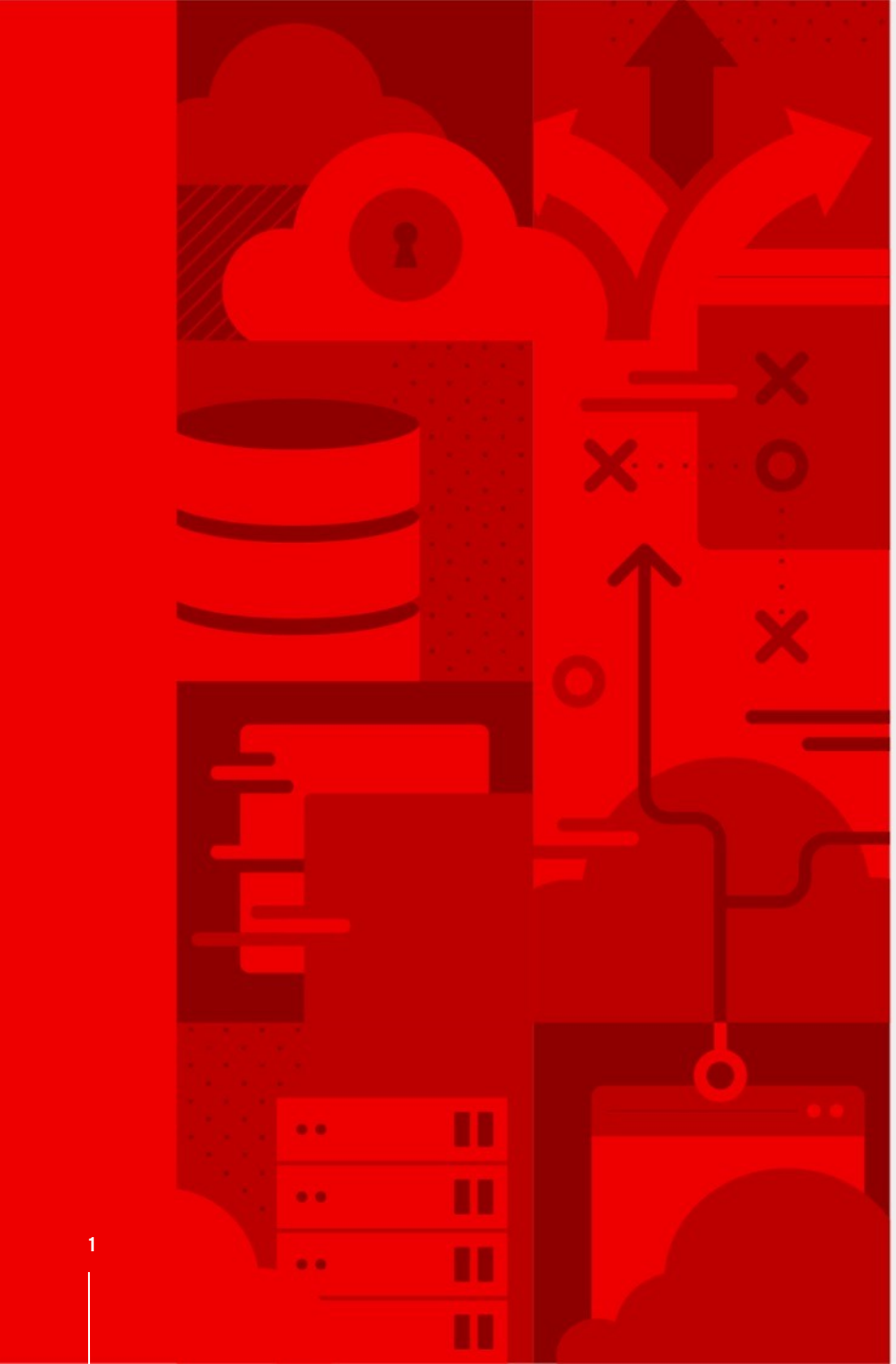

Introducing Git

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Red Hat

An Engineer's Toolbox

* Operating system
* Programming language
* Version control
* Your $EDITOR

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https://xkcd.com/1597

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What changed?

```
$ cat file1.txt
The Royal Tenenbaums is my favorite movie.
Luke Wilson is the best Wilson brother.
He should have won an Oscar for that movie.

$ cat file2.txt
The Royal Tenenbaums is my favorite movie.
Owen Wilson is the best Wilson brother.
He should have won an Oscar for that movie.
```


