

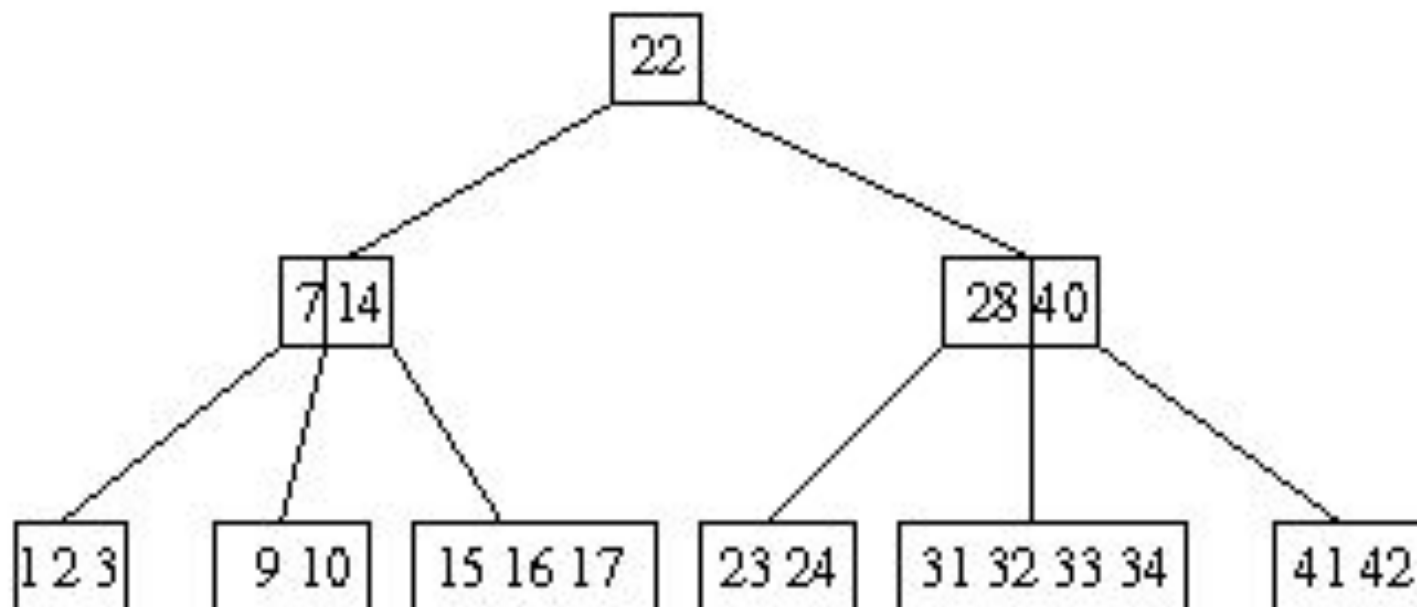


ESTRUTURA DE DADOS

AULA 15

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- Árvores B



Árvores B

Como um acesso a disco é

uma operação cara

Então ao invés de buscar um dado de cada vez, procura-se

transferir, em cada acesso uma quantidade maior de dados

Os criadores da B-árvore (R. Bayer e E. McCreight) não explicam o porquê do nome B-árvore

Com diversas variantes usadas na implementação de bases de dados de uso comercial, como

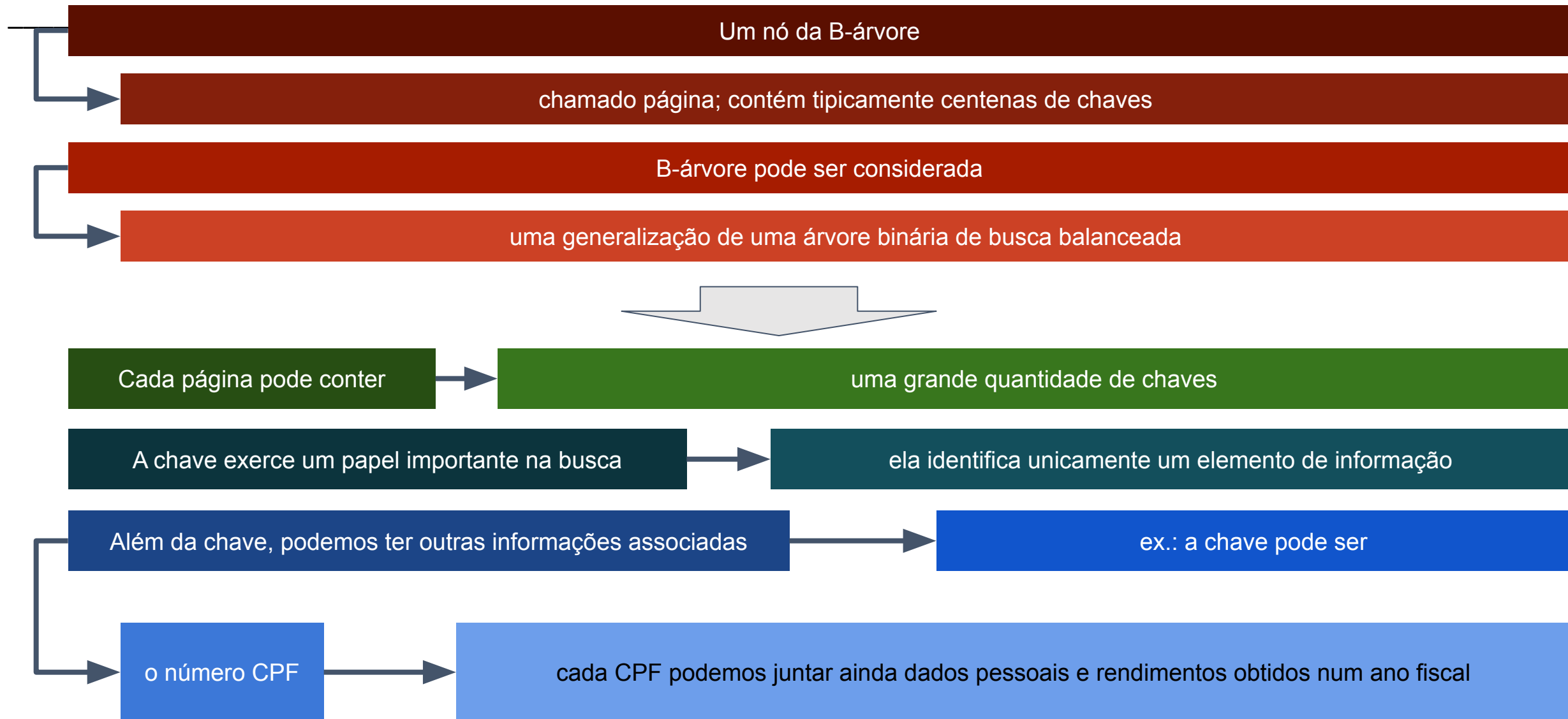
Oracle

Sybase

VSAM da IBM

dBASE

etc



Propriedades

Cada página contém no máximo $2b$ chaves

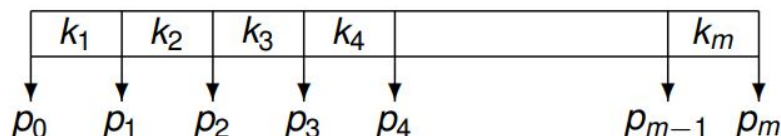
Cada página, exceto a página raiz, contém no mínimo b chaves

Uma página com m chaves $k_1 < k_2 < \dots < k_m$ possui: $m + 1$ ponteiros p_0, p_1, \dots, p_m .

