Interviewer
Awesome. So to get started, from my first question, what have been your motivations for learning Rust and choosing to use it?

Participant
Come again?

Interviewer
What have been your motivations for learning Rust and for choosing to use it?

Participant
For me, using Rust I think it's easy to learn and also to apply and also it's integration with the other programming languages, it's easy. And so I feel it's convenient for me to work with.

19:6 u...

Rust is ergonomic

Interviewer
So how is that transition then to what you were using before Rust then to using Rust in your applications?

Participant
I think transition was quite transformative. And okay, switching to Rust, maybe a hard task, I would say as per say, and I was so glad to have discovered Rust. And it's something I was introduced to my colleagues who are working on together on the projects. As you know, when it comes to programming languages, sometimes you get to learn them just because you're gonna be using them. So, okay, when it comes to Rust and its applicability, you know, when it comes to application, maybe in network programming or maybe web development or some kind of such you get, it's easier to to sync it with the programming languages and to synchronize. So for me, it's been a good experience. And I think I like using Rust as per say.

19:2 So, okay,...

Networking &...buted S

Rust is ergonomic

Web Application Devel

Interviewer
Gotcha. So it's like the integration of other languages that you particularly like about it.

Participant
Yeah, yeah, that's it.

Interviewer
Gotcha. And which languages have you typically been using?

Participant
Sorry for that. So, come again? Yeah, I've used multiple languages. I've used Ruby, I've used JavaScript, I've used Java, Python, C++, C++, C. I've used multiple languages. Yeah, so, yeah.

Interviewer
Gotcha. And then when you use unsafe Rust, what are you using it for then?

Participant
Mostly it's for, maybe, web development or maybe, yeah, mostly web development.

19:... Web Application Devel

Interviewer
Gotcha. So is it that you were, I guess, so you're using Rust in these web applications, like where does the Rust come in? Is it a part of your backend or are you like using it when it's compiled to WebAssembly and having that running in the browser? And having that running in the browser?

Participant
Okay, let's say it's the backend, but sometimes I do accept this to run it all together.

Interviewer
Gotcha, okay. And so I guess more specifically in the backend, like when would you need to use unsafe to do something?

Participant
Um, maybe when I want to, to interface with some kind of low level API or something.

Interviewer
Gotcha. Any particular APIs that you can think of?...Oh yeah, sure. So you were talking sometimes when you're working with Rust in the backend, you have to use unsafe to access low level APIs. Like what types of APIs would you be accessing?

Participant
Maybe critical private libraries, maybe the pointing system APIs or, maybe the point in system API, so maybe foreign functional interfaces, such kind of APIs.

Interviewer
So like, what's an example, I guess you mentioned that the thing you'd like a lot about Rust is compatibility with different languages. Like what's, what's important of a situation where you needed to use Rust foreign function interface?

Participant

Come again?

Interviewer
What's a situation where you needed to use unsafe to call a foreign function?

Participant
Maybe when I want to, I want maybe to review calls or maybe to do some kind of routing or maybe abstraction.

Interviewer
Yeah. Gotcha. So I guess, but like what, like in the last application you worked on where you had to call a foreign function, like what, what was that foreign code doing for your Rust application?

Participant
Mostly, maybe clipping or maybe creating some false positives or maybe learning curves or maybe compile time errors, some kind of, it matters to me, kind of maybe what I'm working on. I'm not, so I guess I wasn't quite understanding what you meant there.

Interviewer
I mean, like, or at least with, with compile time errors, like, I guess I was more curious about like what was the role of the foreign code in that application? Like, I guess with, with one of my projects where it's using the FFI, I have part of it that is in Rust, which is interpreting this one particular file format. And then there's another library in C that I have which interprets a different file format. And because I need this project to interpret both of those formats, I have to use the FFI to be able to like use that C library. So like, I guess what I'm curious about is in your applications in Rust, where you are using both Rust code and code in some other language to do something together. Like, what's the role of the code in that other language? Like, what is it accomplishing for you in that, in that Rust application?

Participant
I think, I think it's true to some, maybe dependency management or maybe to compile maybe a code or maybe mostly to just build configurations for the purpose of, of maybe tweaking or maybe, you know, creating some conditional compilation targeting specific, maybe platform or something to just to make it, you know.

