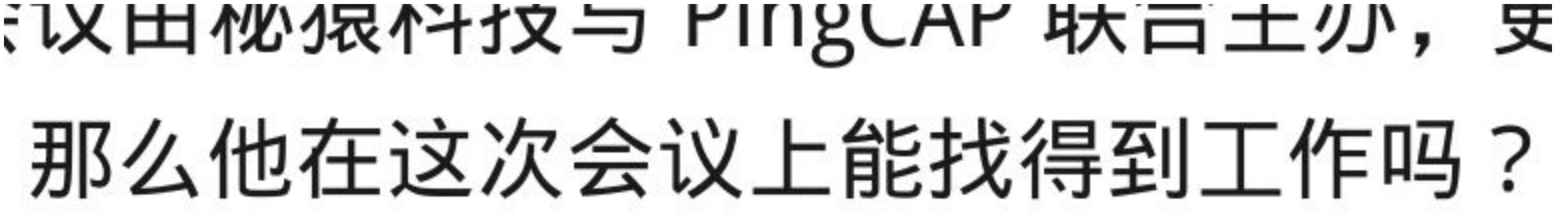
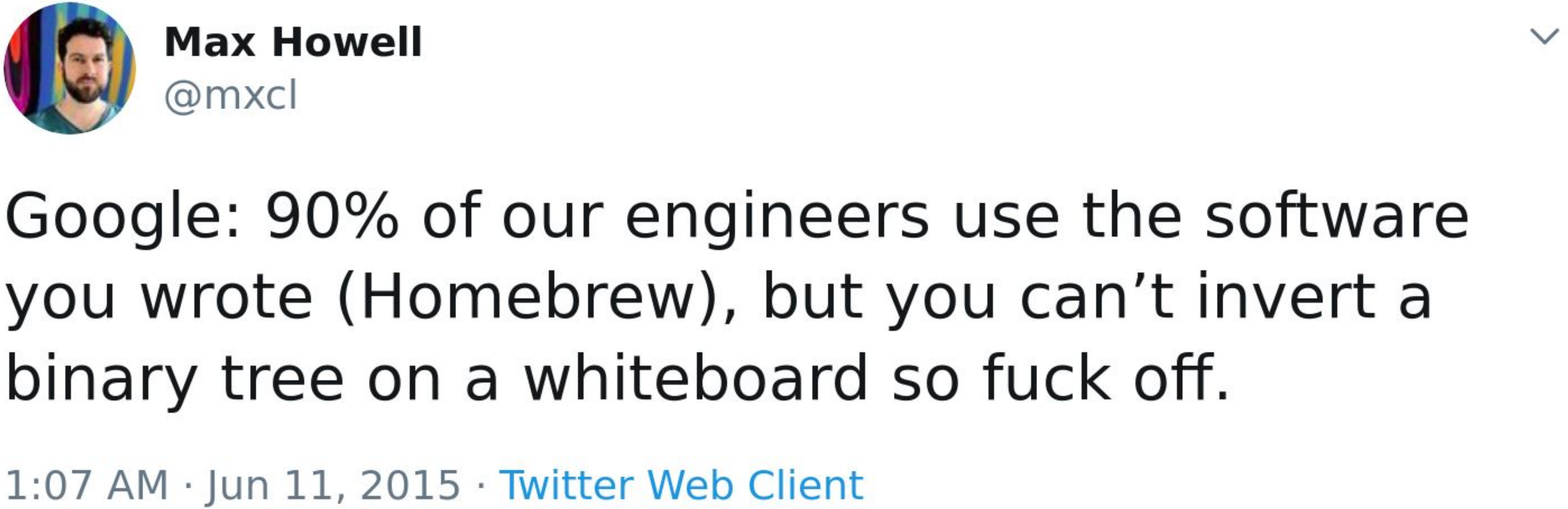
Making Rust library for Competitive Programming

About me



会议由秘猿科技与 PingCAP 联合主办，要

那么他在这次会议上能找得到工作吗？



Max Howell

@mxcl

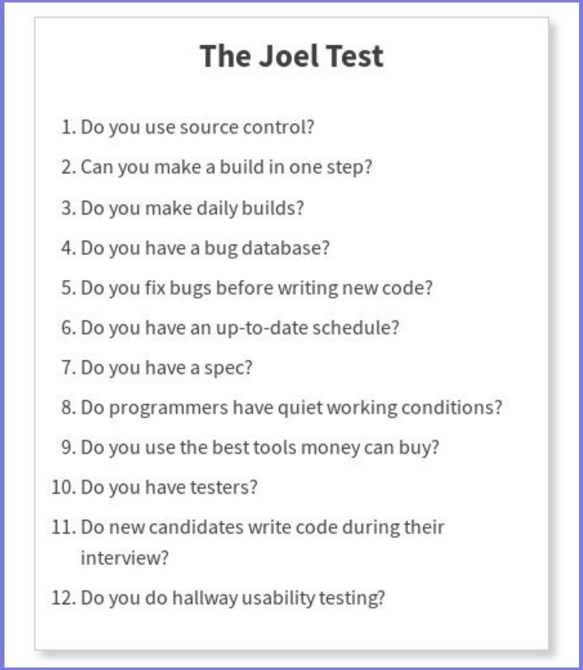
Google: 90% of our engineers use the software you wrote (Homebrew), but you can’t invert a binary tree on a whiteboard so fuck off.

1:07 AM · Jun 11, 2015 · Twitter Web Client

HTTPS://MOBILE.TWITTER.COM/MXCL/STATUS/608682016205344768

```
inline PSplay
node(PSplay x,int
v){x->f=x->c[0]=x->c[
1]=&null;x->v=v;if(x<
st[17])x->s=num[b[(x-
*st)%500000]];return
x;}
```

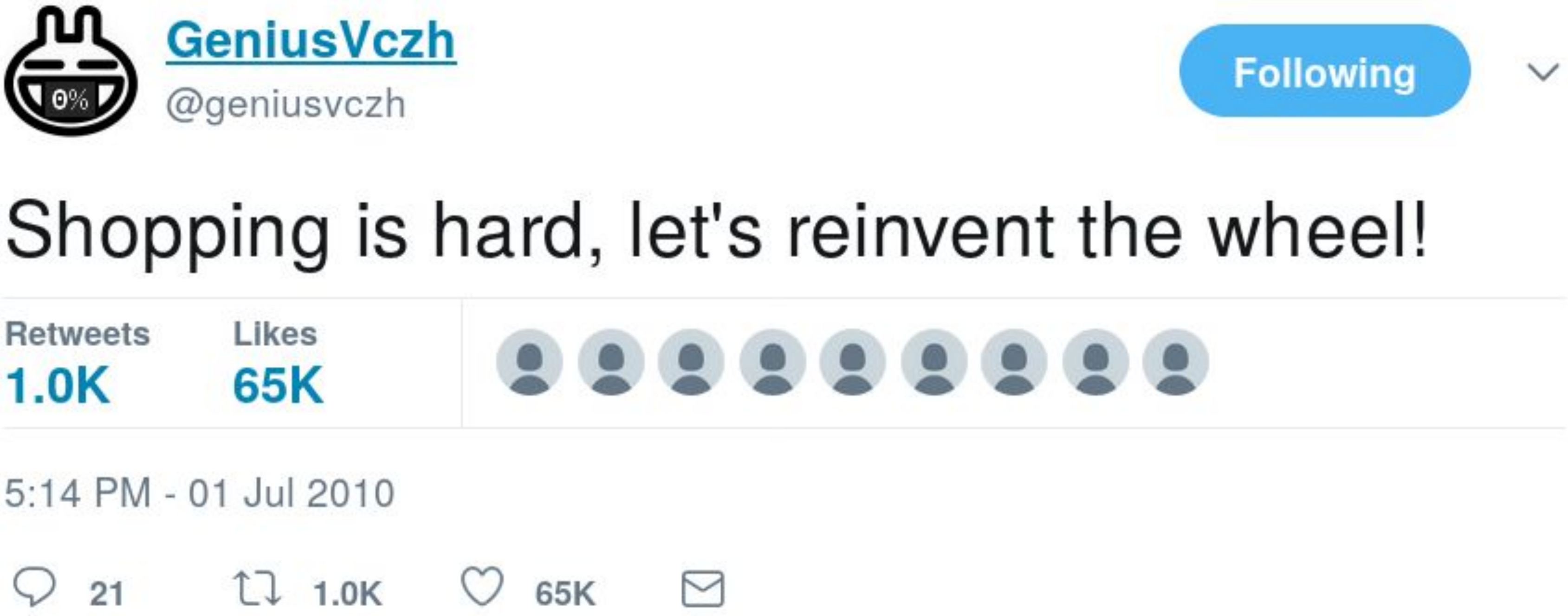
- ✗ SOURCE CONTROL
- ✗ BUILD IN ONE STEP
- ✗ DAILY BUILDS
- ✗ BUG DATABASE . . .



