

Writing a grep like program in Zig

Seminar Programming Languages

Tobias Schmitz

University of Siegen

Contents

Language

About

Error Handling

Comptime

Defer

Program

Synchronization

Compiler Bug

Benchmarks



Compiled

General Purpose

Systems Programming Language

Successor to C

Focus on readability
and maintainability

Appeared 2016

Written by Andrew Kelley

Zig Software Foundation (ZSF)

No exceptions

Errors as values

Error sets and unions

```
// inferred error set
pub fn main() !void {
    const num = try parseInt(u32, "324", 10);
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};
fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}
```



```
// inferred error set
pub fn main() !void {
    const num = try parseInt(u32, "324", 10);
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};
fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}
```

```
// inferred error set
pub fn main() !void {
    const num = try parseInt(u32, "324", 10);
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};
fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}
```

```
// inferred error set
pub fn main() !void {
    const num = try parseInt(u32, "324", 10);
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};
fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}
```

```
// inferred error set
pub fn main() !void {
    const num = try parseInt(u32, "324", 10);
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};
fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}
```

Error Handling

Language

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};

fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}

switch (checkNull(value))
    .IsNull => doOneThing(),
    .Invalid => doAnotherThing(),
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};

fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}

switch (checkNull(value))
    .IsNull => doOneThing(),
    .Invalid => doAnotherThing(),
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};

fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}

switch (checkNull(value))
    .IsNull => doOneThing(),
    .Invalid => doAnotherThing(),
}
```

```
// named error set
const IntError = error{
    IsNull,
    Invalid,
};

fn checkNull(num: usize) IntError!void {
    if (num == 0) {
        return error.IsNull;
    }
}

switch (checkNull(value))
    .IsNull => doOneThing(),
    .Invalid => doAnotherThing(),
}
```



```
class Container<T>(  
    var items: ArrayList<T>,  
)  
  
fn Container(comptime T: type) type {  
    return struct {  
        items: ArrayList(T),  
    }  
}
```

```
class Container<T>(  
    var items: ArrayList<T>,  
)  
  
fn Container(comptime T: type) type {  
    return struct {  
        items: ArrayList(T),  
    }  
}
```

```
class Container<T>(  
    var items: ArrayList<T>,  
)  
  
fn Container(comptime T: type) type {  
    return struct {  
        items: ArrayList(T),  
    }  
}
```

```
class Container<T>(  
    var items: ArrayList<T>,  
)  
  
fn Container(comptime T: type) type {  
    return struct {  
        items: ArrayList(T),  
    }  
}
```

```
pub fn ArrayList(comptime T: type) type {  
    return ArrayListAligned(T, null);  
}
```

```
fn fibonacci(n: usize) u64 {  
    if (n == 0 or n == 1) {  
        return 1;  
    }  
    return fibonacci(n - 1) + fibonacci(n - 2);  
}
```

```
const FIB_8 = fibonacci(8);
```

```
comptime {  
    // won't compile  
    std.debug.assert(fibonacci(3) == 1);  
}
```

```
fn fibonacci(n: usize) u64 {  
    if (n == 0 or n == 1) {  
        return 1;  
    }  
    return fibonacci(n - 1) + fibonacci(n - 2);  
}
```

```
const FIB_8 = fibonacci(8);
```

```
comptime {  
    // won't compile  
    std.debug.assert(fibonacci(3) == 1);  
}
```

```
fn fibonacci(n: usize) u64 {  
    if (n == 0 or n == 1) {  
        return 1;  
    }  
    return fibonacci(n - 1) + fibonacci(n - 2);  
}  
  
const FIB_8 = fibonacci(8);  
  
comptime {  
    // won't compile  
    std.debug.assert(fibonacci(3) == 1);  
}
```



```
Build Summary: 0/3 steps succeeded; 1 failed (disable with --summary none)
install transitive failure
└─ install zig-demo transitive failure
    └─ zig build-exe zig-demo Debug native 1 errors
zig/0.11.0/files/lib/std/debug.zig:343:14: error: reached unreachable code
    if (!ok) unreachable; // assertion failure
        ^~~~~~
src/main.zig:13:21: note: called from here
    std.debug.assert(fibonacci(3) == 1);
    ~~~~~^~~~~~
```

