×	✓	×	✓	✓	✓	✓
Rich	✓	✓	✓	×	✓	×	✓	?	×	×	~

~ : Under progress

? : Not quite sure