Só há duas situações possíveis

A página é uma folha e não tem filhos: todos os ponteiros p_i , $0 \leq i \leq m$ apontam para nulo

A página não é folha e possui $m + 1$ filhos apontados por p_i , $0 \leq i \leq m$: nenhum ponteiro é nulo

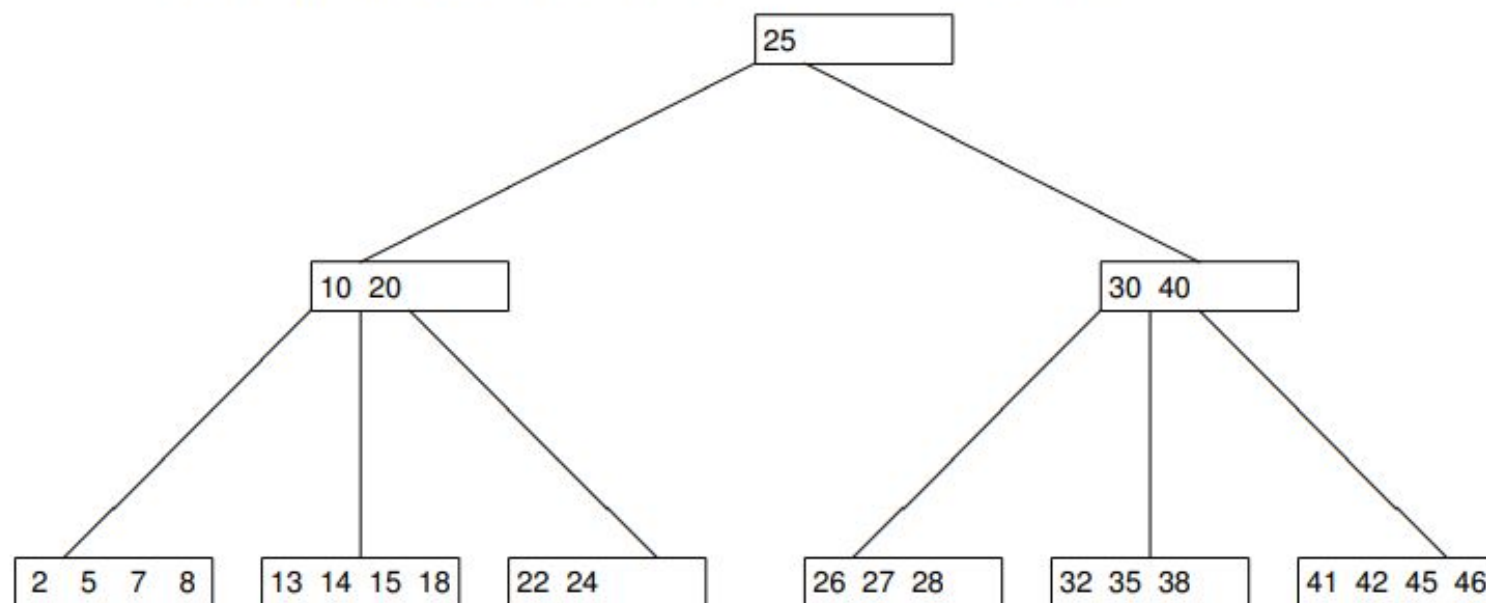


- Para toda chave k na subárvore apontada por p_0 , $k < k_1$.
- Para toda chave k na subárvore apontada por p_m , $k > k_m$.
- Para toda chave k na subárvore apontada por p_i , $1 \leq i < m$, $k_i < k < k_{i+1}$.

Propriedades

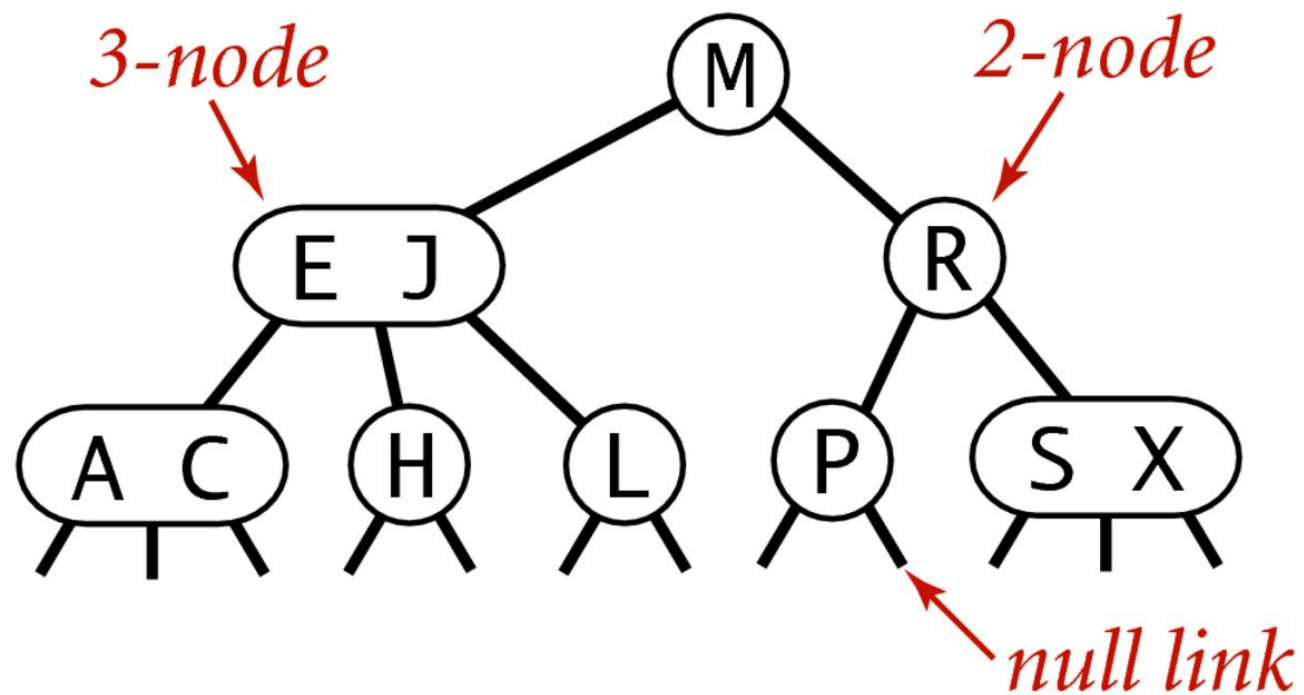
Todas as páginas folhas aparecem no mesmo nível

A raiz de uma B-árvore de ordem $b=2$ pode ter de 1 a $2b = 4$ chaves;
as demais páginas podem ter de $b = 2$ a $2b = 4$ chaves.



