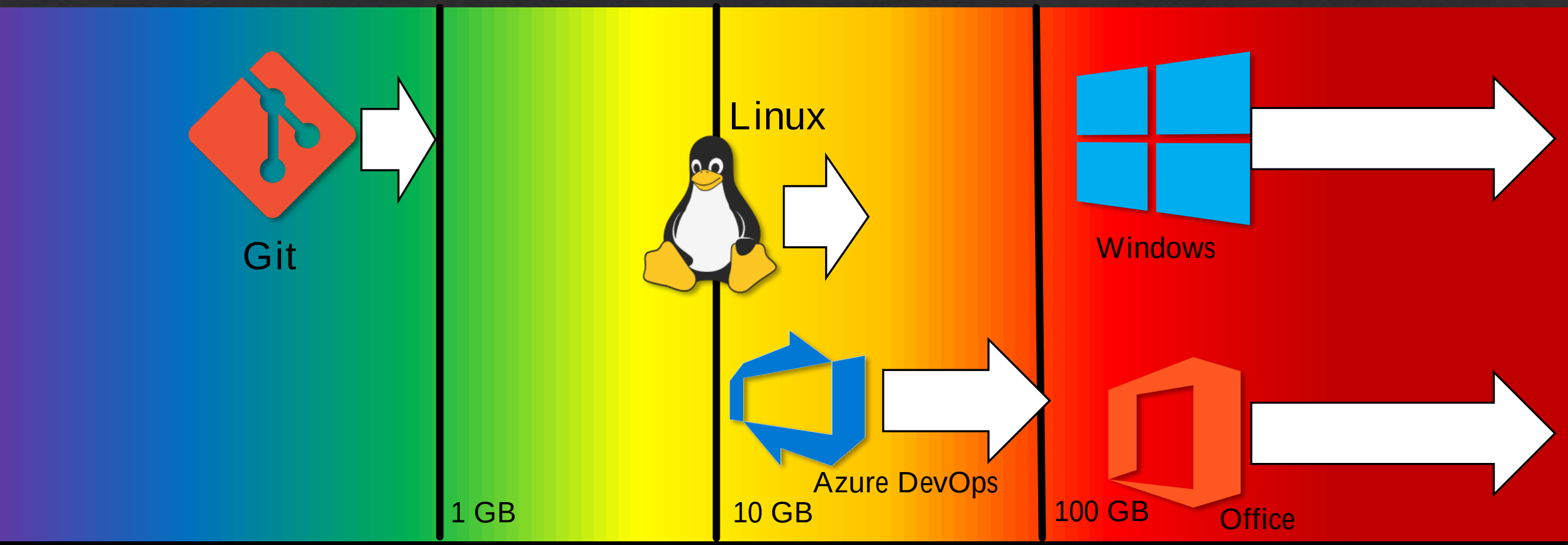
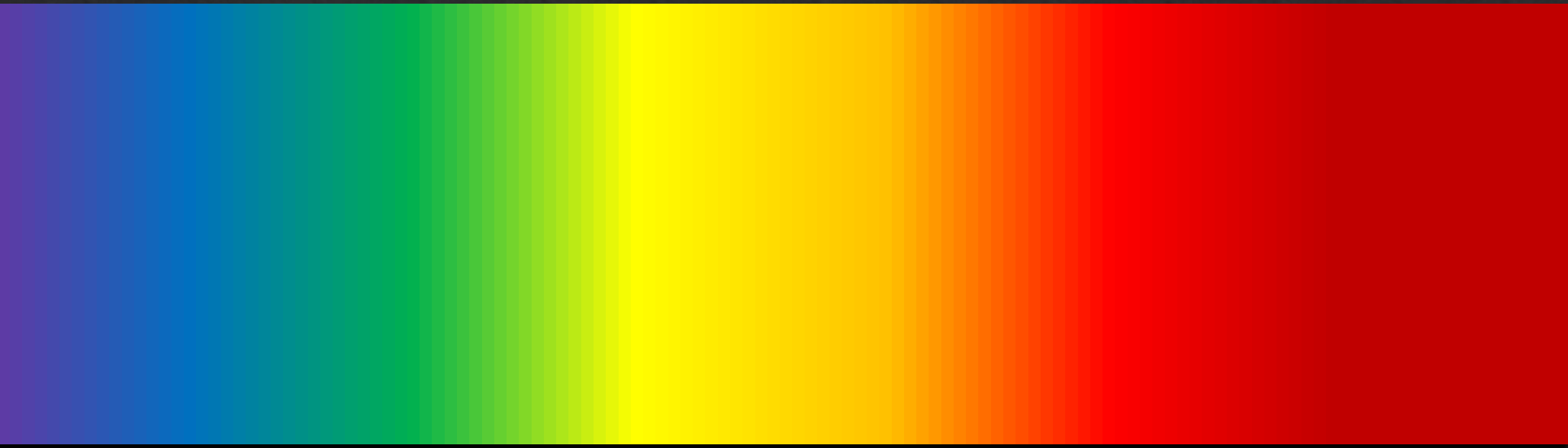
# Git at Scale for Everyone

# Spectrum of Scale




Pack-file size for initial clone

# Spectrum of Perceived Performance




http://gunshowcomic.com/648

# Success Story: Microsoft Windows

- Largest Git repository
- VFS for Git enabled using it *at all*
  - Virtualized filesystem "fakes" working directory updates
- Measuring real user interactions showed need for Git performance improvements
- Delivered most improvements as contributions to core Git client