The Joel Test

1. Do you use source control?
2. Can you make a build in one step?
3. Do you make daily builds?
4. Do you have a bug database?
5. Do you fix bugs before writing new code?
6. Do you have an up-to-date schedule?
7. Do you have a spec?
8. Do programmers have quiet working conditions?
9. Do you use the best tools money can buy?
10. Do you have testers?
11. Do new candidates write code during their interview?
12. Do you do hallway usability testing?

Rockstar programmer do not born with a factor of ten. They just make better use of tools.



GeniusVczh
@geniusvczh

Shopping is hard, let's reinvent the wheel!

Retweets 1.0K Likes 65K

5:14 PM - 01 Jul 2010

21 1.0K 65K

Great execuse for NIH Syndrome

Develop library in Python

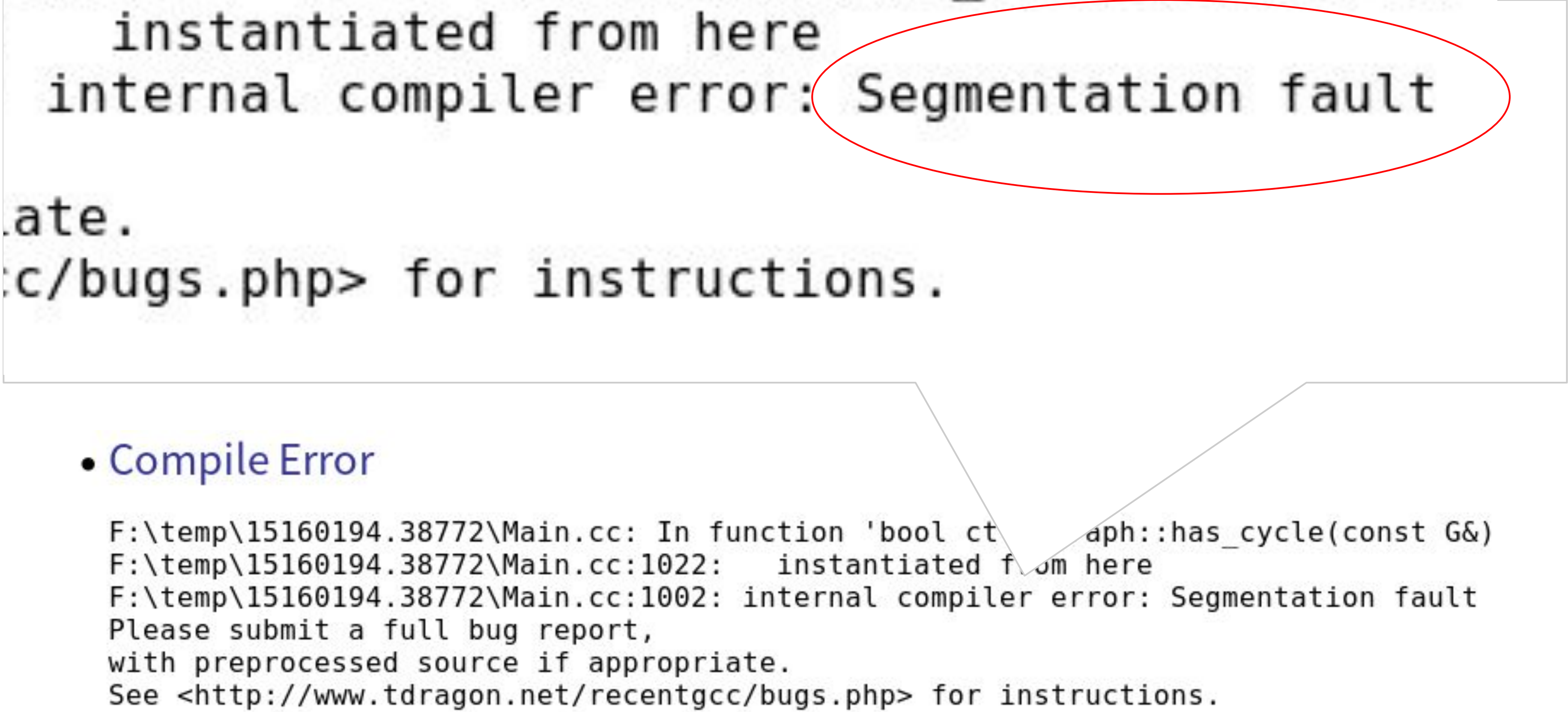
- ✓ import ast
- ✓ significant indentation

- ✘ Few online judges

Develop library in C++

✓ Many online judges

✗ Have to be compatible with C++ 98/03/11/17/...



```
   instantiated from here
 internal compiler error: Segmentation fault

ate.
c/bugs.php> for instructions.
```

- Compile Error

```
F:\temp\15160194.38772\Main.cc: In function 'bool ct      aph::has_cycle(const G&)
F:\temp\15160194.38772\Main.cc:1022:   instantiated f  om here
F:\temp\15160194.38772\Main.cc:1002: internal compiler error: Segmentation fault
Please submit a full bug report,
with preprocessed source if appropriate.
See <http://www.tdragon.net/recentgcc/bugs.php> for instructions.
```

Some stucked with ancient compiler, thanks to Trisolarans

Myth

assembly is BANNED

Reality

__asm__ is OK

WRONGANSWER

```
wa $URL test -- echo Hello World

wa $URL submit C $FILENAME

URL=http://judge.u-aizu.ac.jp/onlinejudge/description.jsp?id=ITP1_1_A

FILENAME=solutions/judge.u-aizu.ac.jp/ITP1_1_A.c
```