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diff

```
$ diff file1.txt file2.txt
2c2
< Luke Wilson is the best Wilson brother.
---
> Owen Wilson is the best Wilson brother.
```


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unified diff

```
$ diff -u file1.txt file2.txt

--- file1.txt 2019-11-08 11:14:06.927351536 -0700
+++ file2.txt 2019-11-08 11:14:37.986533112 -0700
@@ -1,3 +1,3 @@
The Royal Tenenbaums is my favorite movie.
-Luke Wilson is the best Wilson brother.
+Owen Wilson is the best Wilson brother.
He should have won an Oscar for that movie.
```


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unified diff

```
$ diff -u hello1.py hello2.py

--- hello1.py   2020-02-10 18:27:16.748772276 -0700
+++ hello2.py   2020-02-10 18:27:45.261180670 -0700
@@ -1,4 +1,4 @@
 #!/usr/bin/env python3

-greeting = "Hello world!"
+greeting = "Hello gorgeous!"
 print(greeting)
```


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Version control is the history of changes to text.

A version control system (or revision control or source control) is software that records those changes over time.

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An abbreviated list of prior art

* Concurrent Versions System – CVS (retired)
* Subversion (client-server)
* BitKeeper (proprietary)

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How Git is different

```
$ man git

*NAME*
       git - the stupid content tracker

*DESCRIPTION*
       Git is a fast, scalable, distributed revision control system
```


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Things we can do with Git

* Everyone has a local copy of project history. (**clone**)
* Develop features concurrently alongside releases. (**branch** and **rebase**)
* Record when a feature was released. (**tag**)
* Identify where a bug was introduced. (**bisect**)
* Identify who introduced the change. (**blame**)
* Quickly search repository history. (**grep** and **log**)

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2017 kernel rate of change

* New kernel released every ~70 days
* ~8 changes per hour
* 13,000 to 16,000 patches per release
* Bonus: Red Hat was the third most active corporate contributor

2017 State of Linux Kernel Development – 4.8 through 4.13
https://www.linuxfoundation.org/2017-linux-kernel-report-landing-page

Red Hat

Provide mechanism, not policy.

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Commit Identifier

Hashing the content plus some entropy produces a unique ID.

This is the **Commit Identifier**.

The commit ID is a globally unique number that is mapped to the content change.

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```
commit a430e67d9a2c62a8c7b315b99e74de02018d0a96
Author: Tadeusz Struk <tadeusz.struk@intel.com>
Date:   Tue Jan 7 14:04:48 2020 -0800

    tpm: Handle negative priv->response_len in tpm_common_read()

    The priv->response_length can hold the size of an response or an negative
    error code, and the tpm_common_read() needs to handle both cases correctly.
    Changed the type of response_length to signed and accounted for negative
    value in tpm_common_read().

    Cc: stable@vger.kernel.org
    Fixes: d23d12484307 ("tpm: fix invalid locking in NONBLOCKING mode")
    Reported-by: Laura Abbott <labbott@redhat.com>
    Signed-off-by: Tadeusz Struk <tadeusz.struk@intel.com>
    Reviewed-by: Jarkko Sakkinen <jarkko.sakkinen@linux.intel.com>
    Signed-off-by: Jarkko Sakkinen <jarkko.sakkinen@linux.intel.com>

--->8
```


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```
diff --git a/drivers/char/tpm/tpm-dev-common.c b/drivers/char/tpm/tpm-dev-common.c
index b23b0b999232..87f449340202 100644
--- a/drivers/char/tpm/tpm-dev-common.c
+++ b/drivers/char/tpm/tpm-dev-common.c
@@ -130,7 +130,7 @@ ssize_t tpm_common_read(struct file *file, char __user *buf,
                priv->response_read = true;

                ret_size = min_t(ssize_t, size, priv->response_length);
-               if (!ret_size) {
+               if (ret_size <= 0) {
                        priv->response_length = 0;
                        goto out;
                }
diff --git a/drivers/char/tpm/tpm-dev.h b/drivers/char/tpm/tpm-dev.h
index 1089fc0bb290..f3742bcc73e3 100644
--- a/drivers/char/tpm/tpm-dev.h
+++ b/drivers/char/tpm/tpm-dev.h
@@ -14,7 +14,7 @@ struct file_priv {
        struct work_struct timeout_work;
        struct work_struct async_work;
        wait_queue_head_t async_wait;
```


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Directed Acyclic Graph - The DAG

Commit identifiers are not very useful if we cannot see how they relate to each other.