# Next Milestone: Microsoft Office

- Similar size and shape to Windows OS repo
- Hosted on Azure Repos
- Client **must** work on Windows & macOS


https://github.com/microsoft/scalar

# Lessons for Git at Scale

**Lesson 1:** Focus on the files that matter

**Lesson 2:** Reduce object transfer

**Lesson 3:** Don’t wait for expensive operations

# Lesson 1: Focus on the files that matter

# Reduce Populated Size: Sparse-checkout

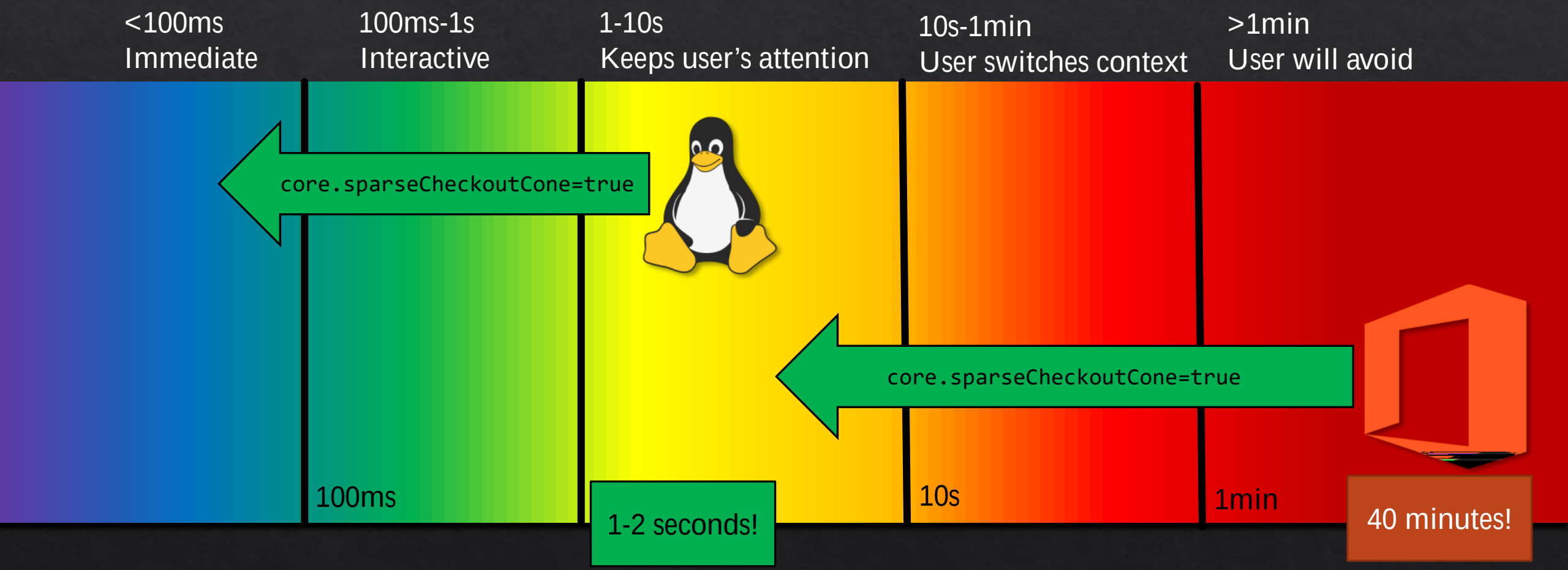
To control the number of files in your working directory, run

```
git sparse-checkout init --cone
```

initializes sparse-checkout in “cone mode”. This starts with only the files at root.