WRONGANSER.PROJECT

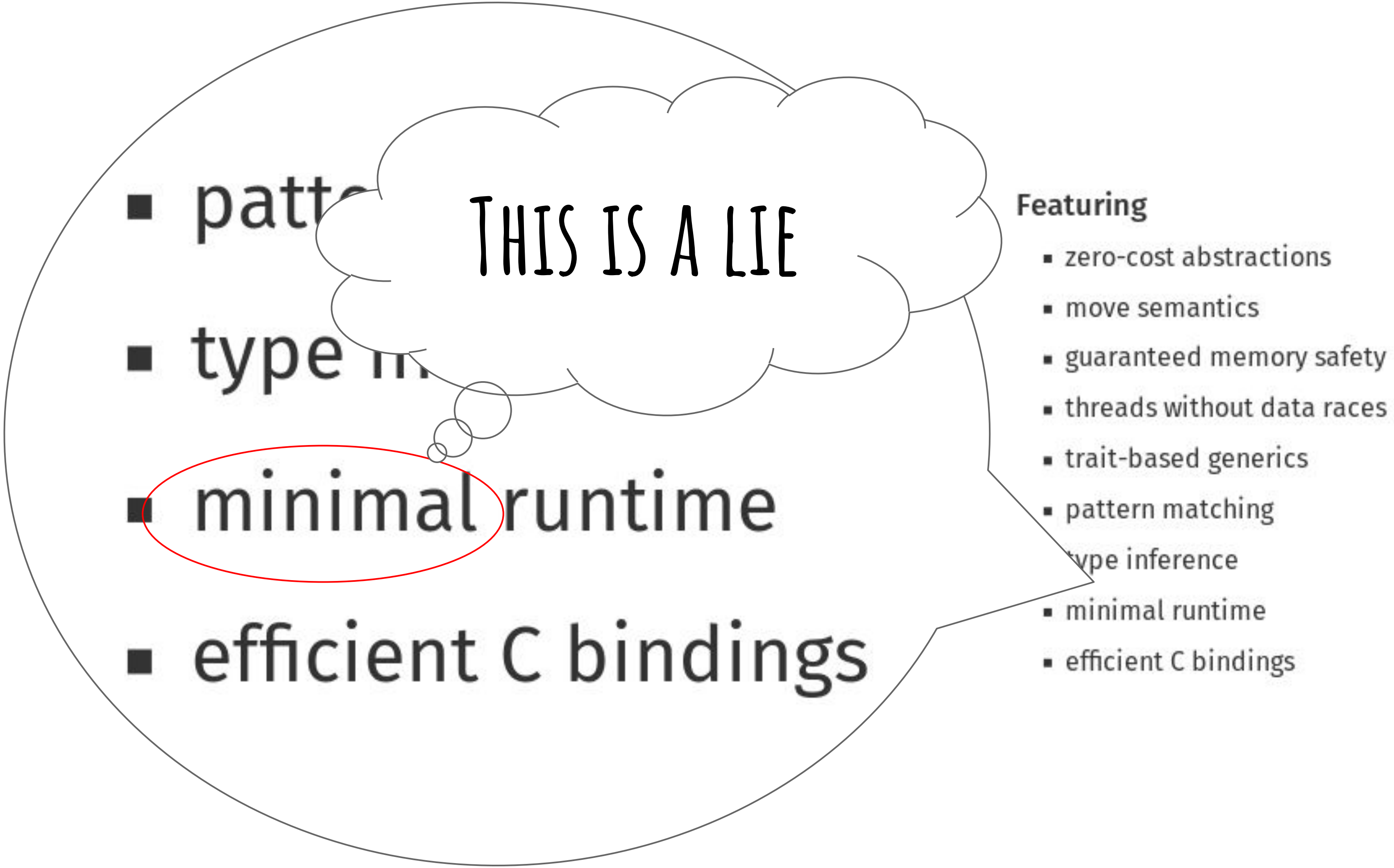
```
./c.py test $FILENAME

./c.py submit $FILENAME

./c.py preview $FILENAME
```

SOLUTIONS/JUDGE.U-AIZU.AC.JP/ITP1_1_A.C

```c
#include <stdio.h>

int

main() {

  printf("%s\n", "Hello World");

}
```

./c.py preview solutions/judge.u-aizu.ac.jp/ITP1...

```
__asm__("\t.text\n\t.file\t\"-\"\n\t
.globl\tmain\n\t.type\tmain,@functio
n\nmain:\n\t.cfi_startproc\n\tpushq\
t%rax\n\t.cfi_def_cfa_offset
16\n\tmovl\t$L._,
%edi\n\tcallq\tputs\n\txorl\t%eax,
%eax\n\tpopq\t%rcx\n\tretq\nL_:\n\t.
```



THIS IS A LIE

- patt
- type in
- minimal runtime
- efficient C bindings

Featuring

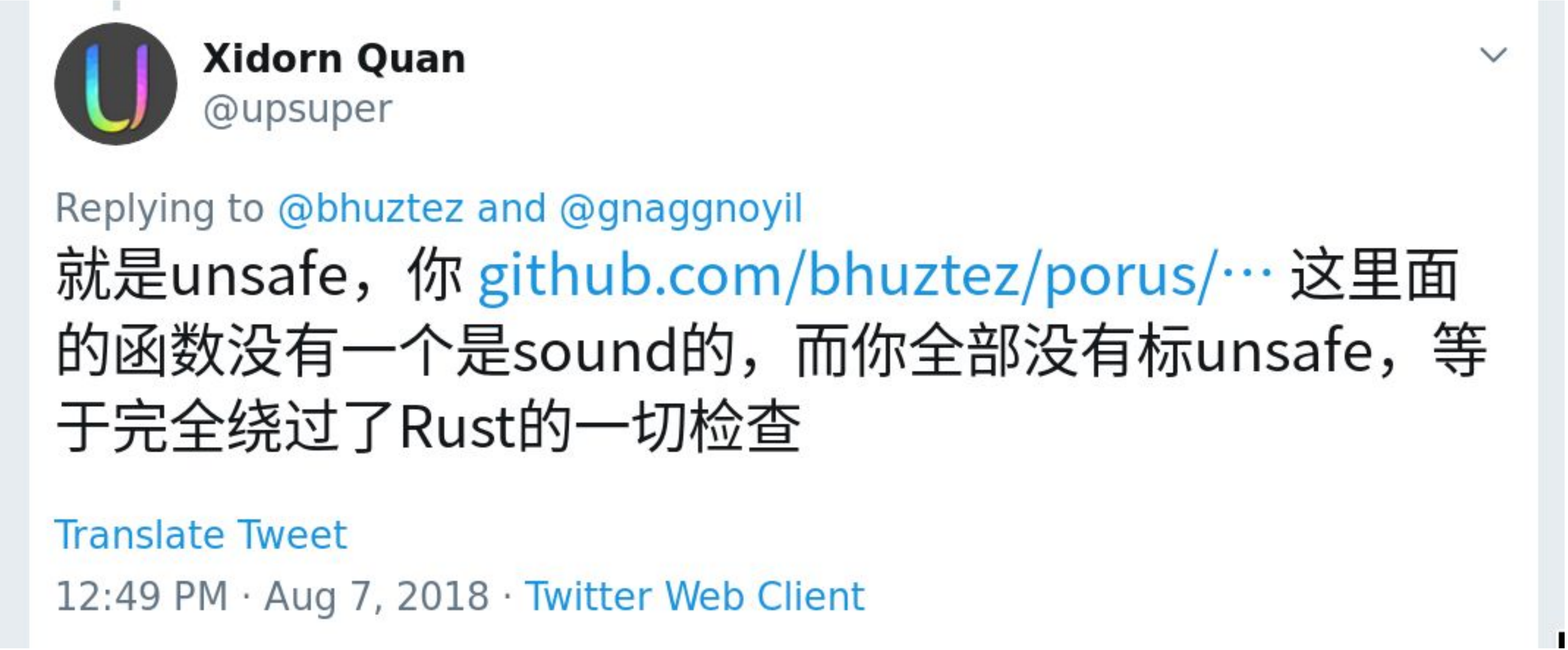
- zero-cost abstractions
- move semantics
- guaranteed memory safety
- threads without data races
- trait-based generics
- pattern matching
- type inference
- minimal runtime
- efficient C bindings

Why is a Rust executable large?

