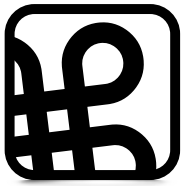


Macoun

lldb - Debugger auf Abwegen

Oliver Bayer
inovex GmbH

Disclaimer: Nur weil es technisch geht, muss es noch lange nicht sinnvoll sein!

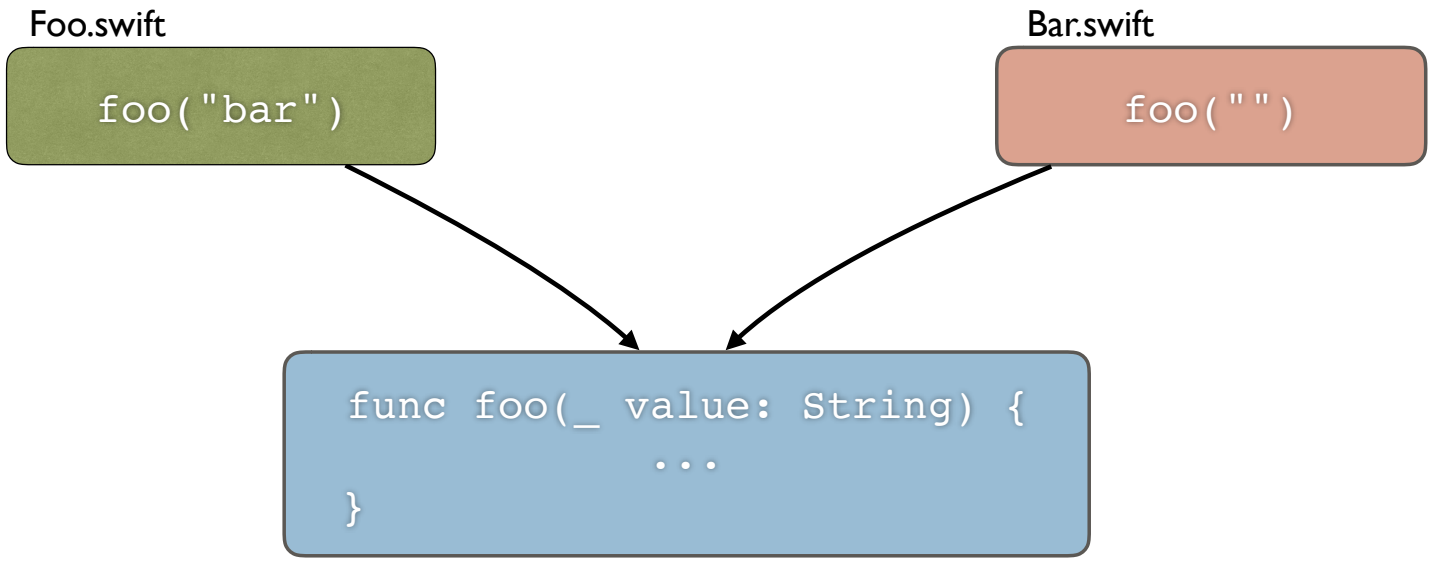
Ablauf

- Breakpoints per CLI
- Metabreakpoints
- Kontrollfluss Manipulation / Demo

Breakpoints

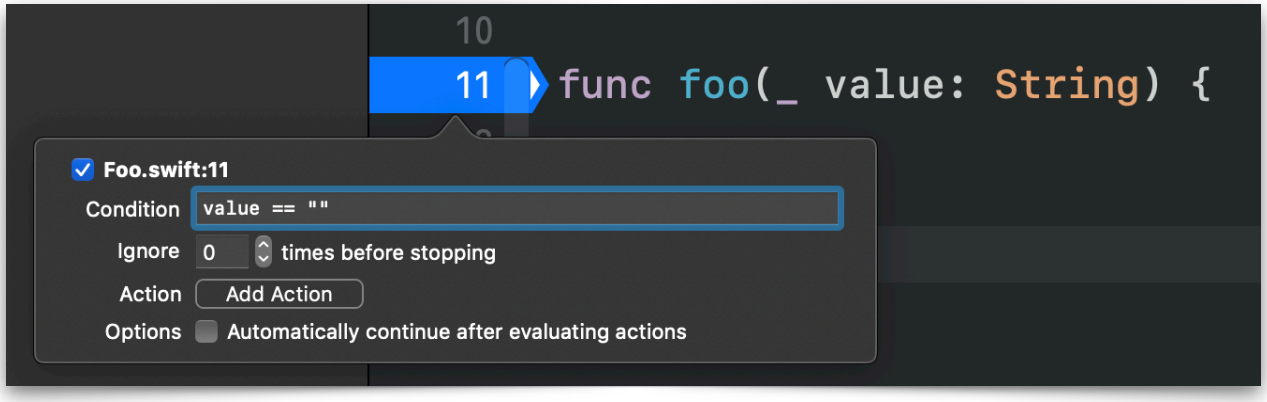
- Software Breakpoint
- Symbolic Breakpoint
- Non-Symbolic Breakpoint