Interviewer
Gotcha. So is it like certain platforms only supports? Like, so there are, there are like cases where because a certain platform is like it is, you'd need to call a foreign function on that platform like in place of what you'd use a Rust function for?

56

57 **Participant**
Yes, yeah.

58

59 **Interviewer**
Gotcha, gotcha. What would, I guess, what prevents you from just using Rust everywhere? Like, why, why would you need to have foreign code at all? So like, in these applications, what's preventing you from, like, is there a reason why you have to use a foreign function in those cases? Like, could you potentially have everything rewritten in Rust or is that just like way too much work or impossible for some other particular reason?

60

61 **Participant**
Yeah, maybe I have to consider maybe other things like memory safety or maybe, you know, something that you can get results from this undefined behavior of which you're going to have challenges trying to work it through. And so I try to talk with that just because it can be difficult to identify and resolve bugs and it's an upheaval task to go through that. Also, maybe, sometimes maybe code maintenance or refactoring, I have to consider that, especially when we are working as a group or people outside, maybe a particular project, I have to share my codes. I have to consider other people, maybe to do some kind of refactoring and I live into it.

19:7 som...

Unsafe is Diffi...to Und

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63 **Interviewer**
Gotcha, gotcha. So, I guess, is that just... So, it's preferable then for you to use as little unsafe code or foreign function calls as possible because it would be easier for other collaborators to understand the safe code and avoid errors?

64

65 **Participant**
Yes, the safe.

66

67 **Interviewer**
Gotcha. So then have there been challenges like that where you've been working with someone else and they just haven't quite understood what your code is doing and then that causes an issue?

68

69 **Participant**
Yes, there have been challenges, especially with people who are not quite... they are not quite familiar with unsafe rust or maybe the rust programming algorithm, maybe they are trying to learn it or they are not so proficient with it. So, there have been challenges, but I got some challenges. So, I would say it has happened got some time, several times, that is.

70

71 **Interviewer**

Gotcha, gotcha. So then my next question. So, it seems like the motivation that you have for using unsafe is to call foreign functions and that's required for a particular platform or architecture. Are there any other motivations that you might choose to use unsafe? Do you ever replace something with an unsafe bit of code to increase performance, or is it just for the foreign function calls?

Participant
Okay, don't really understand what you mean. We can replace that. Sure, yes.

Interviewer
One practice that some developers do is if you just write things in safe rust, you might have a lot of extra bounds checks that are inserted by the compiler or you might end up using a bunch more memory space for how rust types work. So, instead of just using safe everywhere, sometimes developers will introduce unsafe code to skip certain bounds checks or to attempt to use less space to increase performance. Have you ever done that, or is it really just because you need to use foreign functions that you use unsafe?

Participant
No, I think, okay, I can reference from your previous from your issue question. Apart from maybe the need to apply unsafe rust in foreign functions, I use unsafe rust just to maybe do some unsafe abstractions. And that is to use unsafe rust just to create safe abstraction. And this may be involved, maybe writing a safe API around unsafe implementation. In these operations, it just can work around implementation details and I think when it comes to unsafe rust, it won't be to use it to create abstractions to work better than maybe most of programming languages and a lot of other things that I use unsafe rust for. And also, maybe writing a low level code that maybe I'm needed to share maybe a collaborator for future reference for other programmers or users.

19:8 I...

Exposing a Safe API

Interviewer
Gotcha. So what's one of these abstractions that you've had to write with unsafe? What's an example of some sort of tool or pattern that you had to use unsafe to implement and then had to make a safe API around it?

Participant
Yeah. I had to appear to this minute. I've been postponing it on and off and I'll put that today.

Interviewer
No worries. I mean, we can always reschedule it. So no worries whatsoever.

71 **Participant**

No, no. I think we can just continue. I can handle it. [unknown]?

Interviewer
Yeah. So I guess the question was, what's a specific example of a part of your program where you had to use unsafe to create some sort of abstraction and then you created like a safe API around it?