RUSTLOG · 2016-06-02 23:58 +09:00

```
fn main() {
    println!("Hello, world!");
}
```

650 *kilobytes* to print anything?! You reme



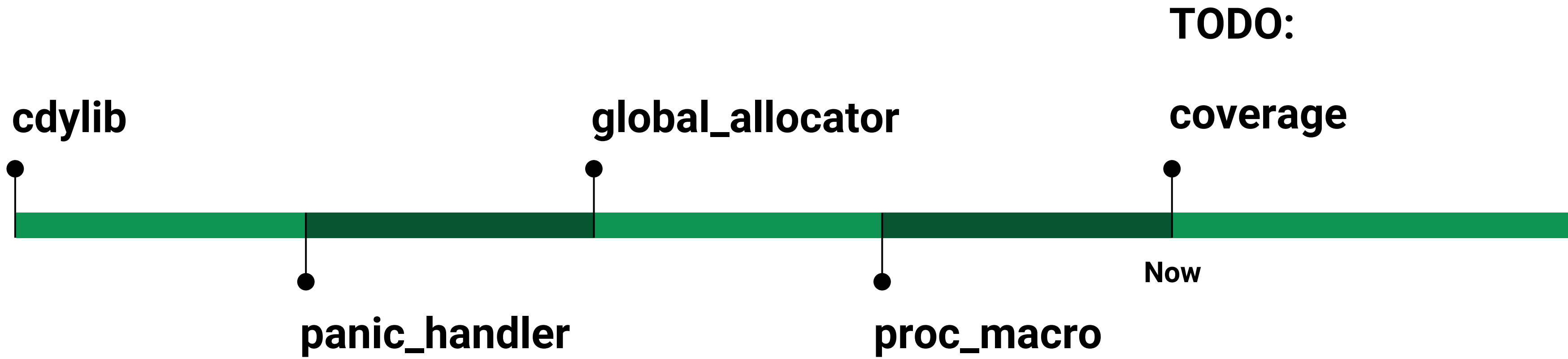
Xidorn Quan
@upsuper

Replying to @bhuztez and @gnaggnoyil

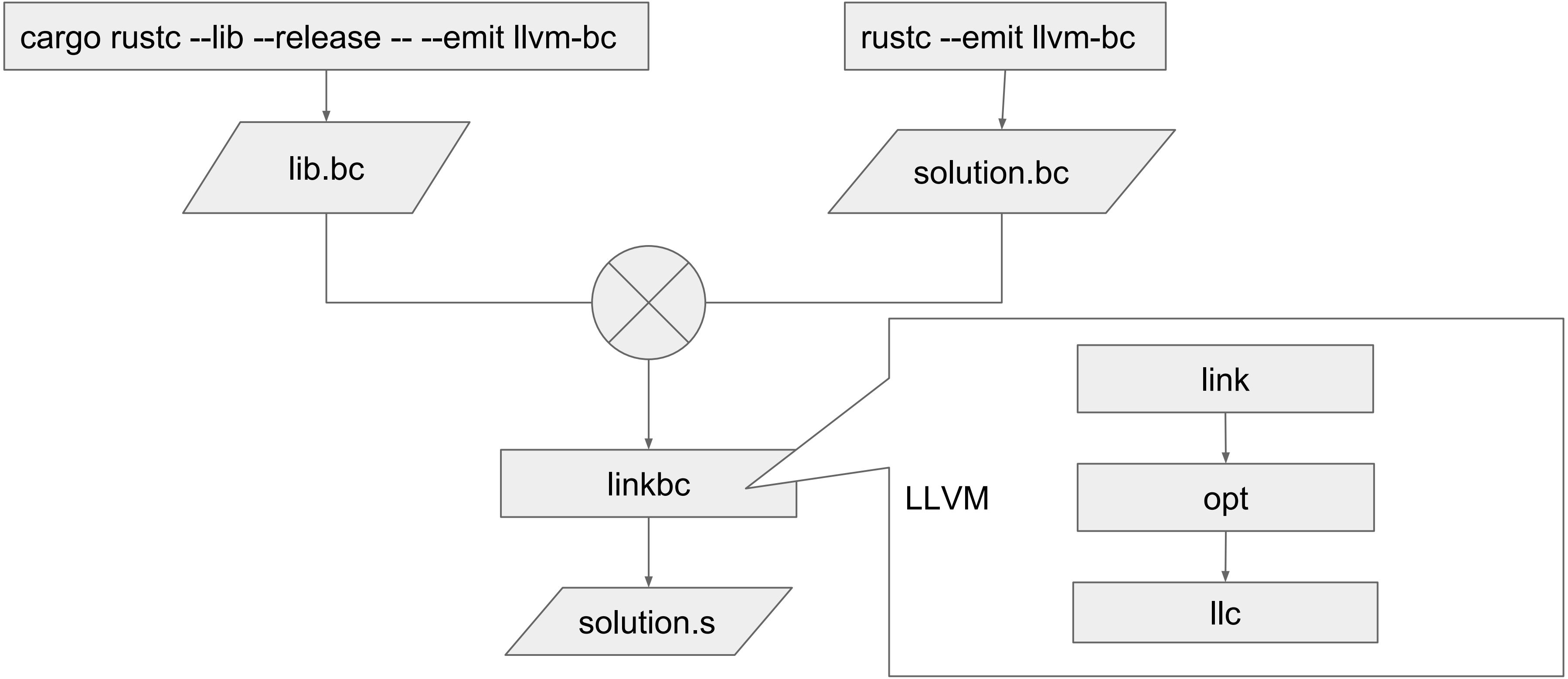
就是unsafe，你 github.com/bhuztez/porus/… 这里面的函数没有一个是sound的，而你全部没有标unsafe，等于完全绕过了Rust的一切检查

12:49 PM · Aug 7, 2018 · Twitter Web Client

As rust become better and better



Before cdylib



cargo rustc --lib --release -- --emit llvm-bc

rustc --emit llvm-bc

lib.bc

solution.bc

linkbc

solution.s

LLVM

link

opt

llc

After cdylib

```
rustc --crate-type cdylib --emit asm -C lto=fat
```

Before panic handler

```
#[cfg(debug_assertions)]
macro_rules! abort {
    ($msg:expr) => ({ panic!($msg); }); }


#[cfg(not(debug_assertions))]
macro_rules! abort {
    ($msg:expr) => ({ unsafe { $crate::abort(); } }); }
```

After panic_handler

```
#[panic_handler]

#[no_mangle]

pub fn panic(_info: &::core::panic::PanicInfo) -> ! {

    unsafe { ::core::intrinsics::abort() }

}
```

Before global_allocator

```
#[no_mangle]

pub extern fn __rust_allocate(size: usize, _align: usize) ->
*mut u8 { unsafe { malloc(size) } }


#[no_mangle]

pub extern fn __rust_deallocate(ptr: *mut u8, _old_size:
usize, _align: usize) { unsafe { free(ptr) } }
```

After global_allocator

```
#[global_allocator]
static _A: allocator::System = allocator::System;

#[alloc_error_handler]
fn oom(_info: ::core::alloc::Layout) -> ! {
    unsafe { ::core::intrinsics::abort() }
}
```

Before proc_macro

```
extern "C" {
    pub fn printf(fmt: *const u8, ...) -> i32;
    pub fn scanf(fmt: *const u8, ...) -> i32;
}
```

After proc_macro

```
int a, b;

scanf("%d%d",&a,&b);

printf("%d\n",a+b);
```

```
let a : usize = read!();

let b : usize = read!();

writelnf!("{:d}", a + b);
```