Um caso particular de B-árvore é a chamada

árvore-2-3 ou árvore 2-3-4



Um caso particular de B-árvore é a chamada árvore-2-3

- | | | |
|----|---|--|
| 01 | Uma árvore-2-3 é | <ul style="list-style-type: none">• uma B-árvore de ordem $b = 1$. |
| 02 | Cada nó da árvore-2-3 tem | <ul style="list-style-type: none">• 1 ou 2 chaves. |
| 03 | Cada nó da árvore-2-3 tem | <ul style="list-style-type: none">• 2 ou 3 filhos, daí o nome. |
| 04 | A árvore-2-3 é | <ul style="list-style-type: none">• uma árvore usada fazer busca de dados armazenados na memória principal. |
| 05 | Para armazenamento e busca em disco, uma B-árvore usa | <ul style="list-style-type: none">• uma ordem b grande;• tipicamente de alguma centenas de chaves; |

Entregas

Review

Manutenção

Equipe

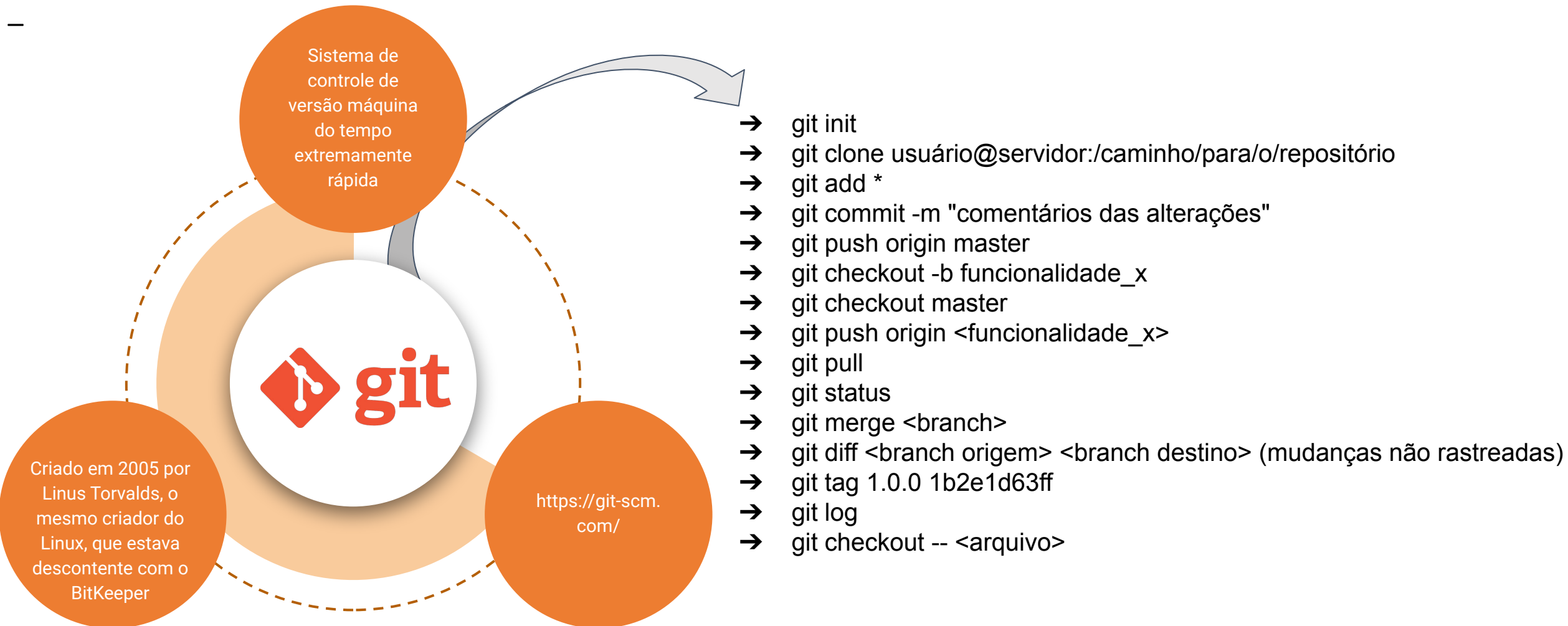
```
▼ 2 git.md
...  @@ -103,7 +103,7 @@ Os nomes de arquivos/diretórios ou extensões de arquivos listados no arquivo *
