pin-init: Solving Address Stability in Rust

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A Motivation for Rust

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```
$ git log --oneline --since 2023-01-01 | grep 'fix.*uninitialized'

cca202a5e595 fbdev: hyperv_fb: fix uninitialized local variable use
fc12a722e6b7 exfat: fix setting uninitialized time to ctime/atime
2a76e7679b59 media: platform: mtk-mdp3: fix uninitialized variable in mdp_path_config()
8f8abb863fa5 net: usb: dm9601: fix uninitialized variable use in dm9601_mdio_read
72151ad0cba8 ASoC: codecs: wsa-macro: fix uninitialized stack variables with name prefix
9147b9ded499 btrfs: fix some -Wmaybe-uninitialized warnings in ioctl.c
e10a35abb3da net: ethernet: mtk_eth_soc: fix uninitialized variable
1c9fd080dffe kunit: fix uninitialized variables bug in attributes filtering
13a0d1088c8f power: supply: qcom_pmi8998_charger: fix uninitialized variable
222a6c42e9ef octeontx2-af: Initialize 'cntr_val' to fix uninitialized symbol error
8362bf82fb54 Input: mcs-touchkey - fix uninitialized use of error in mcs_touchkey_probe()
f72207a5c0db netdevsim: fix uninitialized data in nsim_dev_trap_fa_cookie_write()
f61d2d5cf142 sfc: fix uninitialized variable use
97deb66ed4f9 selftests/mm: fix a "possibly uninitialized" warning in pkey-x86.h
df14afeed2e6 ksmbd: fix uninitialized pointer read in smb2_create_link()
48b47f0caaa8 ksmbd: fix uninitialized pointer read in ksmbd_vfs_rename()
8fd9f4232d81 btrfs: fix an uninitialized variable warning in btrfs_log_inode
0d9b41daa590 nfc: llcp: fix possible use of uninitialized variable in nfc_llcp_send_connect()
714dd3c29a22 phy: mediatek: hdmi: mt8195: fix uninitialized variable usage in pll_calc
8ba7d5f5ba93 btrfs: fix uninitialized variable warnings
c17caf0ba3aa f2fs: fix uninitialized skipped_gc_rwsem
08570b7c8db6 gpu: host1x: fix uninitialized variable use
e88adb4ac27a drm/rockchip: vop2: fix uninitialized variable possible_crtcs
05107edc9101 selftests: sigaltstack: fix -Wuninitialized
7d31677bb7b1 gpu: host1x: fix uninitialized variable use
dc934c183d43 accel/habanalabs: fix a maybe-uninitialized compilation warnings
...
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  $\Longrightarrow$ try to avoid `unsafe` code.

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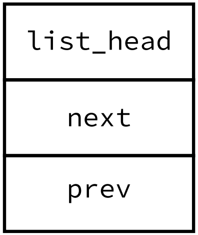

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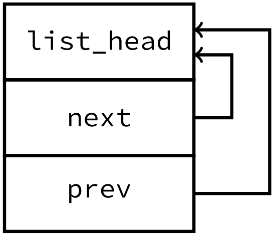

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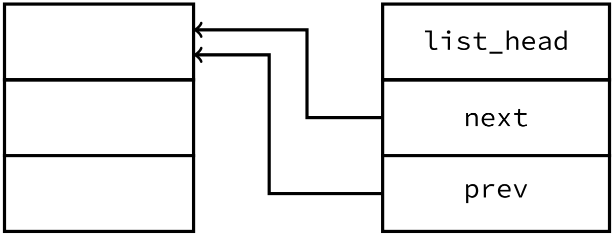

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$\Longrightarrow$ cannot give access to `&mut T` from `Pin<&mut T>`

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But this requires unsafe code!

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Rust aims to offload most of this work to the compiler.

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Into this:

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fn new() -> impl PinInit<ListHead> {
    pin_init!(&this in ListHead {
        prev: this,
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It is a feature-rich API, so if you need help just ask on zulip:
`https://rust-for-linux.zulipchat.com`

The `pin-init` API in action

Code from the `rust` branch without the `pin-init` API:

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```rust
let mut state = Pin::from(UniqueRef::try_new(Self {
    // SAFETY: `condvar_init!` is called below.
    state_changed: unsafe { CondVar::new() },
    // SAFETY: `mutex_init!` is called below.
    inner: unsafe { Mutex::new(SharedStateInner { token_count: 0 }) },
})?);

// SAFETY: `state_changed` is pinned when `state` is.
let pinned = unsafe {
    state.as_mut().map_unchecked_mut(|s| &mut s.state_changed)
};
kernel::condvar_init!(pinned, "SharedState::state_changed");

// SAFETY: `inner` is pinned when `state` is.
let pinned = unsafe {
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Ok(state.into())
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Improved code with the pin-init API:

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pin_init!(Self {
    state_changed <- new_condvar!("SharedState::state_changed"),
    inner <- new_mutex!(
        SharedStateInner { token_count: 0 },
        "SharedState::Inner",
    ),
})
```

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  - But this is not (safely) possible in Rust at the moment

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- These are called pin projections, they depend on the "intended usecase" of the field and are determined on a field by field basis.

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Thanks for Your Attention!

Follow my work:

- RFC for adding general field projection support to Rust: `https://github.com/rust-lang/rfcs/pull/3318`
- `pin-init` userspace library: `https://github.com/Rust-for-Linux/pinned-init`

Contact me on:

- `https://rust-for-linux.zulipchat.com`