Floating point number

C:

```
printf("%.6f", 1.0);
```

Rust:

```
writelnf!("{:.6f}", 1.0);
```

when run locally, outputs ESC "Xf.6" ESC "\"

ESC X Start Of String

ESC \ String Terminator

Leetcode two-sum

```
pub fn two_sum(nums: Vec<i32>, target: i32) -> Vec<i32> {
    let mut map = BTreeMap::new();
    for (i, x) in nums.iter().enumerate() {
        let y = target - x;
        if let Some(&j) = map.get(&y) {
            return vec![j as i32, i as i32];
        }
        map.insert(x, i);
    }
    unreachable!();
}
```

Generated code

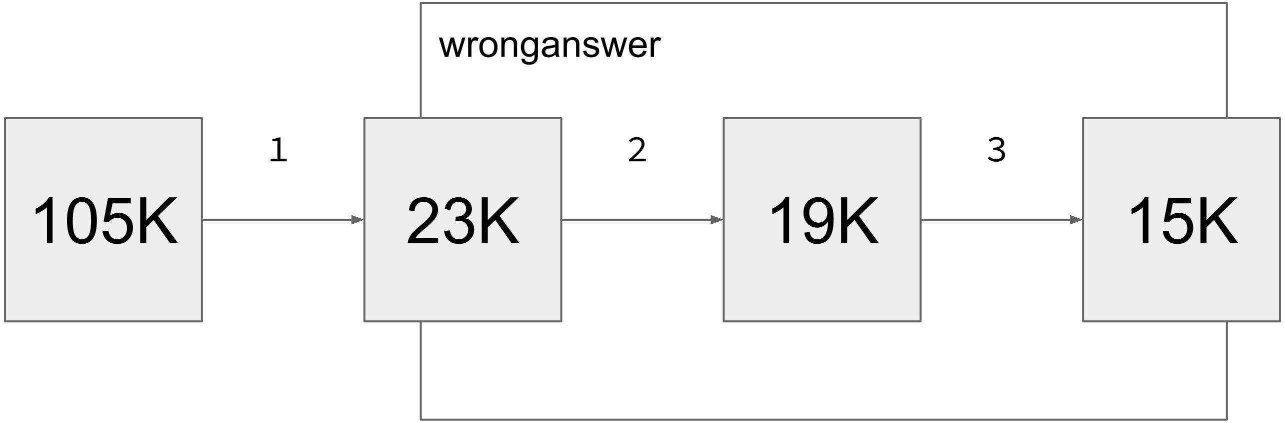
```
/**
 * Note: The returned array must be malloced, assume caller calls free().
 */
int* twoSum(int* nums, int numsSize, int target);
#define _ "\n\tmov"
#define a "movq\t"
#define b "ax\n\t"
#define c ":\n\t"
#define d ""_"q\t"
#define e "q\t%r"
#define f "di\n\t"
#define g "), %r"
#define h "leaq\t"
#define l "\n\t."
#define j "addq\t"
#define i "cx\n\t"
#define k "_\n\t"
#define m "(%rsp)"
#define n "_"c""
#define p "callq\t"
#define o ", %r"b""
#define s "8(%rs"
#define r ", %r"f""
#define q "p2align\t"
#define t ""a"%r"
#define v ""q"4, 0x90"
#define x ""s"p)"
#define w "zwl\t"
#define z "bx\n\t"
#define y "(%rax)"
#define B "dx\n\t"
#define A ")\n\t"
#define D ""d"%r"
#define C ", %r"i""
#define F "si\n\t"
#define E ""b"mov"
#define J "je\tL"
#define I ", %rdx"
#define H "movw\t"
#define G "192(%r"
#define K "@GOTPCREL(%ri"
#define N "p)\n\t"
#define M ""I"\n\t"
#define P ""x", %r"
#define O "\\000"
#define T "\n\tj"
#define S "\n\tlea"
#define Q "(%rbp"
#define W "jne\tL"
#define V ""E"q\t"
#define X "."v"\nL"
#define Y "), %e"
#define _a "(%rbx)"
#define __ ""S"q\t"
#define Z ", %rsi"
#define _e "bp\n\t"
#define _d ""k"mov"
#define _c ""n"mov"
#define _b ", %r12"
#define _i "xorl\t"
#define _h "cmpq\t"
#define _g "subq\t"
#define _f ""y"\n\t"
#define _k "def_cfa_offset "
#define _l "test"e""
#define _j ""Z"\n\t"
#define _o ""m", %r"
#define _n ", %edx"
#define _m ""8 a""
#define _s ""r"mov"
#define _r ", %r14"
#define _q "(%rcx)"
#define _p "mov"w""
#define _y ""l"cfi_"
#define _x "jmp\tL"
#define _w "12, %r"
#define _v ",%rax,8)"
#define _t "\",@prog"
#define _z ""_c"q\t"
#define _D ", %r"F""
#define _C "\n\tcmp"
#define _B ""_b"\n\t"
#define _A ""p"*mem"
#define _G ""_d"q\t"
#define _F "bx,%r15"
#define _E "shlq\t$3"
#define _J "24(%rsp)"
#define _I "bp, (%r"
#define _H ""H"%cx, "
#define _V "pushq\t%r"
#define _T ""_e a""
#define _S ""_F",8)"
#define _Q ", %r15\n\t"
#define _P "move"K""
#define _O ", %r"z""
```

```
#define _N ""_n _""
#define _M "q\t"G""
#define _K ""O"\\00"
#define ae ""l v"\nL"
#define ad ""_a", %r"
#define ac "64(%rsp)"
#define ab ""_E M""
#define aa ""_ w"10"
#define a_ ""_r"\n\t"
#define _Z ""f"movq\t"
#define _Y ""C _p""
#define _X "\n\n\t."
#define _W ""_t"bits"
#define an ""_y _k""
#define am "\n\t"h""
#define ak ""p"*malloc"K""
#define al ""i a"%r"
#define aj ",%rbx,8"g""
#define ai ""G"di"g""
#define ah ",8)"_Y"10"_q _N _M"cx,%rdx"
#define ag ""_m G"dx"g""
#define af "@object"l"section\t."
#define aE "\"ax"_t"bits"
#define aD "@function\n"
#define aC "\n\t"_V""
#define aB "offset %r"
#define aA "\n\t"_i""
#define az ""_A"cpy"K""
#define ay ""T"ae\tL"
#define ax ""T"mp\tL"
#define aw ""a"192(%r"
#define av ""al"cx, "
#define at "15,%rax,8)"
#define as ""d P b h""
#define ar "bx,8"g""
#define aq ""_H"8"_f""
#define ap ""ai _Z""
#define ao ".cfi_"_k""
#define aM ""_j a P b h""
#define aK ""N a x""
#define aJ ""ak N"test"e"ax"o J"u"
#define aI "\n\tpop"e""
#define aH "\n\n\t.section\t.text."
#define aG ""af"rodata.L"
#define aF "\""l"size"
#define bc "12,%r15,8"g""
#define bb "80"m", %r"
#define ba ", %e"f aJ _G""
#define b_ "(%r14), %r"
#define aZ ""_v C t _I"cx"A""
#define aY "72"m", %r"
#define aX "%ecx, %ecx"
#define aW ""ar V"%rdi, (%rax"A""
#define aV "leal\ti(%r"
#define aT ""V"%r"_I"ax"A""