```
Build Summary: 0/3 steps succeeded; 1 failed (disable with --summary none)
install transitive failure
└─ install zig-demo transitive failure
    └─ zig build-exe zig-demo Debug native 1 errors
zig/0.11.0/files/lib/std/debug.zig:343:14: error: reached unreachable code
    if (!ok) unreachable; // assertion failure
        ^~~~~~
src/main.zig:13:21: note: called from here
    std.debug.assert(fibonacci(3) == 1);
    ~~~~~^~~~~~
```

```
Build Summary: 0/3 steps succeeded; 1 failed (disable with --summary none)
install transitive failure
└─ install zig-demo transitive failure
    └─ zig build-exe zig-demo Debug native 1 errors
zig/0.11.0/files/lib/std/debug.zig:343:14: error: reached unreachable code
    if (!ok) unreachable; // assertion failure
        ^~~~~~
src/main.zig:13:21: note: called from here
    std.debug.assert(fibonacci(3) == 1);
    ~~~~~^~~~~~
```

```
fn fibonacci(n: usize) u64 {  
    if (n == 0 or n == 1) {  
        return 1;  
    }  
    return fibonacci(n - 1) + fibonacci(n - 2);  
}  
  
const FIB_8 = fibonacci(8);  
  
comptime {  
    // won't compile  
    std.debug.assert(fibonacci(3) == 1);  
}
```

```
fn fibonacci(n: usize) u64 {  
    if (n == 0 or n == 1) {  
        return 1;  
    }  
    return fibonacci(n - 1) + fibonacci(n - 2);  
}
```

```
const FIB_8 = fibonacci(8);
```

```
comptime {  
    // but this will  
    std.debug.assert(fibonacci(3) == 3);  
}
```

Execute code at scope exit

Clean up resources

```
fn main() !void {  
    var gpa = std.heap.GeneralPurposeAllocator(.{}){};  
    defer _ = gpa.deinit();  
    const allocator = gpa.allocator();  
  
    var input_paths = ArrayList([]const u8).init(allocator);  
    defer input_paths.deinit();  
  
    const pattern = try parseArgs(&input_paths) orelse {  
        return;  
    };  
  
    // 1. input_paths.deinit();  
    // 2. _ = gpa.deinit();  
}
```

```
fn main() !void {  
    var gpa = std.heap.GeneralPurposeAllocator(.{}){};  
    defer _ = gpa.deinit();  
    const allocator = gpa.allocator();  
  
    var input_paths = ArrayList([]const u8).init(allocator);  
    defer input_paths.deinit();  
  
    const pattern = try parseArgs(&input_paths) orelse {  
        return;  
    };  
  
    // 1. input_paths.deinit();  
    // 2. _ = gpa.deinit();  
}
```



```
fn main() !void {  
    var gpa = std.heap.GeneralPurposeAllocator(.{}){};  
    defer _ = gpa.deinit();  
    const allocator = gpa.allocator();  
  
    var input_paths = ArrayList([]const u8).init(allocator);  
    defer input_paths.deinit();  
  
    const pattern = try parseArgs(&input_paths) orelse {  
        return;  
    };  
  
    // 1. input_paths.deinit();  
    // 2. _ = gpa.deinit();  
}
```

```
fn main() !void {
    var gpa = std.heap.GeneralPurposeAllocator(.{}){};
    defer _ = gpa.deinit();
    const allocator = gpa.allocator();

    var input_paths = ArrayList([]const u8).init(allocator);
    defer input_paths.deinit();

    const pattern = try parseArgs(&input_paths) orelse {
        return;
    };

    // 1. input_paths.deinit();
    // 2. _ = gpa.deinit();
}
```

Program

```
const AtomicQueue = struct {  
    mutex: std.Thread.Mutex,  
    state: std.atomic.Atomic(State),  
    buf: []T,  
}
```

Futex: fast userspace mutex

“A futex consists of a kernel-space wait queue that is attached to an atomic integer in userspace”