Git uses a data structure called a graph to build a timeline of commits.

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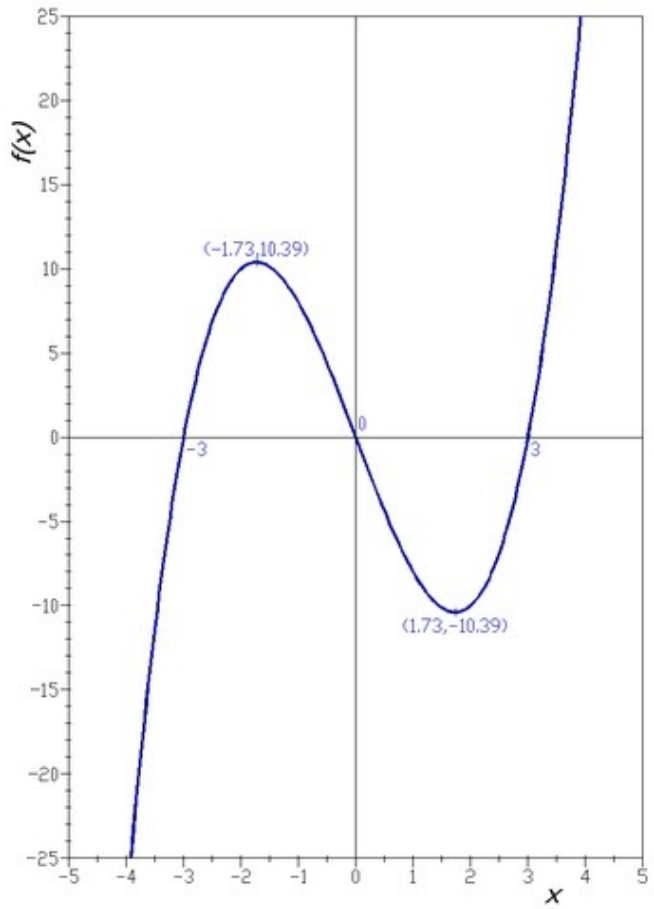
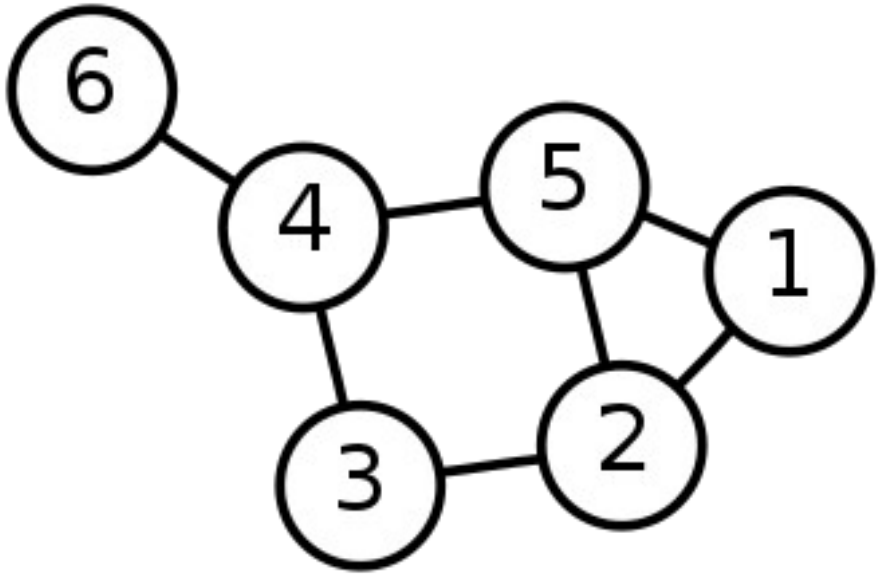
Not this kind of graph



CC BY-SA 4.0 https://en.wikipedia.org/wiki/Graph_of_a_function#/media/File:F(x)_=_x^3_%E2%88%92_9.PNG

A graph is a structure with nodes and edges.

