

Pro Git

Scott Chacon, Ben Straub

© <

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QRST Pro Git UV7? UW7X7TY\$Z[\] ^_` ? TabFGitcdXY^8efgFhi j kI em@Dn0Wpqr ? st Gituvwxyz{ N| } ~-•€• , Ff „ ...Tabte‡uv^‰Š<Œ• dkŽFhi •• GitD' ' j i kW" mtD" • Šfg? ! – DUV7—i t ^~™_š> œ•ž" f Ÿ „ y™' i ~ k¢£?

¤¥L UW7 | F Git y§ `` ©ª « S¬j i W- / y®' F^-° ±²³' Dµ¶? . , ¹ \$° » D' ' ¼½¾ ¢ ÅFhi j ÅkÅTÅabWÄÅÆç\$D5È? Èž | ÈFÈl í W- , ï' ' ï D' ^ . ? Git \$ Windows ÑPÒ^®, ÓMDÔÈFÖÖfk×ØDUÚ' ; ÜÜy. DÝ{ PIDE DÝ{ F, B+, . ' D àá2çÀ? _` âD Pro Git yå WÅfå? ™7! Då @æçèW—i éB Git' ' ¼ž" fk™Dâéë i ?

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¥\$ Pro Git D> 1 7! ¼L^W? ¥> Çi | @9DA~Fi " t BCD Git üýEF / GDHI D GitHub? ¥\$–J LDKL! MÑI i B' ' kGDFhi NÇÒÇOPT¥D! " FòQ¥ÇRQ? O| ¥j ÇRQ ž - ST DUVF GitHub \$ Git' ' ¼Dm@- i ÅWXYPD? ¥Z[Z» [! – Dž\] ^gt_ù) * GitHub i ` a, BpbçŽ5. ' ' F&Çdi " t W- Git üýDHI ? pefghi pb. ' GitFža ^ • pb. ' GitHub [j ¢£f • kTW- I †D' ' ¼? ÇPfZ» t ÉmDno. ' pW- Git üýEFF öï I kqr ?

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¥' ' f° 3` ö- " ©7 D Pro Git?

Ben Straub \$

! – DUW7—i [¥Š Git" <Ç• è• D>s? – ¼Ð' Di ¥– ÐD%—~ D™š F ò8™š> ¥èâ•
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Ahmadi		
al ex-kozi el l	Jan Groenewald	Ri chard
Hoyl e		
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Senft		
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Meng		
branchzero	Kenneth Ki n Lum	Shi Yan
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Bobryk		
brotherben	Kyrylo Yatsenko	Si arhei
Krukau		
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Shekatkar		
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Eric Henziger	myd7349	Yann
Soubeyrand		
evanderiel	neo1218	Yedda
Explorare	networm	yi kang
eyherab	nicktime	Yue Lin Ho
Ezra Buehler	Niels Widger	Yunhai Luo

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flip111	ousugo	Zheeeng
fly ingzumwalt	Owen	zhou
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Gerry	Pavel Jan'k	ÊË
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grgbnc	pedrorijo91	*WÍ"
guan wang	Perry	ÐÑ
Guthrie McAfee Armstrong	Peter Kokot	

Table 1. OPQRS8T

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1. ÈÈ		
1.1 GS7! ØØ	@Lax	8ØØ
1.2 Git } Ö	@Lax	
1.3 Git × Ø	@Lax	@Geno1024
1.4 ^ %oÙ	@hbrls	@spacewander
1.5 ÚÚ Git	@Lax	8ØØ
1.6 Üt ÝÙ Git à DPÓ	@networm	@xinqiu @robinwen @ahljin 8ØØ
1.7 OP¢£	@Lax	
1.8 ß"	@Lax	@devbean
2. Git × Ø		
2.1 OP Git à á	@alamier	@networm
2.2 áãí t ~ ™Tàá	@alamier	@networm 8ØØ
2.3 ä • Cå æö	@alamier	8ØØ
2.4 çèï "	@networm	@pktangyue @robinwen @ahljin
2.5 éØàáD. '	@networm	@pktangyue @ahljin @wych42
2.6 êçë	@networm	@pktangyue @wych42 @robinwen
2.7 Git ï)	@networm	@pktangyue @wych42 @robinwen
2.8 ß"	@alamier	
3. Git] Ý		
3.1] Ý})	@archermind	

) *	+ (, - (
3.2] Ÿ D™í Šî >	@archermind	@zwpaper @wych42 @robinwen @networm
3.3] Ÿ ý €	@networm	@zwpaper @wych42 @robinwen
3.4] Ÿ , ȝ μ" ī	@archermind	@xinqiu @wych42 @zwpaper
3.5 é Ó] Ÿ	@networm	@wych42 @zwpaper @robinwen
3.6 g x	@hbrls	@Albert @networm
3.7 B "	@Jun995	
4. EF ØÑD Git		
4.1 : ;	@wych42	@Geno1024 È ñ @xinqiu @morefreeze
4.2 \$ EF ØÑðí Git	@neo1218	@Geno1024 È ñ @xinqiu
4.3 óf SSH! ô	@oranzhang	@secondwtq @IceNature @jeffsui
4.4 PÓEF Ø	@oranzhang	@Geno1024 @IceNature @secondwtq
4.5 Git ðö ØØ	@branchzero	@networm @IceNature @morefreeze
4.6 Smart HTTP	@branchzero	8ØØ @IceNature @morefreeze
4.7 GitWeb	8ØØ	@networm @IceNature È ñ
4.8 GitLab	@neo1218	@IceNature @jeffsui @networm
4.9 U÷1 Üý Døù	@branchzero	8ØØ @networm @IceNature
4.10 B "	@8loser	
5.] , ȝ Git		
5.1] , ȝμ" ī Ó	@leshiv	@secondwtq @summershrimp @IceNature
5.2 NW- . æ£ ø	@networm	@secondwtq @IceNature @morefreeze
5.3 úö. æ	@secondwtq	@IceNature @morefreeze È ñ
5.4 B "	@xiaket	@summershrimp @IceNature @vangie
6. GitHub		
6.1 ȝj D%í BPÓ	@devbean	@branchzero @buginix @IceNature
6.2 y . æ‰X E ø	8ØØ	@branchzero @buginix @IceNature
6.3 úö. æ	@qinglangee	@branchzero @polarlights @IceNature
6.4 ý €úü	@zwpaper	@Geno1024 @branchzero @secondwtq
6.5 ý ! GitHub	@networm	@Geno1024 @branchzero @IceNature
6.6 B "	@devbean	@branchzero @buginix @IceNature
7. Git µ¶		
7.1 øù» þ 7!	@leo108	È ñ
7.2 å ý 2! "	@networm	@IceNature @jeffsui @M1seRy
7.3 # \$ Š % €	@networm	@IceNature @Geno1024 @M1seRy
7.4 è (μ"	@networm	@IceNature @tvvocold @Geno1024
7.5 &'	@leo108	È ñ

) *	+ (, - (
7.6 mL æÖ	@networm	@Kyle-ak @IceNature @Geno1024
7.7 mÓ()	@networm	@IceNature @Geno1024 @OlingCat
7.8 c ©† >	@networm	@IceNature @Geno1024 @jeffsui
7.9 Rerere	@networm	@Geno1024 @IceNature @jeffsui
7.10 . ' Git * +	@leo108	Ê ñ
7.11 l , -	@networm	@IceNature @Geno1024 @OlingCat
7.12 ê Õ	@networm	@xff2016 @Geno1024 @IceNature
7.13 .	@Gnahceg	@xff2016 @Geno1024 @IceNature @oldsharp Ê ñ
7.14 / O" #	@leo108	
7.15 ß "	@leo108	
8. É » 1 Git		
8.1 PÓ Git	@spacewander	@neo1218 @IceNature @branchzero
8.2 Git 2 -	@spacewander	@IceNature @secondwtq @oldsharp
8.3 Git 3 I	@spacewander	@IceNature @M1seRy @secondwtq
8.4 . ' ² Ö45DW- HI	@spacewander	@gisphm @IceNature @M1seRy
8.5 ß "	@spacewander	@devbean @networm @IceNature
9. Git Š 6 • ,		
9.1 " t « j 7 D Git	@networm	@IceNature @Geno1024 @KevenYoung @secondwtq @branchzero 8ÖÖ
9.2 89T Git	@networm	@IceNature @Geno1024 @youngWM 8ÖÖ
9.3 ß "	@networm	@IceNature @KevenYoung @Geno1024
10. Git A \ > €		
10.1 : ; ^ %oB C ; ^ %o	@oldsharp	
10.2 Git y <	@oldsharp	@networm @ZKHelloworld @OlingCat
10.3 Git – '	@oldsharp	@devbean @networm @ZKHelloworld
10.4 Ö½~	@zwpaper	@oldsharp @robinwen @IceNature
10.5 – ' = >	@morstar	@networm @oldsharp @robinwen
10.6 x y: ;	@zwpaper	@byr-gdp @robinwen @IceNature
10.7 ú ö Š ‡ ? @A	@networm	8ÖÖ @IceNature @Geno1024
10.8 ! B g C	@qinglangee	@vangie @IceNature @jeffsui
10.9 ß "	@oldsharp	@branchzero
A1. . B ¼ D Git		
A1.1 Ü Ú Ü Ü	@hbrls	@IceNature

) *	+ (, - (
A1.2 Visual Studio ¼D Git	@liwenzhuo	@devbean @IceNature @Geno1024
A1.3 Visual Studio Code ¼D Git	@Asurada	@networm
A1.4 Eclipse ¼D Git	@WispZhan	@IceNature @Geno1024 8ÔÓ
A1.5 IntelliJ / PyCharm / WebStorm / PhpStorm / RubyMine ¼D Git	@Asurada	@networm
A1.6 Sublime Text ¼D Git	@Asurada	@networm
A1.7 Bash ¼D Git	@WispZhan	@IceNature @Geno1024 @neo1218
A1.8 Zsh ¼D Git	@branchzero	@IceNature @Geno1024 @polarlights
A1.9 Powershell ¼D Git	@branchzero	@IceNature @Geno1024 8ÔÓ
A1.10 ß "	@networm	@IceNature @Geno1024 8ÔÓ
A2. [Git Dk f D- '		
A2.1 ^ %oÙ Git 1 2	@Geno1024	
A2.2 Libgit2	@Geno1024	@IceNature @fatjyc @branchzero
A2.3 JGit	@Geno1024	@IceNature @fatjyc @branchzero
A3. Git ^ %o	@banxi1988	@peizh @IceNature @byr-gdp
A3.1 E ÖŠ PÖ	@banxi1988	@peizh @IceNature @byr-gd
A3.2 OPŠ%í . æ	@banxi1988	@peizh @IceNature @byr-gd
A3.3 ½F × Ø	@banxi1988	@peizh @IceNature @byr-gd
A3.4] ŸŠ† >	@banxi1988	@peizh @IceNature @byr-gd
A3.5 . æ] 3Š ~ ™	@banxi1988	@peizh @IceNature @byr-gd
A3.6 Gæ Š> H	@banxi1988	@peizh @IceNature @byr-gd
A3.7 * +	@banxi1988	@peizh @IceNature @byr-gd
A3.8 I J	@banxi1988	@peizh @IceNature @byr-gd
A3.9 K ~	@banxi1988	@peizh @IceNature @byr-gd
A3.10 L \ • ,	@banxi1988	@peizh @IceNature @byr-gd
A3.11 ý €	@banxi1988	@peizh @IceNature @byr-gd
A3.12 : ; ^ %o	@banxi1988	@peizh @IceNature @byr-gd

Coding.NET í k MNÈ ø O P- tvvocold QRS T U VWW XY Z [\ 8] Å ^ Å

f [ō_f ó^ ¼D¶· ū| SA` k G Git D/ GA~? a ¥' ' E] b | ÷S) * <¥' [cf œ• DA~? <Üi ! - g ½de Bf ã ÷e D½¾B" ?

\$ O1) F ¥' [) * 7! ØÓ• , óVCSsø B Git D x! <ŒÑÑÇé B• • A~F ggi ` ai GitF t` a· j f t VCSs t #h ¼DW3F· Š · VCSs D' ì F, Bt` ažae%l \$. ' Git? d | F ¥' [) * pb<i Git, Bpef D• , Ák ÚÚ GitF pb t UWt YÙ‰tj ?

\$ O2) F ¥' [k l Git D x! . ' ÑÑÔmf \$. ' Git | 9° nTD 80% DoÚ? o\A` ! eFf- C° pqr àáPä• . ææÖP» f ½~ B Eœ~ f? pe! - \$asÉt Ff- CZ[° p. ' Z[hT Duvk' D Git äwOPTuLW° xy?

O3) GOŠ Git D] Y, z?] Y, z o€{ | t i Git D} ~©° - ? ðJ Ff [hi T• €i ` aa Git Š• ÇO? hi ô! eFf 9° , @Wf | ÷S, ...F \$ Git] Yft f Dó t DW\] èåFf T: i pbó t D?

O4) GOŠ EFð7D Git? ! e ÜNž " ' ' \$f ÉmDùüJ - %EFðòí ' Sí " D Git D` K? p ef' ' aì %Æ€ò" nFF ¥' í j ðOW" üyø. ?

O5) [k l e8] , 2μ" ï D^? F, Bpb. ' Git ...Y. ' ? hi ô! eFf- C° p\$e- éÖà áè ÷S‰k ŠFo\< l K~ . ' GitF œ• 5Æ€e- éÖ] YBí " K EœDI J?

O6)) * GitHub üy EF, B_ ; t Dμ¶? ¥' [Ž• O1Š2j y€F %í B. ' Git àáF Eœ. æ D• oμ" ï , B³ ^ 6%D£œF GitHub D9' Œ³' Bž" ° paf Dó t gÒ~ } ~Dú• " ?

O7) GS Git Dc ©^ %o? f [hi TW" c ©å" F• p—9~ DØresetÓ^ %oF . ' V] & wì ™ 1 F' šæÖF ^ ? 7! øù> > ?! eD) * [œ• f D Git äwFa f f t W- žgDt Y?

O8) GS Git | BDÉ» 1 PÓF ÕÖE Ö' §" 2 J ØÉ» 1 45D3I y! F, Bj Fff, @D1 2ÔÙμ" D| BPÓ? ¥' j j) * ¢í f ÉmDý! EF, " 2 É» 1 Cå 45?

O9) y> Git B . VCSsF ÕÖ\$ SubversionÓ SVNØD.. Ü. ' Git, B s . VCSs 89T Git? I eü üœ\$. ' SVNF> ¥í Ák | Šf gFã | Ff [^• T Git Ç9, ; D° .. ÑÑ! e[Á©F \$f ÇÒÇ. ' SVN EFðD; a pb: Oí " ? ¥' j [) * pbsÇO• , «k. æF, - f° pŽ- v®k Git D- °?

O:) _k Git ±² &uv D...Y^ ?? Y\$Ff Z[äj f k k G Git Dä wF° pŒ• Y' Git D² + ³ - D• ° ?³ <SFf 9, μ¶hi Git pb" #y <P Git Dy <, zi . ÄDþeÖ½~ D^ ? PEFð: ; > ~ eäw? ! - É¹ ñ, Þ[- ' ! eDA~F, - f° p\$œ| - 9, _k ^• ? hi Fpef Á¥' W Å' ' _k hi •• ^? Ff 9° : 1 A` Ude? ¥' [øù>åcf?

\$; < AF ¥' hi e- \$° » | B½. ' Git D...H? ¥' Ž• e- f 9° j . ' Git De- GUI B IDE' Õ| BFð" Þ 9, ° f Émøù? pef: \$ shellPIDEJ ½! ' šð½. ' GitF GA` ! e?

\$; < BF ¥' ðOo\» ¼ libgit2 B JGit Dμ¶' L Git y! P½À Git? pef y' LA¾P½¾DÉ» 1 μ¶¾STF, @^• Git D: ; HI F! e-i ff, @^• D?

¥| \$; < CF ¥' Wt - ð B Git Df k å @^ %oFAi \$! - ¼) * DA~F ÅÁ¥' ° p. ' ð" ^ %o

%o` a? p e f , @ä j ! - ¼¥' . ' ^ p " ° » Git ^ %oF f 9 „ \$òJ ä A ?

< Ü a ¥' „ ¹ Ø ?

= >

! e t Git k Å? ¥' s) * 7! ØÓµ¶ DÃÄäw, ¹ F d | æ• pb\$ f D• , ÑÝÙ GitF ¥| i GS
pbEÓ Git „ ¬, ¹ µ" ? o\! eDhi Ff ° C° ^• t` a Gitòaï ÙF t` af ° C. ' Git „ B
f ° Cp b EÓ „ . ' Git?

? @ABCD

` ai Ø7! ØÓÓÅ¥t` a@Gv. ÆÅ 7! ØÓi W8âäW- J ¶. ½~ A~g6F „ ¬[SäA°
» 7! » þoÇD• , ? \$! - fÀ©DHI ¼F ¥' yz" È—~ ï noD½~ " 7! ØÓF h...ÉÑF f
9„ yœb» z D½~ ØÙ7! ØÓ?

þef i ÈÙÚJ þEE| ÝF 9° j , @z" l wí Ùî J ÈÜ, Í ½~ Dfk » þ7! óðJ 8i f * €Ð
' / k D• ° øFÐ' 7! ØÓ• , óVCSøi - ÑÒDøù? k ^· f-9„ [ø» D½~ ÀÓTèåDÔ
ØF « ¬[Ö- . æï Á×T\] l - | ÷QDØÖFF 9„ > H½~ Dg 6^ ? FäX¥| i Ø» f ^p- 5
1Fs&ÙX« ÚÙ• I " XYD>s FNi Ø\$b | ÜÝ^l - • ° þB> > ? . ' 7! ØÓ• , o€j 9
àÈF—áf å SWä ä Ö- . æ¼D½~ f Df å Då Ff í FÄ9„ æç@AT>¹ DÄI ? hèL" •
Dµ" Céêl ê?

BE ABCDF G

8e%i ë' AÓÖ- . ææä D1 2Sz" ÇOD7! FJ 8j j f) • Ñj ° | ÷ „ ©' ì ? ða‰ì W
D5Æ—i } ~Fhi ° ì ~í î ™? k | ^ a j ï Øf\$Dµ" æä FWÇùvj L ™½~ J Kñ• 9: LD
½~ ?

t ^• Zò- I " F%' | ò„ å—. ï ^8e8! 57! ØÓ• , F†eï i D' l 8} ~D‡? áSâä ½
~ Dæt ~ ™ó• ?

Figure 1. UVWUXY.

¼¥ï ÜDW8Ô% RCSF Ya 8e | áö• , Ñï j • ÒT· Dö÷? RCS Dµ" >€i \$øùÑz " I
J EÓI J i • ½~ » þâ | Dg 6øúo\ - ' fk DI J F 9 „ m™| áXû- 7! D½~ A~?

H I J K A B C D F G

³ < S %' Nn T W- I " F pba \$ Ç O• , ÑD , ï K: Oµ" Å S i F E ¼ 6 D 7 ! Ò O• ,
Ó Centralized Version Control SystemsF } ü CVCSØ - Ý & Ó? ò » • , F • p CVS P Subversion „ ß
Perforce > F ï k W- ~ WD E ¼ y € D E F Ø F z " f k ½~ D » þ 7 ! F &: Oµ" D %' ï o \ « j 7
- T ð Ø E F Ø F P X ¥™ D ½~ J K C å ~ ™? e ` „ S F ð Z f t 7 ! Ò O• , D ç † % o W ?

Figure 2. Z Q[#WUXY.

Ø 8%Wý S ^ 8e 5ÆF° i i / H§þ 2D! 5 VCS S -? Y\$FÍ - %í 9,, \$W» ÕùÑ• T. æ½ D 6%g \$‰ `` a? &ý€3í 9,, æç- Óí - , ï K D>ÿ F > ¥ý€W- CVCS@é > \$ù- « i 7 Ñúö! 5‡?á S ðæç~í ?

n] ! ÜF k 5k " ? ða%¥# &í \$DPQi ¼%EFØD~Q&' ? pe(ðWú | Fža\$ðWú | AFØí ÅWCå ~ ™Fí —ÅW: Oµ" ? pe½v‡?áf\$D) ùçó* " FNÁk‰+ ñj ° F, Å - I f [. / fk‡?ÑÑÖÖ. æDÖ- g ~ æÖF - O<%' \$ùÉöðÑz 1D~2½F? ! 57! ØÓ • , í " \$» ¼I " F - @Ö- . æDæÖâã { z " \$~WÈÓF—k. / fkæÖ~ ™âã D™3?

L M N A B C D F G

§ i] , 27! ØÓ• , óDistributed Version Control SystemF } ü DVCSØÜ.. ^? \$ò» • , ¼F Å GitþMercurialþBazaar „ ß Darcs > F « i 7 > Ç~ CP¥™7! D½~ ½FF &i änoàáôÖ54Å < SF ØÖöÖDæÖâã ? ða WS Fœb WÆ: Oµ" ' DEFØçó&' Fn | í 9,, ' œb W- 4Å XSD! 5àá@A? stí Wt Dqr í " F...ÉÑí i Wt ynoàáDôÖj ° ?

Figure 3. \] ^WUXY.

~ ÔWÈF8eò»•, Ì 9„ • » B¶· ÇODé 7noàá ÔÙåÿ? šã Ff—9„ \$OW-. æ¼F]
ì BÇOµ" ûûD%/ÿ: " ? f 9„ 5?, @E » ÇOD: " Ì ÕF> p; t, z 2Dµ" Ì F &ò\$,
â DÈ¼2•, ½i ÅW...YD?

Git OP

Óó † ¼D8e Ó† n 6WÄF Git 7ó§W- ú• 89†: %™D` n?

Linux Au, † . æk Èt ‡ • eD; ŠK? <† e‡ D Linux Auúöµ" ī ó\$^Cå I J Bz" => D
?@n F Ñó1991A 2002` ÷ø? T 2002` F Ö- . æû, ¹ B' W- Ck D] , 27! ÒÓ• ,
BitKeeper Sý€Búöno?

T ^ 2005` F , ð BitKeeper D+ , ! " O Linux Au, † ' ' Dî " G• " DF 6' EÀ ^ Linux Au' ' Y_. ' BitKeeper D>'' ? ò—F. Linux, † ' ' ó° i i Linux DGHK Linus Torvaldsø x §. ' BitKeeper | D[I ©J F , ð XÉmD7! • , ? 6' y™D• , Óþ ^ ¶· æç O

¥ ¾ù

¥ } ~DE |

¥ y * K- , ð , 2D² .. Ý{ óL8f\$Ñ- -> Ù , ð D] Ýø

¥ ôŽ] , 2

¥ k ° .. c Žy €» ¼ Linux AuWÄD'' † =, . æó ¾ù B‡ ? Cø

É 7ó§ 2005` , SF Git r UfŒôMF \$cùí ' DO| F ødz 1ÈÜNE » Dæç? . D¾ùO½F
ú Pî ý€†. æF k È%%®, ÓMD* K-] Ýý€• , ó; \$ [Git](#)] Ýø?

Git QRS T

ž a F } ~5¬F Git • €i . ÄDW- • , ÆÅ GO9³ <SDA ~* €m@F ¶f €• ^ Git D,, : Bx!
µ" >€F' ÈS—j ä f „ dF §‰k Š? \$hi Git | FGQC€%f y . 7! ý€• , ZkD| wF
þ CVSP Subversion J PerforceF öÄ° ¶Ef. ' µ¶| XY ðóï ð? Qý Git' ÈSS . D7! ÒÓ
• , * €/ ¼F h. \$y MRD" #B| ä12Ñékl †ó• F€• ð" ó• [k £§XY. ' ¼DST?

UVW<XYZ[\] ^_`

Git B . 7! ÒÓ• , óÑÖ Subversion BU¼µ¶øDå @óí \$§ Git y V‡? D1 2? s<ŒÑS
¬F . †\] • , , ½~ g ~ W° D1 2" #MRF ð» • , óCVSP SubversionP PerforceP Bazaar
› ø [. ' " #DMR• " i Wû x! ½~ BÍ - ½~ X| ÷YÈZ[Dó• ó. ' o€ü" a@] ^
b delta-basedc D7! ÒÓø?

Figure 4. _` a b R c d e 2WU# f g.

Git Çj F „ Ñ1 2y VJ z " ‡??\ è F Git ~ Äi ä‡?• " i y ûz ½~ • , DW• W½F ? \$ Git
½F í øf Cå ~ ™J z " . æÔÖ! F· x! Ñ—j y ø! DŽ\ ½~ %í W- ½F > z " ð- ½F D' – ?
t ^ Ž] F p e ½~ Ák » f F Git Çd m™" # C½~ F & i ^ z 1 W- ^ 3 • Nèâ" # D½~ ? Git y V
‡? ~ Äi W- XYd?

Figure 5. _` h i j M k l m# n o.

ði Git ŠŒl fk · 7! ðÓ• , Dm@' i ? sā Git m™..._ ^ „ áí Wn 7! ðÓ• , Y¶<SD•
e 1 Ü? Git ~ Äi W- ûz D½~ • , FCD^8e , át x Øfí D'' 2 µ¶F & Ç" i W- } ~ D VCS?
` | ¥' \$ Git] Ÿ OP Git] Ÿý€! F [‡• ò81 2y V‡? f° OÒDa Å?

e f g h i j k Q B E l m

\$ Git ½D<† e ‡í " í ~ , @HI ! 5½~ BbÍ F Wc Ç, @SÉþwÑ · | áõDMR? pef i è
\$ fk í " í k þwY! , d D E ½27! ðÓ• , F Git \$ ð1 Üj a f ¾T ¾ùèef c ^ Git " g D°
C? s t f \$! 5) ùÑ—k . æDô ÖæÖF f , † \] í " • ÈSh ÷ ôf?

: - HI F @ ð B. æDæÖF Git Ç, L - T E F ð] OPæÖF d | d # ©XS ÑÑ. ~ , ...³ s! 5‡?
á¼` P? f° i j • T. ææÖ? pef: ä• øâ 7! ŠW- k â D7! è ÷ - k D» f F Gitj ä ÙTW

- Kâ D½~ %oWt ! 5Dó• | áF &Çi ° éŒEF ÕÆ€J s éŒEF ÕI Åm7! ½~ dS! 5Æ€? Òí 9àÈf \$nKJ KÁk VPN | F Ël 9, ÔÙœbÍ " ? pf \$OÖJ opÑ: %o" µ" F—° q½5 CåóTf DBE E! Fj âÒr ÅøF ...Tkþw- ³ | dÑx?pf Å#| VPN « j 7Çg€Fžaí ø ° µ" ? . ' . • , Ds F%oTò" i Ç9° J I _" D? > pf' Perforce Ds F Ák - ³ EF Õ| Ël Ç° %` anú&' Subversion B CVS Ds F f ° » f ½~ F hÇ° N‡? áCå» f óstf D! 5‡? áñK^ø? òÄ½l i " Ç†Fhi f 9° j ^ R5ç Y· ýSDI †DÇO?

Git n#opq

Git ¼fk D‡? \$" #âl | áNI BFd| „ NI BS- ' ? ò9àÈÇ9° \$ Git Çäo| ~ f œb½~ A~J æäA~? ò- • ° í \$ Git: ; Fi \$f Git t hÇ9J PD\] ? ¶f \$xu\Ö¼. / MRJ * " ½~ F Git—° ¿Y?

Git' „ | áNI BDÖÓô‰SHA-1 v WóhashF w' ø? òi W- ° 40- dx ÔÓy z ó0-9 B a-føû fDyz { F x§ Git ¼½~ DA~J æä" \$| áXS? SHA-1 w' • ÈSi òÄO

24b9da6552252987aa493b52f8696cd6d3b00373

Git ¼. ' ò8w' r DoÇI eFf [[€• Tò8w' r? ...ÉÑF Git‡? á¼z" DMRÍ i „ ½~ A ~Dw' r S' – F &Çi ½~) ?

Git 1rstuvwxyz

f, ÙD Git Í " F Ël - | Git‡? á¼tu‡?? f | ®. ' Git s‡? á¼å}‡? Fí —i → Git Ël Çj , Ùœb 9° « Ú½~ Ç9@ADÍ " ? Oì D VCS WÄF 4Cå~™| k9° . / J ~â» f DA~? hi W• f Cå½FT Git ¼F —®, d. /‡? F° i pef » ND€u‡? áT · àáDs?

ò. Ò¥' . ' Git f t W- Úvq• D\ÖFst ¥' _ä9, Qo‰û8, +F&Ák äno~fD, 3? ~_ù‡ O Git pbz"‡? B@A. /‡? Ds" FG; ...çèÍ"?

3xyz

Y\$GO9F pef' ' | ÜDhi ~ ...†FGå‡<Üò" G§ Git D< Æ? Git k÷8ÖOF f D½~ 9° ÆS ~ùèWO{ | } b committedc P{ ~• b modifiedc B{ €• b stagedc?

¥ Z» f° ©» f ^ ½~ F h j Áz" T‡? á¼?

¥ Z! " ° ©yW- Z» f ½~ Døâ7! %o^çâF. èÖm\$<t Cå D½F ¼?

¥ Z Cå° ©‡? Z[ÚŽ5z" \$! 5‡? á¼?

òj a ¥' D Git. æ/k ÷ - ^ f Oµ" ' P! " ' „ B Git æä?

Figure 6. pqi rst_uv5wGitxy.

μ" ' i y. æDl - 7! 2i CPXSDA~? ò" s Git à á D‰Š‡? á ¼CPXSD½~ F< \$) üÑ Df. ' J » f?

! " ' i W- ½~ Fz" ^<t [@Cå D½~ W° MRF Wc \$ Git à á æä ¼? j F Git D• ØE‰Ø' - ØF Ç\ Wc -Wj i ðØ! " ' Ø?

Git à á æä i Git' Sz" . æD^‡? By <‡? á D51? òi Git ¼¥m@D\] Fs . | áðqr à á | FAÓD-i ðJ D‡???

x! D Git μ" ï Øp<O

1. \$μ" ' ¼» f ½~ ?
2. [f: @<t Cå D~ f øù- 5! " FòÄ~ j [~ f D\] •• T! " ' ?
3. Cå ~ ™F ÜT! " ' D½~ F [½F Žò- " # T Git æä ?

p e Git æä ¼z" È° » 7! D½~ F—2S { | } ØØ? p e ½~ Z» f > < k! " ' F—2S { €• Ø Ø? p e ÈÑt GX| F" ^» f h j Ák < T! " ' ï F—i { ~• ØØ? \$ Git x Ø We F f j ØWÈ ^ • ò" ØØD^? F > h j pb5? ½~ ØØ...• | ¶ï " F , B· Ä• \! " ...³ Cå?

, fm

Git k e 8. ' 12? f 9,, . ' > ØD^‰Ù, 2Fí 9,, . ' GUI, 2Fò" GUI—~í ° CD e 8• ° ? \$! - ¼F ¥' [. ' ^‰Ù, 2? òi st' 1 F~ k \$^‰Ù, 2< f' ° , Ù Git D g h ^‰F & t e ‡ D GUI—~ - ... Y ^ Git f k • ° DW- I E,, " " ï " ®Ù? p e f h j ^\$^‰Ù < p b ï " F ž a f \$ï " GUI—~ | - Cí Çj n T` a S ® F h i F \ è• Ç f i ? á L F ° §í - % D: W Š - m Q Ç O F Ç O D % € € j Ú Ü Ç O D GUI—~ F h z (% W » j k ^‰Ù μ ¶?

—pf i macOS' i F ¥' ' ' f ~ Øpb. ' , 7 ó Terminal Ópf i Windows' i F ¥' ' ' f ~ Øpb. ' ^ %o™' ó Command Prompt J PowerShell? pf š4—, Ñ• ° F ¥' í ; f 1 > <S ½¾hi W< F ! – ¼Døl B: H[' Tò" • ° ?

„ ... Git

\$f „ . ' Git áF, @[· ÚÚ\$fd| áõÑ? j ~Z [ÚÚF¥5[· " ©T¥™D7! ? f 9,, o \—~ ÕJ K . ÚÚÓœS ÚÚFJK*i* Í o' • ÚÚ?

! ! – L" | . ' Dgit 7! t 2.8.0? ¥' . ' D†\] ^ %o¤d9,, \$I ž þDgit 7! Ñ . ' Fhí kó\] ^ %oÇ5' JK\$ m7! ¼DÙt kó• ? st git\$z{ N| } ~1 Ü ° YI 5F! – . ' Dò" ^ %o\$ 2.8e | D7! ~ Ck Ž?

† Linux ‡ „ ...

pef: \$ Linux Ñ' VÔÓÚÚÓœS ÚÚx! Dgit µ¶F 9,, . ' ïÙ7ÓmDxØ—~ Õý€µ¶S ÚÚ? , Fedora t HF pef \$. ' . óJ ŠèÝ) / GDx § RPM DÙ7F p RHEL J CentOSøF f 9,, . ' **dnf**O

```
$ sudo dnf install git-all
```

pef \$ x § Debian DÙ7ÑF p Ubuntu F G. ' **apt**O

```
$ sudo apt install git-all
```

@^• ~ eøùF Git 1þýÑk \$u8 Unix ïÙ7D• , ÑÚÛÈ i F þ¢t <https://git-scm.com/download/linux>?

† macOS ‡ „ ...

\$ Mac ÑÚÛ Git k e 81 2? ¥} ~D1 Wi ÚÚ Xcode Command Line Tools? Mavericks Ó10.9Ø J ~ c 7! D• , ¼F \$ Terminal J , +' t ÝÙ git ^ %o j 9?

```
$ git --version
```

peÁk ÚÛ\ ^ %oÙ, ïKµ¶F [j C©f ÚÛ?

pef: ÚÛ~™D7! F 9,, . ' VÔÓÚÛÓœ? 1 úöD macOS Git ÚÛÓœ9,, \$ Git 1þý< i F þ¢t <https://git-scm.com/download/mac>?

Figure 7. Git macOS Installer.

fí 9, [· " t GitHub for macOS DW\] SÚÚ? · ' DÙÚ6 Git µ¶ k W- ÚÚ^ %Ùµ¶ Dø. ?
f 9, s GitHub for macOS þ ý < i Cµ¶F þ ¶t <https://mac.github.com>?

† Windows ‡ „ ...

\$ Windows ÑÚÛ Git í k Ë8ÚÛ1W? 17! 9 „ \$ Git 1þÿ<i ? ê, <https://git-scm.com/download/win> F <i j ÉÝ, 1 ? @O9ò i W-) t Git for Windows D. æóí ô‰ msysGitø F B Git i] i 2i D. æú~ eMRGHI <http://msysgit.github.io/>?

@ÓÙÉ ÝÚÛF f 9 „ . ' Git Chocolatey Ő? O9 Chocolatey Ői ° ' ' úöD?

uW- } ~ D1 Wi ÚÚ GitHub Desktop? CÚÚÖœÖmÙÚ6B^ %Ù7! D Git? . í °Ý{
Powershell IF CD^ E» D/ O¤" B¥ŽD| ÙEÓ? ` | ¥' j yò1Ük~ e^• FY\$- @W| s—
p^Fò" Ŧ i f f, @D? f 9, \$ GitHub for Windows þÿ<i Fþ¢t GitHub Desktop þÿ?

^ %o Š < „ „

k %§ØsÎ oÚÛ Git ~ ...' Fst f ° ØT ¥™D7! ? VÔÓÚÛØœ'' N§kW" ©| F ødUE`
Git Z fŒFò- ó• Cd#^a ?

pef: s1 oÚÚ GitF, @ÚÚ Git • « Dá OautotoolsPcurlPzlibPopensslPexpat B libiconv? pe

fedora, Nk **dnf** óp FedoraøJ K **apt**óp x S Debian D•, øF
9 „ . ' y - D^ %oS ÚÚ¥ÖD• « „ -' • > ÚÚ Git DVÔÓ7O

```
$ sudo dnf install dh-autoreconf curl-devel expat-devel gettext-devel \
  openssl-devel perl-devel zlib-devel
$ sudo apt-get install dh-autoreconf libcurl4-gnutls-dev libbexpat1-dev \
  gettext libbz-dev libssl-dev
```

t ^••½> De 8š 2ódocþhtmlþinfoøF, @,, < f • D• « O

```
$ sudo dnf install asciidoc xmlto docbook2X
$ sudo apt-get install asciidoc xmlto docbook2X
```

! . ' RHEL B RHEL-7 F p CentOS B Scientific Linux D' j, @, B EPEL á,, -<
 i docbook2X Ő?

pef. ' x S Debian Dž Ù7ó Debian/Ubuntu/Ubuntu-derivativesøF f í, @ i nstall -i nfo ŐO

```
$ sudo apt-get install install -i nfo
```

pef. ' x S RPM Dž Ù7ó Fedora/RHEL/RHEL-7øF f j, @ getopt Őó. Z [\$ x S Debian
Dž Ù7½- Ú^øO

```
$ sudo dnf install getopt
```

á L F pef. ' Fedora/RHEL/RHEL-7 F žaf, @, Ú,, < ^ %oO

```
$ sudo ln -s /usr/bin/db2x_docbook2texi /usr/bin/docbook2x-texi
```

„ áS• ZVÔÓ½~) DÇO?

xf ÚÚ5fk D®@• « Ff 9,, µ¶s È- 51SPÒ¥™ž, 7! D tar Ő? f 9,, s Kernel.org þ ý
OPF þ¢t <https://www.kernel.org/pub/software/scm/git/> J s GitHub þ ý ÑD4ÃSOÒF þ¢t
<https://github.com/git/git/releases>? o€\$ GitHub ÑDi ¥™7! F h kernel.org ÑÖmk ½~ < i è
) F pef: I O<i g- - Dsj ' T?

³ ÈF' • > ÚÛO

```
$ tar -zxf git-2.8.0.tar.gz
$ cd git-2.8.0
$ make configure
$ ./configure --prefix=/usr
$ make all doc info
$ sudo make install install-doc install-html install-info
```

Ôf | Ff 9 „ . ' Git S OP Git D™ O

```
$ git clone git://git.kernel.org/pub/scm/git/git
```

Œ• Ž m Git • K • '

Œd Z [\$ • , ŅÚÛ^ GitF f j : @%Œ~ nS » Óf D Git | B? I Ø| áõÑ~, @PÓWt F Œœ“
©! j z 1 PÓMR? f 9 „ \$œb | ^ d t o\ÝÛ^ %S » f . ' ?

Git Éy W- **gi t config** Dµ¶S¢EEÓÒÓ Git L° BÙt DPÓgC? ò" g C" # \$÷ - ÇODÈ
OO

1. **/etc/gitconfig** ½~ : Ņí W- ' i B6' àáDo' PÓ? pe\$, Ù**git config** | ýÑ
--system Ø. Fž a. —j ` LC½~ ¼DPÓgC? ó° §. i . , PÓ½~ Fsäf, @ý€3J
" ©' i >ÿS » f . ?Ø
2. **~/.gitconfig** J **~/.config/git/config** ½~ O° ±y øâ' i ? f 9 „ x² --global Ø. a Git
` Lã ½~ Fòj yf . , Ñgh DàáOŽ?
3. øâ. ' àáD Git æä ¼D **config** ½~ ój . **git/config** øO±y Càá? f 9 „ x² --local Ø
. a Git² Ó` Lã ½~ Fcd³ | oÇ<' D—i . ?? ó ødFf, @Ók l - Git àá ¼' ° a Cø
. óŽ?Ø

I W- ©i j ñ • ÑW©i DPÓF f „ . **git/config** DPÓgCj ñ • **/etc/gitconfig** ¼DPÓgC?

\$ Windows • , ¼F Git j äÙ \$HOME æä <óWc oÇ< i C:\Users\\$USER ØD . **gitconfig** ½~ ?
Git OÄí j ' Ù **/etc/gitconfig** ½~ F h° ýS MSys D5æä < Fj ÚÛ Git | f ØDæç ÈÓ? pe
f \$ Windows Ñ. ' Git 2.x „ | D7! Fž a j k W- • , ©DPÓ½~ F Windows XP Ñ\$
C:\Documents and Settings\All Users\Application Data\Git\config F Windows Vista ß ~ ™
D7! \$ C:\ProgramData\Git\config? å ½~ " ° „ ý€3>ÿo\ **git config -f <file>** S »
f ?

f 9 „ o\ „ < ^ %œ • fk DPÓ „ B. ' f \$ D½~ O

```
$ git config --list --show-origin
```

ÚÚô Gitè | F@%DUW~ n—i EÓf D' j) BK~ 5¢? òWQI m@Fstí W- Git Cå ī j .
' ò" MRF· ' j LkTf Dí Wt Cå ¼F Ç9~ f O

```
$ git config --global user.name "John Doe"  
$ git config --global user.email john.doe@example.com
```

d t 2 * Fpe. ' ^ --gl obal ø. FžaC^ %o-, @ÝÙWt Fstè | ÅPf \$C• , Ñ‰œb n
oF Git ī j . ' ž" MR? xf: ±y° ». æ. ' ÇOD' j) üŠK~ 5¢| F9, \$ž - . ææã <Ý
ÙAk --gl obal ø. D^ %SPO?

I e GUIµ¶í j \$UWt YÙ| ¶Ef PÓò" MR?

- B—~™

Œd' j MRZ [EÓôµFf 9, PÓ³ | ½! ' šð^F x Git, @fykMR|j *' · ? p e 4P
ÓF Gitj . ' ī" • , ³ | D½! ' šð?

pef: . ' ÇOD½! ' šðF Hp EmacsF 9, òÄ‰O

```
$ git config --global core.editor emacs
```

\$ Windows • , ÑF pef: @. ' i D½! ' šðFža ®¶• » 9, Ù½~ DôÖ¢. ? . 9° Xf D'
šðDê Õ1 2&ÇO?

y § Notepad++FW- ï ÜDno' šðS-Ff 9° : @. ' 32ÊD7! Fst \$! - ' L | 64ÊD7!
šçY{ fk D, ~ ? pef \$. ' 32ÊD Windows • , FJ \$ 64Ê• , Ñ. ' 64ÊD' šðFžaf,
@yk p< ^‰O

```
$ git config --global core.editor "' C:/Program  
Files/Notepad++/notepad++.exe' -multiInst -notabbar -nosession -noPlugin n"
```

! VimPEmacs B Notepad++ ï i ï ÜD½! ' šðF o €‰3' j \$ Linux B macOS ò
» x § Unix D• , J Windows • , Ñ. ' . ' ? pef \$. ' 6DJ 327! D' šðF
G\$ [git config core.editor ^ %o ¼ä • EÓt C' šðD¶¹ Èj ?](#)

!! pef ÇòÄEÓ' šðFža x Git + ÜBÝ. | f 9° j { ~° » PÇäf ¼? HpF \$
Windows Ñ Git \$, ' š | 9° j \½5" D?

Š> • ' " •

pe: @Gäf DPÓF 9, . ' [git config --list ^ %oSWXfk Git x | ° ÜTDPÓ?](#)

```
$ git config --list
user.name=John Doe
user.email=johndoe@example.com
color.status=auto
color.branch=auto
color.interactive=auto
color.diff=auto
...
```

f 9° j • TmADgC) Fst Gitj sÇOD½~ ¼` POW- PÓóHpO/etc/gitconfig Š
~/.gitconfig? ò8oÇ<FGitj . ' . ÙTDÍ W- gCD¥| W- PÓ?

f 9,, o\yk git config <key>O SGä Git DÌ W. PÓ

```
$ git config user.name
John Doe
```

◦ § Gitj se - ½~ ¼` POWPÓgCDÇOr Fsäf 9° j \$ ¼• T 9¾è L Dr
&Çäj t` a? ä | Ff 9,, ä ã Git ¼Cg CDœ• r F· j ÝÀf pW- PÓ½~ ¥
| EÓ^Cr O

!

```
$ git config --show-origin rerere.autoUpdate
file:/home/johndoe/.gitconfig false
```

ž Y i

¶f. ' Git | , @OPCEFk÷8> qD1W9,, ÙT Git ^ %DÁî ~1 ómanpageO

```
$ git help <verb>
$ git <verb> --help
$ man git-<verb>
```

HpF@: OÖ git config ^ %D~1 F , Ù

```
$ git help config
```

ò" ^ %ol ÅFstfX| X59,, ' &Å, Åþ? pef \$ò~1JK! – DA~j Çp' Ff 9,, +
\$ Freenode IRC EF Ó <https://freenode.net> ND #gitJ #gitHub Åj ' Å¢£? ò" Åj [€k ÑÆ%
\$KF6' I Ýo Git> ¥±§£%?

ãLF pef Ç, @ŽÜD~1F~, @9' ø. D½¾; ...Fža9,, ' -hø. OÖ~ } ND ØhelpÓy

```
$ git add -h
usage: git add [<options>] [--] <paths>...

- -n, --dry-run           dry run
- -v, --verbose            be verbose

- -i, --interactive        interactive picking
- -p, --patch               select hunks interactively
- -e, --edit                 edit current diff and apply
- -f, --force                allow adding otherwise ignored files
- -u, --update               update tracked files
--renormalize              renormalize EOL of tracked files (implies -u)
- -N, --intent-to-add-later record only the fact that the path will be added later
- -A, --all                  add changes from all tracked and untracked files
--ignore-removal-as-no-all  ignore paths removed in the working tree (same as --no-all)
--refresh                   don't add, only refresh the index
--ignore-errors             just skip files which cannot be added because of errors
--ignore-missing-dry-run    check if - even missing - files are ignored in dry run
--chmod (+|-)x              override the executable bit of the listed files
```

CF

f - CZ[y Git i ` a PGit Šf 9° g\$. ' DЕ½27! ØÓ• , kb' ï > l " k ^ x! D^• ? Y
\$F\$f D• , ¼- Cí k ^ W° ° pμ" D Git 7! ? i | ^ , ¹ hi k G Git Dx Øä w^?

Git a ñ

pef - : o\A` We Shi GitFža! e[i f DÇVøù? ! eŽ• ^f \$. ' Git ôf û 8µ" | [j ' TDû8x! ^‰? \$hi ô! eè| Ff - C° pPÓ> Ü¹ 6W- àá repositoryøP, 1 J > ÇÈ öótrackø½~ P! " óstageøJ Cå ócommitø~ f? ! eí [Nf É©^p b PÓ Git S È 5• » D½~ B½~, 2Ppb È¾&} ~5çd™1 ī " Ppb ß Bf D. æDæÖ7! „ BÇOCå ócommitsøè ÷ Dó• Ppb Nf Dé Õà á€uópushø, Bpbsf Dé Õà áI Pópullø½~ ?

Ž Ý Git ¥ |

o€k! 8OP Git. æà áD1 2O

1. [š 4ÔÙ7! ÒÓD! 5æä ^ | t Git à áú

2. s . EF Ø §" W- Z" \$D Git à á?

! 812ī j \$f D! 5ôôÑÒTW- µ" —l D Git à á?

† { • † ©< | Æ• J ¥ |

pefkW- š 4ÔÙ7! ÒÓD. ææä F: @' Git SÒÓ· Fža' 1, @Ôk C. ææä ¼? pefj ÁðÄ‰\ Fža ÇO• , ÑD‰Wk " ÇOO

\$ Linux ÑO

```
$ cd /home/user/my_project
```

\$ macOS ÑO

```
$ cd /Users/user/my_project
```

\$ Windows ÑO

```
$ cd /c/user/my_project
```

è | , ÙO

```
$ git init
```

C^‰[%í W-) t .gi t DI æä Fò- I æä mk f Ü¹ 6D Git à á ¼fk D®¶½~ Fò" ½~ i
Git à áDí · ? hi F\$ò- | ^ F¥' ggi %o^W- Ü¹ 6Dī " Ff D. æJ D½~ j Ák { Èö?
(: \$ Git A\ >€ S^• ~ eG§T: .gi t ½~ î ¼Öm^p" ½~ DMR?)

pe\$W- Z" \$½~ D½~ Í ó&* í ½~ Í ø¼ÓÙ7! ÓÓFf- C, ¹ Đöò" ½~ > ÓÙÜ¹ Cå? 9,, o\ git add ^ %oS• » f, D½~ SÔÙĐÖFd|, Ù git commi t O

```
$ git add *.c  
$ git add LICENSE  
$ git commit -m 'initial project version'
```

` | ¥' dYW• Ñò" • %oDÙt? Y\$FfZ[ÓT^W- " \${ Đö½~ ŠÜ¹ Cå D Git à á?

§ .. a hK¥!

pef: OÒW° Z[" \$^D Git à á Dx y F > p¬Ff: t l - , Í . æE øÉmDW° " F ò | —@' T git clone ^ %o? pef y . D VCS . , ó> p¬ Subversionøl ÓÒFG1vW<ff. ' D ^ %o i "clone"&Çi "checkout"? òi Git' ì § . 7! ÓÓ• , DW- m@° - F Git qr Di C Git à á EF ÓÑDÈl fk‡? F&Çi ggAÓôff Dµ" f, @½~ ? øf, Ù git clone ^ %oD| ^ F³ | PÓ <éÓGit à á ¼DÍ W- ½~ DÍ W- 7! Í [{ | P<S? n...ÑF pef DEFØD) ù" Ó^Ffo€ 9,, . ' œbW- qr <SD' ; 7Smí EFØÑDà á ócd9° j . /l " EFØ7D3I óhookøE ÓFhi fk 7! D‡? ø\$F Ø\$ \$EFØÑòí Git ø?

qr à á D^ %o git clone <url>? > pF@qr Git D^3 á | i bgi t2F 9,, ' <ÜD^ %oO

```
$ git clone https://gitHub.com/i bgi t2/i bgi t2
```

òj \$ øâ æã <%í W-) t Ólibgit2Ó Dæã F > \$ò- æã <Ü¹ 6W- . git ½~ Í F s é Óà á I P<fk‡? < k . git ½~ Í Fd| s ¼` P¥™7! D½~ Dx y? pef ÓkTò- ™í D | i bgi t2 ½~ Í Ffj ð YfkD. æ½~ Z[\$J Ü^Ftj —l > V| ¶D, ð B. ' ?

pef: \$qr éÓà á D| ^ F É» 1! 5à á D) y Ff 9,, o\ èLD; ‡• » ™Dæã) O

```
$ git clone https://gitHub.com/i bgi t2/i bgi t2 myl i bgi t
```

òj , ÙŠÑWž ^ %o/ ODÍ " F hæç æã) g t ^ myl i bgi t?

Git Ý{ e8‡?xy: ; ? ÑÜDH! . ' Di <https://: ; FÇ\ fí 9,, ' git://: ; JK. '> SSH xy: ; F > p user@server: path/to/repo. git? \$EFØÑòí Git[j] *fkò": ; \$E FØ7pbPÓ. ' F, ßù812è÷Dt Ó?

W<< • ¬ - ®¥ |

Y\$¥' DÖÐÑk ^W- - ° ± © D Git à á F > sò- à á ¼GX^fk ½~ D²j³ B? o€Ffj y ò" ½~ %o" » f F Í øof ^W- ^ f Dæç F: @[åã <· | F—[· CåTTà á?

Gâ ‡ Ff µ" æã <DÍ W- ½~ Í CLl ò! 8ÔÓO{ ' µ J ¶ ' µ? ZÈÖD½~ i • ž" { Ök ^ 7! ÓÓD½~ F \$ÑWt ½F ¼k. ' Dâã F \$µ" Wf | ÷ | F . ' DÔÖ9° i 4» f FZ » f J Z

< k! " ' ? } &xèFZÈöD½~ —i Git Z [äj D½~ ?

μ" æā½} ZÈö½~ LD · fk½~ ī 2§4Èö½~ F· ' œç" \$§Ñt½FDâä½Fí Ák { < k! " ' ? Ütqrì - àáD! " F μ" æā½Dfk½~ ī 2§ZÈö½~ F> Æ§4» f ÔÖFst Git ØØGX^· ' F &f š4' š\· ' ?

' š\l " ½~ è | F° §ÉÑt Cå | fy· ' %o^» f FGit [· ' çâtZ» f ½~ ? \$μ" | Ff 9,, øù- 5[ò" » f \D½~ < k! " ' Fd | CåfkZ! " D» f Fpā\A?

Figure 8. Rc #{} | m[] ~

š> · · - , yz

9,, ' git status ^ %oä • p" ½~ Æ§` aÔÖ? pe\$qr àá | i j . ' ã ^ %oFj • T» ½òÄD
yXO

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
nothing to commit, working directory clean
```

ò–Ñf Y\$Dμ" æā / ø. Ù? | | s–FfkZÈö½~ \$Ñt Cå | ī 4{ ~ f \? äLFÑÜDM
Rj ° ÑF øäæä < Ák XYœbÆ§4ÈöÔÖD™½~ F a • Gitj \$òJWX§? ¥| FC^ %oj # ©
^ øäf\$] ÝF> ÝÀfò-] ÝOéÕEFðÑy~ D] ÝÁkÚn? Y\$F] Ý) i ÒmasterÒ,òi ³
| D] Ý) ? ¥' \$ Git] Ý ¼j Ô^ OP] ÝB- ' ?

Y\$Fa¥' \$. æ<%í W-™D README ½~ ? peèâ> Ç" \$ò- ½~ F. ' git status ^ %oFf
[• TW-™D4Èö½~ O

```
$ echo 'My Project' > README
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Untracked files:
  (use "git add <file>..." to include in what will be committed)

    README
```

nothing added to commit but untracked files present (use "git add" to track)

\$ ÓÓÜÝ¼9 „ • T™Í D README ½~ XY\$ Untracked files <Ü? 4ÈöD½~ 9àÈ Git \$èå
D½FóCåø¼Ákò“ ½~ úGit Çj ÉÝ[èÖk Èö>• F } * f ÑÑWW5ÝÀ. Ø¥, @ÈöC½~
Ó? ðÄDÆ€af Ç®Ûv [óf DVÓÓ½~ J . Ç: { ÈöD½~ ÕmÔS? Ç\Y\$DHI ¼F
¥' - ...: @Èöy€ README ð- ½~ ?

' μ - - ,
. ' ^ %o git add , ¹ ÈöW- ½~ ? f „ F @Èö README ½~ F ÝÙO

```
$ git add README
```

ä ; dÝÙ git status ^ %oFj • T README ½~ Z { ÈöF > A€§! " ÓÓO

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)

    new file: README
```

- @\$ Changes to be committed ðÙ<ÜDF —— Ni Z! " ÓÓ? p e å | C å F ž a C½~ \$f Ý
Ü git add | D7! [{ 1" \$ | ¶ DæÖå å ¼? f 9° j : Èèå ¥' . ' git init | —ÝÙ^ git
add <files> ^ %oF , ¹ Èö ø å æ å <D½~ ? git add ^ %o. ' ½~ J æ å D¢. " t ; þúpe;
‡ i æ å D¢. FC^ %o[² = 5ÈöCæ å <Dfk ½~ ?

€ • { ~ • K - ,

Ý\$¥' S » f W- Z { ÈöD½~ ? p ef » f ^ W-) t CONTRIBUTING.md DZ { ÈöD½~ F d | Ý
Ü git status ^ %oFj • T <ÜA~O

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file: README

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

    modified: CONTRIBUTING.md
```

½~ CONTRIBUTING.md XY\$ Changes not staged for commit ÒÙ<ÜF→ÑZÈÖ½~ DA~¿
ó^g6Fhj Ák< T! " ' ? @! " Òt~™F, @ÝÙ git add ^ %o? Òi - e•° ^ %oO9, ' . ,
¹ ÈÖ™½~ FJ KäZÈÖD½~ < T! " ' Fj °' §î > | äkUVÐ½~ çâtZ•ZÔÔ> ? [ò
- ^ %o€• t ÒÝ~ 5[A~•• T < Wt Cå½Ó&Çi Ò[W-½~ •• T. æ½Ó@~ • î P? Y\$a
¥' ÝÙ git add [ÒCONTRIBUTING.mdÓ< T! " ' Fd | d•• git status Dy XO

```
$ git add CONTRIBUTING.md
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file: README
    modified: CONTRIBUTING.md
```

Y\$! - ½~ Í Z! " F < t Cå | —j W> âãTàá? —Eã | Ff: @\$ CONTRIBUTING.md J d•ž
OÑ? m™' š" ù | F + j 5Cå? Ç\ ¥ÜFdÝÙ git status •• O

```
$ vim CONTRIBUTING.md
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file: README
    modified: CONTRIBUTING.md

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

    modified: CONTRIBUTING.md
```

• a ÄnÅ Y\$ CONTRIBUTING.md ½~ O! XY\$! " ' B*! " ' ? ò· a 9° AEÅ 5ØF ...ÉÑGit-
 Ç\! " ^f YÙ git add ^ %o! D7! ? pef Y\$CåF CONTRIBUTING.md D7! i f ¥| Wt YÙ
 git add ^ %o! Dž - 7! F &Çi f YÙ git commi t | F \$μ" æä ¼D¤ä 7! ? f „ F YÙ ^ git
 add è | N" ^ » þ D½~ F , @m™YÙ git add ä ¥™7! m™! " ÉSO

```
$ git add CONTRIBUTING.md
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file: README
    modified: CONTRIBUTING.md
```

yz Ø¹

git status ^ %oDyXd] Ô^ Fh ' Æk " ?@? Git kW- ø. 9„ Cf ŠÝÔÖ^ %oDyXF ðÄ9
 „ „ } PD12ä • ~ f ? pef . ' git status -s ^ %oJ git status --short ^ %oFf [ÒTW8
 ř 2~ t ŸÐyX?

```
$ git status -s
M README
MM Rakefile
A lib/git.rb
M lib/simplegit.rb
?? LICENSE.txt
```

™• • D4Èö½~ âÜk ??çâF™• • T! " ' ¼D½~ âÜk AÇâF» f \ D½~ âÜk Mçâ? y X¼k! àFáà • Ñ^! " ' DÔÖFâà • Ñ^µ" ' DÔÖ? Hp F ÑÜDÔÖÜÝ# ©O README ½~ \$µ" ' Z» f hš 4! " F & Lib/simpl egi t. rb½~ Z» f ¥Z! " ? Rakefi le½~ Z» F! " | N " ^ » f F sã C½~ D» f ¼Œk Z! " D\] FNK 4! " D\] ?

° » - ,

Wc ¥' Bj K" ½~ Å, ÖK Git Dý€Fí Ç' ' ' ' BXY\$4Èö½~ W°? o€ï i " ÉÝöfD½~ F> prä½~ FJK' • \Ö¼%í Dä | ½~ > ? \$ò8oÇ< F¥' 9,, %í W-) t . gi ti gnore D½~ FWX@È5D½~ D, 2? S• W- ...ÉD . gi ti gnore HI O

```
$ cat .gi ti gnore
*. [oa]
*~
```

UWÙÝÀ Git È5fk „ .oJ .a" åD½~ ? Wc ò» y <½~ B" >½~ T i ' ' \Ö¼XYD? UV ÜÝÀ Git È5fk) y „ ñæz Ó~ø" åD½~ F8e½! ' š—~ ó> p Emacsöï ' ðÄD½~) z" E! ? åLFF 9° j , @È5 logF tmp JK pidæäF „ BÉÝöfD½>> > ? @çfW, ¹ —t f D™à áEÓ5 .gitignore ½~ Di èF „ Y[S¹ Cåò» Å' D½~ ?

½~ . gi ti gnore Dš 2=>p <O

¥ fkï ÜJ K „ # , èDÜï j { Git È5?

¥ 9 „ . ' ç†D glob, 2éPF· j ² = 5- ' \$Ö- µ" ' ¼?

¥ éP, 29 „ , ó/ø, èêÇ² =?

¥ éP, 29 „ , ó/ø" å• » æä?

¥ @È5• » , 2 „ LD½~ J æäF 9 „ \$, 2â• Ñëi ó! øP\?

fí D glob, 2i • shell f. ' D} 6^Dg• ° Å2? î i ó*øéPï - Je- æ9yzú [abc] éP œbW- W\$1Öì ¼Dyz óò- HI @aéPw- aF @aéPw- bF @aéPw- cœú l i ó?ø- éPw- æ9yzúpe\$1Öì ¼. ' YSK] ð! - yz F ° ©fk \$ò! - yz >• ADï 9 „ éP õ> p [0-9] ° ©éPfk 0T 9D‡yø? . ' ! - î i ó**ø° ©éPæ9¼÷æäF> p a/**/z 9 „ éP a/z P a/b/z J a/b/c/z > ?

¥' d• W- . gi ti gnore ½~ DHl O

```

# È5fkD .a ½~  

*.a

# hÈöfKD lib.aFj -f $â ÜÈ5^ .a ½~  

!lib.a

# - È5¤åæã< D TODO ½~ F &ÇÈ5 subdi r/TODO  

/TODO

# È5œbæã<) t buil d D½~  

buil d/  
  

# È5 doc/notes.txt hÇÈ5 doc/server/arch.txt  

doc/*.txt  
  

# È5 doc/ æãß fkI æã< D .pdf ½~  

doc/**/* .pdf

```

GitHub k W- d] Ö^ D±y‡d8. æßŒxD .gi ti gnore ½~ W° F f 9,, \$
<https://github.com/github/gitignore> ÙT. ?

! \$¥} ~DOÇ<FW- àá9° - 5æã<kW- .gi ti gnore ½~ F· ² = 5° ' TÖ
- àá½? d&FI æã<í9,, kèLD .gi ti gnore ½~ ?I æã½D .gi ti gnore
½~ ½D=• " ' §· f\$Dæã½? óLinuxAuDÍ oá/k 206- .gi ti gnore ½~ ?ø

e- .gi ti gnore ½~ D¶¹ ^ ? .. X^! - D>• F~ eÖo\$ man gi ti gnore ?

> ¼{ €• ½¶€• K~•

pe gi t status ^ %DyXySfS~\S} 5F&f: äj ¶¹ »f ^` a51F9,, ' gi t diff ^
%? ` | ¥' j Ö^) * gi t diff Ff o€9° j ' · SÀ®ò! - I " O¤å%Dp" ~™š4! " Åk
p" ~™Z! " > tj 5<t CåÅcd gi t status Z[o\\$/- à<WX½~) D12À®^ò- I
" Fh gi t diff ° o\½~ I J Dš2~ • ¶¹ 5#©p" Ùçó^fg?

—pd t »f README ½~ | ! " Fd | ' š CONTRIBUTING.md ½~ | ¹ Ç! " F ÝÙstatus ^ % [j •
TO

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    modified:   README

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

    modified:   CONTRIBUTING.md
```

@ä • Š 4! " D½~ ~ ™^ p" \] FÇ• ; ‡...³ yk **git diff**O

```
$ git diff
diff --git a/CONTRIBUTING.md b/CONTRIBUTING.md
index 8ebb991..643e24f 100644
--- a/CONTRIBUTING.md
+++ b/CONTRIBUTING.md
@@ -65,7 +65,8 @@ branch directly, things can get messy.
EPILease include a nice description of your changes when you submit your PR;
If we have to read the whole diff to figure out why you're contributing
In the first place, you're less likely to get feedback and have your
change
-merged in.
+merged in. Also, split your changes into comprehensive chunks if your
patch is
+longer than a dozen lines.

If you are starting to work on a particular area, feel free to submit a
PR
That highlights your work in progress (and note in the PR title that it's
```

ä ^ %o HDI µ" æä½¤å½~ B! " ' i ½Fè÷Dó•? i —i » f è | j Ák! " ÉSDg6A
~?

¶@ä • Z! " D[@• • T<t CåJ DA~F 9, ' **git diff --staged** ^ %o? Òž ^ %o[> y Z! "
½~ Š¥| Wt CåD½~ ó• O

```
$ git diff --staged
diff --git a/README b/README
new file mode 100644
index 0000000..03902a1
--- /dev/null
+++ b/README
@@ -0,0 +1 @@
+My Project
```

GO9F git diff! - - # ©š 4! " Df ŸF&Çi ÉÑt Cå „ Sf‰Dfk f Ÿ? f , k | ^ a f W< I !
" ^ fk ~ ™\ D½~ F ŸÙ git diff | é` aí Ák F—i ò- >s?