#define aS ", %e"i _N""
#define aQ "(%rbx,%rax,8)"
#define aP ""aE l v l"typ"
#define aO ""_y"endproc"
#define aN "\"a"_W"\nL"
#define bj "$0, "y _"w\t$0, 10"
#define bi ""r j"$112"_s e""
#define bh ", 8"_q d"2"
#define bg ""Q aj aT""
#define bf ""8 _A _P""
#define be "(%rbx,%r15,8)"o a"%rbx, "_f""
#define bd ""c".cfi_startproc"
#define bC "test"e"ax, %r"b J""
#define bB ""_l"9, %r9\n\t"W"N"k _x"a"
#define bA "\n\t"_l"si"_D W"m"
#define bz "22"_o"14"d"40"_o"15"
#define by ""F h"(%r"bc f j"$8"_s e"14"
#define bx ""h"(%rax,%r15,8"g""
#define bw "mem"_P"p)"o t"ax"_B p"*%rax"D _w"cx"d P E e"ax"
#define bv ""bj y __"12"y _z""
#define bt "(%rdx"Y F H"%si"
#define bs "\n\ttestw\t%bx, %"z""
#define br ""h"3"ad i aq j"$4, %r"z _h""
#define bq "%r"f t _w B _g""
#define bp "(%r15"Y i aq a""
#define bo "22"m _r d"40"_o"15"
#define bn ""n h"Li_(%rip)"o _h""
#define bm "(%rip)"r p"LF._\n\tud2\n"
#define bk ""0 0 0 0 0 0""
#define bl ",\"aw"_W l q"3\nL"
```

```
__asm__("\t.text\n\t.file\t\"rust_out.3aifbbbh-cgu.0\"\n\t.section\t\".text.LU_\",\"aE"\n\t."v"\n\t.type\tLU_,"aD"LU_"c _V b p"L2"k"ud2\nLH._"c".size\tLU_, LH._-LU_"aH"twoSum,"aE l"globl\ttwoSum"l v l"type\ttwoSum,"aD"twoSum"c".cfi_startproc"aC"bp"l"cfi_"_k"16"aC"15"an"24"aC"14"an"32\n\t"_V"13"an"40"aC"12\n\t.cfi_"_k"48"aC"bx"an"56\n\t"_g"$440, %rsp"l"cfi_"_k"496\n\t.cfi_"aB"bx, -56\n\t.cfi_"aB"12, -48"_y aB"13, -40"_y aB"14, -32\n\t.cfi_"aB"15, -24"_y aB"bp, -16"_"l\t%edx, 124(%rsp)"_ e"di,
%rbp"_"slq\t%esi, %rbx"_"l\t$4, %edi"_ e"bx, %r"b"mulq\t%r"f"jo\tLd"k bC"I"_d e"ax, %r"f ak"p)"_ e"ax, %r"f bC"u_\nLI"n h"(,%rbx,4), %rdx"_ e"di, 12"s"p)"_ e"bp, %r"F az N"testl\t%ebx, %e"z J"7_1"d"12"s"p), %r"b h"(%rax,%rbx,4), %rcx"D"cx, 152(%rs"N h"Li_(%rip), %r13"aA"%r11d, %r11d"aA aX D"cx, 4"x N _i"%r14d, %r14d"D"ax, %r15"ae"1._"c"mov"e"15, %r"b"mov"e"14, %r12\n\t"h"4(%r15), %r15"am"1(%r14), %r14"D"ax, "s N"movl\t(%rax), %r8d"_"l\t124(%rsp), %edx\n\tsubl\t%r8d, %edx\n\tmov"e"13, %rcx"D"
%r9\n\t"_x"P"k X"N"n j"$-1, %r9\n\t"a"192(%rcx,%rdi,8), %rcx\nLP"_c w"10(%rcx), %r10d"am"(,%r10,8), %r"_e"neg"e _T"$-1, %r"f _i"%eax, %eax\nL7_"c"cmp"e"ax, %r"_e J"r"_G"24(%rcx,%rdi,8), %r"z _i"%esi, %esi"_C"l\t(%rbx), %edx\n\tsetge\t%bl\n\t"J"4._"_"b\t%bl, %sil\n\t"j"%rsi"_D j"$-1"_D _x"K._"ae"4._"c _i"%esi, %esi\nLK._"c j"$-8"o _l"si"_D J"E"k j"$1, %r"f _h"$1, %r"F J"7_\n\t"b8"_\nLr"_c e"10"r bB k X"G"n h"96"_q I _C e"ax"I"\n\t"W"7_2\nLa"bn"%rax, %r12\n\t"W"w"_d"l\t$192"ba"%rax, %r13"d bj
e"ax"r j"$12"_s"l\t$180, %edx"am"164(%rsp)"_D az aK o"movl\t(%rax"g"8d"aK"%r11d, %r11d\nLw"_c e _w _T"%r15, 40(%rs"N t"14, 32(%rs"N t"13"_O t"11"_D _x"C._"ae"m"n j"$-1"_D aw _F",8"g"bx\nLC._"c h"16"ad"12"am"10"ad f"mov"w"10"ad"14d"am"(,%r14,8"g b a"$-1, %r15\nL2._"c _l"ax"o J"A._"d"24(%r"_F",8"g"cx"aA"%edx"_n _C"l\t(%rcx"g"8d\n\tsetge\t%cl\n\t"J"3._"_"b\t%cl, %dl\n\t"j"%rdx"H j"$-1"H _l"dx"H W"x"k _x"I_4"ae"3._"c _i"%edx"_n"\n\t"_l"dx"H J"I_4\nLx"n j"$1"_Q j"$-8"o _h"$1, %rdx\n\t"J"2._"bA k
_x"I_0\nLA._"c t"14, %r15"bA"_\nLI_0"c t"11, 96(%rs"N"cmpw\t$11"_r"w"ay"S"k h"(%r"bc by _B _g"%r15"_B _E _B t _w bf aK o t"ax, 16(%r"_S am"(%r"_S _D j"$104, %rsi"am"(%r"_S bi _w bf N a"%rbp, 104(%r"_S S"l\ti(%r14), %e"E"w\t%ax, 16"_a"\nLI_1"c a"4"P _T"96"_o"11\nLI_2"c a bz ax"7_0"ae"I_4"c a"%rbp, 112(%r"_S d bz _C"q\t152"_o"15"T"ne\tLi._"ax"7_1\nLS"_c e"di, 16"m _"l\t$192"ba"%rax, %r14"d bv"l\t$180, %edx"__"164(%rsp)"_D az N a"64(%rbx)"o t"ax, 80"m d"152"ad E e"ax, 8"x aa _a", %e"b h"-7"y",
%rcx"D"cx, "_J __"72"ad F h"16(%r14)"_s e"ax, 56"m __"-56(,%rax,8"g B t"dx, "ac D"di, 104(%rsp)\n\t"az N h"160"_a _D h"104(%r14"g _Z ac M az N H"$6, 10"_a d"24(%rsp)"o H"%ax, 10(%r14)"_C"q\t$6"_Q t"14, 72"m T"a\tLI_8"aa _a _r"d"__"(%r"bc by M _g"%r15"M ab t"dx, "_J d bw", 16(%r"_S __"(%r"_S _B j"$104, %r12"__"(%r"_S bi _w F a _J M _x"H_\nLI_8"c h"10(%r14)"o t"ax, 16(%rs"N h"-7(%r15"g"cx"d"%rcx, "_J d"56(%rsp)"o"addl\t$-7, %e"b"mov"w"%ax"_n d"104(%rsp)"o bx F j"$-56"_D bx f j"$-48"r _g"%rcx,