```
const AtomicQueue = struct {  
    mutex: std.Thread.Mutex,  
    state: std.atomic.Atomic(State),  
    buf: []T,  
}
```

```
pub fn append(self *AtomicQueue, item: T) void {  
    self.mutex.lock();  
    defer self.mutex.unlock();  
  
    if (self.len ≥ self.buf.len) {  
        self.mutex.unlock();  
        Futex.wait(&self.state, State.Full);  
        self.mutex.lock();  
    }  
  
    self.buf.append(item)  
  
    const new_state: State = .NonEmpty;  
    self.state.store(new_state, Ordering.SeqCst);  
    Futex.wake(&self.state, 1);  
}
```

```
pub fn append(self *AtomicQueue, item: T) void {  
    self.mutex.lock();  
    defer self.mutex.unlock();  
  
    if (self.len ≥ self.buf.len) {  
        self.mutex.unlock();  
        Futex.wait(&self.state, State.Full);  
        self.mutex.lock();  
    }  
  
    self.buf.append(item)  
  
    const new_state: State = .NonEmpty;  
    self.state.store(new_state, Ordering.SeqCst);  
    Futex.wake(&self.state, 1);  
}
```



```
pub fn append(self *AtomicQueue, item: T) void {  
    self.mutex.lock();  
    defer self.mutex.unlock();  
  
    if (self.len ≥ self.buf.len) {  
        self.mutex.unlock();  
        Futex.wait(&self.state, State.Full);  
        self.mutex.lock();  
    }  
  
    self.buf.append(item)  
  
    const new_state: State = .NonEmpty;  
    self.state.store(new_state, Ordering.SeqCst);  
    Futex.wake(&self.state, 1);  
}
```

```
pub fn append(self *AtomicQueue, item: T) void {
    self.mutex.lock();
    defer self.mutex.unlock();

    if (self.len ≥ self.buf.len) {
        self.mutex.unlock();
        Futex.wait(&self.state, State.Full);
        self.mutex.lock();
    }

    self.buf.append(item)

    const new_state: State = .NonEmpty;
    self.state.store(new_state, Ordering.SeqCst);
    Futex.wake(&self.state, 1);
}
```

```
pub fn append(self *AtomicQueue, item: T) void {
    self.mutex.lock();
    defer self.mutex.unlock();

    if (self.len ≥ self.buf.len) {
        self.mutex.unlock();
        Futex.wait(&self.state, State.Full);
        self.mutex.lock();
    }

    self.buf.append(item)

    const new_state: State = .NonEmpty;
    self.state.store(new_state, Ordering.SeqCst);
    Futex.wake(&self.state, 1);
}
```

```
pub fn append(self *AtomicQueue, item: T) void {  
    self.mutex.lock();  
    defer self.mutex.unlock();  
  
    if (self.len ≥ self.buf.len) {  
        self.mutex.unlock();  
        Futex.wait(&self.state, State.Full);  
        self.mutex.lock();  
    }  
  
    self.buf.append(item)  
  
    const new_state: State = .NonEmpty;  
    self.state.store(new_state, Ordering.SeqCst);  
    Futex.wake(&self.state, 1);  
}
```

```
pub fn append(self *AtomicQueue, item: T) void {
    self.mutex.lock();
    defer self.mutex.unlock();

    if (self.len ≥ self.buf.len) {
        self.mutex.unlock();
        Futex.wait(&self.state, State.Full);
        self.mutex.lock();
    }

    self.buf.append(item)

    const new_state: State = .NonEmpty;
    self.state.store(new_state, Ordering.SeqCst);
    Futex.wake(&self.state, 1);
}
```

```
const UserArgFlag = enum {  
    Hidden,  
    FollowLinks,  
    Color,  
    NoHeading,  
    IgnoreCase,  
    Debug,  
    NoUnicode,  
    Help,  
};
```

```
const UserArgFlag = enum {  
    Hidden,  
    FollowLinks,  
    Color,  
    NoHeading,  
    IgnoreCase,  
    Debug,  
    NoUnicode,  
    Help,  
};
```

```
@@ -27,12 +27,12 @@ const UserArgKind = union(enum) {  
    flag: UserArgFlag,  
};
```