Ãèâ¬DF! " CONTRI BUTI NG. md | d' šF 9, . ' git status ä • Z{ ! " D» f J 4{ ! " D»
f ? p e ¥' D! Bó , 7y Xø• ÈSp<O

```
$ git add CONTRI BUTI NG. md
$ echo '# test line' >> CONTRI BUTI NG. md
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

  modified:   CONTRI BUTI NG. md

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

  modified:   CONTRI BUTI NG. md
```

Y\$ ŸÙ git diff • ! " â | Dg 60

```
$ git diff
diff --git a/CONTRI BUTI NG. md b/CONTRI BUTI NG. md
index 643e24f..87f08c8 100644
--- a/CONTRI BUTI NG. md
+++ b/CONTRI BUTI NG. md
@@ -119,3 +119,4 @@ at the
È## Starter Projects
```

ÈSee our [projects
list](<https://github.com/libgit2/libgit2/blob/development/PROJECTS.md>).
+# test line

d | ' git diff --cached & • Z[! " ÈSDg6ó --staged B --cached i O1 ñøO

```
$ git diff --cached  
diff --git a/CONTRIBUTING.md b/CONTRIBUTING.md  
index 8ebb991..643e24f 100644  
--- a/CONTRIBUTING.md  
+++ b/CONTRIBUTING.md
```

@@ -65,7 +65,8 @@ branch directly, things can get messy.

ÈPlease include a nice description of your changes when you submit your PR;

ÈIf we have to read the whole diff to figure out why you're contributing
Èin the first place, you're less likely to get feedback and have your
change

-merged in.

+merged in. Also, split your changes into comprehensive chunks if your
patch is

+longer than a dozen lines.

ÈIf you are starting to work on a particular area, feel free to submit a
PR

Èthat highlights your work in progress (and note in the PR title that it's

Git Diff # • c WU

! \$! -½F ¥' . ' git diff\$] ð½~ ð• ? hi fí 9,, . ' ÜÚ6Dμ¶J L\
diff μ¶S> Hó• ? 9,, . ' git diff tool ^ %oS* ' emergeJ vimdiff> —~ ðÓ
Ö+, —~ øyX diff D] ð" e? . ' git diff tool --tool -help ^ %oS• f D• ,
Ý{ p" Git Diff „ ~ ?

| } --

Y\$D! " ' Z[+j -l F 9,, Cå^? \$æèäFGF®" | j k ` aZ» f J™í D½~ j Ák git
add\ F ^ a • CåD! ^ Cj âäò" š4! " Dg6? ð" Z» f h4! " D½~ - j z 1 \$! 5) ù? f
„ Fí t +j CåâF 1 ' git status • < F f f, @D½~ i Çi ī Z! " ÈS^F d| dÝÙCå ^ %o
git commi tO

```
$ git commi t
```

ðÄj BÝf øùD½! ' šðSyk Cå – Ñ?

! BÝD' šði o\ Shell D! Bg C EDI TOR • » DF Wc t vimJ emacs? ædí 9,,
i F ÈÈ) * D12F . ' git config --global core.editor ^ %oE Óf RQD'
šð?

' šðj # ©» ¼< ÜD½! MRÓ! Hø' Vim Dó# 12À©øO

```

# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
# Your branch is up-to-date with 'origin/master'.
#
# Changes to be committed:
#   new file: README
#   modified: CONTRIBUTING.md
#
~ 
~ 
~ 

".git/COMMITMSG" 9L, 283C

```

9 „ • TF³ | DCå è RÖm¥| Wt ÝÜ git status Dy XF< \$OÑÙJ FuL, èj kW- Í ÙF
Df yk Cå -Ñ? f ôŽ9,] Óò" OÑÙFÇ\1Èí AG• Feö° Cf Å: Èòt ~™DA~kp
" ?

! | ~ Ö^ DA~» f C©9, ' -vø. ä• Fòj [ff" D~ f D diffy Xî Y\$' šð
¼F, -afäj ! t Cå¶1" Xp" » f ?

x X' šð | F Gitj . ÕOÑÙF' f yk DCå -Ñóf Wt Cå?

uLFFí 9, \$ commi t ^ %o| • • -mø. F [Cå MRŠ ^ %o< \$OWÙF p< f ©O

```

$ git commit -m "Story 182: Fix benchmarks for speed"
[master 463dc4f] Story 182: Fix benchmarks for speed
 2 files changed, 2 insertions(+)
 1 create mode 100644 README

```

5FY\$FZ[%í ^ UW- Cå õ 9, • TFCå | · j ÝÀf F øai \$p-] ÝómasterøCå DF!
t Cå DôÖSHA-1NI Bi ` a ó 463dc4føF, B\$! t Cå ¼F keö½" » þ\FeöÙ• • Båf
\?

Gå f FCå | åå Di < \$! " ' ì D½F? œbj 4! " ½~ Dødz { Z» f ÖOF 9, \$< t Cå |
Ök 7! ý€? f Wt ÝÜCåT " FÍ i yf. æ" Wt ½FF, | 9, ÀTò- ÖOFJ KÖÙ> H?

¾¿À' €• ÁÂ

Qý. ' ! " ' ì D129, Ýv+j @Cå D^ ?Fhk | ^ òa‰5#? @? Git CD^W- • \. ' !
" ' ì D12F - @\$Cå D| ^ Fc git commi t • Ñ -aø. F Git—j ÉÝäfkZ[Èö\D½" !
ÈSW> Cå Fs&• \ git add Èj O

```

$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

  modified:   CONTRIBUTING.md

no changes added to commit (use "git add" and/or "git commit -a")
$ git commit -a -m 'added new benchmarks'
[master 83e38c7] added new benchmarks
 1 file changed, 5 insertions(+), 0 deletions(-)

```

- T^r ÅCåèâÇd, @git add ½~ ÖCONTRIBUTING.mdÓ^? òi st -a ø. . ! t Cå Óm^fk » f \ D½~ ? òl 1¬Fhi @uvFk | ò- ø. j [Ç, @D½~ • • TCå ¼?

ÄÄ-

@S Git ¼9} l - ½~ F—®¶@S Z Èö ½~ %~ ¼9} ó~ { 5¬F i s! " ' i 9} øFd | Cå? 9,, ' git rm ^ %Öfā. µ" F> - ýsµ" æä ¼å } • » D½~ FòÄ„ | —Çj XY\$4Èö ½~ %~ ¼^?

pe~ i } ~5sµ" æä ¼~ µå } ½~ F ÝÙ git status | —j \$ ÖChanges not staged for commitÓ\] óí —i €t _• , ø• TO

```

$ rm PROJECTS.md
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes not staged for commit:
  (use "git add/rm <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

  deleted:    PROJECTS.md

no changes added to commit (use "git add" and/or "git commit -a")

```

d | d ÝÙ git rm âääät 9} ½~ DÍ " O

```
$ git rm PROJECTS.md
rm 'PROJECTS.md'
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    deleted:    PROJECTS.md
```

<Wt Cå | FC½~ —ÇdÖk 7! ý€^? pe@å} èâ»f \J Z[< T! " ' D½~ F • ®¶. ' ² Óå} ø. -fó• OOj force D' y öø? òi W8ÚŽ° - F' ŠéÇ¹ åš4• • T½FD‡? F ò ÄD‡? Ç° { Git @A?

uLW8oÇi F¥' : ä½~ s Git àá¼å} ó÷j s! " ' i 9} øFh¤d' ' z1\$¤âµ" æä½? | | s¬Ff: a½~ z1\$) ùFhi > Ç: a Gitµ¶Èö? ¤føâ• • .gi t ignore ½~ FÇü väW- I †Dr ä½~ J Wù .aðÄD' • öf½~ • • T! " ' | FòW‰Wú k' ? t ÄTòWæ DF. ' --cached ø. O

```
$ git rm --cached README
```

git rm ^ %o| Ü9, WX½~ J KæäD) yFí 9, . ' gob, 2?> pO

```
$ git rm log/*.*.log
```

O9Tî i *èâD\ûü\F st Gitk. ÉmD½~, 2½ÅéP12Ff, ¥' Ç' shell S¢ýÅ, ? ä^‰å} Log/ æä<½Å) t .log Dfk½~ ? » ¼D> pO

```
$ git rm \*~
```

C^‰j å} fk) y, ~" åD½~ ?

ÃÅ—,

ÇÃ . DVCS•, FGit> Ç#2Èö½~ 9ÝÍ " ? pe\$ Git ¼m^) ^l - ½~ Fàá¼" #D^‡ ?> Çj ¹ YXòi Wtf) l " ? Ç\ Git * €þÑF· j €ÿX• €¿Ó^` aF¬S¶¹ i pb‰TDF ¥' ` | d! ?

ŒdpäF¤f • T Git Dmv ^‰! W» j STÇZ? @\$ Git ¼y½~ f) F 9, òa‰O

```
$ git mv file_from file_to
```

· j + p - Ncg€μ" ? ...ÉÑFj ñā | ä • ÔÖMRFí j ÑWÅ¹ 5• TG\$ m^) Í " D-ÑO

```
$ git mv README.md README
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    renamed:    README.md -> README
```

...FÝÙ gi t mv —/¤§ÝÙ^<Ü÷ž ^ %O

```
$ mv README.md README
$ git rm README.md
$ git add README
```

pā] , Í " F Gití j 9wTòi Wt m^) Ff „ Çýb812" eÍ WÄ? ! Kì WD' i i Fmv i W
ž ^ %&* ÷ž ^ %F ...³' git mv 1-Óe? Ç\k | ^ ' 6μ¶=Æ€m^) Ds F@â Ó\$Cå å
å } mD½~) Fd••™D½~) ?

> ¼ | } AEP

\$ Cå ^¶. ~ ™F NJ Kqr ^l - . æè | F f í 8: Å" <Cå æÖ? öfò - œF ¥} ~ &Nk Ž D
μ¶i git log ^ %?

¥' . ' W- * €} ~ D ÓsimplegitÓ . æ" t ©H? ÝÙ<ÜD^ %O OPC. æO

```
$ git clone https://github.com/schacon/simplegit.t-prog
```

¤f \$ä . æ¼ÝÙ git log ^ %! F 9 „ • T<ÜDy Xo

```
$ git log  
commit ca82a6dff817ec66f44342007202690a93763949  
Author: Scott Chacon <schacon@geech-mail.com>  
Date: Mon Mar 17 21:52:11 2008 -0700
```

È changed the version number

```
commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7  
Author: Scott Chacon <schacon@geech-mail.com>  
Date: Sat Mar 15 16:40:33 2008 -0700
```

È removed unnecessary test

```
commit a11bef06a3f659402fe7563abf99ad00de2209e6  
Author: Scott Chacon <schacon@geech-mail.com>  
Date: Sat Mar 15 10:31:28 2008 -0700
```

È first commit

Çx kæb; † D³ | oÇ< F **git log** j i | ÷¹ | ...œWXfk DCå F ¥UD~™# \$¥ÑÜ? gp f
f • TDFò- ^ %oj WXÍ - Cå D SHA-1 NI BP" KD) yB< I K~ 5\$PCå | ÷ „ BCå -Ñ?

git log k 8eø. 9 „ ¢Ef & ' ff@ÙDCå F <Ü¥' j) * È- ¥€' Dø. ?

¼W- → Hk' Dø. i -pJ --patch F· j #©í t Cåf- k Dó• øj ÇÈ Dš 2y Xø? f í 9
„ ý Ø# ©Dr á ž æ‡ CF Hp. ' -2ø. S- #©¥UD! t Cå O

```
$ git log -p -2
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@geek-mail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700
```

È changed the version number

```
diff --git a/Rakefile b/Rakefile
index a874b73..8f94139 100644
--- a/Rakefile
+++ b/Rakefile
@@ -5,7 +5,7 @@ require 'rake/gempackagetask'
Espresso = Gem::Specification.new do |s|
È   s.platform = Gem::Platform::RUBY
È   s.name      = "simplegit"
-   s.version    = "0.1.0"
+   s.version    = "0.1.1"
È   s.author    = "Scott Chacon"
È   s.email     = "schacon@geek-mail.com"
È   s.summary   = "A simple gem for using Git in Ruby code."
```

```
commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
Author: Scott Chacon <schacon@geek-mail.com>
Date:   Sat Mar 15 16:40:33 2008 -0700
```

È removed unnecessary test

```
diff --git a/lib/simplegit.rb b/lib/simplegit.rb
index a0a60ae..47c6340 100644
--- a/lib/simplegit.rb
+++ b/lib/simplegit.rb
@@ -18,8 +18,3 @@ class SimpleGit
È   end
```

È end

```
- 
-if $0 == __FILE__
-  git = SimpleGit.new
-  puts git.show
-end
```

CØ. } ^#©x! MRèLFj fý^Í t CåDg6? ☺ÙnøMäFJ K½¾¿BÌ - ò>DCåƒ
ýSDg6D! ªFò- ; ‡-*€k' ^?fí9, t git log fýW•WDß" - ø. ?> pf: • TÍ
t CåD} 5, | MRF9,, ' --stat ø. O

```
$ git log --stat
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@geech-mail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700
```

È changed the version number

```
Erakefile | 2 ++
1 file changed, 1 insertion(+), 1 deletion(-)
```

```
commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
Author: Scott Chacon <schacon@geech-mail.com>
Date:   Sat Mar 15 16:40:33 2008 -0700
```

È removed unnecessary test

```
Elib/simplegit.rb | 5 -----
1 file changed, 5 deletions(-)
```

```
commit a11bef06a3f659402fe7563abf99ad00de2209e6
Author: Scott Chacon <schacon@geech-mail.com>
Date:   Sat Mar 15 10:31:28 2008 -0700
```

È first commit

```
ErEADME           |  6 ++++++
Erakefile         | 23 ++++++ ++++++ ++++++ ++++++
Elib/simplegit.rb | 25 ++++++ ++++++ ++++++ ++++++
3 files changed, 54 insertions(+)
```

gpff • TDF --stat ø. \$ít CåD<ÜWXfk{ » f \ D½~ Pkeö½~ { » f ^ „ B{ » f \
D½~ Dp" Ù{ 9} Ji • • ^? \$ít CåD¥| j kW- B" ?

uW- * €k' Dø. i --pretty? ø- ø. 9„ . ' ÇOŠ³ | š2D12À©CåæÖ? ø- ø. kW
" Áí DI ø. Df. ' ? > p onel i nej [í - Cå< \$WÙ#©F\$¿B†CDCå; * €k' ? uLj
k shortF ful l B ful l er ø. F· ' À©MRDš2x! WÚFhi ÔQÖùÇWO

```
$ git log --pretty=oneline
ca82a6dff817ec66f44342007202690a93763949 changed the version number
085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7 removed unnecessary test
a11bef06a3f659402fe7563abf99ad00de2209e6 first commit
```

¥k 9„ Di format F 9„ » ÓâãD#©š 2? öÄDyXy | NCP] øšLk' ŇÑstfäj yXD
š2Çj XÈ Git D~™&¿óf gO

```
$ git log --pretty=format:"%h - %an, %ar : %s"
ca82a6d - Scott Chacon, 6 years ago : changed the version number
085bb3b - Scott Chacon, 6 years ago : removed unnecessary test
a11bef0 - Scott Chacon, 6 years ago : first commit
```

git log --pretty=format €' DØ. WX^ format³ ´ D€' š2\$Êz DLWB n° D91 ?

Table 2. git log --pretty=format f „ # ...h

É ±	Ê Ë
%H	Cå Dô Öw' r
%h	Cå D} Lw' r
%T	%Dô Öw' r
%t	%D} Lw' r
%P	&Cå Dô Öw' r
%p	&Cå D} Lw' r
%an	" K) y
%ae	" KD< I K~ 5¢
%ad	" K» þr NÓ9 „ ' --date=ø. S» Óš 2ø
%ar	" K» þr NF i eð, áD1 2# ©
%cn	Cå KD) y
%ce	Cå KD< I K~ 5¢
%cd	Cår N
%cr	Cår NÓ' ae, ÷ø
%s	Cå →Ñ

f W» (ÜqT B†‡T è÷• €kbóì F ..." K• Di ...É" X» f D%F Cå K• Di ¥| [äµ " f e Cå Tà áD%? f „ F øf t l - . æð, I J F d | l - uvf 3[f DI J > k. æ| Ff — " K F &ž - uvf 3—i Cå K? ¥' j \$] , 2 Git dÔ^) *! Kè ÷D^ êóì ?

¤ onel i neJ format ŠuW- logø. --graph" î . ' | ú k' ? ð- ø. • • ^W" ASCII yz { SÚ<5À©f D] Ýþî > æÖO

```
$ git log --pretty=format:"%h %s" --graph
* 2d3acf9 ignore errors from SIGCHLD on trap
* 5e3ee11 Merge branch 'master' of git://github.com/dustin/git
|\
| * 420eac9 Added a method for getting the current branch.
* | 30e367c timeout code and tests
* | 5a09431 add timeout protection to git
* | e1193f8 support for heads with slashes in them
|/
* d6016bc require time for xml schema
* 11d191e Merge branch 'defunkt' into local
```

Ø8y X»zj \$¥' <We hô] ŸŠî >, | gØ~ • kT?

„ Ñ- i } ~) * ^W“ git log ^ %oÝ{ Dø. ? git log D€' ø. WX^¥' æâéBTDBÁéB
T Dø. F „ B· ' i pb÷) log ^ %oDy XDO

Table 3. git log #f, ...h

É±	ÉÈ
-p	j I J š 2# ©í - Cå – k Dó • ?
--stat	# ©í t Cå D½~ » f , MR?
--shortstat	- # © --stat ¼¥ DÙ‡ » f • • 9} , ?
--name-only	g \$ Cå MR # ©Z » f D½~ %~ ?
--name-status	# ©™" P » f På } D½~ %~ ?
--abbrev-commi t	g # © SHA-1 NI Bfk 40 - yz ¼Då È - yz ?
--relative-date	. ' HÝD/y ÷ &Ci ôÖš 2# ©r Nø> pØ2 weeks ago Øø?
--graph	\$ r å * „ ASCII ÜÚ# ©] ŸŠî > æØ?
--pretty	. ' 6š 2# ©æÖCå MR? 9' Dø. ØÖ onelinePshortPfullPfuller B formató' S » 1 ÉmDš 2ø?
--onel i ne	--pretty=onel i ne --abbrev-commi t î ' D} L?

I DÍ Í Í Ð

} ^ » Øy Xš 2Dø. èLF git log j k8e* €...' DýØy X, ùDø. Fí —i — yXW\] DC
å? èâf Z[• T\ -2ø. ^F· — j # ©¥UD! ž Cå F ...ÉÑFFf 9,, . ' » ¼ -<n> Dø. F ¼
D n 9,, i œb Ö‡ F° ©g# ©¥UD n ž Cå? Ç\ ...+ ¼Ø- ø. Ci | €' Fst Git³ | j [fk
Dy Xx uT] È Øœ¼F f, f Wt — j • TWÈDA~?

hi F » ¼ --si nce B --until Ø8j F | ÷" ýØDø. I k' ? Hp F < ÜD^ %oj WX¥U! XDf
k Cå O

```
$ git log --si nce=2 weeks
```

C^ %9' Dš 2d] æ• ÑÑ9,, i » ¼ "2008-01-15" D¶¹ DÌ WbFí 9,, i » ¼ "2 years 1 day
3 mi nutes ago" D/yr N?

j 9,, \, XéP• » ž ~ DCå? ' --author ø. # ©• » " KDCå F' --grep ø. & Cå -Ñ½
DG- y?

! f 9,, • » e- --author B --grep & ' ž ~ FòÄj - yX ÑÒéP --author , 2B
--grep , 2DCå? d&Fpef • • ^ --all -match ø. F • - j yX gh éP
--grep , 2DCå?

uW- * €k' D\, ði -Só. üÓpickaxeØø. FPÒ' / O1 \$ 2J 34è Óè 9øF . ³ ' W- y
z { ; ‡F> ¥- j # ©ž" • • J å} ^ Cyz { DCå? —Ef: ÙX• • J å} ^ y l W- ° » 5‡D
- ' DCå F 9,, * ' O

```
$ git log -S function_name
```

¥| W- I ...' Dgit log ø. i ¢. ópathøF pe- Gv l " ½~ J Kæä DæÖCå F 9,, \$ git log
ø. D¥| • » . ' D¢. ? sti < \$¥| ÈÓÑDø. Ff, ' ! - ÝSKÓ--øð, èâ Dø. B| Üy
» D¢.) ?

\$ ýÓgit log yX Dø. ¼WX ^ €' Dø.

Table 4. ^ Y git log %S# ...h

É±	ÊÈ
-<n>	g# ©¥UDnž Cå?
--since, --after	g# ©• » ÷ è DCå?
--until, --before	g# ©• » ÷ è â DCå?
--author	g# ©" KéP• » yz { DCå?
--committer	g# ©Cå KéP• » yz { DCå?
--grep	g# ©Cå -Ñ½Öm• » yz { DCå?
-S	g# ©• • J å} A~éP• » yz { DCå?

S• W- ...É DHI Fpe @\$ Git l oá ¼ä • Junio Hamano \$ 2008 ` 10 k ÷ F } ^ î > Cå è LD
pW- Cå » f ^ 6+ ½~ F 9,, . ' < ÜD^ %O

```
$ git log --pretty="%h - %s" --author='Junio C Hamano' --since="2008-10-01" \
    --before="2008-11-01" --no-merges -- t/
5610e3b - Fix testcase failure when extended attributes are in use
acd3b9e - Enhance hold_lock_file_for_{update,append}() API
f563754 - demonstrate breakage of detached checkout with symbolic link HEAD
d1a43f2 - reset --hard/read-tree --reset -u: remove unmerged new paths
51a94af - Fix "checkout --track -b newbranch" on detached HEAD
b0ad11e - pull: allow "git pull origin $something:$current_branch" into an unborn branch
```

\$ U 40000 ž Cå ¼F ÑÜDy XgWX ^z i ž ~ D6žâã?

<Œ• Ž†‡
i Ff noàáDμ" ī ŒFâã¼9° kt‡ÇöDî > CåF. ' fÖmDMRø€> Ç
e? t ^XY#©Dî > Cå~âæÖâãF9, t Log • Ñ --no-merges ø. ?

ÓÔi j

\$œbW- ^ fFfī k9° : @çèl " l " ? òJ F¥' [j hi Ë- çèff‰» fDx! μ¶? O
9Fk " çèl " i Ç97D? òi \$. ' Git D\ Ö¼Fj stl " /¹ &< ÚèâDμ" . / DöKDË-
51èW?

k | ^ ¥' Cåô^' ï Y8O^Ë- ½~ Ák•• FJKCåMRL™^? å| F9, ÝÙýk --amend ø
. DCå ^ %Sm™CåO

```
$ git commit --amend
```

ò- ^ %oj [! " ' ¼D½~ Cå? pe ËNt Cå, Sfj 4%œb» fóHpF\$Ñt Cå | 9Ñ, Ù^
ã ^ %oF ža ½Fj z { ÇgF&ff» fD- i CåMR?

½! ' šØBÝ| F9, • TèâDCåMR? ' š| z" j ñ• >SDCåMR?

HpFfCå | ï YØâ^! " l " , @D» fF9, Å<ÜðÄl " O

```
$ git commit -m 'initial commit'
$ git add forgotten_file
$ git commit --amend
```

¥, f - j kW- Cå ÑÑUVt Cå [n. UWt Cå D" e?

¤ f \$ » I ¥ | DCå | F > Çi o\ ' f Ô | DCå œÖÖx Ómk Cå D1 2S » A
DF € • ðWQ* €m@? sŽeÑS-F—Äi mk DCå s 4" \$ \ WÄF · > Çj X
Y \$ à á DæÖ½?

» I Cå ¥Ñ# Dqri 9 „ ` èf Ôf ¥ | DCå F &Çj aÒ: F ø^ • • W- ½~ ÖJ
K Òù» I F » g; ¹ Óò8Cå MR~â f Dà á æÖ?

ÝÔ€ • K- ,

³ <SD! - û? É©pbï " ! " ' Bµ" æã ¼Z » f D½~ ? ò" ^ %o\$ » f ½~ ÖÖDO | Fí j C
©pbçèï " ? HpFf Z[» f ^! - ½~ > ¥: @[. ' " t! t 2i D» f Cå F hi é9L5y k
gi t add *! " ^. ' ! - ?pb- Pè! " ! - ¼DW- ÄÅ gi t status ^ %oC©^f O

```
$ git add *
$ git status
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

  renamed: README.md -> README
  modified: CONTRIBUTING.md
```

\$ ÒChanges to be committedÖ ½y g <1 FC©. ' git reset HEAD <file>... SPè! " ? f
„ F ¥' 9 „ ðÄSPè! " CONTRIBUTING.md ½~ O

```
$ git reset HEAD CONTRIBUTING.md
Unstaged changes after reset:
M CONTRIBUTING.md
$ git status
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

  renamed: README.md -> README

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

  modified: CONTRIBUTING.md
```

ð- ^ %oK Q< (ÜF hi È" ' ^? CONTRIBUTING.md ½~ Z[i » f 4! " DÔÖ^?

! git reset - ...i - „ 3D^ %oF p e • Ñ^ --hard ø. • ~ i pā? d & \$ ÑI < Ä
½F µ" æā ½D½~ š 4» f F sā / y ÚŽW" ?

Tæå t Çò- e(D* ' —i f , @y git reset ^ %o^ • DŽ\? ¥' [j \$ mÓ() ½^ • reset D
~ e^ ? , Bpb— %oW" ž g k T Dn?

ÓÔØ- , K ~ •

p e f > Ç: z 1 y CONTRI BUTI NG. md ½~ D» f · a = Å f C p b 1 → 5çè » f ÑÑ[· j > f Ñt C
å | DÄI óJ K Øqr öDÄI F J K Øä · < k µ" æā | DÄI øÅ > YDi F git status í YÀ^
f ^ C p b%? \$¥| W- HI ½F 4! " ' i i öÄO

Changes not staged for commit:

Ê (use "git add <file>..." to update what will be committed)

Ê (use "git checkout -- <file>..." to discard changes in working
directory)

Ê modified: CONTRI BUTI NG. md

· * €%? 5YÀ^ f p bçè èå f %oD» f ? a ¥' S i F C ©, ÙO

\$ git checkout -- CONTRI BUTI NG. md

\$ git status

On branch master

Changes to be committed:

Ê (use "git reset HEAD <file>..." to unstage)

Ê renamed: README. md -> README

9 „ • Tž " » f Z [{ çè ^ ?

\$

GF ®å Ø git checkout -- <file> i W- „ 3D^ %o? f yž - ½~ \$! 5Dœb »
f ū j è / ÑÑGitj ' ¥UCå D7! ñ • Ø. ? } * f ^ ...%? Ç: @yž - ½~ D! 5
» f ^ F a • GÇ@. ' ð - ^ %o?

p e f ad: z 1 y ž - ½~ %oX D» f F h i Y\$ ad, @çè F ¥' [j \$ Git] Y) * z " ÖùŠ] Y F
ð o € i ~ 5D%oW?

â f \$ Git ½œb { | } DKL Æ l Bi 9 „ @AD? « -ž " { å } D] Y ½DCå J . ' --amend ø
. ñ • DCå í 9 „ @A óA` ‡? @A ^ • ‡? @A ø? d & F œbf 4Cå DKL . / | | 9 ° dí ÙC
T ^ ?

ÙÚ¥ | KA'

t ^ ° \$œ9 Git . æÑ: " Ff , @äj pbý€ÉmDéÑàá? éÑàái • üý\$° þJ 6þw¼ Df D. æD7! á? f 9, k 5É - éÑàáFo€k " àáyf - ` Fk " • 9, ` L? Š6%: " éB ý€éÑàá, ß5?, @€uJ| P‡?? ý€éÑàáÖÖ^• pb•• éÑàáP9} ÅŽDéÑàáPý€ÇODéÖ] Ý> » 1. ' i ^ { Èö> > ? \$! ? ¼F¥' [) * W\] éÑý€D• ° ?

• • x y' 5H' #UV" " •

!

f ôŽ9, \$W- ÒéÑÓàáÑµ" F&...ÉÑ. \$f! 5DåõÑ? ñÆÒéÑÓ4® ° ©àá\$þwJ ýÃþND . ÊÓF&- i ° ©. \$i Æ? \$ðÄDéÑàáÑµ" F ðd, @B . éÑàáÑWÄDç†€uPI PB@PÍ " ?

> ¼ÙÚ¥ |

pe: ä• f Z[PÓDéÑàáEFØF9, YÙ **git remote** ^ %o? . j WXf • » Dí W- éÑEFØD} L? pefZ[qr ^ ÉmDàáFža-ö- C° • T origin ÑÑòi Git cf qr DàáEFØD³ |) yO

```
$ git clone https://github.com/schacon/ti.cgi.t
Cloning into 'ti.cgi.t'...
remote: Reusing existing pack: 1857, done.
remote: Total 1857 (delta 0), reused 0 (delta 0)
Receiving objects: 100% (1857/1857), 374.35 KiB | 268.00 KiB/s, done.
Resolving deltas: 100% (772/772), done.
Checking connectivity... done.
$ cd ti.cgi.t
$ git remote
origin
```

fí 9, • » Ø. -vFj #©, @` LéÑàá. ' D Git z" D} LŠ y- D URL?

```
$ git remote -v
origin  https://github.com/schacon/ti.cgi.t (fetch)
origin  https://github.com/schacon/ti.cgi.t (push)
```

pef DéÑàáÇÇW- FC^ %o) [· ' Ž\WX? HpFŠE- : " Kî " DF / ke - éÑàáDàá • ËSÃ<ÜðÄO

```
$ cd grit
$ git remote -v
bakkdoor https://github.com/bakkdoor/grit (fetch)
bakkdoor https://github.com/bakkdoor/grit (push)
cho45 https://github.com/cho45/grit (fetch)
cho45 https://github.com/cho45/grit (push)
defunkt https://github.com/defunkt/grit (fetch)
defunkt https://github.com/defunkt/grit (push)
koke git://github.com/koke/grit.git (fetch)
koke git://github.com/koke/grit.git (push)
origin git@github.com:mojombo/grit.git (fetch)
origin git@github.com:mojombo/grit.git (push)
```

Óº ©¥' ° * €1¬5I P · ' i D£¤?¥' j 9, / k N6' €uD>ÿFòJ! ÇÔI ?

O9ò" éÖàá. ' ^ÇOD: ; ?¥' [j \$ \$EFÐÑòí Git¼^• GS· ' D~ eMR?

t uÙÚ¥!

¥' \$èâ De?¼Z [CT> À©^ git clone ^ %oi pbÉÙ• • éÖàáDF Ç\òJ [ÝÀf pbÉ
mS• • ? ÝÙ git remote add <shortname> <url> • • W- ™Dé ÒGit àáFO! • » W- 1¬
. ' D} LO

```
$ git remote
origin
$ git remote add pb https://github.com/paulboone/ticgit
$ git remote -v
origin https://github.com/schacon/ticgit (fetch)
origin https://github.com/schacon/ticgit (push)
pb https://github.com/paulboone/ticgit (fetch)
pb https://github.com/paulboone/ticgit (push)
```

Ý\$F 9, \$^ %oÙ¼. ' yz { pbSn. Ö- URL? HpF pef: I P Paul Dàá¼k hf Ák DM
RF 9, ÝÙ git fetch pbO

```
$ git fetch pb
remote: Counting objects: 43, done.
remote: Compressing objects: 100% (36/36), done.
remote: Total 43 (delta 10), reused 31 (delta 5)
Unpacking objects: 100% (43/43), done.
From https://github.com/paulboone/ticgit
 * [new branch] master      -> pb/master
 * [new branch] ticgit      -> pb/ticgit
```

Ý\$ Paul D master] Ý9, \$! 5o\ pb/master HI TÑÑf 9, [· î > TÉmDl -] Ý¼F J Kp

ef: @ä•· DsF9, GXW- • NCQD! 5] Ÿ? ó¥' [j \$ Git] Ÿ
¼Ô^) * ` ai] Ÿ, Bpb. '] Ÿ?ø

^ ÙÚ¥| | ÙÝÜÝÝ

—pØ' f\$FséÖàá¼OØ‡?F9,, ÙO

```
$ git fetch <remote>
```

ò- ^ %oj HI éÖàáFs½l Pfkfj ÁkD‡??, Ùôf| Ff [j / kž - éÖàá¼fk] Ÿ
D- ' F9,, X| î > Jä•?

pef. ' clone ^ %qr ^ W- àáF ^ %oj ÉŸ[•• t éÖàá>³ | , ØoriginØt } L? f
„ Fgit fetch originJ Ñwt @PØ| ™€uDfkμ" ? ®¶O9 git fetch ^ %o- j
[‡? <i TfD! 5àáÑÑ- > Çj ÉŸî > J » ff øâDμ" ? øtj 5| f ®¶~Ÿ[î > kfD
μ" ?

pef Døâ] ŸEÓ^ÈöéÖ] ŸóA` <W? B Git] Ÿ ^ • ~ eMRØFža9,, ' git pull ^ %o
SÉŸ@P| î > CéÖ] ŸTøâ] Ÿ? òJ8i - ~•} ~AEDμ" i Õ?³ | oÇ<Fgit clone ^
%oj ÉŸEÓ! 5 master] ŸÈöqr DéÖàáD master] ŸóJ .) yD³ |] Ÿø? ŸÙ git
pull o€j s¥Üqr DEFØÑ@P‡? > ÉŸ, +î > Tøâf\$D] Ÿ?

ÞB®ÙÚ¥|

øf:] 3fD. æ| F ®¶[€uTÑS? ò- ^ %oI } ~Ogit push <remote> <branch>? øf
: @[master] Ÿ€uT originEFØ| ódt - ÑFqr | o€j ÉŸ¢fEÓ5ž! -) yøFža
ÝÙò- ^ %o—9,, [ff%oDj ° TEFØO

```
$ git push origin master
```

- k øfkfqqr EFØDLk >ÿF > ¥èâÁk %€u\| Fòž ^ %o' ° óž? øf B 6%\$OW!
÷qr F6' 1 €uTÑSd | fd€uTÑSFFD€u-j, Å- I 5{ B<? f ®¶¹ @P6' Dμ"
> [î > ØfDμ" | ' ° €u? A` Git] Ÿ ^ • pb€uTéÖàáEFØDØ^ MR?

> ¼àáÙÚ¥|

pe: @ä•l W- éÖàáD~ eMRF9,, ' git remote show <remote> ^ %o? pe: „ W- °
» DŠL) ŸÙò- ^ %oFHp originFj ØTÃ<Ü» ¼DMRO

```
$ git remote show origin
* remote origin
  Fetch URL: https://github.com/schacon/ticgit
  Push URL: https://github.com/schacon/ticgit
  HEAD branch: master
  Remote branches:
    master                               tracked
    dev-branch                           tracked
  Local branch configured for 'git pull':
    master merges with remote master
  Local ref configured for 'git push':
    master pushes to master (up to date)
```

· OÄj WXéÖàá D URL ŠÈö] ŸDMR? ò" MR*€k' F. ŸÀf gÆS **master**] ŸF> ¥p eÝÙ **git pull** F —j @PfkDéÖ- 'Fd| [éÖ**master**] Ÿî> T! 5**master**] Ÿ? · í j W XI PTDfkéÖ- ' ?

òi W- [€nTD} ~HI ? pefi Git Dmù. ' KFžaj 9„ o\ **git remote show** • T~ eD MR?

```
$ git remote show origin
* remote origin
  URL: https://github.com/my-org/complex-project
  Fetch URL: https://github.com/my-org/complex-project
  Push URL: https://github.com/my-org/complex-project
  HEAD branch: master
  Remote branches:
    master                               tracked
    dev-branch                           tracked
    markdown-strip                      tracked
    issue-43                            new (next fetch will store in
    remotes/origin)
    issue-45                            new (next fetch will store in
    remotes/origin)
    refs/remotes/origin/issue-11       stale (use 'git remote prune' to
    remove)
  Local branches configured for 'git pull':
    dev-branch merges with remote dev-branch
    master     merges with remote master
  Local refs configured for 'git push':
    dev-branch           pushes to dev-branch
    (up to date)
    markdown-strip        pushes to markdown-strip
    (up to date)
    master               pushes to master
    (up to date)
```

ò - ^ %WX^ xf \$° » D] ÝÑ, Ù git pushj ÉÝ5€uTpW- éÖ] Ý? . í OÄ5WX^p" éÖ] ÝÇ\$ f D! 5F p" éÖ] ÝZ[sEFØÑ9} ^F j k xf, Ù git pul l | p" ! 5] Ý9, Š. ÈöDéÖ] ÝÉÝ† > ?

ÙÚ¥| Kâ, ã ÜÄÄ

f 9,, ÝÙ git remote rename S» f W- éÖàáD} L) ? HpF: @[pbm^) t paul F 9,, ' git remote rename ðÄ%O

```
$ git remote rename pb paul
$ git remote
origin
paul
```

r ðO9Di ðOÄí j » f f f k éÖÈöD] Ý) y? ž" \] - ' pb/master DY\$j - ' paul /master?

pest W" >s: @9} W- éÖàáÑÑf Z[sEFØÑCD^J Çd: . '] W- ° » D4Ä^F NJ KÌ W- E¤KÇd E¤^ÑÑ9,, . ' git remote removeJ git remote rmO

```
$ git remote remove paul
$ git remote
origin
```

W• f . ' ð812å} ^W- éÖàáFžafkBò- éÖàá/GDéÖÈö] Ý,, BÞÓMRí j WÊ { å} ?

ä å æ

Ã 67! ðÓ• , óVCSØWÄF Git 9,, cääæÖ½Dl W- CåêÑçëF,, ©m@? > Hk n° - D i %' j . ' ð- • ° Sçâ¿, " Qó v1.0 P v2.0 > > Ø? \$! ? ½Ff [j hi pbWXZkDçëP pb%í Bå} ™DçëP,, BÇO» z Dçë] i i ` a?

ç î å æ

\$ Git ½WXZkDçë * €} ~F - , @yk git tag ð9yÑ9øD -I ø. --listøO

```
$ git tag
v1.0
v2.0
```

ò - ^ %o,, y ö...œWXçëFhi . ' # ©D...œ> Çm@?

f í 9,, i F° » D, 2äÙçë? HpF Git É - Dî noàá ÕmçëD‡C° \ 500 - ? pe - y 1.8.5

- W^{3/4}ST F 9 „ YÙO

```
$ git tag -l "v1.8.5*"
v1.8.5
v1.8.5-rc0
v1.8.5-rc1
v1.8.5-rc2
v1.8.5-rc3
v1.8.5.1
v1.8.5.2
v1.8.5.3
v1.8.5.4
v1.8.5.5
```

- o-~™šš> æ• ž -l Y --list ...h

! pef - : @ôÖDçëW° Fža YÙ git tag-j ³ | → f : @W- W° F· j ...³
cfWXSF ā | D -l J --list i 9øD?

d&F pef CD^W- éPçë) DoP, 2Fža -l J --list-i ² Ø. ' D?

è é å æ

Git Y{ ! 8çë OæCçë ö lightweightö Šf Oçë ö annotatedö?

æCçë I ÄW- Çj f g D] YÑÑ- - i ï - ° » Cå D- ' ?

&f Oçë i " # \$ Git f ? á ¼DW- ô Öy < F · ' i 9, { NI DF ¼Ömêçë KD) y P< I K ~
5¢Pr N! ÷ F ä Lj k W- çë MRF > ¥9, . ' GNU Privacy Guard ö GPGøë) > I O? o€j í
; %í f Oçë FòÄf 9, / k , Ñfk MR? hi pef - i : ' W- ä | Dçë F JKstl " >sÇ
: @z " ö" MRFža í 9, ' æCçë?

; ê å æ

\$ Git ¼%í f Oçë d] } ~? ¥} ~D1 2i øf \$ YÙ tag ^ %o| • » -a ø. O

```
$ git tag -a v1.4 -m "my version 1.4"
$ git tag
v0.1
v1.3
v1.4
```

-m ø. • » ^ Wž [j " # \$çë ¼DMR? pe Ák t f Oçë • » Wž MRF Gitj BÝ' šð@Åf y
k MR?

o\ . ' git show ^ %o9, • TçëMRBŠèy - DCå MRO

```
$ git show v1.4
tag v1.4
Tagger: Ben Straub <ben@straub.cc>
Date:   Sat May 3 20:19:12 2014 -0700
```

my version 1.4

```
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@geekmail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700
```

È changed the version number

y X# ©^ ê ç è K DMRPê ç è Dr N | ÷ Pf OMRFd | # ©¶¹ DCå MR?

ë i å æ

uW8cCåêçèD12i . ' æCçè? æCçè! MÑi [CåNI B" #TW- ½~ ¼ÑÑÅkz" oeb 6MR? %í æCçèFÇ, @. ' -aP-sJ -mø. F , @CDçè) yO

```
$ git tag v1.4-lw
$ git tag
v0.1
v1.3
v1.4
v1.4-lw
v1.5
```

ò | F pe \$çè ÑÝÙ git show f Çj • T è L Dç è MR? ^ %o- j # ©XCå MRO

```
$ git show v1.4-lw
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@geekmail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700
```

È changed the version number

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f í 9, y\] DCåêçè? —ECåæÖi òÄDO

```
$ git log --pretty=oneline
15027957951b64cf874c3557a0f3547bd83b3ff6 Merge branch 'experiment'
a6b4c97498bd301d84096da251c98a07c7723e65 beginning writing support
0d52aaab4479697da7686c15f77a3d64d9165190 one more thing
6d52a271eda8725415634dd79daabbc4d9b6008e Merge branch 'experiment'
0b7434d86859cc7b8c3d5e1ddd6ed6ff742fcbe added a commit function
4682c3261057305bdd616e23b64b0857d832627b added a todo file
166ae0c4d3f420721acbb115cc33848dfcc2121a started writing support
9fce02d0ae598e95dc970b74767f19372d61af8 updated rakefile
964f16d36dfccde844893cac5b347e7b3d44abbc committed the todo
8a5cbc430f1a9c3d00faaef07798508422908a updated readme
```

Y \$ F — E \$ v1.2 | f ø å c . æ ê ç ë F í — i \$ Øupdated rakefileÓ Cå ? f 9 „ \$ è | I Ñç ë ? @ \$ ž - Cå Ñê ç ë F f , @\$ ^ %DE å • » Cå DNI BØJ \] NI BØO

```
$ git tag -a v1.2 9fce02
```

9 „ • Tf Z [\$ ž t Cå Ñê Ñç ë ^ O

```
$ git tag
v0.1
v1.2
v1.3
v1.4
v1.4-lw
v1.5

$ git show v1.2
tag v1.2
Tagger: Scott Chacon <schacon@gee-mail.com>
Date: Mon Feb 9 15:32:16 2009 -0800

version 1.2
commit 9fce02d0ae598e95dc970b74767f19372d61af8
Author: Magnus Chacon <mchacon@gee-mail.com>
Date: Sun Apr 27 20:43:35 2008 -0700

    È updated rakefile
    ...
    
```

i Øå æ

³ | oÇ< F git push ^ %> Çj xuçëTéØàáEFØÑ? \$%í ôçë | f ®¶# 25€uçëT &3EFØÑ? ð- \ Ø—Å&3éØ] ÝWÄÑÑf 9 „ ÝÙ git push origin <tagname>?

```
$ git push origin v1.5
Counting objects: 14, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (12/12), done.
Writing objects: 100% (14/14), 2.05 KiB | 0 bytes/s, done.
Total 14 (delta 3), reused 0 (delta 0)
To git@github.com: schacon/simplegit.git
  E* [new tag]           v1.5 -> v1.5
```

pe: @Wt - €ul eçëFí 9,. ' ýk --tags ø. Dgit push ^ %? ò[j äfkÇ\$éÖàá EFÖNDçëŽ\xuTžJ?

```
$ git push origin --tags
Counting objects: 1, done.
Writing objects: 100% (1/1), 160 bytes | 0 bytes/s, done.
Total 1 (delta 0), reused 0 (delta 0)
To git@github.com: schacon/simplegit.git
  E* [new tag]           v1.4 -> v1.4
  E* [new tag]           v1.4-lw -> v1.4-lw
```

Y\$F ø 6%saá¼qr JI PF6' í ° ÒTf Dž " çë?

gi t push i \$E> ø
 . ' git push <remote> --tags èuçë> Çj '] æCçëBf OçëF Ák } ~D
 ø. ° paf - øùèuW8çë?

ñÄåæ

@å } Óf ! 5àáÑDçëF 9,. ' ^ %o git tag -d <tagname>? HpF 9,. ' < ^ %oå } W-
 æCçëO

```
$ git tag -d v1.4-lw
Deleted tag 'v1.4-lw' (was e7d5add)
```

O9ÑI ^ %o> Çj sœbéÖàá¼9} ò- çëFf ®¶' git push <remote>
 :refs/tags/<tagname> S~™f DéÖàáO

UW8g¹ i git push <remote> :refs/tags/<tagname> O

```
$ git push origin :refs/tags/v1.4-lw
To /git@github.com: schacon/simplegit.git
  È- [deleted]           v1.4-lw
```

NÜò8Í " Dm1i F[Fì à ÜDÍ r €uTéÖçë) Fs &c Ž5å} . ?

UV8~ ...° Då } éÖçëD1 2i O

```
$ git push origin --delete <tagname>
```

ſÍ åæ

pef: ä•l - çëf• ND½~ 7! F 9,, . ' git checkout ^ %F cdøj . f DàáÆSÒ] nè
• ± Ódetached HEAD ØÓDÔÖÑÑò- ØÖk " Ç5DE" ' O

```
$ git checkout 2.0.0
```

Note: checking out '2.0.0'.

You are in 'detached HEAD' state. You can look around, make experimental changes and commit them, and you can discard any commits you make in this state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may do so (now or later) by using -b with the checkout command again. Example:

```
git checkout -b <new-branch>
```

HEAD is now at 99ada87... Merge pull request #89 from schacon/appendix-final

```
$ git checkout 2.0-beta-0.1
```

Previous HEAD position was 99ada87... Merge pull request #89 from schacon/appendix-final

HEAD is now at df3f601... add atlas.json and cover image

\$Ò] nè• ± ÓÔÖ< F pef %o^] " ~ fd | Cå· ' FçëÇj ïóg6F hf D™Cå [Ç2Sœ b] ÝF> ¥[ÅWHI F} * o\ - { DCåw' ' ° HI ? sãF pef, @ØÙ~ f F> pf @» Am 7! ¼D™1 Fžao€, @%í W-™] ÝO

```
$ git checkout -b version2 v2.0.0
```

Switched to a new branch 'version2'

pe\$òè| NØÙ^Wt Cå F **versi on2**] Ý—j stò- f ÝNå9ÝF å| · —j B **v2.0.0** çë`
ék " ÇOF ò| —@¤v ^?

Git òå

\$¥' " D! e Git xØèå F g5kW- ú• " 9,, . f D Git¹ l ~ } ~ P~í PŒØOí) ? ¥' Çj
\$è| De? ¼- ' TJ—» f. ' \· ' Fhi f t< - Cäj pb. ' · ' ?

Git > Çj \$f yk\] ^ %o| ÉÝ€ýXf: @D^ %o? p eç: İ t İ yk ô ÖD Git ^ %oF 9,, o\ git config ½~ Sæç 5t İ W- ^ %oE ÓW- i) ? òJ kW" HI f 9,, ++O

```
$ git config --global alias.co checkout  
$ git config --global alias.br branch  
$ git config --global alias.ci commit  
$ git config --global alias.st status
```

ò9à ÈF ø@yk git commi t | F^ , @yk git ci? XÈf µ¶Çy5. ' GitF 9° í j [€. ' 6^ %oF f „ %í i) | Ç@GH?

\$%í f | t ^ C" \$D^ %o| ò- • • j | k' ? HpF t ^ • ZPè! " ½~ Dí ' - I " F 9,, N Git ¼ • • f ÉmDPè! " i) O

```
$ git config --global alias.unstage 'reset HEAD --'
```

òj . <ÜD! - ^ %o> qO

```
$ git unstage fileA  
$ git reset HEAD -- fileA
```

òÄ• ÈS~ %? W" ? o€í j • • W- last ^ %oF ÄòÄO

```
$ git config --global alias.last 'log -1 HEAD'
```

òÄF 9,, æç 5• T¥| Wt CåO

```
$ git last  
commit 66938dae3329c7aebe598c2246a8e6af90d04646  
Author: Josh Goebel <dreamer3@example.com>  
Date: Tue Aug 26 19:48:51 2008 +0800
```

È test for current head

È Signed-off-by: Scott Chacon <schacon@example.com>

9,, • XF Git - i } ~5[i) . | t y - D^ %o? d&F f 9° : @, ÜL\ ^ %oF &Çi W- Git I ^ %o? pei ž ÄDs F 9,, \$^ %oâÜ• k ! z i ? pef Ém@L W" Š Git àá: " Dµ¶Ds Fžj I k' ? ¥' Y\$É©[git visual » 1t git tk Dì) O

```
$ git config --global alias.visual '!gitk'
```

⌚ ↴

Y\$Ff - C° offk Git x! D! 5" ^A%í Jqr W- àáþòù~ þ! " > Cåò" ~ þþ B
àás%í TY\$Dfk ~ fæö? ³ <SF! - [) * Git D} ~ ©° - O] Ÿ, z?

Git LÓ

Él fkD7! ÓÓ• , ī „ l 8Ú2Ý{] Ý? . '] Ý9àEf 9, äf Dμ" s, åKÑ] n, SF „ Y÷) , åK? \$I e7! ÓÓ• , ¼Fòi W- 5ē" ŽD\ ŐÑÑ€€, @ÓŽ%í W- ī noæäD E! ?y§†. æS¬FòÄD\ Öj I _I e| ÷?

k %ä Git D] Ý, z üt· DÒ®} • ° - ÓFí g stòW° - F. ÒGits• e7! ÓÓ• , ¼J K& X? t b Git D] Ý, z pāX• ÅÅ GitÆ€] ÝD129í i ®, ÓMDæCF%í ™] ÝòWí " Él ° \$h÷öFF> ¥\$ÇO] Ýè÷D{ | ī " í i WÄ-L? Š8e . 7! ÓÓ• , ÇOF Git MN\$μ" í Õ½Ä?5. '] ÝŠí > Fp~ WbèAÖÙ8et? €• BÝoòW° - Ff¬j 9wT Git i pāD² t &N2° F> ¥sāžgf gf D, å12?

LÓOÔ

t ^ž g€• GitÆ€] ÝD12F¥' , @À" W< Git i pbz" ‡? D?

J 8f j à ÒÊÈ DA~F Git z" DÇi ½~ Dg 6J Kó• F&i W• WÇO| s DXY ?

\$ÖÙCåÍ " | F Gitj z" W- Cåy <ócommit objectø? äj ^ Git z" ‡? D12F¥' 9, | É dD: TÑÑCCåy <j ÕmW- • N! " A~½FD• ±? hÇggi òÄFCCåy <j Õm^" KDO) BKPPCå| y k DMR, B• N· D&y <D• ±? ' t Cå QóDCåy <Ák &y <F • oCåÍ " QóDCåy <k W- &y <F &° e-] Ýí > QóDCåy <k e- &y <F

t ^~ • Ú<5-ÑF¥' —EY\$kw- μ" æäFJ ÜÕm^÷- [@{ ! " BCåD½~ ? ! " ī " j t í W- ½~ | áNI Bó. ' ¥' \$ÊÈ ¼CTD SHA-1w' áWøFd| j ä¤â7! D½~ ½Fz" T Git à á ¼óGit. ' blob y <Sz" · ' øF¥, [NI B• kT! " ' ì > VCåO

```
$ git add README test.rb LICENSE
$ git commit -m 'The initial commit of my project'
```

¤. ' git commi t ÖÙCåÍ " | F Gitj 1 | áÍ W- I æäó! H½~ k. æ5æäøDNI BF d | \$ Git à á ¼ò" NI Bz" t %y <? X| F Git¬j %í W- Cåy <F· } ^ÕmÑÜCTDž" MR LFj Õm• Nò- %y <ó. æ5æäøD• ±? pãWSFGit—9, \$, @D| ^mYåtz" D½F?

Y\$FGit à á ¼kï - y <O÷- blob y <óz" È½~ ½FøPW- õ y <óâã Èæä" \$B blob y < ' - ø, BW- | } y <óÕmÈ• NâI %y <D• ±Bfk CåMRø?

Figure 9. ☰ ¥†‡ | § w.. ©ª «

%o“ » f | d t Cå Fž aò t Qó DCå y < j ŒmW- • NÑt Cå y < ó & y < ø D• ± ?

Figure 10. †‡ | § w.. → | §

Git D] ŸF ...! MÑggi • NCå y < D9g• ± ? Git D³ |] Ÿ) yi **master**? \$et Cå ī " è
| Ff ...Z [k W- • N¥| ž - Cå y < D**master**] Ÿ? **master**] Ÿj \$í t Cå | É Ý Nâ 9Ý?

!

Git D **master**] Ÿ> Çi W- ° R] Ÿ? . —È .] ŸoŽÁk' i ? èf „ Èl í W
- à á ī k **master**] ŸF i st **git init** ^ %o³ | %í . F> ¥†e‡%í SÒ] f Ÿ
. ?

Figure 11. \ @w^{..} + # - ®

Lóðé

Git i . a %í ™] ÝDÆÅI } ~F· - i t f %í ^W- 9, 9ÝD™D• ±? > p F %í W- testing]
ÝF f , @. ' git branch ^ %oO

```
$ git branch testing
```

Øj \$ øâƒ\$ DCåy <Ñ%í W- • ±?

Figure 12. ¶b - ° ± 2 + # - ®# \ @

ž a F Git Ni . a äj øâ \$pW-] ÝÑÆÅí I } ~F· k W-) t HEAD D° R• ±? GO9. B8e

· 7! ØÓ• , óp Subversion J CVSØJ D HEAD < ØÓŽÇO? \$ Git
½F· i W- • ±F • N¤âƒ\$D! 5] Ýó• OO[HEAD: <t¤â] ÝDì) ø? \$! H½Ff ¤d\$
master] ÝÑ? st git branch ^ %oogg èé W- ™] ÝF> Çj ÉÝ{ | T™] Ý½] ?

Figure 13. HEAD - ° ³ ' z H# \ @

f 9 „ } ~5. ' git log ^ %¤¤ • ¤-] Ý¤âƒ• Dy <? CDòW• ° D; # i --decorate?

```
$ git log --oneline --decorate
f30ab (HEAD -> master, testing) add feature #32 - ability to add new
formats to the central interface
34ac2 Fixed bug #1328 - stack overflow under certain conditions
98ca9 The initial commit of my project
```

gpff\$F¤â master B testing] ÝT• NNI B, f30ab, èDC¤y <?

LÓÖ x

@{ | TW- Z" \$D] ÝFF, @. ' git checkout ^ %o? ¥' ¥\${ | T™%í D testing] Ý
] O

```
$ git checkout testing
```

ðÄ HEAD —• N testing] Ý^?

Figure 14. HEAD - ° ³ ' z H#\`@

ž a F ð Ä D...Y 1 2j c ¥' ý S` a 5 Ä Ä Å Y \$ Ç U d C å W t O

```
$ vim test.rb
$ git commit -a -m 'made a change'
```

Figure 15. HEAD \ @j B t f μ q ¶ · ° ' , .

p Ù f © F f D testing] Ý N â 9 Ý ^ F h i master] Ý é Á k F. ø d • N Ý Ù g i t checkout | f
• Dy < ? ð — k 9 „ ^ F Y \$ ¥' { | Á master] Ý • • O

```
$ git checkout master
```

Figure 16. 1 ŠM HEADj L .

Óž ^ %‰‰^! ~ n? Wi . HEAD • À master] ÝFVi [μ" æä @Af master] Ýf • ND½FA
~? í —i → Ff Y‰‰» f Ds F. æ[¹ §W- HmD7! ? ! MÑSœF ò—i È5 testing] Ýf‰
D» f F „ → §NuW- 1 NÔÙ . ?

! \ @° » OI m' pqi r Q#Rc
\${ |] Ý| FW» @O9f μ" æä J D½~ j { fg? pei { | TW- HmD] ÝF
f Dμ" æäj @ATC] Ý¥| Wt Cå | DÄI ? pe Git Ç° · Ùt V5öfò- œ
FF· [WÇ{ |] Ý?

¥' ÇUd` ê‰‰» f > Cå O

```
$ vim test.rb  
$ git commit -a -m 'made other changes'
```

Ý\$Fò- . æDCå æÖZ [Qó^] Xó; \$. æ] XæÖø? st Ø' f %í ^W- ™] ÝF> { | \
] ÔÙ^W" μ" FX| N{ | À master] ÝÔÙ^uLW" μ" ? ÑI ! tf Ý±y Di ÇO] ÝOf 9,
\$ÇO] Ý÷Çy5SÀ{ | Bμ" F> \$! öfŒ! [· ' î > ÈS? &fkò" μ" Ff, @D^ %o- k
branchPcheckout B commi t?

Figure 17. *hi \ ¼- ®*

f 9 „ } ~5. ' git log ^ %oä •] XæÖ? Ý Ü git log --oneline --decorate --graph
--all | F· j y Xf DCå æÖPü -] Ý D• N„ B. æD] XoÇ?

```
$ git log --oneline --decorate --graph --all
* c2b9e (HEAD, master) made other changes
| * 87ab2 (testing) made a change
|/
* f30ab add feature #32 - ability to add new formats to the
* 34ac2 fixed bug #1328 - stack overflow under certain conditions
* 98ca9 initial commit of my project
```

◦ S Git D] Ý...MÑgi Õmf• y <NI Bó „ ùt 40 D SHA-1 r yz { øD½~ Ff „ · D%í Bd Y
Í • €c Ž? %í W- ™] Ý—/ øS | W- ½~ ¼Lk 41 - y? Ó40 - yz B1 - | Üz øF pā D} ~
◦ Ç½r Å

ðŠ\] t e‡7! ðÓ• , Úf^ZÑDy> F· ' \$%í] Ý | F [fKD. æ½~ Í AÓW[F> z" T
W- ° » Dæä? ðfðÄ? @D\ Õo€, @5E\ bFk | « ñ, @5E] b?f, | ÷D„ ÝFôŽP
Z§. æD=, ? &\$ Git ¼Fœb=, D. æï ° \$h ÷ %í ™] Ý? O| F° §í t CâÍj áä&y
< Ff „ ' Ù+ øDî > xØÓ• OOj &O] ¹ øí i OÄD} ~Bc Ž? ò" c ŽD° - . ðGit MN, ð
%3Ä? 5%í B. '] Ý?

³ <SFa ¥' • • ft` a- CðÄ‰?

! $\frac{1}{2} \frac{3}{4} \check{\zeta} \backslash @\#^2 M^o \gg \AA \AA$
 $\text{O} \text{E} \text{Y}' \text{ j } \$ \% \text{í} \text{ W- } \text{TM}] \text{ Y| i j } \{ | \backslash] \text{ F} \text{ò} \text{9}, \text{ ' gi t checkout -b}$
 $\langle \text{newbranchname} \rangle \text{ W} \check{z} ^ \% \text{o}^{\wedge} \gg ?$

LÓK - é Ü ÷ Ø

a ¥' S • W- } ~ D] Y TMÍ Š] Y î > DHI F ... Éµ" ¼f 9° j ' T » ¼Dµ" i ? f [[æp < È
 i O

1. „ ð l - þ ý?
2. t ... Y l - TM D' i , ÅF %í W-] Y?
3. \$ ò -] Y Ñ, Åµ" ?

g \$ã | F f Vd³ TW- < s - k - l _ mDI " , @Y` » I ? f [i F p < 1 2 SÆ€O

1. { | Tf DK Ñ] Y Ó production branchø?
2. t ò - Y` œF TMÍ W-] Y F > \$ ¼» A. ?
3. \$ 6+o\è | F { | ÅK Ñ] Y F d | î > ò - » I] Y F ¥ | [f Y € u T K Ñ] Y?
4. { | Åf ¥ Üµ" D] Y Ñ F µ ¶ µ" ?

- é LÓ

' 1 F ¥' —Ef g \$f D. æÑµ" F > ¥\$ master] Y Ñ Z [k ^ W" Cå ?

Figure 18. > b O, t ð - ®

Y \$ F f Z [Z » @• Z f D! " . ' DI " Đö• , ¼D #53 I " ? : @TMÍ W-] Y > O | { | T z -]
 Y Ñ F f 9, Y ÜW- ýk -b; ð D gi t checkout ^ %o O

```
$ git checkout -b iss53
Switched to a new branch "iss53"
```

· i < Ü! ž ^ %o D} LO

```
$ git branch issue53  
$ git checkout issue53
```

Figure 19. $\frac{1}{2} \frac{3}{4} > b \dot{c} \setminus @^- \tilde{A}$

f μ¶ \$ #53 | " Ñμ" F > ¥‰^W" Cå? \$ã \Ö½F issue53] Ÿ\$Çý DNâ€ÖF stfZ [GX
TC] Ÿ óí —i ¬F f D HEAD • ± • N^ issue53] Ÿø

```
$ vim index.html  
$ git commit -a -m 'added a new footer [issue 53]'
```

Figure 20. issue53 \ @j Bpq#ÄÄ° ' Ä

Ý\$ƒ³Tž-
- < sFk - Ÿ` | " > VfS•Z? k ^ Git DFEFF Ç®äò- Ÿ` | " B issue53 D» f
i \$WÊF fí Ç, @ö†“ãSj >GS 53#| " D» fFd | d•• GSò- Ÿ` | " D» fF¥| [ö
- » f CåTKÑ] Ÿ? f f@‰Dggi { | Ä master] Ÿ?

hi F\$f òa%èâF@19f Dμ" æãB! " ' J ž" j Ák{ CåD»f F· 9°j Bfj [GXD
] ÝQÓUVs &aÇ Git{ | TC] Ý? ¥5D1Wi F\$f { |] ÝèâFz { 5W-· ÜDÔO? kW
" 1W9,, • \ò- I " ój F! " óstashingø B »| Cå ócommit amendingøøF ¥' j \$ b\$S%
€ ¼• TG\$ò! - ^ %oD) * ? Y\$F¥' —EfZ[äfD»f Ž\ Cå ^Fò| f 9,, { | Å master
] Ý^O

```
$ git checkout master
Switched to branch 'master'
```

ò- | ^ Ff Dμ" æãBf \$, 1 #53I " èâW, WÄFY\$f 9,, Cv»AÝ` I " ^? GcâOøf
{ |] ÝD! ^ F Gitj mÓf Dμ" æãF. • ÈSÃÀT^f \$ž-] ÝÑ¥| Wt Cå DÄI ? Gitj
ÉÝ• • På} P»f ½~, - zā| f Dμ" æãBò-] Ý¥| Wt Cå | DÄI W, WÄ?

³ <SFf @» Aò- Ý` I " ? ¥' Sí i W- hotfix] ÝÑµ" ...TI " • ZO

```
$ git checkout -b hotfix
Switched to a new branch 'hotfix'
$ vim index.html
$ git commit -a -m 'fixed the broken email address'
[hotfix 1fb7853] fixed the broken email address
 1 file changed, 2 insertions(+)
```

Figure 21. ÅÆ master \ @# ÇÈÉÊ\ @hotfix branch

f 9,, ÝÜf D6+F- z f D»f i g- DFd| [hotfix] Ýî > Åf D master] ÝS\ (TKÑ?
f 9,, . ' git merge ^ %SÄTÑI æDO

```
$ git checkout master
$ git merge hotfix
Updating f42c576..3a0874c
Fast-forward
  index.html | 2 ++
  1 file changed, 2 insertions(+)
```

\$ î > D! ^ a Ff - CO9T ^ Ò½Ó fast-forward Øò - ñ? ° §f: @î > D] Ÿ hotfix f • NDC
 å C4 i f f \$ DCå C2 D...³ | µF sã Gitj ...³ [• ± Nâ 9Ÿ? | | s - F æf + Ùî > ! -] Ÿ
 | F p e ...ÈW-] Ÿ D<] ° p T Å u W-] Ÿ F ž a Git \$î > ! K D! ^ a F - j } ~ D[• ± Nâ € Ô
 Ó • ± â 9ØF st ð 8o Ç < Dî > ï " Ák , @• Z D] d Ñ Ñ ò — õ % Ò½Ó fast-forward ØÓ?
 Y \$ F ¥™D» f Z [\$ master] Ÿ f • NDCå ½F ¼F f 9 „ È ~ ã , C» A ^ ?