Participant
Yeah. It would be an instance where I'm creating an unsafe function which mostly associated with an implementation type or maybe the requirement of maybe to perform a low level operations or interface with the external resources in some kind of unsafe manner. And so this can be a trend maybe as unsafe function or maybe that could be a safe method and mostly safe methods and so I required to provide default implementation which can create maybe some kind of consumer traits or maybe unsafe operations or maybe we can create some kind of Rust or maybe safety guarantees. And these safety guarantees when it comes to Rust, I think they are much useful when you're creating with multiple APIs and they have some kind of synchronization behavior in these calls for security and also have maybe less bugs or less challenges trying to implement and I think those have got a way to let others more applicable with Rust.

19:9 And these saf...

Fearless Concurrency

Memory Safety

Interviewer
Gotcha. Gotcha. So are there cases where you can't expose something as like a safe API or that you choose for some reason to just expose like an unsafe function to people?

Participant
Yeah, I think that's mostly just it. Yeah.

Interviewer
Gotcha. So when you do write an unsafe function and expose it to people, do you like write documentation for it to describe how to use it correctly?

Participant
Yes. You have to write documentation. You have to write a documentation for it.

Interviewer
So what's an example of something that you would document for one of those functions?

Participant
Maybe let's say I call this supposed to perform a low level operation and
85 in this instance, it's also supposed to run some kind of unsafe safety

19:...

Documented...ract or I

guarantees. So you have to write a documentation to instructs in some kind of file that the code can be handled and I think that's the right way to do it just avoid backlogs and maybe pointer dereferencing or some kind of, yeah.

19:3 May...

Documented...ract or In

Interviewer
Gotcha. So it would be something like with a pointer that it has to be a valid pointer?

Participant
Yeah.

Interviewer
Gotcha. And so then with, let me just double check something. So with your screening survey, one of the questions was about different memory container types that you might have used with raw pointers or like to contain raw pointers and you selected Box, unsafe cell, rough cell and lazy cell. So could you talk a bit about where you'd use those with unsafe code? Maybe starting with Box. Like what's the situation where you've used Box with like in an unsafe context?

Participant
I think with Box, it's good to use it in building configurations and that is in a number, or maybe a different features, or maybe some kind of conditional computation or targeting specific platforms that may require understanding or tweaking the project's cargo or some kind of, some kind of maybe, some kind of challenging configuring builds that need to be correctly trained or maybe developing specifics for it.

Interviewer
I guess how does Box in particular help you there? Like are you, like what are you using the type to do in those cases where you need conditional compilation? Like when you call Box new and create a new Box, like what is it containing?

Participant
Maybe it contains maybe some compile codes or builds or maybe last installations or some kind of commands for creating pure new tests or maybe publishing the last projects or some kind of, yeah.

Interviewer
I guess, so is it that you have this like struct that contains all of these commands and then you need to allocate it so you put it into a Box?

101 **Participant**
Yeah.

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Interviewer
Gotcha. And then what about UnsafeCell? Like where do you use UnsafeCell?

Participant
Well, unsafe cell will be what took my performance and reliability. Then I can maybe do some maybe targeted ideas or maybe integration with coeditors or some kind of building some reliability cross sections or coeds in a project. You know.

Interviewer
Gotcha. So is it like when would you, because I know RefCell can be used in a similar way to UnsafeCell. So like when would you choose to use unsafe cell instead of RefCell?

Participant
Well, I was saying.

Interviewer
Still there? Can you hear me?

Participant
I can hear you now. I can hear you. I think you made it now though Well, I was saying. Yeah, so I'm saying. It's a light weight and it's a little container. And so it has the capability of holding single values and also provides interior mutability. That's quite a very nice instrument. They are just because it allows values to mutate directly, even when only mutable.

Interviewer
I'm sorry. I don't think I think you just muted. Can you hear me? Oh, I can hear you now.

Participant
Yep. I don't know what's happening here. Yeah, so I'm saying, yeah, do you hear my point?

Interviewer
Yeah. Yeah. So it's just a more lightweight container than ref cell.

Participant
Yeah. Yeah.

Interviewer
So have there been situations where you've like tested something with ref cell and then compared it to unsafe cell like a difference in performance?

Participant
Yes. Yes.

Interviewer
Gotcha. So like how significant was the difference in performance?

Participant
Okay. It's not a major significant performance, but I'll say there's a substantial difference.