103  103
104  104      git rm -r diretorio
105  105
106  -   ### Visualizar hitórico
106  +   ### Visualizar histórico
107  107
108  108      ##### Exibir histórico
109  109
...  ...
```

```
danilo@danilo-Aspire-F5-573G: ~/workspaceProgramasC/aula17
Arquivo  Editar  Ver  Pesquisar  Terminal  Ajuda
(base) danilo@danilo-Aspire-F5-573G:~/workspaceProgramasC/aula17$ git status
No ramo master
Your branch is up to date with 'origin/master'.

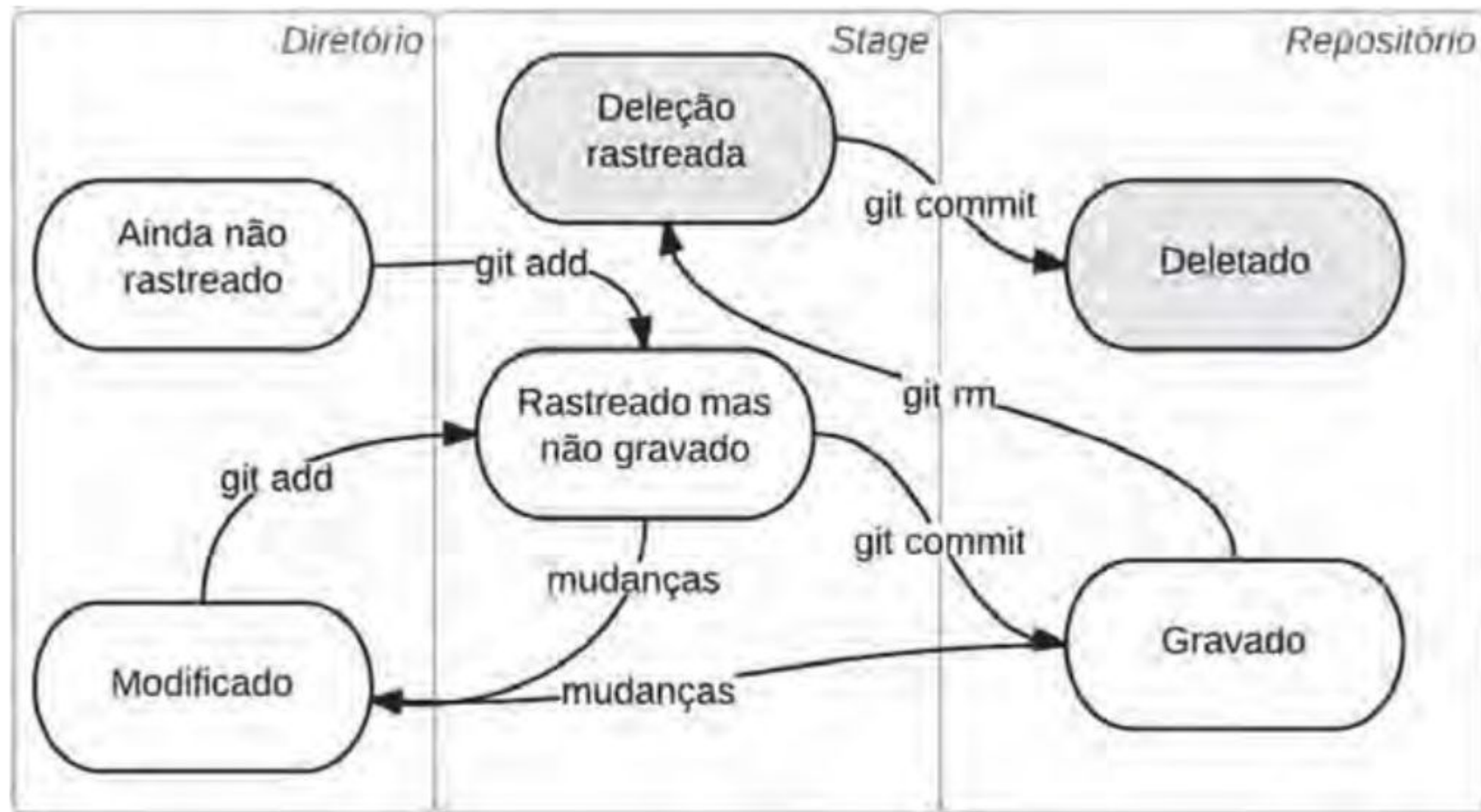
Arquivos não monitorados:
  (utilize "git add <arquivo>..." para incluir o que será submetido)

  arvore.c
  grafo_lista.c
  grafo_matriz.c

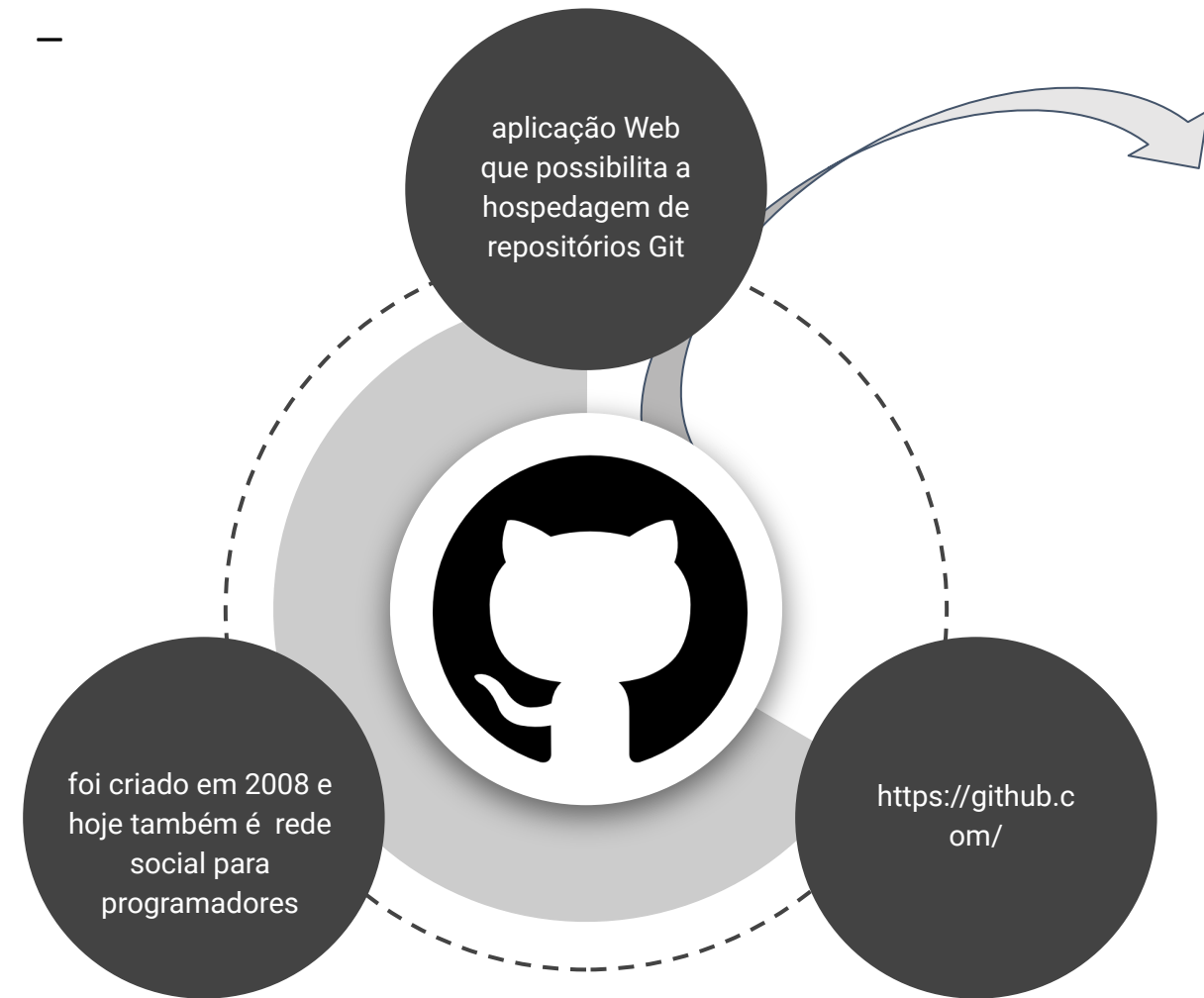
nada adicionado ao envio mas arquivos não registrados estão presentes (use "git
add" to registrar)
(base) danilo@danilo-Aspire-F5-573G:~/workspaceProgramasC/aula17$
```