Figure 22. master Ën Äl hotfix

G§ò- Ÿ` I " D• Z 1 e ã , è | Ff t j AT{ ê y è â | Dµ" ¼? d & Ff - C¹ å } hotfix]
 Ÿ F st f Z [Çd , @. ^ Ñ Ñ master] Ÿ Z [• N ^ OW- È Ó? f 9 „ . ' ý - d Ø. D g i t
 branch ^ % S å }] Ÿ O

```
$ git branch -d hotfix
Deleted branch hotfix (3a0874c).
```

Y \$ f 9 „ { | À f g \$ µ" D] Ÿ µ ¶ f Dµ" Fí — i ± y #53 I " Dž -] Ÿ Õ iss53] Ÿ Ø?

```
$ git checkout iss53
Switched to branch "iss53"
$ vim index.html
$ git commit -a -m 'finished the new footer [issue 53]'
[iss53 ad82d7a] finished the new footer [issue 53]
1 file changed, 1 insertion(+)
```

Figure 23. І І H i ss53 \ @• # pq

ƒ \$ hotfix] ŸÑf‰Dμ" > Åk ŸmT i ss53] Ÿ½? pef , @I P hotfix‰D» f Ff 9.. .
' git merge master ^ %o[master] Ÿi > k i ss53] ŸFJKfí 9.. > T i ss53] Ÿôf . ^ F
d[i > Å master] Ÿ?

LÓK ÷ Ø

—Ef Z[» g ^ #53I " F > ¥êá[f Dμ" i > k master] Ÿ? t äFf , @i > i ss53] ŸT
master] ŸFòBèâf i > hotfix] Ÿf‰Dμ" óÇe? f - , @GXTf: i > k D] ŸFd | ŸÙ
git merge ^ %oO

```
$ git checkout master
Switched to branch 'master'
$ git merge iss53
Merge made by the 'recursive' strategy.
index.html |    1 +
1 file changed, 1 insertion(+)
```

òBf èâi > hotfix] ŸD| ^ • ÈSK WQÇWÄ? \$ò8oÇ< Ff D , æÖs W- ~ ½D51 ,
1] X , Sódivergedø? st F master] Ÿf\$Cå> Çi i ss53] Ÿf\$Cå D...³] 1 F Git ÇÒÇ

%oW" èL Dμ" ? XYò8oÇD| ^ F Gitj . ' ! -] ŸDE 7f• D½F óC4 B C5
ø „ ßð! -] ŸD! &] ^ óC2øF %oW- } ~D÷1† > ?

Figure 24. > ¥ї Đ• ŹQz „ l #Ñbno

Bèâ [] Ÿ• ±Nâ €ÔfÇODi F Git [át ÷ 1† > D" e%o^W- ™D½F > ¥É Ÿ%í W- ™DC
å • N. ? ò- { ü" Wtî > Cå F. D° i èÆ\$§6kÇÇW- &Cå ?

Figure 25. > b • Ź t ‡

Œd f D» f Z [î > ÔS ^ F—Çd, @iss53] Ÿ^? Y\$f 9„ \$œF Đö• , ¼Gf å. œF F > å
} ò-] Ÿ?

```
$ git branch -d iss53
```

Ù®ÚúÜKLÓ÷Ø

k | ^ > Í " Çj pā...+? pef \$! - ÇOD] Ý½FyOW- ½~ DOW- \] ÔÙ^ÇOD»
f F Git—ÁW· ÜDí > . ' ? pef y #53I " D» f Bk G hotfix] ÝD» f Í éBTOW- ½~ DO
WÆF \$í > . ' D| ^ —j QÓí > UVÖ

```
$ git merge iss53
Auto-merging index.html
CONFLICT (content): Merge conflict in index.html
Automatic merge failed; fix conflicts and then commit the result.
```

ã | Git %o^> Fhi ÁkÉÝ5%í W- ™Dí > Cå? Git j ! > <SF> Vf] • Zí > QÓDUV?
f 9,, \$í > UV | Dœ9| s. ' git status ^ %Sä• ž" sÖmí > UV&Æ§ 4í >
óunmerged ØÖD½~ O

```
$ git status
On branch master
You have unmerged paths.
  (fix conflicts and run "git commit")

Unmerged paths:
  (use "git add <file>..." to mark resolution)

  both modified:    index.html

no changes added to commit (use "git add" and/or "git commit -a")
```

œbs Ömí > UV&KV• ZD½~ FÍ j „ 4í > ØÖçwXS? Git j \$k UVD½~ ¼• k ç t DUV
• ZçâFðÄf 9,, ê, ð" ÖmUVD½~ d | ~Ý• ZUV? XYUVD½~ j ÖmW" ° R' fF •
ÊSÃ<Üð- ÄI O

```
<<<<< HEAD: index.html
<div id="footer">contact : email.support@github.com</div>
=====
<div id="footer">
  Please contact us at support@github.com
</div>
>>>>> iss53: index.html
```

Ø° © HEAD f• ©D7! óí —i f D master] Ýf\$DÉÓFstf \$ÝÙ merge ^ %D| ^ Z [GX
T^ò-] Ýø\$ò- ' fDÑg\] ö===== DÑg\] öF& iss53] Ýf• ©D7! \$ ===== D
<g\] ? t ^ • ZUVFF®¶øù. ' ° =====] hD! \] ¼DW- FJKfí 9,, ÉÙí > ò" A
~? HpFf 9,, o\äòfA~ | f<ÜDÄI S• ZUVO

```
<div id="footer">  
please contact us at email.support@github.com  
</div>
```

NI DUV• Z1egz1 ^ ¼W-] ŸD» f F > ¥ <<<<< , ===== , B >>>>> ò" Ü{ ôŽå }
^? \$f • Z^fk½ J DUVè | FyÍ - ½ . ' git add ^ %oS[çât UVZ• Z? W• ! " ò
" >! k UVD½ F Git—j [· ' çât UVZ• Z?

pef: . ' ÜÚ6µ¶S• ZUVFF9, ŸÜ git mergetool FC^ %o j tf BYW- i PD9i 6i >
µ¶F > ýef WÈWÈ• Zò" UVO

```
$ git mergetool
```

This message is displayed because 'merge.tool' is not configured.
See 'git mergetool --tool-help' or 'git help config' for more details.
'git mergetool' will now attempt to use one of the following tools:
opendiff kdiff3 tkdiff xxdiff meld tortoisemerge gvimdiff diffuse
diffmerge ecmerge p4merge araxis bc3 codecompare vimdiff emerge
Merging:
index.html

Normal merge conflict for 'index.html':
E {local}: modified file
E {remote}: modified file
Hit return to start merge resolution tool (opendiff):

pef: . ' } 3 | µ¶Ó\$òJ Git. ' opendiff%ot 3 | Dî > µ¶Fst" K\$ Mac ÑÝÜCÖœø
LD 6i > µ¶Ff 9, \$ Ø<Wµ¶¼óone of the following toolsøÓò! | Ü• TfkÝ{ Dî > µ
¶? d | ykf RQDµ¶) y—9, ^?

! pef, @~ • c©Dµ¶S• ZA¾Dî > UVF ¥' j \$ c©i >) * ~ eGS] Ÿi
> DA~?

> f × Xî > µ¶è | F Gitj ï Ø' Dî > i a f • ? pef Å®i F Gitj ! " ž" ½" , ° ÑUVZ•
ZO f 9, dt ŸÜ git status S- | fk Dî > UVÍ Z{ • ZO

```
$ git status  
On branch master  
All conflicts fixed but you are still merging.  
E (use "git commit" to conclude merge)
```

Changes to be committed:

E modified: index.html

pefy" e%T@9F > ¥- » èâkUVDD½~ Ŧ Z[! " ^Fò| f 9,, yk git commi t Sôfî
> Cå? ³ | oÇ<CåMR• ÈSÄ<Üò- ÄI O

Merge branch 'iss53'

Conflicts:

```
È index.html
#
# It looks like you may be committing a merge.
# If this is not correct, please remove the file
# .git/MERGE_HEAD
# and try again.
```

```
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
# All conflicts fixed but you are still merging.
#
# Changes to be committed:
#   modified:   index.html
#
```

pef \$ ÒÑI DMRÇpj] FÇ° ôŽ¹ Y] Ýî > D\ÓFF 9,, » f ÑI MRF • • W" ^ ? c 4S
Gi ò- î > D` KW" ÇEFÝÀ6' fi pb• Zî > UVDF, B€° i ` a?

Lóýþ

Y\$Z[%í Þí > Þå} ^W"] ÝFa¥' • • W" €' D] Ýý€µ¶?

git branch ^ %oÇ- i 9,, %í Šå}] Ý? peÇ• œb; ‡ÝÙ· Fj ÒTœâf k] ÝDW- Wº O

```
$ git branch
È iss53
* master
È testing
```

O9 master] ÝâD *yzO. n° Y\$GXDžW-] Ýóí —i —Fœâ HEAD• ±f• ND] Ýø?
ò9àÈpe\$ò; ª CåF master] Ý[j XÈ™Dμ" Nå9Ý? pe, @ä• í W-] ÝD¥| Wt C
åF 9,, ÝÙ git branch -v ^ %o

```
$ git branch -v
* iss53 93b412c fix javascript issue
* master 7a98805 Merge branch 'iss53'
* testing 782fd34 add scott to the author list in the readmes
```

--merged Š --no-merged Ø! - k' Dø. 9,, \, Ø- W° ¼Z [î > J Š 4î > T øâ] ŸD] Ÿ?
pe@ä• p"] ŸZ [î > T øâ] ŸF 9,, ŸÙ git branch --merged○

```
$ git branch --merged
* iss53
* master
```

s t èâZ [î > ^ iss53] ŸF f,, Y\$• T· \$W° ¼? \$Ø- W° ¼] Ÿ) yâ Ák *ì D] Ÿo€9
. . ' git branch -d å} Óúf Z [[. ' Dμ" Öî T^uW-] ŸF f,, > Cj /] œb KL?

ä• fk Őm4î > μ" D] ŸF 9,, ŸÙ git branch --no-merged○

```
$ git branch --no-merged
* testing
```

ØJ # @^ 6] Ÿ? st· Őm^j 4î > Dμ" F, +. ' git branch -d ^ %oå} . | j / k○

```
$ git branch -d testing
error: The branch 'testing' is not fully merged.
If you are sure you want to delete it, run 'git branch -D testing'.
```

pež D: @å}] Ÿ> . Øž " μ" F pOΦEMRJ f• XDF 9,, . ' -Dø. ² Øå} . ?

NÜI I Dø. --merged B --no-mergedj \$Ákc» CåJ] Ÿ) " t; ‡ | F] i
WXZî > J 4î > T · ·] ŸD] Ÿ?

f Bi 9,, CDW- f • D; ‡ Sä · ·] ŸDî > ØÖ&C®GX· ' ? Hp F ř 4î
> T master] ŸDk p" Å

#

```
$ git checkout testing
$ git branch --no-merged master
* topicA
* featureB
```

LÓY! ² j d

Y\$FZ[hj ™í Bî >] ÝFžaf 9„ JK- C' . S‰“ ` aÆÅ \$! ?F¥' j) * W" €\$D† '] ÝÔÙ, ¿ Dµ" i Œ?&gi ° §] Ýý€D-LF' -óXò" mz Dµ" , 2Ff 9„ 5?. æ... ÉoÇøùW8' ' • ?

Í Í LÓ

s t Git. ' } ~D÷1î > Ff „ —á\$WfH, D| ÷AF\AäW-] Ýî > k uW-] ÝFí Ci ` a®n? í —i -F\$Ö- . æ, ¿ XNDÇO^ fFf 9„ O| / ke- , < D] Ýúf 9„ » N5ä1 " á"] Ýî > k 6] Ý¼?

8e. ' GitD, ¿ KI RQ. ' ò812Sµ" F> p- \$ master] ÝÑz 1ôŽE» DnoÑÑk 9° g gi Z[¿, Jj [¿, Dno? 6' j kW") t developJ K next D×Ù] ÝF{ ' S‰| ¶, ¿JK 6+ E» - ÑÑò"] ÝÇ®z{ <y E» Fhi W• ÄT E» ÔÖF· ' -9„ { î > k master] Ý^? ò ÄF\$- zò" ZöfDå"] ÝóÝN] ÝF> pèâD iss53] Ýø° po\fk6+F> ¥Çj - k ~ e bugè | F-9„ î > kå·] Ý¼F> V<Wt D¿, ?

n...Ñ¥' Ø' OPDFi XÈf DCå &Çÿå 9D• ±? E»] ÝD• ±Bi \$Cå æÖ¼V | Wt nF &âê] ÝD• ±| | > Hoâ?

Figure 26. ÓÆÓÔ\ @# ÓÖx

o€ä 6' : <fï pKó work silosø 9° ~ 5€• WQFž" [\ 6+...I DCåj { qøT~ • E» Di pKÑ] ?

Figure 27. ÓÆÓÔ\ @# ØÙÕÚÙsiloÓÛÜx

f 9 „ ' ò81Wúöçö; t D£» - ? W" †z . æj kW- proposedóí ; ø J pu: proposed updatesóí ; ~™ø] ÝF· 9° s ŒmW" ÇfŒDA~&C° Ôk next J K master] Ý? òa%D æDi . f D] Ý¶kÇO©ì D£» - ú¤. ' ¶kW» ÕùD£» - | Fdä. ' † > k¶k~ c©ì £» - D] Ý½? dt ² * W<F. ' e- , N] ÝD1W> * ®@Fhi òa%o€I k¢EFú i¤f \$W - * €r † J KA¾D. æ½μ" | ?

" #LÓ

å"] Ýyæb=, D. æi P' ? å"] Ýi W8ÝN] ÝF· { ' S...Y~W° - J / Gμ" ? í 8f sÁk\$ 6D7! ÒÓ• , óVCSøÑòa%øFst\$ž" 7! ÒÓ• , ¼%í Bî >] Ýo€I _s? d&F\$ Git ¼WbèAet%í P. ' Pî > På}] ÝÍ I €\$?

f Z [\$ÑW? ¼f %í D i ss53 B hotfi x å"] Ý½• T\ò8' W? f \$ÑW?' TDå"] Ý õ i ss53 B hotfi x] Ýø ¼Cå ^W" ~™F> ¥\$. ' † > kå.] Ýè| Ff Nå} ^. ' ? ð. •• °. f ½¾> ¥öÖ5ÖÜÑ<½{ | õcontext-switchøÑÑs t f Dμ" {] vTÇODí pK¼F\$ÇO Dí pK¼í -] ÝÍ gŠ æç° - / GFsãF\$%ønoMäè» Dμ" D! a—° ~•~í 5• Xf %ø^ p" f Ý? f 9, æ%øXDf Ý\$å"] Ý½z 1E] bPËb«¬E- kF> . ' fŒè| dî > F&C' \$! . ' í i D...æJ μ" Õù?

..._òÄW- HI Ff \$ master] ÝÑμ" T C1Fò| t ^• ZW- I " &™í iss91] ÝF\$ iss91] ÝÑμ" T C4Fd&ySž- I " f NK ^™D: WFsi fd™í W- iss91v2] Ý+Ü' uW81W• Z ž- I " F³ Èf AT master] Ýμ" ^Wj <Ff NF X^W- Çt " » D: WFf ¬\$ C10 D! a™í W- dumbi dea] ÝF> \$ÑÜ%" ...I ? f DCå æö• ÈSÃ<Üò- ÄI O

Figure 28. Ÿ(Pb" È\@#†‡ - ®

Y\$F¥' —E! ~ noOf Z». ' UV- 1eS• Zž - I " Fj . ' \$ iss91v2] Ÿ½1e? uLFf
[dumbi dea] Ÿucf DOn• \è| F" e¿ Yòi - ^ %è: ? ò| f 9, vò iss91] Ÿój . ô
C5 B C6 CåøFd | äuL! -] Ÿ? ¥, f DCåæÖ• ÈSÃ<Üò- ÄI O

Figure 29. • ŽB dumbi dea C i ss91v2 \@Là #†‡ - ®

¥' [j \$] , 2 Git ¼Nf (©~ e k G] Ÿµ" ī D^ ? F sā FG^- z f A` ôž - e? è | F d S Z
» f D< - . æ @. ' ` a ÄD] Ÿ 45óbranching schemeø?

Gc â F xf %oæaeł " D| ^ Fò"] Ÿ Ž\ł " §! 5? xf tmí Bî >] Ÿ D| ^ F f k ò W{ ī -
ç ó\$ f ! 5D Git 7! á ¼ ÑÑ Ák ŠEF ðç óå ý?

ÚÚLÓ

é Õ- ' i yé Õà á D- ' ó• ± ø F ÕÖ] Ÿ Pçë > > ? f 9 „ o \ git ls-remote <remote> S
250 Õé Õ- ' Dô ÕW° F J K o \ git remote show <remote> O Õé Õ] Ÿ D~ eMR? d
& FW- ~ € \$ D‰ Wi † ' é ÕÈ Õ] Ÿ?

é Ö È ö] Ý i é Ö] Ý Ö Ö D- ' ? . ' i f Å W 9 Ý D! 5- ' ? W• f Ö Ü ^ þ wo MF Git - j t f 9
Ý . ' " Ý - \ wé Ö à á D Ö Ö? G[. ' • % o - è F ö Ä 9 „ C x f C] Ý \$ é Ö à á ¼ D È Ö - i f ¥
| W t - 3 T. ' D È Ö?

. ' " <remote>/<branch> D Ú 2 ^) ? H p F p e f : @ • f ¥ | W t Š é Ö à á ori gi n o M!
m a s t e r] Ý D Ö Ö F f 9 „ ä • ori gi n / m a s t e r] Ý ? f Š O n i " • Z W - I " > ¥ 6' € u ^ W -
i s s 5 3] Ý F f 9 ° k É m D! 5 i s s 5 3] Ý F d & \$ E F ð Ñ D] Ý j „ ori gi n / i s s 5 3 S ° ©?

ò 9 ° k W Q < ® „ € • F a ¥' S • W - H I ? - E f D p w J k W - \$ g i t . o u r c o m p a n y . c o m D G i t E
F ð ? p e f s ò J q r F G i t D c l o n e ^ % o j t f É Ý [^) t ori gi n F I P . D f k f ? F % i W -
• N . D m a s t e r] Ý D • ± F > ¥ \$! 5 [^) t ori gi n / m a s t e r ? G i t í j c f W - Š origin D
m a s t e r] Ý \$ • N O W - 5 1 D! 5 m a s t e r] Ý F ð Ä f - k μ " D x Ø?

Origin Ö Ž á â ä å

é Ö à á) y Origin Ö Š] Ý) y Ö master Ö W Ä F \$ G i t ¼ > A k œ b ° i D m 1 W
Ä ? O ! Ö master Ö i æ f Ý Ü g i t i n i t | ^) | D È 1] Ý) y F > s g g i . D y z
. ' F Ö origin Ö i æ f Ý Ü g i t c l o n e | ^) | D è Ö à á) y ? p e f Ý Ü g i t c l o n e
- o booyah F ž a f ^) | D è Ö] Ý) y [j i booyah / m a s t e r ?

Figure 30. æç L à # è é ê d U V x y

pef \$! 5D **master**] Ÿ‰^W" µ" F\$OWf! ÷AK 6%€uCåT **git.ourcompany.com**
> ¥~ ™^. D **master**] ŸFð—i ñf' DCåæÖZ DNÇOD1N? j ñðÄF ð@f z { ÇŠ
ori gi n EFð-³ ð> | P‡?øFf D **ori gi n/master** • ±—Çj 9Ÿ?

Figure 31. UVd • • # pq' 5\¼

pe@Šc » Dé Õà á OÈ‡? F ŸÙ **git fetch <remote>** ^ %o\$! H¼t **git fetch ori gi n**ø?
ð- ^ %oä Ù ÐoriginØ i pW- EFðó\$! H¼F· i **git.ourcompany.com**øF s ¼@P! 5Ák D
‡? F> ¥~ ™! 5‡?áF 9Ÿ **ori gi n/master** • ±T ~ ™è | DÊÓ?

Figure 32. `git fetch`

t ^ É©ke - éÖàáŠéÖ] ÝDoÇF¥' —» f k uW- A\ Git EFØFgEF\$ f Dl - { L , ç
wx ? ò- EFØÊS `git team1.ourcompany.com`? f 9 „ ÝÙ `git remote add` ^ %o• • W- ™Dé
Öàá- ' T øâ D. æFò- ^ %o¥' j \$ `Git xØ½Ô^ -Ñ?` [ò- éÖàá^) t `teamone`F [" t öÖURLDŠL ?

Figure 33. $\hat{1} \ddot{1} \eth > b \bullet \bullet \times y$

Ý \$ F 9 „ Ý Ü gi t fetch teamone S @Pé Ö à á teamone k &! 5 Á k D f ? ? s t ž Ø E F ð Ñ Y
k D f ? i ori gi n E F ð Ñ D W - I E F f „ Git > Cj @ P f ? & i j E Ó é Ö È ö] Ý
teamone/master • N teamone D master] Ý?

Figure 34. • • ï í \@ teamone/master

PB

xf: @! ,] 3W-] Ý| F, @[ÈuTkLk > Ý Dé Óà á Ñ? ! 5D] Ý> Çj É Ý Šé Óà á
OÈ ÑÑf ®¶# 25€u: @] 3D] Ý? òÄFF—9, äÇ| 9] 3DA~< T} %] ÝÑF &[, @B
i %: " DA~€uT! ,] Ý?

pe' ' Bì %WÊ \$) t serverfi x D] ÝÑµ" Ff 9, Ä€uUW-] Ýž Ä€u. ? ÝÙ gi t push
<remote> <branch>:

```
$ git push origin serverfix
Counting objects: 24, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (15/15), done.
Writing objects: 100% (24/24), 1.91 KiB | 0 bytes/s, done.
Total 24 (delta 2), reused 0 (delta 0)
To https://github.com/schacon/simplegit
 * [new branch]      serverfix -> serverfix
```

òJ k " µ" { } 6^? Git É Ý[serverfix] Ý) yÀ, t

refs/heads/serverfi x: refs/heads/serverfi x F ž 9à ÈF Ò€u! 5D serverfi x
] ŸS ~ ™é Õà á ÑD serverfi x] Ÿ?Ó¥' [j Ô^ hi Git A\ > € D refs/heads/\] F hi
Y\$9, 1 ä. < \$< ?fí 9, ŸÙ gi t push ori gi n serverfi x: serverfi x F · j %OÄDn ÑÑ
í —i — Ò€u! 5D serverfi x] ŸF[" t é Õà á D serverfi x] ŸÓ9, o\ò8S 2S€u!
5] ŸTW- ^) Ç/ ODé Õ] Ÿ? pe> Ç: aé Õà á ÑD] Ÿó% serverfi x F 9, ŸÙ gi t push
ori gi n serverfi x: awesomebranch S[! 5D serverfi x] Ÿ€uTé Õà á ÑD awesomebranch
] Ÿ?

ñòóôa ¥‰õö÷

pefg\$. ' HTTPS URL S€uF Git E F Ðj ¼ i) Š) o? ³ | oÇ<· j \$,
7½C©EF Ði ª L8f ÒÙ€u?

!

peÇ: \$í Wt €u; í yk' i) Š) oFf 9, EÓW- Òcredential cacheÓ? ¥
} ~D12—i [z" \$A" ½E] bF 9, } ~5ÝÙ gi t config --global
credenti al . hel per cache S EÓ. ?

: @^• ~ eG§ÇOI O¤" D9' ø. Fä • / O" #?

<Wt 6: " Ks EF ÐÑ@P‡? | F 6' j \$! 5ófW- é Õ] Ÿ ori gi n/serverfi x F • NEF Ð
D serverfi x] ŸD- ' O

```
$ git fetch origin
remote: Counting objects: 7, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 3 (delta 0)
Unpacking objects: 100% (3/3), done.
From https://github.com/schacon/simplegit
 * [new branch]      serverfix      -> origin/serverfix
```

@° i O9DWQi x@PT™Dé ÕÈö] Ÿ| F! 5Çj É ÝófW° 9' ŠDE! óxyø? | W| s
¬F ð8oÇ<F Çj KW- ™D serverfi x] ŸÑÑ- kW- Ç9, » f D ori gi n/serverfi x • ±?

9, ŸÙ gi t merge origin/serverfix [ò" µ" î > T xâf\$D] Ÿ? pe: @\$ÉmD
serverfi x] ŸÑµ" F 9, [i i \$é ÕÈö] ŸèÑO

```
$ git checkout -b serverfix origin/serverfix
Branch serverfix set up to track remote branch serverfix from origin.
Switched to a new branch 'serverfix'
```

òj cf W- ' §µ" D! 5] ŸF> ¥ÊQÊ§ origin/serverfix?

' µLÓ

sW- é ÕÈö] ŸGXW- ! 5] Ÿj É Ý%í fí DÒÈö] ŸÓo. ÈöD] Ÿó%ÒÑ§] ŸÓø?
Èö] Ÿi Šé Õ] Ÿk...³ G• D! 5] Ÿ? pe\$W- Èö] ŸÑy k gi t pul I F Git° É Ý5wì] p

- EF ÓÑ@PPÍ > Tp-] Ÿ?

¤qr W- àá | F· o€j ÉŸ5%í W- Èö ori gi n/master D master] Ÿ? d&F pef | 9Ds 9, EÓ 6DÈö] ŸFJ i W- \$ 6éÖàá NDÈö] ŸF NJ KÇÈö master] Ÿ? ¥} ~D... H-i Äèâ • TDž ÄF YÙ git checkout -b <branch> <remote>/<branch>? ði W- d] €' DÍ " f,, Git CD^ --track ½L 1 2O

```
$ git checkout --track origin/serverfix
Branch serverfix set up to track remote branch serverfix from origin.
Switched to a new branch 'serverfix'
```

° Sò- Í " t €' ^FCL· ! - j kW- L· ? pef, +GXD] Ÿ (a) Ç" \$¥ (b) Ø5- kW-) y ŠèéPDéÖ] ŸFž a Git—j tf %í W- Èö] ŸO

```
$ git checkout serverfix
Branch serverfix set up to track remote branch serverfix from origin.
Switched to a new branch 'serverfix'
```

pe: @[! 5] ŸSéÖ] ŸEÓt ÇOD) yFf 9, æç 5. ' NW- ^ %o" • W- ÇO) yD! 5]
YO

```
$ git checkout -b sf origin/serverfix
Branch sf set up to track remote branch serverfix from origin.
Switched to a new branch 'sf'
```

Y\$F! 5] Ÿ sfj ÉŸs origin/serverfix | P?

EÓZkD! 5] ŸÈöW- ØØI P<SDéÖ] ŸFJK: @» fg\$ÈöDÑS] ŸF f 9, \$œ9!
÷. ' -uJ --set-upstream-toø. ŸÙ git branchS#25EÓ?

```
$ git branch -u origin/serverfix
Branch serverfix set up to track remote branch serverfix from origin.
```

• ønùú^

! ¤EÓ5Èö] Ÿ| F 9, o\} L @{upstream} J @{u} S- ' . DÑS] Ÿ? f,, \$ master] Ÿ| > ¥· g\$Èö origin/master | Fpe | 9Ds 9, . ' git merge @{u} SPn git merge origin/master?

pe: @ä • EÓDfkÈö] ŸF 9, . ' git branchD -vvø. ? ðj [fkD! 5] ŸWXS> ¥Õ m~ eDMRFpí W-] Ÿg\$Èöp- éÖ] ŸŠ! 5] Ÿi a i è¹ PV| Ji Í k?

```
$ git branch -vv
* iss53      7e424c3 [origin/iss53: ahead 2] forgot the brackets
* master     1ae2a45 [origin/master] deploying index fix
* serverfix f8674d9 [teamone/server-fix-good: ahead 3, behind 1] this
should do it
* testing    5ea463a trying something new
```

ÓJ 9 „ • T **iss53**] Ýg \$ Èö **ori gi n/i ss53** » ¥ ØaheadÓ i 2F 9à È! 5k! - Cåj Ák €u
T E F ØÑ? í ° • T **master**] Ýg \$ Èö **ori gi n/master**] Ý» ¥i ¥™D? ³ < S 9 „ • T
serverfix] Ýg \$ Èö **teamone EF ØÑD server-fix-good**] Ý» ¥ë ¹ 3V | 1F 9à È EF ØÑ
k Wt Cåj Ák î > k O! ! 5k ÷ t Cåj Ák €u? ¥| • T **testing**] Ý» Ák Èöæbé Ö] Ý?

, @mQO9DWQi ò" ‡ y Dr SÉSfsí - EF ØÑ¥ | Wt @PD‡?? ò- ^ %o> Ák - ³ EF
ØF· - j ÝÀf G\$! 5¤" DEF Ø‡?? pe: @, | ¥™Dë ¹ ŠV | ‡ y F, @\$ÝÙä ^ %oâ @
Pfk Dé Øà á? 9 „ ÅòÄ‰O

```
$ git fetch --all; git branch -vv
```

Ý Ý

¤ **git fetch** ^ %oS EF ØÑ@P! 5Ák D‡? | F· > Cj » f µ" æä ¼DA ~? · - j OP‡? d
| a f Émî > ? d&F k W- ^ %oÔ" **git pull** \$†e‡oÇ<· Dm1i W- **git fetch** Ý³ ÈW-
git merge ^ %o? pek W- Åèâe? ¼É©DE Ø5DÈö] ÝF Çý· i #25EÓj i o\ **clone**
J **checkout** ^ %o t f %í DF **git pull** i j äÙ¤â] Ýf ÈöDEF ØŠ] ÝF sEF ØÑ@P‡? d
| , +î > k ž - é Ö] Ý?

° § **git pull** D~W[€%%STf „ o€ ~2#25. ' **fetch** Š **merge** ^ %o j ~ 5W" ?

ñÄÙÚLó

-Ef Z[o\é Ö] Ý%oÔf k Dµ" ^ ÑÑí —i → f Bf D: " KZ[ôf ^ W- ° - F > ¥[· î >
T ^ é Öà á D **master**] ÝÓJ æb 6E» no] Ýø? 9 „ ÝÙýk --del ete ø. D **git push** ^ %o
Så} W- é Ö] Ý? pe: @sEF ØÑå} **serverfix**] ÝF ÝÙ< ÜD^ %oO

```
$ git push origin --delete serverfix
To https://github.com/schacon/simplegit
  [deleted]           serverfix
```

x! Ñò- ^ %oD- i sEF ØÑ9} ò- • ±? Git EF Øo€j z 1‡? Wf | ÷ ... T • €ÀEÝÙF f
„ peÇüvå} Ø^Fo€i | ~í @AD?

\$ a

\$ Git ¼Ö† SÉÇO] ÝD» f å@k! 81 WOmerge „ ß rebase? \$! ? ¼¥' [hi ` ai Òg
x ÓF· Ä. ' Òg x ÓF> [À©CÍ " D^ • èÆF „ ß• X\$b8oÇ<f - XY. ' . ?

\$aKaBi j

GÀ" èâ \$] ÝDî > ¼DW- HI Ffj • T , ðœF] XT! - ÇO] ÝFNûÉCå ^ ~ ™?

Figure 35. \ ¼# † ‡ - ®

èâ) * \FÖ†] Ý¥~í D1Wi merge ^ %o? . j ä! -] ÝD¥™½FóC3 B C4Ø„ BVK¥UD
&O] ¹ óC2ØÓÙ÷1î > Fî > D" ei ófW- ™D½Fó> CåØ?

Figure 36. —À• Žμqûü• \ ¼# - ®

...Fj k W81 WOf 9,, CP\$ C4 ¼- k DI J B» f Fd | \$ C3 D×ØÑ- ' Wt ? \$ Git ¼Fò8
Í " —ö‰\$abrebasec? f 9,, . ' rebase ^ %o[CåTÌ W] ÝÑDfk» f Í 9¬uW] ÝÑF—

5ÃØm™, < ÓWÄ?

\$ò - HI ¼F f 9 „ GX experiment] ŸFd | [· g × T master] ŸÑO

```
$ git checkout experiment
```

```
$ git rebase master
```

First, rewinding head to replay your work on top of it...

Applying: added staged command

· D>€i ' 1 ÙTð! -] Ÿój øâ] Ÿ experiment Pg x̄ " Dæç x:] Ÿ master Ø D¥U&O
] 1 C2Fd | y> øâ] Ÿ/y§C] 1 Dæt Cå FCP/ " D» f > " t ä | ½~ F d | [øâ] Ÿ• N
æç x: C3, ¥| „ ä[èåu" t ä | ½~ D» f • œ" ? ó• OOL Ñ^ commit idF „ ¬€• F < OØ

Figure 37. ý C4 Q# þl mÅl C3 •

Y\$AT master] ŸF ØÙWt ½Ôî > ?

```
$ git checkout master
```

```
$ git merge experiment
```

Figure 38. master \ @# n Å• Ž

ã | F C4' • ND½F—B the merge example ¼ C5 • ND½F W, WÄ ^? ð! 8Öî 1 WD¥, " eÅ
kœb' i Fhi g x. ØCåæÖ~ • ÖP? f \$ä • W- [\g × D] ŸDæÖå å | j ï YFQy...É
D, ïµ" i > ÜDF h. ' • Ñ] —Äi { ÜDWÄFCåæÖi Wž...KÅk] X?

Wc ¥' ðÄ‰DæDi t ^ - z \$NéÖ] Ý€u! ° z { Cå æÖDÖþÑÑHp NÌ - 6%úöD. æ
E¤no! ? \$ò8oÇ< Ff ' 1 \$ÉmD] ÝJ ÔÙ, ¿ F¤, ¿ ôf| f, @¹ [f Dnog x T
ori gi n/master ÑFd | d Nå. æCå » f? ðÄDs FC. æDúöK—Çd, @ÔÙÖí µ" F- ,
@½Ôí > -9?

GO9FÅPi o\g x Fj i o\÷1î > FÖî D¥, " ef• ND½F¹ , i WÄDF- Ç\ Cå æÖC
O7^? gxi [W• WCå; F>k t æ• t - ' TuW] ÝÑF&i > i ä¥, " eî \$WÈ?

-h%K \$a &'

\$y! -] ÝÔÙg x | Ffóf DÒm< Ó> ÇW» @\$æç] ÝÑ- ' Ffí 9,, • » uLDW-] ÝÔÙ
- ' ? —Ä sW- å"] ÝJd] XW- å"] ÝDCå æÖ½DHI žÄ? f%í ^W- å"] Ý
serverFt EF7•• ^W" • ° FCå ^ C3 B C4? d| s C3 Ñ%í ^å"] Ý clientFt « i 7••
^W" • ° FCå ^ C8 B C9? ¥| Ff AT server] ÝFNCå ^ C10?

Figure 39. ÿ > b" È\@! " \S>b" È\@#†‡ - ®

-Ef' ' [client ½D» f î > Tå] Ý> ¿, Fh! | > Ç: î > server ½D» f F st. ' j , @
[\~ ŽÜD6+?ò| Ff—9,, ' git rebase ^ %D --onto Ø. F Ø½\$ client] ÝJ hÇ\$
server] ÝJ D» f ój C8 B C9ØF [· ' \$ master] ÝÑm< O

```
$ git rebase --onto master server client
```

, Ñ^ %D9,, i OÒPX client] ÝFÙX· s server] Ý] dè| DI J F d| äò" I J \$
master] ÝÑm< W[Fa client • ÈSÃ...³ x § master » f WÄÓ? ð€• ÈSk WQA ¾F Ç\ Ž
e * €f?

Figure 40. # \$ " È \ @• # Ø > b " È \ @&%à mÅl .. &\ @

Ý \$ 9 „ ½ Ø i > master] Ý ^ ? Ø p Ù ½ Ø i > master] Ý F . è ÖmSÉ cl i ent] Ý D » f ø O

```
$ git checkout master  
$ git merge client
```

Figure 41. n Ä • Ž master \ @&' L (ä u ¶ cl i ent \ @# þ l

³ < Sf Z » [server] Ý ¼ D » f í Ø i ÖS? . ' git rebase <basebranch> <topi cbranch> ^ % 9 „ ... ³ [å "] Ý ój ! H ¼ D server ø g x Tæç] Ý ój master ø N? ö Ä % ° „] f ¹ { | T server] Ý F dy , Üg x ^ % o De - È i ?

```
$ git rebase master server
```

p Ù [server ¼ D » f g x T master N f © F server ¼ Dn o { Ø ¶ ÖT ^ master | Ü?

Figure 42. Y server Q#þl mÅl master •

d | —9 „ ½Ôî > å] Y master ^ O

```
$ git checkout master  
$ git merge server
```

—ã F cl i ent B server] Y¼D» f ī Z [Öî Tå] YJ ^F f 9, å } ò! -] YF ¥, CåæÖj g
fÙ ¥, DCå æÖ ¼DÄI O

```
$ git branch -d client  
$ git branch -d server
```

Figure 43.) * # † ‡ - ®

\$a K()

...F(† Dg xí > * ô‡ÅþF@' . Ò^ õWž t • O

* + | } • † @, K¥| - . Z[ò/ " Oa@12| } 3mÿ! Z4S56l m\$a 7

p e f ^ %oòž Š< Æ• F—Çj XÓ™? a • F%Ž • • j • 6f Ff D' ' B#%í j " " f F • ôf ?

g xī " D...Mi . ôW" Yk DCå Fd | / - 5™í W" A~WÄh...ÉÑÇODCå? pef Z[[C
å€u-ł - àáF& 6%í Z[sCà ál PCå> ÔÙ^| ¶µ" Fã| Fpef' git rebase ^ %
m™Ö€^Cå> dt €uFf DO-sã[ÇÒÇdt[6' ~èDµ" Šf DCå ÔÙÖi Fpe³ < Sf
j @I P> Öî 6' » f \ DCå Fno—j gÒWwf?

a ¥' S• W- \$! , Dà áÑ, Ùg xī " f ý SDI " ? —Ef sw- ¼%EFðqr d | \$. D×ØÑ
ÔÙ^W" , ¿? f DCå æÖpÙf ©O

Figure 44. æç > b × y &%à H + # Å , • Æ - ß > < 1 .

d | F l %NN14%EF ØCå ^W" » f F ¼j ØÖWt i > ? f @P ^ò " \$é Ø] ÝÑD» f F > [
i > Tf ! 5D , ð] ÝFd | f DCå æö—j gf ð ÅO

Figure 45. / \$O; #†‡&• Žł ¶1#1. \@

³ <SFò- %NZ» äî > ī " Å—Ff' g×úμ&N' git push --force ^ %oñ• ^ EFðÑDCå
æÖ? è | f s EFð@P~ ™Fj ¿ Y e X S W" ™DCå?

Figure 46. (; i ß 2ÀmÅ# †‡ &Ž 34ß' # UV1. z ÅÆ# >< †‡
" e—i f' ! %DÆBÍ d] ~ ™? pef , Ù gi t pul l ^ %oFf [i > SÉ! ž Cå æÖDA~Fóf
W- ™Dí > Cå F¥, à áj pÙf©O

Figure 47. ' ý ±² # 567• Žß > ¥&89ß > bç # †‡

ā | pef, Ùgi t log ^ %oFf j ġ Yk! - Cå D" Kpr Npr åšdi WÄDF òj %%%3/4T i â? āLF pef [ðWùN€uTEFðÑFF...ÉÑi [ž " Z[{ g x v ôDCå NÙ^ÀSF òj %%%3/4T ~ • i â? | Ñ#y 1> Ç: \$Cå æÖ¼• T C4B C6F st èâ-i 6äò! - Cå o\g x. ôD?

' \$a89\$ a

pef - K > n ^ » ¼DÆBF Gitj kW" c ©~W9, fTf? pewx ¼Dl %² Ö€u> ñ• ^W" ffx§DCå Ff, @%oD-i Gäf %o^p" » fF, B6' ñ• ^p" » f?

...ÉÑF Git} ^yÖ- Cå | á SHA-1 NI B, LFÍ y! t Cåf-k D» f | á ^NI BÑÑj Øpatch-idÓ?

pef | P{ ñ• \D~™> [f ~èDμ" x§å ØÙg xDs F Wc oÇ< Git l° f•] œXp" i f D » fF > ä. ' - ' T™] ÝÑ?

: - HI FpenTå ÜCTD k %€u^ [\g xDCå F>. ö^f D! 5, ġ f x§DW" Cå ž 80 BF pe¥' Çi , Ùi > F&i , Ùgi t rebase teamone/master, Git [j O

¥ Gäp" Cå i ¥' D] ÝÑ2k DóC2F C3F C4F C6F C7Ø

¥ Gä ¼p" Cå Çi i > Í " D" eóC2F C3F C4Ø

¥ Gäp" Cå \$y 1 ñ• ~™| > Ák { Ök æç] Ýö" k C2B C3F st C4 ...-i C4'Ø

¥ ääTDò" Cå - ' \$ teamone/master ÑÜ

s &¥' [ðTŠ f [/ODA~Nî > ^Wt Fóf ^W-™DCå ¼ÇOD" eF pÙ \$W- { g x d | ² Ö€uD] ÝÑdt , Üg x f©?

Figure 48. H>b ē mÅ%å : Y i # \@• " ¥; - mÅ

@: NI 1ekŽFj , @y 1\$gx! " z C4' B C4i Eł WÄD?

a • gx! " [ÅWwì F> ™í uW- » ¼C4 DI J ó&ò- I J I 9° ÅWÖP DÖî kæÖF st I J
¼D» f Z[" \$§! - 51 ^ø?

\$! H¼uW8} ~D1Wi . ' git pull --rebase ^ %&Çi ...³ git pull ? NJ Kf 9, Em~Ý
öfò- \ÖF¹ git fetchFd git rebase teamone/master?

pefi è. ' git pull FO| N' ' ³ | . ' ø. --rebaseFf 9,, ÙòžŒ| git config
--global pull.rebase trueS~ f pull.rebase D³ | PÓ?

pef yCj n, f< • DCå, ÙgxFž—Çj kn? pef yZ[€u\DCå, ÙgxFhì %Å
kx§. DCåFžaí Çj kn? pef yZ[€u¬&' àáDCåÑ, ÙgxF^ %F> sã. / ^W"
i %D, ¿fx§DCåFžf—k†žÝ^Ff DOní j sã i f?

pef Jf DOn\$! " oÚ<Z 9@òa%oFGW» @oäí - %, Ùgit pull --rebase ^ %FòÄQ
ýÇ° XYi °Fh° kf¤•?

\$a vs. ÷ø

¬äFfZ\$...£¼hi ^gxBî > D' WFfW»j : I FT: p812~ 5? \$À®ò- I " èâFa
¥' x | WÈF: OPW<Cå æÖT: 9àÈ` a?

KW8° Q| tFàáDCåæÖj i W<° : ! ; ¿RS? · i ±yæÖD½>F! - —kqr FÇ° â
f? sò-¤ù• SFFgCåæÖi W8¥| Ff. ' <=§• ^...É¿ó\Dno? pe°î > QóDC
åæÖi Wwf. a=ÅŒdn...—i pãFžaò" " ©— C{ z 1<SFa | %° pãA?

uW8° Q• g5/\F6' | tCåæÖi ±©¿ÚI ! ; K<? Á%j X7W! – DUW7ª «F—~ ú
ö~1í i , @\A» þ' ° 1¬. ' ? { òW° QD%j . ' rebaseB fil ter-branch> µ¶S' L&
nF· a1¬| SD` K— aL?

Y\$Fa¥' ATèåDI " NSFT: î > j i gx5Å' ' f° ÑWFò> ÁkW- } ~D®e? Git i W
- * €² †Dµ¶F· L8fyCåæÖ%8enoFhí - wxþí - . aeyäD, Å> Ç/O? œdfZ
[] i hi ^! KD' WF/Mf° p5? ...ÉoÇ" XÑÒDøù?

BD>• i F" yš4€uJ] 3cì %D! 5» f , Ùgxi " %€æÖF sÇyZ€u¬ì AEDCå , Ù
gx! " FòÄFf' ° 3' T! 812ýSD¬†?

¢£

¥' Z[œô^ Git] ÝŠî > DxØäw? f Y\$- C° Ép5%í > { | ¬™] ÝP\$ÇO] Ýè÷{ | „
Bî > ! 5] Ý? f Y\$- Cí ° o\€ufD] Ý¬&3EF,] 3. ' þ. ' &3] ÝŠ6%: " „ B\$
&3èâ. ' gx! " î > fD] Ý? <WeF¥' [@œTFpef: @ÝÙÉmD Git àáüý EFðFf
, @äj " ` a?

= > TM ≠ K Git

Tæâ t ÇFf - CZ [k = W. ' Git Sôfr €µ" ? d&F t ^ . ' Git: " • ° Ff j , @k éÖD Git à á? Qý \$• • Ñf 9, s - %àá ÖÙ€uópushø BI PópulløS» f A~F hÇMN. ' ò81 WFst WÇ1v—I ~í ~í 6%DÔù? ãLFF' ' f Dî " K' j . \$f D< • 4Äõ! ÷ ° " P àá Ñ/kW- ~ 9oD! ' àád] k' ? sãFŠ6%î " D¥-1Wj i í i W- f Šî " K' ī k> t HI F ¥9sžJ €uBI Pb¾D&' àá?

- EWØGit EF Ø> Ç®? ' 1 F Øùf' ' EF Ø. ' Do ®: ; ? \$! eUW? [) * 9' D: ; „ B úÉ³ PQ? <ÜW? [• Ñ. ' ž" : ; Dmz EÓBpb\$ f DEF ØÑYÙ? ¥| F pef Ç) 9üy f Dno\$ 6%DEF ØF ¥Ç: [æE OŠúöÉmEF ØDž ÝF 9, ++¥') * DË- àáüy E F?

pef y - EÉmDEF ØÁSTF 9, • T! e¥| W?] • • pb - GW- noüy EFD° i d | µ¶< We F ¥' j \$žJ OP] v2î oØO! BD±±ßß?

W- éÖàáo€- i W- ² àáóbare repositoryøÑÑj W- Ák øâµ" æäDàá? st Càágg " tî " ³) F Ç, @s) ùGä½F ú" < D- k Git Db ¾? } ~D- F ² àá-i f µÖæäAD . git I æäA~F ÇÖm 6b ¾?

? @

Git 9, . ' _8ÇOD: ; Sxyb¾O! 5: ; öLocalØF HTTP: ; F SSHöSecure Shell: ; B Git : ; ? \$ãF ¥' [j OPž" : ; Bp" oÚ- C. ' óJ XY. ' ø6' ?

BE? @

¥x! D—i UV>? ÚLocal protocolÛ F ¼DéÖ7! á—i OWåöNDuW- æä? ò€\$§wx ï W- f 3ï y W- &3D½~ • , öHpW- ' i D NFSø/ k HI >F J K> Hö\$De %&' OWØ< • DoÇ? | K> Ç€: Fst f Dfkno7! ápe, " SOWØ< • F~ 9° ¿óµ®- D* /?

pef. ' &3½~ • , F—9, s! 57! áqr ócloneøP€uópushø, BI Pópullø? ÄòÄ] qr W- 7! áJ K" • W- éÖTYKD. æ½F. ' 7! á¢. " t URL? HpFqr W- ! 57! áF 9, , Ùp<D^ %oO

```
$ git clone /srv/git/project.git
```

J f 9, , Ùò- ^ %oO

```
$ git clone file:///srv/git/project.git
```

pe\$ URL, èÑ- D• » file://Fža Git DÙtj 5k ÇO? pegi • » ¢. F Gitj , +. ' ø^ ³ öhard linkøJ ...³ AÓf, @D½~ ? pe• » file://F Gitj ¶ç x| ' §þ¢x yb¾DÖÖF ž Äxyž] j ~" ? • » file://Då@æDi PÒW- Ák L\; ...öextraneous referencesø J y < öobjectøD. Ù7! áE! ÑÑo€i \$s 67! ØÓ• , « k | JW" » ¼oÇ, @ða‰öG§úöœ

F 9; \$ Git A\ >€ ø? \$ã¥' [. ' • o\$· Fst òÄo€~½?

@" • W- ! 57! áTYk D Git. æF 9,, Ùp < D^ %oO

```
$ git remote add local_proj /srv/git/project.git
```

d | F—9,, o\™DéÖàá) local_proj Å\$þwÑWÄsé77! á€uBI P~™^?

AB

x§½~•, D7! áD³Qi } ~F> ¥...³. ' ^YKD½~>ÿBþwHI >ÿ? pef Dwx Z[k &3½~•, Fí i 7! áj d] ~í? -, @ÆEÓ 6&3æäWÄFäW-²7! áDE! < T†#í 9,, HI D\$· F> EÓ5` /LD>ÿF—9,, ^F ¥' j \$ \$EFðÑòí GitOPþb«XW-²7! á?

ðí i ½¾Sì %Dμ" æã¼I P~™D1W? pef Bi %WÊí " W-. æF 6: af s 7! á¼I P~™| FÝÙ» ¼git pull /home/john/project D^ %o> €uTEFðd@PÀS} ~e^?

CB

ð81WDþQi Fo€&3½~•, > H®þÓF> ¥> Èx! Dþw-³ HI FòÇ1-se- ÈÓHI ? pef: s#J€uA~F®¶¹ i W- éÖ) ùF/> þw-³ DHI 12FþÓÇ1-F¾ùí Ü?

r ðWCdi F pef. ' Di » ¼S&3' i D½~•, | Fò- 1WÇW» i ¥½D? HI ! 57! áD ¾ùŠf HI ‡? D¾ùi WÄD? \$OW- EFðÑFþeL8Git HI ! 5øùFWcDo\ NFS HI 7! á@> o\ SSH HI Ü?

¥, Fò-: ; > Çz öäáXY9LD* " ? í W- ' i Í k ðé ðóæä Dðöshell >ÿF Ák 1W9,, aÇ6' » f J å} Git A\½~ B* " àá?

HTTP? @

Git o\ HTTP oMK! 8, 2? \$ Git 1.6.6 7! èå~ k W- 129' Fd] } ~> ¥o€i ~` , 2D? Git 1.6.6 7! – k ^W8™Dþ~ ð° D: ; Fa Git 9,, Åo\ SSH ž Äð° D: +Bxy ‡?? è| È ` Fò-™D HTTP: ; st } ~þð° gDd] í Ü?™7! D HTTP: ; Wc{ üt DO HTTP: ; F m7! DWc{ üt E HTTP: ; ? ¥' 1^• W<™Dð° HTTP: ; ?

DO HTTP? @

ð° HTTP DÝÙ1 2B SSH ß Git: ; » ¼F~ i ÝÙ\$ç† D HTTP/S 7' ñ> ¥9,, . ' û8 HTTP I OðÓF ð9àÈ. ' ÈSj > SSH: ; } ~De F> p9,, . ' HTTP: ; D' i) /) o=>FY] EÓ SSH! ô?

ð° HTTP: ; J 8Z[i ¥i ÙD. ' Git D1 2^F· j Ý{ Å git://: ; WÄEÓ.) EFF í 9,, Å SSH: ; WÄCDx y | D=>B•) ? &¥~' W- URL—9,, Í %oTF,,] ^t ÇOD, ÅEÓÇOD URL? pef @€uTW-, @=>DEFðÑóWcSœí, @ðFEFðj C©f yk' i) B) o? s EFðOP‡? | í WÄ?

n...ÑF » ¼ GitHub DEF Ff \$þEÑ• TD URLÓ» p <https://github.com/schacon/simplegit> ØF
Bf \$qr P€uópefk >ÿø! . ' Di WÄD?

E b Dumbc HTTP? @

p e EF ð Ák CDÒ° HTTP: ; DEF F Git « j 7j , +. ' ~ } ~ DÒ, Ø HTTP: ; ? , HTTP:
; J web EF ð gä 2 7! á ø" • o½~ Sy VF CD½~ EF? , HTTP: ; D³ f èÆ\$SEØÈS}
~? x! ÑF - , @äW- 2 7! á< \$ HTTP 5æä F E ØW- Ø%o post-update D' 3—9, ^ Ø\$ Git
3I ø? á | F - @° HI web EF ð ñf D7! áF—9, qr f D7! á? <Üi E Øs HTTP HI 7!
á D1 WO

```
$ cd /var/www/htdocs/  
$ git clone --bare /path/to/git_project.git  
$ cd git_project.git  
$ mv hooks/post-update.sample hooks/post-update  
$ chmod a+x hooks/post-update
```

ðÄ—9, ^? Git Éy D post-update ' 3j ³ | , Ùî PD^ %oógi t update-server-i nfoØFS
- z o\ HTTP DOPBqrÍ " g€µ" ? ðž ^ %o j \$f o\ SSHN7! á€uè | { , Ùúd | i %—
9, o\ » ¼< ÜD^ %o Sqr O

```
$ git clone https://example.com/gitproject.git
```

ðJ ¥' ' ^ Apache J E Ø^€' D¢. /var/www/htdocsF Ç\ f 9, . ' œb¹ Ø Web EF ð ññ -
, @ä 2 7! á< Tg - Dæä <—9, ? Git D¢? i , x! D' Ø½~ Ú2CDDóÔo \$ Git A\ >
€Ø?

o€DFj \$9, CD` ° LDÒ° HTTP EFB} ~D- ` D, HTTP EF è ÷ ØW- ? úøj [VKI î
CDEF?

AB

¥' [- GOÒ° HTTP: ; D³ Q?

ÇODHI 12-, @W- URL, B E F ð - \$, @=>| C©yk => MRF ð! - } - - a, 7' | . '
Git g ð* €} ~? /> SSH: ; F 9, . ' ' |) °) o=>i W- I + D³ » F ð Ä' | —Ç®¶\$. '
Git èå 1 \$! 5óf SSH) öydä! öñxTEFð? y * b_D. ' KFJKK•, Ñpö SSH/GÖœ
D. ' KF HTTP: ; D9' - i å@D³ » ? Š SSH: ; » ¼F HTTP: ; í * €½BcŽ?

f í 9, \$ HTTPS: ; ÑCD- ` 7! áDEF F pãf \$xy‡? D| a—9, •) ‡? úJKFF « -9
, a « j 7. ' • » D SSL O- ?

uW- 5Æi HTTPS: ; { yz. ' FWcD½, èo½Í j L8ò" 7' D¢? o\ ?

CB

\$W" EFØÑF - E HTTPS: ; DEF 7j > SSH: ; D¾~W" ? } ^ØWQF' 6: ; CD Git EF
ŠØ° HTTP: ; /> —EÍ Ák³ » ^?

pef \$ HTTP Ñ. ' , =>D€uFý€/Oj > . ' SSH) Ø| Øž ÝW" ? d&Ff 9,, øù. ' /O
" #µ¶F > p macOS D Keychain J K Windows D/ Oý €Ø? ; ... / O" # pbÚŽ 5z " HTTP)
o?

SSH ? @

- E Git EFØ | €' SSH: ; " t x y: ; ? st t e‡ | B<EFØZ[Ý{ o\ SSH HI ÑÑj . Á
kí I ~í - E? SSH: ; í i W- I O=>Dþw: ; ú> ¥Fst • [- F - EB. ' Í I ~í ?

o\ SSH: ; qr 7! áFf 9,, • » W- ssh:// D URLO

```
$ git clone ssh://[user@]server/project.git
```

J K. ' W- } ÝDscp 2DLWO

```
$ git clone [user@]server:project.git
```

\$ÑÜ! 8oÇ¼F pef Ç• » 9øD' i) Fža Gitj . ' xâžã D' D) y?

AF

' SSH: ; D³ » kI e? ' ¹ FSSH - E/y } ~ ÑÑSSHØöÔØI €\$Fe‡ý€3Í k. ' [I F>
¥e‡Í " • , Í Øm^· B/GDý€µ¶? t Fo\ SSH HI i ÚŽDÑÑfkxy‡?Í @[\=>
B•) ? ¥| FŠ HTTPS: ; PGit: ; B! 5: ; WÄF SSH: ; I cŽF\$xyâí j QC%Š‡??

CB

SSH: ; DPQ\$§· ÇÝ{ .) HI Gitàá? pef. ' SSHFžaj ¬ i ` P‡?F. ' Kí GHO
\ SSH HI f DåÖF ò. ØSSH: ; Ç†§, Í D. æFµ€%' 9° : äf Dàáqr <Sä•? p
ef - \$! " þw. ' FSSH: ; 9° i fì W@' TD: ; ? pef@O| CD.) -` HI BSSH: ; F
žaf } ^t Ém€u- E SSH EF, LFj Ø- EW- 9,, a 6%HI DEF?

Git ? @

¥| i Git: ; ? ði Øm\$ Git J DW- ° RDØöÔØú. ÀÁ\$W- ° » D7' Ø9418ØF » ¼§ SSH
EFFhi HI Å, æb=>? @a 7! áÝ{ Git: ; F, @¹ %í W- git-daemon-export-ok ½~
ÑÑ· i Git: ; ðöÔØt ð- 7! áCDEF D®@ž ~ ÑÑhi } åèLÁkæbÚŽ ¼•? @a ØÍ
9,, qr ð- 7! áF@a ØÍ Ç°? ð9àÈFo€Ç° o\ Git: ; €u? ° §Ák=>ØÓFW• f,
< €uÍ " F9àÈþwÑä; ð- . æURLD%Í 9,, N. æ€u‡?? Ç' ¬Fúöj k%ða‰?

AB

æâ F Git: ; i Git. ' Dþwx y: ; J ¥½D? pef D. æk I † DHI CF J Kf D. æl r † > ¥ Ç, @t L ÔÙ' j => F - E Git ðöÖSCDEFi Ç™Døù? . . ' Š SSH / OD‡? xy ÕÓF hi ,] ^•) B=>D, d?

CB

Git: ; PQi PÂ=>ÓÓ? æ Git: ; " t HI . æ7! áDì W~fi Ç9PD? Wc D‰WJ Fj O! CD SSH J K HTTPS: ; DHI EFF a ö‡E- , ÇKk€uóLø>ÿF 6%o\ git:// HI - k † >ÿ? Git: ; í 8í i ¥®- ED? . @Åk ÉmDðöÖÓF ð—@þÓ xi netdþsystemd J K 6 DðœF ð" µ" > Ç} ~? . j @Åêo½, < 9418 7' Fhi ¼, êo½Wc Çj , < ð- * ç† 7' ? &tz D¼, êo½o€j ÅÄò- 7' ?

† = >™‡ | é Git

Y\$¥' [OPpb\$f ÉmDEF ðÑòí Git EF SÝÙò" : ; ?

! ðJ ¥' [@É©\$ Linux EF ðÑÔÙWt x! ¥} 6DÚÛf, D^‰ŠÈ; F ðd \$ macOS J Windows EF ðÑOÄ9, ÝÙò" EF? n...ÑF \$f D| áõxØ- €½í i W- óQ! BEF ðF[Ç9XYD. ' TÇODÚŽ½• ŠÍ" •, µ¶?hi F' ' f ° s! ?½OÒW" ®@Dä w?

\$, 1 - E Git EF ðâF, @ä Yk àá « Xt ² àá ÑÑj W- ÇÖm¤âµ" æâ Dàá? ðo€i | } ~D? t ^o\qr f DàáS%í W- ™D² àá Ff, @\$qr ^‰| • Ñ --bare Ø. ? | FëHF ² àá Dæä) „ .git" åF—ÅòÄO

```
$ git clone --bare my_project my_project.git
Cloning into bare repository 'my_project.git'...
done.
```

Y\$Ff D my_project. git æâ ¼- Ck Git æâ DE! ^?

Ö¹ Ñž e t Ú/ ð§

```
$ cp -Rf my_project/.git my_project.git
```

cd \$þÓ½~ ¼k¶. ÇOFhi y\$ f DæDS -F ð! 812ï i WÄD? . - PX Git àá É- F Ç@ µ" æâ Fd | ° i t. ~2%í W- æâ ?

J K ¥| L ®= >™‡

Œdf k ^2 àá DE! F O<@‰D—i ä ² àá < TE F ðÑ> E Óf D: ; ? —EW- i) t gi t. example. com DEF ðZ[- E 5F > 9, o\ SSH - ³ F f: äf k D Git àá < \$ /srv/gi t æâ < ? —EE F ðÑ" \$ /srv/gi t/ æâ F f 9, o\ , < ^‰AÓf D² àá S%í W- ™àá O

```
$ scp -r my_project.git user@git.example.com:/srv/git
```

ã i F 69o\ SSH` Pä EF ÓÑ /srv/git æä D' i F 9ÝÙ, < ^ %Sqr f Dà á?

```
$ git clone user@git.example.com:/srv/git/my_project.git
```

pew- ' i Fo\ . ' SSH- ³ TW- EF ÓF > ¥ y /srv/git/my_project.git æä / k 9L > ý Fža 6[ÉÝ/k€u>ý?

péTC. ææå ¼ÝÙ git init ^ %F > • Ñ --shared ø. F ža Gitj ÉÝ» f Cà á æä Dû > ý t 9L? O9FYÙä ^ %DµÓ¼Cj ÅYœb Cå P- ' > A~?

```
$ ssh user@git.example.com  
$ cd /srv/git/my_project.git  
$ git init --bare --shared
```

◦ ã 9\$F 5? Yk D Git à á %í W- ² à á Fd | ä. < Ñf B: " Kï k SSH HI > DEF Ói ea ~ í ? Y\$f' Z[+ j 5\$OW. æÑÀ, î " ^?

r ÓO9Di F ðD- i - EW- È- %/k- ³ > D Git EF DŽ\ ÑÑ - @\$EF ÓÑ• k 9,, ' SSH ð à D° i Fd | ä² à á < \$t#ï k` L > ý D51? f Z[+ j 5^W{ F Å, ~ e?

< ÜDÈ? ¼Ff j ^ • pb ½ÅT~ A¾DE »? ò" A~ Ómp bXYt í W- ' i i W- 2j Fc à á • • ! &` P > ý F- Eþ È ÜÜ > ? d&FGå ðòWQF pe- i BÈ- %\$W- } k. æÑî " D s F @ @ i W- SSH EF ÓB² à á—Æp ^?

MN, ...

péEj HÖJ Kf- : \$úz, ð wx J, + Git F ža W{ Í I } ~? - E Git EF ¥A¾D51 \$S' i ý€? pø, @à á y° » D' i 9` F&c uW\] ' i ` L > ý F ža HI B89Ú#—j > HS ®?

SSH OV

pef k WØfk, ð Kï 9,, ' SSH- ³ DEF ÓF- Ef DUW- à á—d] } ~^F st f Æl ` aï C' %ógp ¥' ÑW? f ñ Dø? pef: \$f Dà á ÑEÓ~ A¾DHI ÓÓ> ý F- @. ' EF ÓI " •, D• o D½~ •, > ý—Ù ^?

pø, @wx J DÍ - %í y à á k L > ý F NÇ° c í - %\$EF ÓÑí i 2j F ža CD SSH- ³ —i i WDøù ^? ¥' —E' S&3à á DEF ÓZ[ÚÜ^ SSH EFF &¥f o\ . HI EF Ó?

k È- 1 W9,, . fc wx í - f 3CDHI >? UW- —i c wx J DÍ - %%í 2i F ð 81 WI ...³ h í i ž Ý? J 8f Cj : @t í - %ÝÙWt adduser ð J K useradd ø, ¥E Óä |) o?

UV- =Wi \$å ÓÑí i W- git 2j Fa í - , @L > ý D%ð uW- SSH! ð F d | [• k git 2j D ~/. ssh/authorised_keys ½~ ? ð ÄWSF fk %í [o\ git 2j HI å õ? ð WQí Cj ÷) Cå D

‡ ? ÑÑHI å ō' D- ° Çj ÷) Cå y < DCå KMR?

uW- =Wi a SSH EF Õo\l - LDAP E F F J K 6Z[E » 5D E ¼=> ÕÓF S ÕÙ=>? - @Í - ' i 9,, O Õå ÕD shell HI >ÿ F œb SSH => ÕÓf ï 9i t i k ŽD?