a bw", -40(%r14,%r15,8)"aa"(%r14), %e"b h"48(%r14,%r15,8)"_B h"(%r14,%r15,8)"r j"$56"_s e"ax, %r14"d"%rax, %r"B _g _J H ab a"%r12"Z"\nLH"n p"*%rcx"d"16"_o E e _I"12"A"addl\t$1, %r14d"_"w\t%r14w, (%rax"A a ad i _l"cx, %r"i a bo T"e\tL8"_d w"8"_a _N w"%dx, %eax"aa _q _b"d"_C"w\t$11"_b"w"D"cx"_r ay"V"_G aY _T bb"10"d"8"P"8"D"14"_O _x"4_\nLB"_z"8"P"12"d bb z _x"P_8\nLV"n h"10"b_ av"16"m D"14"_O X"B._"c H"%dx, "_J d"%rbx, 144(%rsp)"D"ax, "x _"l\t$288"ba"%rax, %r"_T bv"l\t$276"_n __"164(%rsp)"Z
d"memcpy"K"p)"o p"*%r"V"64(%r14"g V"%rax, 56"m d"152"b_ V"%rax, "ac d"16(%rsp)"o _p y", %e"z h"-6(%rbx)"_Q h"-7(%rbx)"o t"ax, 112"m __"72"b_ F h"16(%rbp"g f h"-56("aj"12"d"%rdi, 136(%rsp)"D _w B _A"cpy"K N h"160(%r14)"Z __"104(%rbp"g f t _w _m"memcpy"K"p)"_B p"*%r12"D"14, 104(%rsp)\n\t"h"240"b_ F h G"bp"g"14"__"-40("aj _m"%r14"r p"*%r12"d"112"m o a"16"m C H"$6, (%rcx"A H"%ax, 10"Q A _l"15"_Q a P"8"T"e\tL1._3\n\taddl\t$2, %e"z"andl\t$3, %e"z _h"$3"o"jae\tL1"k _i"%eax, %eax"bs W"1._1"ax"1._3\n
_g"%rbx, %r15"aA"%eax, %eax"ae"D._"c aw"bp"a2"movl\t%eax"_n _"w\t%ax"bh"00"Q a2"leal\t1"bt bh"00"Q a2"leal\t2"bt bh"16"Q _v C j"$4, %rax"D _I"cx"A"leal\t3(%rdx"Y B H"%dx, 8"_q _C"q\t%rax, %r15"T"ne\tLD._"bs J"1._3\nLi._1"c"neg"e z X"g"_z G"bp"a2"movw\t%ax, 8"_q __"1"y", %r"b"inc"e z W"g_\nLi._3"c _p _3", %e"b"cmpw\t$6, %"b"ja\tLN_1"d"16(%rsp)"_Y _q _r"d"D"14, 112"m d"104(%rsp)"_Q h"(%r15,%r8,8)"_j j"$16"_j h"1(%r8"g z h"(%r15,%r8,8)"r j"$24"r _g"%r8"a_ _E a_ t"14, %r"_m"mem"_P"p)"_B p"*%r12"
av"16(%r"at as"104(%r"at aH"(%r"at bi"14"M p"*%r12"d"%r12, %r8"d P V"88"_o av"104(%r"at d"112"m o aV"ax"g"12d"d"16(%rsp)"o H"%r12w, (%rax"A _p"%r12w"_N e"dx, 16"m as"(%r"at a_ j"$200, %r14"as"(%r"at r j"$208"r _g"%rbx, %r"B ab a"%r14"_j p"*%r8"d"16(%rsp), %r11"d P"9\n\t"a aY V"%rax, 200(%r15,%r9,8)"_C"w\t%r12w, "_J d ac", %r8"d"144(%rsp)"_s"q\t56"m", %r10"ay"2"_d"l\t%r11d, %e"b"subl\t%r9d, %e"b"not"e"9\n\t"j"%r11, %r9\n\tandq\t$3"o J"S"k _i aX ae"s"n"leal\t(%rbx,%rcx"Y _m"(%r14,%rcx,8)"_j t"
(%rsi"A H"%dx, 8(%rsi"A j"$1"C _h"%rcx"o W"s"k j"%rcx, %rbx\nLS"n _h"$3, %r9\n\tjb\tL2"k X"N_0"c aw"15,%r"aW H"%bx, 8"y _"q\t200(%r15,%r"aW aV"bx)"aS"8"y _"q\t208(%r15,%r"aW"leal\t2"_a aS"8"y _"q\t216(%r15,%r"aW br"%r11"C W"N_0"ax"2"k X"N_1"c h"-7(%r8"g"15"aa Q Y _m"136(%rsp)"o h"(%rax,%r8,8)"_j j"$-56"_j h"-6(%r8"g z h"(%rax,%r8,8)"r j"$-48"r _g"%r15"M ab a"mem"_P"p)"o a"%r14, 16(%rs"N t"ax"a_ p"*%r"V P V bb av"-40"Q _v aa Q g"12d"as"40"Q _v aW"56("_v r j"%rbp"_s"q\t%r12"M _g"%r15"M ab p"*%
V"88"_o av"48"Q _v S"l\ti(%r12"Y E"w\t%ax, 16"Q A _p"%ax"_b"d"d P V"16"m C h"-48(%rcx"_v aH"(%rcx"_v r j"$-40, "bq"%rbx, %r"B ab p"*%r14"d P _m aY V"%rax, 144(%rbp,%rdx,8)"_C e _w z a ac", %r8"d"104(%rsp)"_Q a"56(%rsp), %r10"T"a\tL2"k"leal\t-1(%r12"Y i"subl\t%edx, %ecx"__"6(%r12"g b _g"%rdx, %rax\n\tandq\t$3"C J"N_S\n\tneg"e i X"M"_z G"bp,%r"ar _m"%rbp, (%rdx"A H"%bx, 8(%rdx"A j"$1"_O"inc"e i W"M_\nLN_S"c"cmpq\t$3"o"jb\tL2"k X"N_6"c a G"bp,%r"ar aT H"%bx, 8"_f a"200"bg aV"bx)"aS"8"_f
a"208"bg"leal\t2"_a aS"8"_f a"216"bg br"%r12"C W"N_6\n\t"X"2"_z"(%r15"g z _l"bx, %r"z J"3"_d w"8(%r15"Y B _p"%dx, %eax"__"10"_a C t"cx, 16"m aa _a _b"d"D"bx, %r14"d"%r8, 8"x D"10, 80"m D"bp, 72"m _C"w\t$11"_b"w"ay"B._\nL4"_z"%r10, 56(%rsp)"D"8, "ac _"w\t%dx, "_J d"%rax, "x _ w"%r12w"_r"d"__"(%rbx,%rax,8)"_j j"$16"_j h"1(%rax"g"15"__"(%rbx,%rax,8)"r j"$24, %r"f _g"%rax"a_ _E a_ t"14, %r"bf aK o a"56(%rsp), %r"av"16"aQ as"104(%rbx,%rax,8)"aH aQ r j"$1"_w _Z"%r14"M _A _P aK o a ac C t"cx,
104(%rbx,%rax,8)"S"l\ti(%r12"g"14d"_"w\t%r14w, 10"_a _ w"%r14w"_b"d"as"200"aQ aH aQ r j"$208, "bq"%r15"M ab _A _P aK C t"bp, 200(%rbx,%rcx,8)"_C"w\t%r14w, "_J ay"I_2\n\t"t"bx, "Q A H"%r15w, 8"Q A _h"%r12"_Q a"48"_o _T"96"_o"11"T"e\tLI_2"_"l\t%ecx, %eax\n\tnotl\t%e"b"leal\t(%r12,%rax"Y b h"-2(%r12"g"8\n\t"_g"%rcx, %r8\n\tandq\t$3"o J"P_S\n\t"j"$26"C"neg"e b _i"%edx"_n"\n\t"X"J"_z"(%rbx,%rcx,8)"_j t"bx, (%rsi"A"leal\t-24(%rcx"Y f"movw\t%di, 8(%rsi"A j"$-1"M j"$1"C _h"%rdx, %rax\n\t"W"J"k _g"%r