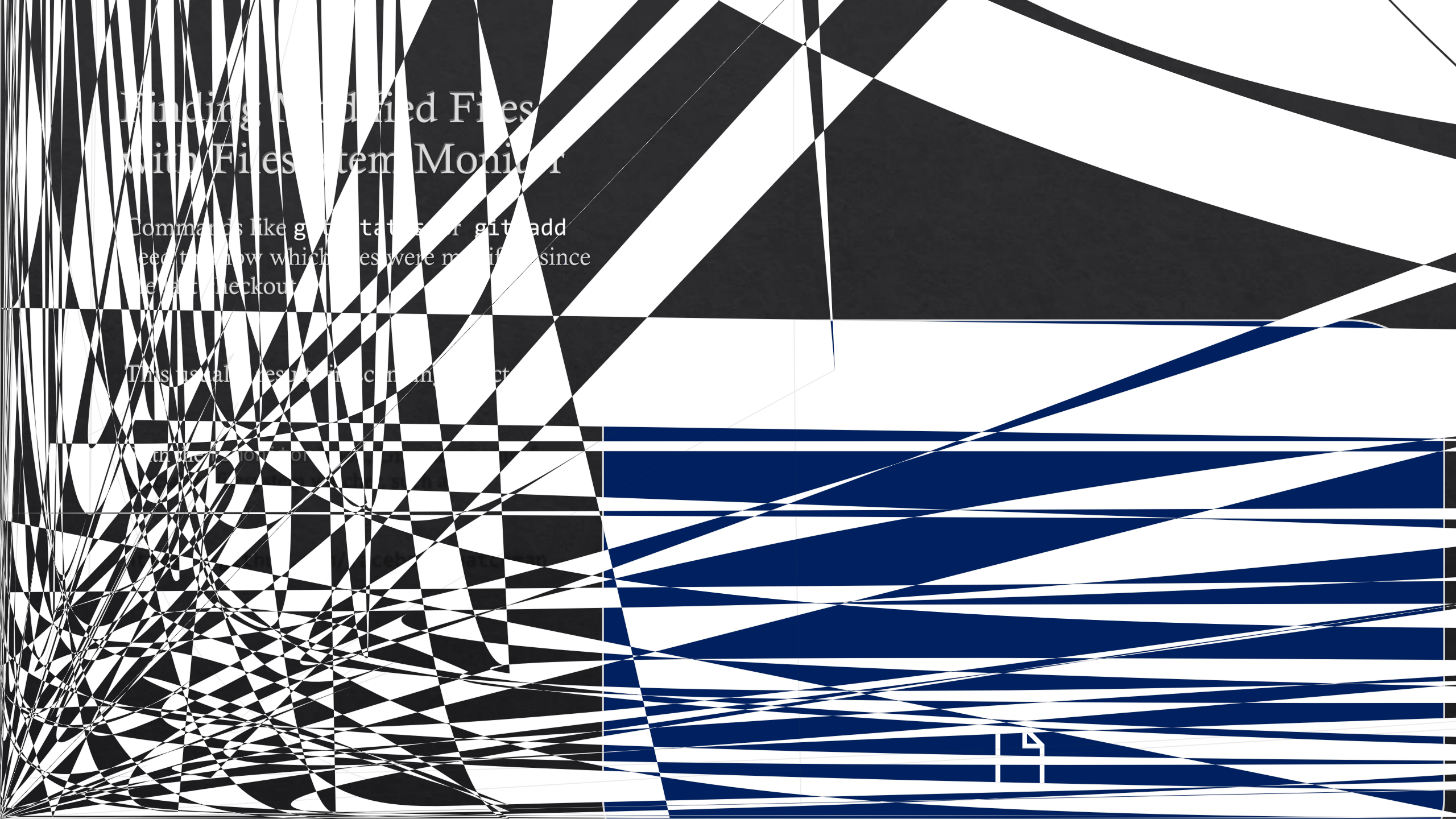
Included paths can be expanded using

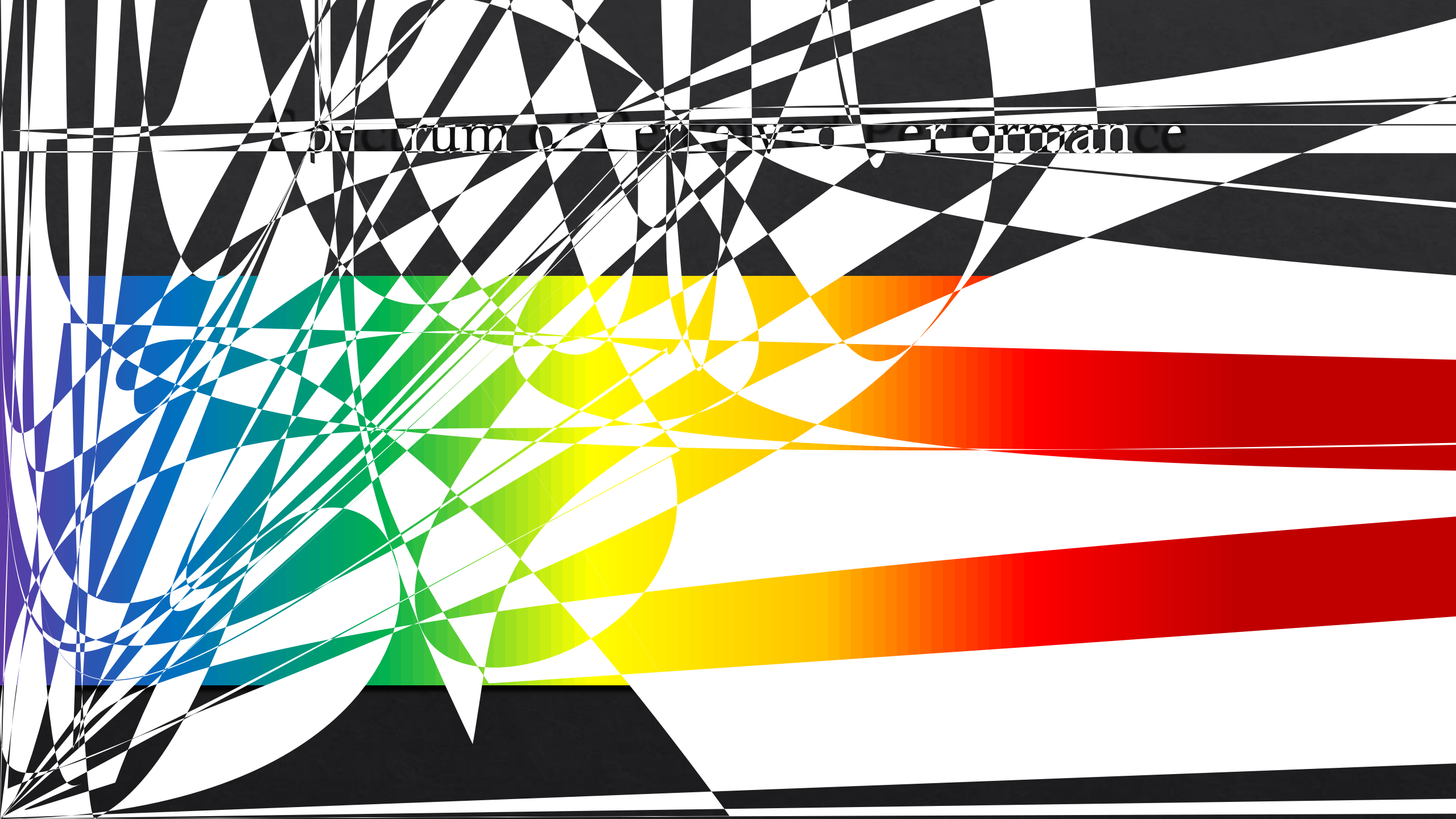
# Spectrum of Perceived Performance




Time to update sparse-checkout definition

# Finding Modified Files
## with Filesystem Monitor




Spectrum Overview Performance

# How can Git better focus on files that matter?

**Sparse-Checkout**

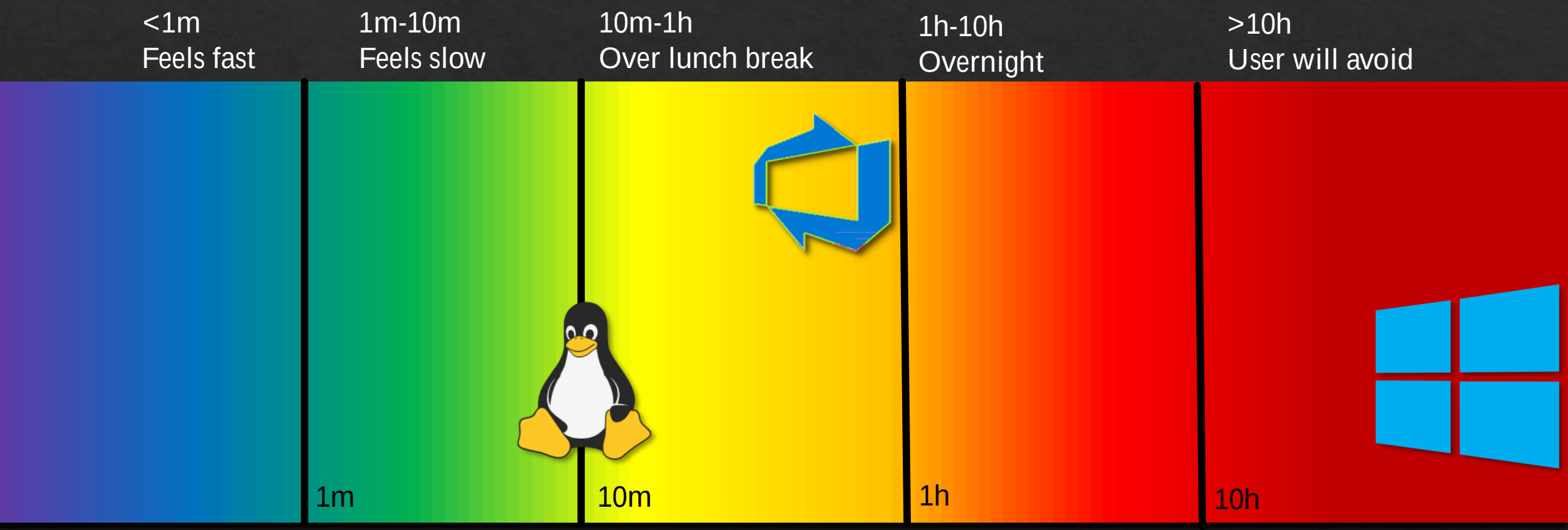
- Continued UX improvements
  - `git sparse-checkout add <dir>`
  - `git sparse-checkout stats`
  - Update with non-empty `git status`