; P SSH QR

pâfI F 8e Git E F Õi . ' SSH! ÕÔÙ| O? t ^N Git E F ÕCD SSH! ÕF p e l • , ' i Š 4 /k) ÕF ®¶n¹ t õfW° ? Õ- \Õ\$fkï " • , Ñi i / ¼D? ' 1 Ff , @- | Émi ª Z [/k) Õ? ³ | oÇ<F' i D SSH) Õ" # \$ ~/. ssh æä <? Õk Cæä > WX ¼A~F f ñ 9,, ½ ¾- | Émi ª Z /k) ÕO

```
$ cd ~/.ssh  
$ ls  
authorized_keys2  id_dsa      known_hosts  
config           id_dsa.pub
```

¥' , @' ÙWy „ id_dsa J id_rsa ^) D½~ F ¼W- ýk . pub ½À) ? . pub ½~ i f D! ÕFu W- • i Šèy - D} Õ? p e ÙCT òÄD½~ ÕJ K5! Ák . ssh æä ÕF f 9,, o\ÝÙ ssh-keygen ÕœS%í . ' ? \$ Linux/macOS • , ¼F ssh-keygen X SSH — ÕCDú\$ Windows ÑF CŒœÓm§ MSysGit — Õ¼?

```
$ ssh-keygen -o  
Generating public/private rsa key pair.  
Enter file in which to save the key (/home/schacon/.ssh/id_rsa):  
Created directory '/home/schacon/.ssh'.  
Enter passphrase (empty for no passphrase):  
Enter same passphrase again:  
Your identification has been saved in /home/schacon/.ssh/id_rsa.  
Your public key has been saved in /home/schacon/.ssh/id_rsa.pub.  
The key fingerprint is:  
d0:82:24:8e:d7:f1:bb:33:53:96:93:49:da:9b:e3 schacon@mylaptop.local
```

' 1 ssh-keygenj - |) ÕD" # ÕÓó³ | i . ssh/id_rsa ÕFd | . j @Åf yk! t) Õ' %o? p ef Ç: \$. ') Õ| yk' %oF [1ï j 9? d&F pef . ' ^) ÕFžaG- z • • ^ -oø. F· j „ > ³ | Š 2~ ° ÇÈ" È• Dš 2z" } Õ? f í 9,, ' ssh-agent µ¶SX YÍ t ï @yk) o?

Y\$F ÕÙ^ÑI ï " D' i , @[ûÉD! Õ¿ucœ9W- Git E F Õy€3 ó—EEF Õg\$. ' x§!
ÕDSSH! OEÓø? 6' f@‰D—i AÓuÉD . pub ½~ A~F> [o\K~ ÿu? ! Õ• ÊSi ò ÄDO

```
$ cat ~/.ssh/id_rsa.pub
ssh-rsa AAAAB3NzaC1yc2EAAAABIwAAQEAkI0UpkDHrfHY17SbrmTIpNLTGK9Tjom/BWDSU
GPI+nafzlHTYW7hdI4yZ5ew18JH4JW9jbhUFrvQzM7xIELEVf4h9lFX5QVkbPppSwg0cda3
Pbv7k0dJ/MTyBIWXFCR+HAo3FXRitBqxiX1nKhXpHAZsMciLq8V6RjsNAQwdsdMFvSIVK/7XA
t3FaoJoAsncM1Q9x5+3VOWw68/e1Fmb1zuUF1jQJKprrx88XypNDvjYNby6vw/PbOrwert/En
mZ+AW40ZPnPPI89ZPmVMLuayrD2cE86Z/iI8b+gw3r3+1nKatmlkjn2so1d01QraTI MqVSsbx
NrRFi9wrf+M7Q== schacon@mylaptop.local
```

G\$ \$e 8T " • , ¼Óf SSH) ÓD~ _k ©ÓFG; A GitHub D SSH) • É
[https://help.github.com/articles/generating-ssh-keys?](https://help.github.com/articles/generating-ssh-keys)

• ' = > TM

¥' S••pbþÓEFð7DSSHHI ? ! H½F ¥' [. ' authori zed_keys 1WSy' i ÓÙ| O?
O! ¥' —Ef. ' DÍ " • , i ç t D Linux ðÙ7F> p Ubuntu? ' ¹ F%í W- T" • , ' i gi tF>
t í i W- . ssh æä?

! „ <T" 9o\ ssh-copy-id ^ %ÓÉ ÝÓf FðÄ—Ç®~ ÝAÓ> ÚÚ! ó^?

' ¹ F%í W- T" • , ' i gi tF> t í i W- . ssh æä?

```
$ sudo adduser git
$ su git
$ cd
$ mkdir .ssh && chmod 700 .ssh
$ touch .ssh/authori zed_keys && chmod 600 .ssh/authori zed_keys
```

³ ËF ¥' , @t • , ' i gi t D authori zed_keys ½~ • • W" , ðK SSH! ó? —E ¥' Z[OÒ^
¶· ' MœD! óF> [· ' z" \$ä | ½~ ¼? Šå ½» ¼Fð" ! ó• ÉSi ðÄDO

```
$ cat /tmp/id_rsa.john.pub
ssh-rsa AAAAB3NzaC1yc2EAAAQABAAQCB007n/ww+ouN4gSLKssMxXnB0vf9LGt4L
ojG6rs6hPB09j9R/T17/x4lhJAOF3FR1rP6KYBRsWj2aThGw6HXLm9/5zytK6Ztg3RPKK+4k
Yj6541NYsnEAZuXz0jTTyAUfrtU3Z5E003C4ox0j6H0rfI F1kKI9MAQLMdpgW1GYEIgS9Ez
Sdfd8AcCIicTDWbqLAcU4UpkaX8KyGI LwsNuuGztobF8m72ALC/nLF6JLtPofwFBIgc+myi
v07TCUSBdLQIgMVOfq1I2uPWQ0k0WQAHukE0mfjy2jctxSDBQ220ymjaNsHT4kgtzg2AYYgPq
dAv8JggJI CuVax2T9va5 gsg-keypai r
```

[ð" ! ó• k • , ' i gi t D . ssh æä < authori zed_keys ½~ DE å O

```
$ cat /tmp/id_rsa.john.pub >> ~/.ssh/authorized_keys
$ cat /tmp/id_rsa.josie.pub >> ~/.ssh/authorized_keys
$ cat /tmp/id_rsa.jessica.pub >> ~/.ssh/authorized_keys
```

Y\$¥' St, Ñ K™í W- Í àá? 9, ÈEý --bare Ø. Dgit init ^ %S%TòWQFC^ %\$Ü
1 6àá | Cj %í µ" æäO

```
$ cd /srv/git
$ mkdir project.git
$ cd project.git
$ git init --bare
Initialized empty Git repository in /srv/git/project.git/
```

³ ÈF JohnPJosieJ K Jessica ¼Dœ9W%9, [6' . æD¥Ü7! €uTò- àá ¼F 6- , [ãàá EÓt. æDéÓàá> N €u] Ý? GO9FÍ • • W- ™. æFÍ , @k %ÑæEFØPØshellF> %í W- 2 àá? ¥' —» Ò- EÓ^ git' ; B GitàáDEFØ. ' gitserver" tåö) ? O! F—E CEFØÝÙ\$AþF> ¥f Z\$ DNS PØ½[gitserver • NæEFØ? ža¥' 9, ÝÜp< ^ %Ó—» myproject i Zk. æ¥ ¼Z Øm½~ ØO

```
# on John's computer
$ cd myproject
$ git init
$ git add .
$ git commit -m 'initial commit'
$ git remote add origin git@gitserver:/srv/git/project.git
$ git push origin master
```

ã|F 6, Ñ K9, qrãàáF> €ÀùÉDfÝFÈi I } ~O

```
$ git clone git@gitserver:/srv/git/project.git
$ cd project
$ vim README
$ git commit -am 'fix for the README file'
$ git push origin master
```

o\ò81WFf 9, ½¾òí W- ¶k` L>ÿPÜNe-, Ñ KDGitEFØ?

, @O9Di FæâfkóØ=>DØ, Ñ K' i Í° „ • , ' i gitD- ° ÑæEFØs&OØW- • o shell? pef: yã• „ ýÓF• , @» f /etc/passwd ½~ ¼Ógit' i fy- ØDshellr?

ÈEw-) t git-shell D' ÿ shellµ¶FFf 9, 1-5[' i gitDt ÝÿÓ\$Š Git/GD>• A? C µ¶X Git—~ ØWOCD? pe[git-shell EÓt' i gitDÑæ shelllogin shellØF žaC' i ~ Ç° ØðæEFØD• o shellHI >ÿ? ¶@. ' git-shell F, @' . . | ØbashJ cshF. f t C'

ì Dz á shell? t ÓÙÑI ī " F' 1 f ®¶ - z git-shell DôÖf.) Z" §§ /etc/shells
½~ ¼O

```
$ cat /etc/shells # see if git-shell is already in there. If not...
$ which git-shell # make sure git-shell is installed on your system.
$ sudo -e /etc/shells # and add the path to git-shell from last command
```

Y\$F 9,, . ' chsh <username> -s <shell> ^ %o» f œW• , ' i D shellO

```
$ sudo chsh git -s $(which git-shell)
```

ðÄF' i git—° t' SSH - ³ y Git à á ÓÙ€uBI Pī " F&C° ðæðø PÒ• o shell? pe+ÙðæFFfj ðY, +{ B<F ÄðÄO

```
$ ssh git@gitserver
fatal: Interactive git shell is not enabled.
hint: ~/git-shell commands should exist and have read and execute access.
Connection to gitserver closed.
```

á | F' i ð9o\SSH 7' ^ ðSHI œb 9ÄDgit EFð? pef: @XY. F 9' š
authorized_keys ½~ > \$fk: @ÿÓD! ðèå•• „ <ø. O

no-port-forwarding, no-X11-forwarding, no-agent-forwarding, no-pty

" e p<O

```
$ cat ~/.ssh/authorized_keys
no-port-forwarding, no-X11-forwarding, no-agent-forwarding, no-pty ssh-rsa
AAAAAB3NzaC1yc2EAAAQABAAQCB007n/ww+ouN4gSLKssMxXnB0vf9LGt4LojG6rs6h
PB09j9R/T17/x4l hJAOF3FR1rP6kYBRsWj 2aThGw6HXLm9/5zytK6Ztg3RPKK+4kYj h6541N
YsnEAZuXz0j TTyAUfrtU3Z5E003C4ox0j 6H0rfI F1kKI 9MAQLMdpgW1GYEI gS9EzSdfd8AcC
I i cTDWbqLAcU4UpkaX8KyGI LwsNuuGztobF8m72ALC/nLF6JLtpofwFBI gc+myi v07TCUSBd
LQI gMVOFq1I 2uPWQOkOWQAHukE0mfj y2j ctxSDBQ220ymj aNsHT4kgtZg2AYYgPqdAv8JggJ
ICUvax2T9va5 gsg-keypair
```

no-port-forwarding, no-X11-forwarding, no-agent-forwarding, no-pty ssh-rsa
AAAAAB3NzaC1yc2EAAAQABAAQDEwENNMMomTboYI+LJi eaAY16qi Xi H3wuvENhBG...

Y\$F þw/GD Git ^ %o• d° pg€μ" Fhi , ðK' i Z[ÅWÒTW- • o shell ^? gpy XMR
ƒC©DFffí 9,, \$ git' i Då æã <í i W- æã FSy git-shell ^ %oÓÙW» ÓùDÉ» 1? >
pFF 9,, ÿÓÓI " ! " { EFð³ ' D Git ^ %oFJ KyØ' D SSH B< ðæMRÓÙÉ» 1FòÄF ð
K , ðK' i „ » ¼12, + ðæ | F -j • Tf DMR? @^• ~ e k GÉ» 1 shell DMRF GÝÙ git

hel p shel l?

Git ST 3Ú

³ < S ¥' [o\ ÓGitÓ: ; í i W- × Šõõ ÕÖDà á? y Š½¾¥Å, => D Git f? HI Fòi W - €: èø? GO9Fst Çõm=>EFFæbo\ C: ; ý€DA~[\$ þwÑ! .?

peÝÙ\$éo½èLDEFðÑF· - C- yž" ! , D-` . æEF? peÝÙ\$éo½èADEFð ÑF· 9' ŠÝl tC; Š%3JÉÝ• , ó' Š{ ¶EfJ' • Dåðø-` HI D. æFðÄ9,,] Y WPÓSSH! ðDž Ÿ?

ÅPb| FC Git: ; T i / y ~í E» D? o€FF- , @, ōöÖDÚ2ÝÙC^ %oO

```
$ git daemon --reuseaddr --base-path=/srv/git/ /srv/git/
```

--reuseaddr ø. L8EFð\$Å, > Vm- ³ '' | DoC<mBF & --base-path ø. L8' i \$4ðŽ • » \$. Dž ~ <qr . æF " åD\$. [ŸÀ Git õõÖOs bÆ' ÜàáS« X? pekéo½g \$Ý ÙFF , @, < 7' 9418 DoM>ÿ?

f 9,, o\8e12[CÔÓ,, ōöÖD12ÝÙFðå@PZ§ff. ' DÍ" • , ?

◦ Š\$YnD Linux ÿ 7½F **systemd** i ¥€\$DÜ¹ 6• , Fsäf 9,, ' . SÄTäæD? - @\$ /etc/systemd/system/git-daemon.servi ce ¼< W- ½~ j 9F A~p<O

[Unit]

Description=Start Git Daemon

[Service]

ExecStart=/usr/bin/git daemon --reuseaddr --base-path=/srv/git/ /srv/git/

Restart=always

RestartSec=500ms

StandardOutput=syslog

StandardError=syslog

SyslogIdentifier=git-daemon

User=git

Group=git

[Install]

WantedBy=multi-user.target

f 9° j O9ðJ,, git BÝD Git l 1 ÓoeO! . ' ^ Group B User >ÿ? j , » f . > - z CDD' i \$ä• , Ñ?äLF G- z Git VÔÓ½~ È Š /usr/bin/git F ®@! 9» f ä¢. ?

¥| Ff, @ÝÙ systemctl enable git-daemon, a. \$•, BÝ| ÉÝÝÙF òÄí ° a. o\ systemctl start git-daemon BÝF o\ systemctl stop git-daemon> Ç?

\$ 6•, ¼Ff 9„ . ' sysvini t•, ¼D xi netdý! FJ KULD12S...YÑÑ- @f° p[^ %o õöööö6...YÄÖ?

³ <SFF, @ÝÀ Git p" àáL8×SEFØDÅ=>HI ? f 9„ \$í - àá<%í W-) t git-daemon-export-ok D½~ S...Y?

```
$ cd /path/to/project.git  
$ touch git-daemon-export-ok
```

C½~ [L8 Git CDÅ, => D. æHI EF?

Smart HTTP

¥' Wc o\ SSH ØÙ=>HI Fo\ git:// ØÙÅ=>HI Fhi j kW8: ; 9„ O| ...Y, Ñ! 812 DHI ? EÓ Smart HTTP Wc~, @\$E FØÑB' W- Git Éy D) t git-http-backend D CGI ý ! ? C CGI ý! [j ` P° git fetch J git push ^ %oN HTTP URL ð uDGÅ¢. Bè\ MRF SÎ ý C« j 7i ª Ý{ HTTP ØMØÇ" § 1.6.6 7! D« j 7Ý{ ä° - ø? pe CGI ð YC« j 7Ý{ Ø° öSmartø, 2F· [j „ Ø° , 2S· ØÙoMF ª •• [j ÄVT, öDumbø, 2<ósä· 9„ y] " þD« j 7...YN<} ~ø?

\$ Õf „ Ñ} ~DÚÛÈj | F ¥' [' Apache S" t CGI EFØ? pe f Ák ÚÛ ApacheF f 9„ \$ Linux | B<, Üp<J » ¼D^ %oS ÚÛO

```
$ sudo apt-get install apache2 apache2-utils  
$ a2enmod cgi alias env
```

CÍ " [j B' mod_cgi F mod_alias F B mod_env> Apache, - F ð", - T i . C• ° g€µ" f® ¶D?

f j , @[/srv/git D Unix' i ûEÓt www-data F òÄ Web EF Ø' °` LCà áF st ÝÙ CGI ý ! D Apache ...H³ | j „ C' i D>ÿÝÙO

```
$ chgrp -R www-data /srv/git
```

³ <S ¥' @N Apache ÞÓ½~ •• W" A~F Sa git-http-backend" t Web EF Øy /git ¢. G ÅDÆ€Ø?

```
SetEnv GIT_PROJECT_ROOT /srv/git  
SetEnv GIT_HTTP_EXPORT_ALL  
ScriptAlias /git/ /usr/lib/git-core/git-http-backend/
```

þe1Í GIT_HTTP_EXPORT_ALL ò- | BgCFGit [- yÅ=>« i 7CDÝ gi t-daemon-export-ok
½~ D7! áF—Ã Git õöÔÓWÄ?

¥| Fpe: a Apache L 8 gi t-**http-backend** GÅ> ...YLkÍ " D=>I OF. ' p<=>óÍ PÓj
9O

```
<Fi les "gi t-http-backend">
  È   AuthType Basic
  È   AuthName "Gi t Access"
  È   AuthUserFile /srv/gi t/.htpasswd
  È   Requi re expr !(%{QUERY_STRI NG} -strmatch '*servi ce=gi t-recei ve-pack*'
  || %{REQUEST_URI } =~ m#/gi t-recei ve-pack$#)
  È   Requi re val i d-user
</Fi les>
```

ò, @f %í W- Ómfkî W' i) oD .htpasswd ½~ ? „ <i W- • • ÓschaconÓ' i Tã ½~ D
HI O

```
$ htpasswd -c /srv/gi t/.htpasswd schacon
```

f 9, o\8e12• • Apache =>' i Føù. ' ¼W812j 9? „ Ñgg- i ¥' 9, ÜTD¥}
~DW- HI ? pe | 9Ds Ffí 9, o\ SSLÝÙ· F, z Ofk‡?i \$•) ÔÖ<ÔÙx y D?

¥' Ç: _k] œ• Apache PÓ½~ Fstf 9° j . ' ÇOD Web EF ÐFJK9° k ÇOD=>, Å?
· Då@>€i . ' W- Gitf ýDF) t gi t-**http-backend** D CGI?· { -' SÆ€: +o\ HTTP¿ u
B³ ED‡?? · ! -> ÇÓmœb=>• ° Fhi =>• ° 9, \$ Web EF Ð; -' · | { æç...Y? f 9
, \$œbfk 9, Æ€ CGI D Web EF ÐÑ=TòQF f, X¬DW- f ¥ŒÒD Web EF Ð+~Ð?

!

Ñ^• ~ e Dk GPÓ Apache => HI DMRF Go\ „ < ^ 3 ¿ B Apache ½> O
<https://httpd.apache.org/docs/current/howto/auth.html>

GitWeb

þef y. æk` L>jy J - ` >jy Ff 9° , @í i ÊW- xSþED} í ä• ð? Git CD^W- ô%
GitWeb D CGI ý! S‰ð. µ" ?



Figure 49. GitWeb # A B „ CDE

p e f : @ä • GitWeb p b Å ©f D. æF > ¥\$ E F ð Ñ Ú Ü ^ æC © Web E F ð > p l i g h t t p d J
webri ck F Git CD ^ W - ^ %o Sa f B Ý W - ä | D E F ð ? \$ Linux • , D < • Ñ F l i g h t t p d o € Z [
Ú Ü ^ F f „ f - , @\$. ææä J , Ù g i t i n s t a w e b ^ %o j 9 ? p e f . ' Mac • , F Mac OS X
Leopard • , Z [- Ú Ü ^ Ruby F f „ webri ck J 8 i f ¥ 5 D Ø ù ? p e Ç : . ' l i g h t t p d B Ý
i n s t a w e b ^ %o F f , @\$, Ù | • k -- h t t p d ; ‡ ?

```
$ git instaweb --httpd=webbrick
[2009-02-21 10:02:21] INFO  WEBrick 1.3.1
[2009-02-21 10:02:21] INFO  ruby 1.8.6 (2008-03-03) [universal-darwin9.0]
```

Ø - ^ %o B Ý ^ W - Å Å 1234 7' D H T T P E F ð F > ¥ É Ý è , ^ ð B ð ? ð y f S ñ d] 1 ñ ? ø f Z
[Ø f ^ µ " > : G f ø - E F ð F f 9 „ , Ù O W - ^ %o F > • Ñ --stop ø . O

```
$ git instaweb --httpd=webbrick --stop
```

p e f Y \$: t f D w x J f ü y D , î . æ { ¶ D Ý Ù ð - Ë Ü F f , @ o \ • o D Web E F ð S E Ó C G I
ý ! ? W " L i n u x ð Ù 7 D — á k g i t w e b Õ F 9 „ o \ a p t J d n f S Ú Ü F f 9 „ 1 + + ? ³ < S ¥ ' S
½¾ D ^ • W < p b ~ Ý Ü Ü G i t W e b ? ' 1 F f , @ O ð G i t D ï n o F · Õ m ^ G i t W e b F > 9 „ ó f É »

1 D CGI ý! O

```
$ git clone git://git.kernel.org/pub/scm/git/git.git
$ cd git/
$ make GITWEB_PROJECTROOT="/srv/git" prefix=/usr/gitweb
Ê   SUBDIR gitweb
Ê   SUBDIR ../
make[2]: `GIT-VERSION-FILE' is up to date.
Ê   GEN gitweb.cgi
Ê   GEN static/gitweb.js
$ sudo cp -Rf gitweb /var/www/
```

, @O9Di FF, @\$^ %o% » **GI TWEB_PROJECTROOT** gCSa Óæä; f D Git 7! áDÉÓ? Y
\$FF, @\$ Apache %. ' ò- CGI ý! FF, @t ä•• W- ÒÓåoo

```
<VirtualHost *:80>
Ê   ServerName gitserver
Ê   DocumentRoot /var/www/gitweb
Ê   <Directory /var/www/gitweb>
Ê     Options +ExecCGI +FollowSymlinks +SymlinksIfOwnerMatch
Ê     AllowOverride All
Ê     Order allow,deny
Ê     Allow from all
Ê     AddHandler cgi-script cgi
Ê     DirectoryIndex gitweb.cgi
Ê   </Directory>
</VirtualHost>
```

d t Cx F GitWeb 9,, o\æbW- Ý{ CGI J Perl DþwEF ð- Eúpef, @Ds F - EÊS - CQj
I S®? Y\$Ff 9,, HI <http://gitserver/> \$Kä• f D7! á?

GitLab

cd GitWeb / ø} ~? hpef g\$` ÙW- ~ YnF • ° ~ Ž D Git EF ðJ K Ê- , Í D• Z 1 e
9Df øùÚÙ? st GitLab i ¼¥X) DW- F ¥' [. " t ©H» OP· DÚÙB. ' ? ò> GitWeb
@A¾De> ¥, @~ eDúöFh· D- i W- • ° ~ Ž Døù?

" ...

GitLab i W- ‡? áÝ{ D web - ' Ff, /> § 6 git EF ðF· DÚÙ\ ÕéBT~ eDKL? >Ý D
i F ð- \ Õk * €Ô^ D½> ñNBÝ{ ?

ðJ K W" 9; ...D1 W¢f ÚÙ GitLab? t ^ ~ ½¾DBÝBÝÙFF 9,, <i ÒÓõ4ÃJ K \$
<https://bitnami.com/stack/gitlab> ÑOPW- ÚÙÕFO! * ÕPÓ. èzî f° » D| B? Bitnami DW-
3 Q\$S· D¿ ã ÜÜðo\ alt+Ô - Ôk øF · j ÝÀf ÚÙ5D GitLab D IP 5¢, ß³ | D' i) B)
o?

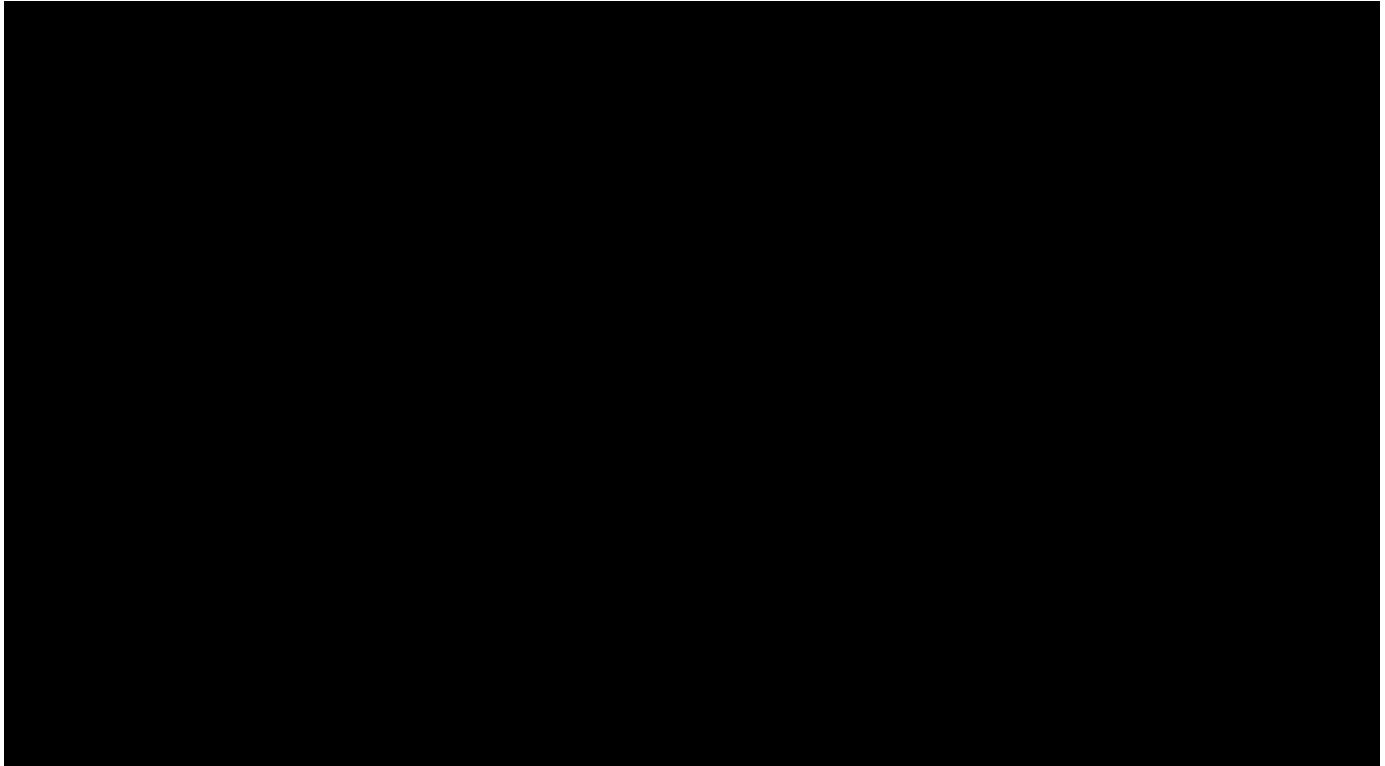


Figure 50. Bitnami GitLab F G" Hr DE 3

ÅPpbF ÈÈ GitLab' ' 7D readme ½~ WÈÈSFf 9,, \$òJ ÙT. <https://gitlab.com/gitlab-org/gitlab-ce/tree/master>? \$òJ f [j \$åÖ~¼ÙT ÚÛ GitLab DFEFW- 9,, \$ Digital Ocean ÑÝÙDÒÓÖF,, ß RPM B DEB ÖöÍ i 6+7ø? òJ j k Ò* 1ÓD- « a GitLab ÝÙ\$* ç†DÍ "•, B‡?áÑFW- Ž~ÝDÚÛý! F,, ß8e 6Ds" ?

ýþ

GitLab Dý€ÛÜi o\þwÔk D? [f D¿ BÐ^TZ [ÚÛ GitLab D åõ) J IP 5¢Fd | , ý€3 - ° çãj 9? ³ | D' i) i **admi n@l ocal . host**F³ | D) o i **5i veL! feóf j** ÒT » ¼G¿ã | Q ½~ |) o DC©ø? çã | F QÖå à Ñ1oâ ÈÓD ÒAdmin areaÓ Ùç ÓÙý€?

Figure 51. GitLab " I # ÒAdmin areaÓ ×> 3

À' (

GitLab ÑD' i • Di y~ : " KD° i ? ' i ° i ÁkI eA¾D51Få@i Õm¿ã‡?D' i MRE i ? í W- ' i 2i Í kW- , åUV Fj C' i . æDxšEí ? pëW- ô **jane** D' i / kW-) üi project D. æFž aò- . æD url j i <http://server/jane/project> ?

Figure 52. GitLab „ CJ KDE 3

9} W- ' i k! 81W? ÓóT óBlockingóW- ' i aÇ6¿ã GitLab...HF hi C' i ^) T ÷ < D
f k‡? adj { z" F > ¥¤9, o\ C' i Cåy- D¿ãKP^3 Å6D- %MRÉ?

&uW1 ÜF ÓdYóDestroyingóW- ' i Fj Ø: D[6s‡?áB½~ • , ¼9} ? 6^) T ÷ < D
f k. æB‡?T j { å} F / k Dœbûí j { 9} ? ð#di W- ~ Žò¥~ ¶É" " DÙt Ff, I ö
' Tò81W?

W

W- GitLab Dûi W" . æD£î F - OG\$eö' i 9, HI ð" . æD‡?? í W- úT k W- . æ^)
T ÷ óS' i WÄøFf, pëW- ô trai ni ng Dû/k W-) üi materials D. æFža ð- . æD
url j i <http://server/trai ni ng/materials>?

Figure 53. GitLab L J K DE 3

Í W- úř k 8e' ; ŠèGĀFí W- ' ; yû¼D. æ, Bû! - D>ÿT k ©ì '] ? >ÿD>• s
ÒH« Óóg° CI " BOPøT Ò/kKÓóôŽÒÓúPf 3B. æø? >ÿD8» t e,, -§®, \$ò
J WWW: F Ç\ \$ GitLab Dý €ÜÜÑk ££^3 ?

± ©

W- GitLab D. æ/ ø§ git D7! á? í W- . æř 2§W- ' ; J KW- úD~ - ^) ī ÷? peò- .
æ2§W- ' ; Fžaò- / k Kyfk 9, OPò- . æD%/ k ...³ ý€>ú peò- . æ2§W- úF
žaCû¼' ; ©ì D>ÿí j È" ' ?

Í W- . æř kW- 9i ©ì FÒÓÈØ9, • Tò- . æE ÜBàá? peW- . æi M(DFò- . æD
/ k K®¶Ñ- =>s & . ° » D' ; 9, HI ? W- 5ND. æ9, { fkžåD%• TF&W- O1 D
. æ• i yfk %9\$D? O9Fò8ÒÓÆÖÖ **git fetch** D. ' í ÓÖy. æweb' ; ÜÜDHI ?

X'

GitLab \$. æB• , ©ì Ñí Y{ 3I Óæ? yæ9©ì F øk / Gn~ žó | F GitLab DE F ðj , ÜW-
Óml I - JSON ð? D HTTP GÅ? ði ÉÝ6- ³ f Dgit 7! áB GitLab ...HT 6D, žµ¶F> p
CIEF ðF Üb ÚFJ K\ (µ¶DW- ú51W?

a B' Y

f : @\$ GitLab %DUW~ n—i í i W- ™. æ? ðo\ QÖµ¶àÑD ð+ÓÙçôf? f j { @ÅÜL
. æ) üFí —i ð- . æf 2D^) ī ÷F , B· D9i ; ©? < t e ð DE »> Ci ŽðDF 9, o\ E
ÓÙÜm™* Ö? QÖ ðCreate ProjectÓF f —ôf ^?

. æ" \$ | Ff 9° j : [· Š! 5D Git 7! á- ³ ? í W- . æř 9, o\ HTTPS J K SSH - ³ F œ9!
KÍ 9, { ' SþÓé ðGit? \$. æå EDE à 9, • Tò- . æD URLs? y§W- " \$D! 57! áF ð

- ^ %o[j Nå ÓÉÓ• • W- ô **gi tl ab** Dé Óà á O

```
$ git remote add gitlab https://server/namespace/project.git
```

pef D! 5Ák 7! áDE! Ff 9,, òÄ%o

```
$ git clone https://server/namespace/project.git
```

web' i ÜÜCD^E - k' DOP7! áMRDþE? í W- . æDå EÍ #©^¥UD†ÝF, ¥o\ E
\\D^3 9,, f ð B. æ½~, BCárã?

1 = 2 j

\$W- GitLab. æÑWÊµ" D¥} ~1W-i ÜY: " Ky git 7! áD...³ push > ý? f 9,, o\ . æ
E» DÒMembersóf 3øÓ\] NW- . æ• • L" KF > ¥[ð- ™D: " KŠW- HI @í GÃÓÇO
DHI @í \$ ü ¼Z} ~OPØ? o\ ÜYw- : " K ÒDeveloperó, ð KøÓJ K~ cDHI @í F ð
- ' i —9,, ÅPD5...³ N7! áJKN] YÖÙCå?

uLW- aî " ~ • BD1W-i . ' i > GÅ? . D³ Q\$Saæb° p• Tð- . æD: " K\${ yÒD
oÇ<yð- . æ" XÈ¤? 9,, ...³ HI D: " K° p} ~D%í W-] YÖÙCå Fí 9,,
, BW- N **master** JK 6æbW-] YDî > GÅ? y 7! áAk €u>ýD: " K• 9,, ÒforkÓð-
7! áoj %í 2SÉmDò- áDE! øFNGb E! ÖÙCåFd | sž - E!, , BW- Tå. æDî >
GÅ? ð- , z. Ò. æ/kKôŽÒÓEN7! áDCåF, B` a | ^ L8• kàó: " KÐE¤?

\$ GitLab ¼î > GÅBI " i W- , ðOPDå@\\] ? í W- î > GÅÍ L8\$CXfgDÙÖÙOPó.
Ý{ W- æC©DnøMäøFí L8yW- B¹ - s" ÖÙOP? ! KÍ 9,, {] Pç' i FJKüüt
milestonesóJ Öáø ÜÜ?

ð- \] å@âã § \$ GitLab ¼Š Git / GD° - Fhi GitLab" t W- fŒD• , F· CD^8e 6Q#
S¢Ef: Oµ" FHø. æwiki Š• , úöµ¶? GitLab DW- ³ Q\$SFEFðEÓBÝÙ, | Ff [I
ö, @* ÖPÓ½~ J o\ SSH - ³ EFð? <t e‡ Dý€Br €. ' Í 9,, \$ð BðÜÜ¼öf?

O3Z[yKE\

peÇ: Ei ÉmD Git EFðFf 9,, øù[f D Git. æüýTW- L\ C, DÜýþy? ðýS^W" 5
ÆOW- üýþy 9,, ' S½¾í i > , ¹ . æF ¥Å, ÖÙEFðúöBÀØµ" ? j . f \$A\ Ei > ¥
ÝÙ^ÉmDEFðFf ñd9,, äf D, ï noüý \$! &üýþy ÑÑðo€~ k£S, ï ' ' Sð YB¢
Ef?

Y\$Fk * €e DÜýDf øùFí - øùÍ k ÇOD³ PQ? Ñä • ¥™W° FGð B Git ú x D
GitHosting È Ü <https://git.wiki.kernel.org/index.php/GitHosting>

¥' j \$ GitHub Õ^ æ• GitHubF" t æâ ¥† D Git üý x ØF f I 9° , @Šüý \$ GitHub ÑD. æÔ
Ùå ýF & ¥f í I 9° > Ç:] Ei f ÉmD Git EFð?

¢ £

f k e 8é Ó" P Git à á Døù - § Š 6%î " J i] 3f Dμ" ?

ÝÙf ÉmDEFð[k 8e > ý ¥L 8f ÝÙCEF§f ÉmDêo½AF h pāo€, @I _f t CD| ÷] EÓŠúöEFð? pef < Óf Db¾Süý EFðAF 9æí DEÓŠúöúÅPpbFf ®¶° pz " f Dno\$ 6EFðF¥l " üüÇL8ã" W? ò[...n ^ øDZ » p - " WJ üî D1 2HPî f J f Dûü?

L MN Git

f Y\$/k^W- é Ö Git 7! á F° t f k , ¿ K&3noCDEF\$W- ! 5μ" i Ö<FFfí Z[E
Ö^x! Git ^ %? f Y\$9, hi pb t' Git CDDW"] , 2μ" i Ö^?

òWe ¼Ff [j hi pb" t E¤KJ Öi KF\$W-] , 2: " D| B¼. ' Git? f j hi t W-. æf
• 5E¤nøF> ³ ¶W" ¥¬...+12Fa f B. æDúÖK° æç 5ôfò- \Ö? uLFFí j hTp b
ý€kI e, ¿ KCå E¤D. æ?

L MN² j dÚ

Šx, DE ¼27! ÖÓ• , óCVCSØ/\F Git D] , 2° - . Ö, ¿ K÷D: " gÖ~ • ä+eÄ? \$E
¼2• , ¼FÍ - , ¿ K—Äi - ³ \$EKÖND? QFåāDμ" 12†¹ / Ä? &\$ Git ¼FÍ - , ¿ KO
| æÉÈ? QBEKÖD¤çÑÑí —i ¬FÍ - , ¿ KŒ9, [ÉmDnoE¤T 6Dàá¼FO|í ° ú
öÉmD! , àáFa 6%9, \$ ×ØÑμ" > E¤nø? ° äF Git D] , 2: " 9, t f D. æBwx
¬öX88ÇODμ" i ÖF ³ <SDe?j) * E8†' ^ Git Dò8ä† - D€\$- ' 12? ¥' [OP
í 812D³ Q, B9° DPQúf 9, øù. ' ¼DÌ W8FJK[· ' D° - i i öP. ' ?

HI N² j d

E ¼2• , ¼O€. ' Di ~Q: " , z ÑÑE ¼2μ" i ? W- ¼vEKÖFJ K¬ ¥| F 9, ³ ' noF
f k %[ÉmDμ" ŠèOÈ? ¶· - , ¿ K• " t? QFj ¼vàáDè_KŠ ¼vàáOÈ?

Figure 54. Z Q^pqØ3

ò9àÈpe! - , ¿ Ks ¼vàáqr no<SFO| " ^W" » f Fža^- k UW- , ¿ K9, ...† 5ä‡
? €uÀ&3EFÖ? UV- , ¿ K\$€u» f èâF®¶¹ [UW- %Dμ" i > ÖSFòÄ' Çj ñ• U
W- %D» f ? òB Subversion óJ æb CVCSØ ¼D< EWF &¥ò- , 2í 9, | 55Ý' T Git ¼?

pe\$! " J Kwx ¼Ff Z[i è^ . ' ò8E ¼2μ" i ÖFòŽ9, μ¶D' ò8} ~D, 2? - , @
òí 5W- ¼vàáF> c, ¿ wx ¼DÍ - %€u‡? D> ýF- 9, , Äμ" ^? Git Çj a' | ñ• åä
D» f ?

Hp John B Jessica O| , 1 μ" ? John ôf ^ 6D» f > €uTEFð? 3 È Jessica , + Cå è ÉmD » f Fé > TEFðB<? è{ Ýä è D» f go\ * ½Ô2Ónon-fast-forwardðD1 2€uF - k [‡? @ P<S> ¥† > | 1° €u? ò8, 2Dμ" ī ÓD. ' * €yz Fst t e‡%y I Æðí I i è?

¤dò > Çī ý§ûwx? †' Git D] Ý, z Fo\O| \$e-] ÝÑμ" D1 2Fj . i ÑÆ%D, ¿wx i 9,, I 55\$~-. æÑ: " ?

HPýþ(² j d

Git L8e- éÖàá" \$F. ÒðÄW8μ" ī ft 9° Oí - , ¿K/k ÉmàáDL > ýB 6fk %à áD` > ý? ò8oÚ<o€j k - n° Ò 1Ó. æD>éDàá? @t ò- . æ‰E¤Ff, @SC. æ qr XW- ÉmD! , àáFd | [ÉmD» f €uÑ] ? 3 Èf 9,, GÅ 1àáDúöKI P~™i > T å. æ? úöK9,, [f Dàá" t éÖàá• • ÔSF\$! 56+f Dg~ F[† > k6' D] Ý> €u Å 1àá? òWi ÕDμ" 12p< f ©ó\$ Efý€Kμ" ī ?øO

1. . æúöK€uTååá?
2. E¤Kqr ååáF‰X» f ?
3. E¤K[‡? €uTÉmD! , àá?
4. E¤KcúöK¿ uK~ FGÅI PÉmD~™?
5. úöK\$Ém! 5Dàá¼F [E¤KDàá• t éÖàá> † > » f ?
6. úöK[† > | D» f €uTååá?

Figure 55. Z 9J KT p q Ø3

ò i GitHub B GitLab > EKð2Óhub-basedðμ¶¥€' Dμ" ī Ó?%' 9,, ~í 5[l - . æêóf t ÉmD! , àáF Nò- àá€uÉmD» f F > t í - %f\$? òa‰¥å@D³ QèWi f 9,, { ¶5 μ" F&ååååDúöK9,, X| I Pf D» f ? E¤Kç®> VúöKÆ€ôCå D~™ÑÑÍ W1 Í 9,, i FÉmD? ëμ" ?

" ýÜ³ " ý² j d

ò ...i eàáμ" ī ÕDg8? Wc / k ‡ÆÈ: " , ¿KD" ‡z. æ' j ' TòÄDμ" 12F Hp^a) DLinuxAu. æ? { üt ³" ýb lieutenanc Dû- Efý€K] i i í Ef. æ¼D° » \] ? fk ò" EåýèÑj k WÊüt " ýb dictatorc DBEfý€Kì í , i ? åýúöDàá" t; ...àáF t

fK: " KCD6' , @I PD. æno? Ö- i Ö• ÈSi òÄDó\$ åyŠEåyμ" i ? øO

1. • o „ K\$ÉmDå"] YÑμ" F> 5? master] YÖÙg x? òJ i åy€uD; ...àáD master] Y?
2. Eåy[• o „ KDå"] Yî > TÉmD master] Y¼?
3. åy[fK EåyD master] Y> kÉmD master] Y¼?
4. ¥| Fåy[Ef | D master] Y€uT; ...àá¼F, ¬fK 6, „ K, åt xØÖÙg x?

Figure 56. " J d P" J pqØ3

ò8μ" i Ö> Ç€' F- k . æútr ¾FJK, @e©i y€| F' j ¹ YX³ »? t' ò812F. æßi í %oj åyø9, åtC] vDEfμ" i ücÇODüùí í %] i A€Fd| \$ÇO| s[t - D nol €, i ÈSF' §è| DÖi ?

² j dÚ¢E

ÑÜ) * ^\$ Git>] , 2• , ¼[€. ' Dμ" i ÖFhi \$...ÉD, å ¼Ffj nT8e9° Pî f D° » μ" i ÖDg8? Y\$f- CZ[%? p8μ" i Öüi 9° > HPî f ^F¥' j cXW" pbæÉÇOμ " i Ö¼å@çD~ ¶¹ DHI ? <W? ¥' [j hi t. æ%€ åDW" €' , 2?

] 1 á ± ©' %

I I pbNW-. æE åDå@S®\$§ôfE åkI eÇOD12? st Git* €åtF%' 9, o\ÇO D12SWÈμ" Ff, I I - CpbE å> Çi * €t- ÑÑí W-. æi k WQ<ÇO? ÷) sðÖÖtñ E åKD‡CþøùDμ" i ÖPCå>yŠ9° ÕmDL\ E å1W?

UW- ÷) sði tñE åKD‡CÑÑ[ú5Nò-. æE ånoD' ; ‡C, B6' D£ åÄ] ? \$8eo Ç<Ff 9° j k! ÷- , „ K WbCå Èt Fy§ÇtñD. æ9° ~ ö? y§tW" D! " J. æF , „

KD‡C9° j i Ñ\$FÍ bÍ kfÆÑ\$t Cå?
ðl m@Fst XÈ, ð KòSðeF\$- z f Dno°. Ù5- ' J æç 5† > | j nT~ el " ? Cå D
f Ý9° ° Yt\ | DFÍ 9° \$fg\$%f ÝJK> Vf Ý{ =† - ' | { † > kDμ" _m* " ? pbz
Ono¹, i ¥™DF> ¥Cå¹, i kŽDÅ

<W- ÷) sði . æ. ' Dμ" ï Õ? . i ¼v 6Dr Fj Í W- , ð Kï yåKnok / ODLk >ÿÅ
. æi ª kW- GäfkI JDÚÖKJ Öi KÅ i ª fkDI J i OÙÓM| =† DÅ fi ª ; Š^ž - \
ÖÅ i ª " \$E • , Ff ®¶¹ [f Dμ" Cå TÑÜÅ

<W- ÷) sði Cå >ÿ? i ª k. æDL >ÿj . N. æE¤f, Dï Õkú† DÇO? peÁKL >
ÿF. æj øùb812³ ª E¤Dμ" Å i ª « ¬kW- pbE¤D=>Å f Wt E¤eöμ" Å f eòE
¤Wt Å

f kò" I " ï j ÷) ...ÉpbNW- . æE¤F, Byf S-p" μ" ï Õ~ Pî JK9' ? ¥' [j ° ö
k_Fo\W• W' HSœl ¼DÍ W- 1 Üúsò" HI ° C° pí i ...É½f, @D° » μ" ï Õ?

| } ^ _

\$¥' , ¹ ä • ° » D' Hâ FòJ kW- G§ Cå MRD½¾¬Ñ? kW- 5D%í Cå D† • > ¥ö{ .
' j aŠ Gitμ" BŠ 6%: " ~ ~í ? Git. æCD^W- ½>F ¼W: ^G§ %í Cå TCå I JD¶
· 5DC©ÑÑ9, \$ GitÎ no½D Documentati on/Submi tti ngPatches ½~ ¼A` . ?

' ¹ Ff DCå Ç- CÔmœbÍ W™¹ ? Git CD^W- } ~D1 2SGä òQÑÑ\$ Cå å FÝÙ git
di ff --checkF· [j ÙT9° Dï W™¹ > [· ' t f WXS?

Figure 57. git di ff --check # %oŠ

pe\$Cå å ÝÙž - ^ %oF9, ä j Cå ¼i ª Õm9° j . 6, ð Kò÷Dï WI " ?

³ <SF, +aÍ W- Cå ftW- xšÑD2i g~ E? pe9, F, +af Ý9, €• ÑÑÇ@\$Ö- XE
' o• Zï - I " Fd | \$XW| [· ' Cå tW- I tDCå? j . \$XEN÷f ÅWCå F\$XW| . '

! " ' ì [f Dμ" ¥öø] tí - i " W- CåF > ¥tí W- Cåf ýW- k' DMR?
pe ¼W" f Ÿ» f ^OW- ½~ F, +. ' gi t add --patchS\] ! " ½~ ó\$ åÿ2! " ¼kÔ~
) * ø? Çýf %oW- J i - CåF @fk Df Ÿi \$OW! s•• DF. æ] YÉ7D½F—i 2i DF
. On, ¿K®¶Mäf Df Ÿ| QCano~í " ?

¤f è| , @| ð- 1Wí j . | XJj >W- g~ E~ ~í " ? mLæÖ| | ^mLæÖŠåÿ2! " ½~
D¶· k' D Git• " ÑÑ\$[μ" ¿uc 6%â. ' ð" μ¶S¢EófW- · ÙNí ~ DæÖ?

¥| W- @cåDni CåMR? k W- %í ³ MCåMRDi ej . Git D. ' Š: " ~í De? WcoÇ
<FMR- ¤, ö§ 50- yz ö25- ùyøD~Ù, ¹ ¥} @5I | g~ F³ Èi W- Í WÜFd³ Èi W-
~ Ô^ D• Ñ? Git. æ@ÅW- ~ Ô^ D• ÑF ÖÖ%oF ŸDÝöB· D...YŠèåÙt Dy> ÑÑòi W-
r Ô^ %oD5=• ? . ' • %o2DŒä S' LCåMRF> p. ' ØFix bugØ&* ØFixed bugØJ ØFixes
bugØ? ðJ i W° ¥Ü° Tim Pope LD, ÚO

' y ö†LDü@öCeS 50 - yzø

pe®@DsF• k~ Ô^ D• Ñ½y? \$†< 72 - yz D| ^ | Ù?
\$l " oÚ<FUWÙ{ ¤" WÃ¹ K~ Dç" FO<D½! " tg½?
] ðü@Šg½DÍ Ùi ®¶Dó} * f ôŽ, 5g½øF
pef [! Kï \$WÊFža» ½g×> μ¶ÅWg€μ" ?

. ' • %o2DŒä S' LCåMRO. ' ØFi x bugØ&* ØFi xed bugØJ ØFi xes bugØ?
ãP» Š gi t merge B gi t revert ^ %oÓfCå - Ñ/ O?

Í Ù³ È~ ÔWÈDfV?

- çì í i 9,, D?

- . æzì 9,, . ' mz D- yz Jí i F | ÈW- Í šFÙè÷' Í Ùð, F
È h i 9,, • ? ÇODëHk fÇO?

- . ' ü' 2ŠÔ

peffk DCåMRÍ ^ %oã, 7Fžayf BŠf: " D 6, ¿KS-noj gØ* €~í ? Git. æk
W- ý5š 26DCåMRÑÑ, +\$ž <ÝÙ gi t log --no-merges S•• uv Dš 26D. æCå æÖ
Ä` aÄ?

- " QR#ÅS&/žoB" QS#ÅS3

t } ~È\$F! - ¼l eHI DCå - Ñ> Ák ^ %oðÄý 5Dš 2F ¥' - i y gi t
commi t . ' ^ -mø. ?

} &xèF i ¥' - D] %oF Ç@F È¥' %oD] %o?

` hMNab

f 9° j nTD¥} ~DPÓi kW! - 6, ¿KD} k. æ? Ø} kÓ\$ð - Ñ<½¼F 9àÈfÍ ÑÑ
Ç9,, sLÜD" Ü¼HI T? f B 6D, ¿Kï kàáD€u>ÿ?

\$ò- | B< F 9 „ D' W- » ¼. ' Subversion J 6E½2D• , | j . ' Dμ" ī Œ? • d9 „ OTĀ
nKCåP* €~í 5™í] ŸŠí >] Ÿ> c©• ° Fhi μ" ī Œ9 „ i i } ~Dúå@D' ī i ī > Þó
\$« i 7òþ&Çi \$Cå | Þó\$EFðžþ? a¥' • • þ! - , ÞK\$W- &3àá½WĒμ" | j i
` aÄI ? UW- , ÞKF JohnF qr ^àáF‰^f ŸFd| ! 5Cå? ót ^ŠÝð" HI „ ùF: ; M
RZ{ . | t ... ?ø

```
# John's Machi ne
$ git clone john@gi thost: si mpl egi t. gi t
Cloning into 'si mpl egi t'...
...
$ cd si mpl egi t/
$ vim lib/si mpl egi t.rb
$ git commi t -am 'remove invalid default value'
[master 738ee87] remove invalid default value
1 files changed, 1 insertions(+), 1 deletions(-)
```

UV- , ÞKF JessicaF‰^OÄDnoÑÑqr àá > Cå ^W- f ŸO

```
# Jessi ca's Machi ne
$ git clone jessica@gi thost: si mpl egi t. gi t
Cloning into 'si mpl egi t'...
...
$ cd si mpl egi t/
$ vim TODO
$ git commi t -am 'add reset task'
[master fbff5bc] add reset task
1 files changed, 1 insertions(+), 0 deletions(-)
```

Y \$F Jessica ä è Dμ" €uTEFðÑFW{ g€O

```
# Jessi ca's Machi ne
$ git push origin master
...
To jessica@gi thost: si mpl egi t. gi t
* 1edee6b..fbff5bc master -> master
```

Ñ1 y XMR½¥| WÙ# ©Di €uī " , Ùôμ| ýÀDWžl k' DèR? èRDx! š2i
<ol dref>.. <newref> fromref -> toref F ol dref Dm1 i €uâf• ND- ' F newref Dm1 i
€u | f• ND- ' F fromref i [@{ €uD! 5- ' D) y F toref i [@{ ~™DéŒ- ' D) y ?
\$ | ÜDOP½f j j • T » ½Dy XèRFf „ y ðž è RDm1 kW" ×ØD^• [j €f €• àáD•
eŒŒ? : @^• ~ e^? GHI ½> git-push ?

John ` a í %„ f ŸF[· ' CåT ^! 5àá½Fd| +È[· ' €uTOW- EFðO

```
# John's Machine
$ git push origin master
To john@ghost: simplegit.git
! [rejected]          master -> master (non-fast forward)
error: failed to push some refs to 'john@ghost: simplegit.git'
```

Ó | Johnj €u/kFst èâ JessicaZ [€u^èD~ f? p e èâ i ë§' Subversion ž a€• ÓQ
 ° ì m@Fstfj O9T! - , ï K> Ák' šOW- ½~ ? Qý Subversionj y' š DÇO½~ \$EFÐ
 ÑÉÝÖÙWt î > Fh Git@Åf¹ \$! 5î > Cå? | x è F John ®¶¹ @P Jessica DÑSf Ý> [.
 ' î > TÉmD! 5àá¼F' ° { L8€u?

UWÈ F John @P Jessica Dμ" óò" j ÜÝ Jessica DÑSμ" F > Çj [· î > T John Dμ" ¼øO

```
$ git fetch origin
...
From john@ghost: simplegit
+ 049d078...fbff5bc master -> origin/master
```

\$ò- | ^ F John D! 5àá• ÈSÃòÄO

Figure 58. John # \ ¼- ®

Y \$ John 9, [@P<SD Jessica Dμ" î > T 6ÉmD! 5μ" ¼^O

```
$ git merge origin/master
Merge made by the 'recursive' strategy.
 TODO | 1 +
 1 files changed, 1 insertions(+), 0 deletions(-)
```

↑ > ÖÙÒI ...† ÑÑJohn ~ ™| DæÖY \$ • ÈSÃðÄO

Figure 59. • ŽB ori gi n/master L à John # x y

â | F John 9° : @6+ ™Dn oF „ - z Jessica Dμ" Åk ÷) 6ÉmDμ" F øW{ g€| F 6—° [
™† > Dμ" €uTEF Ø^O

```
$ git push origin master
...
To john@gi thost: simplegit.git
  fbff5bc..72bbc59  master -> master
```

¥ , F John DCå æÖ• ÈSÃðÄO

Figure 60. i l ori gi n è é ê à John # - ®

\$ã N÷F Jessica ™í ^W-) t i ssue54 Då "] ÝFd | \$C] ÝÑCå ^÷t ? èj Ák @P John
Df ÝFf „ è DCå æÖ• ÈSÄòÄO

Figure 61. Jessica # " È \ @

È d F Jessica ÿ John NE F ð€u ^W" ™Dμ" F è: @• W< F § i —@P ^fk EF ðÑD™A
~ O

```
# Jessica's Machi ne
$ git fetch origin
...
From jessica@gi thost: simple egi t
È fbff5bc..72bbc59 master      -> origin/master
```

ž j O! I P John €u Dμ" ? Jessica DæÖY \$ • ÈSÄòÄO

Figure 62. / \$ John #1 . à Jessica # - ®

Jessica | t è Då"] ÝZ[+j 5^F hè: äj , @[John μ" Dp" → T ÉmDμ" ¼' ° €u? è ÝÙ git log Ù^XSO

```
$ git log --no-merges issue54..origin/master  
commi t 738ee872852dfa9d6634e0dea7a324040193016  
Author: John Smith <jsmith@example.com>  
Date:   Fri May 29 16:01:27 2009 -0700
```

È remove invalid default value

issue54..origin/master DEWI W- rā\, ØF@Å Git - # ©fk \$ | Ü] Ýó\$! H½i
origin/master ØhÇ\$âÜ] Ýó\$! H½i issue54 ØDCå DW° ? ¥' [j \$ Cå' ÷ ¼Ô^) *
Ø - DEW?

æâ F ¥' 9,, sy X¼• TKW- John ófDhi Jessicaj Åkî → DCå? p e è î →
origin/master Fž - 4î → DCå [j » f è D! 5μ" ?

Ý\$F Jessica 9,, î → è D° - μ" T è D master] ÝF î → John Dμ" ó origin/master ØOk è D
master] ÝFd | dt €uÀEF Ø?

' 1 ó\$Z[Cå ^fk issue54 å"] ÝÑDμ" | ØF t ^Öî fkò" μ" F è{ | Åè D master]
Ý?

```
$ git checkout master  
Switched to branch 'master'  
Your branch is behind 'origin/master' by 2 commits, and can be fast-  
forwarded.
```

Jessica DE9,, 1 î → origin/master í 9,, 1 î → issue54 ÑÑ· ' î i ÑÑFF,, ...œ> Åk G• ? Ç
Pè øùD...œi ` a ¥,, D" e ½Fi ôŽWÄDú- i æÖj ` êk" ÇO? è øù¹ î → issue54 O

```
$ git merge issue54
Updating fbff5bc..4af4298
Fast forward
 README | 1 +
 lib/simplegit.rb | 6 +++++-
 2 files changed, 6 insertions(+), 1 deletion(-)
```

Ák ḡ ól " Fpf f\$· i Wt } ~D½Ôî > ? Y\$ Jessica \$! 5î > ^èâ @PD ori gi n/master
] ÝÑ John Dμ" O

```
$ git merge origin/master
Auto-merging lib/simplegit.rb
Merge made by the 'recursive' strategy.
lib/simplegit.rb |    2 ++
1 files changed, 1 insertions(+), 1 deletions(-)
```

Í W-½~Í·Ù5Í>^F Jessica DæÖY\$•ÊSÃòÄO

Figure 63. • Ž B John #1 . à Jessica # - ®

Y\$ origin/master i 9 „ s Jessica D master] ÝTADF „ è „ C9 „ f • 5€uó—EOW | ÷ John> Ák ~ e€uøO

```
$ git push origin master
...
To jessica@ghost: simplegit.git
  72bbc59..8059c15 master -> master
```

Í W- „KÍ Cå ^ Et > f • 5î > ^ 6%Du" ?

Figure 64. j z (#! · Tèéêà Jessica # - ®

ði W- ¥} ~Dμ" i Ó? f o€j \$W- å"] ŸÑμ" Wj < F ø. +j 5Öî | —i > Tf D master
] Ÿ? ø: @&3μ" | F pekf ŸDs—@P· d | i > Tf ÉmD master] ŸF è | €uTEFðÑ
D master] Ÿ? o€...œÃðÄO

Figure 65. > b O, # P; Git p q Ø• # —f U c V W

` hybab

\$³ <SD< Ä½Ffj • Ttz } kwx ¼E¤KD¤ç? f [hTp b\$ò8µ" | B½µ" F ¼ûû
x§° - ÖÜ: " F &ò" wx D£¤[j ° 6%Öî ?

a ¥' —E John Š Jessica \$W- ° - ö **featureA** ñµ" F O| Jessica Š U÷ - , ð K Josie \$UV-
° - ö **featureB** ñµ" ? \$! H½F! " . ' ^W8Öî -ý€Kµ" i ÖF2i ûûDµ" - ° { ° » D
µÖYÖî F åàáD **master**] Ÿ- ° { ž" µÖY~™? \$ò8oÇ<FFkDµ" i \$x§wx D]
ŸÑôfD> ¥` | j { Öî KI TWÊ?

s t Jessica \$! - ° - ñµ" F> ¥xÙ5Š! - ÇOD, ð K: " Fa ¥' ÈXèDµ" i Ö? —EèZ[
qr ^åàáF' 1 Z» \$ **featureA** ñµ" ? ètž - ° - %í ^W-™] Ÿd | \$ž‰^W" µ" O

```
# Jessica's Machine
$ git checkout -b featureA
Switched to a new branch 'featureA'
$ vim lib/simplegit.rb
$ git commit -am 'add limit to log function'
[featureA 3300904] add limit to log function
1 files changed, 1 insertions(+), 1 deletions(-)
```

\$ò- ! ª Fè, @[µ" &3c JohnFf, è€u^ **featureA**] ŸDCåTEFÖÑ? Jessica Åk
master] ŸD€u>ÿÑÑ- kÖî KkÑÑf, t ^Š John: " ®¶€uuW-] Ÿ?

```
$ git push -u origin featureA
...
To jessica@github: simplegit
 * [new branch]      featureA -> featureA
```

Jessica N John ð K ~ ŸÀ6Z [€u^W" µ" T **featureA**] ŸY\$9, • W• ? ñè> V John D\!
| F Jessica Z» Š Josie , 1 \$ **featureB** ñµ" ? t ^, 1 µ" Fèx§EFÖD **master**] Ÿ, 1 ^W-
™] Ÿ?

```
# Jessica's Machine
$ git fetch origin
$ git checkout -b featureB origin/master
Switched to a new branch 'featureB'
```

Y\$F Jessica \$ **featureB**] ŸÑ%í ^Èt CåO

```
$ vim lib/simplegit.t.rb
$ git commit -am 'made the ls-tree function recursive'
[featureB e5b0fdc] made the ls-tree function recursive
1 files changed, 1 insertions(+), 1 deletions(-)
$ vim lib/simplegit.t.rb
$ git commit -am 'add ls-files'
[featureB 8512791] add ls-files
1 files changed, 5 insertions(+), 0 deletions(-)
```

Y \$ Jessica Dà á • ÈSÃÒÄO

Figure 66. Jessica # e 2 t f - ®

è t j 5€uμ" ^F h i wĀsÉ Josie DK ~ Yä W" Ü¹ DÒfeatureBÓμ" Z [{ €uTEFØD
featureBee Ñ^? Jessica \$ ° p [è Dμ" €uTEFØâ F, @ [ž " f YŠèÉmDî > ? è' ¹ o
\ **git fetch**@P ^ Josie Df YO

```
$ git fetch origin
...
From jessica@ghost: simplegit
* [new branch]      featureBee -> origin/featureBee
```

—E Jessicaj \$èGXDI**featureB**] YÑF Y\$9 „ o\ **git merge** [→ Tè‰Dμ" ¼^O

```
$ git merge origin/featureBee
Auto-merging lib/simpler.git.rb
Merge made by the 'recursive' strategy.
El 1 file(s) changed, 4 insertions(+), 0 deletions(-)
```

Ã | F Jessica: @[fK Í > | DÒfeatureBÓ€uÀEFÒFF hè> Ç: ...³ €uè ÉmD **featureB**]
Ý? ° § Josie Z [, B^W- ÑSD **featureBee**] ÝFs ã Jessica: @€uT 1á] ÝÑFSi èòÄ
‰O

```
$ git push -u origin featureB:featureBee
...
To jessica@gi thost: simplegit
  Ê   fba9af8..cd685d1  featureB -> featureBee
```

ðÜ" W- X, YZ? ä• -' => ^• GS Git-' => Šo\· ' 9, %DÇODnöDÔ^ OP? í @
O9 -uçâúði --set-upstream D} LFCçâj tè| æç5€uŠI PPÓ] Ý?