Conditional Breakpoints



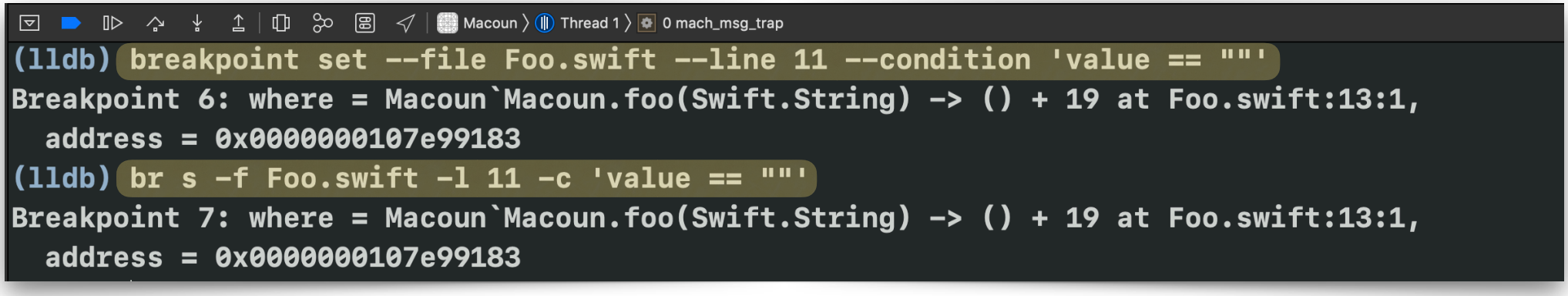
Conditional Breakpoints

Conditional Breakpoints



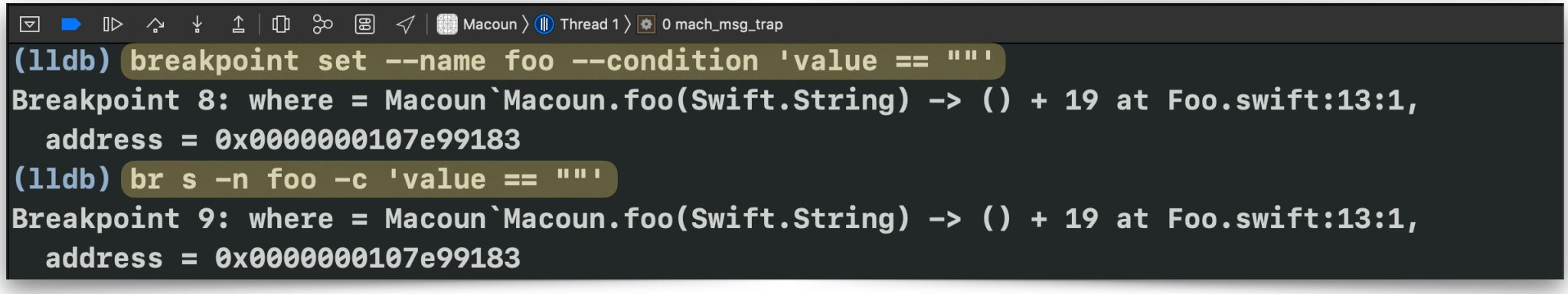
Conditional Breakpoints

Non-Symbolic Breakpoint

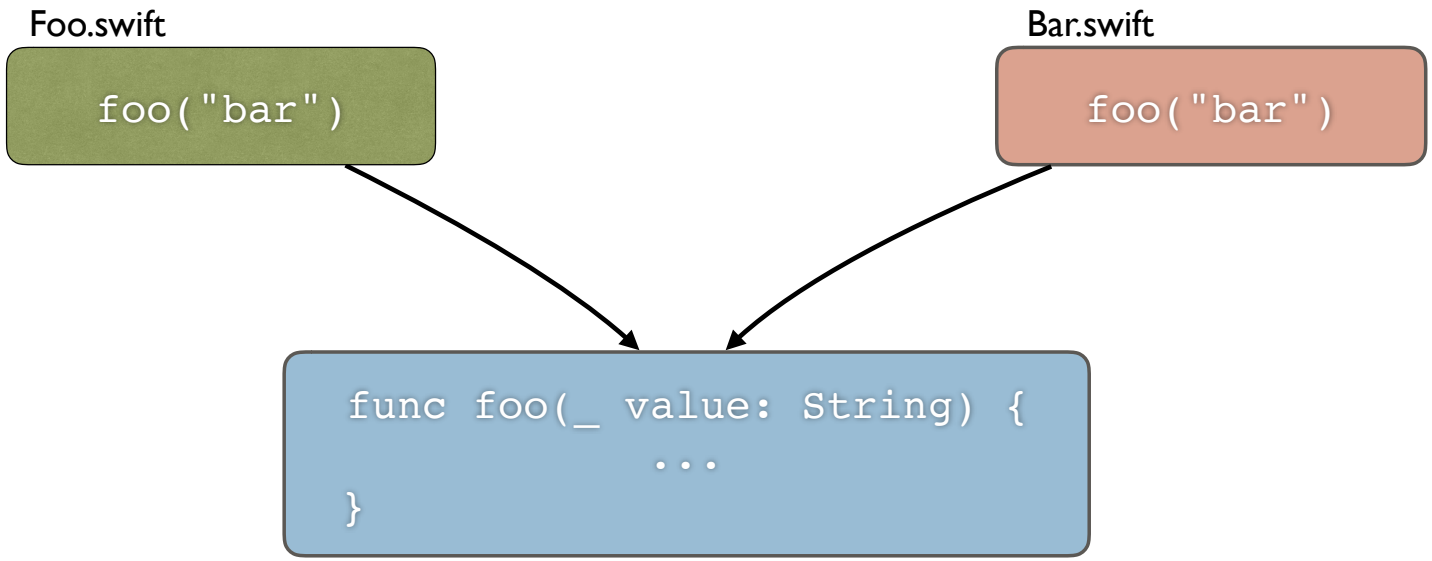


Conditional Breakpoints