# Lesson 2: Reduce Object Transfer

```
dstolee@stolee-book MINGW64 /c/_git/t
$ git clone --single-branch https://dev.azure.com/mseng/_git/AzureDevOps
Cloning into 'AzureDevOps'...
remote: Azure Repos
remote: Found 6938156 objects to send. (1090 ms)
Receiving objects:   0% (18433/6938156), 3.13 MiB | 1.17 MiB/s
```

# Spectrum of Perceived Performance

# Spectrum of Perceived Performance




`git clone` time

# GVFS Protocol → Partial Clone

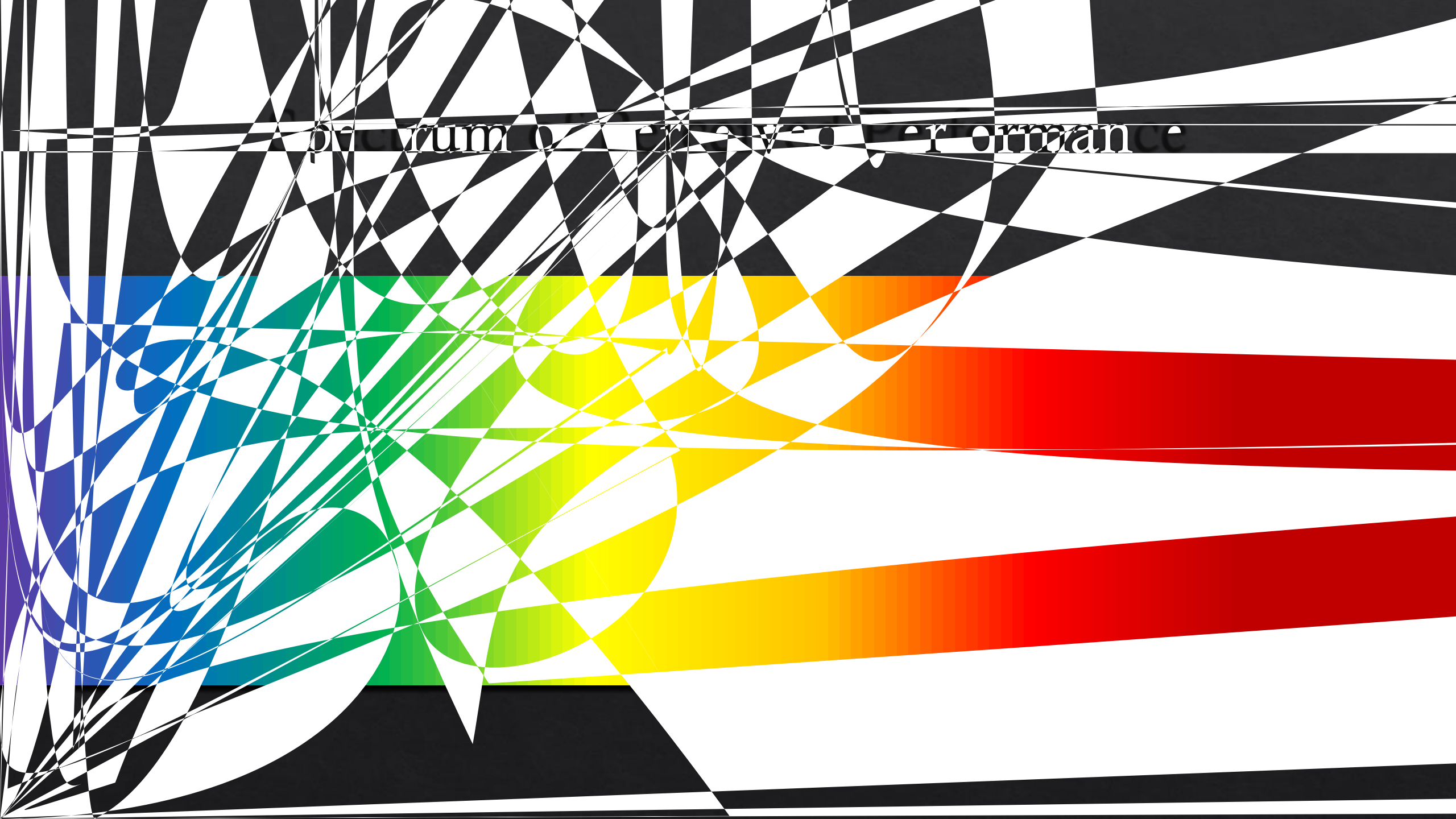
## GVFS protocol (Created 2015-16)

- Uses these REST API endpoints:
  - `GET <url>/gvfs/config`
  - `GET <url>/gvfs/objects/{objectid}`
  - `POST <url>/gvfs/objects`
  - `GET <url>/gvfs/prefetch`
  - `POST <url>/gvfs/sizes`