Ý³ ÈF John Ð K~ c Jessica – 6Z [€u^W" f ÝT **featureA**] Ý> @Åè] | O· ' ? èÝÙW-
git **fetch** SI P<ž" f ÝO

```
$ git fetch origin
...
From jessica@gi thost: simplegit
  Ê   3300904..aad881d  featureA -> origin/featureA
```

Jessica o\> H™@PD **featureA**] ÝBèOW] ÝD! 5E! F• T^ John D™µ" r ã?

```
$ git log featureA..origin/featureA
commit aad881d154acdaeb2b6b18ea0e827ed8a6d671e6
Author: John Smith <jsmith@example.com>
Date:   Fri May 29 19:57:33 2009 -0700

Ê   changed log output to 30 from 25
```

p e Jessica § Ò9,, Fè—° [John D™µ" î > Tè! 5D **featureA**] ÝÑO

```
$ git checkout featureA
Switched to branch 'featureA'
$ git merge origin/featureA
Updating 3300904..aad881d
Fast forward
  Elib/simpler.t.rb |    10 ++++++-
  1 files changed, 9 insertions(+), 1 deletions(-)
```

¥| F Jessica 9° : @y Ö- î > | DA ~‰W" Ú» f F Si è[ò" » f CåT ^! 5D **featureA**]
 ÝF³ È[¥, D" e€uÅ^EFØ?

```
$ git commit -am 'small tweak'
[featureA 774b3ed] small tweak
  1 files changed, 1 insertions(+), 1 deletions(-)
$ git push
...
To jessica@gi thost: simplegit.git
  3300904..774b3ed  featureA -> featureA
```

Jessica DCå æÖY \$• ÈSÅòÄO

Figure 67. H>b" È\@t‡à Jessica # - ®

ò| F Jessica Josie Š John öä Öî K E F ØÑD **featureA** Š **featureBee**] Ýtj 5Öî TåK ¼
 ^? \$Öî K[ò"] Ýî > TåK | F—° Wt [ö - ™Dî > Cå@P<SF æÖ• ÈS—j ÅòÄO

Figure 68. • Ž B Jessica # \$ b " E \ @ a) # - ®

8ewx { | T Git — i • ¼ ^ Ø 8° æ - wx > Üµ" P > \$ è | î > ÇOµ" D° .. ? wx ¼ ~ ü W" D
I ü ü 9 „ o \ é Ö] Ý: " & Ç ® ÷) J U" Ö - wx D° .. i Git DW - I † ³ » ? \$ Ø < • T D µ" í Ö
...œ» ¼ Ø Ä O

Figure 69. + EJ K[\ pqØ• #ÅUVW

c; KQÿ ± ©

N! , . æ‰E ø K WQ<ÇO? st Åk >ÿ...³ ~ ™. æD] ÿF f ®¶' 6=W[µ" cúöK? U
W- HI || \$Ý{ } ~ êóD Git üýÑ. ' êóS‰E ø? 8e üýÿQÝ{ ð- • ° öÖÖ
GitHubBitBucketrepo.or.cz > øF 8e. æúöKN' ð8™š D£ ø? <W?j OPÚ5o\K~ ³
' E ø I J D. æ?

' 1 Ff 9° : @qr åàáF t | § E ðDI JJ | J œW%í W- å"] ÝFd | \$ž <%oμ" ? ...œ•
ÊS x! ÄòÄO

```
$ git clone <url>
$ cd project
$ git checkout -b featureA
Ê ... work ...
$ git commit
Ê ... work ...
$ git commit
```

! f 9, ' rebase -i [μ" %ŠfW- ~2DCåFJ Km#Cå ¼Dμ" . I J ~ ~í {
úöKMuÑÑä • mLæÖ ^ • GŠåÿ2gxD~ eMR?

¤f D] Ýμ" òf | tj [E ðÀúöKF] >¹. æ¼d | QÖÖForkÓj #F%í W° ÉmD9LD.
æêóàá? d | , @\$! 5àá¼[Càá • • t W- ™DéÖàáF \$! H¼ü" myforkO

```
$ git remote add myfork <url>
```

d | , @€uμ" TÑÜ? / y§i > Tå] Ýd€uÑ] F€uf g\$μ" Då"] ÝTàáÑ~ } ~? >
si μ" peÇ{ ³ ' JK { \$øDF—Ç®Àxf D master] Ýó\$øï " cherry-pick Ø\$ g×Š
\$øμ" i ø? peúöKî > Pg×J \$øf Dμ" FÇý· Äf ¥, j o\I P6' DàáÙÀSf Dμ
" ?

\$œb oÇ< Ff 9, . ' < ÜD^ %œuf Dμ" O

```
$ git push -u myfork featureA
```

¤μ" Z [{ €uTf Dêóàá | Ff, @oä >. æDúöKf k: @6' 1 > Dμ" ? ðo€{ ü" W
- ÝYde bPull Requestc Ff o€9, o\þyöf. ÑÑ GitHub k. ÉmD Pull Request öÓF ¥'
[j \$ GitHub) * ÑÑí 9, ÝÙgi t request-pul l ^ %od | [X| DyXo\< I K~ ~Ý¿uc. æ
úöK?

gi t request-pul l ^ %o³ ' W- @I På"] ÝDxØ] ÝF, B. ' @I PD Git àá D URLF QóW-
GÅI PDfk » f Dû@? Hp F Jessica: @¿uc John W- I PGÅF èZ [\$ØØ€uD] ÝÑ%o^
! t Cå?è9, ÝÙò- O

```
$ git request-pull origin/master myfork
The following changes since commit
1edee6b1d61823a2de3b09c160d7080b8d1b3a40:
Jessica Smith (1):
  E added a new function
```

are available in the git repository at:

E git://github/simplegit.git featureA

```
Jessica Smith (2):
  E add limit to log function
  E change log output to 30 from 25
```

E lib/simplegit.rb | 10 ++++++++
E 1 files changed, 9 insertions(+), 1 deletions(-)

ãyX9{ ¿ucúöKÑÑ· ÝÀ6' µ" i sp-] Ý, 1 DPCåDû@P, BspJ I Pò" µ" ?

\$W- f Çi úöKD. æÑF o€kW- Bi Eö **origin/master** D **master**] Ýj | 1 -F \$å"] Ý
Ñ%µ" i stpe. ' { B<| f 9, æç5. ô? peOW| ÷åàá9Ý^d | f DCåÇd° . Ù5
- ' Fža. µ" å" 2i §å"] Ýí j . fgxórebaseøµ" | ~ ~í ? HpFf: @CDUV- ° -
µ" T. æF Ç@µ¶\$ØØ€uDå"] ÝÑµ" ÑÑsåàá D **master**] Ým™, 1 O

```
$ git checkout -b featureB origin/master
E ... work ...
$ git commit
$ git push myfork featureB
$ git request-pull origin/master myfork
E ... email generated request pull to maintainer ...
$ git fetch origin
```

Y\$FÍ W- ° - ī z " \$W- b\$á¼ÑÑ» ¼§I J x WÑÑ9, mL Pg xŠ» f &Çj a° - ý / · é
J ý / • « F ÄòÄO

Figure 70. **featureB** # e 2 t f - ®

—E. æúÖKZ [I P^W{ 6I JFd | , +I Pf DUW-] ÝFhi Ák. Ù5î > ? \$ò8oÇ
< F9,, +g xž -] ÝT ori gi n/master DË\ Ft úöK• ZUVFd | m™Cåf Df ÝO

```
$ git checkout featureA
$ git rebase origin/master
$ git push -f myfork featureA
```

ðÄj mLf DæÖFY\$• ÊSÄi **featureA** μ" è | DCå æÖ

Figure 71. **featureA** pqLà # t f - ®

s t f [] Ýg x^Ff, ®¶t €u^ %o• » -fø. FðÄ' ° [EFðÑkW- Çi . D| nDCå D
featureA] Ý. | Ø? W- . nDø. i €uð- ™μ" TEFðÑDW- ÇO] Ýó9° ü"
featureAv2ø?

a ¥' • W- ~ k 9° DoÇOúÖK• T ^f DUV-] ÝÑDμ" > ¥I RQ ¼D< ØFhi : @f » f
W< ...YD^ ?? fí 9,, t' øt øj [μ" x§. æY\$D **master**] Ý? f s Y\$D **origin/master**
] Ý, ¹ W- ™] ÝF\$ž <%oŠ **featureB** Df ÝF• ZœbUVFf g...YFd | €u· t W- ™] Ý?

```
$ git checkout -b featureBv2 origin/master
$ git merge --squash featureB
Ê ... change implementation ...
$ git commit
$ git push myfork featureBv2
```

--squash ø. ³ ' { î > D] ÝÑDfkμ" F> [%oŠ¬W- g~ EF. àágfW- žgDî > ð ØDÖÖF &Cj ž DófW- î > Cå? ò9àÈf D4SDCå [j ~ kW- &CåF> L8f – k uW-] ÝDfkf ÝFd | \$âãW- ™Cå â‰~ eDf Ý? OÄ --no-commit ø. \$³ | î > \Ó¼9,, ' SY%ófî > Cå?

Ý\$f 9,, cúöK ð uWž èRF° ©f Z [%o^@ÅD» fd | 6' 9,, \$f D **featureBv2**] ÝÑÙT
ž " f Ý?

Figure 72. **featureBv2** pqLà#†‡ - ®

f ð g , KQÿ ± ©

8e. æí i ^³ ' I J Dí ÕÑÑ, @GäÍ W- . æD° » =• Fst. ' è÷k' ì ? st k Ë- æÖ
&òDPt z D. æj o\W- , ð KDK~ W° ³ ' I J FY\$¥' [j o\W- HI SÉ©?

μ" ï ÕŠèâD' Hi » ¼DÑÑf t μ" Dí W- I J œW%í å"] Ý? ' ì i pbCå. ' T. æ¼?
ófí W- Cå œWD< I K~ 7! d | K' . ' T, ð KK~ W° F&Ci êó. æd | €uTf ÉmD9L
7! ?

```
$ git checkout -b topicA
Ê ... work ...
$ git commit
Ê ... work ...
$ git commit
```

Ý\$k! - Cå @ð uTK~ W° ? . ' git format-patch Sóf9,, K' TW° D mbox š 2D½
~ ÑÑ. [í W- Cå ^ | t WÃ< I K~ FCå MRDUWÙ" t å" FOŠMRŠCå – k DI J " t g
½? . k W- 5Æi . ' format-patch óf DWÃ< I K~ - ' DCåg~ 5z 1 ^ fk DCå MR?

```
$ git format-patch -M origin/master
0001-add-limit-to-log-function.patch
0002-changed-log-output-to-30-from-25.patch
```

format-patch ^ %oé (X· %í DI J ½~) y? -M , GÝÀ Git ä Üm^) ? ½~ ¥| • ÈSÄòÄO

```
$ cat 0001-add-limit-to-log-function.patch
From 330090432754092d704da8e76ca5c05c198e71a8 Mon Sep 17 00:00:00 2001
From: Jessica Smith <jessica@example.com>
Date: Sun, 6 Apr 2008 10:17:23 -0700
Subject: [PATCH 1/2] add limit to log function

Limit log functionality to the first 20

---
diff --git a/lib/git/limit_rb.rb b/lib/git/limit_rb.rb
index 76f47bc..f9815f1 100644
--- a/lib/git/limit_rb.rb
+++ b/lib/git/limit_rb.rb
@@ -14,7 +14,7 @@ class SimpleGit
End

End def log(treeish = 'master')
-   command("git log #{treeish}")
+   command("git log -n 20 #{treeish}")
End

End def ls_tree(treeish = 'master')
--
```

2.1.0

Í 9,, ' šò" | J ½~ t K~ W° • • ~ eÇ: @\$CåMR¼# ©XSDMR? pe\$ --- ÙŠI J , è
ódi ff --gi t Ùøè ÷ • • ½! Fža , žK—9,, A` · Fhi ~' | J | j È5· ?

t ^[K' TK~ W° FfŒ9,, [½~) * Ø< | K~ « i 7Fí 9,, o\ ^ %oÙØœž u· ?) * ½!
[€j žóš26l " F° i i ž" Çj ī P5z1 | ÙzŠ 6ī WDØ~ þNDØ« i 7? >ÝDi FGit
CD^W- µ¶¢£f o\ IMAP žug- š26DI J Fò9° yf ~ ~í " ? ¥' [j È©pb o\ Gmail
žuW- I J F· g5i ¥' fä¥5DK~ n€ú9,, \$èâCTDGit ï no½D
Documentation/SubmittingPatches ½~ D¥< Ü^• W• WK~ ØœDØ^ • %o?

' 1 F , @\$ ~/ .gitconfig ½~ ¼EÓimap' - ? 9,, o\ W• WD git config ^ %oS] ï EÓí W
- r F JK~ Ý• • ' F Çý· Ä¥| PØ½~ - C• ÈSÄòÄO

```
[imap]
Ê folder = "[Gmail]/Drafts"
Ê host = imap.gmail.com
Ê user = user@gmail.com
Ê pass = YX]8g76G_2^sFbd
Ê port = 993
Ê ssl verify = false
```

p e IMAP E F ÓÇ. ' SSLF ¥| ! Ü9° Ák ®@F host Dr j i imap:// &Çi imap://? øž " E
Óóf | F 9,, . ' git imap-send [I J œW< \$° » IMAP E F Ó D Drafts ½~ ̄ ¼O

```
$ cat *.patch |git imap-send
Resolving imap.gmail.com... ok
Connecting to [74.125.142.109]:993... ok
Logging in...
sending 2 messages
100% (2/2) done
```

ã | F f 9,, T Drafts ½~ ̄ ¼F » f E~ %yft : @¿ uI J DK~ W° F 9° , @+ucúÖKJì í
ž - \] D%Fd | ¿ u?

f í 9,, o\W- SMTP EF Ó¿ uI J? OèâWÄF f 9,, o\W• WD git config ^ %oS] i EÓø
. F JKf 9,, ~Ý5[. ' • • Tf D ~/gitconfig ½~ D sendmail' - O

```
[sendemail]
Ê smtpencryption = tls
Ê smtpserver = smtp.gmail.com
Ê smtpuser = user@gmail.com
Ê smtpserverport = 587
```

¤òóf | F f 9,, . ' git send-email ¿uf DI JO

```
$ git send-email *.patch
0001-added-limit-to-log-function.patch
0002-changed-log-output-to-30-from-25.patch
Who should the emails appear to be from? [Jessica Smith
<jessica@example.com>]
Emails will be sent from: Jessica Smith <jessica@example.com>
Who should the emails be sent to? jessica@example.com
Message-ID to be used as In-Reply-To for the first email? y
```

d | F y \$ g \$¿ uDÍ W- I J F Gitj , XòÄDW{ r ã MRO

(mbox) Adding cc: Jessica Smith <jessica@example.com> from
 È\line 'From: Jessica Smith <jessica@example.com>'
 OK. Log says:
 Sendmail: /usr/sbin/sendmail -i jessica@example.com
 From: Jessica Smith <jessica@example.com>
 To: jessica@example.com
 Subject: [PATCH 1/2] added limit to log function
 Date: Sat, 30 May 2009 13:29:15 -0700
 Message-ID: <1243715356-61726-1-git-send-email-jessica@example.com>
 X-Mailer: git-send-email 1.6.2.rc1.20.g8c5b.dirty
 In-Reply-To: <y>
 References: <y>

Result: OK

⌚ ↻

⌚ - \]) * ^Æ€9° j nTDÈ--dÇO» z DGit. æDW" €\$Dμ" ī ŒF) * ^¢£ý€⌚ - \ ŒDW" ™μ¶? ³ <SFfj ^• Tpb\$E¤DuWÜμ" OúöW- Git. æ? f [j hi pbftW - . / D2OKJ Öî ý€K?

⌚ T ± ©

} ^pbkŽ5; ŠW-. æDE¤èLFF9° í , @^• pbúö. æ? öÖm³ ' > - ' ì %. ' format-patch óf> o\< | K~ ž u\SDI JFJy. æ• • DéŒ7! á] Ÿ¼D~ f ÔÙÖî ? h ÅPi ý€7! áFj i ¢ýI OPMuETDI JFÍ , @O 6E¤Kþ»í 8, N9{ ¶Dμ" 12?

†" #LÓI ² j

pef: N. æ¼Öî W" ™KLF¥5[ö" , +Í ý\$ " #LÓÑÑW8o€' S, +™KLDä |] Ÿ ¼? öÄ¬§~2* ÖI JFpenTÅwg€μ" DoÇF9,, ¹ Ç' ýF> TK | ÷D| ª dSÆ€? p ef x§ff, +ÔÙμ" D° - t] Ÿ%í W- } ~D) yF> p ruby_client JK¶k » ¼l I - D 6) yFöÄj . f ®¶! | vô· F, | ÅS | í Çj øâ? . æDúöKWcj j t ö"] Ÿf ý^) ī ÷F> p sc/ruby_clientó ¼ sc i E¤C. μ" D%) üD} Lø? f - CâŒF9,, ' p<12x § master] Ÿí i å"] ŸO

```
$ git branch sc/ruby_client master
```

J Kpef O! : i s{ | T™] ŸÑDsF9,, ' checkout -b Ø. O

```
$ git checkout -b sc/ruby_client master
```

Ý\$FZ[†j 5[f ETDE¤¤• KTò-å"] ŸF> ..._i ª [†> T, N] Ÿ¼] ^?

i' j kg, KÇÈ

pefo\<IK~ET^W-, @Öî Ôk. æDI J Ff, @[-' Tå"] Ý¼ÔÙö1? k! 8-
' C8I JD1WO. ' git applyFJK. ' git am?

À' apply, fi' ÇÈ

pef ET^W-. ' git diffJ Unixdiff ^ %oDg 1 öÇ€2. ' ò812F¶¹ \$<W? ø %í DI
J F9,. ' git apply ^ %oS- ' ? —Ef [I J z" \$^ /tmp/patch-ruby-cl i ent. patch ¼F9
" òÄ- ' I JO

```
$ git apply /tmp/patch-ruby-cl i ent. patch
```

òj » f µ" æä ¼D½~ ? . ŠÝÙ patch -p1 ^ %oS- ' I J Èl i > ŽDFhi ò812~ • _šF/
y § patch S-F. ° p³ ' D, ° éP~ ö? . í ° pÆ€ git diff 2½~ fI I D½~ • • ¶å } B
m^) l " F & patch • Çj ? ¥| F git apply ^ %oD' ^ W8ÒŽ\ -' F a • —Ž\ç d óapply all
or abort all ØÓD, z F j I J - kŽ\A~l { -' BôŽÇ{ -' ! - ÔÓF & patch 9° j « ÚI J ½
~ { \} -' F ¥| . f Dµ" æä z { \$W- > H(ÜDÔÖ? B¹ S• F git apply ^ %o@> patch 3
4Øe? > ¥F· Çj t f %í Cå ÑÑ\$ÝÙè | Ff, @~Ý! " > Cå I J f-KD~ f?

\$...É- ' I J à Ff j 9,. ' git apply SGä I J i a 9,. ...t -' ÑÑj y I J ÝÙ git apply
--check ^ %oO

```
$ git apply --check 0001-seei ng-if-thi s-hel ps-the-gem. patch  
error: patch failed: ti cgi t. gemspec: 1  
error: ti cgi t. gemspec: patch does not apply
```

peÁkQóyXF•CI J 9,. ...t -' ? peGä/k ^ FC^ %oj j „ W- * i DÔÖxXFf,, @
| fí 9,. \$ý! ¼. ' . ?

À' am, fi' ÇÈ

pel J DE¤Kí i W- Git' i F > ¥ °Œ• . ' format-patch ^ %oSöfI J FòÄDs f Dµ"
j gØ~ • æç Fst ò8I J ¼Öm^" KMRBCå MRDf ; ...? pe9° Ds F GMNÈ¤K. '
format-patch &Çi diffSt f öfI J? & k yþ2DI J Ff' ®¶. ' git apply ^ %o?

@- ' W- ° format-patch ^ %oöfDI J Ff - C. ' git am ^ %oöC^ %oD) y am ° ©. Ø- '
öApplyøW• WSÉKPóMailboxøDI J Øø? s • • D¤ù• F git am i t ^ ` P mbox ½~ &¢í
DF mbox i W8' S\$~- ½! ½~ ¼" #W- J e- < I K~ èRD} ~5½! š2? + Úš2p<f
©O

From 330090432754092d704da8e76ca5c05c198e71a8 Mon Sep 17 00:00:00 2001

From: Jessi ca Smi th <jessi ca@example.com>

Date: Sun, 6 Apr 2008 10:17:23 -0700

Subject: [PATCH 1/2] add limit to log function

Limit log functionality to the first 20

...—i f â Ü• TD git format-patch ^ %o y XD, 1 È ÜF & O| . i i k Ž D mbox < I K ~ Š 2? p e k %. ' git send-email ^ %o[I J „ < I K ~ D Ú 2 Ð ucf F f → 9, [· < i t mbox Š 2D½~ F è | [git am ^ %o• NC½~ F· j ~ ' ¼ Õ m Df k I J ? p e f f . ' DK ~ « ; 7° p o | [e Ä K ~ z " t mbox Š 2D½~ F f « → ° p [W• WI J ê Õt ~ - mbox ½~ F > †' git am ^ %o[· ' Wt - Ž \ ~ ' ?

d & F p e E ø K [git format-patch ó f D I J ½~ Ñ x T μ ~ • , J » ¼ D œ F A E E • , F f 9, 1 [z " T ! 5 F è | o \ git am S ~ ' I J O

\$ git am 0001-limit-log-function.patch

Appl yi ng: add limit to log function

f j • T I J { ...† 5~ ' F > ¥ t f É Ÿ %í ^ W- ™ DCå ? ¼ D" KMRSÉ Š < I K ~ è \ D From B Date y f F Cå è R • P E Subj ect BK ~ g ½ ¼ I J è à DA ~ ? > p F ~ ' Ñ Üž - mbox © H | ó f DCå i ò Ä D O

\$ git log --pretty=fuller -1

commi t 6c5e70b984a60b3cecd395edd5b48a7575bf58e0

Author: Jessi ca Smi th <jessi ca@example.com>

AuthorDate: Sun Apr 6 10:17:23 2008 -0700

Commi t: Scott Chacon <schacon@gmail.com>

Commi tDate: Thu Apr 9 09:19:06 2009 -0700

È add limit to log function

È Limit log functionality to the first 20

¼ Commi t MR° © Di ~ ' I J D % B ~ ' I J D | ÷ ? Author MR• ° © I J D > " KB > ! D % í | ÷ ?

hi F k | ^ Å W ...† 5~ ' I J ? ð í 8 i s t f D á] Ý B % í I J D] Ý / ó He F í k 9° i s t ð - I J • « § 6 f š 4~ ' DI J ? ð 8 o Ç < F git am Õ Õ [j Ü ™ > ¥ ð I f @ % ` a O

```
$ git am 0001-seeing-if-thi s-hel ps-the-gem. patch
Appling: seeing if this helps the gem
error: patch failed: ticgit.gemspect: 1
error: ticgit.gemspect: patch does not apply
Patch failed at 0001.

When you have resolved this problem run "git am --resolved".
If you would prefer to skip this patch, instead run "git am --skip".
To restore the original branch and stop patching run "git am --abort".
```

C^ %o[j \$fkXYI " D½~ A• kUVçâF—BçóUVD† > JgxÍ " WÄ? &f • ZI " D~
 fI † ÖùÑí i WÄDÑÑj ~Ý' šž" ½~ S• ZUVF! " ™D½~ F è | ÝÙ git am
 --resolved µ¶^- <W- I JO

```
$ (fix the file)
$ git add ticgit.gemspect
$ git am --resolved
Appling: seeing if this helps the gem
```

pef' ' Git° p, + „ ~ • Ø° D12• ZUVFF9, y x² -3ø. S. Git, + ØÙ÷1† > ? C
 ø. ³ | > Ákē, Fstpe' §%í I J DCå > Ç\$fd7! áADsFòÄ%oí Ák' ÆD? &pe
 f - ...kž - CåDsÑÑp I Ji x§l - ! &CåDÑÑžao€ -3ø. y§^- kUVDI Ji ~ •
 ÑØDøù?

```
$ git am -3 0001-seeing-if-thi s-hel ps-the-gem. patch
Appling: seeing if this helps the gem
error: patch failed: ticgit.gemspect: 1
error: ticgit.gemspect: patch does not apply
Using index info to reconstruct a base tree...
 Falling back to patching base and 3-way merge...
No changes -- Patch already applied.
```

> pÑÜð8oÇFþeÁk -3ø. DsFð• ÈS—Ái " \$W- UV? ° §. ' ^ -3ø. FCI J —{
 . Ù5^- ^

pefg\$†' W- mbox½~ - ' e - I J Fí 9, \$åÿ, 2<ÝÙ am ^ %oF ðÄ\$í - I J èâF· j
 > ‡I fi ^ @^- CI JO

```
$ git am -3 -i mbox
Commit Body is:
-----
seeing if this helps the gem
-----
Apply? [y]es/[n]o/[e]dit/[v]iew patch/[a]ccept all
```

ò\$ fz" DI J He || 5' Fstf 9, \$-' èää• øÓA~DI J F> ¥• \Z[-' \DI J?
¤Šf D° - / GDfk I J Ī { -' > CåT] Ý¼è | Ff—9, øùi ^, Bpb[Öi T~, ND]
Ý¼] ^?

šÍ ÙÚLÓ

pef DE¤Kí i ^ÉmD7! áF> ¥N ¼€u^¶. » f F è | [7! áD URL BÖm~ f DéÖ]
Ý¿ucFFžaf 9, [•• tW- éÖ] ÝF> ¥\$! 5ÖÙî > ?

> p Jessica Nf ¿ u^WÃ< I K~ FA~i \$èD7! á¼D ruby-cl i ent] Ý¼k W- I Ç™D™•
° F t ^6+C• ° Ff 9, [•• tW- éÖ] ÝF> \$! 5GXO

```
$ git remote add jessica git: //gitub.com/jessica/myproject.git  
$ git fetch jessica  
$ git checkout -b rubyclient jessica/ruby-client
```

peèdt ¿ K~ -uW-] Ý¼ÖmuW- ³ 6• ° Fst èâZ[EÖ5éÖ] Ý^F f—9, ...³ ÖÙ
fetch B checkout " ?

òySS6%, Nî " μ" S-I k' ? &ySCåI J Ä] HûDE¤KF/ySí - %úöÉmDEF
ðFÇy" åéÖ] ÝD%WF. ' < I K~ S³ E9° j > H, | ? Ç¥fí Çj : @• k‡Æ- CDW
! - I J DéÖ] Ý? d&Fý! BüýEF\$W» ÖùÑ9, } 6ò" μ" ÑÑòI tÖùÑ• «SfBfD
E¤K, ¿ D12?

ò812DuW8³ Qi f 9, O! ÖTCåæÖ? cdnoî > ¼9° j XYI " Fhi f ° Oä 6%Dμ
" i xSf DæÖ¼D¶¹ pW- ÈÓúf, Gitj ³ | ÖÙ÷1î > FÇ, @CD -3ø. Ffí Ç, @Ûv
I J i xSí - f ÅWHI DCåófD?

yS* { ¶ - Dî " F pef • d: @, ò812I P‡? DsFf 9, yéÖ7! áD URL *' git pull
^ %? òj , ÙW- Wt - D@PF &Çj [C URL" t éÖ- ' O

```
$ git pull https://gitub.com/oneti me guy/project  
From https://gitub.com/oneti me guy/project  
 Æ* branch HEAD -> FETCH_HEAD  
Merge made by the ' recursive' strategy.
```

I m. nop2qr

f Z[k^W- Öm 6%E¤Då"] Ý? Y\$f 9, Z» pbÆ€. ' ^? ! ?À" ^¶. ^ %oF, →S
f G¤¶[→ kå] Ýf-KD~ f?

WcS¬Ff - CyC] Ý¼fK master] Ýš 4ÖmDCå ÖÙGä? o\!] Ý) üâ• k --not ø
. Ff 9, #} master] Ý¼DCå? òB¥' èâ. ' Dmaster.. contribù2i WÄD? —E£¤K
Nf ¿ u^! - I J F t åf %í ^W-) ò contribD] Ý> \$ Ñ- ' I J Ff 9, ÝÙO

```
$ git log contrib --not master
commit 5b6235bd297351589efc4d73316f0a68d484f118
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri Oct 24 09:53:59 2008 -0700
```

Ê seeing if this helps the gem

```
commit 7482e0d16d04bea79d0dba8988cc78df655f16a0
Author: Scott Chacon <schacon@gmail.com>
Date:   Mon Oct 22 19:38:36 2008 -0700
```

Ê updated the gemspec to hopefully work better

pe@ä • Í t Cå f – k D¶¹ » f F f – Cå Ø9 „ c git log ^ %o x² -p ø. F ØÄ· j \$Í t Cå | Üf • y – Dó • ó diffø?

&@ä • [Cå "] ŸŠ uW-] Ÿî > Dô Ø diffF f 9° , @. ' W- k " (ÜD• " SØTg – D" e? f 9° j : Tò8120

```
$ git diff master
```

ð- ^ %oj y XW- diffF h· 9° > Çi ¥' : @D? pe\$f%í å"] Ÿè | F master] ŸNâ 9Ÿ ^ F f OØD" e—j #Øk" Çy? ði st Gitj ...³ [Cå "] ŸŠ master] ŸD¥™Cå ½F ØÙ, H? > p¬f \$ master] Ÿ¼Nì - ½~ • • ^ WÙA~Fža ...³ > y ¥™½F D" e • Ñ] —Äi f \$ å"] Ÿ¼[ðWÙå } ^?

pe master] Ÿi f Då"] ŸD...³] ¹ F ...i Ákœbl" Dú hi W•! -] ŸDæØQó^] XF ÑI > y QØD diff• Ñ] —Äi [å"] Ÿ¼f K D™KL• k F > ¥[master] Ÿf 2k DK Lå } ?

&f ž g: @GäDKLF...ÉÑggi å"] Ÿf• • D~ f ÑÑí —i C] ŸŠ master] Ÿî > f@– k Dµ" ? @ÂTäæDFf , @a Git y å"] ŸÑ¥™DCå ŠC] ŸŠ master] ŸD' - ! &] ¹ ØÙ, H?

s • • D¤ùœFf 9„ „ ~µD1 2ÙX! &] ¹ F > y #2ÝÙ diff ^ %oO

```
$ git merge-base contrib master
36c7dba2c95e6bbb78dfa822519ecfec6e1ca649
$ git diff 36c7db
```

J K F ~ } P DÚ20

```
$ git diff $(git merge-base contrib master)
```

d &F ð8%oW> Hž ŸF f „ Git CD^W8> H¬LD12O÷QŒW? yS **git diff**
^ %oS¬Ff 9 „ o\ä ... ÖSuW-] Ÿ) | SyC] ŸD¥™CåŠ! -] ŸD&O] ¹ ÔÙ> HO

```
$ git diff master...contrib
```

C^ %gj # ©É¤åå"] ŸŠ **master**] ŸD&O] ¹ ÈFC] Ÿ¼Dμ" ? ð-ŒWI k' F- Cc
å?

s' %K² j p ÷ 3j

¤å"] Ÿ¼f k Dμ" ī Z[t j 5Öí Ôk~ oUå KD] Ÿ| F³ <SDI " —i pb ÔÙÖí ^? å
LFj kW- I " i Ff: . ' · ÄDB¹ μ" ī Súöf D. æÅ f Døùkl eF ¥' j) * ¼DW\
] ?

÷ø² j d

W8x! Dμ" ī —i [fk Dμ" ...³ → T **master**] Ÿ? \$ð8oÇ<F**master**] ŸÖmDnoi x
! E» D? ¤f ôf l - å"] ŸDμ" FJ Muo\ ^ 6%f E¤Dμ" | Ff j [→ Ôk **master**
] ŸFè | [å"] Ÿå} Fpā\A?

: HS¬Fpe¥' D7! áÖm» ¼ Öm¶· å"] ŸDCåæÖ? D! -) ü] i t **ruby_client** B
php_client D] ŸF > ¥¥' → Ô **ruby_client**] Ÿ| Fd → **php_client**] ŸFž aCåæÖ¥|
j gf → å"] Ÿè | ? DÄI ?

Figure 73. (ä] ^ " È\@#†‡ - ®�

Figure 74. • Ž“ È\@Là 3

òí 8i ¥} ~Dμ" ī ^Fhi ø. æ~ †FJ ~ E» Ff y Émf–k Dμ" ~ • \$9| F· 9° j ýSI
" ?

pef D. æ* €m@Ff 9° j . ' ! ^ fî > %o| ? \$ò8oÇ< Ffj úö! - „ N] ÝF] i i
master B devel opF master] Ý- j \$W- * €E» D7! ï, | ' j ~ ™F&fK D™noj ' 1 Öi Ô
k devel op] Ý? f » N[ò! -] Ý€uT! &7! á¼? í t, @i > ™Då"] Ý| ói > å"] Ý
â?øFf ī - Cî > Ôk devel op] Ýói > å"] Ý| ?øúøéçë, D! a Ffj [master] Ý
½ÔTZ [E» D devel op] ÝóWt ï, è| ?ø?

Figure 75. • Ž“ È\@' 3

Figure 76. • Ž " Ė \ @à 3

Figure 77. > ¥.] L à 3

ØÄ¤%' qr f. æD7! á | FŒ9„ GX master] Ÿ „ Ph ¥™DÈ» 7! > z { ~ ™F í 9„ GX
Øm~ eâêA~ **devel op**] Ÿ? fí 9„ ½Àò- <ŒFúöW- [fkµ" î > TWÊDÖî] Ÿ? ¢C
] ŸDnoÈ»> o\6+è | F[î > Ôk **devel op**] Ÿú [\Wf | ÷F - | È» è | F[„ ½Ô
DÚ2> k **master**] Ÿ?

$$t \pm \odot \div \emptyset^2 j \ d$$

Git. æØm_- „ N] Ÿ O**master**►**next**F' §™µ" D puó proposed updatesøB' §úö- N| 97
µ" ó maintenance backportsøD **mai nt**] Ÿ? E¤KD™µ" j „ » ¼èâf) * D1 2E kå"] Ÿ ¼
ó\$ ý€A¾DW• W³ E¤¤DxÙå"] Ÿ? ø? è | yå"] Ÿ ØÙ6+ó1FGä i a Z[° pî
> FJK¤, @~ eµ" ? ÚŽDå"] Ÿj { î > k **next**] ŸFè | C] Ÿj { €u. Øfk%í 9„ , +
Öî TWÊD° - ?

Figure 78. J K_` #>a šbcS8#d-“ È\@3

peå"] Ÿ, @~ eµ" F· • j { > k **pu**] Ÿ? ø. ' ôŽÈ»è | Fj { dt> k **master**] Ÿ? ð
9àÈ **master**] Ÿ¹ , \$ÛÙ½ÛF **next**] Ÿ89j { gxF & **pu**] ŸDg×> HÄ?O

Figure 79. ýS8#“ È\@žöe~ü•\@3

øå"] Ý¥, { > k **master**] Ý| F-nj { s 7! á¼å} Ó? Git
. æj kW- s ÑWt ð, ¼êóXSD **mai nt**] ÝSCDN| 97\SDI J, Dð, úö~™? sãF ø
f qr GitD7! áè| F-j k_- 9] i ó1C. æ, ðDÇO^ fD9GXDX] ÝF GXp-] ÝFPZ
§f, @e™D7! FJKf: @pbÖÙEøú y §úöKS-Fò: " \$6Dµ" i ° \$E. ' Mä™D
E ø? Git. æDµ" i i ° i D? @%; 5€•· FGA` **Git úÖK-1?**

\$a ÜuÉ² j d

t ^z { K- DCåæÖFk" úöK~ RQ\$ **master**] ÝÑy £ ø\SDµ" ÖÙg x B\$øF &Çi ...
³ [i > ? øf öf ^l - å"] Ý¼Dµ" F> ¥Z » @[Öi D| ^ Ff 9, \$C] Ý¼ÝÙg x ~
‰F \$ øâ **master**] ÝÓJ Ki **devel op**] ÝøDxØNm™¢H» f? pe" e€: Ds Ff 9, ½
Ö **master**] ÝF ¥| ÖTW- K- D. æCåæÖ?

uW8[-k Dµ" ^9T 6] ÝD1Wi \$ø? Git ¼D\$ø» ¼S y° » Dl t Cå Dg x? · j CP
CCåDI J Fè| , +[m™- ' T øâ] ÝÑ? ò812\$f^- : -k å"] Ý¼Dl - Cå FJ Kå
"] Ý¼- kW- Cå F&f Ç: ÝÙg x | I k' ? : - HI F-Ef D. æCåæÖ» ¼O

Figure 80. f ...L ` #gh- ®3

pef' ' [Cå **e43a6** | PT **master**] ÝFf 9, ÝÙO

```
$ git cherry-pick e43a6
Finished one cherry-pick.
[master]: created a0a41a9: "More friendly message when locking the index
fails."
3 files changed, 17 insertions(+), 3 deletions(-)
```

ðÄj I PB **e43a6** / OD~ f Fhi st- ' Dr NÇOFFj ÖTW-™DCå SHA-1 r? Y\$ f DæÖ
j g f ðÄO

Figure 81. f ..." È\@Q#>b†‡à#- ®3

Y\$f 9,, å} ð- å"] ÝF>. ôÇ: l k DCå?

Rerere

pef \$ÖÙ† CDî > J g x F J úöW- „ NDå"] ÝF Git CDDW- ô‰ÖrerereÓD• ° j k W" £?

Rerere i Öm' Z å ä DUV• Z 1 e ó reuse recorded resolutionÓD9,, ÑÑ. i W8} 6UV• Z D1 W? x B' rerere | F Git [j úöW" f• î > è å Bè | D4ÄF x Git ÿ Yè å Z [» A \ » ¼DUV | F ñj . ' è å D» A 1 e F & Ç, @f D. - ?

ð- • ° Öm! - \] OW- PØø. BW- ^ %? ¼DPØø. i **rerere.enabled** Fä. < \$ŽÍ PØ ¼—9,, ^ O

```
$ git config --global rerere.enabled true
```

Y\$í xf ÖÙWt, @• Z UV Dî > | F• Z 1 e î j { å ä \$x" ¼F,, j è | . ' ?

pef, @B rerere D" å y F f 9,, . ' **git rerere** ^ %? x ~ 2 * ' . | F Git j Gæ • Z 1 e ‡? å F, + ' ÜW- B x å œWUV/ GDé P. > • Z UV ó Qý x **rerere.enabled** { E Ót **true** | j É ÝÖÙø? . í k ¶. | ^ %oF 9' Sä • å ä. Få } ° » • Z 1 e B%} x" Ž\ A~> ? ¥' [\$ Rerere ¼Ö^ ‡ Ø?

v! Mä å æ

x f Z » ÖÙWt , | F f 9° : @êW- ç ë F ð Ä \$ è | DœbW- Cå QÍ 9,, m™%í C, ? f \$ **Git x Ø ¼Z [^ • ^ %í ™ç ë D \ Ø? " t W- úöKF pef Z » @t ç ë e) Ds F ê ç ë D \ Ø - Ci ð Ä I DO**

```
$ git tag -s v1.5 -m 'my signed 1.5 tag'  
You need a passphrase to unlock the secret key for  
user: "Scott Chacon <schacon@gmail.com>"  
1024-bit DSA key, ID F721C45A, created 2009-02-09
```

perf tçëë) ^FF 9° j nT] ï' Së) DPGP! ÕDI " ? Git. æDÚÖKZ[• Z ^ ðWI
" F 1Wi \$7! á¼„ blob y < DÚ2Öm6' D! ÕF > • • W...³ • NCA ~ Dçë? @õf ðW
œFF' 1 f 9, o\ÝÙ gpg --list-keys ÙXff: @D keyO

```
$ gpg --list-keys  
/Users/schacon/.gnupg/pubring.gpg  
-----  
pub 1024D/F721C45A 2009-02-09 [expires: 2010-02-09]  
uid Scott Chacon <schacon@gmail.com>  
sub 2048g/45D02282 2009-02-09 [expires: 2010-02-09]
```

è | f 9, o\ « X key > o\ ý i x² c git hash-object S...³ [key « K T Git D‡? á¼F git
hash-object ^ %o j N Git ¼L k W- Öm A ~ D™ blob y < F > Nf ý Á C blob y < D SHA-1 r O

```
$ gpg -a --export F721C45A | git hash-object -w --stdin  
659ef797d181633c87ec71ac3f9ba29fe5775b92
```

Œd Git ¼Z [Ömf D key DA ~ ^ FF — 9, o\ • » ° hash-object ^ %o C X D™ SHA-1 r S %í W
- ...³ • N. Dçë O

```
$ git tag -a maintainer-pgp-pub 659ef797d181633c87ec71ac3f9ba29fe5775b92
```

perf YÙ git push --tags ^ %o F ž a mai ntai ner-pgp-pub çë [j { &3cfk %? , @NI çë
D%9, o\ s‡? á¼...³ | P blob y <> « K T GPG ¼S « K PGP keyO

```
$ git show maintainer-pgp-pub | gpg --import
```

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, o\ÝÙ git show <tag> SOP~ eG§çë NI D→Ñ?

; P1 á wé x

Git ¼Ç" \$XÍ t Cå ² " DÒv123Öè» D‡ y œWF perf: @t Cå f ÑW- 9` D) üF 9, y
ÝÙ git describe ^ %? " t Å° F Git [j ófW- yz { F · ° ¥UDçë) PÉCçëè | DCå‡
æBf fI I DCå D\] SHA-1 r óâ < D g° © Gitø¢fO

```
$ git describe master  
v1.6.2-rc1-20-g8c5b85c
```

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! áqr <S> Çí DFža git --version ^ %oC XD" ei Šā» ¼D? pef fl I DCå É- —k
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CçëóÅO• DçëøFG\$^ %o| • • --tags Ø. ? fí 9,, . ' ò- yz{ S* ' git checkout J
git show ^ %oF hi ò• « § EåD} Ÿ SHA-1r FsäÇW» W...kŽ? > pF ¥U Linux Aut ^ z
O SHA-1r y<Dì W- F[È‡° 8È½AT ^ 10ÈF « Ú,, àD git describe yXž\ / ž?

^ y 1 • ! M

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```
$ git archive master --prefix='project/' | gzip > `git describe  
master`.tar.gz  
$ ls *.tar.gz  
v1.6.2-rc1-20-g8c5b85c.tar.gz
```

pék%[ò- %oŠÓ• %oF 6—9,, \$W- project æä ¼ÒTf. æD¥™½F? fí 9,, „ » ¼D12
%í W- zip%oŠÓF hā | f - CN git archive ^ %oX² --format=zip Ø. O

```
$ git archive master --prefix='project/' --format=zip > `git describe  
master`.zip
```

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" ú> pFf DÑWt ð,) üi v1.0.1Fža <ÜD^ %o9,, c XÑt ð, „ Sfk Cå Dß" O

```
$ git shortlog --no-merges master --not v1.0.1
```

Chris Wanstrath (6):

- Æ Add support for annotated tags to `Git::Tag`
- Æ Add packed-refs annotated tag support.
- Æ Add `Git::Commit#to_patch`
- Æ Update version and `History.txt`
- Æ Remove stray `puts`
- Æ Make `ls_tree` ignore nils

Tom Preston-Werner (4):

- Æ fix dates in history
- Æ dynamic version method
- Æ Version bump to 1.0.2
- Æ Regenerated gemspec for version 1.0.2

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GitHub

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ff, @‰DUW~ ni %í W- Y_2j ? ...³ HI <https://github.com>F øùW- 4{ \$' D' j) FC
DW- < I K~ 5¢B) oF QÖL ÈÒSign up for GitHubÓD? ç t j #j 9?



Figure 82. GitHub j_kl_3

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GitHub t Y_2i CD^Èl fKD• ° F} ^W" c©D° - ?

!

GitHub D@_ | §ÖmW" c©µ¶B• ° FÇ\! - [ÇéBò\] A~? GS 9ø1e
B y> D~ eMR\$ <https://github.com/pricing>?

QÖöAá Ñ¤D Octocat Ùç Ff [STÖÖÜúÈÜ? Y\$Ff Z[%o5^. ' GitHub D†j µ" ?

SSH | }

Y\$Ff ôŽ9„ . ' [pef i è. ' SSHéÖFFf, @PÓW- ! ô? ópef Ák! ôF; ... óf SSH! ô?ø. ' ™' àÑ
¤D^3 è, f D2i EÓO](https://: ; Fo\ f ØØ%í D' i) B) oHI Git 7! á? hi Fpeggq
r ! k. æFf « -Ç, @O1 ÑÑØØ¥' %í D2i i t ^ „ | fork . . æF „ B€u¥' ÉmD» f ?</p></div><div data-bbox=)



Figure 83. Account settings

d | \$á – øù OSSH keys] ?



Figure 84. OSSH keys

\$ò - È ÜQÖÖAdd an SSH keyÓj #Fc f D! ôÈW-) y F [f D ~/.ssh/id_rsa.pub óJ K È
» 1 D ·) y ø! ô½~ DA ~) * T½! ' F d | QÖÖAdd keyÓ?

! - z c f D S S H) ôÈW- ° pâ Ò‡ D) y? f 9,, t í W-) ôÈ) yó Hp F Ò¥D
; â! < • óJ K Òµ" 2j Ó> øF,, -,, | , @Bd) ô| ° p1 - 5'] ?

~ •

< WÈ F p e | 9Ds F f 9,, [óf Dè Á | ff R Q D Ù Í ? ' ' F S T ÒProfileÓçë È ó \$ÒSSH
KeysÓçë È Ñ1 øF QÖÖUpload new pictureÓ?

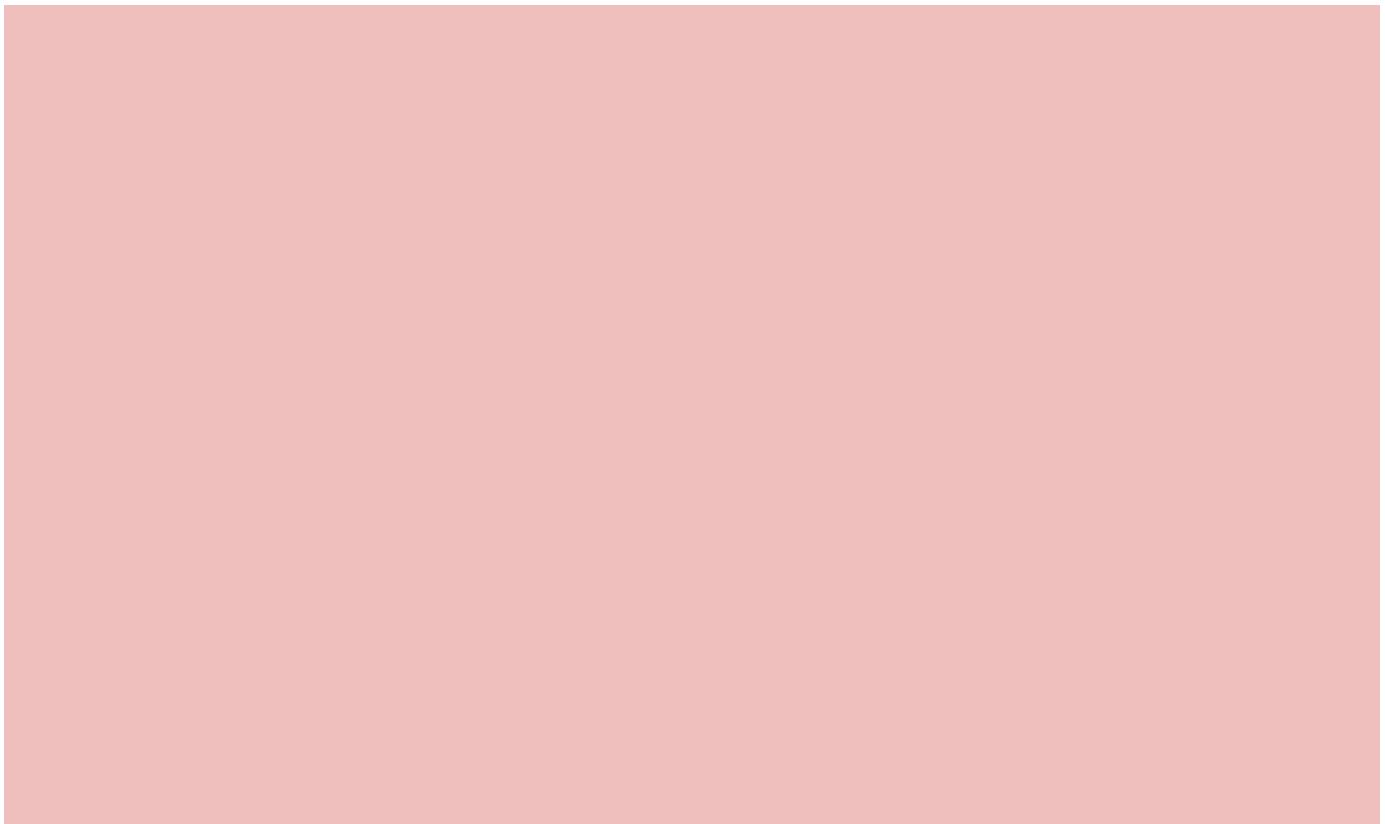


Figure 85. ÓProfileÓmb 3

¥' øù ^! 5) ùÑDW- Git Ùç F Ñx è | j 9 „ y ÓÙOC?

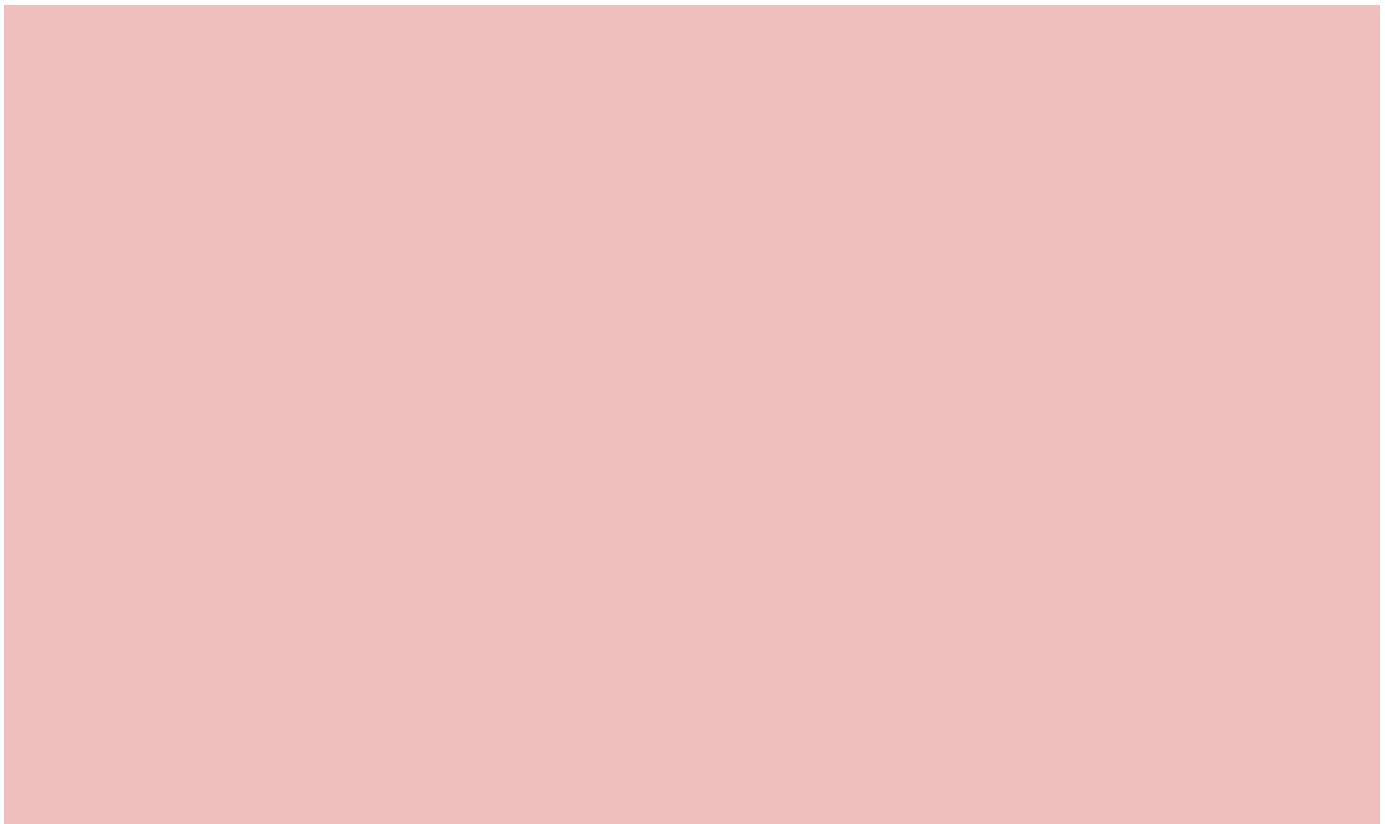


Figure 86. n o p q

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5[. ' - ³ ÈSF f, @\$ý€ÜD Emails\] • • f / k Dfk KP5¢?

Figure 87. î í r cVs

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ÈC5¢j ³ ETfk DoäBÀA? UV- 5¢i o\I ODFpe| 9Ds F9,, [EÓt å@5¢?
¥| W- 5¢i 4o\I ODFò9àÈf Ç° [EÓt å@5¢? x GitHub ï Yæ97! á¼Dœ9Cå
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f 9,, \$ Account settings È ÜD Security çë È ¼ÛT Two-factor Authentication E Ó?

Figure 88. Security > œBQ# 2FA

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œ app œF F œo öW8Öx§ | ÷ DWt -) oÓøFj i @ GitHub o\ SMS œ uF Fœ?

øùi PD1W| F j FC©Èj EÓ 2FAFF D2j j gÖ~ ÜŽFí t¿ã GitHub | ī , @CD}) o,
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C ; ± ©

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Figure 89. ÓForkÓ– t

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Figure 90. &už SSS8#hi

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HI 5¢i O <https://github.com/tonychacon/blink?> ¥' [· qr T! 5F %í W-] ÝF » f n
o F ¥| d [f Ý€uT GitHub?

```

$ git clone https://github.com/tonychacon/blink M
Cloning into 'blink'...

```

```

$ cd blink
$ git checkout -b slow-blink N
Switched to a new branch 'slow-blink'

$ sed -i '' 's/1000/3000/' blink.ino (macOS) O
# If you're on a Linux system, do this instead:
# $ sed -i 's/1000/3000/' blink.ino O

$ git diff --word-diff P
diff --git a/blink.ino b/blink.ino
index 15b9911..a6cc5a5 100644
--- a/blink.ino
+++ b/blink.ino
@@ -18,7 +18,7 @@ void setup() {
// the loop routine runs over and over again forever:
void loop() {
    digitalWrite(led, HIGH);      // turn the LED on (HIGH is the voltage level)
    [-delay(1000); -]{+delay(3000); +}          // wait for a second
    digitalWrite(led, LOW);       // turn the LED off by making the voltage LOW
    [-delay(1000); -]{+delay(3000); +}          // wait for a second
}

$ git commit -a -m 'three seconds is better' Q
[slow-blink 5ca509d] three seconds is better
1 file changed, 2 insertions(+), 2 deletions(-)

$ git push origin slow-blink R
Username for 'https://github.com': tonychacon
Password for 'https://tonychacon@github.com':
Counting objects: 5, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 340 bytes | 0 bytes/s, done.
Total 3 (delta 1), reused 0 (delta 0)
To https://github.com/tonychacon/blink
* [new branch]      slow-blink -> slow-blink

```

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Figure 91. v \$wx – t

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Figure 92. v \$ wx ½¾BE

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Figure 93. | v \$wx 5#â Ö>- . | yz

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Figure 94.—À{ %r c . i #yz† |

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Figure 95. v \$wx } z BE

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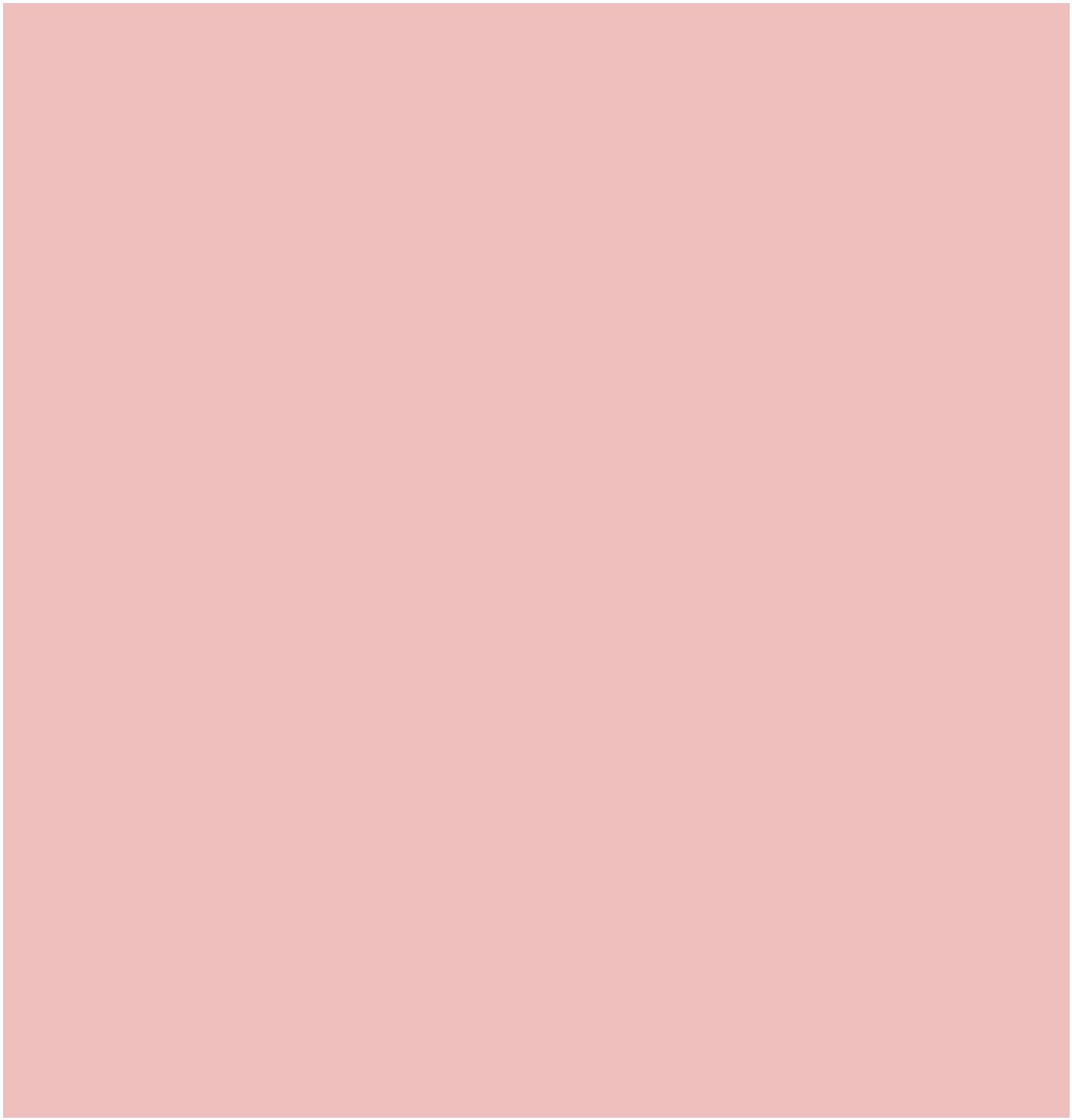


Figure 96.) * # v \$wx

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• WWÄ? t e‡ D GitHub. æ[I PGÅD] Ý¤" yf ÝDåï 12F> [g~ €† ÈS, WÔÙî > ?

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úöKB' ' CX^W" 9\$Fò- I J • W> ç, @sèS\ F~, @[f ÿm™Cå> €uT] Ý¼Fò
. ÕOPDÄÄB\ Õ9,, Zè> Õ?

: - HI Ff 9,, Å] • • ¥, DI PGÅFf j O9T E¤KÅkg×6DCådCå W- ™DI PGÅF
&i ...³ " • ^™DCå> €uTZkD] Ý¼? pef è| dÅ] ä• ò- I PGÅFf 9,, æç 5ÙT ò
- » f D>s? QÖþ ÆÑDÒMergeÓî > øi # | Fj í i W- î > Cå> • Nò- I PGÅFf—9,,
I æç D[• > SDOPA~?

Ü‡< nŒ• >

pef DI PGÅ° §\| J 6>sç° . Ù5î > Ff, @ÔÙ» A' ° aúöKy ÕÙî > ? GitHub
j yí - Cå ÔÙ6+Fafä; f DI PGÅ° a } PDî > ?

Figure 97. / NÃ- ^• • Ž

pef • T ^ Å Ç° ÕÙ· Ùî > ¼D\ ÜFf —, @» Af D] Ýaò- C©gf? çFòÄúöK—ç,
@d‰è L Dμ" ?

f k! 81WS•Zò- I " ?f 9,, äf D] Ýg xTæç] Ý¼] óo€i f êóXD7! á¼D master
] ÝøFJ Kf 9,, î > æç] ÝTf D] Ý¼] ?

GitHub ÑD† e‡ D, ÑKj . ' | W81WF x§¥' \$ÑW? CT D€° O
¥' ¥• mDi æÖâãB¥| D† > Fg x} ^cf ýS• Ñ] } PDæÖâãF - j af Dµ" gÒ~ •
S®¥~ ~í ï™?

pef: @† > æç] ÝSa f DI PGÅgÒ9† > Ff, @[Í 7! á•• t W- ™Dé 7F> s é 7@P
A~F† > å] ÝDA~Tf D] Ý¼] F» Af k DI " > ¥, m™€uÀf Cål PGÅ. ' D] Ý?

\$ò- HI ¼F¥' dt. ' èâ DÒtonychaconÓ' i SÔÙ©>FÍ " KCå ^W- f ÝF. ÒI PGÅ
B· Qó^UV? Y\$S• ¥' • Zò- I " DÈ i ?