Edges connect each node.



Public domain https://upload.wikimedia.org/wikipedia/commons/thumb/5/5b/6n-graf.svg/333px-6n-graf.svg.png

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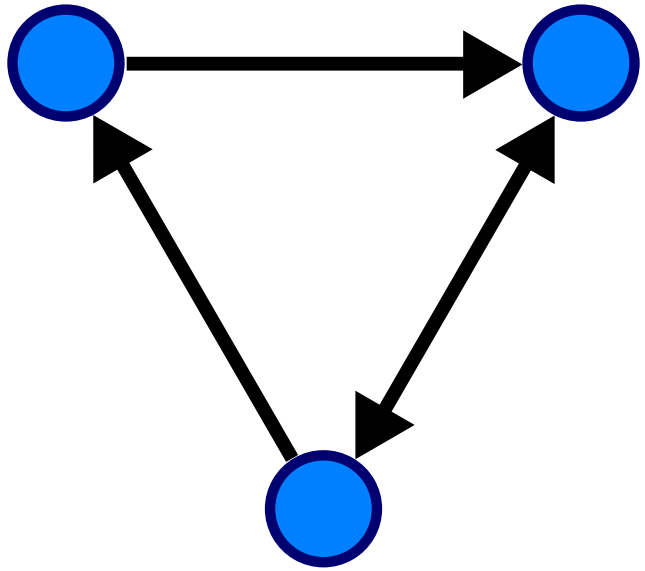
In a directed graph, edges have a direction.



Public domain https://en.wikipedia.org/wiki/File:Directed.svg

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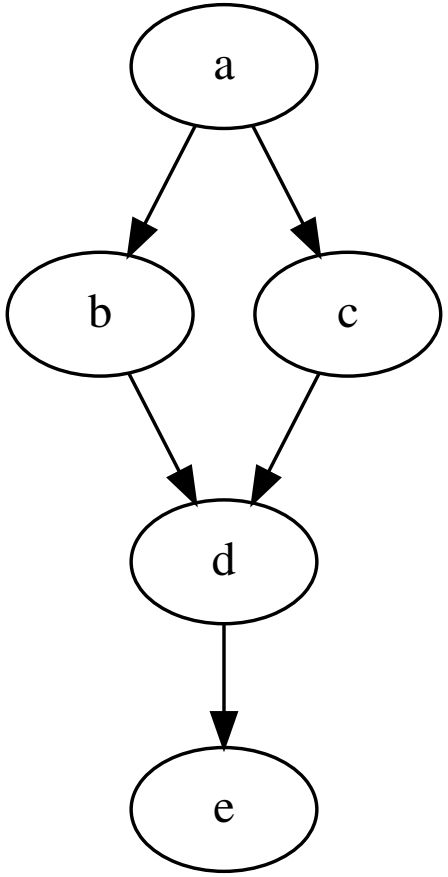
An acyclic graph does not have a closed path.



CC BY-CC0 1.0 https://upload.wikimedia.org/wikipedia/commons/e/ef/Tred-Gprime.svg