Symbolic Breakpoint

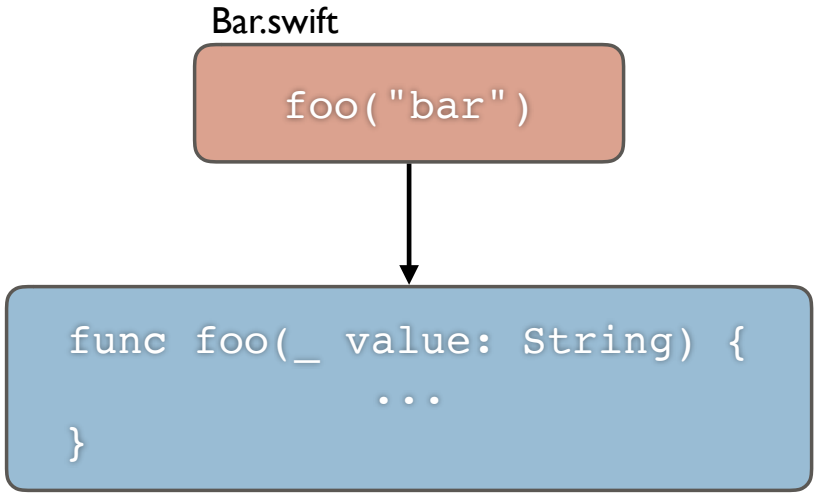


Metabreakpoints



Metabreakpoints

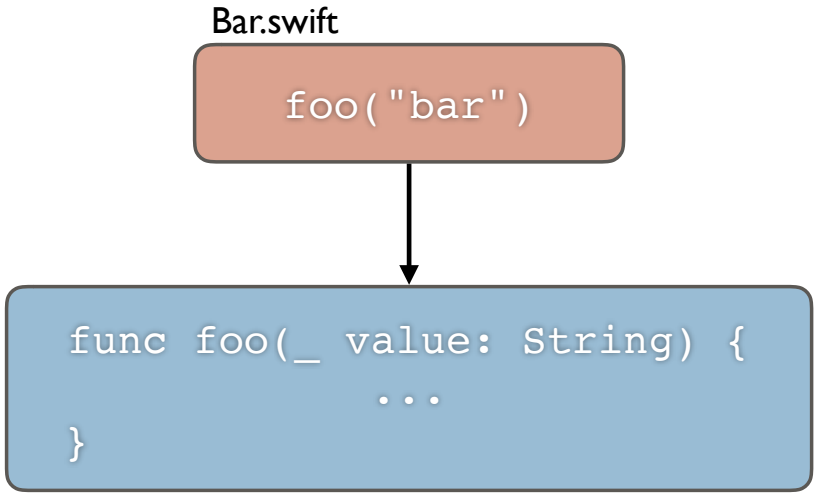
```
br s -n foo -N macoun -d
```



Metabreakpoints

```
br set -n foo -N macoun -d

br s -f Bar.swift -l 42 -C "br en macoun" -G
true
```