19… Profiling

Interviewer
Okay. I want to choose to motivate you to choose one or the other. Yeah. I guess what's the situation? So when do you choose to use an unsafe cell? Like what's the situation where you think, yeah, no, I need to use an unsafe cell for this because of some particular reason, like what's what would the reason be?

Participant
Um, maybe when I want to create, maybe I want to allow multiple references to be contained in a particular body or maybe when I want to, maybe I have concurrent and multi threaded application. So in such instances, then it's a preference.

Interviewer
Sure. That makes sense. Um, and then when do you use lazy cell?

Participant
Um, with lazy cell, okay. Don't know. Maybe it's mostly, but maybe it's useful for me. Uh, when I need to store a value, um, uh, on the heap or other than me, then we prefer to store a value in a heap or other than.

Interviewer
Hello. Yeah, I hear your audio cut out there. So I didn't hear your response.

Participant
Yeah. Um, yeah, somebody, I'm using my phone and someone was calling me. So, um, did you get my points?

Interviewer
Uh no, I, I don't think I heard what you, what you said about, um, when you use lazy cell.

Participant
Um, maybe when I want to, uh, to store values, uh, on the heap, maybe not the, uh, no, rather maybe not this time. Maybe, maybe when I want to

require some kind of presence to control over the memory location. So maybe in such instances.

Interviewer
Gotcha. I guess, um, how would that be different than using a Box, right? Because with a Box, you get a heap allocation.

Participant
Um, yeah. Um, so that would be different in just because, uh, with a Box, you can be able to create, uh, exercise containers. But, uh, with lazy cells, um, it's only maybe it's dynamically sized. So, uh, like Boxs, some kind of a difference there. Confusion, maybe working through both of them.

Interviewer
Gotcha. Wait, so it's that you use both of them together or?

Participant
No, not together. It's really, it's possible.

Interviewer
Gotcha. Um, so is, uh, Just a second. Um, Gotcha. Um, so then. All right. I guess, when would you choose to use a lazy cell instead of a RefCell then, or just a normal cell? Like what, why would you need that sort of delayed initialization?

Participant
Um, Maybe, um, Okay. In a, in a station, I want to maybe, uh, Do some kind of resizing, uh, Of really hard structures, uh, Yeah, in some kind of in such instances, maybe. And I don't want to be, Uh, the entire cells, maybe, yeah, it makes it, makes a sense, maybe take that.

Interviewer
Wait, so it's, it's that you use it to get that you. Oh no, you're, you're. Yeah. Yeah. So is it, would you use it just to contain a value that you'd expect to be resized?

Participant
Come again.

Interviewer
Like is it, I guess I'm, I'm kind of confused. Is it something like what, why would needing to resize something mean that you'd need a lazy cell versus like a different structure? 161

181 **Participant**

Maybe, maybe this is when I, when I, maybe, but you can be able to do this with a Box and it's when I'm required to, to put some precise control over, over memory allocation. So where I can, maybe I use Box entirely, although I have never used a lazy cell as much, but okay, maybe I'm saying I guess I'm, maybe I have not much experience with lazy cell as much. So actually, maybe we might want to skip that question. So I don't, it's leaving something off of me.

Interviewer
So then with, so when you're using like foreign function code, you've mentioned using a couple of different tools. Like bindgen, cbindgen, windows-bindgen, dart-bindgen is also ocaml-interop. Like what's, what's been your experience using these binding tools? Like have they been generally good experiences? Like what's, or have there been things that you've struggled with? Like what's your general experience using these tools to create like foreign bindings between Rust and other languages?

Participant
I think with Rust programming languages, it comes to using, you know, the various types of binding tools. I think it's a, an awesome, awesome experience and I can't complain. But it got to you. So they, they might be, you know, some kind of challenges in there. But it's been a nice experience, I would say. Yeah. This place.

Interviewer
Do you ever have to like change the output of these tools? Like, are you just having them compile and run and then trusting the update or other cases where you've had to like go in and change the output because it's been incorrect or not quite what you expected.

Participant
So only in real cases. I, I can maybe call an instance where I had to maybe edit it or do some kind of improvements. I think they just work for me to maybe, once I know that I need these binding tools. And then I can find myself, maybe trying to review the code or maybe trying to, how to edit or maybe, you know, no, no, it's a real case. I can't recall that.