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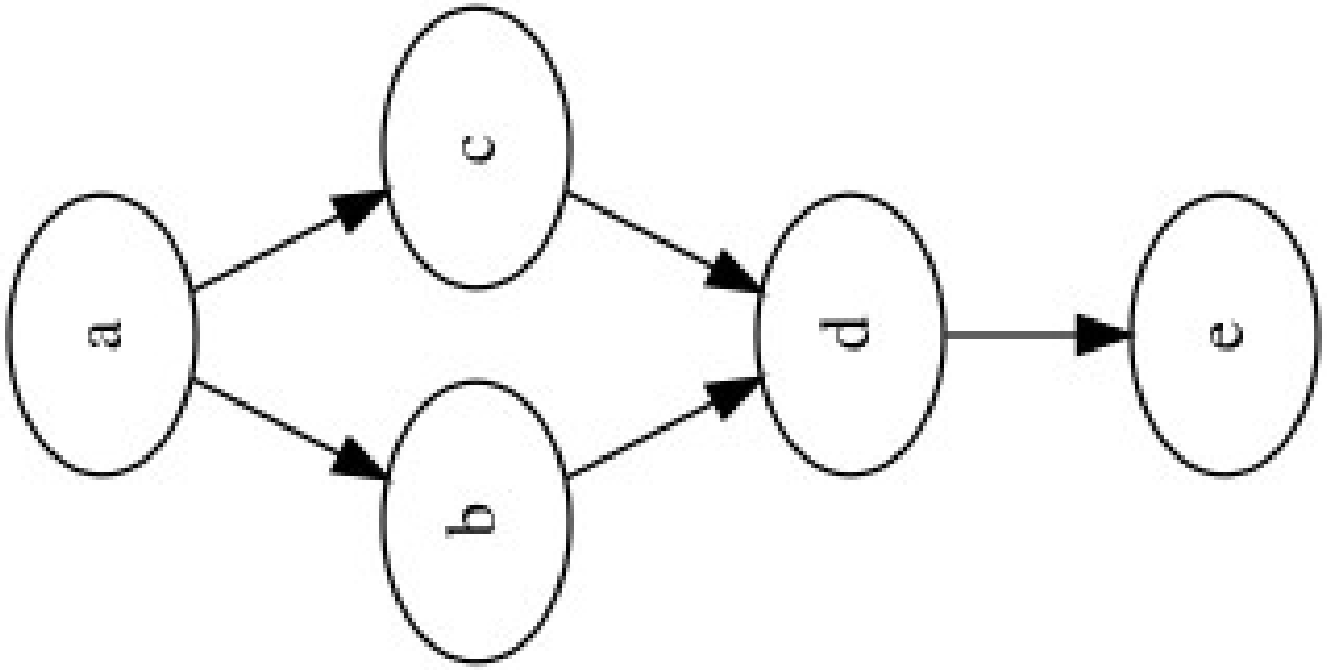
For us humans, time is linear.



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Build and survey history

Nodes are the commit IDs.

Edges connect ancestor commits to construct a timeline.

An (arbitrary) ordering of commits produces a DAG.

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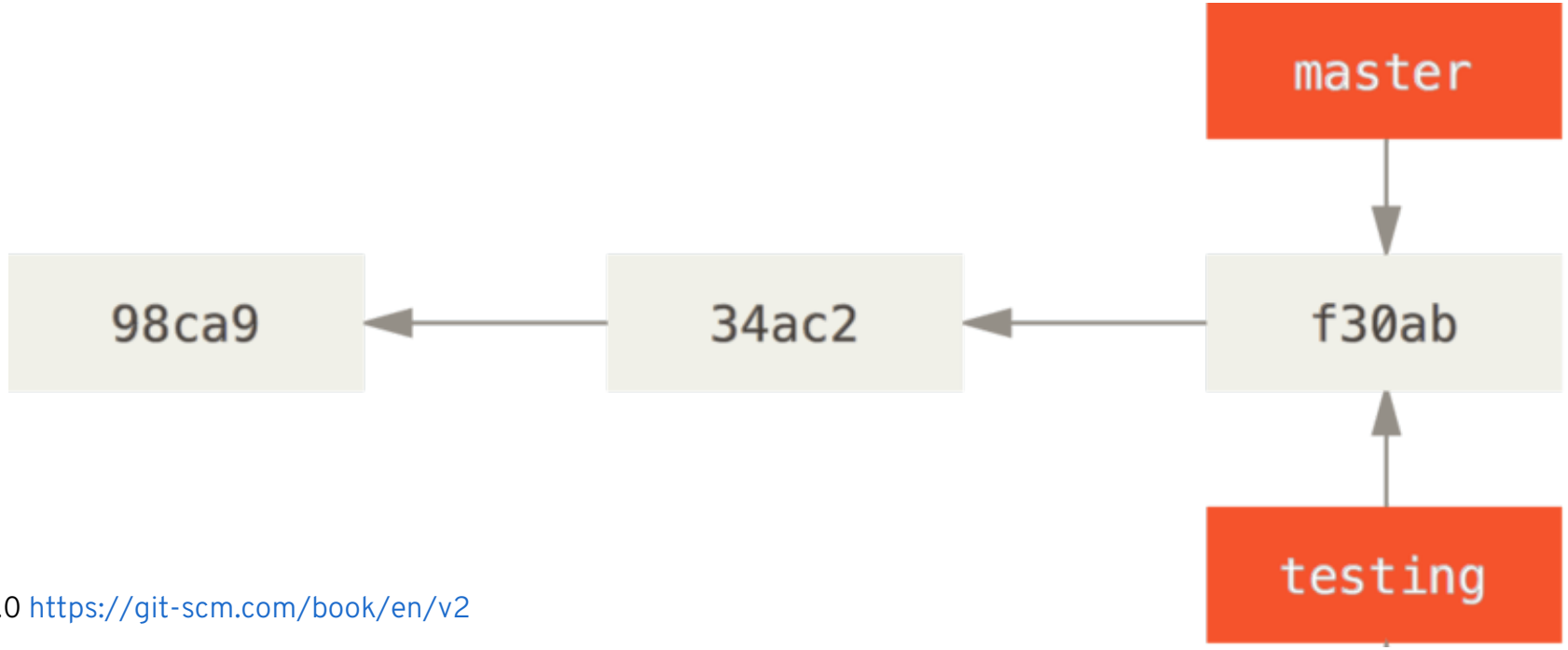
Putting it all together