Metabreakpoints

```
func seiteneffekteFuer100() {
 print("1")
 do()
 print("2")
 something()
 print("3")
 forMe()
}
```

Metabreakpoints

```
func seiteneffekteFuer100() {
 do()
 something()
 forMe()
}
```

```
br s -p . -X seiteneffekteFuer100 -f Foo.swift -G true
br command add -s python
print("Line: {}".format(frame.GetLineEntry().GetLine()))
DONE
```

Metabreakpoints

```
func seiteneffekteFuer100() {
 do()
 something()
 forMe()
}
```

```
br s -p . -X seiteneffekteFuer100 -f Foo.swift -G true
br command add -s python
print("Line: {}".format(frame.GetLineEntry().GetLine()))
DONE
```

Metabreakpoints

```
func seiteneffekteFuer100() {
 do()
 something()
 forMe()
}
```

```
br s -p . -X seiteneffekteFuer100 -f Foo.swift -G true
br command add -s python
print("Line: {}".format(frame.GetLineEntry().GetLine()))
DONE
```

Metabreakpoints

```
func seiteneffekteFuer100() {
 do()
 something()
 forMe()
}
```

```
br s -p . -X seiteneffekteFuer100 -f Foo.swift -G true
br command add -s python
print("Line: {}".format(frame.GetLineEntry().GetLine()))
DONE
```

Metabreakpoints

```
func do() {
  …
  let player = AVPlayer(playerItem: item)
  …
  player.play()
  …
}
```

Metabreakpoints

```
func do() {
  …
  let player = AVPlayer(playerItem: item)
  …
}
```

```
br s -f Player.swift -l 4 -C "call player.isMuted = false"
-G true
```

Metabreakpoints

```
func do() {
  …
  let player = AVPlayer(playerItem: item)
  // Hier der Breakpoint
  …
}
```

```
br s -f Player.swift -p "// Hier der Breakpoint" -X do
-C "call player.isMuted = true" -G true
```

Metabreakpoints

- Auf dem Stack[1] steht die Rücksprungadresse des Aufrufenden
- Nach dem Rücksprung steht die Adresse der *AVPlayer* Instanz in Register *rax*[1]

[1] x86 Architekturen

Metabreakpoints

```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Metabreakpoints

```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Metabreakpoints

```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Metabreakpoints

```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Metabreakpoints

```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Metabreakpoints

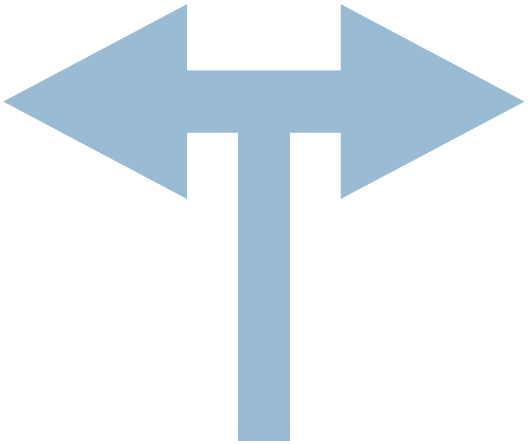
```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Metabreakpoints

```
br s -S "-[AVPlayer init]" -K false
br command add
settings set target.language objc
br s -a `(unsigned long)*(unsigned long *)$rsp` -o true
-C "exp -l objc -- [(AVPlayer *)$rax setMuted: @YES]" -G
true
settings set target.language swift
continue
```

Neue Wege gehen mit *thread*

- Codepfade zur Laufzeit manipulieren
- Methoden kurzschließen
- Rückgabewerte ändern



Demo

Neue Wege gehen mit *thread*

- Nachteil an *thread return* et al. → bremst das Ausführen des Codes aus

- Idee: (Binary) Patch → genauso schnell wie vorher

Binary Patch Breakpoint

```
private func isExpectedInput(_ value: String) -> Bool {
 if value.lowercased() == secret {
  return true
 } else {
  return false
 }
}
```