%r15\nLP_S"c"cmpq\t$3, %r8"T"b\tLI_3"ae"F"_z"200"be aW"15"Y i aq a"208"be"leal\t2"bp"216"be"leal\t3"bp"224(%r"_S o j"$4, %r15"D"bx, "_f H"%r15w, 8"_f _h"%r15"_B W"F"k _x"I_3\nL3"_z"%rbp, 72"m D"8, %r12"D"10"_O a bo"\nLP_8"c"movl\t$288"ba"%rax, %rbp"d"$0, "_f H"$0, 10"_f a"%rax, %r"f j"$12"_s"l\t$276"_n __"1"ac _j az N t"12, 192"Q A a"96"_o"11\n\t"j"$1, %r11"D"bp, (%r13"A H"$0, 8(%r13"A _p"10"Q Y V"%rbx, 16"Q _v D"12, 104(%rbp,%rax,8)"__"1"y", %r"i a aY _m"%rdx, 200"Q _v S"l\ti(%rax"Y B H"%dx
a"200"Q _v o a"%rbp, (%rax"A aq t"bp, %r13"d"48"_o"bp\nL7_0"c j"$1, %r"_T"%rbp, 4"x _C"q\t152"m _Q W"1._\nL7_1"c h"L7._"bm"L7_2"c"mov"e"11, %r"_T"112(%rcx,%rdi,8)"_O"movl\t$8, %edi\n\t"aJ _d"l\t%ebx, "_f"movl\t%r12d, 4"_f _l"bp, %r"_T"48"_o"14"d"%rax, 32"m T"e\tLE._\n\t"h"-1(%rbp"g al"bp, %r"B"andq\t$7"M J"6._\n\t"t"dx, %rsi\n\tneg"e F a"%r13"_O X"7_6"c"mov"_H"bx)"_O"inc"e F W"7_6"D"bp, %rsi\n\t"_g"%rdx, %rsi\n\t"_h"$7"C"jb\tL7_9\n\t"X"7_8"c aw"bx)"_s"q\t"ap ap ap ap ap ap ai z j"$-8,
%rsi\n\t"W"7_8\nL7_9"c _l"dx, %r"B J"6"_G"%rdx, %rsi\n\tneg"e F X"k"_c w"10(%r13"Y f"mov"_H"13,%rdi,8), %r13\n\tinc"e F W"k"k _g"%rdx, %rbp\nL6"n _h"$7"C"jb\tL9._\n\t"X"v"_c w"10(%r13"Y i a G"13,%rcx"ah ah ah ah ah ah ah",8), %r13\n\t"j"$-8, %rbp"T"ne\tLv_\nL9._"c t"bx, %r13\nLE._"c _i aX d"free"K"p)"_Q X"8"n _l"14"a_ J"W"_d w"10(%r13"Y b _h"%rax, %rcx"ay"C"_G"16(%r13,%rcx,8)"o j"$1"C _x k X"C"_z"(%r13"g _e _l"bp, %r"_e J"o"_d w"8(%r13"Y z"movl\t$1, %r12d"ax"b_\nLo"n _i"%r12d"_b"d"aK"%ebp,
%ebp\nLb"_z"%r13"r _x"q"k X"y"n j"$1"_B _p"8(%rdi"V"bx\nLq"n p"*%r15"aa Q Y V"%rbp, %r"f _h"%rax, %r"z"jb\tLz"_G"(%rdi"g _e _l"bp, %r"_e W"y"k _i"%ebp, %e"_e _x"q"k X"z"_z"16"Q aj V"%r"_w i a"200"Q aj"13\n\t"j"$-1"C J"h"k h"-2(%r12"g _m"%rcx, %r"F"andq\t$7"_j J"D"_G"%rsi"C"neg"e i X"4._1"c aw"13"g"13\n\tinc"e i W"4._1\n\tnot"e F j"%rsi"_B t _w"cx\nLD"n _h"$7"M"jb\tLh"k X"_._"c aw"13"g ag ag ag ag ag ag ag"13\n\t"j"$-8, %rcx"T"ne\tL_._\nLh"n _i aX"\nL"n j"$-1"a_ _l"ax"o W"8_\nLW"bn"%rax,
%r13"T"e\tLt"_G"(%r13"g _e t"13"r p"*free"K"p)\n\ttest"e"bp, %r"_e J"t"k X"K"_z"(%rbp"g z a"%rbp"r p"*%r15"D"bx, %rbp\n\ttest"e"bx, %r"z W"K_\nLt"_z"12"P f p"*%r15"_"l\t$0, %edi\n\t"ak N a"%rax, %r"z a"32"m _s"q\t(%rdi"g V"%rax, "_a"\n\t"p"*%r15"D"bx, %rax\n\t"j"$440, %rsp"l"cfi_"_k"56"aI z ao"48"aI"12"an"40"aI"13\n\t"ao"32\n\tpop"e"14"an"24"aI"15"an"16"aI _e ao"8\n\tretq\nL6._"c ao"496"D"13"_O a"%rbp"_j _h"$7"C"jae\tL7_8"ax"7_9\nLu"n"ud2\n\tud2\nLd"n p"LU"k"ud2\nLJ._"c".size\ttwoSum, LJ._-t
aH"LT_,"aP"e\tLT_,"aD"LT_"c"retq\nLR"n".size\tLT_, LR_-LT_"aH"LZ_,"aP"e\tLZ_,"aD"LZ_"bd aC b ao"16"__"LY_"bm"LG"n".size\tLZ_, LG_-LZ_"aO aH"L0_,"aP"e\tL0_,"aD"L0_"bd"\n\t"ud2\n\tud2\nLj"n".size\tL0_, Lj_-L0_"aO aH"LF._,"aP"e\tLF._,"aD"LF._"bd"\n\t"_V b ao"16\n\t"p"L0_\n\tud2\nLP._"c".size\tLF._, LP._-LF._"aO _X"type\tL._,"aG"._,"aN"._"c".ascii\t\"internal error: entered unreachable code"aF"e\tL._, 40"_X"type\tLp_,"aG"p_,"aN"p_"c".ascii\t\"<anon>"aF"e\tLp_,
G"_X"type\tL7._,"af"data.rel.ro.L7._"bl"7._"c".quad\tL._\n\t.asciz\t\"("bk"\""l"quad\tLp_"l"asciz\t\"\\000"bk O"\\032"O"\\000"O"\\t"_K"0\""l"size\tL7._, 40"_X"type\tLi_,"aG"i_,\"a"_W l q"3\nLi_"c".zero\t16"l"size\tLi_, 16"_X"type\tLY_,"af"data.rel.ro.LY_"bl"Y_"c".quad\tL.._\n\t.asciz\t\"\\021"_K"0"_K"0"_K"0\""l"quad\tL9"k".asciz\t\"\\027"_K"0"_K"0"_K"0"O"\\352\\002\\000"_K"S"_K"0"aF"e\tLY_, 40"_X"type\tL.._,"aG".._,"aN".._"c".ascii\t\"capacity overflow"aF"e\tL.._,
17"_X"type\tL9_,"aG"9_,"aN"9_"c".ascii\t\"src/liballoc/raw_vec.rs"aF"e\tL9_, 23\n"_X"section\t\".note.GNU-stack\",\""_W"\n");
```

Reduce size of generated code

1. -C llvm-args=-disable-debug-info-print
2. rename all mangled names
3. grammar-based compression



Most wanted

- Generic Associated Type
- Coverage

The END