## Git Partial Clone (Created 2018)

- `git clone --filter=blob:none <url>`
- Fetches only commits and trees
- Blobs are fetched in a batch request during `git checkout` and similar requests

https://git-


Spectrum of Performance

# GVFS Cache Servers and Git Promisor Remotes

# Recommended Updates to Partial Clone

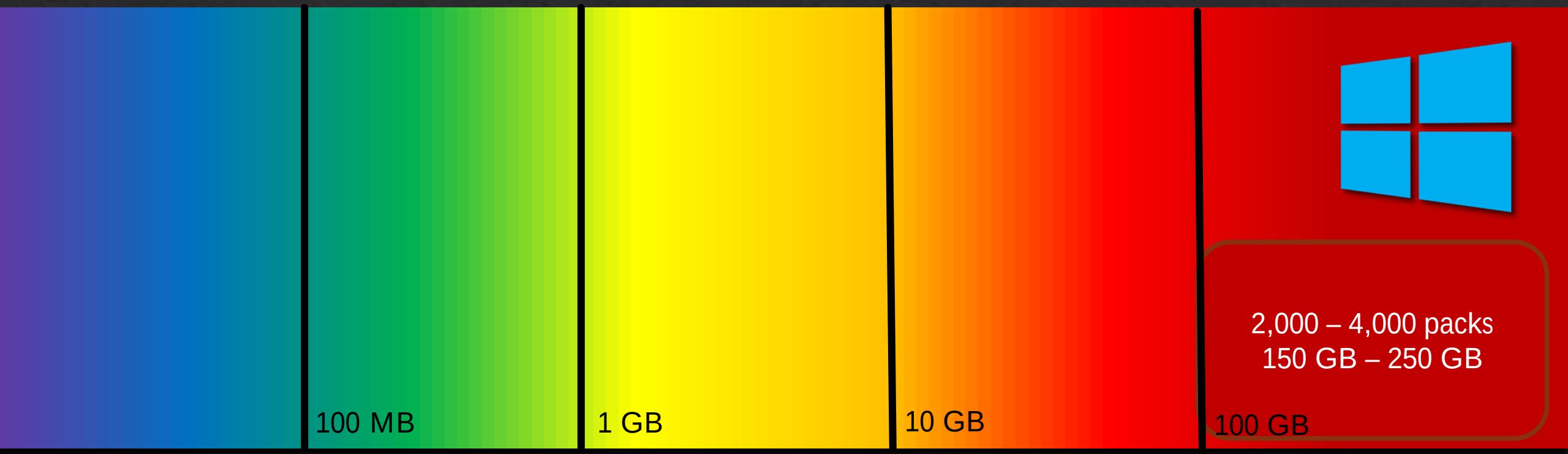
1. Extend multiple promisor remotes to do commit and tree fetches.

2. Extend Git protocol to assist auto-discovery of nearby promisor remotes

# Lesson 3: Don’t wait for expensive operations

# Spectrum Overview Performance

# Too Many Packs?



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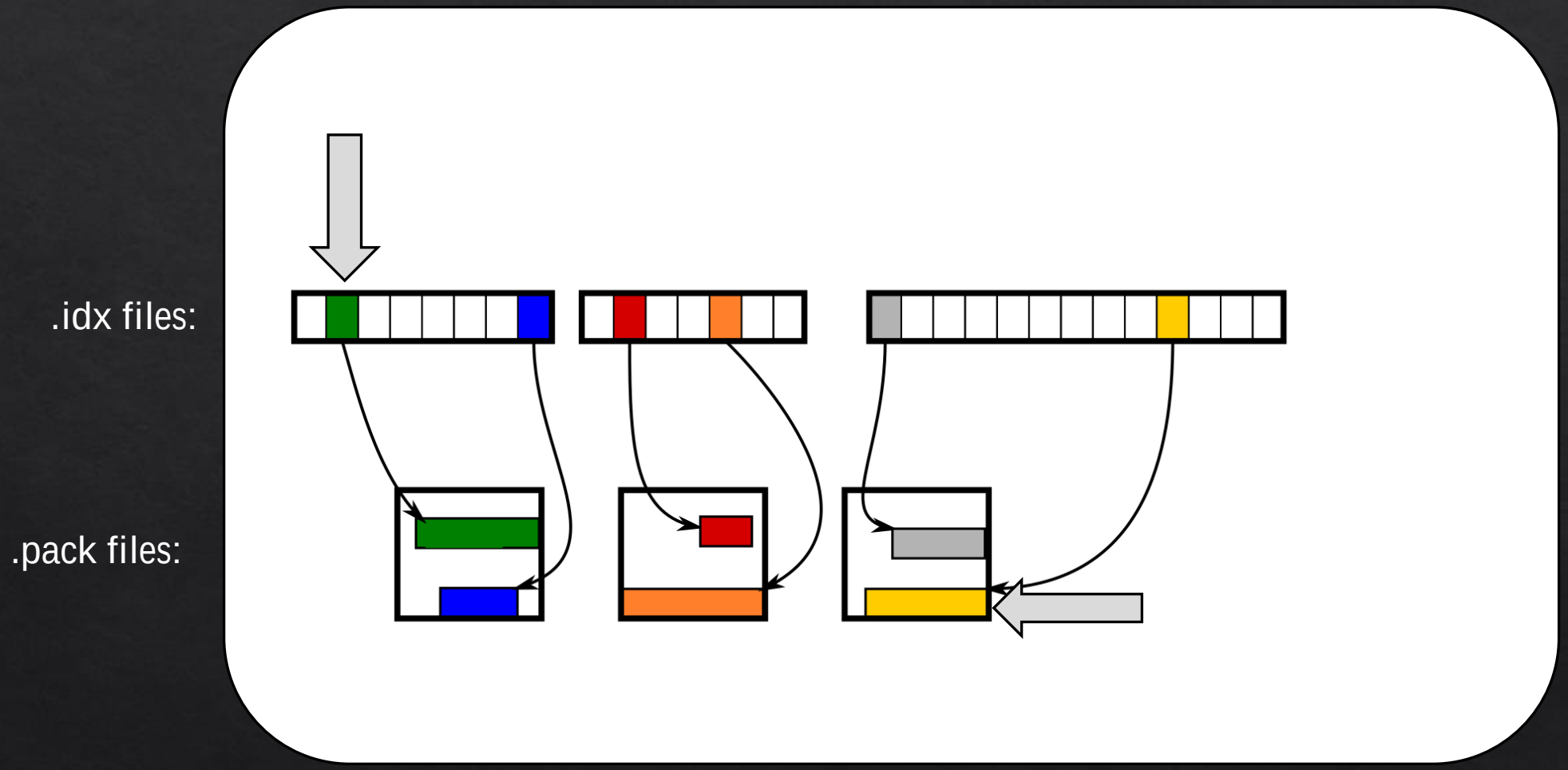
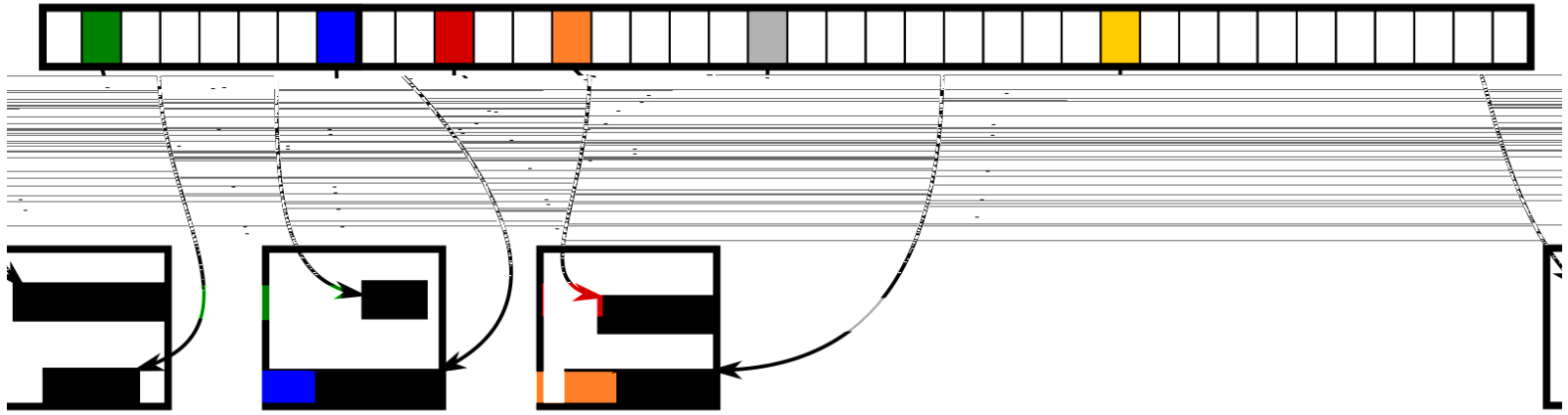