```
-const UserArgValue = enum {  
+const UserArgValue = enum(u8) {  
    Context,  
    AfterContext,  
    BeforeContext,  
};
```

```
-const UserArgFlag = enum {  
+const UserArgFlag = enum(u8) {  
    Hidden,  
    FollowLinks,  
    Color,
```


Compiler Bug

Program

```
const UserArgFlag = enum {  
    Hidden,  
    FollowLinks,  
    Color,  
    NoHeading,  
    IgnoreCase,  
    Debug,  
    NoUnicode,  
    Help,  
};
```

`0b100` truncated to `0b00`

already fixed on master

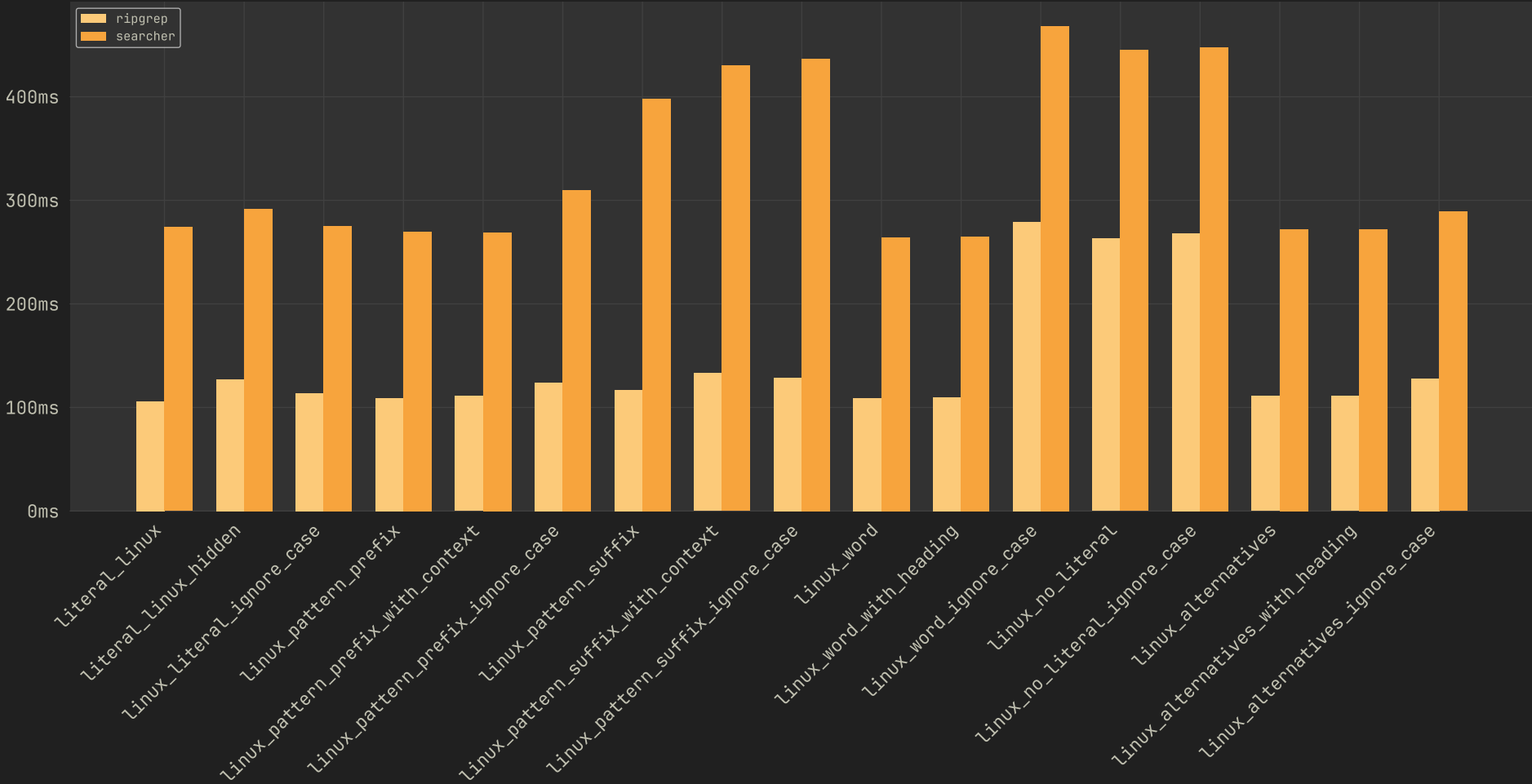
Run using hyperfine

On testsuite

2-3x slower than ripgrep

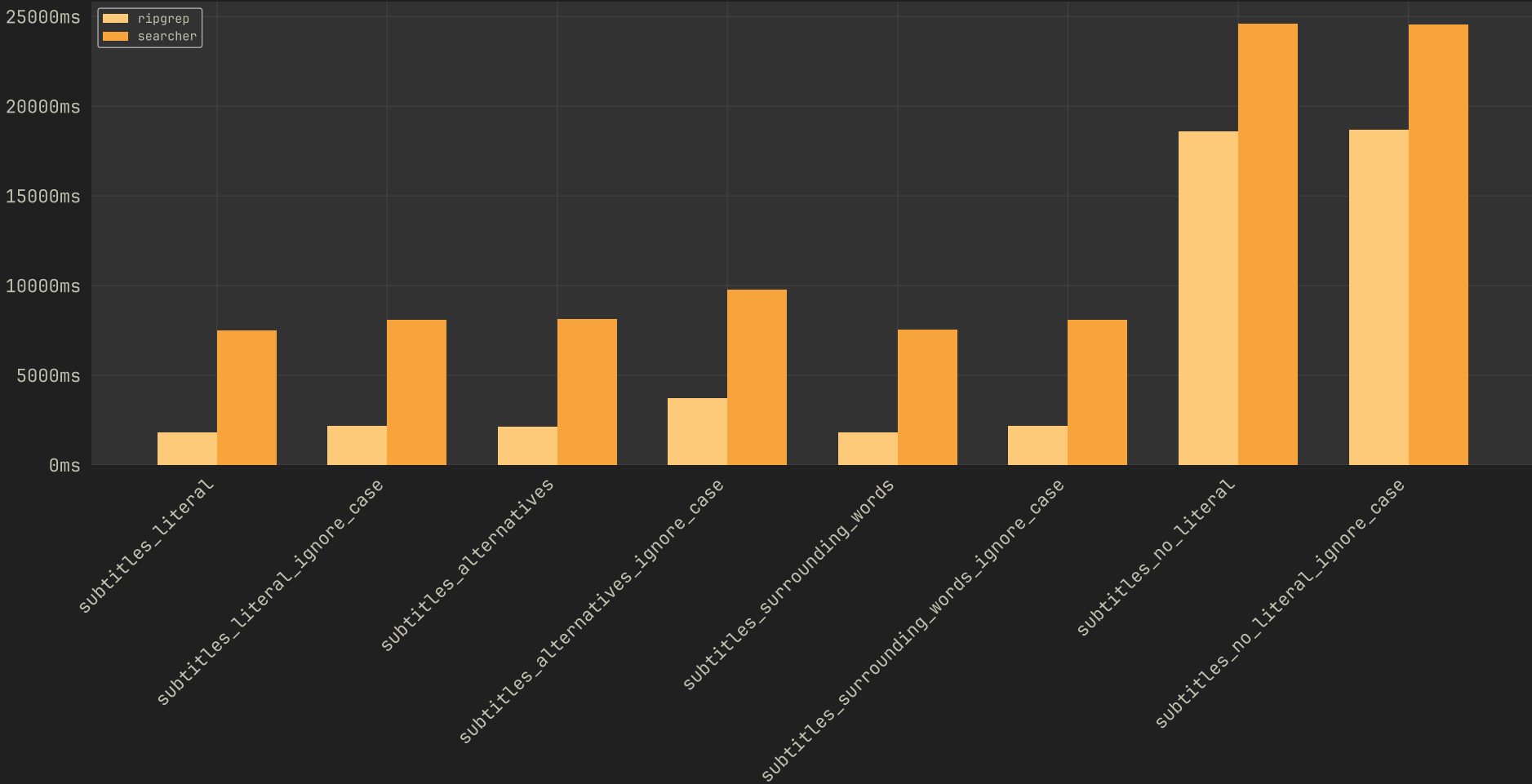
Results R5 5600x & 32Gb

Program