CC BY-NC-SA 3.0 https://git-scm.com/book/en/v2

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9520b835ffda - mfd: 88pm860x-core: Convert to i2c_new_dummy_device (3 months ago) <Wolfram Sang>
83215897356f - mfd: 88pm800: Convert to i2c_new_dummy_device (3 months ago) <Wolfram Sang>
aee36174b22d - mfd: timberdale: Use dev_get_drvdata (3 months ago) <Chuhong Yuan>
e406b832d89d - mfd: da9063: Remove now unused platform_data (3 months ago) <Wolfram Sang>
a604e5b29ce6 - mfd: tps80031: Convert to devm_i2c_new_dummy_device (3 months ago) <Wolfram Sang>
624e3fceb533 - mfd: cros_ec: Update cros_ec_commands.h (3 months ago) <Yicheng Li>
ed075453d527 - dt-bindings: mfd: rn5t618: Document optional property system-power-controller (3 months ago) <Jonathan Neuschäfer>
cbfe612d471f - mfd: aat2870: No need to check return value of debugfs_create functions (3 months ago) <Greg Kroah-Hartman>
64e8a9bacadb - mfd: ab8500: No need to check return value of debugfs_create functions (3 months ago) <Greg Kroah-Hartman>
efecc3b531a3 - mfd: ab3100: No need to check return value of debugfs_create functions (3 months ago) <Greg Kroah-Hartman>
b5e29aa880be - mfd: davinci_voicecodec: Remove pointless #include (4 months ago) <Arnd Bergmann>
197df18f7038 - mfd: max77620: Add of_node_put() before return (4 months ago) <Nishka Dasgupta>
d0b3cfee333e - Merge tag 'backlight-next-5.4' of git://git.kernel.org/pub/scm/linux/kernel/git/lee/backlight (7 weeks ago) <Linus Torvalds>
c0b64faf0fe6 - backlight: pwm_bl: Set scale type for brightness curves specified in the DT (10 weeks ago) <Matthias Kaehlcke>
511a204638d7 - backlight: pwm_bl: Set scale type for CIE 1931 curves (10 weeks ago) <Matthias Kaehlcke>
d55c028f8b25 - backlight: Expose brightness curve type through sysfs (10 weeks ago) <Matthias Kaehlcke>
6451e123dec3 - MAINTAINERS: Add entry for stable backlight sysfs ABI documentation (10 weeks ago) <Matthias Kaehlcke>
ec665b756e6f - backlight: gpio-backlight: Correct initial power state handling (10 weeks ago) <Peter Ujfalusi>
28a1d72a221e - video: backlight: tosa_lcd: drop check because i2c_unregister_device() is NULL safe (10 weeks ago) <Wolfram Sang>
bcd69da98e36 - video: backlight: Drop default m for {LCD,BACKLIGHT_CLASS_DEVICE} (10 weeks ago) <Geert Uytterhoeven>
30f644fd6ec9 - backlight: lms283gf05: Fix a typo in the description passed to 'devm_gpio_request_one()' (3 months ago) <Christophe JAILLET>
072e2c8192cf - backlight: lm3630a: Switch to use fwnode_property_count_uXX() (3 months ago) <Andy Shevchenko>
865cac14c2da - backlight: rave-sp: Leave initial state and register with correct device (3 months ago) <Lucas Stach>
299d14d4c31a - Merge tag 'pci-v5.4-changes' of git://git.kernel.org/pub/scm/linux/kernel/git/helgaas/pci (7 weeks ago) <Linus Torvalds>
c5048a73b477 - Merge branch 'pci/trivial' (7 weeks ago) <Bjorn Helgaas>
55507aca5882 - PCI: Remove unnecessary returns (2 months ago) <Krzysztof Wilczynski>
b071c1fd7a8a - PCI: OF: Correct of_irq_parse_pci() documentation (2 months ago) <Lubomir Rintel>
d1bbf38aaf88 - PCI: Fix typos and whitespace errors (2 months ago) <Bjorn Helgaas>
cdc7e184abb3 - Merge branch 'remotes/lorenzo/pci/vmd' (7 weeks ago) <Bjorn Helgaas>
a1a30170138c - PCI: vmd: Fix shadow offsets to reflect spec changes (7 weeks ago) <Jon Derrick>
e3dffa4f6c36 - PCI: vmd: Fix config addressing when using bus offsets (7 weeks ago) <Jon Derrick>
3efa7f1febe6 - Merge branch 'lorenzo/pci/tegra' (7 weeks ago) <Bjorn Helgaas>