```
$ git remote add upstream https://github.com/schacon/blink M
```

```
$ git fetch upstream N
```

```
remote: Counting objects: 3, done.  
remote: Compressing objects: 100% (3/3), done.  
Unpacking objects: 100% (3/3), done.  
remote: Total 3 (delta 0), reused 0 (delta 0)  
From https://github.com/schacon/blink  
* [new branch] master -> upstream/master
```

```
$ git merge upstream/master O
```

```
Auto-merging blink.ino  
CONFLICT (content): Merge conflict in blink.ino  
Automatic merge failed; fix conflicts and then commit the result.
```

```
$ vim blink.ino P
```

```
$ git add blink.ino  
$ git commit  
[slow-blink 3c8d735] Merge remote-tracking branch 'upstream/master' \  
E into slower-blink
```

```
$ git push origin slow-blink Q
```

```
Counting objects: 6, done.  
Delta compression using up to 8 threads.  
Compressing objects: 100% (6/6), done.  
Writing objects: 100% (6/6), 682 bytes | 0 bytes/s, done.  
Total 6 (delta 2), reused 0 (delta 0)  
To https://github.com/tonychacon/blink  
E ef4725c..3c8d735 slower-blink -> slow-blink
```

M [Í 7! á•• t W- é 7F> ^) t ÒupstreamÓóÑ§ø

N s é 7@P¥™DA~

O [CåáDå] ÝDA~† > Tf D] Ý¼

P » AQóDUV

Q d€uÀOW-] Ý

f öf ^ ÑÜDÈj | FI PGÅ[j ÉÝ~™> m™Gäi a°. ÜDî > ?



Figure 98. v \$wx , H' 5^• V• Žß

Git DÖt èÆ—i f 9,, W...mA,, Ñi " ? pef k W- YÙ^d] òD. æF f 9,, æç 5i > æç] Y
¥- , @Æ€¥UDWt UVFò. Òy€i Õ~ • ~í ?

pef W» : y] Y%g x> ÔÙ%€F f 9,, òa%oFhi ² <i ; f Ç@² Ü5CåTZ[Cå^I PGÅ
D] Y? pe 6%I P^ò-] Y> ÔÙW" » f Ff [j nT g x D™3 ¼CTDI " ? / y DF [g x
| D] Y€uT GitHub ÑDW-™] Y¼F > ¥%í W- Ž™DI PGÅ- ' mDI PGÅFd | Gf mDI
PGÅ?

Ž •

f D<- I " 9° i Ò¥Cpb- ' mDI PGÅÅÓ? k 8e1W9,, af \$ GitHub ÑDEl æb 51 -
6KL?

1 spbyI PGÅJ ; " óIssueøÔÙ/ y- ' , 1 ? fkDI PGÅB; " \$,. æ½i j k W- 2WÅV
D' i ? : - HI Ff ÅWO! / k 3i I PGÅB3i ; " ? pef: @-' æbW- I PGÅJ ; " F f
- , @\$CåJ I I ¼y k #<' i >j 9? fí 9,, • » - ' 67! áD; " J I PGÅF pef: @-'
6%yC7! áDÒForkÓ¼D; " J I PGÅF yk ' i) #<' i >F p e\$ÇOD7! á¼F yk ' i
) /7! á) #<' i >?

¥' S• W- HI ? -E ¥' yÑ- HI ¼D] YÔÙ^g xF > t å%í W- ™DI PGÅF Y\$¥' ' '
° \$™DI PGÅ¼- ' mDI PGÅ? ¥' O! ' ' - ' W- êóXD. æ½D; " BW- ôŽÇOD. æ
¼D; " F —9,, Ä \$I PGÅ¼Då X- ' òÄÜLII ?

Figure 99. Hv \$wx Q# ≠ ¼X „

¤ ¥' Cå ^ ð - I PGÅF ¥' [j • T „ ÑA ~ {] ^ f ð Å O \$ I PGÅ¼] ^ | Då X - '

Figure 100. Hv \$wx Qf „ à # ≠ ¼X „

f j O9T ð ÖD GitHub 5¢{ } 6^F - 1 < ^ ®@DMR?

p e Tony Å] Gf ^ î I PGÅF ¥' 9 „ • TW- { - ' DC©F GitHubj É YD\ NÐöñ ~ > # ©\$ I PGÅD! ÷ _ Ñ? ð 9à Èœbä • ð - I PGÅD%9 „ æç 5HI ™DI PGÅ? ð - ^ 3 — Ä \$ I PGÅ¼] ^ | Då X - ' ¼À©Dž Ä?

Figure 101. Hv \$wx Qf „ à # ‡ ¼X „

} ^; " ' ì LFFj 9„ o\.' CåD SHA-1S-' Cå? f ®¶öDL X 40È, D SHA-1F GitHub
j \$óP½ÉÝ5Qó• Nò- CåD^3? OÄDFf 9„ Ä-' ; " WÄyêóD. æ½DCåJK 6
. æ½DCåÖÙ-' ?

GitHub (• K Markdown

y\$ GitHub ½<† e‡½! ` ½° p‰TDnF-' 6; " - i - , 1? \$; " BI PGÅDI I FóP
BnoÓPj k 651FÍ 9„ . ' ÒGitHub™š D MarkdownÓ? Markdown 9„ af yk 5½! Fhi
] ^ Xœ• DA~?

ä • [W- Markdown D©HB](#)] ^ Že J D©HS ^• pb-LóPJ ½! F> o\ Markdown ÖÙ] ^?

Figure 102. > b Markdown # g h Cf „ ...†

GitHub (• K Markdown

GitHub™š D Markdown " • ^ W" ×ØD Markdown ½‰ÇT DKL? · \$%í I PGÅB; " ½DóP
BI I | d] k' ?

Ñ>ç'

UW- GitHub C2D Markdown • ° F° i i ' \$I PGÅ½F—i œFW° ? W- œFW° 9„ Å©XW
• Wf : @ôfDnoF > ýkAø` ? ä· ' < \$; " J I PGÅ½| Fo€9„ Å©f : @ôfDno?

f 9„ ðÄ%í W- œFW° O

- [X] ' Lno
- [] ' Lfk 6+Öœ
- [] tno' L½>

pe¥' [ð- W° • k I PGÅJ ; " DI I ½F· [j {] ^ [Markdown ÖP½](#)] ^ | DœFW° ðÄ?

Figure 103. Markdown yz Qf „ à#‡éšI

\$I PGÅ½F œFW° [€{ ' S\$î > èâÅ©ð-] Ý[@ôfDno? ¥fD51—i Ff- , @Q
ÖAø` F—° ~ tmÖP ÑÑfç, @...³ » f Markdown?

Çgpå F GitHub j [f \$; " BI PGÅ½DœFW° Ö€ÊSE½Å©? : - HI F pef \$W- I P
GÅ½k œF %~Ff [j \$fk I PGÅ½DßBËÜÑ•T· DÔù? ð. ð%' 9„ àW- I PGÅ] •
fÇODÙœFFO| →§ 6%^•] ÝDÔù? f 9„ \$ \$I PGÅW° ½DœFW° B" • TW- H
I ?

Figure 104. Hv \$wxšI Q#‡éšI • a

¤f \$...YW- œF D½N—Cå I PGÅF > . ' œF %~Döf DÔùFð- • ° j d] Dk' ?

Š< ' "

f í 9„ \$ÖP½• • noî f? ð\$ f: @Å©š 4CåT] Ý½Dno | j d] k' ? · í [€{ ' \$Å
©ÅWg€μ" DnoJ ð- I PGÅ, @Dno?

f , @' Ö\ - i Ö[, @• • Dnoî fÖÈS?

```
```java
for(int i=0 ; i < 5 ; i++)
{
 System.out.println("i is : " + i);
}
```
```

p e • kŒxD) üF—Ä¥' öJ • k DÒjavaÓWÄF GitHub j ÉY, +y ûã DÎ fÖÙŒWc v? \$
<ÜDHI ¼F· ¥, j] ^fò- ÄI O] ^| Dnoî f©H?

Figure 105. f „ à # ^ ÷ %o, gh

p e f \$ÀAW- l „ DóPè ¼DWûFFf , @AÓf , @DÎ fF> \$í Üâ•• >zì j 9? n...
ÑFst ò- • ° j { [€' TF· í kW- ½L- ? - @f äf @À- D½y ø ¼F> j < r - Fø ¼DI
" j ÉY- ' > ÚkóP` ?

- ' D\] —ÄöÄ:

- > Whether ' tis Nobler in the mind to suffer
- > The Slings and Arrows of outrageous Fortune,

How big are these slings and in particular, these arrows?

[\] ^| F—j g fòÄO] ^| D- ' ©H

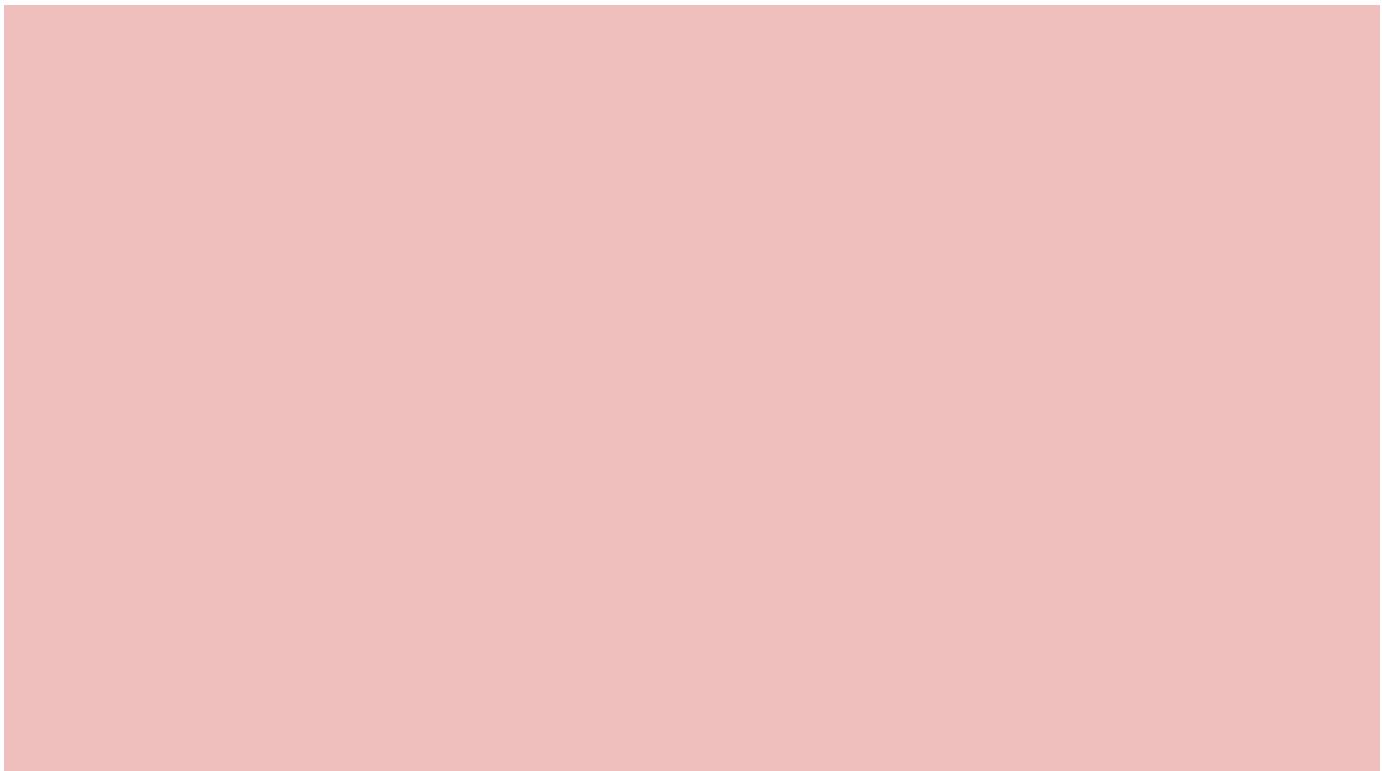


Figure 106. $f \circ a \# X \circ gh$

' " • x

¥| F ¥' 9, \$óP½. ' ° ozì ? ð[€XY\$ GitHub D; " BI PGÅDóP½? GitHub Ñ« ¬ k
° o£~? pef \$ykóP! , : , èFÉÝöfðj £fÙTf , @D° o?



Figure 107. I Š™_¶ · Ø9é

f í 9, \$óPDœb 51. ' : <° o) Ü>: S••° ozì ? : - HI Ff 9, yk, <½y O

I :eyes: that :bug: and I :cold_sweat: .
:trophy: for :microscope: it.
:+1: and :sparkles: on this :ship:, it's :fire: :poop: !
:clap: :tada: :panda_face:

] ^è | F—j gƒòÄO. ' ^†C° ozì DóP

Figure 108. ' „ ß• ŽI Š™< #yz

cdò- • ° > Çi * €... ' Fhi · \$ò8Ç1 ¬° Å¾oD³ ¹ JF• k ^TàD^ð?

n...ÑY\$Z[k†CD\$KEF9„ . ' ° ozì FòJk - W° 9„ af ½¾DÙT° °
Âf Doł D° ozì O

<https://www.webfx.com/tools/emoji-cheat-sheet/>

- '

s•• ; ÜS¬Fò> Çi GitHub™š Markdown D• ° Fhi í l k' ? peÇ: . ' MarkdownŒWS
, k ÜÛ F GitHub L8f o\ab ÜÛ T½! ' S, k ÜÛ ?

Figure 109.—À•• # ú ^ ¶ . • Õ × %

p e f Á] ä • o \ a b D 1 2 É Y , k Ú Í F f j ï Y ½! ' Ñ k - Ô Parsed as Markdown Ó D C © ? Q
Ö· f 9 „ ^ • f k ° \$ GitHub Ñ. ' D Markdown • ° ?

—, K GitHub Qi ¥ | n E - -

¤ f ê ð ^ W - GitHub à á è | F f D à á ó j f D ð ê ð Ó ð j 2 i § > à á & 2 i ? ° i 5 F ¤ > à á k
™ D C å | F GitHub j o ä f O

This branch is 5 commits behind progit:master.
ó!] Ý V | progit:master 5 - C å ? ø

hf D GitHub à á Ç j { GitHub É Y ~ ™ F ð ~ n ® ¶ ° f É m S % ? j 5 F ð n < l } ~ ?

UW81WÅ, PÓ? Hp F ¶ f s <https://github.com/progit/progit2.git> ê ð ^ . æ F f 9 „ Å
ð Ä ~ ™ f D master] Ý O

```
$ git checkout master M
$ git pull https://github.com/progit/progit2.git N
$ git push origin master O
```

M p e \$ u W -] Y Ñ F — { | T master

N s https://gitHub.com/progit/progit2.git @P~ f | → T master

O [master] Y € u T ori gi n

Ø cd ð Ù F h í t í @y k s p - URL @P k Q ž Y ? f 9 , ` è E Ó W < S É Y ò f . O

```
$ git remote add progit https://gitHub.com/progit/progit2.git M
$ git branch --set-upstream-to=progit/master master N
$ git config --local remote.pushDefault origin O
```

M • • Í à á > P W -) y F Ò J Ò · progit

N [master] Y E Ó t s progit é 7 @ P

O [³ | € u à á E Ó t ori gi n

^ » è | F μ " i Ò t ~ • } ~ O

```
$ git checkout master M
$ git pull N
$ git push O
```

M p e \$ u W -] Y Ñ F — { | T master

N s progit @P~ f | → T master

O [master] Y € u T ori gi n

Ø 8 1 W * € k ' F & ¥ Á k P Q ? Git * € ± 9 t f c ¼ % o ð " μ " F & ¥ . C j \$ f N master C å ~ f F
s progit I P ~ f F d | N ori gi n € u | o ä f F f k ð " Í " \$ ð 8 P Ó < Í i k ž D ? s ä f C ® y
... ³ C å T master k f " _ F s t C] Y s Ž e Ñ S - 2 S Ñ S à á ?

h T ± ©

Y \$ ¥ ' 9 „ | 1 ÷ 5 N W - . æ E ø A ~ F S • W < u W - 1 Ü D A ~ O % í P ú ö B y € f É m D . æ ?

è é - K A B !

a ¥ ' % í W - 7 ! á S] 3 ¥ ' D . æ ? o \ Q Ö Ü ú á – D Ø New repository Ó i # F J K Ë \ μ ¶ ž f
' i) * þ D + i # S , ¹ ¥ ' D d Ó ? ; \$ ð i Ø New repository Ó < I W ° . ?

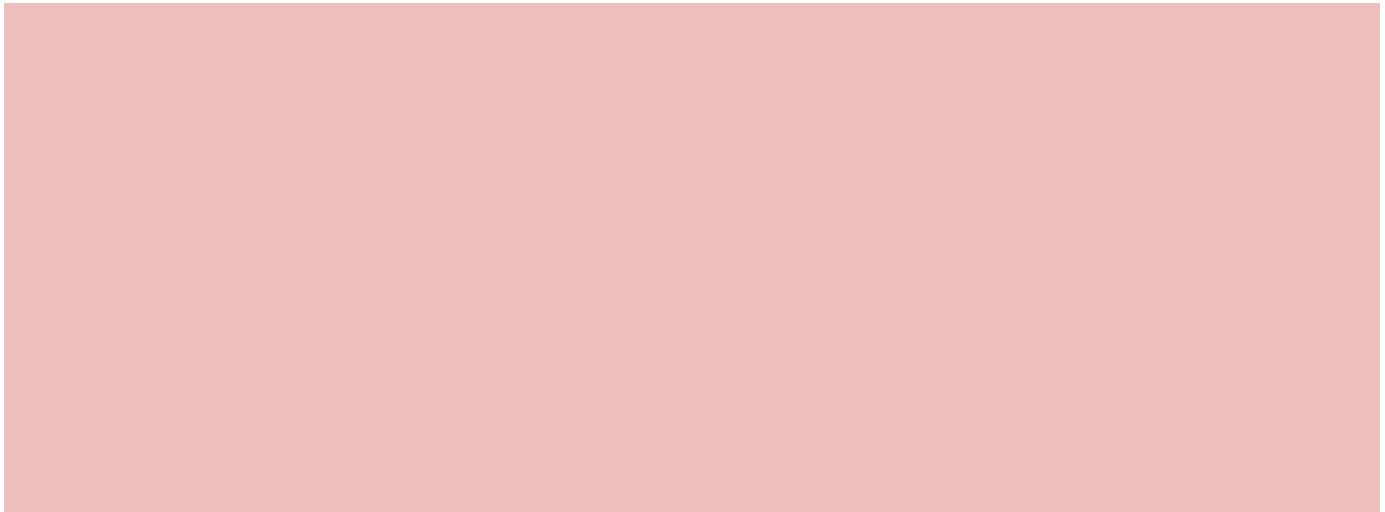


Figure 110. + € ØYour repositoriesØ u v .

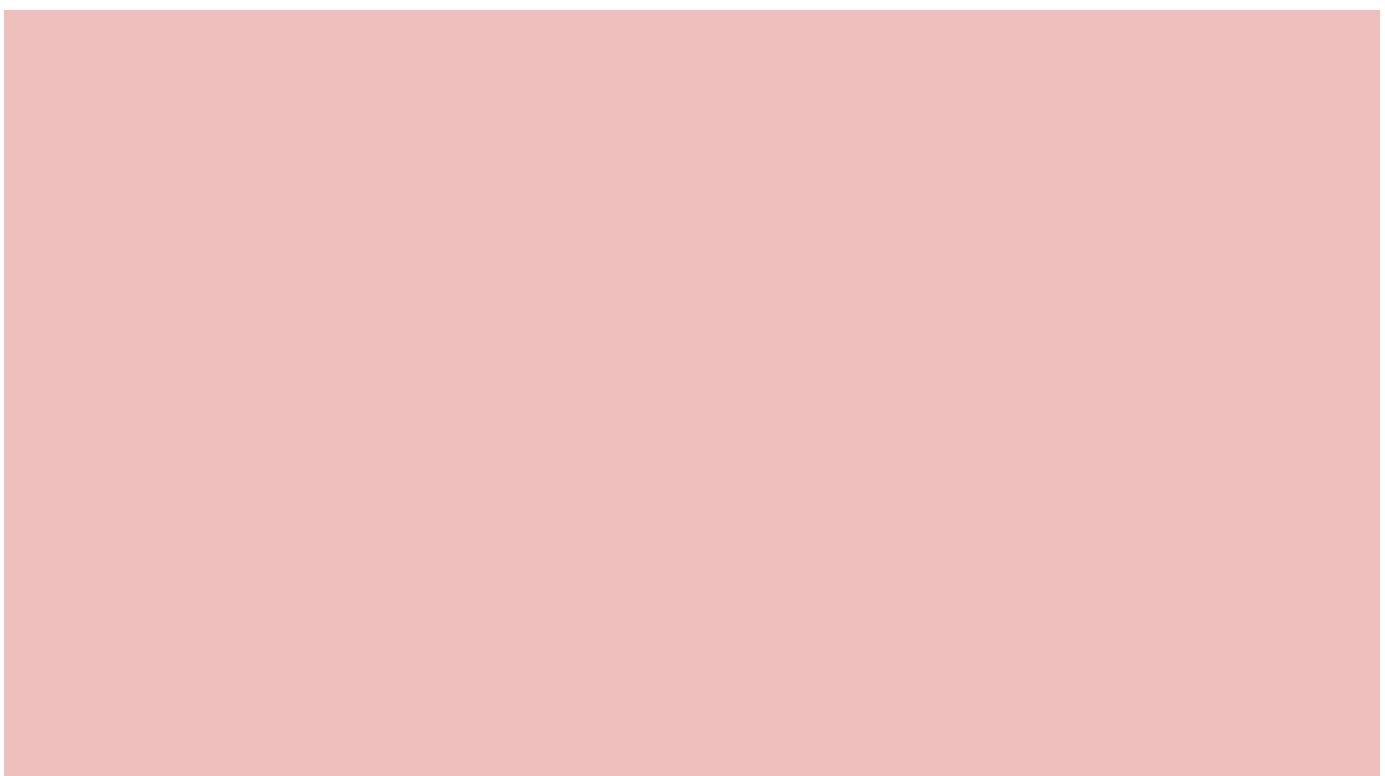


Figure 111. + € ØNew repositoryØ ‘ v š I .

Øj ý f T Ønew repositoryØ ° ~ :



Figure 112. + € Ónew repositoryÓ I , .

ØJ } ^W- f ®¶@ÙD. æ) F 6yfī i 9øD? Y\$-, @QÓ ÓCreate RepositoryÓ i
F Duang!!! Øf —\$ GitHub Ñ/ k ^W- „ <user>/<proj ect_name> ^) D™à á ^?

s t æâ! ÅnoF GitHub j # ©k G%í ™7! áJ KGÄTW- ZkD Git 7! áDW" ¬Ñ? ¥' Çj
\$ØJ Ø^ ¬Ñä. F pef, @Ai F] • Git x Ø?

Y\$f D. æ—üý \$ GitHub Ñ^Ff 9, ä URL cœbf :] 3D%? GitHub ÑD. æ9o\ HTTP J
SSH HI F HTTPS t https://github.com/<user>/<proj ect_name> F SSH t
gi t@gi thub. com: <user>/<proj ect_name> ? Git 9, o\ „ Ñ! 8 URL ØÙ@PB€uFhi ' i DH
I >ÿNs - ³ | . ' DO- ÇO&• ?



o€y §! „ æ9, ³ 1] 3x§ HTTPS D URLF s t ' i qr. æÇ, @k W-
GitHub ° i ? pef] 3 SSH URLF ' i ®¶k W- ° i > ¥Ñx SSH) ö' ° HI f D
. æ? HTTPS URL Šf * T ðJ ä• . æ' D5¢i WÄD?

t u÷j (

pef: Š6%î " F> : c6' CåD>ÿFf, @ä6' • • t ÓCollaboratorsÓ? pe
BenF JeffF LouiseÍ \$ GitHub ÑO1 ^Ff: c6' €uD>ÿFf 9, [6' • • Tf D. æ? ðÄ‰oj
c6' Ó€uÓ>ÿF—i ¬6' y. æB Git 7! áÍ k` LD>ÿ?

QØþà: \ D ÓSettingsÓ ^3 ?

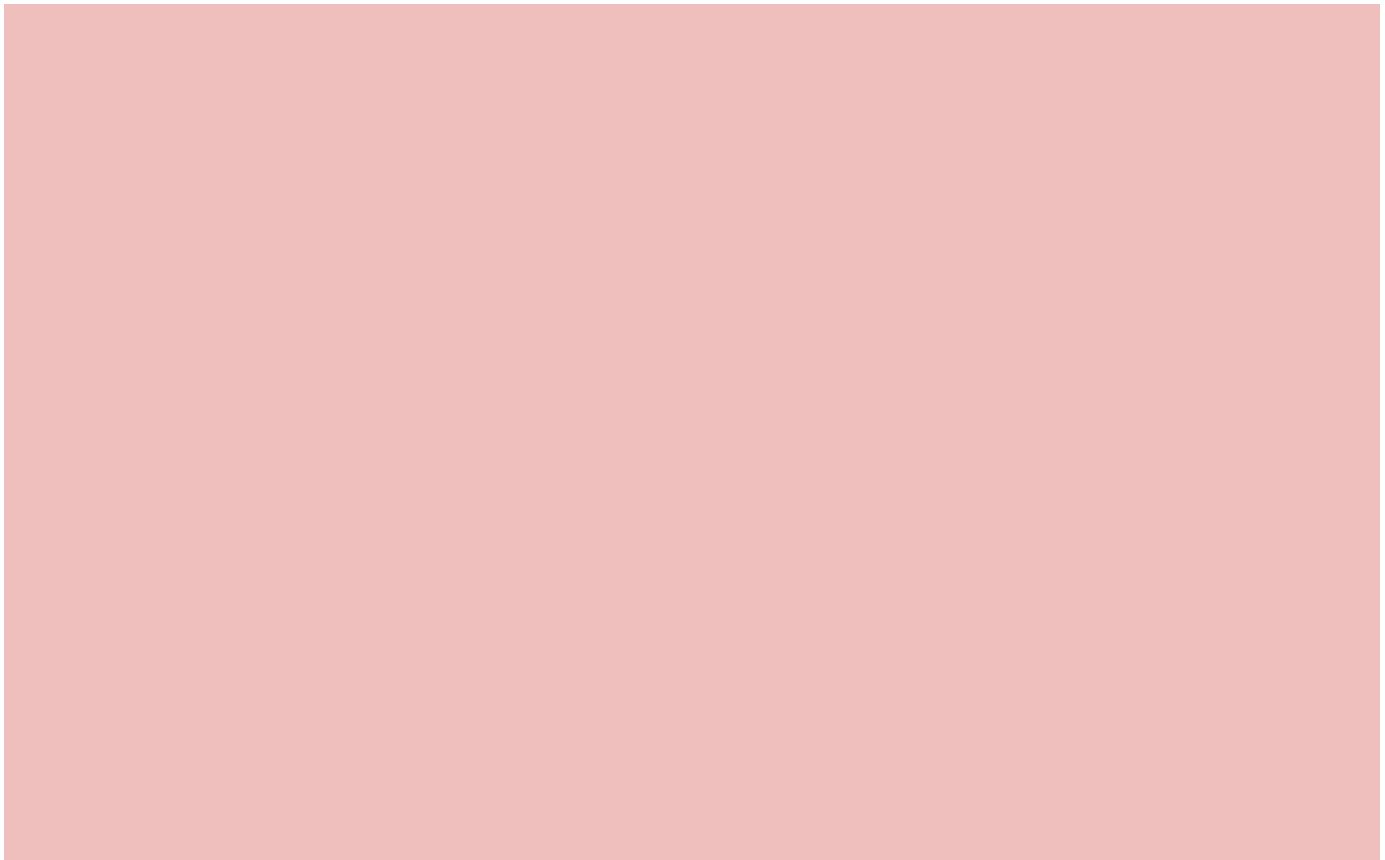


Figure 113. WUy' " mb.

d | s á – Ó~ ¼øù ÒCollaboratorsÓ? d | F \$y k ` ¼ÛL' _) F QÖ ÒAdd collaborator.Ó p e
f : =>c e - %F f 9 „ et mAð - È_ ? pef : EÀ>ÿ F QÖ6' OWÙâ – D ÒXÓ

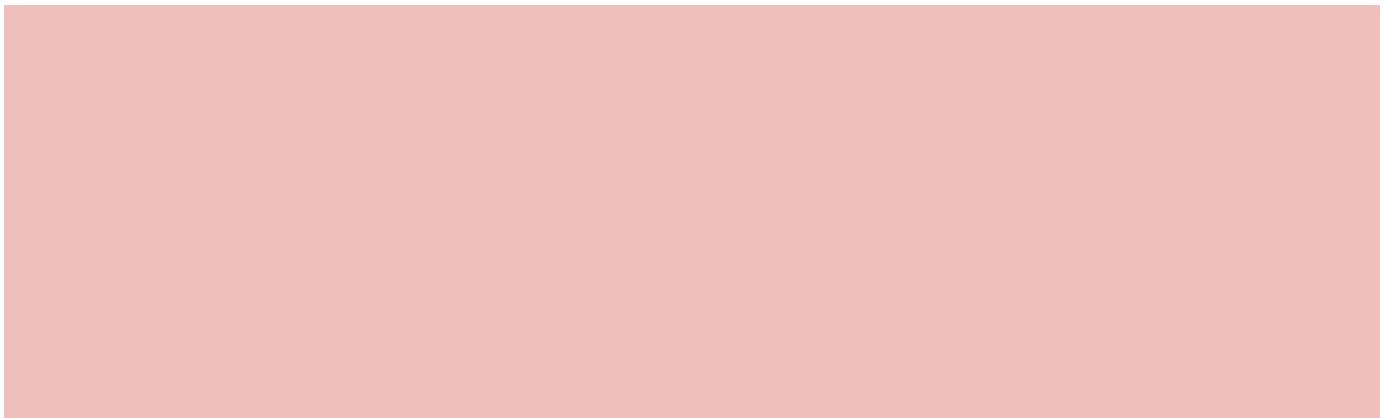


Figure 114. WUy • qT.

ýþ ÷ øde

Y\$fkW- ÓmW" n o D. æF 9° j k Ë - k €u >ÿ Dî " K F < ÜS • øf ETî > GÅ | C%`
a?

í > GÅ9 „ SÉà á E! DW-] ÝF J KOWà á DuW-] Ý? i WD' i i fork \ SDoei Bf Ç
° ÿ / €u D%F & A \ D€uo€í 9 „ ÿ / HI ?

" t HI F —Ef i ÒtonychaconÓ F f %í ^ W-) t ÒfadeÓ D Arduino . æ.

g, f ~

k %S» f ^ f Dn o Fc f c ^ W- i > GÅ? f j EWÄG\$ i > GÅDCx K~ F. • ÈSÄ TM D i > GÅDK~ o ä?

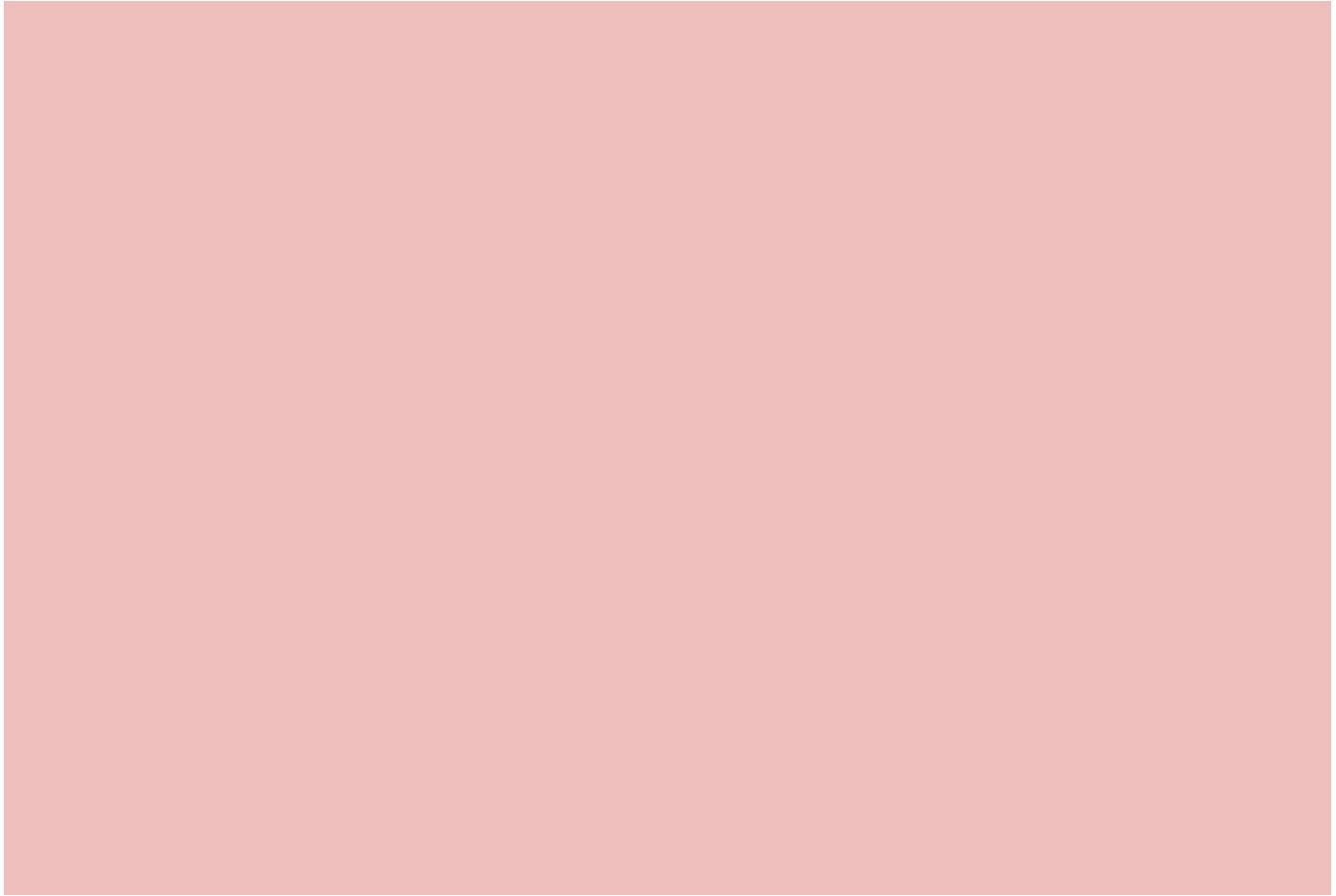


Figure 115. c # • Žwx#rc—” .

GÅò- K~ k È- @O9D51? · j cf W- ûDg Y, | " ee ÑeW- Õm i > GÅ½f g D½~ B f g ^ eöDW° ? · j cf W- GitHub ÑÔÙ i > GÅT " D^3 ? j k È- 9, \$ ^ %oÙ. ' D URL?

pef O9T gi t pull <url> patch-1 ðWÙFòi W8 i > éÖ] YD} ~12F Å, ®¶•• W- é Ö] Y? ¥' | ½j \$ GXéÖ] Y æT. ? pef | 9Ff 9, %í > { | TW- å"] YFd | YÙò- ^ %oä i > GÅ i > OS?

j k W" k T D URLF Ä . di ff B . patch F—Äf f Dž ÄF. ' CD diff B patch Dç t 7! ? f 9, • - 5' <ÜD1 W i > Ø i > GÅOO

```
$ curl https://github.com/tonychacon/fade/pull/1.patch | git am
```

t ÷ øde ÷ 3m ÷ j

—Ä¥' \$ GitHub i Ö ¼¬\ DF Y\$ f 9, È, B i > GÅD%ÔÙj s? f Æ9, y l " no •• O ÑF i 9, y Ö- Cå •• OÑJ y Ö- i > GÅ •• OÑF \$œb 51 i 9, ' GitHub TM S D Markdown?

Í t k%\$î > GÅÑÔÙOÑf ī j EToäK~ FoäfpJ ï ófg? 6' ī j ÕmW- Tf gÊÓD
^ 3 Ff 9 „ ...³ \$K~ ¼yî > GÅÔÙOÑ?

Figure 116. T_r c O(ä HÖ• ÚtreadÜQ3

W• nozî ^f D@ÅFF: ä· î > ÔSFF 9 „ änol P<S\$! 5ÔÙî > Fí 9 „ ' ¥' èâCT
\D gi t pull <url> <branch>ŒWF J Kä fork • • t W- remoteF d | ÔÙ@PBî > ?

y§I @g Dî > Ff í 9 „ ' GitHubþýÑD ÒMergej #? · j %oW- Ònon-fast-forwardÓî > F
j . 9 „ ½Ôófast-forwardøî > í j QóW- î > Cåâã? —i →ÅPpbF - @f QÖ mergej # F
—j QóW- î > Cåâã? f 9 „ \$ î > j #B~μî > W- î > GÅD• %o. • TF pef QÖC©^
³ F GitHubj cf fk Dò" MR?

Figure 117. • Ž – t C- p • Ž > b • Ž wx # - —.

pef Z» Çî > . Ff 9 „ äî > GÅGÓF , Bî > GÅD%j EToä?

÷øde. '

pe f g \$Æ€! ™↑ > GÅFÇ: • • Wù remoteJ Kí t Í @‰Wt I PFòJ k W- 9, \$ GitHub Ñ ' DÙ• " ? òi k Qc ©D• " Fh· / øk' F¥' j \$ - ' => k ~ eD^ ? - Ñ?

...É Ñ GitHub \$EFðÑäî > GÅ] Ýi t W8Ò—] ÝÓ? ³ | oÇ<fqr | Çj ÒT· ' Fh· ' j i ± 25" \$Ff 9, I ~í 5HI T· ' ?

t ^À©ò- F¥' @' TW- ô‰ls-remote D" ©^‰óo€{ ô‰oplumbingÓF ¥' j \$: ; ^‰ ŠÑ; ^‰` T~ e/GA~ø? ò- ^‰\$r € Git Í " ¼x! Çj ' TFh\$#©EFðÑkp" - ' óreferenceø | I ý' ?

pe \$¥' èâ' \DòblinkÓ 7! áÑ. ' ò- ^‰F¥' j ÒTW- 7! áJfkD] ÝFçëB . - ' óreferenceø DW° ?

```
$ git ls-remote https://github.com/schacon/blink
10d539600d86723087810ec636870a504f4fee4d      HEAD
10d539600d86723087810ec636870a504f4fee4d      refs/heads/master
6a83107c62950be9453aac297bb0193fd743cd6e      refs/pull/1/head
afe83c2d1a70674c9505cc1d8b7d380d5e076ed3      refs/pull/1/merge
3c8d735ee16296c242be7a9742ebfb2665adec1      refs/pull/2/head
15c9f4f80973a2758462ab2066b6ad9fe8dcf03d      refs/pull/2/merge
a5a7751a33b7e86c5e9bb07b26001bb17d775d1a      refs/pull/4/head
31a45fc257e8433c8d8804e3e848cf61c9d3166c      refs/pull/4/merge
```

¤dF pef \$f ÉmD7! áJ . f: Gä Dé Ó7! á¼. ' git ls-remote originF· j #©/ ¼DA~?

pe 7! á\$ GitHub Ñ> ¥k ê, Dî > GÅFf j ÒTW" , refs/pull/ , èD- ' ? . ' ...É Ñi] ÝFhst· ' Ç\$ refs/heads/ ¼Ff , g€oÇ<fqr | Çj sEFðÑÒT· ' ÑÑ@P\Óg€o Ç<j È5. ' ?

Í - î > GÅk! - - ' ÑÑ ¼, /head" áD- ' • NDCåååŠî > GÅ] Ý¼D¥| W- Cååå
i OW- ? f, pek‰¥' D7! á¼, B^W- î > GÅF6' D] Ýô‰bug-fixF • Na5a775 ð - CåååFža\$š> K 7! á¼¥' Ák bug-fix] Ýostži \$6' D fork ¼øF h¥' " t k W - pull/<pr#/>/head • Na5a775? ò9àÈ¥' 9, I ~í 5I Pí W- î > GÅ] Ý&Ç' • • Wùé Óàá?

Ý\$Ff 9, Å...³ @P- ' WÄ@Pž"] ÝJ Cå?

```
$ git fetch origin refs/pull/958/head
From https://github.com/lbogit2/lbogit2
 * branch                  refs/pull/958/head -> FETCH_HEAD
```

òÝÀ GitO Ò- ³ T originò- remoteF <i) y t refs/pull/958/head D- ' ? ÓGit c c S S] , ÜF <i Çí ž - - ' , @DfkA~Fd | ä• ±• N . git/FETCH_HEAD <Üf: @DCååå? d |

f 9 „ ' git merge FETCH_HEAD ä· î > Tf: ÖÙ6+D] ÝF hž - î > DCåMR• ÈSKQÜ?
d&F pef, @Mä 1tœî > GÅFØÄI " j I ž Ÿ?

j K W81W9 „ @P z (# î > GÅF > ¥\$f - ³ TéÖàáD! ^ z { ~ ™? ' f ¥RQD' šðê,
. gi t/config F äÙ ori gi n éÖàá? • ÈSóÇeÃ<ÜðÄO

```
[remote "ori gi n"]
  url = https://gitHub.com/1i bgi t2/1i bgi t2
  fetch = +refs/heads/*: refs/remotes/origin/*
```

„ fetch = , èDÙi W- Ørefspec.Ø· i W8ä remote D) üwhTf ! 5 . gi t æä D1W? ðWž
ö—i ÑÜDðWž øÝÀ GitF Øremote Ñ refs/heads <ÜDA~\$¥! 57! á½í < \$
refs/remotes/origin? Øf 9 „ äðWf » f W<F • • uW- refspecO

```
[remote "ori gi n"]
  url = https://gitHub.com/1i bgi t2/1i bgi t2. git
  fetch = +refs/heads/*: refs/remotes/origin/*
  fetch = +refs/pull/*/head: refs/remotes/origin/pr/*
```

¥ | WÙÝÀ GitO Øfk • ÈSÃ refs/pull /123/head D- ' - C\$! 57! áÃ
refs/remotes/origin/pr/123 WÄ" #ÓY\$F pef z" ž - ½~ F, Ùgi t fetchO

```
$ git fetch
# É
* [new ref]          refs/pull/1/head -> origin/pr/1
* [new ref]          refs/pull/2/head -> origin/pr/2
* [new ref]          refs/pull/4/head -> origin/pr/4
# É
```

Ý\$fk Dî > GÅ\$! 5Ã] ÝWÄÀYF· ' i - ` DF øf, Ü@P| · ' í j ~ ™? ða\$! 56+
î > GÅ½DnogØ" ©} ~O

```
$ git checkout pr/2
Checking out files: 100% (3769/3769)F done.
Branch pr/2 set up to track remote branch pr/2 from origin.
Switched to a new branch 'pr/2'
```

f Di j • , j ÿÝ\$ refspec D remote \] D" åk - head? \$ GitHub ž þí k W-
refs/pull/#/merge - ' F· n° Di pef \$þýÑj ^ ØmergeØj #y - DCåâã? ð« -af 9
„ \$j j #èâ—6+ð-î > ?

÷øde - † K ÷øde

f Çg 9 „ \$å] ÝJ K ~ master] ÝÑ, Bî > GÅF ...ÉÑf 9 „ \$þwÑDœbW-] ÝÑ, Bî > GÅ? ...Ff « ~ 9 „ \$uW- î > GÅÑ, BW- î > GÅ?

p e f • TW- î > GÅ\$Ng - D1NçÀFd | f: \$ò- î > GÅÑ%oW" » f J Kf Çt - » òi - 5 å 9FJ Kf Åkæç] ÝD€u>ÿFf 9 „ ...³ \$î > GÅÑ, BW- î > GÅ?

¤f , BW- î > GÅ; F\$ËÜDË7KW- `` #©f @î > Tp-] ÝBf sp-] Ýî > \SD? p e f QÖž - `` âþD ØEditØ | #Ff Çg 9 „ fg] ÝFj 9 „ øùp- fork?

Figure 118. – pþl • Žwx#i > .

òJ f 9 „ l } ~ 5• Ñî > f D] ÝTpW- î > GÅJ fork?

| • ½f ~

GitHub AÓ^W- l 5Doä• , F¤f , @Ši %J i Dwxåi | ' ÈSI 1 ~?

\$œbóP¼f 9 „ ¹ y k W- @F • , j ÉÝI Ž. æ¼î " KJ E¤KD) y B' |) ?



Figure 119. %oÓ @ Ú† | ~ ; .

fí 9, Cx Ç\$W° ¼D' i Fhi o€ÉÝI Ž' È~ ½?

¤fž, ^W- ý' i CxDóPFž - ' i j EToä? ò9àÈä%' I Öj s ¼@> a6' ®k kŽ] Òe? y§ GitHub NDî > GÅF%' [€ä6' wxJ! " ¼D · %I SMäI " Jî > GÅ?

pék%ET^i > GÅJ I " DCxF6' j ÒþAO· F | Ük™DtÝžó6' Ŧj { ¶ETCx? pefi i > GÅJKI " DžÈ1fíj { þAÑF> pf\$GOW- 7! áJKfóP^` aKL? pefC: dETCx F\$ËÜÑk - ÒUnsubscribeÓ i #FQW<-Cj dET~™^?

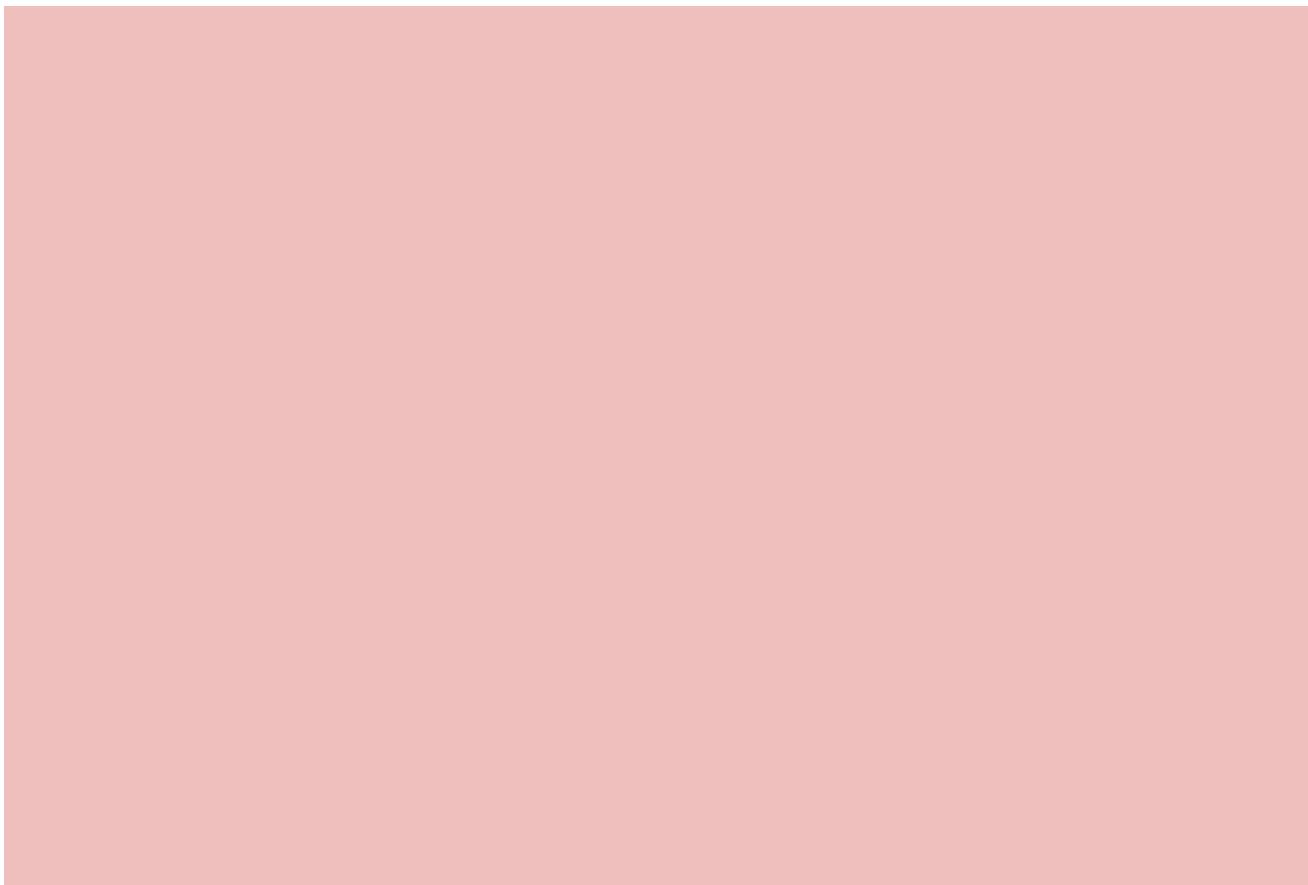


Figure 120. \$™š> >b É ÈÝ• Žwx.

f ~ ž Ÿ

¤ ¥' \$òCT° • GitHub DÒnotificationsÓ F • Di ¤ GitHub Ñk n~ žó | F. oäf D1 2FòJ
k È8ÇOD1 2SþÓ. ' ? pef ê, þÓÈÜD ÒNotification centerÓ çëFF f 9,, • TW" ø. ?

Figure 121.—" Qœ...h .

k! - ø. Fo\ÒK~ óEmailóÓBo\ÒþÈóWebóÓF f 9,, ø' W- J KÍ ÇøJ KÍ ø?

ž f ~

þÈoä~ \$ GitHub Ñ" \$Ff í ~ ° \$ GitHub Ñä • ? pef ê, ^ò- ø. > ¥kW- f DoäFf j
\$f óAÑ1 DoäÙç Ñ• TW- úl Q?; \$ oä ¼v.?

Figure 122.—" Qœ.

pef QÖž - m9< Ff j • Tf { oä T Df kž æF j F. æ] 5^û? f 9, QÖá þà D. æ) y S\, . æ/ GDoä? f 9, QÖoä * þDyì Ùçäoäçt Z` FJ KQÖùÑÜDÙçä. æ¼g hK oäçt Z` ? \$í - yì Ùç * þI kW- 1 n; #Ff 9, QW< F, | -çj ET. / GDoä? fkò" µ¶y§Æ€†Coä * €k' ? I e GitHub b_ ' i I Gf K~ oä F\$ò- EÜÑÆ€6' fk Doä?

g, f ~

K~ oä i fÆ€ GitHub oä DuW812? pef ê, ð- ø. Fí økoä | Ff j ETWÄK~ ? ¥ ' \$ o\< I K~ ¿uDÓPCx B™Dî > GÅDK~ oä. • T^W" HI ? K~ í j { î P5j s" ü ü\$WÊF pef. ' W- ¶kj s•° DK~ « i 7žj | 1 -?

GitHub \$¿ucf DK~ è¼f ý^I e^‡? Fðoy§EÓ\, ðBK~ =• * €k¢£?

: - HI F¥' S•W• \$™Dî > GÅDK~ oä. ¼¿c Tony DWÄž ...K~ Dè\ F¥' j • T<Üð " O

To: tonychacon/fade <fade@noreply.github.com>
Message-ID: <tonychacon/fade/pull/1@github.com>
Subject: [fade] Wait longer to see the dimming effect better (#1)
X-GitHub-Recipient: tonychacon
List-ID: tonychacon/fade <fade.tonychacon.github.com>
List-Archive: https://github.com/tonychacon/fade
List-Post: <mailto:replay+4XXX@github.com>
List-Unsubscribe: <mailto:unsubscribe-XXX@github.com>...
X-GitHub-Recipient-Address: tchacon@example.com

ÓJ K W" K T DKL? pef: cvJK^ž Ó- . æ« -Ó- î > GÅ/GDK~ F Message-ID
½DMRj „ `<user>/<project>/<type>/<id>` DŠ 2ÀYfk D‡?? HpF p e ði W- I " Ó issueøF
ž a <type> y f-j i ÓissuesÓ &Çi ÓpullÓ?

Li st-Post B Li st-Unsubscribe y f° ©pef DK~ « i 7° pÆ€ò" Fžaf 9,, I ~í 5\$W°
½ž * J Pèy Ó- / GoI DþA? žj I kŽ] F—Ã\$E Ü½QÖ¹ n̄ #J \$I " î > GÅE ÜQÖ
ÓUnsubscribeÓ WÄ?

r ÓO9Di F pef O! ê, ^K~ BþEoäFža xf \$K~ « i 7L8• i ÙÎ DoÇ<A` K~ oä
| Fy" DþEoäí [j O! { çåtZ` ?

i ¢- ,

pef D7! á½k W" ° R½~ F GitHubj Cx f?

README

UW- —i README ½~ F 9,, i Èl œb GitHub 9,, wì Dš 2? HpF· 9,, i README F README.md
F README. asc i doc? pe GitHub \$f D7! á½ÙT README ½~ Fj ä· \$. æD' È] ^XS?

I ewx \$ó- ½~ J < 7! áJ. æ™%, @^• Df k / GDMR? · Wc Õmò" A~O

¥ C. æD" '

¥ pb þÓŠÚÙ

¥ kGpb. ' BÝÙDHİ

¥ . æD89O

¥ pbN. æE xf C

s t GitHubj] ^ó- ½~ F f 9,, \$½~ J 7k ÙÎ J ^3 a. ~ ~í €• ?

' % CONTRIBUTING

uW- GitHub 9,, wì D° R½~ i CONTRIBUTING? pef kW- œ9½À) D CONTRIBUTING ½~ F
xf %, BW- î > GÅ! GitHubj #©, Bî > GÅ! k CONTRIBUTING ½~ " \$.?



Figure 123. 1 • • Žwx M(CONTRIBUTING Rc_H.

Ø- D" ' -i f 9,, \$ØJ • Xy §f D. æ, BDî > GÅf : @D° Ç: @DÙ8no? ØÄi %\$,
Bî > GÅèâ 9,, ` TØ" • « 1 ±?

± ©ýþ

y §W- -- . æ ...Ák I e ý€n F @%oF hí k ĚQk TD?

• \$E¤LÓ

pef: ' ØmasterØèLD] Ÿ" t f D³ |] ŸF 6%[³ | j \$Ø-] ŸÑ, Bî > GÅJ ØÙ¿
BFf 9,, \$f 7! áDEØÜD "options" çë<> f ?



Figure 124. I mhi #ž Ÿ\@.

} ~5f g³ |] Ÿ<| W° ¼Dø. F· —j " t fkå@í " D³ |] ŸF 6%ØÙqr | C] Ÿí [{ ³
| GX?

Ā} ± ©

pef: äW- . æ9åc GitHub ¼DuW- %J uW- üüFj i EØÜDØ- ØoptionsØçë<kW
- ØTransfer ownershipØø. 9,, ' S· Ø- ?

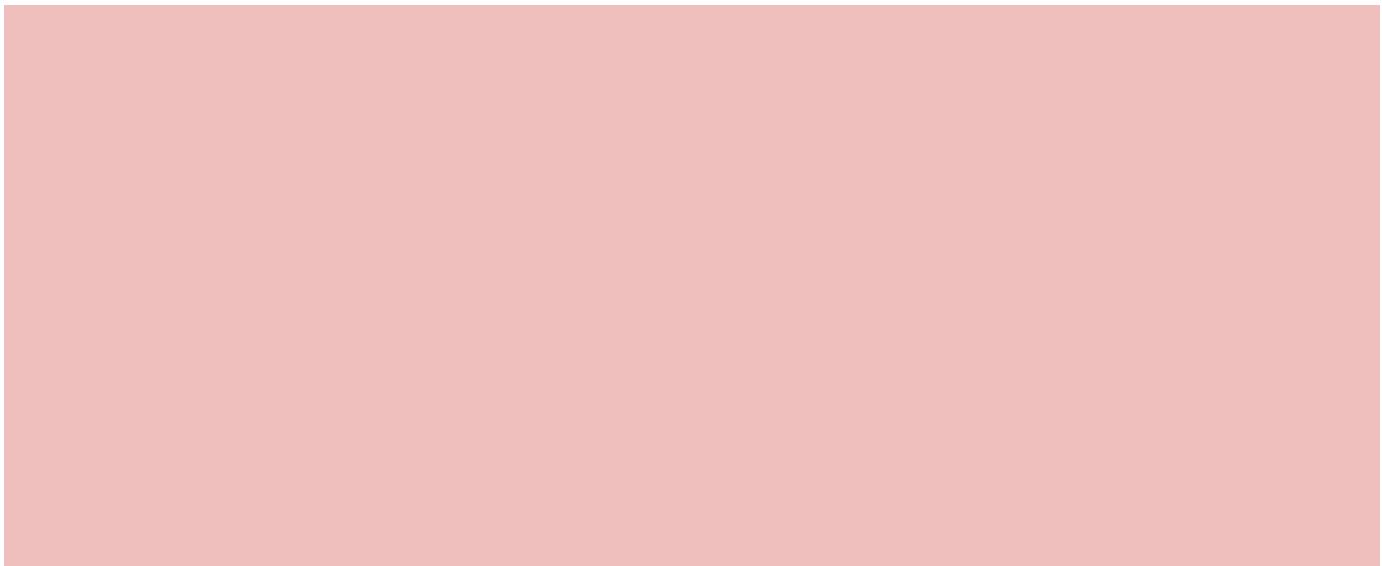


Figure 125. hi „ ‡ 9ð>b GitHub „ CYLj 3

¤ f g t j < ôW- . æ¥g 5kì %: @³ ~ | F J Kf D. æp t ^: ä· 9TW- üüJ | F ð—y' ^?

ða‰Çgj ä 7! á - ý· f K DGOKBî ç ‡ ï 9TuW- 51F· j j [f D URLm» NT™DÊ
Ó? · í m» N^SÉ Git Dqr B@PF &Çggi þ Ë 7GÅ?

ÝþW¥

} ^ - %° j è L F GitHubj CD{ üt üüóOrganizationsøD° j ? üü2j B- %2j WÄT k W-
' §" < f / k. æD^) ï ÷ F hi 8e 6DKLï i ÇOD? üü° j n° ^ Wû&O/ k e - . æD
%FO; í CDW" µ¶' §yf 3ÖÙ] üý€? o€F ð 82j { ' §, ï • üóHp OÖperlØJ K
ØrailsØF J K! " óHp OÖgoogleØJ K ØtwitterØø?

W¥Ka B~ !

¥' 9 „ I } ~ 5%í W- üüF - , @QÖœ9 GitHub È Üâ Ñ¤ DØ+ÓÙç F \$ Õ ~ ¼øù ØNew
organizationØj 9?

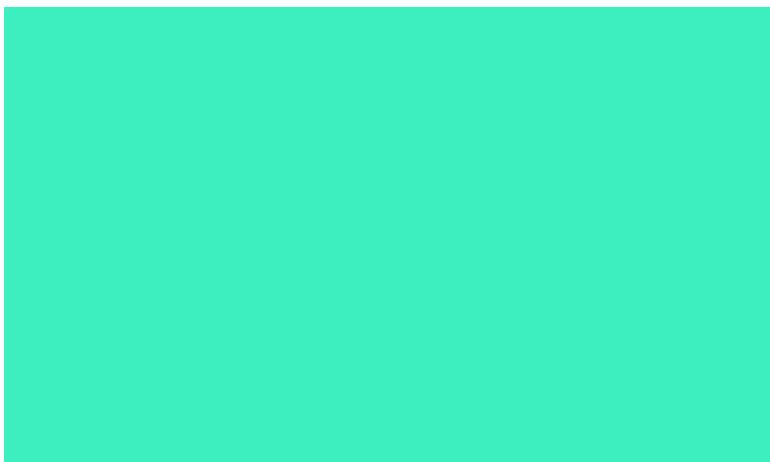


Figure 126. ØNew organizationØ¢, h

' 1 f ®¶CDüüD) üBüüDå@Ä• KP? d | Fpef' ' DsFí 9,, qG 6' ; " t &O/k %?

ôf,, ÑÈj | Ff-j / kW- Ž™Düü? » ¼S - %° ; FpeüüDfkA~Í i , Í DFžaf- 9,, Y_. ' ð- üü?

" t W- üüD/kKF xf \$êóW- 7! áD| a Ff 9,, øùä· êóTf DüüD^) Í ÷A? xf ™í 7! á | Ff 9,, ä. " < Tf D- %° ; Jf / kDüüA? O| Ffí j ÉÝ5ØGOÓfkò" üüAD™7! á?

—ÄèÄFf 9,, t f DüüÑxèÄF. . ~ - - 6? O| Fí B- %° ; » ¼Füüj kW- Èr È landing pageøF' §WXCuüfkD7! áF> ¥CÉÜ9Dfk%¿B?

<Ü¥' S¬W" üüB- %° ; ÇOD51?

a b

üü. ' wx óTeamsøSý€f 3Fwx—i üü¼DWü- %2j B7! áF,, Bwx f 3yò" 7! áD HI >ÿ?

Hp F—Ef D! " k ÷ - 7! áO**frontend**P**backend** B **depl oyscri pts?** f j ' ' f D HTML/CSS/Javascript , ¿ Kk **frontend** J K **backend** DHI >ÿ Fí " %3k **backend** B **depl oyscri pts** DHI >ÿ? wx a ð- œFgÒ~ } ~F&Ç' t í - 7! áý€· D: " K?

üüÈÜå@° W- ÜúÓdashboardø¢fFò- s° üÖm^ò- üüADfk 7! áF' ; Bwx?



Figure 127. L j BE

f 9,, QÖ üü E Ü âþ Dwx – þà ó TeamsøS ý€f Dwx ? QÖè | F f j Ôk W- ™E ÜF \$òJ
f 9,, • • ™f 3B7! áTwx ¼F J Ký €wx DHI >ÿ B · EÓ? í - wx y § 7! á9,, k -
` þ` LBý €÷8>ÿ? f 9,, o\ QÖ\$ wx E Ü AD ØSettingsØ j # ~ f / - >ÿ > ©?

Figure 128. [\ BE

¤ f q GW- ' i • k wx F C' i j ETWÄoä 6{ q GDK ~ ?

} ãèLFwxí » ¼§ - %° i Fk @menti onsó Hp O@acmecorp/frontendøD• ° F ÇOèÆ-\$
§{ CÐDwx A gh f3Í j ftò- s" DþAK? xf' ' ðTwx ¼l - %DGOF NÇä i ¶¹ -
CI ØD! ª F ð- • ° —#ðI k¢£?

W- ' i 9,, • kœ9‡ CDwx Ff,, i äÉmÍ ý§/kHI ðÓDwx? y§l W» t " FÃ ux,css
J K refactoring ðÄk È° RGOQDwx—#ðI k¢£F &Ã legal B col orbl i ndðÄD—ôŽi
±y· ' úÉëi D?

, § .. ©

úüD/kKj 9,, HI úü¼‡ ðDn oDfk MR? \$ Audit Log çë Ëk Ö- úüDr å Ff 9,, • TØ
\$.. ÚÑp - 51‰^` an?

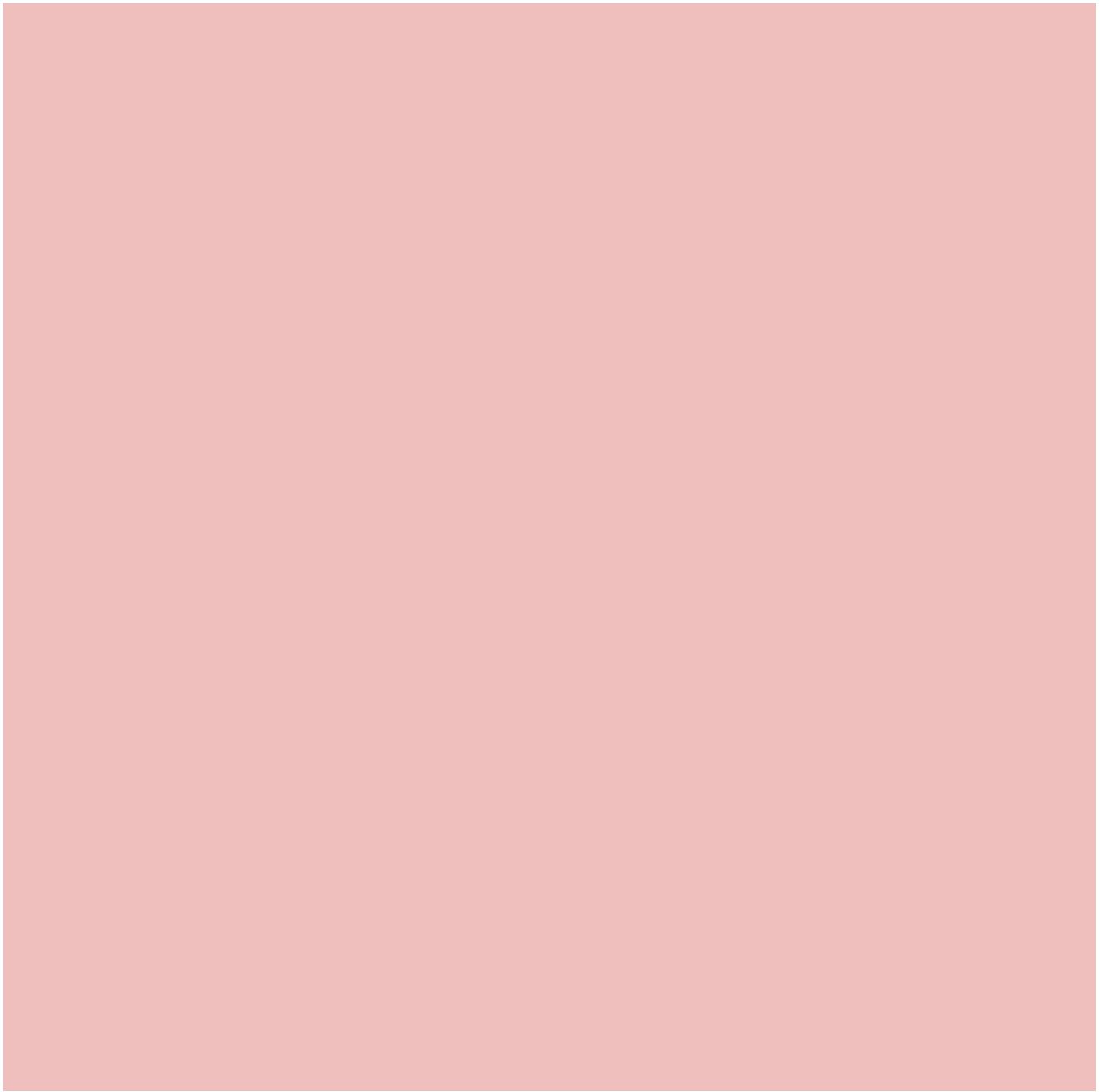


Figure 129. E ø ¥ |

f í 9 „ o \ø » l W » z Dn ~ pl - 51 pl - %yr á Öù\ , ?

a B GitHub

f „ Y\$¥' Z [) * ^ GitHub Dt \] • ° Šµ" i ŒFhi œ9W- u u J . æi j] É » 1 F s t 6' : @%HJ ½À: @Ö† DEF?

y ¥' S - I > Ÿ Di F GitHub \$ 8 e 1 Üi ž Di 1 - Hack? \$! ? ¼ ¥' [j) * p b . ' GitHub 3 I • , Š API ³ ' F . GitHub j F ¥' DE: Šµ" ?

= > ÜX'

GitHub à á ý €¼D3I ŠEF' - i GitHub ŠL \ • , å ý ¥} ~D1 2?

= >

' 1 ¥' S • W<EF? 3I ŠEF Ö† ī 9, \$à á DEÓ' - ¼ÙTF-\$¥' èâ • • : " KŠf g.
æD³ |] ÝD51? \$ ØWebhooks and ServicesØ çë<f j • T Š EFŠ3I PÓ' i » ¼DA~?

Figure 130. è é d § %~ " uv

K 8e 9, øùDEF F t e t i Ö† T 6D+, Š, ī • , ¼? . ' ¼Dt e t i t ^ Ö† { ¶EfE
F PBUG ŠI " Đö • , PÙbÚ• , Š½>• , ? ¥' [j o\ EÓW- * €} ~DHI S) * ? pes
ØAdd ServiceØ øù ØemailØF j ØTW- » ¼< I K~ EF PÓ DpÓóA?

Figure 131. { %r c è é ~ "

\$! H½F p e ¥' QÖ ØAdd serviceÓ ; # F í t k %€uA~T à á | F • » D< I K~ 5¢í j E T W
ÃK~? EF 9, ÅÁ8e ÇO» z Dn~ F h i t e ‡ - ÅÁ€un~ d | . ' ž " ‡?‰W" no?

p e k W- g \$. ' D• , : @Öí T GitHubF - ☰ 1 G ä ð J • k Ák Z k D9' DEF Öí ? Hp F p e
g. ' Jenkins S 6+f Dnoá F ☰ í t k %€uT f Dà á | f 9, B' Jenkins A ÓDÖí B Ý 6+Ý
Ù?

X'

p e, @‰W" ~ ¶ 1 Dn F J K: @Öí W- Ç\$ò - W° ¼DEF J ý QF 9, ^ &. ' ~ o' D3I •
, ? GitHub à á 3I i * €} ~ D? • » W- URL d | GitHub \$œWN' Dn~ ï ï | —j ï uW- HTTP
GÅT ž - URL?

o€‰ò~ n D1 2i 9, E ÓW- û D web E F S Å Á GitHub 3I GÅd | . ' E T D‡?‰W" no?

t ^ B' W- 3I F QÖ EF Š 3I PÓ' i ¼D ØAdd webhookÓ ; #? ð j [f - « - W- » ¼ Web 3
I PÓ DË Ü?



Figure 132. Web § %~ "

Web 3I DEÓ* €} ~? t e f o Ç< - , @y k W- URL ŠW-) ôd | QÖ ØAdd webhookÓ? k E - ø. 9,, • » \$p - n~ | : @GitHub ð uGÅÑÑ³ | DÙt i - k øl %€u™n o T à á DœW] Ý | D push n~ OÒW- GÅ?

a ¥' • W- E ØÆ€ web 3I D web E F Dû HI ? ¥' [j . ' Ruby web` - SinatraF s t . / ø } PF - C° pæç 5• T ¥' g \$%` a ?

—E ¥' : @\$l - ° » D%€uT ¥' D. æD° »] Ý> » f W- ° » ½~ | ØTWĀK~ ? ¥' 9,, / ø ~í 5. ' » ¼< ÜDn o %o T O