Code review Github



Code review Github

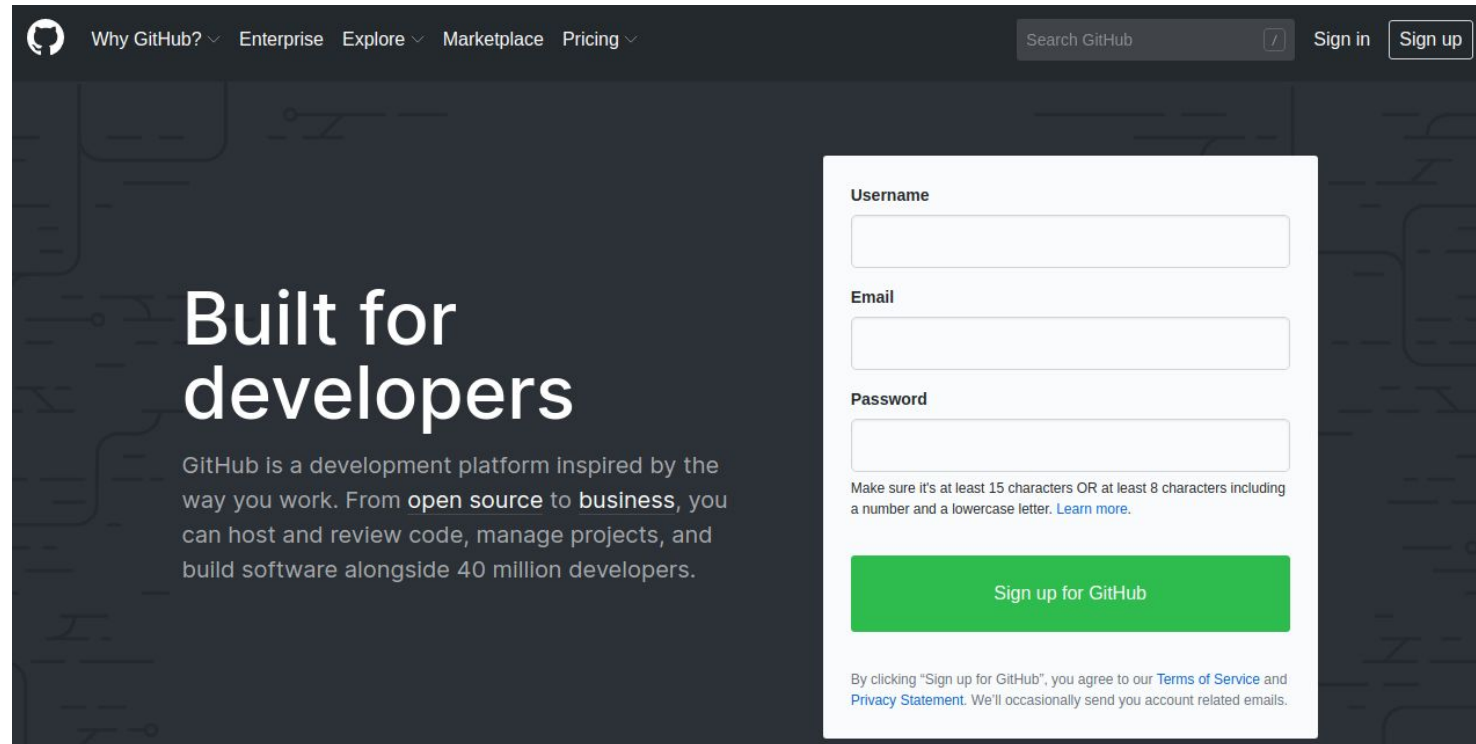


O GitHub diversos projetos de código aberto importantes são hospedados nele:

- ★ jQuery;
- ★ Node.js;
- ★ Ruby On Rails;
- ★ Jenkins;
- ★ Spring;
- ★ JUnit;
- ★ e muitos outros.

Crie uma conta no Github

Crie um repositório no GitHub



The screenshot shows the GitHub homepage with a sign-up overlay. The navigation bar at the top includes links for 'Why GitHub?', 'Enterprise', 'Explore', 'Marketplace', and 'Pricing', along with a search bar and 'Sign in'/'Sign up' buttons. The main heading reads 'Built for developers'. Below this, a paragraph describes GitHub as a development platform for open source and business. The sign-up form on the right contains fields for 'Username', 'Email', and 'Password', followed by a green 'Sign up for GitHub' button. A disclaimer at the bottom of the form states that clicking 'Sign up' agrees to the Terms of Service and Privacy Statement.

Why GitHub? ▾ Enterprise Explore ▾ Marketplace Pricing ▾ Search GitHub / Sign in Sign up

Built for developers

GitHub is a development platform inspired by the way you work. From [open source](#) to [business](#), you can host and review code, manage projects, and build software alongside 40 million developers.

Username

Email

Password

Make sure it's at least 15 characters OR at least 8 characters including a number and a lowercase letter. [Learn more.](#)

Sign up for GitHub

By clicking "Sign up for GitHub", you agree to our [Terms of Service](#) and [Privacy Statement](#). We'll occasionally send you account related emails.

Code review Github

- Github Flow:

01

Crie

- um branch do repositório.

02

Crie, edite, renomeie, mova ou exclua

- arquivos.

03

Envie

- uma pull request de seu branch com as modificações propostas para iniciar uma discussão.

04

Faça

- as modificações necessárias em seu branch. Sua pull request atualizará automaticamente.

05

Faça

- o merge da pull request assim que o branch estiver pronto.

06

Limpe

- seus branches com o botão delete (excluir) na pull request ou na página branches.

Code review Github

[do-community](#) / [cloud_haiku](#)

Watch 5

Star 0

Fork 1

<> Code

Issues 0

Pull requests 0

Projects 0

Wiki

Insights

Community-made poetry about infrastructure

14 commits

1 branch

0 releases

1 contributor

MIT

Branch: master ▾


New pull request







Create new file


Upload files

Find file

Clone or download ▾

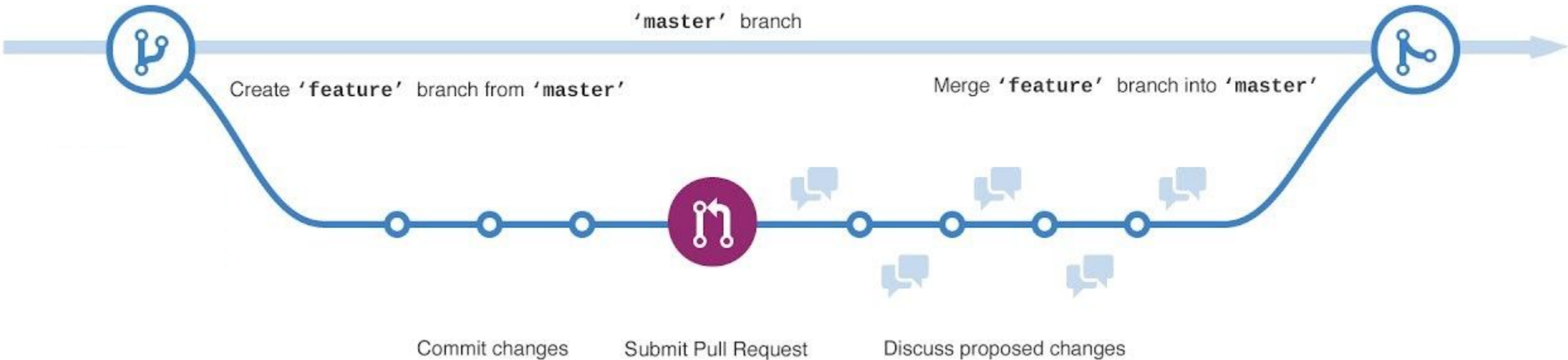
 Itagliaferri Merge pull request #3 from Itagliaferri/master ... Latest commit 35f1587 a day ago

 _haikus	adding haikus, layouts, assets	a day ago
 _layouts	adding haikus, layouts, assets	a day ago
 assets	adding haikus, layouts, assets	a day ago
 LICENSE	Initial commit	a day ago
 README.md	add links	a day ago
 _config.yml	update config file	a day ago