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Let’s rewrite history!

CC BY 2.5 https://commons.wikimedia.org/w/index.php?curid=11293395

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git init

```
$ diff -u file1.txt file2.txt
--- file1.txt 2019-11-08 11:14:06.927351536 -0700
+++ file2.txt 2019-11-08 11:14:37.986533112 -0700
@@ -1,3 +1,3 @@
The Royal Tenenbaums is my favorite movie.
-Luke Wilson is the best Wilson brother.
+Owen Wilson is the best Wilson brother.
He should have won an Oscar for that movie.
```


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Let’s rewrite history!

```
$ git rebase
```

```
$ git reflog
```


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The art of finding stuff

Like regular grep, but faster!

```
$ git grep <pattern>
$ git log --grep=<pattern>
$ git blame <file>
$ git bisect
```


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Demo 1

Version 1 is working.

Version 2 has a bug.

Can we find the commit that introduced the bug,

even if there are hundreds of commits between V1 and V2?

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Let’s play a game!

I am thinking of a number between 1 and 100.

What should your first guess always be?

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Binary search

If the problem set can be ordered, each pass reduces the problem space by half.

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Demo 1

```
$ git bisect
```


Red Hat

Demo 2

Customer sees a new error after updating kernel:

```
[drm] Unable to create a private tmpfs mount, hugepage support
will be disabled(-22).
```


Red Hat

Demo 2

```
$ git grep '[drm] Unable to create a private tmpfs mount,
hugepage support will be disabled(-22).'
```


Red Hat

Demo 2

```
$ git grep '\[drm\] Unable to create a private tmpfs mount,
hugepage support will be disabled\(-22\)'
```


Red Hat

Demo 2

```
$ git grep 'Unable to create a private tmpfs mount, hugepage
support will be disabled'

drivers/gpu/drm/i915/gem/i915_gem_shmem.c:593:
DRM_NOTE("Unable to create a private tmpfs mount, hugepage
support will be disabled(%d).\n"
```


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Demo 2

```
$ git log --grep='Unable to create a private tmpfs mount,
hugepage support will be disabled'
```


Red Hat

Demo 2

```
$ git blame drivers/gpu/drm/i915/gem/i915_gem_shmem.c
```


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Demo 3

Find this definition.

```
$ git grep 'struct task_struct'
```


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Demo 3

We only want the definition, but we are getting every usage.

```
$ git grep 'struct task_struct'

struct task_struct *task;       /* main task structure */
syscall_get_arch(struct task_struct *task)
...
```


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Demo 3

Domain specific knowledge of the C language quickly narrows our search:

```
struct foo {
        field1
        field2
        ...
    }
```