```

requi re ' si natra'
requi re ' j son'
requi re ' mai l '

post '/payl oad' do
  push = JSON.parse(request.body.read) # parse the JSON

  # gather the data we're looking for
  pusher = push["pusher"]["name"]
  branch = push["ref"]

  # get a list of all the files touched
  files = push["commits"].map do |commit|
    commit['added'] + commit['modified'] + commit['removed']
  end
  files = files.flatten.uniq

  # check for our criteria
  if pusher == 'schacon' &&
    branch == 'ref/heads/speci al -branch' &&
    files.include?('speci al -file.txt')

    Mai l .del i ver do
      from      'tchacon@example.com'
      to        'tchacon@example.com'
      subject   'Scott Changed the File'
      body     "ALARM"
    end
  end
end

```

ØJ ¥' uTW- GitHub xuc ¥' D JSON GÅd | äÙ€uKF6' €uT^` a] Ÿ„ B€uDfkC
 åÍ fŸ^p" ½~ ? d | ¥' Gä. i ^ Š¥' Dž~ ' PFpeéP• ¿uWĀK~ ?

t ^, ¿Š6+» ¼òÄDKLF\$EÓ3I D51kW- uvD, ¿KÒÓØ? 9„ • T GitHub t ž -
 webhook D¥| Èt GÅ? yÍ W- 3I F¤. ¿u | Í 9„ _kuvFG6. i ^ i f • DŠGÅBÀ- D
 èRèŠèR¹ ? ò. Ø6+Š* +3I * €~í ?

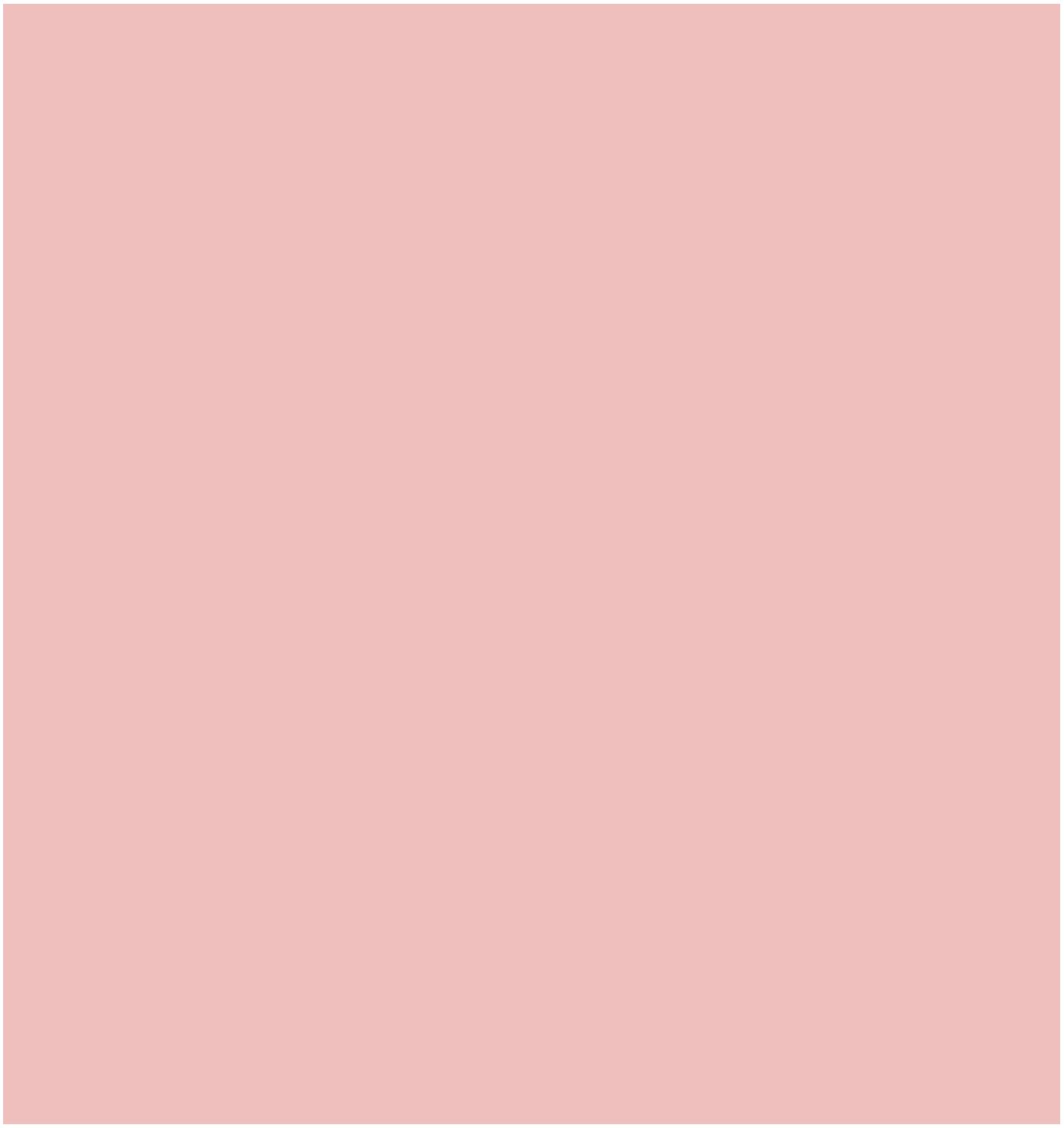


Figure 133. Web § %.. ©ª «

, „KÖÓØDuW- I ÄD• ° i 9„ æç 5m™ç uœb GÅS 6+f DEF?

GŞ p b' L web 3I Šfk 9ÀÁDÇOn~ » z D~ e MRF GHI \$ <https://developer.github.com/webhooks/> D GitHub , „K½>?

GitHub API

E F Š 3I cf CD^W812S³ E GŞ \$àá¼ç óDn~ D€uoäFhi pbOP/Gn~ DÔo
ÆÅ pbÉÝ6W“ • p••: " KJ cI " • çëDnoÆÅ

ðí GitHub API ê Ñ' < D51? \$ÉÝ6í ÙDw» < F GitHub CD^† CD API 3 ' F 9,, ÔÙÈÍ æ b° \$þýÑÔÙDÍ " ? \$! ? ¼¥' [j hi pb=>Š- 3 T APIF pb o\ API\$W- I " ÑÓPŠp b» f W- Pull Request DÔÓ?

a B' Y

9,, %D¥x! Dnoi NW- Ç, @=>D3' Ñç uW- } ~D GET GÅ? C3' 9° i W- ' i J , T . æD- ` MR? HpF pe¥' : @äj ~ eG§) t ÒschaconÓ D' i MRF ¥' 9,, ÝÙ» ¼<ÜD KLO

```
$ curl https://api.github.com/users/schacon
{
  "login": "schacon",
  "id": 70,
  "avatar_url": "https://avatars.githubusercontent.com/u/70",
  # ...
  "name": "Scott Chacon",
  "company": "GitHub",
  "following": 19,
  "created_at": "2008-01-27T17:19:28Z",
  "updated_at": "2014-06-10T02:37:23Z"
}
```

k † C» ¼ðÄD3' SOÒG§ ÚÜP. æPI " PCå DMReÑeóÇe—i f° \$ GitHub Ñ• T Df k KL? « → 9,, . ' APIS] ^œ9 MarkdownJ ' ÙW- . gitignore , ú?

```
$ curl https://api.github.com/gitignore/templates/Java
{
  "name": "Java",
  "source": "*.class

# Mobile Tools for Java (J2ME)
.mtj.tmp/

# Package Files #
*.jar
*.war
*.ear

# virtual machine crash logs, see
https://www.java.com/en/download/help/error_hotspot.xml
hs_err_pid*
"
}
```

† 1 á } # ‡ « ¬

d & F p e: @\$þ ý ÑÓÙW- ī " F p \$ Issue J Pull Request ÑÓPFJK: @ä • } k A ~ J Š å
ý F f , @= > ?

òJ CD^ Ë 8=>1 2? f 9,, . ' g, ' i) Š) oDx! =>F hi o€~ 5Då 9i . ' W- - %H
I %o x? 9,, s E ÓË D ÒApplicationsÓ çëófHI %o x?

Figure 134. ý' " B# ÒApplicationsÓ> œ89-É—- 3

· j ð | ð- %o x D" ' ì ŠW- I I ? - z . ' W- 5DI I MRF ðÄ¤ý! J - ' Cd. ' | f j | <
v 59} ?

GitHub - j # @%o x Wt F f,, â ÒW» @x y. ? Y\$9,, \$ý! ¼. ' · n. . ' ' i) L) oS=>?
ðl uvFst 9,, ýÓ: @%o D>• > ¥%o x i 9y} D?

ðí j k W- Cc Ä] Ñý Df • ³ Q? pe Ák => Ds F f j { ýÓ\$Wû | ¥e ð È 60 t GÅ? pe=
>• 9,, Wû | ¥e ð È 5000 t GÅ?

f,, a ¥' †' · S y ¥' D ¼W- I " ÒÙÓP? : @y W- ° » I " Issue #6 1 < Wž óP? ®¶ . '
ØØÓf D%o x" t Authorization è MRF ð uW- T
[repos/<user>/<repo>/issues/<num>/comments](https://api.github.com/repos/<user>/<repo>/issues/<num>/comments) D HTTP POST GÅ?

```

$ curl -H "Content-Type: application/json" \
-H "Authorization: token TOKEN" \
--data '{"body": "A new comment, :+1;"}' \
https://api.github.com/repos/schacon/blink/issues/6/comments
{
  "id": 58322100,
  "html_url": "https://github.com/schacon/blink/issues/6#issuecomment-58322100",
  ...
  "user": {
    "login": "tonychacon",
    "id": 7874698,
    "avatar_url": "https://avatars.githubusercontent.com/u/7874698?v=2",
    "type": "User",
  },
  "created_at": "2014-10-08T07:48:19Z",
  "updated_at": "2014-10-08T07:48:19Z",
  "body": "A new comment, :+1;"
}

```

Ý \$ p e Ô k T ž - I " F 9 „ • T ¥' ØØ¿ , D Ó P F Å s GitHub API ¿ , DWž Ø P W Ä ?

Figure 135. ý GitHub API .] # > ® y z

9 „ . ' API] %oœb 9 „ \$þýÑ%œDnoeÑe%í Š E Ó J Œá P • ê %3T Issues Š Pull Requests F %í Š » f ç œ P H I C å ‡ ? P %í ™ D C å Š] Ý P è , G f J î > Pull Requests P %í Š ' ř w x P \$ Pull Request ¼ o P l Ù n o P & ' þ ý > > ?

~ • Pull Request K y z

¥' @• ¥| W- HI \$. ' I PGÅ! * €k' ? í W- C å 9 „ k W- J e - Š . G Ä D Ö Ö F k API S • • Š ä ¿ ØÖ?

t e ‡ { ¶ E f Š 6 + E F o \ 6 + € u D n o | . ' ð - A P I S à - F d | Ü Y C å i ª o \ ^ Ž \ 6 + ? f í 9 „ . ' C ³ ' S G ä C å M R i ª [\ î P D Š 2 6 P C å K i ª ^ % o ^ f k f D E x t • P C å i ª [\ k Ž D e) e Ñ e 8 8 ò » n o ?

— E \$ à á ¼ E Ó ^ W- web 3 I HI W- ' S G ä C å M R ¼ D Si g n e d - o f f - b y y z { D û D web E F ?

```

require 'httparty'
require 'sinatra'
require 'json'

post '/payload' do
  push = JSON.parse(request.body.read) # parse the JSON
  repo_name = push['repository']['full_name']

  # Look through each commit message
  push["commits"].each do |commit|
    # Look for a Signed-off-by string
    if /Signed-off-by/.match(commit['message'])
      state = 'success'
      description = 'Successfully signed off!'
    else
      state = 'failure'
      description = 'No signoff found.'
    end

    # post status to GitHub
    sha = commit["id"]
    status_url =
"https://api.github.com/repos/#{repo_name}/statuses/#{sha}"

    status = {
      "state" => state,
      "description" => description,
      "target_url" => "http://example.com/how-to-signoff",
      "context" => "validate/signoff"
    }

    HTTParty.post(status_url,
      :body => status.to_json,
      :headers => {
        'Content-Type' => 'application/json',
        'User-Agent' => 'tonychacon/signoff',
        'Authorization' => "token #{ENV['TOKEN']}" })
  end
end

```

' ' ð/ð~í‰? \$ð- web 31 Å€ð½¥' ð BØØ€uÑSDÍ W- CåF\$CåMR½äÙyz {
 Signed-off-by> ¥¥, . ' HTTP N /repos/<user>/<repo>/statuses/<commit_sha> API³' ð uW-
 - ýk ØÖD POST GÅ?

\$! H½ø„ ð uW- ØÖösuccess, failure, errorøPW- ð ó^` aDI I MRøW- ' i 9„ ^• ~ e
 MRDæç URL ŠW- ØcontextÓ, èW- ~ 2DCåke - ØÖ? HpFW- 6+EF9„ CDW- ØÖ
 ŠW- » ½ðÄDI OEFÍ 9° CDW- ØÖeÑeØcontextÓ yfi ' S' i · ' D?

peł %\$ GitHub ¼ê „ ^ W- ™DI PGÅ› ¥ò - 3I Z[EÓFj • T » ¼ o\ API DCå Øõ DM R?

Figure 136.—À API # † ‡ { |

Y\$9, • TW- ÛD? çyz çâ \$Cå MR¼k ØSigned-off-byØ DCå * þF{ çDy z çâ \$" Kø
âë) DCå * þ? í 9, • T Pull Request # ©\$ž -] ÝÑD¥| Cå DÔÖF pe/kDsj | Ýf?
pey6+ " e. ' ò- API ž a—Çj Çûvî > l " 4o\ 6+D¥™Cå ?

Octokit

Qý¥' \$ò" HI ¼í i o\ curl Šx! D HTTP GÅS‰Éí f k Dn o Fj k W" „ ~ Éd D1 2t'
API D, Í á" \$È? \$Lò(½e D| a F{ Ý{ DŒxØÖ GoþObjective-CþRuby Š .NET? HI
<https://github.com/octokit> ^• ~ e / GMRF· ' ¢f Å€€^ ~ e HTTP / GDA~?

' ' ò" µ¶° ¢Ef É» 1Š» f GitHub S~ 55t° » Dµ" i Œµ" ? G§Ž\ API DôØ½>Š€\$
œF D• È F Gæ A <https://developer.github.com>?

¢£

Y\$f Z[i W) GitHub' i ^? f ä j ^þb%í 2j Pý€üüþ%í B€u7! áPNi %D. æCD
£¤, B³ ' i %D£¤? \$<We ¼F f [hi ~ e² k" Dµ¶F, BÆ€A³%oÇDä wF ò" [. f
ft ž gD Git t Ý?

Git 2 -

Y\$FfZ[hi ^ý€J Kúö GitàáP..YnoÖÓf, D†e†r €^ %Bµ" ī Ő? fZ[, +^È
öBCå½~ Dx! ī " F> ¥—^! " ' BæC©5] ÝBî > Dé" ?

³ <Sf[hi W" GitD² t•° Fò" •° f 9° > Cj \$r €í" ¼. ' Fh\$í" | a f 9° j , @?

É\ ~ ®AB

Git° p „ e812S• » ~ - CåPWûCåPJ KW» >• ADCå? ^• . ' > Çi ®, DFhi ^• W
<ßÁ" AE?

- á ~ ®AB

f 9„ o\œ9W- CåD40 - yzDôÖSHA-1vWr S• » . F Ç\j kI e~ %- 6D12S%OÄD
no?! ?[j) * OP~ - CåDe81W?

O° K SHA-1

Git d] Ö° Ff - , @CD SHA-1 Dâ È - yz - 9„ OÒy - Dž t CåF ødf CDD SHA-1 yz ≠ C
ÇÒÖ§ 4 - F> ¥Ák d1ÑÑí - i - F øây <‡?á¼Ák · y <, òf SHA-1 , è?

HpF@ä • f ä i ¼• • ^] - • ° DCåF' 1 ÝÙ **git log** ^ %S» ÈCCåO

```
$ git log
commit 734713bc047d87bf7eac9674765ae793478c50d3
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri Jan 2 18:32:33 2009 -0800
```

È fixed refs handling, added gc auto, updated tests

```
commit d921970aadf03b3cf0e71becdaab3147ba71cdef
Merge: 1c002dd... 35cfb2b...
Author: Scott Chacon <schacon@gmail.com>
Date:   Thu Dec 11 15:08:43 2008 -0800
```

È Merge commit 'phedders/rdocs'

```
commit 1c002dd4b536e7479fe34593e72e6c6c1819e53b
Author: Scott Chacon <schacon@gmail.com>
Date:   Thu Dec 11 14:58:32 2008 -0800
```

È added some blame and merge stuff

\$! H¼F—Ef: @DCå SHA-1 „ 1c002dd... , èF žaf 9„ ' p<È8 **git show** Dg¹ SG
i CCåó—E} ÝD7! Ák d1øO

```
$ git show 1c002dd4b536e7479fe34593e72e6c6c1819e53b  
$ git show 1c002dd4b536e7479f  
$ git show 1c002d
```

Git 9, t SHA-1 r ófx} Ÿ¥í WDŠL? pef \$ git log | • Ñ --abbrev-commi t; ‡ FyX"
eJ—j #©} Ÿ¥í WDr ú³ | . ' } - yz FÇ\k | t ^XY SHA-1 Dd 1 Fj " • yz ‡O

```
$ git log --abbrev-commi t --pretty=oneline  
ca82a6d changed the version number  
085bb3b removed unnecessary test code  
a11bef0 first commi t
```

o€ 8T 10 - yz —Z [Äp \$W- . æ¼XY SHA-1 Dd 1 ? HpFT 2019` 2k t ÇF Linux Auò -
/ æ† D Git. æF y <‡? á¼k " \ 875,000 - CåF Öm} Ä- - y <Fí , @â 12 - yz —° z
Öi W- ?

- Ä SHA-1#O° R±
8e%§Ò6' DàáJ k 9° XY! - ÇODy < SHA-1r / O? d | ÄÅ
pef ž DNàáJ Cå ^W- y <F. ÈèâDl - 5• y <D SHA-1r / OF Gitj
YCy <DvWr Z[" \$§àáJ ^F§i —j | t Cy <{ LkFd | ...³. ' . ? p
eè | f: GXž - y <| Ff [ÒT¹ âž - y <D‡???

! hi ò8oÇž óD<] d] ~â? SHA-1û@, ùi 20y? Fí —i 160 È? 2^80 - X
öw' y <' k 50%D<] XYWt UVö| áUVö] D! 2i p = (n(n-1)/2) *
(1/2^160)) ø? 2^80 i 1.2x10^24Fí —i w• • • Fòi 5€Ñ• , B‡D 1200 f?

: H¬W<. Ä' ° QóWt SHA-1 UV? pe 5€Ñ 65• - %» Ŧ \$' ŦFí %í \ Ŧ \$
Qó> q§Ö- Linux AuæÖó 650 - - Gity <øDn oF > [èCåTW- I ‡ D Git
àáJ ÜFòÄ{ ¶! ` D| ÷' j QóÆp Dy <F . / k 50% D<] QóWt SHA-1
y <UVF ö> f' Ŧwx Df 30W- „ Ñ\$ÿÇ/· D9L½{ ...† Ö> } ‡ Dö] j
@û?

LÓ. '

- ' ° » Cå DW8...³ 1 Wi F¶· i W-] ŸDÈ 7DCåF ž a 9, \$œb, @- ' CCå D Git ^ %œ¼
...³. ' C] ŸD) ü? HpFf: @ä• W-] ŸD¥| Wt Cå Dy <F—E topi c1] Ÿ• NCå
ca82a6d... F ž a, <D^ %œi > qDO

```
$ git show ca82a6dff817ec66f44342007202690a93763949  
$ git show topi c1
```

pef: äj l -] Ÿ• Np - ° » D SHA-1F J K: • œbW- HI ¼{ } LD SHA-1F f 9, . ' W- ô

%o rev-parse D Git ‡ 6µ¶? f 9,, \$ Git A \ > € ¼ä • ~ eG\$ ‡ 6µ¶ DMR? } ~S -F rev-parse i t ^: ; Í " &Ci r €Í " E | D? Ç\ F k | f: • Git Y\$T: ÅS` a ÔÖ! F· 9° j | k' ? f 9,, \$f D] ÝÑ, Ù rev-parse

```
$ git rev-parse topic1
ca82a6dff817ec66f44342007202690a93763949
```

. ' .. ©

¤f \$µ" | F Gitj \$| Øz" W- -' r ā óreflogøF -' r ā âā ^ ¥UË - kf D HEAD B] Ý- ' f• NDæÖ?

f 9,, . ' git reflog Sä • -' r ā

```
$ git reflog
734713b HEAD@{0}: commit: fixed refs handling, added gc auto, updated
d921970 HEAD@{1}: merge phedders/rdocs: Merge made by the 'recursive'
strategy.
1c002dd HEAD@{2}: commit: added some blame and merge stuff
1c36188 HEAD@{3}: rebase -i (squash): updating HEAD
95df984 HEAD@{4}: commit: # This is a combination of two commits.
1c36188 HEAD@{5}: rebase -i (squash): updating HEAD
7e05da5 HEAD@{6}: rebase -i (pick): updating HEAD
```

Í ¤f D HEAD f• NDÉÓž ó ^ g 6F Git —j [ò- MR" #T- ' r ā ò- æÖâ â J ? f í 9,, o \
reflog ‡ ? SOPè â DCå æÖ? pef: ä • à á ¼ HEAD \$í t â Df• NDCå F f 9,, . ' @{n} S -' reflog ¼y XDCå â â ?

```
$ git show HEAD@{5}
```

f OÄ 9,, . ' ò- ØWSä • l -] Ý\$W» | ÷â DÉÓ? HpF ä • f D master] Ý\$qbD! a • N^p - Cå F f 9,, yk

```
$ git show master@{yesterday}
```

—j # @qb master] ÝDÉ 7• N^p - Cå? ò- 1W- yj \$f -' r ā J D‡? k' Ff,, Ç° ' Sä 5Ë - k è â DCå ?

9,, ÝÙ git log -g Sä • » ¼S git log y Xš 2D- ' r ā MRO

```
$ git log -g master
commit 734713bc047d87bf7eac9674765ae793478c50d3
Reflog: master@{0} (Scott Chacon <schacon@gmail.com>)
Reflog message: commit: fixed refs handling, added gc auto, updated
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri Jan 2 18:32:33 2009 -0800
```

È fixed refs handling, added gc auto, updated tests

```
commit d921970aadf03b3cf0e71becdaab3147ba71cdef
Reflog: master@{1} (Scott Chacon <schacon@gmail.com>)
Reflog message: merge phedders/rdocs: Merge made by recursive.
Author: Scott Chacon <schacon@gmail.com>
Date:   Thu Dec 11 15:08:43 2008 -0800
```

È Merge commit 'phedders/rdocs'

r ØO9Di F- ' r ā " §§! 5àáF· - i W- áäf \$ k ± DàáJ %\` aDr ā? 6%xy
DàáJ D- ' r ā Çj Bf D/ OF &f ™qr W- àáD! ^ F- ' r ā i T DFstf \$àáJ j Ák ī
" ? git show HEAD@{2.months.ago} Øž ^ %` k \$f qr ^W-. æ¬ö! - k ! ' j # @é PDC
å ÑÑ pef ØØqr ^àáFž a· [Çj k œb" e ý Å?

Ý X, ¥| uq Git W# shell - ®² r
pefk UNIX JK Linux DÄÄF ÇU[- ' r ā: " Git 7D shell æÖâã F mQ\$ S
gŠf Bf Dj s / GF &Š6%ÅG?

2 3 . ,

] ¹ - ' i uW8• ÑW- Cå D1 2? pef \$- ' Då \ • ÑW- ^ÓJ yz øF Gitj [• òt C-
DÑW- Cå? —Ef DCå æÖi O

```
$ git log --pretty=format:'%h %s' --graph
* 734713b fixed refs handling, added gc auto, updated tests
*   d921970 Merge commit 'phedders/rdocs'
| \
| * 35cfb2b Some rdoc changes
* | 1c002dd added some blame and merge stuff
| /
* 1c36188 ignore *.gem
* 9b29157 add open3_detach to gemspec file list
```

f 9,, . ' HEAD^ Sä • ÑW- Cå Fí —i ØHEAD D&Cå ØO

```
$ git show HEAD^  
commit d921970aadf03b3cf0e71becdaab3147ba71cdef  
Merge: 1c002dd... 35cfb2b...  
Author: Scott Chacon <schacon@gmail.com>  
Date: Thu Dec 11 15:08:43 2008 -0800  
Ê Merge commit 'phedders/rdocs'
```

H Windows • ³ å ´ µ™

\$ Windows D cmd.exe ¼F ^ i W- ° Ryz Fsã, @' ï yV? f 9,, ^ L· JK[
Cå- ' < \$- ï ¼O

!

```
$ git show HEAD^      # $ Wi ndows ÑÅWµ"  
$ git show HEAD^^    # 9,,  
$ git show "HEAD^"   # 9,,
```

fí 9,, \$ ^ | Ü• • W- ï yS• Ñ: @p1á &Cå ÑÑHp d921970^2 n° Ød921970 DUV&C
å Øò- ØW- P' §î > DCå Fstî > Cåj ke- &Cå? î > Cå DUW&Cå i fî > ; f\$]
Ýóo€t masterøF&UV&Cå i f fî > D] ÝóHp topi cøO

```
$ git show d921970^  
commit 1c002dd4b536e7479fe34593e72e6c6c1819e53b  
Author: Scott Chacon <schacon@gmail.com>  
Date: Thu Dec 11 14:58:32 2008 -0800
```

Ê added some blame and merge stuff

```
$ git show d921970^2  
commit 35cfb2b795a55793d7cc56a6cc2060b4bb732548  
Author: Paul Hedderley <paul+git@mj.r.org>  
Date: Wed Dec 10 22:22:03 2008 +0000
```

Ê Some rdoc changes

uW8• Ñ] ¹ Cå D1 Wi ~óñæì ø? OÄi • NUW&Cå Fsã HEAD~ B HEAD^ i > q D? &
í \$§f\$| Ü• ï D! ^ ? HEAD~2 n° ØUW&Cå DUW&Cå ØFí —i Ø] &Cå ØÑÑGitj 5
?f • » Dt ï OPy - DUW&Cå? Hp F \$èå DWX DCå æØ¼F HEAD~3 —i

```
$ git show HEAD~3
commit 1c3618887afb5fbbea25b7c013f4e2114448b8d
Author: Tom Preston-Werner <tom@mojombo.com>
Date:   Fri Nov 7 13:47:59 2008 -0500

    E ignore *.gem
```

Í 9 „ Lf HEAD~~~Fí i UW&Cå DUW&Cå DUW&Cå O

```
$ git show HEAD~~~
commit 1c3618887afb5fbbea25b7c013f4e2114448b8d
Author: Tom Preston-Werner <tom@mojombo.com>
Date:   Fri Nov 7 13:47:59 2008 -0500

    E ignore *.gem
```

fí 9 „ Úî . ' ò! - ÆWÑÑf 9 „ o\ HEAD~3^2 SPÒèâ-' DUV&Cå ó—E· i W- î > C
åø?

| } ÁV

f Z [hj pb• » ~ t DCå FY\$S• • pb• Ñw» ' ÷ DCå? xf k l e] Ý | Fòyyéf D]
Ýd] k' F f 9 „ Cå' ÷ S• ZÒò-] Ýj kp" Cåš 4î > Tå] ÝÅÓDI "

‘ B

¥€' D• ÑCå' ÷ ÆWi ^ Q? ò8ÆW9 „ a Git øX\$W-] Ý¼&Ç\$uW-] Ý¼DCå? H
p F f k p < DCå æÖ Example history for range selection.

Figure 137. Example history for range selection.

f : @ä • experiment] Ý¼j kp" Cåš 4{ î > k master] Ý? f 9 „ . ' master.. experiment
Sa Git # @ò" Cå?í —i Ø\$ experiment] Ý¼&Ç\$ master] Ý¼DCå Ó? t ^ . HI } ~ Ñ
^ F ¥. ' ^ @9Ù¼Cå y < Dy öSn. ž ...r á Dy XF f „ j # @O

```
$ git log master..experiment
D
C
```

\`SF pef: ä• \$ master] Ý¼&Ç\$ experiment] Ý¼DCå Ff - @å |] Ý) j 9?
experiment.. master j # ©\$ master] Ý¼&Ç\$ experiment] Ý¼DCå O

```
$ git log experiment..master  
F  
E
```

ò9,, afz { experiment] ÝÈX¥™DÔù,, Bä• fj [i > DA~? uW- €' D^k Äi ä• fj
[€uTé7DA~O

```
$ git log origin/master..HEAD
```

ò- ^ %oj yX\$f øâ] Ý¼&Ç\$éÖorigin¼DCå? pef, Ùgit push> ¥f Døâ] Ýg\$
Èö origin/masterF° git log origin/master..HEADfyXDCå—i j { xyTé7EFØDC
å? pef 1i ^ ¼DWþF Gitj ³ | t HEAD? HpF git log origin/master.. [j yXŠèâH
I / OD" e ÑÑGit. ' HEADSn. 1i DWþ?

™B

^ QŒWI 5' Fhk | ^ f 9° , @! - , ÑD] Ý' ° - » ff, @D» þF > pä• p" Cåi { Œm
\$l "] Ý¼DW- Fhi Ç\$f øâD] ÝÑ? GitL8f \$œ9- ' å• Ñ^yzJK --not S• Ñf Ç
' Cå { Œm ¼D] Ý? sã<W÷ - ^ %o i > qDO

```
$ git log refA..refB  
$ git log ^refA refB  
$ git log refB --not refA
```

ò-ŒWI 5' Fstf 9,, \$ä¿¼• » `` ! - D- ' Fòi ^ QŒWÅW...YD? > pFf: ä• fk
{ refAJ refB ŒmDhi Ç{ refC ŒmDCå Ff 9,, . ' , <œ9W- ^ %oO

```
$ git log refA refB ^refC  
$ git log refA refB --not refC
```

ò-Œf^W- d] ² † D» þä¿• , Ff 9,, o\· Sä• f D] ÝJ Œm^p" KL?

3B

¥| W8å @D' ÷øùŒWi ÷QFò-ŒW9,, øùX{ ! - - ' - 1 ŒmhNÇ{ ! KO| ŒmDC
å? d• • èâ^ QHI ¼DCå æÖ? pef: • master J K experiment ¼ŒmDhÇi ! K&k DC
å Ff 9,, ÙO

```
$ git log master...experiment  
F  
E  
D  
C
```

Ø Bo€ Log i r N#œDy XWÄF ggc X^4- Cå DMR?

Ø 8oÚ< F Log ^ %oDW- €' ; † i --left-right F· j #©Í - Cå T: ÅspW- D] Ý? Øj a y X‡? ~ • %; ?

```
$ git log --left-right master...experiment  
< F  
< E  
> D  
> C
```

k^ø" µ¶FF-9, d] 1-5ä• f Git à á ¼DCå?

} µN€•

! ? ¼DE- åÿ2 Git ^ %o9, ¶Ef [½~ D° » \] ûî fCå? xf \$» f ^ tC½~ | F' ' ø" f
Ý° ø] t¶. Cå &Çi ï ¾\$WÊf tW- Cå | FðE- µ¶j *€k' ? o\ø812F9, - z C
åi xšÑ2i Dg~ EFOf i j . 6, ï K\$Šfµ" || ~í 5Mu? peÝÙgi t add | . ' -i
JK --interactive ø. F Git [j ØkW- åÿ2, 7, 2F#©» ¼< ÜDKLO

```
$ git add -i  
È staged unstaged path  
È 1: unchanged +0/-1 TODO  
È 2: unchanged +1/-1 index.html  
È 3: unchanged +5/-1 lib/simplegit.rb  
  
*** Commands ***  
È 1: [s]tatus È 2: [u]pdate È 3: [r]evert È 4: [a]dd untracked  
È 5: [p]atch È 6: [d]iff È 7: [q]ui t È 8: [h]el p  
What now>
```

9, • TØ- ^ %o, Bx| * €ÇODi Ù#©^! " ' ÑÑx! ÑŠ git status i / ODMRFhi ~ }
Ñ%o@W" ? . [! " D» f W\$á- F 4! " D» f W\$â- ?

\$Ø- ' i | i ØCommandsØ^ %o' i ? \$ØJ f 9, %oW" µ" F ØÖ! " ½~ PPè! " ½~ P! " ½
~ DW\] P• • 4{ ØÖD½~ P#©! " A~D' i ?

€ • ÜÝÔ€ • - ,

pe\$ What now> C©z | - k u J 26~ tmøF· j l f : @! " p - ½~ O

```
What now> u
Ê      staged      unstaged path
Ê 1:  unchanged      +0/-1 TODO
Ê 2:  unchanged      +1/-1 index.html
Ê 3:  unchanged      +5/-1 lib/simplegit.rb
Update>>
```

@! " TODO B index.html ½~ F 9, y k ‡ y O

```
Update>> 1, 2
Ê      staged      unstaged path
* 1:  unchanged      +0/-1 TODO
* 2:  unchanged      +1/-1 index.html
Ê 3:  unchanged      +5/-1 lib/simplegit.rb
Update>>
```

I - ½~ à ÜD * 9à Èø¼D½~ [j { ! " ? pe\$ Update>> C©z | Çykœb KL> ...³ i Å
p F Git [j ! " è à øùD½~ O

```
Update>>
updated 2 paths

*** Commands ***
Ê 1: [s]tatus      2: [u]pdate      3: [r]evert      4: [a]dd untracked
Ê 5: [p]atch       6: [d]iff        7: [q]ui t       8: [h]elp
What now> s
Ê      staged      unstaged path
Ê 1:      +0/-1      nothing TODO
Ê 2:      +1/-1      nothing index.html
Ê 3:  unchanged      +5/-1 lib/simplegit.rb
```

Y\$ 9, • T TODO Š index.html ½~ Z [{ ! " & simplegit.rb ½~ j 4{ ! " ? peòl : @Pè
! " TODO ½~ F . ' r J 3óçèøø. O

```

*** Commands ***
Ê 1: [s]tatus      2: [u]pdate       3: [r]evert       4: [a]dd untracked
Ê 5: [p]atch       6: [d]iff        7: [q]ui t       8: [h]elp

What now> r
Ê           staged      unstaged path
Ê 1:         +0/-1      nothing TODO
Ê 2:         +1/-1      nothing index.html
Ê 3:     unchanged      +5/-1 lib/simplegit.rb

Revert>> 1
Ê           staged      unstaged path
* 1:         +0/-1      nothing TODO
Ê 2:         +1/-1      nothing index.html
Ê 3:     unchanged      +5/-1 lib/simplegit.rb

Revert>> [enter]
reverted one path

```

d t ä • Git ØÕF 9 „ • TZ [Pè! " TODO ½~ O

```

*** Commands ***
Ê 1: [s]tatus      2: [u]pdate       3: [r]evert       4: [a]dd untracked
Ê 5: [p]atch       6: [d]iff        7: [q]ui t       8: [h]elp

What now> s
Ê           staged      unstaged path
Ê 1:     unchanged      +0/-1 TODO
Ê 2:         +1/-1      nothing index.html
Ê 3:     unchanged      +5/-1 lib/simplegit.rb

```

pe: @ä • Z! " A~D' ì F 9 „ . ' d J 6ó' ì ø^ %o? · j #©! " ½~ DW- W° F 9 „ S ¼øù
: @ä • D! " ' ì ? òÈf \$^ %oÙ• » git diff --cached * € / ¼O

```

*** Commands ***
Ê 1: [s]tatus      2: [u]pdate       3: [r]evert      4: [a]dd untracked
Ê 5: [p]atch       6: [d]iff        7: [q]ui t      8: [h]el p
What now> d
Ê           staged      unstaged path
Ê 1:         +1/-1      nothi ng index.html
Review diff>> 1
diff --git a/index.html b/index.html
index 4d07108..4335f49 100644
--- a/index.html
+++ b/index.html
@@ -16,7 +16,7 @@ Date Finder

Ê<p id="out">...</p>

-<div id="footer">contact : support@github.com</div>
+<div id="footer">contact : email.support@github.com</div>

Ê<script type="text/javascript">

```

o\ò" x! ^ %oF 9,, . ' å ý 2•• , 2Sæç 5Æ€! " ' ?

€ • ÇÊ

Git í 9,, ! " ½~ D° » \] ? Hp F p e \$ simplegit.rb ½~ ¼%o^ ! Æ» f F h - : @! " ¼DW- & Ci uW- F Gitj Cf æç 5ôf? \$BÑW? WÄDå ý 2C©z ¼F y k p J 5óI J ø? Gitj çI f : @\] ! " p" ½~ úd | F y Zøù½~ Dí W- \] F· T j W- - 5#©½~ ' ì > çI f i a : @! " . ' O

```

diff --git a/lib/simplegit.rb b/lib/simplegit.rb
index dd5ecc4..57399e0 100644
--- a/lib/simplegit.rb
+++ b/lib/simplegit.rb
@@ -22,7 +22,7 @@ class SimpleGit
Ê end

Ê def log(treeish = 'master')
-   command("git log -n 25 #{treeish}")
+   command("git log -n 30 #{treeish}")
Ê end

Ê def blame(path)
Stage this hunk [y, n, a, d, /, j, J, g, e, ?]?

```

o|k|eø. ? y k ?#©fk 9,, . ' D^ %oW° O

Stage this hunk [y, n, a, d, /, j, J, g, e, ?]? ?
 y - stage this hunk
 n - do not stage this hunk
 a - stage this and all the remaining hunks in the file
 d - do not stage this hunk nor any of the remaining hunks in the file
 g - select a hunk to go to
 / - search for a hunk matching the given regex
 j - leave this hunk undecided, see next undecided hunk
 J - leave this hunk undecided, see next hunk
 k - leave this hunk undecided, see previous undecided hunk
 K - leave this hunk undecided, see previous hunk
 s - split the current hunk into smaller hunks
 e - manually edit the current hunk
 ? - print help

o€oÇ<9 „ yk yJ nSøùi ^ @! " í W- ' - F ødF! " ° » ½~ ¼Dfk\] Jtè | Døù
 • \W- ' - í i * €k' D? pef^ ! " ½~ DW\] FÔÓy X9° j Å<ÜðÄO

| | | |
|-----------|-----------|------------------------|
| What now> | 1 | |
| Ê | staged | unstaged path |
| Ê 1: | unchanged | +0/-1 TODO |
| Ê 2: | +1/-1 | nothi ng index.html |
| Ê 3: | +1/-1 | +4/-0 lib/simplegit.rb |

si mpl egi t. rb ½~ DÔÓI KT? . #©X¶. Ü{ ! " Š¶. Ü4{ ! " ? Z[\] 5! " ^ð - ½~ ?
 \$ð | F9 „ xXåÿ2••ý! > ¥ÝÜ gi t commi t SCå\] ! " D½~ ?

í 9 „ Ç®\$åÿ2•• , 2¼‰\] ½~ ! " ÑÑ9 „ \$^ %œÙ¼. ' gi t add -p J gi t add --patch
 SBÝOÄDý! ?

~ ÔWÈ5F9 „ . ' gi t reset --patch ^ %DI J , 2S\] mÓ½~ F o\ gi t checkout
 --patch ^ %S\] GX½~ Š gi t stash save --patch ^ %S\] ! " ½~ ? ¥' [j \$³ ¶ð" ^
 %œDC ©. ' 1W| ^•~ eÔ^ MR?

¶. Ü, þ

k | F øf \$. æDW\] ÑZ[µ" Wf | ÷ | FfkKLÍ Ôk ^í åDÔÓF &ð | f: @{ | TuW
 -] Ý‰WQì Dnø? I " i Ff Ç: ggst\j <ATòWQ&t %œ^ WgDµ" %í Wt Cå? ±y
 ð - I " D®ei gi t stash ^ %œ?

b \$óstashøj AEEµ" æã DŠDÔÓÑÑj Èö½~ D» f Š! " Df ÝÑÑd | [4ôfD» fz" TW
 - < ÑF &f 9 „ \$œb | ^ a m™- ' ð" f ÝÓ« ¬ \$ÇOD] ÝÑø?

¶. 1 git stash push

н ~ 2017 ~ 10 k < DEF Git K ~ W° ÑÔÙ^yz OPF COP½Ô' ^ git stash
save ^ %oF nè, Yk git stash push ^ %o? åsi git stash push -k ^ b \$ø
» D 1 ° » ½ Dø. F &k " KL git stash save ÇÝ{ ?

git stash save Çj I ½—è / Ff, Ç' Üv. VdÇ\$? Ç\ f 9° : @89T
push SOP™• ° ?

¶. 2 j

t ^ É ©b\$Ff, @Ôk. æ> f ÝÉ - ½~ Fd | 9,, ! " ½DW- f Ý? peÝÙ git status F 9
„ • Tk f ÝDÔÓO

```
$ git status
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)
```

È modified: index.html

Changes not staged for commit:

È (use "git add <file>..." to update what will be committed)
 È (use "git checkout -- <file>..." to discard changes in working
 directory)

È modified: lib/simplegit.rb

Ý\$: @{} |] ÝFhi j Ç: @CåèâDµ" úf, b\$» f? [™Db\$€uT< ÑFÝÙ git stash
J git stash push O

```
$ git stash
Saved working directory and index state \
  È "WIP on master: 049d078 added the index file"
HEAD is now at 049d078 added the index file
(To restore them type "git stash apply")
```

9,, • Tµ" æä i . ÜD^O

```
$ git status
# On branch master
nothing to commit, working directory clean
```

ã | Ff 9,, { |] Ý> \$ 651µ" úf D» f { "#\$< Ñ? @ä • b\$DKLF 9,, . ' git stash
list O

```
$ git stash list
stash@{0}: WIP on master: 049d078 added the index file
stash@{1}: WIP on master: c264051 Revert "added file_size"
stash@{2}: WIP on master: 21d80a5 added number to log
```

\$! H½F K! - èâ Db\$F f, f³ ¶T ^÷ - ÇODb\$μ" ? 9,, o\ >S stash^ %D¢ E C©½
D^ %o[f ØØb\$Dμ" m™- ' Ogi t stash apply? pe: @- ' ¼W- ~ mDb\$F 9,, o\)
y • » . F ÄòÄOgi t stash apply stash@{2}? peç• » W- b\$F Git | t • » Di ¥UDb\$O

```
$ git stash apply
On branch master
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

    modified:   index.html
    modified:   lib/simplegit.rb

no changes added to commit (use "git add" and/or "git commit -a")
```

9,, • T Git m™» f ^ xfz" b\$| çèD½~ ? \$! H½F ø, + - ' b\$| kW- · ÜDμ" æäF>
¥, + [. - ' \$z" · | f\$D] Ý? > Ci ®¶@kW- · ÜDμ" æäF JK@- ' TOW] Ý' °f
• - ' b\$? 9,, \$W-] ÝÑz" W- b\$F{ | TuW-] ÝFd| , +m™- ' ò" » f? ø- ' b\$|
μ" æä½í 9,, k » f Š4Cå D½~ ÑÑpekœbKLÇ° . Ü5- ' F Gitj Qóî > UV?

½~ Df Ý{ m™- ' ^F hi èâ! " D½~ éAk m™! " ? : @ž ÄDs F ®¶. ' --index ø. SÝ
Ügi t stash apply ^ %oFS, +m™- ' ! " D» f? peZ[žÄ‰^Fžaf[AT>SDÊÓO

```
$ git stash apply --index
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    modified:   index.html

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

    modified:   lib/simplegit.rb
```

- ' ø. - j , + - ' b\$Dμ" ÑÑ\$ù< Ñj k. ? 9,, ÝÜgi t stash drop • Ñ[@9} Db\$D)
yS9} . O

```
$ git stash list
stash@{0}: WIP on master: 049d078 added the index file
stash@{1}: WIP on master: c264051 Revert "added file_size"
stash@{2}: WIP on master: 21d80a5 added number to log
$ git stash drop stash@{0}
Dropped stash@{0} (364e91f3f268f0900bc3ee613f9f733e82aaed43)
```

í 9 „ ÝÙ git stash pop S- ' b\$ d | i j s < Ñ• Ó· ?

¶· Kè ÒqÀ'

k È - b\$ Dg 89° í l k' ? UW- * €ï ÙDø. i git stash ^ %oD --keep-index ø. ? . ÝÀ Git Çg @b \$fk Z! " DA~FO! j @[· ' z 1 \$' - ¼?

```
$ git status -s
M index.html
EM lib/simplegit.rb

$ git stash --keep-index
Saved working directory and index state WIP on master: 1b65b17 added the index file
HEAD is now at 1b65b17 added the index file

$ git status -s
M index.html
```

uW- [€. ' b\$ S%oDnoi Äb\$Èö½~ WÄb\$4Èö½~ ? ³ | oÇ< F git stash - j b\$ Z
» f B! " D { ' µ½~ ? p e • » --includetracked J -u ø. F Git í j b\$ œb 4Èö½~ ? d
&F \$b\$ ¼Öm4Èö½~ ñd Çj ÖmÑ~ ° » D½~ ? @è L ÖmÈ5D½~ FG. ' --all J -a
ø. ?

```
$ git status -s
M index.html
EM lib/simplegit.rb
?? new-file.txt

$ git stash -u
Saved working directory and index state WIP on master: 1b65b17 added the index file
HEAD is now at 1b65b17 added the index file

$ git status -s
$
```

¥, F p e • » ^ --patchç â F Git Çj b\$ fk » f \ Dœb KLF h i j å ý 25C©p" f Ý: @b

\$þþ " f ÿ, @z " \$μ" æā ¼?

```
$ git stash --patch
diff --git a/lib/simplegit.rb b/lib/simplegit.rb
index 66d332e..8bb5674 100644
--- a/lib/simplegit.rb
+++ b/lib/simplegit.rb
@@ -16,6 +16,10 @@ class SimpleGit
  return `#{git_cmd} 2>&1`.chomp
end
end

+
+ def show(treeish = 'master')
+   command("git show #{treeish}")
+ end

end
test
Stash this hunk [y, n, q, a, d, /, e, ?]? y
```

Saved working directory and index state WIP on master: 1b65b17 added the index file

^ ¶· èé1áLó

þeb\$^W" μ" F [· 1\$ž<^Wj <Fd | μ¶\$b\$D] ÿÑμ" F\$m™- ' μ" | 9° j k l
" ? þe- ' , +» f ØØ» f D½~ Ffj ØTW- î > UV> ÇØÇ• Z· ? þe: @W- æçD12S
dt 6+b\$Df ÿF9, ÿÙ **git stash branch <new branchname>**, f • » D] ÿ) %í W- ™]
ÿFGXb\$μ" | f\$DCå Fm™\$ž- ' μ" Fd | \$- ' f• | . ôb\$O

```

$ git stash branch testchanges
M index.html
M lib/simplegit.rb
Switched to a new branch 'testchanges'
On branch testchanges
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

  modified:   index.html

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

  modified:   lib/simplegit.rb

Dropped refs/stash@{0} (29d385a81d163dfd45a452a2ce816487a6b8b014)

```

Øi \$™] Ýæç@Ab\$µ" > µ¶µ" DW- I Ç™DŽ· ?

, þ²j ©<

y§µ" æã¼W" µ" J½~ Ff: %Dí 8Çi b\$&i 9} ? git clean ^ %—i ' S· ò- D?

%€µ" æã kW" €\$D>SF > p¬t ^9} °î > JL\µ¶ófDKLFJit ^ÝÙW- · ÙD¢í &9} èâ¢í D• 1?

f, @345. ' ò- ^ %Fst · { E! tsµ" æã¼9} 4{ ĐöD½~ ? p eff g å 9^Ff í Ç W» ° ÙÀSž " ½~ DA~ ? W- ~ ÚŽDø. i ÝÙ git stash --all S9} í WÄKL > " < \$< ¼?

f 9,, . ' git clean ^ %] } • Š½~ JK%€µ" æã? . ' git clean -f -d ^ %S9} µ" æã¼fk 4ĐöD½~ „ BÍ DI æã? -f9à ÈÒ² ÓóforceøÓJ Ò- » @9} ÓF. ' . , @Git PÓg C clean. requi reForce Ák #2EÓt fal se?

pe- i : @••• j %` a F 9,, . ' --dry-runJ -nø. SÝÙ^ %F ò9à ÈÒ%Wt Éi d | ÝÀ f s69} ` a Ó?

```

$ git clean -d -n
Would remove test.o
Would remove tmp/

```

³ | oÇ<F git clean ^ % - j 9} Ák È5D4Èö½~ ? œbŠ . git ignoreJ 6È5½~ ¼D, 2éPD½~ Í Çj { 9} ? pefí : @9} ž " ½~ FHpt ^ %Wt òŽ. ÙD¢í &9} fk ° ¢í ÓfD . o ½~ F 9,, c clean ^ %o" • W- -xø. ?

```
$ git status -s
ÊM lib/simplegit.rb
?? build.TMP
?? tmp/

$ git clean -n -d
Would remove build.TMP
Would remove tmp/

$ git clean -n -d -x
Would remove build.TMP
Would remove test.o
Would remove tmp/
```

peÇäj git clean ^ %o[j %o` aF \$[-nf t -fSžg%oèâBi ' ' -nSÝÙ. %o^ mGä? u
W- ûvÆ€\ ØD12i . ' -i J ØinteractiØçâSÝÙ. ?

ð[j „ åÿ, 2ÝÙ clean ^ %o?

```
$ git clean -x -i
Would remove the following items:
Ê build.TMP test.o
*** Commands ***
Ê 1: clean 2: filter by pattern 3: select by numbers
4: ask each 5: quit
Ê 6: help
What now>
```

ð812<9,] i 5Gäí W- ½~ JKåÿ5• »å} D, 2?

!

\$W8(ÜDoÇ<F9°, @šL' '' ' a Git%€f Dμ" æä? pef + 5\$μ" æ
ã¼AÓJ qr ^ 6 Gitàáó9° i l, -øFžaj ~i git clean -fdřj B<å
} ð" æä? ð8oÇ<Ff, @• NUV- -fø. S² * ?

æ½² j

Git cdi) o©ÚŽDFh. Çi - ÅW/ D? pef ss° þÑD 6%žJuPμ" F> ¥: @I OCå
i Çi žg5SÉ§9MS† F Git CD^ È8o\ GPG Së(BI Oμ" D12?

GPG Ø¾

' 1 F \$, 1 èäf, @1 PØGPG> ÚÛ- %) ô?

```
$ gpg --list-keys  
/Users/schacon/.gnupg/pubring.gpg  
-----  
pub 2048R/0A46826A 2014-06-04  
uid Scott Chacon (GitHub signing key) <schacon@gmail.com>  
sub 2048R/874529A9 2014-06-04
```

pefj Ák ÚÚW-) ÓF 9„ . ' gpg --gen-key ófW- ?

```
$ gpg --gen-key
```

W• f kW- 9„ è(D} ÓF 9„ o\ EÓGitD user. si gni ngkey ø. Së(?

```
$ git config --global user.signingkey 0A46826A
```

Y \$ Git³ | . ' f D) ÓSë(çëŠCå?

æ½å æ

peZ[EÓ5W- GPG } ÓF 9„ . ' . Së(™Dçë? fk, @‰D- i . ' -sn. -aj 9O

```
$ git tag -s v1.5 -m 'my signed 1.5 tag'
```

You need a passphrase to unlock the secret key for
user: "Ben Straub <ben@straub.cc>"
2048-bit RSA key, ID 800430EB, created 2014-05-04

pe\$ž - çëÑYÙ git showFj • Tf D GPG è) f 2\$ | ÜO

```
$ git show v1.5
tag v1.5
Tagger: Ben Straub <ben@straub.cc>
Date:   Sat May 3 20:29:41 2014 -0700
```

```
my signed 1.5 tag
-----BEGIN PGP SIGNATURE-----
Version: GnuPG v1
```

```
i QEcBAABAgAGBQJTZbQI AAoJEF0+svi ABDDrZbQH/09PfE51KPVPI anr6q1v4/Ut
LQxfoj UWi LQdg2ESJI tkcuweYg+kC3HCyFej eDI Bw9dpXt00rY26p05qrpnG+85b
hM1/PswpPLuBSr+oCI Dj 5GMC2r2i EKsfv2fJbNW8i WAXVLoWZRF8B0MfqX/YTMbm
ecorc4i XzQu7tupRi hsl bNkfvfcI MnSDeSvzCpWAHI 7h8Wj 6hhqePmLm9I AYqnKp
8S5B/1SSQuEAj RZgI 4I expZoeKGVDptPHxLLS38fozsyi 0QyDyzEgJxcJQVMXxVi
RUysgqj cpT8+i QM1PbI GfHR4XAhu0qN5Fx06PSaFZhqvWFezJ28/CLyX5q+oI Vk=
=EFTF
```

```
-----END PGP SIGNATURE-----
```

```
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@gmail.com>
Date: Mon Mar 17 21:52:11 2008 -0700
```

È changed the version number

, # å æ

@I OW- ë (Dçë F 9 „ ÝÙ git tag -v <tag-name>? ò - ^ %o. ' GPG SI Oë) ? t ^ I O°
g€µ" F ë (KD! ô, @\$f Dô' ^ ¼?

```
$ git tag -v v1.4.2.1
object 883653babd8ee7ea23e6a5c392bb739348b1eb61
type commit
tag v1.4.2.1
tagger Junio C Hamano <junkio@cox.net> 1158138501 -0700
```

GIT 1.4.2.1

Mi nor fixes since 1.4.2, including git-mv and git-http with alternates.
gpg: Signature made Wed Sep 13 02:08:25 2006 PDT using DSA key ID F3119B9A
gpg: Good signature from "Junio C Hamano <junkio@cox.net>"
gpg: aka "[jpeg image of size 1513]"
Primary key fingerprint: 3565 2A26 2040 E066 C9A7 4A7D COC6 D9A4 F311
9B9A

peÁkë(KD! ôFžaf [j ÓT » ¼< ÜDKLO

```
gpg: Signature made Wed Sep 13 02:08:25 2006 PDT using DSA key ID F3119B9A
gpg: Can't check signature: public key not found
error: could not verify the tag 'v1.4.2.1'
```

æ½| }

\$ ¥™7! D Git ¼Óv1.7.9 ß „ ÑøFí 9 „ è(- %Cå? pe/y §çë&xfy...³ è(TCå ~ ¾S
T Ds FƒK @‰D" i " • W- -ST git commi t ^‰?

```
$ git commit -a -S -m 'signed commit'
```

You need a passphrase to unlock the secret key for
user: "Scott Chacon (Git signing key) <schacon@gmail.com>"
2048-bit RSA key, ID 0A46826A, created 2014-06-04

```
[master 5c3386c] signed commit
 4 files changed, 4 insertions(+), 24 deletions(-)
  Rewrite Rakefile (100%)
  Create mode 100644 lib/git.rb
```

git log í KW- --show-signature ø. Sä•ßl Øð" è) ?

```
$ git log --show-signature -1
commit 5c3386cf54bba0a33a32da706aa52bc0155503c2
gpg: Signature made Wed Jun 4 19:49:17 2014 PDT using RSA key ID 0A46826A
gpg: Good signature from "Scott Chacon (Git signing key)
<schacon@gmail.com>"
Author: Scott Chacon <schacon@gmail.com>
Date:   Wed Jun 4 19:49:17 2014 -0700

È signed commit
```

uLFí 9 „ PÓgit log SI OœbÙTDè) > [· ' „ %G? š 2W\$y X¼?

```
$ git log --pretty=format:%h %G? %aN %S"
5c3386c G Scott Chacon signed commit
ca82a6d N Scott Chacon changed the version number
085bb3b N Scott Chacon removed unnecessary test code
a11bef0 N Scott Chacon first commit
```

ØJ ¥' 9 „ • T - k ¥| Wt Cåi è(> k Ž DF &èâ DCåÍ Çi ?

\$ Git 1.8.3 ß „ | D7! ¼F gi t merge Š gi t pul l 9 „ . ' --veri fy-si gnatures
ø. SGä > B<Ák' ý 9M GPG è) DCå ?

pe. ' ò- ø. Sî > W- Œm4è) JK Ž DCå D] Ÿ | Fî > Cj óŽ?

```
$ git merge --veri fy-si gnatures non-veri fy  
fatal: Commit ab06180 does not have a GPG si gnature.
```

peî > ŒmD- k k Ž Dë) DCå Fî > ^ %o j C©f K Dë) · Z [Gæ \ ^d | j µ¶ Nâ ?

```
$ git merge --veri fy-si gnatures si gned-branch  
Commit 13ad65e has a good GPG si gnature by Scott Chacon (Gi t si gni ng key)  
<schacon@gmai l . com>  
Updati ng 5c3386c.. 13ad65e  
Fast-forward  
 README | 2 ++  
E1 fil e changed, 2 i nserti ons(+)
```

í 9 „ c gi t merge ^ %o f • -S ø. Së (Émó f Dî > Cå ? <ÜDHl É©^I O[@î > D] Ÿ D
í W- Cå Ŧ i è) D> ¥è (¥| óf Dî > Cå ?

```
$ git merge --veri fy-si gnatures -S si gned-branch  
Commit 13ad65e has a good GPG si gnature by Scott Chacon (Gi t si gni ng key)  
<schacon@gmai l . com>
```

You need a passphrase to unlock the secret key for
user: "Scott Chacon (Gi t si gni ng key) <schacon@gmai l . com>"
2048-bi t RSA key, ID 0A46826A, created 2014-06-04

Merge made by the ' recursive' strategy.
 README | 2 ++
E1 fil e changed, 2 i nserti ons(+)

« á / GHæ½

é(çéŠCå l ÁFhi peZ » \$g€Dμ" í Œ¼. ' . Ff ®¶ - z wx ¼Dí W- %í €• pbòÄ
‰? peÁk Ff [j ö_+C| ÷\$£ 6%ÙX> ' è) D7! mL Cå ? \$D' è(ft çt μ" í Œ
DW\] áF - z f ôŽ€• GPG ßè (ýSD5Æ?

¿ Á

ÅPà áJ DnoCKeöFF [€, @äÙW- 5‡ i \$pJ * ' JK » 1DFJK# ©W- 1WDg ~ æ
Ö? Git CD^! - k' Dμ¶S½¾5s· D‡?á½¿ Bn oBCå ? ¥' S} ~D• W< ?

Git Grep

Git CD ^ W- grep ^ %oF f 9,, l 1 - 5s Cå æÖPμ" æä P« -' - ¼ä ÜW- yz { J Kg • ° Å 2? ¥' ' Git! - ī noDä Ü" t HI ?

³ | oÇ< git grep j äÜf μ" æä D½~ ? UW8g¹ i Ff 9,, x² -nJ --line-number ø. § Sy X Git ÜT Dé PÙDÙI ?

```
$ git grep -n gmtime_r
compat/gmtime.c:3:#undef gmtime_r
compat/gmtime.c:8:    return git_gmtime_r(timelp, &result);
compat/gmtime.c:11:struct tm *git_gmtime_r(const time_t *timelp, struct tm
*result)
compat/gmtime.c:16:    ret = gmtime_r(timelp, result);
compat/mingw.c:826:struct tm *gmtime_r(const time_t *timelp, struct tm
*result)
compat/mingw.h:206:struct tm *gmtime_r(const time_t *timelp, struct tm
*result);
date.c:482:        if (gmtime_r(&now, &now_tm))
date.c:545:        if (gmtime_r(&time, tm)) {
date.c:758:            /* gmtime_r() in match_diggit() may have clobbered
   it */
git-compat-util.h:1138:struct tm *git_gmtime_r(const time_t *, struct tm
* );
git-compat-util.h:1140:#define gmtime_r git_gmtime_r
```

} ^ ÑÜDx! &' ^ %oL F git grep j Ÿ{ + C · k TDø. ?

HpF¶Ç: ê(fkéPD. Ff 9,, . ' -cJ --count ø. Sa git grep yX< I DMRF ¼g Ö Öž " Ömepy z { D½~ F,, BÍ - ½~ ¼Öm^eö- éP?