 [README.md](#)

- Pull requests:

GitHub Workflow

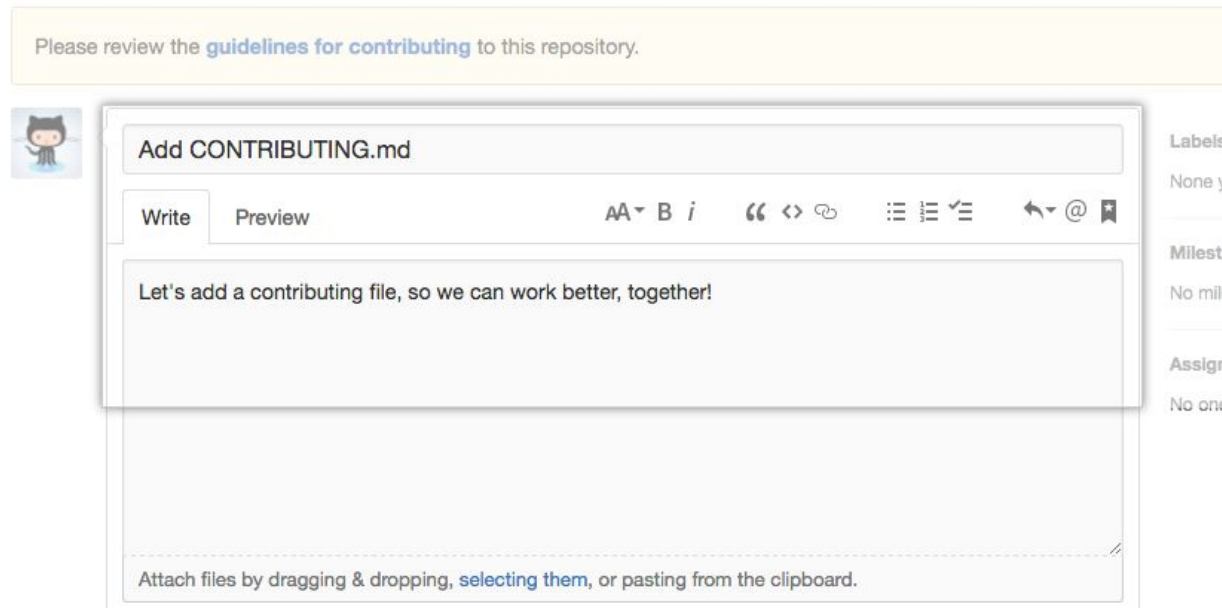


- Pull requests:



Open a pull request

Create a new pull request by comparing changes across two branches. If you need to, you can also [compare across forks](#).



- Visualizando e comparando commits:

Use Sluggable in Milestone

[Browse code](#)

 refactor-sluggable-code (#9878)



foca authored 23 days ago

1 parent 4845db6 commit 57070b4f91595afa36407dfad6d736f0610b3a1d

Bump version in _config.yml

[Browse files](#)