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Demo 3

```
$ git grep 'struct task_struct {'

include/linux/sched.h:629:struct task_struct {
tools/include/linux/lockdep.h:26:struct task_struct {
tools/testing/selftests/bpf/progs/strobemeta.h:14:struct task_struct {};
tools/testing/selftests/bpf/progs/test_core_reloc_kernel.c:24:struct task_struct {
```


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Resources

man pages

```
$ man git
```

Pro Git

https://git-scm.com/book/en/v2

Git from the inside out

https://maryrosecook.com/blog/post/git-from-the-inside-out

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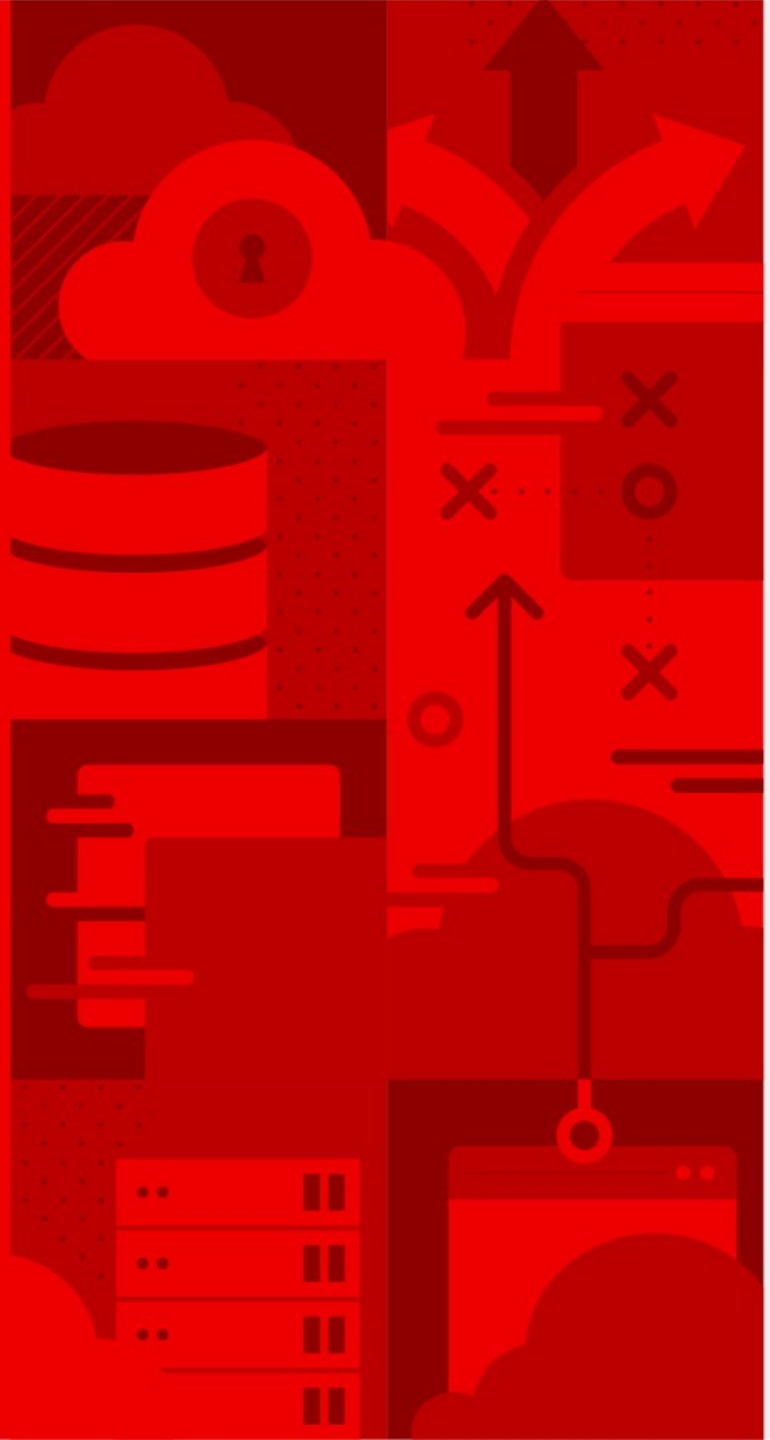

Thank you

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