# Too Many Packs?

```
git multi-pack-index write
```

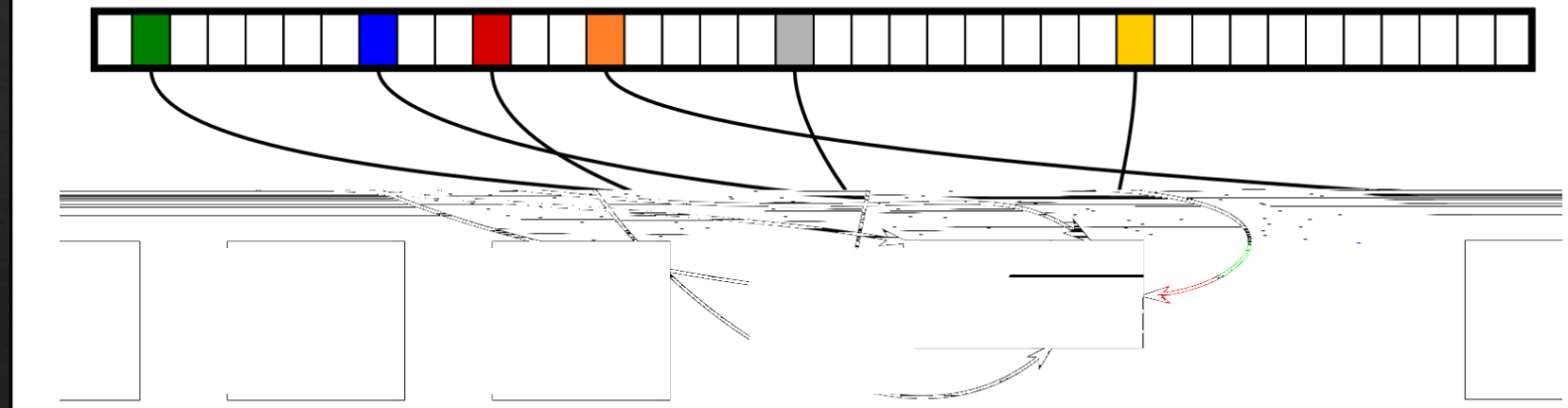
multi-pack-index:

.pack files:



# Incremental Repack

```
git multi-pack-index repack
```

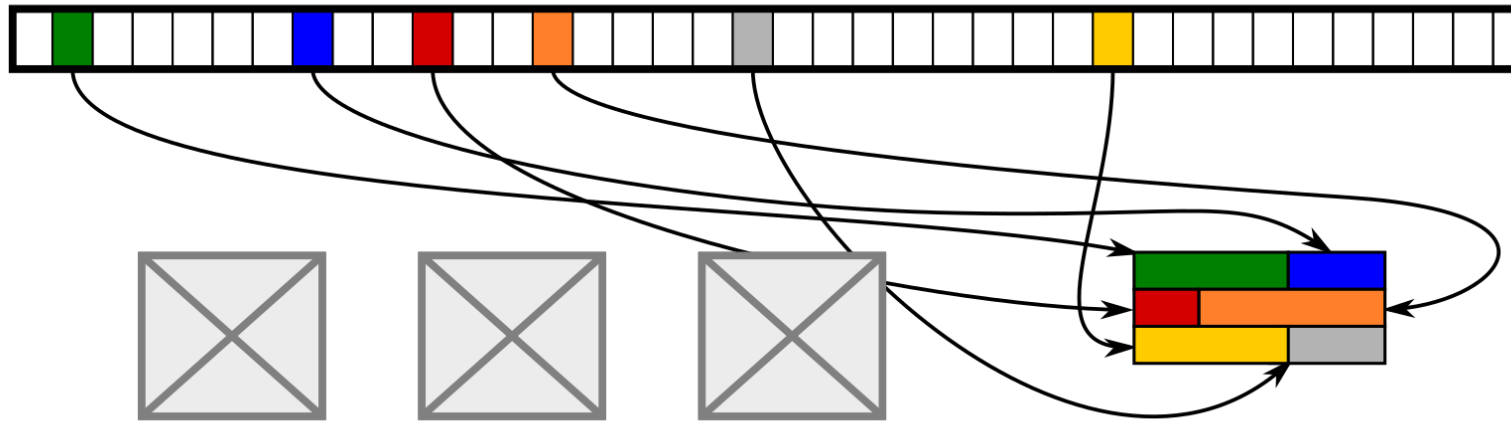


# Incremental Repack

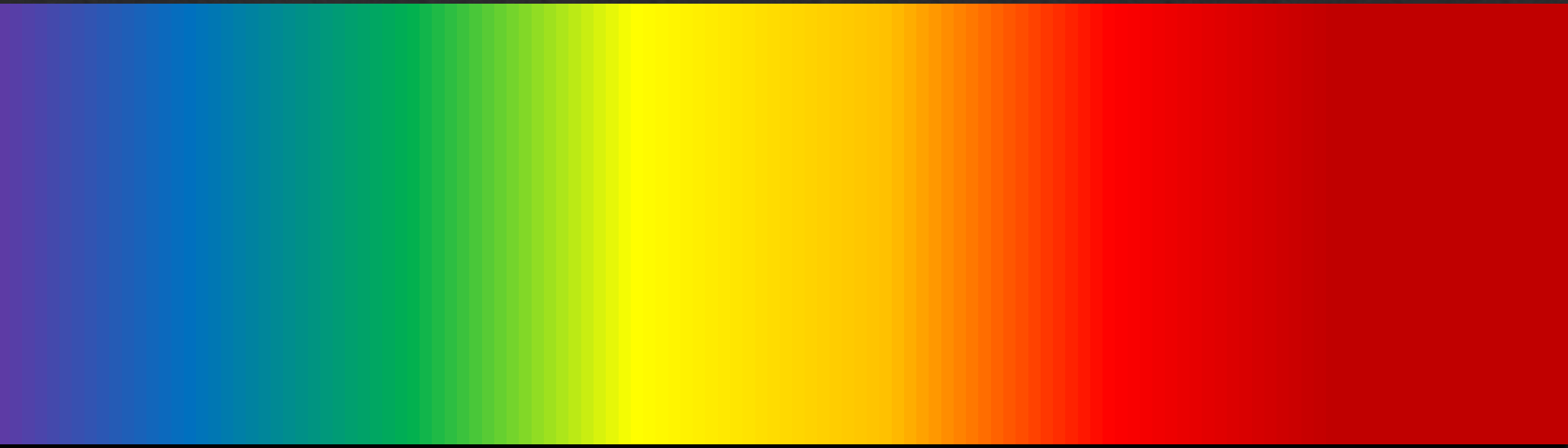
```
git multi-pack-index expire
```

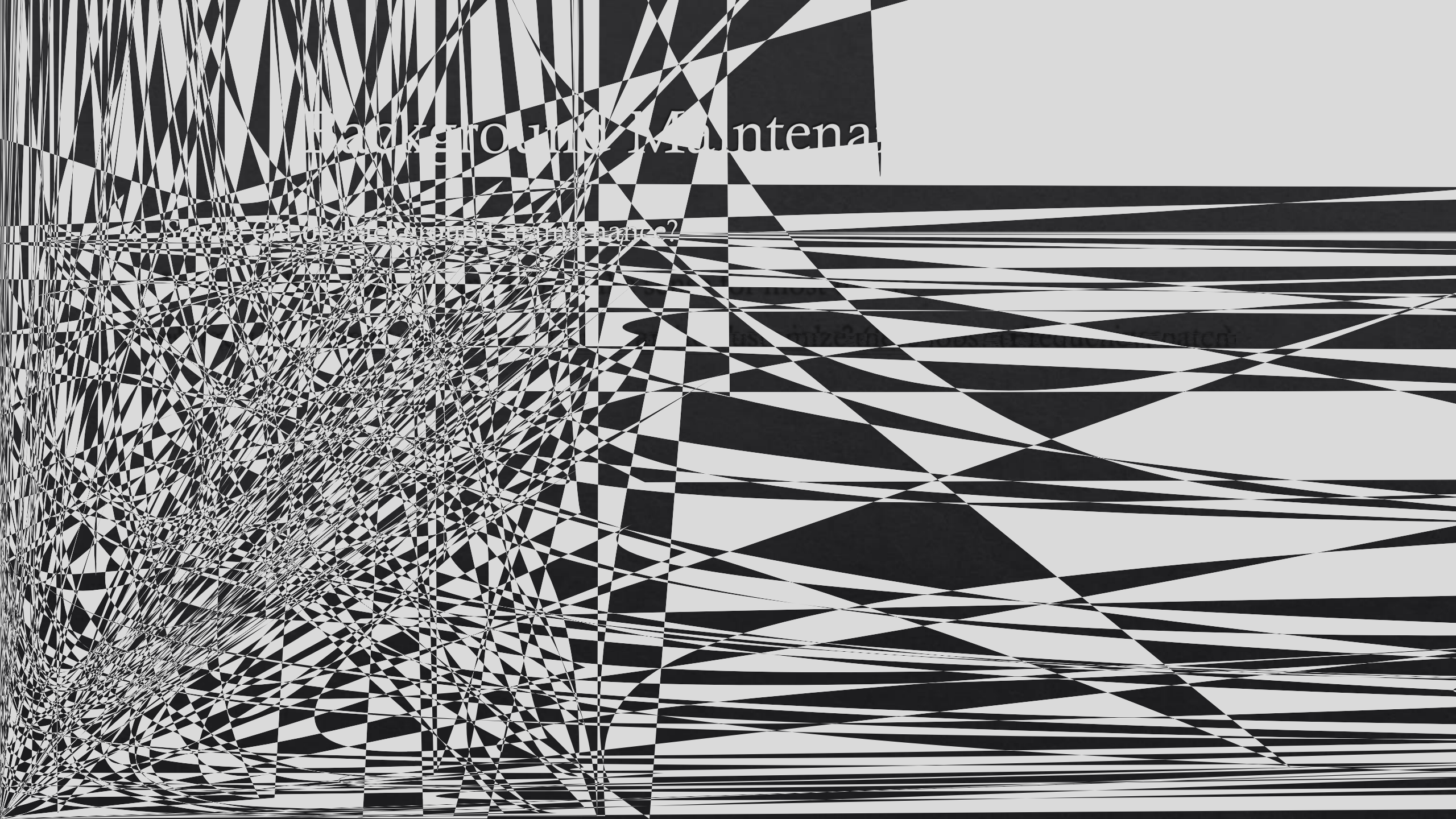
multi-pack-index:

.pack files:



# Spectrum of Scale




Background Montana

# Scalar

https://github.com/microsoft/scalar

Installers available for Windows and macOS

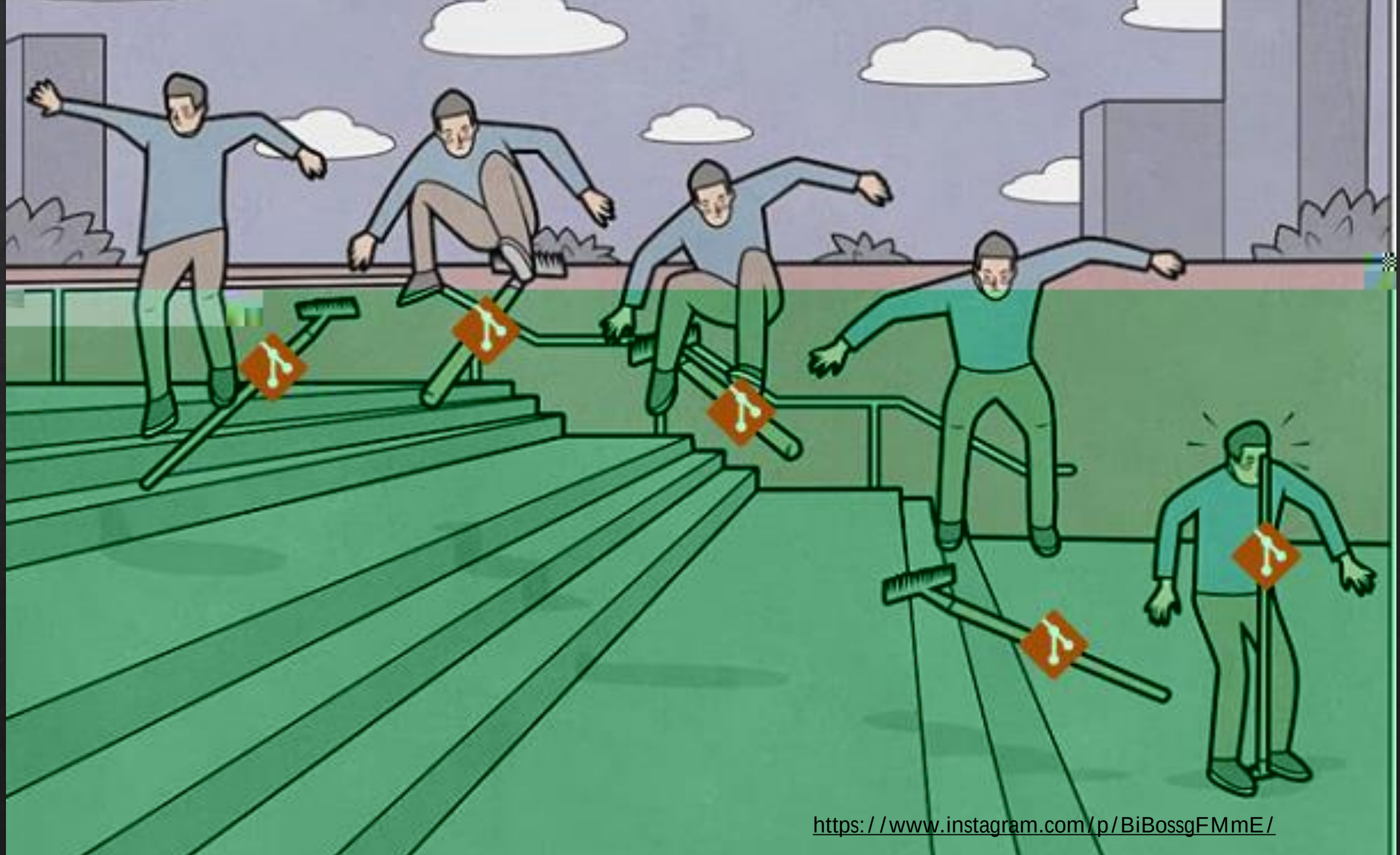
# Scalar Quick Start

```
$ git version
git version 2.25.1.vfs.1.2

$ scalar version
scalar 20.03.167.1

$ scalar register
Successfully registered repo at ‘/Users/stolee/_git/vscode’
```

# What does `scalar register` do?

1. Sets advanced Git config settings for optimal performance
2. Initializes filesystem monitor hook, if Watchman is installed

   https://github.com/facebook/watchman
3. Starts background maintenance


https://www.instagram.com/p/BiBossgFMmE/

# What does `scalar clone` do?

1. Creates new repository with working directory `<name>/src`
2. If remote supports **GVFS protocol**, then configure to use it.
3. Otherwise, configures Git to use **partial clone**.
4. Downloads all commits and trees.

```
out init --cone                    5. git sparse-checko
lar register                       6. Everything from scal
```

# Scalar bridges the gap *for now*

Hopefully, one day Scalar will set recommended config *and that's it*.

# Scalar

https://github.com/microsoft/scalar

Installers available for Windows and macOS