Binary Patch Breakpoint

```
private func isExpectedInput(_ value: String) -> Bool {
 return true
}
```

Binary Patch Breakpoint

```
push    rbp
mov     rbp, rsp
push    0x1
pop     rax
pop     rbp
ret
```

```
'\x55\x6a\x01\x58\x5d\xc3'
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Binary Patch Breakpoint

```
br s -n isExpectedInput -o true -K false
br command add -s python
patch = '\x55\xB8\x01\x00\x00\x00\x5d\xc3'
addr = bp_loc.GetLoadAddress()
error = lldb.SBError()
proc = frame.GetThread().GetProcess()
result = proc.WriteMemory(addr, patch, error)
proc.Continue()
DONE
```

Patch Breakpoint

```
private let secret = "foo" -> "macoun"
```

Patch Breakpoint

```
private let secret = "foo" // -> "macoun"
```

```
br s -F "Swift.String.init(_builtinStringLiteral:
Builtin.RawPointer, utf8CodeUnitCount: Builtin.Word,
isASCII: Builtin.Int1) -> Swift.String" -c "0 ==
(int)strcmp(\"foo\", (char *)$rdi)" -o true
br command add
exp -- char * $value = (char *)"macoun"
register write $rdi `(unsigned long *)$value`
register write $rsi 6
continue
DONE
```

Patch Breakpoint

```
private let secret = "foo" // -> "macoun"
```

```
br s -F "Swift.String.init(_builtinStringLiteral:
Builtin.RawPointer, utf8CodeUnitCount: Builtin.Word,
isASCII: Builtin.Int1) -> Swift.String" -c "0 ==
(int)strcmp(\"foo\", (char *)$rdi)" -o true
br command add
exp -- char * $value = (char *)"macoun"
register write $rdi `(unsigned long *)$value`
register write $rsi 6
continue
DONE
```

Patch Breakpoint

```
private let secret = "foo" // -> "macoun"
```

```
br s -F "Swift.String.init(_builtinStringLiteral:
Builtin.RawPointer, utf8CodeUnitCount: Builtin.Word,
isASCII: Builtin.Int1) -> Swift.String" -c "0 ==
(int)strcmp(\"foo\", (char *)$rdi)" -o true
br command add
exp -- char * $value = (char *)"macoun"
register write $rdi `(unsigned long *)$value`
register write $rsi 6
continue
DONE
```

Patch Breakpoint

```
private let secret = "foo" // -> "macoun"
```

```
br s -F "Swift.String.init(_builtinStringLiteral:
Builtin.RawPointer, utf8CodeUnitCount: Builtin.Word,
isASCII: Builtin.Int1) -> Swift.String" -c "0 ==
(int)strcmp(\"foo\", (char *)$rdi)" -o true
br command add
exp -- char * $value = (char *)"macoun"
register write $rdi `(unsigned long *)$value`
register write $rsi 6
continue
DONE
```

Patch Breakpoint

```
private let secret = "foo" // -> "macoun"
```

```
br s -F "Swift.String.init(_builtinStringLiteral:
Builtin.RawPointer, utf8CodeUnitCount: Builtin.Word,
isASCII: Builtin.Int1) -> Swift.String" -c "0 ==
(int)strcmp(\"foo\", (char *)$rdi)" -o true
br command add
exp -- char * $value = (char *)"macoun"
register write $rdi `(unsigned long *)$value`
register write $rsi 6
continue
DONE
```

Patch Breakpoint

```
private let secret = "foo" // -> "macoun"
```

```
br s -F "Swift.String.init(_builtinStringLiteral:
Builtin.RawPointer, utf8CodeUnitCount: Builtin.Word,
isASCII: Builtin.Int1) -> Swift.String" -c "0 ==
(int)strcmp(\"foo\", (char *)$rdi)" -o true
br command add
exp -- char * $value = (char *)"macoun"
register write $rdi `(unsigned long *)$value`
register write $rsi 6
continue
DONE
```

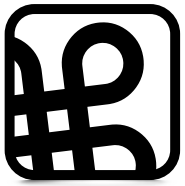
Schlussworte

- Automatismen
  - https://github.com/obayer/Trampoline
  - .lldbinit
  - *command source <filename>*
- für alles andere: *lldb help*

Fragen?

Vielen Dank

Oliver Bayer
inovex GmbH



Macoun