19:10 I can...

Generation VS Validati

Interviewer
So more broadly, Rust has a bunch of these assumptions about memory, right, that, that it makes with aliasing with mutability. But those are very different than what other languages make about memory. So have there been any challenges that you encountered specifically, because you're using rust stuff a fine you have like one version or one view of memory on one side and then a different view of memory on the other.

Participant
I think

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Interviewer
So I guess one, one particular. Like one example would be in rust you when you borrow something mutably. That also comes with the guarantee that that mutable reference to the object is unique. But with C and C plus plus, you don't get any guarantees whatsoever about whether a pointer is is like unique or shared. So, like, and that can lead to then undefined behavior if you are taking something that rust thinks is unique and then using it in a way that is actually shared.

Participant
Yeah, yeah.

Interviewer
Have you had any of those challenges.

Participant
Of course, there are several challenges with the, with unsafe Rust and I think you mentioned one, undefined behavior. And this may be one of the most common challenges. And sometimes it can lead to crashes or memory corruption. And multiple unpredictable program behaviors that you've had. You cannot even tell what it is or so, or maybe it's challenging to maybe to know or maybe how to locate where. It becomes a challenge. Also, maybe there's also memory safety violations. And I think this is a big one of movie. So, so I'm a major challenge with the unsafe Rust and and I think I was such challenges you can get, you can get some kind of an initialized memory. Or you can have maybe trouble creating data races or maybe performing valid pointer operations. I think these kind of violations can be mostly to know how to backlashes or maybe data corruption and develop some kind of security vulnerabilities. And I think that this makes it hard to detect or maybe fixing memory that happens.

19:5 And...

Unsafe is Diffi...to Und

Interviewer
Gotcha. So I guess those are all challenges with unsafe for us, you know, of itself, but have there been problems that you've observed when you're using Rust with other languages?

Participant
Come on, yeah.

Interviewer
Like when when you're using Rust FFI to call into other languages, are there any challenges that are specific to that?

Participant
Yeah, maybe compatibility issues, the languages. Maybe compatibility issues.

Interviewer
I guess which specific compatibility issues?

Participant
To be specific, you can say, maybe development of maybe concurrency or parallelism. Of errors. And that is, they can be the question for it at times. And I think with these comments, some kind of challenges that you need to define customers. Am I trying to change devices? I'm having some...

Interviewer
No worries. So is there...

Participant
Just a sec. Can you hear me?

Interviewer
Yeah, I can still hear you. Do you need to change devices or do you think we'll be okay?

Participant
Let me try to switch devices as we speak.

Interviewer
So I guess describe a bug that you faced that involved unsafe Rust.

Participant
A bug that I faced. So this time, we developed a code and it lagged to maybe... It had no compiler. It was so difficult to develop safety checks and maybe low level ...

Participant
Hello. I appreciate for you being patient with me. I had to maybe do some kind of emergency calls. So I had to have them first. Sorry for that.

Interviewer
No worries. So just in the last couple of minutes, you're... Just one last question I have. I have a couple different... Sorry. No worries. I mean... Can you not hear me? Hello?

Participant
Yes, please.

Interviewer
Okay, gotcha. So the last question is you mentioned in your survey that you've used like different sanitizers to test your code. And then... So let

me double check this. Yeah, so you mentioned using... Yeah, Address Sanitizer, UBSan as well as MSan to find different bugs in code bases with on Safe Rust. So I guess my question is do these development tools handle all the problems that you faced running on Safe Rust? Or do you encounter problems that your tools can't solve?

Participant
With sanitizers. Or just with any type of development tool?

Interviewer
Like are there problems that you face in running on Safe Rust that your current tools that you use in development can't help you with?

Participant
No. I think any specific type of problem that I've ever faced with unsafe Rust, I think they are proper tools that I can use to handle that.

Interviewer
Gotcha. Which particular tools? Is it just the sanitizers that you've used in the past?

Participant
Yes. Yes? Can you repeat?

Interviewer
Oh, yeah. So you said that there are development tools that can help when you're working with, like that solve all your problems that you find with on Safe Rust or that there isn't a problem that you have that your tools can't solve. So is it just that the sanitizers that you use tend to cover all of the use cases you have?

Participant
Yeah.

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