 master  v2.3.0

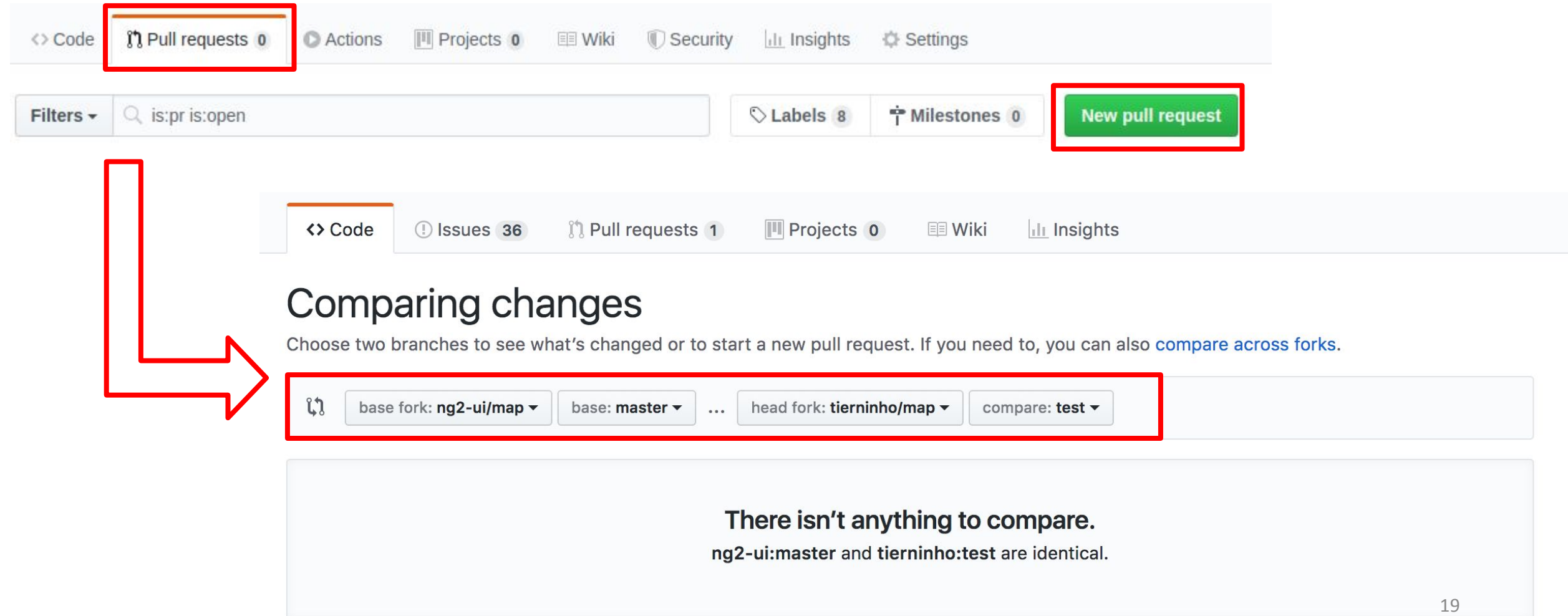


mdo authored a day ago

1 parent f45d2d0 commit 99a89715f1ce016ab957c9d8d10691366a2a8dce

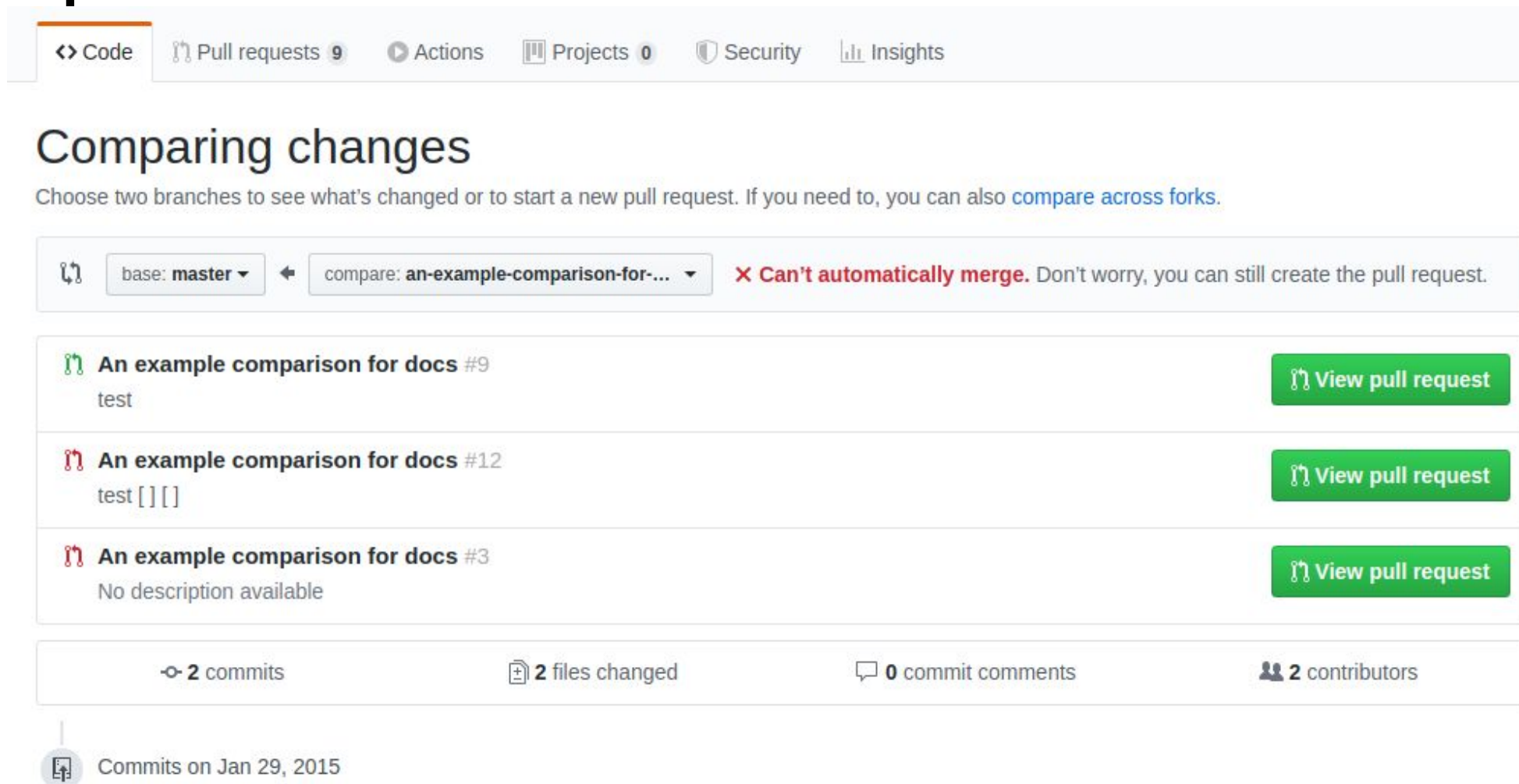
Code review Github

– ● Comparando commits:



The screenshot shows the GitHub interface for a repository. The top navigation bar includes links for Code, Pull requests (0), Actions, Projects (0), Wiki, Security, Insights, and Settings. The 'Pull requests' tab is highlighted with a red box. Below the navigation bar, there is a search bar with the filter 'is:pr is:open', a 'Labels' section with 8 labels, a 'Milestones' section with 0 milestones, and a green 'New pull request' button, which is also highlighted with a red box. The main content area shows the 'Comparing changes' section. The 'Code' tab is selected, and the 'Issues' section shows 36 issues. The 'Pull requests' section shows 1 pull request. The 'Comparing changes' section has a heading 'Comparing changes' and a subheading 'Choose two branches to see what's changed or to start a new pull request. If you need to, you can also [compare across forks](#).' Below this, there is a comparison control bar with a red box around it. The control bar includes a pull request icon, a dropdown menu for 'base fork: ng2-ui/map', a dropdown menu for 'base: master', an ellipsis, a dropdown menu for 'head fork: tierninho/map', and a dropdown menu for 'compare: test'. A red arrow points from the 'Pull requests' tab to the comparison control bar. Below the comparison control bar, there is a message: 'There isn't anything to compare. ng2-ui:master and tierninho:test are identical.'

- Comparando commits:



[Code](#) [Pull requests 9](#) [Actions](#) [Projects 0](#) [Security](#) [Insights](#)

Comparing changes

Choose two branches to see what's changed or to start a new pull request. If you need to, you can also [compare across forks](#).

[base: master](#) [compare: an-example-comparison-for-...](#) **✖ Can't automatically merge.** Don't worry, you can still create the pull request.

An example comparison for docs #9 test	View pull request
An example comparison for docs #12 test [] []	View pull request
An example comparison for docs #3 No description available	View pull request

[2 commits](#) [2 files changed](#) [0 commit comments](#) [2 contributors](#)

[Commits on Jan 29, 2015](#)

● Comparando commits:

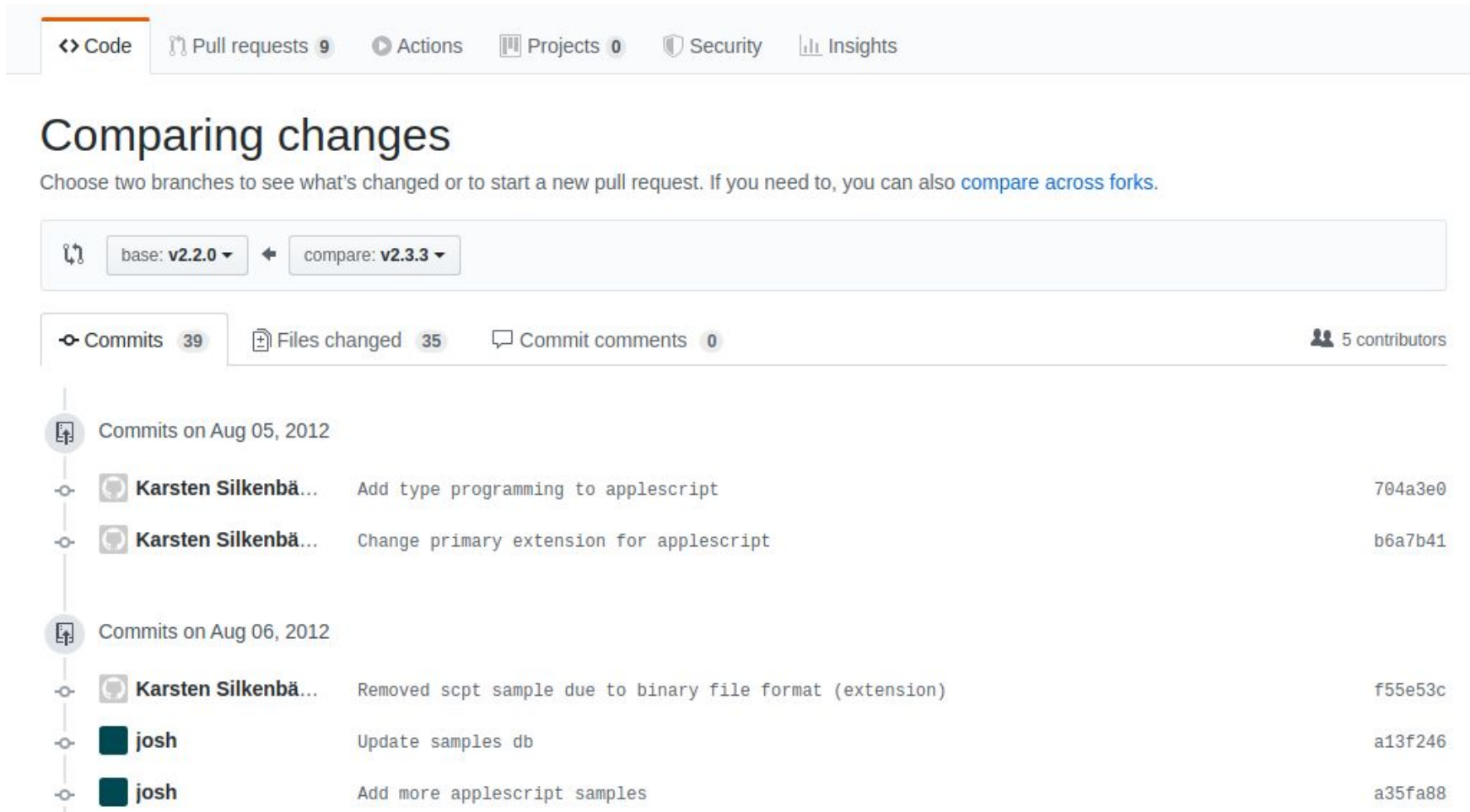
38 test/test_heuristics.rb

```

@@ -22,6 +22,17 @@ def test_no_match
  22 22     assert_equal [], results
  23 23     end
  24 24
  25 + def assert_heuristics(hash)
  26 +     candidates = hash.keys.map { |l| Language[l] }
  27 +
  28 +     hash.each do |language, blobs|
  29 +         Array(blobs).each do |blob|
  30 +             result = Heuristics.call(file_blob(blob), candidates)
  31 +             assert_equal [Language[language]], result, "Failed for #{blob}"
  32 +         end
  33 +     end
  34 + end
  35 +
  25 36     # Candidate languages = ["C++", "Objective-C"]
  26 37     def test_obj_c_by_heuristics
  27 38         # Only calling out '.h' filenames as these are the ones causing issues
  FR
  @@ -148,17 +159,6 @@ def test_cs_by_heuristics
  148 159     })
  149 160     end
  150 161
  151 - def assert_heuristics(hash)
  152 -     candidates = hash.keys.map { |l| Language[l] }
  153 -
  154 -     hash.each do |language, blobs|
  155 -         Array(blobs).each do |blob|
  156 -             result = Heuristics.call(file_blob(blob), candidates)
  157 -             assert_equal [Language[language]], result, "Failed for #{blob}"
  158 -         end
  159 -     end
  160 - end
  161 -

```

- Comparando tags:



The screenshot shows the GitHub 'Comparing changes' interface. At the top, there's a navigation bar with tabs: Code, Pull requests (9), Actions, Projects (0), Security, and Insights. Below this, the title 'Comparing changes' is followed by a subtitle: 'Choose two branches to see what's changed or to start a new pull request. If you need to, you can also [compare across forks](#).' The main comparison area shows 'base: v2.2.0' and 'compare: v2.3.3'. Below this, a summary bar indicates '39 Commits', '35 Files changed', and '0 Commit comments', with '5 contributors' listed on the right. The commit history is displayed as a vertical timeline. The first section is 'Commits on Aug 05, 2012', containing two commits by 'Karsten Silkenbä...' with descriptions 'Add type programming to applescript' (hash 704a3e0) and 'Change primary extension for applescript' (hash b6a7b41). The second section is 'Commits on Aug 06, 2012', containing three commits: 'Karsten Silkenbä...' with 'Removed scpt sample due to binary file format (extension)' (hash f55e53c), 'josh' with 'Update samples db' (hash a13f246), and 'josh' with 'Add more applescript samples' (hash a35fa88).

Code Pull requests 9 Actions Projects 0 Security Insights

Comparing changes

Choose two branches to see what's changed or to start a new pull request. If you need to, you can also [compare across forks](#).

base: v2.2.0 compare: v2.3.3

Commits 39 Files changed 35 Commit comments 0 5 contributors

Commits on Aug 05, 2012

- Karsten Silkenbä... Add type programming to applescript 704a3e0
- Karsten Silkenbä... Change primary extension for applescript b6a7b41

Commits on Aug 06, 2012

- Karsten Silkenbä... Removed scpt sample due to binary file format (extension) f55e53c
- josh Update samples db a13f246
- josh Add more applescript samples a35fa88

- **TDE 3**

- **Desenvolva um algoritmo para a árvore B e faça o upload do arquivo em um repositório no Github.**

1. B-Tree é uma árvore de?
2. Na maioria das outras árvores de busca de auto-equilíbrio (como AVL e Red-Black Trees), assume-se que tudo está na?
3. Para entender o uso de Árvores B, devemos pensar na enorme quantidade de dados que não cabem na?
4. O tempo de acesso ao disco é muito alto em comparação com o tempo de acesso à?

- **Árvore B, B* e B+**
 - <http://wiki.icmc.usp.br/images/8/8e/SCC578920131-B.pdf>
- **Árvores B**
 - <https://docente.ifrn.edu.br/robinsonalves/disciplinas/estruturas-de-dados-nao-lineares/ArvBrl.pdf>
- **Árvores 2-3**
 - <https://www.ime.usp.br/~pf/estruturas-de-dados/aulas/st-twothree.html>
- **Árvore B**
 - <https://ww2.inf.ufg.br/~eduardo/ed2/ArvoreB.pdf>

- Definição de árvore B
 - https://www.youtube.com/watch?v=qXfPA6xqVIQ&ab_channel=avaunitins
- 04 05 Inserção em uma Árvore B
 - https://www.youtube.com/watch?v=fUhxgSNlr3k&ab_channel=MarcosAndr%C3%A9SilveiraKutova
- Aula 29 - Estrutura de Dados - Árvores B
 - https://www.youtube.com/watch?v=jYQWQEKRLCs&ab_channel=RafaelCrivellariSalibaSchouery

- B-Tree Tutorial - An Introduction to B-Trees
 - https://www.youtube.com/watch?v=C_q5ccN84C8&ab_channel=FullstackAcademy
- 10.2 B Trees and B+ Trees. How they are useful in Databases
 - https://www.youtube.com/watch?v=aZjYr87r1b8&ab_channel=AbdulBari
- R2. 2-3 Trees and B-Trees
 - https://www.youtube.com/watch?v=TOb1tuEZ2X4&ab_channel=MITOpenCourseWare

- B-tree
 - <https://www.programiz.com/dsa/b-tree>
- Introduction of B-Tree
 - <https://www.geeksforgeeks.org/introduction-of-b-tree-2/>

FIM

Atividade de casa e slide serão enviados ao Classroom.