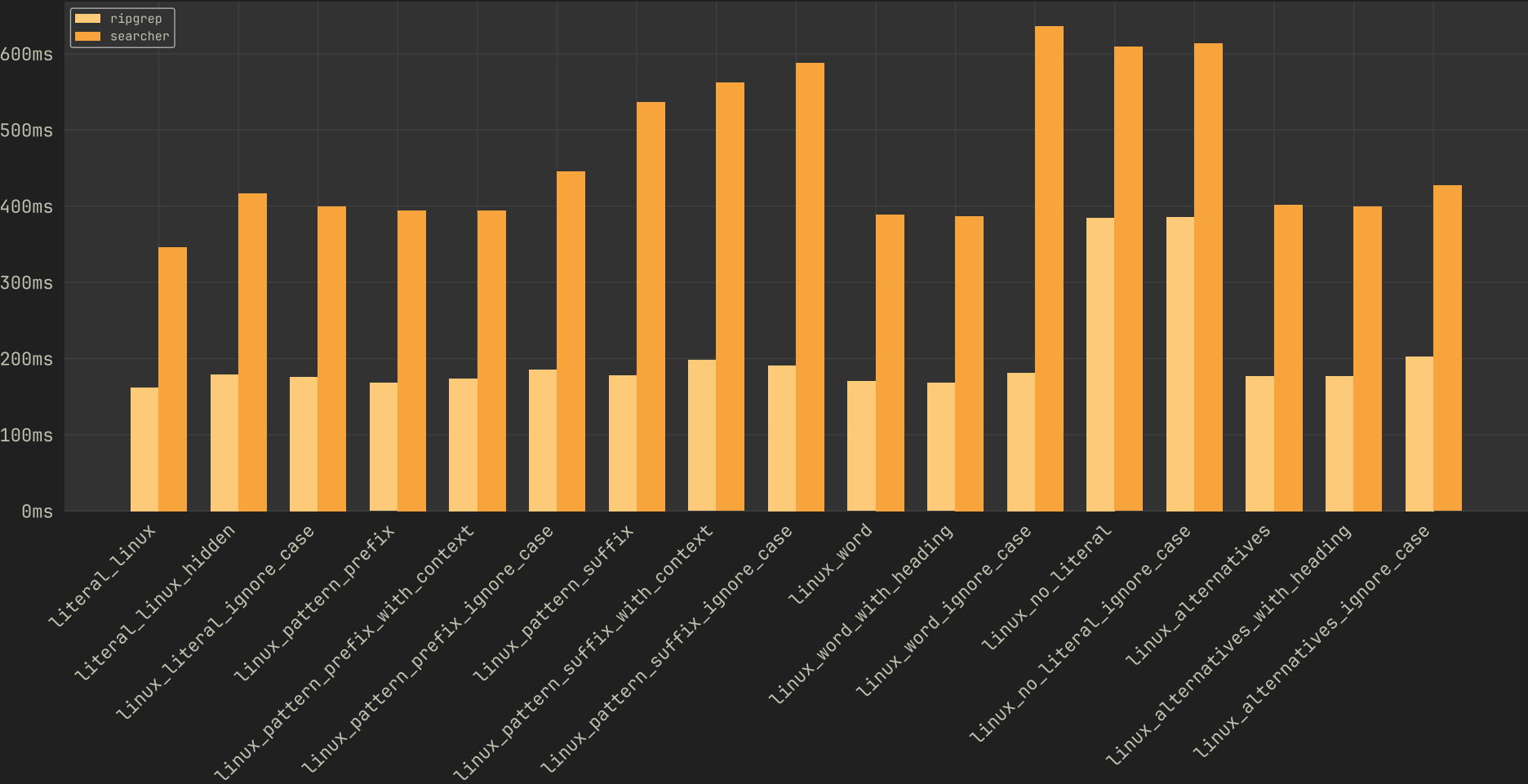
Results R5 5600x & 32Gb

Program



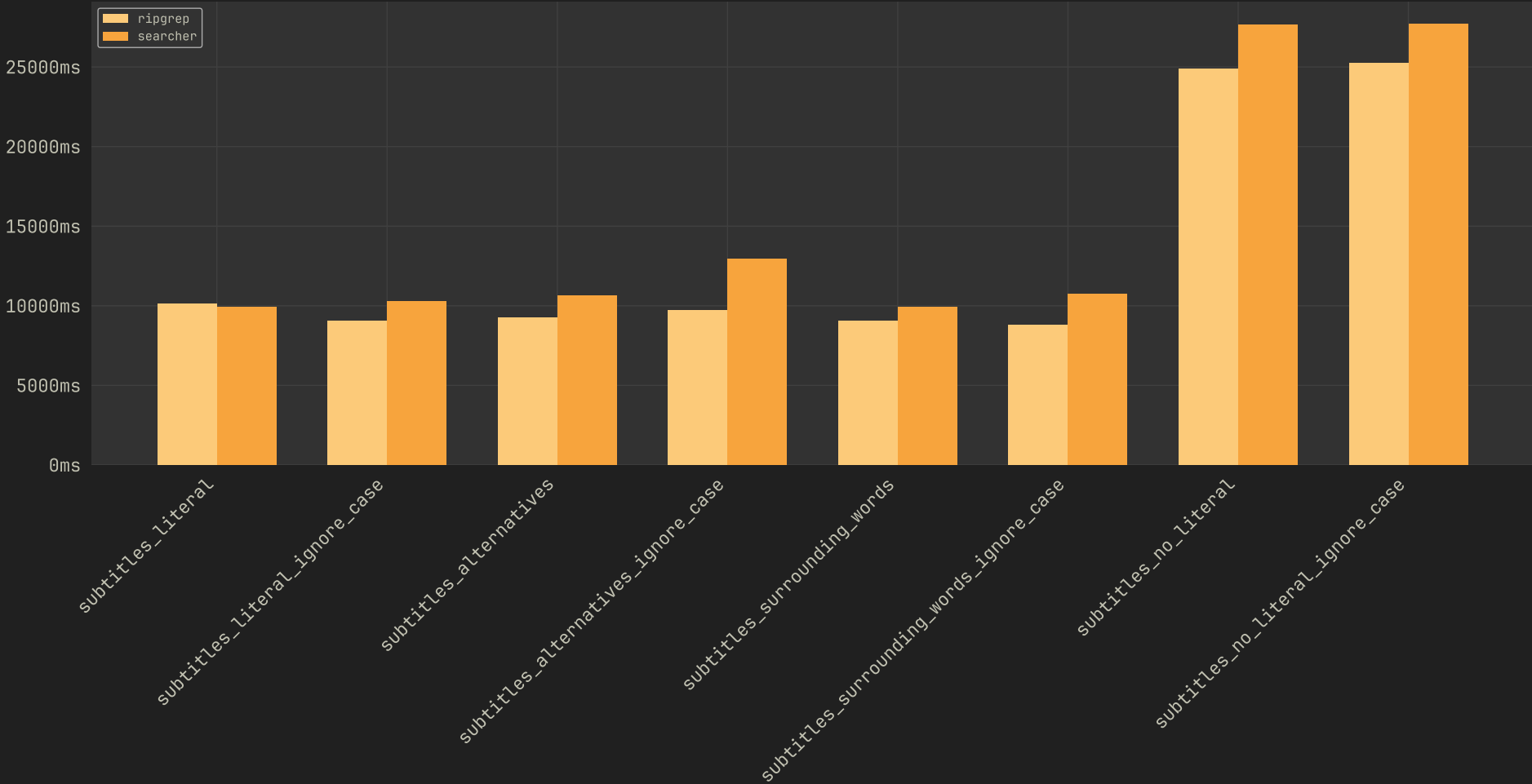
Results R7 5800u & 16Gb

Program



Results R7 5800u & 16Gb

Program



Result

Program

Questions?