```
$ git grep --count gmtime_r
compat/gmtime.c:4
compat/mingw.c:1
compat/mingw.h:1
date.c:3
git-compat-util.h:2
```

pefj Gv &' yz { D‡Å- Fža 9,, xk -pJ --show-function ø. S# ©Í W- éPDyz { f\$D1WJ 5‡O

```
$ git grep -p gmtime_r *.c
date.c=static int match_multiply_timestamp(timestamp_t num, char c, const char
*date,
date.c:           if (gmtime_r(&now, &now_tm))
date.c=static int match_digits(const char *date, struct tm *tm, int
*offset, int *tm_gmt)
date.c:           if (gmtime_r(&time, tm)) {
date.c=int parse_date_basic(const char *date, timestamp_t *timestamp, int
*offset)
date.c:           /* gmtime_r() in match_digits() may have clobbered it */
```

p f f \$ F date.c ½~ ¼D **match_multiply_timestamp** B **match_digits** ! - 5‡Í * ' ^ **gmtime_r** HÓóU
 ÷ - # ©Dé P̄ i OÑ¼Dyz { ø?

f j 9,, . ' --and çãSä • A¾Dyz { ûî F· - z ^ e - éPXY\$OW½! Ü¼? > pF¥' @ä
 • \$m7! 1.8.0 D Git n oá ¼» 1 ^ €C) Õm ÒLINKÓJ K ÒBUF_MAXÓð! - yz { DÙóðJí
 ' T ^ --break B --heading ø. S. yX~ • ~í A` ø?

```
$ git grep --break --heading \
  -n -e '#define' --and \(-e LINK -e BUF_MAX \) v1.8.0
v1.8.0: builtin/index-pack.c
62: #define FLAG_LINK (1u<<20)

v1.8.0: cache.h
73: #define S_IFGIFTLINK 0160000
74: #define S_ISGIFTLINK(m) (((m) & S_IFMT) == S_IFGIFTLINK)

v1.8.0: environment.c
54: #define OBJECT_CREATION_MODE OBJECT_CREATIONUSES_HARDLINKS

v1.8.0: strbuf.c
326: #define STRBUF_MAXLINK (2*PATH_MAX)

v1.8.0: symlinks.c
53: #define FL_SYMLINK (1 << 2)

v1.8.0: zlib.c
30: /* #define ZLIB_BUFSIZE ((ulint)-1) */
31: #define ZLIB_BUFSIZE ((ulint) 1024 * 1024 * 1024) /* 1GB */
```

/> §W" €' D&' ^ %o> p grep B ackF gi t grep ^ %ok W" D³ Q? UW—i ¾ù * €½FUVi
 f Çgg9,, 9,, &' µ" æäFj 9,, &' œ9D Git %? \$ÑW- HI ¼F¥' \$W- m7! D Git Í no
 ¼ä ÜF &Çi øâGX D7! ?

Git --compress

J 8f Ç: äj l w. \$ pÅ F&i : äj i ` a üÅ " \$J K-k D? git log ^ %ok 8e² t Dµ¶9 „ o\ Cå MR« -i diff DA~SÜTl - ° » DCå?

Hp F pe¥' : ÙT **ZLIB_BUFS_MAX** €Ci ` a | ^ - k DF ¥' 9,, . ' -S Ø. Ø\$ Git ¼. üØ/ O 1 öpickaxeø ØØ. ØS# ©™" Bå } Cy z { DCå?

```
$ git log -S ZLIB_BUFS_MAX --oneline  
e01503b zlib: allow feeding more than 4GB in one go  
ef49a7a zlib: zlib can only process 4GB at a time
```

pe¥' ä•ò" Cå DdiffF ¥' 9,, • T \$ **ef49a7a** - Cå - k ^ €CF > ¥\$ **e01503b** - Cå ¼{ » f ^?

pef' ' ØT~ Ý- D" eFf 9,, . ' -G Ø. S. ' g•° Å2&?

m --compress

Ùr ä&' i uW- / øc ©> ¥k' Dr ä&' • °? \$ git log | • Ñ -L Ø. j 9* ' F· 9,, Å©n o ¼WÙJ KW- 5‡ DæØ?

Hp F—E ¥' : ä• **zlib.c** ¼~ ¼`git_deflate_bound` 5‡ DÍ Wt g~ F ¥' 9,, , Ù **git log -L** : **git_deflate_bound**: **zlib.c**? Git j , + ÙXØ - 5‡ D>• Fd | ä ÙæÖå å F > ¥# ©s 5‡ %í è | W• Wg~ y - DI J ?

```
$ git log -L :git_deflate_bound: zlib.c
commit ef49a7a0126d64359c974b4b3b71d7ad42ee3bca
Author: Junio C Hamano <jitster@pobox.com>
Date:   Fri Jun 10 11:52:15 2011 -0700
```

Ê zlib: zlib can only process 4GB at a time

```
diff --git a/zlib.c b/zlib.c
--- a/zlib.c
+++ b/zlib.c
@@ -85,5 +130,5 @@
-unsigned long git_deflate_bound(z_streamp strm, unsigned long size)
+unsigned long git_deflate_bound(git_zstream *strm, unsigned long size)
Ê{
-    return deflateBound(strm, size);
+    return deflateBound(&strm->z, size);
Ê}
```

```
commit 225a6f1068f71723a910e8565db4e252b3ca21fa
Author: Junio C Hamano <jitster@pobox.com>
Date:   Fri Jun 10 11:18:17 2011 -0700
```

Ê zlib: wrap deflateBound() too

```
diff --git a/zlib.c b/zlib.c
--- a/zlib.c
+++ b/zlib.c
@@ -81,0 +85,5 @@
+unsigned long git_deflate_bound(z_streamp strm, unsigned long size)
+{
+    return deflateBound(strm, size);
+}
+
```

p e Git ÅW! á XpbéPf no ¼D5‡JK1WFf 9„ CDW- g• ° Å2? HpFò- ^ %BÑÜD
i > ODOgit log -L '/unsigned long git_deflate_bound/' , /^}/: zlib.c? fí 9„ CD~Ù
JKW- >• DÙì SOÖ/ ODyX?

â ÄÆP

8e | ^ F \$. ' Git | Ff 9° : @» þCåæÖ? Git | ÅDWQi . L8f \$¥| | s %Z » ? f 9„ \$
[! " ' A~CåâZ » p" ½~ ÓkCåF 9„ o\ git stash SZ » ÇŠl " A~µ" F í 9„ mLZ [
¿ ÓDCå—Å· ' „ uW812¿ ÓDWÄ? ò9° éßfgCåD...œF fgCå ¼DMRJ » f ½~ F
[Cå %ŠJ i ø] F J öŽ59} Cå ÑÑ\$[f Dµ" f e Š6%&3èâ?

\$! ? ¼Ff 9„ hTp bôfò" µ" F ðÄ\$Š6%] 3f Dµ" f e | f DCåæÖ[pf f | 5À©X

S?

H. , L' / ž i' #pq

Git D x! >• è Wi F° \$qr ¼k l eμ" i ! 5DFsāf 9,, t BE X-mLæÖâ
ā? d&W• €u^f Dμ" Fž—öŽi uWÀn^F} * f k j] D€° ÖÙ~ f F^a
• - C[€uDμ" i t ¥, " e? } &x è F\$y. ¾T@9> t j Š6%] 3èå F -
¤XY€uf Dμ" ?

~ • Åí 1 • | }

» f f ¥UWt Cå 9° i f k » f æÖCå Dī " ¼¥€\$DW- ? y \$f D¥UWt Cå F f | | : %o!
~ noO} ~5» f Cå MRF J Ko\•• p9} J » f ½~ S~ f Cå ...ÉDA~?

p e F f - i : » f ¥UWt Cå DCå MRF ž a l } ~ O

\$ git commi t --amend

ÑÜòž ^ %oj [¥| Wt DCå MRi k T' šð¼Df » f ? øz" > Gf' šð| F' šðj [~™|
DCå MRLk ™Cå ¼F· j f t ™D¥| Wt Cå ?

uW1 ÜF p e f: @» f ¥| Wt Cå D...ÉA~Fžaï Ōl / ¼O' 1 " Xf: @I ÑD» f F ! " .
' Fd | ' git commi t --amend „ ™Df Ô| DCå S Öx Ómk D¥| Wt Cå F

. ' ð- • " D| ^ , @uvFst » gj f g Cå D SHA-1 NI B? . » ¼S W- ûDg x ÑÑpe Z [€
u^¥| Wt Cå—Ç@» g· ?

þ¹ à#†‡' N• ž þ¹ †‡^ «

øf \$» | Wt Cå | F 9,, O| » f Cå MRBCå A~? p e f » | ^ Cå DA~Fž
a Èl " » @~ ™Cå è R,, \w» f | DA~?

#

uW1 ÜF p e f D» | i @g Dóp » f ^ W- ; 1 J • • ^ W- øå! " D½~ øF ž
a èå DCå MRÇ®» f F f - , " X~ f F! " . ' Fd | o\,, < ^ %oXYÇ®@D'
šð| ?j 9O

\$ git commi t --amend --no-edit

~ • ™á | } " •

t ^ » f \$Cå æÖ¼Hé DCå F ®¶. ' ~ A¾Dμ¶? Git Ák W- f g æÖμ¶Fhi 9,, . ' g x μ
¶Sg x w• WCå F x §. ' > SD HEAD &Çi [9ÝTuW- ™DÑÜ? o\å ý 2g x μ¶F 9,,
\$œb: @» f DCå | > ÇFd | » f MRP• • ½~ J %œb: %oDno? 9,, o\c git rebase" •
-i ø. Så ý 25ÝÙg x? ®¶• » : @mLeòé DæÖFò 9,, o\ÝÀ^ %o[@g x T DCå S‰
T?

Hp F pe: @» f ¥U÷t Cå MRF J Kž ûCå ¼Dœ9W- Cå MRF [: @» f D¥UWt Cå D

&Cå " t ; ‡x² c git rebase -i ^‰Fj HEAD~2^ J HEAD~3? å‡ ~3
9° > H~Í Fstfg, +» f ¥| ÷t Cåúhi O9...ÉÑ• » ^, åD_t CåFj : @» f Cå D&
CåO

```
$ git rebase -i HEAD~3
```

d t å‡òi W- g x ^‰NÑ\$ HEAD~3. . HEAD >• ADÍ W- » f ^CåMRDCåB ghí AEI j {
mL? Ç@éBæbZ [€uT ¼%EF ÐDCå ÑÑòÄ‰oj QóWt g ~ D! - 7! Fs &. 6%ST?

ÝÙò - ^‰oj \$½! ' šðÑcfW- CåDW° F • ÈSÃ<ÜòÄO

```
pick f7f3f6d changed my name a bit  
pick 310154e updated README formatting and added blame  
pick a5f4a0d added cat-file
```

```
# Rebase 710f0f8..a5f4a0d onto 710f0f8# p, pick <commit> = use commit  
# r, reword <commit> = use commit, but edit the commit message  
# e, edit <commit> = use commit, but stop for amending  
# s, squash <commit> = use commit, but meld into previous commit  
# f, fixup <commit> = like "squash", but discard this commit's log message  
# x, exec <command> = run command (the rest of the line) using shell  
# b, break = stop here (continue rebase later with 'git rebase  
--continue')  
# d, drop <commit> = remove commit  
# l, label <label> = label current HEAD with a name  
# t, reset <label> = reset HEAD to a label  
# m, merge [-C <commit> | -c <commit>] <label> [# <oneline>]  
# .      create a merge commit using the original merge commit's  
# .      message (or the oneline, if no original merge commit was  
# .      specified). Use -c <commit> to reword the commit message.  
  
# These lines can be re-ordered; they are executed from top to bottom.  
#  
# If you remove a line here THAT COMMIT WILL BE LOST.  
#  
# However, if you remove everything, the rebase will be aborted.  
#  
# Note that empty commits are commented out
```

, @mQO9Di / y§g€. ' Dlog ^‰Fò" Cå#©D...œi /\ D? ÝÙWt log ^‰Fj • T»
¼òÄDKLO

```
$ git log --pretty=format:"%h %s" HEAD~3..HEAD
a5f4a0d added cat-file
310154e updated README formatting and added blame
f7f3f6d changed my name a bit
```

O9 ¼D\œ#©? åÿ2g×cfW-· [j ÿÙDý! ?· [j sf\$^‰Ù¼•» DCåóHEAD~3Ø
,¹FsÑT<D•t mÉíW-Cå–kD»f?· [¥mD&Çi ¥™DW\$ÑÜFstžj i UW- [
@mÉD?

f, @»f ý! Sa. > 1\$f: »f Dg~Ñ? @ÂTò- æDFf~@[f: »f Dí Wt CåâÜD
ÖpickÖft ÖeditÖ? HpF~: »f U÷t CåMRF9„ Å<ÜðÄ»f½~O

```
edit f7f3f6d changed my name a bit
pick 310154e updated README formatting and added blame
pick a5f4a0d added cat-file
```

¤z" > xX' šð| F Git [f ýÀTW° ¼D¥| Wt CåFäf uÀ^‰Ù> C©,, <MRO

```
$ git rebase -i HEAD~3
Stopped at f7f3f6d... changed my name a bit
You can amend the commit now, with
```

Ê git commit --amend

Once you're satisfied with your changes, run

Ê git rebase --continue

ò" •‰†~ 5ÝÀf C‰` a? yk

```
$ git commit --amend
```

»f CåMRFd | xX' šð? d | F ÿÙ

```
$ git rebase --continue
```

ò- ^‰[j ÉÝ5~' uL! - CåFd | —ôf^? pe, @[ÇÇWÆD pick ft editF, @\$íW-
»f t editDCåÑmAò" Èj ? í Wt F Git [j > ÇFa f »g CåFd | µ¶...Tôf?

â - Ç\$ | }

í 9,, . ' åÿ2g×Sm™#œJ ôŽ9} Cå? pe: @9} Øadded cat-fileØ Cåd | »f uL! - C

â – K D...œF 9 „ [g x ý! s ð Ä O

```
pick f7f3f6d changed my name a bit
pick 310154e updated README formatting and added blame
pick a5f4a0d added cat-file
```

f t ð Ä O

```
pick 310154e updated README formatting and added blame
pick f7f3f6d changed my name a bit
```

¤z " > x X' Š Ó | F Git [f D] Ÿ y Å ò " Cå D&Cå F - ' 310154e d | - ' f7f3f6dF ¥ | >
Ç? n ...» f ^ ž " Cå D...œ o Ž 59 } ^ Ö added cat-file Ö Cå ?

È É | }

o \ å ý 2g x µ ¶ F í 9 „ [W- { Cå % Š f W- ~ 2D Cå ? \$ g x M R ¼ y ! c X ^ k ' D • % o

```
# Commands:
# p, pick <commit> = use commit
# r, reword <commit> = use commit, but edit the commit message
# e, edit <commit> = use commit, but stop for amending
# s, squash <commit> = use commit, but meld into previous commit
# f, fixup <commit> = like "squash", but discard this commit's log message
# x, exec <command> = run command (the rest of the line) using shell
# b, break = stop here (continue rebase later with 'git rebase
--continue')
# d, drop <commit> = remove commit
# l, label <label> = label current HEAD with a name
# t, reset <label> = reset HEAD to a label
# m, merge [-C <commit> | -c <commit>] <label> [# <oneline>]
# .           create a merge commit using the original merge commit's
# .           message (or the oneline, if no original merge commit was
# .           specified). Use -c <commit> to reword the commit message.
#
# These lines can be re-ordered; they are executed from top to bottom.
#
# If you remove a line here THAT COMMIT WILL BE LOST.
#
# However, if you remove everything, the rebase will be aborted.
#
# Note that empty commits are commented out
```

p e F • » Ösquash Ö & Ci Öpick Ö J Öedit Ö F Git [- ' ! K D » f > i > Cå MR \$ W È ? f „ F p

e: @ø÷t Cåg t W- CåF 9, öÄ» f ý! O

```
pick f7f3f6d changed my name a bit
squash 310154e updated README formatting and added blame
squash a5f4a0d added cat-file
```

xz" > xX' ŠØ| F Git " fkD÷t » fd | [f< T' ŠØ¼Sî > ÷t CåMRO

```
# This is a combination of 3 commits.
```

```
# The first commit's message is:
changed my name a bit
```

```
# This is the 2nd commit message:
```

```
updated README formatting and added blame
```

```
# This is the 3rd commit message:
```

```
added cat-file
```

fxz" è | Ff-/k^W- Ōmā÷t CåDž\g~ DCå?

ÊL| }

ø] W- Cåj çèò- CåFd| et 5\] 5! " ŠCå...Tôff f, t‡DCå? HpF-E: @ø
] ÷t CåD¼÷žt Cå? : @[· ø] t! t CåOUW- Øupdated README formattingØF UV-
Øadded blameØSn. >SD Øupdated README formatting and added blameØ? 9, o\» f
rebase -i Dý! S‰TòQF [@ø] DCåD•‰» f t ØeditØO

```
pick f7f3f6d changed my name a bit
edit 310154e updated README formatting and added blame
pick a5f4a0d added cat-file
```

d| F xý! ýf ÔkT^‰Ù| FmØž - CåFuT{ mØD» f F‰%í Êt Cå? xz" > xX'
ŠØ| F Git ýf TW° ¼UW- CåD&CåF " UW- Cåó **f7f3f6d** ØF " UV- Cåó
310154e ØFd| af Ôk ^‰Ù? žJF 9, o\ git reset HEAD^‰Wt ±yž - CåDí î mØF...
ÉÑ[j çèžt Cå> [» f D½~ Pè! " ? Y\$9, ! " > Cå½~ ...Tk Æ- CåFd| xøf| Ý
Ù gi t rebase --continueØ

```
$ git reset HEAD^
$ git add README
$ git commit -m 'updated README formatting'
$ git add lib/simplegit.rb
$ git commit -m 'added blame'
$ git rebase --continue
```

Git \$ ý! ¼- ' ¥| Wt Cå Óa5f4a0døF æÖâ ã • ÊSÃòÄO

```
$ git log -4 --pretty=format:"%h %s"
1c002dd added cat-file
9b29157 added blame
35cfb2b updated README formatting
f3cc40e changed my name a bit
```

d t ² * F ð" f Y ^ f k \$ w° ¼DCå D SHA-1 NI BF f „ @- z w° ¼DCå j Ak €uT&3à á
¼?

ÈÍ ™Í É ±Í filter-branch

k uW- æÖf LDø. F p e: @o\ý! D1 2f L†CCå Ds 9, . ' . ÑÑHpf ZÍ » f f DKP
5\$J s í W- Cå ¼9} W- ½~ ? ð- ^ %o i filter-branchF· 9, f LæÖ¼†CDCå F } * f
D. æj Ák! , > ¥ 6%Ák x§@f LDµ" DCå %oDµ" F a • f Ç- ø. ' . ? d &F· 9, I
k' ? f [j h i T Ë- €' D' ŽF ðÄ—OT ^ . Pî . ' 51 D: W?

% git filter-branch k l e ß" F Çd €2. ' . SmLæÖ? G..._. ' git-
filter-repoF· i W- Python ý! F /> t e‡. ' filter-branchD" S-F·
‰Ø@~ 5?· D½>BÎ o9HI <https://github.com/newren/git-filter-repo> OP?

^ « 1á | } | ÅÄ1á- ,

ð[€¿ó? k %• v 5o\ git add . Cå ^ W- I † DVÖÓ½~ F f: @s f k 51 å} ? 9° 8d
5Cå ^ W- ÕÖW-) o D½~ F d &f: @, † . æ? filter-branch i W- 9° j ' S—Ö- Cå
æÖDµ¶? t ^ s Ö- Cå æÖ¼9} W- ö‰ passwords. txt D½~ F 9, . ' --tree-filter ø.
c filter-branchO

```
$ git filter-branch --tree-filter 'rm -f passwords.txt' HEAD
Rewrite 6b9b3cf04e7c5686a9cb838c3f36a8cb6a0fc2bd (21/21)
Ref 'refs/heads/master' was rewritten
```

--tree-filter ø. \$GX. æDÍ W- Cå | YÙ• » D^ %o d | m™Cå " e? \$! H½F f s í W-
½F ¼9} ^ W- ö" passwords. txt D½~ F ÅP. i ^ " \$? p e: @9} fk 8d Cå D' šðj °
½~ F 9, YÙ» ¼ git filter-branch --tree-filter 'rm -f *~' HEAD D^ %o?

¥| [9 „ • T Git mL %ŠCåd | 9Ý] Ÿ• ±?
o€W- 5D: Wi \$W- 6+] Ÿ¼‰ø~ nFd | øfZ » ¥, " ei žg: @DF 9, ømø master]
Ý? t ^ a filter-branch \$fk] ŸÑÝÙF 9, c ^ %ox² --all ø. ?

À1á' ©<fv - Kï ©<

—EZ[suW- ï noØÓ• , ¼« kF > ¥k È- Å91DI æã ötrunkPtags > > ø? pe: @a
trunk | æã " t í W- Cå D™D. æ5æã F filter-branch í 9, ¶Ef ž a %O

```
$ git filter-branch --subdirectory-filter trunk HEAD  
Rewritten 856f0bf61e41a27326cdæ8f09fe708d679f596f (12/12)  
Ref 'refs/heads/master' was rewritten
```

Y \$™. æ5æã i trunk | æã ^? Gitj ÉÝ9} fk Ç÷) | æã DCå ?

ÐÑ~• gØE€

uW- €\$DoÚi \$f, ¹ µ" | øâ ÝÙgit config SEÓf D) yŠKP5¢F JKf: @_ , ï W-
. æ» ¥» f fk f Dµ" KP5¢tf D- %KP5¢? øboÚ< Ff í 9, o\ filter-branch SW
t - » fe- Cå ¼DKP5¢? , @uvDi - » ff ÉmDKP5¢Ff, f. ' --committ-filterO

```
$ git filter-branch --committ-filter '  
È if [ "$GIT_AUTHOR_EMAIL" = "schacon@local host" ];  
È then  
È GIT_AUTHOR_NAME="Scott Chacon";  
È GIT_AUTHOR_EMAIL="schacon@example.com";  
È git committ-tree "$@";  
È else  
È git committ-tree "$@";  
È fi ' HEAD
```

òj [æ» mLí W- Cå SÖmf D™KP5¢? st Cå Öm^· ' &Cå D SHA-1 NI BF ò- - ^ %oj
» ff DæØ¼Dí W- Cå D SHA-1 NI BF &Çgg- i ž" éPKP5¢DCå?

â' ØÔ

\$µ¶^· ~ C, Dµ¶âF¥' ¹ ≠ OW< Git D reset B checkout ^ %? \$ÜnD Git ^ %¼Fò! -
i ¥a%STD? · ' ° %ol enoFf, • ÈS¥' | ®žg5€• > + ø5Y' · ' ? ±yòWQF ¥'
¹ S‰W- } ~ D> ~ ?

3Øð

€• reset B checkout D¥} 1WF—i „ Git D, ú` - ó[" t A~ý€ðøSý€÷™ÇOD%?
Ø%Ø \$¥' òJ D...É9, i Ø½~ D£í ØF&Çi • ° » D‡?" ¢? ø\$ì " øç<' - • ÈS> Ç
ÃW™%F Ç\ ¥' ¥\$DæDi ' } ~ D12, ... ?ø

Git " t W- • , Fi „ · DWcT " Sý€> T šò÷™%DO

| | |
|-------------------|----------------------------|
| Ó | ' Y |
| HEAD | ÑWt Cå D½F F < Wt Cå D&" Q |
| Index | - ND< Wt Cå D½F |
| Working Directory | • > |

HEAD

HEAD i øâ] Ÿ- ' D• ±F· Bi • NC] ŸÑD¥| Wt Cå? ð° © HEAD [i < Wt Cå D&" Q? o€F€• HEAD D¥} 12F—i [. • % ÖLÓ‡KÅí 1• | } D½F?

...Fä • ½F DÄI I ~í ? < H—# ©^ HEAD ½F ...É Dæã W° F „ B ¼Í - ½~ D SHA-1 NI
BO

```
$ git cat-file -p HEAD
tree cfda3bf379e4f8dba8717dee55aab78aef7f4daf
author Scott Chacon 1301511835 -0700
committer Scott Chacon 1301511835 -0700
```

initial commit

```
$ git ls-tree -r HEAD
100644 blob a906cb2a4a904a152... README
100644 blob 8f94139338f9404f2... Rakefile
040000 tree 99f1a6d12cb4b6f19... lib
```

Git D **cat-file** B **ls-tree** i : ; ^ %oF· ' Wc' S: ; µ" F\$reµ" ¼> Ç. ' ? Ç\· ' ° \$€
¥' ^• T: ¿ó^` a?

À.

' - i f D xî KÅ1• | } ? ¥' í j [ð- < Ø- ' t Git DÒ! " ' ØF ð—i øf ÝÙ **git commit**
| Git • ÈSDÄI ?

Git [ÑWt GXTµ" æã ¼Dfk ½~ Üj T' - ' F· ' • ÈS—Å¥Ü{ GX| DÄI ? è| f j [
¼W" ½~ . | t ™7! F³ Èo\ **git commit** [. ' ^ | t %S" " ™DCå?

```
$ git ls-files -s
100644 a906cb2a4a904a152e80877d4088654daad0c859 0 README
100644 8f94139338f9404f26296befa88755fc2598c289 0 Rakefile
100644 47c6340d6459e05787f644c2447d2595f5d3a54b 0 lib/simplegit.rb
```

d¬Wt F¥' \$òJ N' T^ **git ls-files** ð- A| D^ %oF· j #©X' – øâ DÄI ?

- { S - F' - \$ • • Ñ> * %" \$F. ... i „ œxD%~ ... YD? Ç\y¥' &x F ä. ☉‰%-p ^?

² j ©<

¥| Ff — k ^ ÉmD ² j ©< óo€í ô ² j Áø? uL! ™%, W8cŽh> Ç...° D1 2F [. ' DA ~" # \$. gi t ½~ ¹ ¼? µ" æāj [. ' • Œt ... ÉD ½~ „ ¬' š? f 9 „ äµ" æä ☉‰ ØÙ? \$f [» f CåT! " ' > åãTæØèåF 9 „ X9~ f ?

```
$ tree
```

- ž ž README
- ž ž Rakefile
- ž ž lib
- ž ž simplegit.rb

1 directory, 3 files

² j dÚ

[mD Git µ" ī Œi o\ī šò÷ - ' ī S „ ~ • - ¶ DÔÖåã. æ½F D?

a ¥' S9i 6ò- \ÔO—E ¥' Ôk TW- ™æã F ¼kW- ½~ ? ¥' ü t C ½~ Dv17! F [. çåt l ç? Y\$ÝÙ gi t ini tF òj %í W- Git à áF ¼D HEAD - ' • N4%í D master] Ÿ?

ã | F - k μ" æã k A ~ ?

Y \$ ¥' : @Cåò - ½~ F f „ ' gi t add SOPμ" æã ¼DA ~ F > [A ÓT' - ¼?

³ È Ý Ü **gi t commi tF· j PÒ' – ¼DA ~> [· z " t W- Ž Ò D½FF d | %í W- • NC½F DC
å y < F ¥ | ~ ™ master S • N! t Cå ?**

ã | p e ¥' ÝÙ gi t **status**Fj ð YÁkœb f Ý F s t Y \$ ÷ ™%ôŽ / O?

Y \$ ¥' : @y ½~ ÔÙ» f d | Cå· ? ¥' [j [æOÄD\ Őú' ¹ \$μ" æã ¼» f ½~ ? ¥' ü t C½~ D v2 7! F > [· çât { ç?

pe Y\$ Ý Ù **git status** F ¥' j • T ½ ~ # © \$ ØChanges not staged for commit Ø < Ü > { ç â t {
ç F s t Cž æ \$' – Š µ" æ ä è ÷ " \$ Ç O? ³ È ¥' Ý Ù **git add** S [· ! " T' – ½ ?

ã | F° §' – B HEAD ÇOF ¶ ÝÙ **gi t status** Ds –j • T Øchanges to be committedØ < DC½~
g t ? ç ÑÑí —i ¬FY\$ - ND<Wt Cå ŠÑWt Cå ÇO? ¥ | F ¥' ÝÙ **gi t commi t SôfC**
å?

Y\$ÝÜ **git status** j ÁkyXFst ÷™%NgÖ/ O^?

{ |] ÝJ qr D\Öí » ¼? ☾GXW-] Ý| F· j » f HEAD • N™D] Ý- ' F[Á. Üj t Ct C
å D½FF d| [Á. DA~AÖT ²j ©< ¼?

â' Kj '

\$ „ <oÄ¼° **reset ^ %oj ~ k 91 ?**

t ^ É©ò" HI F—E¥' dt » f ^ **file.txt** ½~ > U÷t Cå· ? Y\$DæÖ• ÈSi ðÄDO

a ¥' ÈÈ **reset** • • • Í %o^` a? . „ W8} ~9- \$D1 2...³ Í š ð ÷ ™%? . %o^ ÷ - ×! Í " ?

O 1 >Í ÅÅ HEAD

reset %DUW~ ni 9Ý HEAD D• N? òŠf g HEAD É - ÇOó**checkout** f%oDøú**reset** 9Ý
HEAD • ND] Ý? ò9àÈpe HEAD E Ót **master**] ÝóHpFf g \$ **master**] ÝÑøF ÝÙ gi t
reset 9e5e6a4 [j . **master** • N 9e5e6a4?

ÅPf * ' ^b 8Ú2Dýk W- Cå D **reset** F· ' ' 1 ī j , + ðÄ‰? . ' **reset --soft** F· [gg> \$ž <?

Y\$• Wj ÑÜF €• W< ÓDnoO. ! MÑi çd ^ ÑWt **git commi t** ^ %o? xf \$ÝÙ **git commi t** ; F Gitj %í W- ™DCå F> 9Ý HEAD f• ND] ÝS. • NCCå? xf [. **reset** Å HEAD~ÓHEAD D&" Qø ; F ...—i äC] Ý9ÝÀ>SDÊÓF &Cj fg' - Bμ" æä? Y\$f 9,, ~ ™' -> dt ÝÙ **git commi t** Sôf **git commi t** --amend f@‰Dno^ó\$ » f ¥| Wt Cå ø?

O 2 > 1 - - Å. b--mixedc

O9F pef Y\$ÝÙ **git status** Ds F—j • T™D HEAD B,, ? çç XD· B' - è ÷ D' ï ?

³ <SF **reset** j ' HEAD • ND øâ ½F DA~S~ ™' - ?

pe • » --mixed∅. F reset [j \$ò! > Ç? òí i ³ | Ùt Ff „ peÁk • » œbø. ö\$! H¹⁴⁻
i git reset HEAD~∅Fò—i ^ %o[j > ÇD51?

Y\$d•Wj NÜF€•W<çöDnoO••dj çdWÑt CâFhj j \$™t _fk DKL? Si F¥
' Å—T^fk git add B git commi t D^ %o, Üèâ?

O 3 >† ¬ - ² j ©-hardc

reset @%oDDU÷ ~ no—i aμ" æä• ÈSÃ' – ? pe. ' --hard∅. F· [j μ¶òWÈ?

Y\$ a ¥' Å: W<Ø' ð óDno? f çd ^ ¥| DCå Pgi t add Bgi t commi t ^ %o + U µ" æä ¼ Dfk µ" ?

®¶O9F --hard çâ i reset ^ %oì WD, 3' WF· í i Gitj žg 5dY‡? Dgk DĒ - ī " èW?
6œbÚ2D reset *' ī 9, æççèFhi --hardø. Ç° Fst · ² Óñ• ^ µ" æä ¼D½~?
\$ò8° RoÇ<F ¥' DGit‡? á ¼DW- Cå Aj 1k C½~ Dv3 7! F ¥' 9, o\ refl og SÙA
· ?hi ¶C½~ j 4Cå F Git øj ñ•· s &< ÚÅW@A?

ÜÜ

reset ^ %oj „ ° » D...œmL ò ÷ ™%F \$f • » „ <Ø. | > ÇO

1. 9Ý HEAD] ÝD• NÚ] - Ôß --soft&° l 6» ¼Ü
2. . ' - • ÈSÃ HEAD Ú] € - Ô --hard&° l 6» ¼Ü
3. . µ" æä • ÈSÃ' -

f₂⁻¹ o j̄ a'

â Üœl ^ **reset** x! Ú2DÙt FÇ\ f j 9, c· CDW- " ' Ⓛ· ? ¶• » ^W- Ⓛ· F **reset** [j • \ U 1ÈF> ¥[· D" ' >• ý» t • » D½~ J ½~ È† ? öÄ‰Édk· Dj €Fst HEAD - i W- • ± Ff ÅWa· O! • N! - Cå ¼ùÉDW\] ? Ç\ ' - Bμ" æã' 5N\ë¿Ff, mÓj μ¶j Ô ÙU 2þ3È?

Y\$F—p¥' ÝÙ **git reset file.txt** Óò ...i **git reset --mixed HEAD file.txt** D} LÚ 2Fst fŒAk• » W- Cå D SHA-1J] ÝFí Åk• » --softJ --hardøF· j O

1. 9Ý HEAD] ÝD• NÚ½¾ÅÛ

2. a' - • ÈSÃ HEADÚì 6ç » ¼Û

f „ . ! MÑ- i [**file.txt**s HEAD AÓT' - ¼?

· j k \$™t _Rc D...ÉŽe? pe¥' ä• C^ %oD©9ÙFd| d: : **git add** f‰DnF—j ¿ Y

· · g 5/ \ ?

ò—i t ` a git status ^ %oDy Xj í ; ÝÜä ^ %oSPè! " W- ½~ ? óä • Pè! " D½~ S ^
• ~ e? ø

¥' 9 „ Ça Git s HEAD I P‡? F & i o\ ¶¹ • » W- Cå S I PC½~ Dy - 7! ? ¥' - , ÝÜ» ¼
§ git reset eb43bf file.txt D^ %oj 9?

· ...‰^ OÄDnoFí —i äμ" æã ¼D½~ @AT v1 7! F ÝÙ gi t add• • · F d | d [· @A
T v3 7! ó~ i Ç' ž D\W[ò" Èj ø? pe ¥' Y\$ÝÙ gi t commi tF· —j âãWž Ò[C½~ @
AT v1 7! ÓD~ f F Qý ¥' > 4\$μ" æã ¼ž g 5dt / k· ?

j k WQO gi t add WÄF —i reset ^ %oí 9 „ ³ ` W- --patch ø. SW- W- 5Pè! " DA~? ò
Äf—9 „ 5? øùSPè! " J @AA~^?

È È

¥' S•• p b †' ò8™D• ° S‰W" k TDnoÑÑ‰ŠCå?

—Ef DW• WCå MR ¼k Òoops.ÓÒWIPÓ B Òforgot this fileÓF þ ÑDf —° . ' reset Sæç ½
¾5[· ' %oŠf ~ - Cå Fí # Xf Dþ Ñ? ó‰ŠCå Å ©^ uW812FÇ\ \$! H¼' reset ~ }
~? ø

—Ef k W- . æF UWt Cå ¼k W- ½~ F UVt Cå " • ^ W- ™D½~ > » f ^ UW- ½~ F U÷t C
å dt » f ^ UW- ½~ ? ° § UVt Cå i W- 4ôfDμ" Fsäf: @‰Š· ?

ž a 9 „ ŸÙ gi t reset --soft HEAD~2 S[HEAD] Ÿ 9ŸTW- mWQDCå Ñój f : @z 1 D¥
UDCå øO

d | - , d t ÝÙ gi t commi tO

Y\$ f 9 „ ä • 9 T Ä DæÖF j [j € u DæÖF Y \$ • È S k - v1 7 file-a. txt DCå F ³ È UV-
Cå [file-a. txt » f f ^ v3 7 > " • ^ file-b. txt? Õm v2 7! D½~ Z [Ç\$æÖ¼^?

š ī

¥ | F f † < j : ä | checkout B reset è ÷ D' ī ? B reset WÄF checkout ī ī š ÷ ™%F Ç \ ·
k WQÇOF Ò PZ § f i ^ a x c C ^ %oW- ½~ ¢ . ?

5 Y¹ °

ÝÙ git checkout [branch] ŠÝÙ git reset --hard [branch] * €/¼F· j ~ ™fk ÷ ™%.
• ÈSĀ [branch] FÇ\K! Qm@D' i ?

' 1 ÇOS reset --hardF checkout yμ" æä i ÚŽDF· j o\GäS~ zÇj [Z~f D½~ ~ . ? ... j ~ pÑW" ?· j \$μ" æä ¼¹ + È} ~i > W< FòÄfk_j 4» f \D_½~ ī j { ~ ™? & reset --hard • j Ç‰Gä—ŽÜ5. | fk KL?

UV- m@D' i i checkout pb ~ ™ HEAD? reset j 9Y HEAD] ŸD• NF & checkout - j 9Y HEAD É- S• NuW-] Ÿ?

HpF—E¥' k master B develop] ŸF· '] i • NÇODCåú¥' Y\$\$ develop Ñóf „ HEAD• N· ø? pe¥' ŶÙ git reset masterFža develop É- Y\$ j B master • NOW- C å? &pe¥' ŶÙ git checkout master Ds F develop Çj 9Y F HEAD É- j 9Y? Y\$ HEAD [j • N master?

f „ Fcd\$ò! 8oÇ<¥' ī 9Y HEAD. • N^Cå AF h_%oW_i * €ÇOD? reset j 9Y HEAD] ŸD• NF & checkout • 9Y HEAD É - ?

Ý 1 °

Ý Ù **checkout** DuW812—i • » W- ½~ ¢. Fòj Ā **reset** WÄÇj 9Ý HEAD? . —Ā gi t **reset** [branch] fi lež Ä' Ct Cå ¼Dž - ½~ S~ ™' – Fhi . í j ñ• μ" æä ¼y~ D½~ ? . —Āi gi t **reset** --hard [branch] fi leópe **reset** L8f òÄÝÙDsøF òÄyμ" æä> Ç ÚžF . í Çj 9Ý HEAD?

ã LFO gi t **reset** B gi t addWÄF **checkout** í ³ ` W- --patchø. FL8f 5? øùW- W- 5 @A½~ A~?

¢ E

' ' f Y\$ŒØ> €• ^ **reset** ^ %oF Ç\ G§. B **checkout** è ÷ D' i Ff 9° j i j k QSTF μ€Ç t 9° å‡ÇO* ' Dfk =• ?

< ÜD¾ä° WX ^ ^ %o y %D÷) ? ØHEADÓ WW¼D ØREFÓ° ©C^ %o 9Ý ^ HEAD • ND] Ý- ' F & ØHEADÓ • ° ©- 9Ý ^ HEAD É - ? ° i O9 WD Safe? WWÑÑpe. çât NOF ža ÝÙC^ %o è å G..._W< ?

| | HEAD | Index | Workdir | WD Safe? |
|---|------|-------|---------|----------|
| Commit Level | | | | |
| reset --soft [commi t] | REF | NO | NO | YES |
| reset [commi t] | REF | YES | NO | YES |
| reset --hard [commi t] | REF | YES | YES | NO |
| checkout <commi t> | HEAD | YES | YES | YES |
| File Level | | | | |
| reset [commi t] <paths> | NO | YES | NO | YES |
| checkout [commi t] <paths> | NO | YES | YES | NO |

ÞÍ ÷ Ø

\$ Git ¼î > i / ø~í D? st Git. etí > uW-] ÝgØI ~í Fò9àÈf 9,, kW- ¹, z { ¥™ D, N] ÝF [€• ZÛDUVF> \$W• WCå | • ZW- I + DUV@5?

d&Fk | í j k ¾~DUV? ÇÄ 6D7! ØÓ• , F Git> Çj , +\§þÑDí > UV• Z1e? Git Dt hi þÑ5Z» Åd1Dí > 1eFhi pekUVF. Çj , +Ø° 5ÉÝ• Z. ? sāFpel ðè | ' î > ! -] XD] ÝFf 9° j i ÑW" I " ?

\$! ? ¼F¥' [j ¢^ ä• ž" l " i ` a „ B Git c ^ ¥' ` a μ¶S¢£¥' AE€ò" ~ ®=Do Ú? ¥' í j ^ • f 9,, %oDÇODP* ç† » z Dí > Fí j • Tpb | xTí > èå?

÷ ØÚÛ

¥' \$ nTUV| D] Ýí >) * ^ • Zí > UVDW" ×ØäwF y§~ A¾DUVF Git CD^ È- μ¶ S¢£f • X[j ðó` a „ Bpb~ 55AEUV?

' 1 F \$%Wt 9° K UVDî > àQ9° z Oμ" æä i . ÜD? pef kg \$%Dμ" F @a Cå TW-
ä |] Ý@a #\$. ? ò. f 9,, çè\$òJ , +%D ÑB<" ? pe\$f , +Wt î > | μ" æä ¼k 4z
" Df ÝF <ÜDò" • " 9° j . f . /ž" μ" ?

a ¥' o\W- * €} ~DHI S^• W<? ¥' k W- .. ©} ~Dê (hello world D Ruby ½~ ?

```
#! /usr/bin/env ruby
```

```
def hello
  puts 'hello world'
end
```

```
hello()
```

\$ ¥' Dà á ¼F %í W-) t whi tespace D™] Ý> [fk Unix | Üz » ft DOS | Üz F ...MÑc d
fg ^½~ Dí WÜF hf gDí - i Í Wyz ? d | ¥' » f Ü Òhello worldÓ t Òhello mundoÓ?

```
$ git checkout -b whi tespace
Switched to a new branch 'whi tespace'
```

```
$ uni x2dos hello.rb
uni x2dos: converting file hello.rb to DOS format ...
$ git commit -am 'converted hello.rb to DOS'
[whi tespace 3270f76] converted hello.rb to DOS
1 file changed, 7 insertions(+), 7 deletions(-)
```

```
$ vim hello.rb
$ git diff -b
diff --git a/hello.rb b/hello.rb
index ac51efd..e85207e 100755
--- a/hello.rb
+++ b/hello.rb
@@ -1,7 +1,7 @@
#!/usr/bin/env ruby
```

```
def hello
- puts 'hello world'
+ puts 'hello mundo' ^M
end
```

```
hello()
```

```
$ git commit -am 'hello mundo change'
[whi tespace 6d338d2] hello mundo change
1 file changed, 1 insertion(+), 1 deletion(-)
```

Ý\$¥' { | À¥' D master] Ý> t 5‡" • W" OÑ?

```
$ git checkout master
Switched to branch 'master'

$ vim hello.rb
$ git diff
diff --git a/hello.rb b/hello.rb
index ac51efd..36c06c8 100755
--- a/hello.rb
+++ b/hello.rb
@@ -1,5 +1,6 @@
#!/usr/bin/env ruby

+# prints out a greeting
def hello
  puts 'hello world'
end

$ git commit -am 'document the function'
[master bec6336] document the function
1 file changed, 1 insertion(+)
```

Ý\$¥' , +î > K¥' D whi tespace] ÝFst » f ^í Wyz Ff , î > j XYUV?

```
$ git merge whitespace
Auto-merging hello.rb
CONFLICT (content): Merge conflict in hello.rb
Automatic merge failed; fix conflicts and then commit the result.
```

I à 1 • ÷ Ø

¥' Y\$K Æ- Ø. ? ' 1 Fa¥') * pbEJ ò- oÇ? f 9° Ç: ÅEUVò8oÇF õŽ9, o\ git merge --abort S} ~5×Xî > ?

```
$ git status -sb
## master
UU hello.rb

$ git merge --abort

$ git status -sb
## master
```

git merge --abort Ø. j , +@ATf ÝÙî > à DÔÖ? h ÙÝÙ^ %oâ F \$µ" æã ¼k 4# \$P4 CåD» f | . Ç° ô‡Æ€F} åèL. Íµ" 5I 5?

peX\$1 " >sf: @mSWt Fí 9, YÙ gi t reset -hard HEAD AT NWt Cå DÔÖ?
Gcââ | œb 4Cå Dµ" ī j . / Ff, G- | f Ç, @z 1 œbf Y?

◦ » Uá

\$ò- ° » DHI ¼F UVŠÍ Wk G? ¥' äj òQi stò- HI I } ~Fhi \$...ÉDHI ¼¿ YòÄ
DUVÍ I ~í Fstí WÙT { 9} &\$uWþí WÙN{ • ÅS^? ³ | oÇ<FGit | tfkò" ÙT f
Y^Ff, · Çj ī > ½~ ?

³ | ī > 459, ýk; ‡F ¼DÈ- g5i GSÈ5Í Wf YD? pef • T\$Wt ī > ¼k + CGSÍ
WDI " Ff 9, ...³ ¼Ç· > m‰Wt F òt. ' -Xi gnore-al I -space J -Xi gnore-space-change
ø. ? UW- ø. \$> HÙ| oD° » ī W» f FUV- ø. [W- ī Wz Še - - ¶DÍ Wyzi " > q
D?

```
$ git merge -Xi gnore-space-change whi tespace
```

Auto-merging hello.rb

Merge made by the 'recursive' strategy.

Êhello.rb | 2 +-

Ê1 file changed, 1 insertion(+), 1 deletion(-)

st \$! H¼F ...ÉÑ½~ » f > Ák UVFW• ¥' È5Í W» f Fí WÙT ° { | 55 ī > ?

pef Dwx ¼DÍ - %9° Çûv m™š 26Í št Ó° z JK/ \DÍ " Fòj i W- ø^ ¥^a ?

âÅ-, ã ÷ ø

cd Git yÍ WD- Å€‰ÒI 5Fj kI e 6» z D» f FGití 8ÅWÉ YÅ€€Fhi ý! 9, Å€·
' ? HpF—E Git ÅWÅ€€Í W» f sã ¥', @~ YÅ€€?

¥' žg: @‰Di y[@ī > kD½~ \$žgî > âYÙ dos2uni x Öœ? f, pež ÄDs F ¥' Cpb
‰Å

' 1 F ¥' Ôk T^ī > UVÔÖ? d | ¥' : @¥D7! D½~ F6' D7! D½~ ós ¥' [@ī > kD
] YØB&OD7! D½~ ós] YX, | DÈÓØDxy? d | ¥' : @» AœbWþD½~ F > ¥t ò-
~ 2D½~ m+ Wt ī > ?

OÒò÷ - ½~ 7! ...ÉÑ/ ø~í ? Git \$' - ¼" # ^fkò" 7! F \$ ØstagesØ <í W- ī kW- ‡
yŠ. ' GÃ? Stage 1 i . ' &OD] 1 7! F stage 2 i f D7! F stage 3 SÉS MERGE_HEAD Fj f [@
ī > kD7! öØtheirsØø?

o\ gi t show ^ %šW- ° i DŒWF f 9, [UV½~ Dò" 7! Ñ< XW° xy?

```
$ git show :1:hello.rb > hello.common.rb  
$ git show :2:hello.rb > hello.ours.rb  
$ git show :3:hello.rb > hello.theirs.rb
```

pef: @~ C, WQFí 9, . ' ls-files -u: ; ^ %SØTò" ½~ D Git blob y < D...É SHA-1

r?

```
$ git ls-files -u  
100755 ac51efdc3df4f4fd328d1a02ad05331d8e2c9111 1    hello.rb  
100755 36c06c8752c78d2aff89571132f3bf7841a7b5c3 2    hello.rb  
100755 e85207e04dfdd5eb0a1e9febbc67fd837c44a1cd 3    hello.rb
```

: 1: hello.rb - i äÙž - blob y < SHA-1 r D} L?

Œd \$ ¥' Dμ" æä ¼Z [kòfk ÷ - ^ f DA ~ F ¥' 9,, ~ μ» A· ' S » A ī WI " F d | . ' Z t
%ä D git merge-file ^ %S m™î > ž - ½~ ?

```
$ dos2uni x hello.theirs.rb  
dos2uni x: converting file hello.theirs.rb to Unix format ...
```

```
$ git merge-file -p \  
È hello.ours.rb hello.common.rb hello.theirs.rb > hello.rb
```

```
$ git diff -b  
diff --cc hello.rb  
index 36c06c8..e85207e..0000000  
--- a/hello.rb  
+++ b/hello.rb  
@@@ -1,8 -1,7 +1,8 @@@  
È #! /usr/bin/env ruby
```

È+ prints out a greeting

```
È def hello  
-   puts 'hello world'  
+   puts 'hello mundo'  
È end
```

```
È hello()
```

ÒI ¥' Z[uv5î > ^ž - ½~ ? ... È ÑFò > . ' ignore-space-change Ø. @~ 5Fst \$î >
âžg5» A^ī W» f &Çi } ~5È5. ' ? \$. ' ignore-space-change ØÙî > ī " | F ¥' ¥,
ØT ^k È Ùi DOS Ùå D½~ F s &. Cå A~ī â ^?

p e f : @\$¥, Cå â • W<¥' òþŠuWþè ÷ ... È D» f F f 9,, . ' git diff S> H[@Cå "t
î > " e Dμ" æä Š ¼œ9W- ^ f D½~ ó• ? a ¥' • • . ' ?

@\$î > â > H" e Š \$f D] ÝÑDA ~ F | W| s - F • • î > - k ^ ` a F 9,, ÝÙ git diff
--ours

```
$ git diff --ours
* Unmerged path hello.rb
diff --git a/hello.rb b/hello.rb
index 36c06c8..44d0a25 100755
--- a/hello.rb
+++ b/hello.rb
@@ -2,7 +2,7 @@
```

```
#!/ prints out a greeting
def hello
- puts 'hello world'
+ puts 'hello mundo'
end

hello()
```

○J ¥' 9,, I ~í 5• T\$¥' D] ŸÑçó^` aF\$òtî > ¼¥' ...É–kTò-½~ Df ŸFi » f
^ ¼WÜ?

pe¥' : @ä•î > D" eŠ6' žþk` açOF 9,, ŸÙ git diff --theirs? \$! Hß | ¶DHI
¼F¥' j . ' -b S] } Ÿ WFst ¥' [· Š Git ¼DF &Çi ¥' %€\ D hel l o. thei rs. rb ½~ >
H?

```
$ git diff --theirs -b
* Unmerged path hello.rb
diff --git a/hello.rb b/hello.rb
index e85207e..44d0a25 100755
--- a/hello.rb
+++ b/hello.rb
@@ -1,5 +1,6 @@
```

```
#!/ /usr/bin/env ruby
```

```
+# prints out a greeting
def hello
- puts 'hello mundo'
end
```

¥, Ff 9,, o\ git diff --base Sä • ½~ \$! þi þbf ŸD?

```
$ git diff --base -b
* Unmerged path hello.rb
diff --git a/hello.rb b/hello.rb
index ac51efd..44d0a25 100755
--- a/hello.rb
+++ b/hello.rb
@@ -1,7 +1,8 @@
#!/usr/bin/env ruby
```

```
+# prints out a greeting
def hello
- puts 'hello world'
+ puts 'hello mundo'
end

hello()
```

\$ git clean -f

```
Removing hello.common.rb
Removing hello.ours.rb
Removing hello.theirs.rb
```

ští úú

í 8k | ¥' > Ç@9òÄD• Z1eFJ8k | j @~ ¥' šWþJK! þDUVFhj i • mÅWg€μ
" Fò | ¥' , @~ eDÑ<½GÄS• Zò" UV?

a¥' S` êf ¥<HI ? y§! HF¥' k! - „ N] ÝFÍ W-] ÝI kÈ- CåFhi \$î > | é%í
^W- î €DUV?

```
$ git log --graph --oneline --decorate --all
* f1270f7 (HEAD, master) update README
* 9af9d3b add a README
* 694971d update phrase to hol a world
| * e3eb223 (mundo) add more tests
| * 7cff591 add testing script
| * c3ffff1 changed text to hello mundo
|
* b7dcc89 initial hello world code
```

Ý\$k - \$ master] ÝÑD÷t ~ 2CåFj k 6÷t Cå \$ mundo] ÝÑ? p e¥' , + [mundo]
Ýî > k master] ÝF¥' ØTW- UV?

```
$ git merge mundo
Auto-merging hello.rb
CONFLICT (content): Merge conflict in hello.rb
Automatic merge failed; fix conflicts and then commit the result.
```

¥' : @• W<† > UVi ` a? pe ¥' ê , ð - ½~ F ¥' [j • T » ¼< ÜDA~O

```
#!/usr/bin/env ruby
```

```
def hello
<<<<< HEAD
È puts 'hol a worl d'
=====
È puts 'hello mundo'
>>>>> mundo
end

hello()
```

† > D! þī Nð - ½~ " • ^A~Fhi « ÚUVÐ>si ¼W" Cå » f ^ ½~ DOW- 51?

a ¥' þ' W<Y\$f ~þ9' Sä Ñð - UVi þbQðDþ¶? - Cþb» Að - UV• ÈSJ 8> ÇÑ
#? ð | f , @~ e Ñ< ½?

W- I k' Dþ¶i ý --conflictø. Dgit checkout? ðj m™GX½~ > . | † > UVçâ? pe
: @mÓçâ> , +dt • Z· ' Dsðj l k' ?

9 „ x² c --conflict ; þ di ff3 J mergeð³ | ø. ø? pexc. di ff3F Gitj . ' W- 5êÇO
7! DUVçâ O Çgg - cf ÐoursÓ B ÐtheirsÓ 7! FO| i j k ÐbaseÓ 7! \$¼÷Scf ~ eD
Ñ< ½?

```
$ git checkout --conflict=diff3 hello.rb
```

W• ¥' ÝÙ. F ½~ • ÈSj Å< ÜðÄO

```
#!/usr/bin/env ruby
```

```
def hello
<<<<< ours
È puts 'hol a worl d'
||||||| base
È puts 'hello worl d'
=====
È puts 'hello mundo'
>>>>> theirs
end

hello()
```

perf RQò8š2F9 „ o\ EÓmerge.conflictstyle ø. t diff3 S‰ot „ | i > UV D³ | ø . ?

```
$ git config --global merge.conflictstyle diff3
```

git checkout ^‰í 9 „ . ' --ours B --theirs ø. Fòi W8Å, i > D½¾1 2Ff9 „ øù1 < WþD» f &. öÓuWþ» f ?

øk VÔÓ½~ UV! ð9° j ° i k' Fst9 „ } ~5øùWþFJK9 „ - i > uW-] YD° » ½ ~ ÑÑ9 „ %oWt i > d | \$CåâGXWþJuWþD° » ½~ ?

÷ø .. ©

uW- • Z i > UVk' Dþ¶i git log? ð9 „ ¢Ef ØTž " yUVk ÷) DÑ<½? Å" WQæÖS åÈt` a! žKÑD, ¿j ¶i OWî nok{j l k' ?

t ^ØTåt i > ¼ÓmDí W-] YDfk2i CåDW° F ¥' 9 „ . ' èå \$ <÷Qhi DÒ÷QÓŒ W?

```
$ git log --oneline --left-right HEAD...MERGE_HEAD
< f1270f7 update README
< 9af9d3b add a README
< 694971d update phrase to hol a worl d
> e3eb223 add more tests
> 7cff591 add testing script
> c3ffff1 changed text to hello mundo
```

ð- uv DW° Óm6 - CåBí W- Cåf\$DÇO, ¿¢. ?

¥' 9 „ o\ ~ • ° » DÑ<½SØWÈ } 6ð- W° ? pe¥' • • --merge ø. T git log ¼F· j - # ©œbWþ³ ¶i ^i > UV½~ DCå ?

```
$ git log --oneline --left-right --merge
< 694971d update phrase to hola world
> c3ffff1 changed text to hello mundo
```

p e f Y U ^ % o l ' - p ø . n . F f j Ò T f k U V ½ ~ D ' i ? ½ ¾ O Ò f , @ F E € • t ` a ð ó U V D
Ñ < ½ F „ B p b þ Ñ 5 • Z · F ð j \ ä k ' ?

W ÷ N] ^ • N

s t Git ! " i > f • D " e F ø f \$ i > U V Ó Ó < Y U g i t d i f f | F - j Ò T Y \$ j \$ U V Ó Ó D ' i ?
ø , @ ä • f j , @ • Z p " U V | ð l k ' ?

\$ i > U V | ...³ Y U D g i t d i f f j c f W - / ø 2 ° D y X š 2 ?

```
$ git diff
diff --cc hello.rb
index 0399cd5, 59727f0..0000000
--- a/hello.rb
+++ b/hello.rb
@@@ -1,7 -1,7 +1,11 @@@
Ê #! /usr/bin/env ruby
```

```
Ê def hello
++<<<<< HEAD
Ê+ puts 'hol a worl d'
+=====
+ puts 'hello mundo'
++>>>>>
Ê end

Ê hello()
```

ò 8 ò " Ò u i 2 ò • Ó D š 2 j \$ í W Ù c f ! W ï ? ? U W W t f # © Ò ours Ó] Y Š μ " æ ä D ½ ~ ' i
í ò • • J å } ø F U V W # © Ò theirs Ó] Y Š μ " æ ä D x y ' i ?

f , \$ Ñ Ü D H I ¼ 9 , • T <<<<< Š >>>>> Ù \$ μ " x y ¼ h i > Ç \$ i > D œ 9 W p ¼ ? ò l k 9
1 F i > μ ¶ s t ¥' D Ñ < ½ { S ï ^ F . N ' ¥'] 9 } . ' ?

p e ¥' • Z U V d t Y U g i t d i f f F ¥' [j • T O Ä D n o F h i . k W Q F E ?

```
$ vim hello.rb
$ git diff
diff --cc hello.rb
index 0399cd5, 59727f0..0000000
--- a/hello.rb
+++ b/hello.rb
@@@ -1,7 -1,7 +1,7 @@@
Ê #! /usr/bin/env ruby
```

```
Ê def hello
-   puts 'holo mundo'
Ê-   puts 'hello mundo'
++   puts 'holo mundo'
Ê end

Ê hello()
```

ÓJ # ©X Óhola mundoÓ \$¥' òþhÇ\$µ" xy¼Fž - Óhello mundoÓ \$6' žþhÇ\$µ" xy¼F ¥, Óhola mundoÓ Ç\$œbWþhi Y\$\$µ" xy¼? \$Cå• Z1eâòyMuI k' ?

í 9,, \$î > | o\ git log SOP/OMRFä• UVi pb• ZD? pefyw- î > CåÝÙ git
show ^ %o Git [j yXò8š2F J Kf í 9,, \$ git log -pó³ | oÇ<C^ %o- j Ácj Ákî > DI
J ø^ %oè | • Ñ --cc Ø. ?

```

$ git log --cc -p -1
commit 14f41939956d80b9e17bb8721354c33f8d5b5a79
Merge: f1270f7 e3eb223
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri Sep 19 18:14:49 2014 +0200

Ê Merge branch 'mundo'

Ê Conflicts:
Ê     hello.rb

diff --cc hello.rb
index 0399cd5, 59727f0..e1d0799
--- a/hello.rb
+++ b/hello.rb
@@@ -1,7 -1,7 +1,7 @@@
Ê #! /usr/bin/env ruby

Ê def hello
-   puts 'hol a worl d'
Ê-   puts 'hello mundo'
++   puts 'hol a mundo'
Ê end

Ê hello()

```

ÓÔ÷ø

cdfZ[äj pb%í W- î > CåFhk| X™i \$f®YD? . ' Git ¥ÂDW~ noi î ™i 9„ DF
st k9° ó†e‡oÇ<í I ~í ø» A. ' ?

î > Cå> ÅÇO? —EY\$\$W- å"] ÝÑµ" FÇüv[î > T master ¼FY\$Cå æÖ• ÊSi
ðÄO

Figure 138. „À#•Ž†‡

k! 81 WS•Zò- I " FòPZSf: @D" ei ` a?

~å. '

peò- Ç: @Dî > Câ " \$§f D! 5àá¼F¥} ~¥¥5D• Z1ei 9Ý] ÝTf: @. • ND5
1? te‡oÇ<Fpef \$™1 Dgi t merge | ÝÙgi t reset --hard HEAD~Fòj mÓ] Ý• Nf
„· · • ÈSÃòÄO

Figure 139. H git reset --hard HEAD~ Lå# - ®

¥' èâ \$ mÓ() Z[) * ^ resetFf „ Y\$• XòJ ¿ó^` a> Çi | S®? a¥' ½¾Ai
<Oreset --hard o€j [æ÷ÈO

1. 9Ý HEAD • ND] Ý? \$! H½F ¥' : @9Ý master Tî > Cå óC6øèâf\$DÊÓ?

2. . ' - • ÈSÃ HEAD?

3. . µ" æã • ÈSÃ' - ?

ò - 1WDÞQi . j mLæÖF \$W- &3Dàá½òj HfI " D? äA g × D™3 S^• ~ e9° ðó
Dnou' } ~Ds —i pe 6%Z[kf [@mLDCåFF - ðXY. ' reset? pekæb 6C
å\$î > è | %í ^ Fžaò- 1Wí j ÅŽú9Ý- ' ...ÉÑj . / ž" f Ý?
æœ| }

pe9Ý] Ý• ±> ÇPî f F Git cf W- ófW- ™Cå Dø. FCå [j çèW- Z" \$Cå Dfk »
f? Git üò- ī" tòj >ÓF \$ò- ° » D< Ä< Ff 9, ÄòÄ* ' · O

```
$ git revert -m 1 HEAD
[master b1d8379] Revert "Merge branch 'topic'"
```

-m 1çâ• X ðmainlineÓ, @{ z 1<SD&" Q? ðf - k W- î > T HEADðgi t merge topicøF
™Cåk! - &" QOUW- i HEADðC6øFUV- i [@î > k] ÝD¥™CåóC4ø? \$! H½F ¥'
: @çèfk° &" Q#2ðC4øî > -k D» f FO! z 1s&" Q#1ðC6ø, 1 DfkA~?

kj >Cå Dæö• ÈSÃòÄO

Figure 140. H git revert -m 1 à # - ®

™DCå ^MŠ C6k ðŽWÄDA~Ff, sò<, 1 —Äî > s4çó\ F} ^ðY\$ j Äî > ÓDCå •
d \$ HEAD Dæö½? pef, +dtî > topic T master Gitj ¾TSTO

```
$ git merge topic
Already up-to-date.
```

topic ½> Ák KLÇ° s master ½ðöTA? ~ fDi F pef \$ topic ½" • µ" d | dtî > F Git

- j - k { j > Dî > L à D» f ?

Figure 141. ä (ÅÄ• Ž# - ®

• Zò- ¥5D1 2i çèj >>¹ Dî > Fst Y\$f: @-k { j > X] D» f F...í %í W- ™Dî > Cå O

```
$ git revert ^M
[master 09f0126] Revert "Revert "Merge branch 'topic'"""
$ git merge topic
```

Figure 142. HÃž • Ž>b F Ä• Žà # - ®

\$! H¼F M Š ^M §è ^? ^^Mn...Ñî > k ^ C3 Š C4 D» f F C8î > ^ C7 D» f F f „ Y\$ topic Z [ôŽ{ î > ^?

ç è é N K ÷ ø

Tæâ t Ç¥') * Dî i o\ W- ô" ØrecursiveØ Dî > 45Sg€Æ€D! -] ÝDg€î > ? d&j k 612Sî > ! -] ÝTWÈ? a¥' S½¾) * ¼DÈ - ?

š > Kéè > Kéì

' 1 F k uW8¥' 9„ o\ ØrecursiveØî > , 2‰Dk' µ" ? ¥' èâ Z [• Tx²c -X D ignore-all I-space Š ignore-space-change ø. F hi ¥' í 9„ ÝÀ Git ø. • \$W- UV | ...³ øùWp?

³ | oÇ< F & Git
 • T! -] Ÿî > ¼DUV | F· j [î > UVçâ • • Tf Dn o ¼> çâ ½~ t UVÔÔSaf • Z? p
 ef ' ' Git } ~ 5øù° » DWþ> È5uLWþ&Ci af ~ Ÿ• ZUVFF 9,, x² c merge ^ %oW-
 -Xours J -Xtheirs; ‡?

p e Git • Tò- F· > Çj " • UVçâ? œb 9,, î > D' ì F· j ...³ î > ? œb k UVD' ì F· j
 } ~ 5øùf ŸI • » DWþF ÔÖVÔÓ½~ ?

p e ¥' ÅTèâ ¥' . ' D Øhello worldÓ HI ¼F ¥' 9,, • Tî > k ¥' D] Ÿ| -‡ ^ UV?

```
$ git merge mundo
Auto-merging hello.rb
CONFLICT (content): Merge conflict in hello.rb
Resolving 'hello.rb' using previous resolution.
Automatic merge failed; fix conflicts and then commit the result.
```

d & p e ¥' ŸÙ| " • -Xours J -Xtheirs; ‡—Çj k UV?

```
$ git merge -Xours mundo
Auto-merging hello.rb
Merge made by the 'recursive' strategy.
 Èhello.rb | 2 ++
 Ètest.sh | 2 ++
 È2 files changed, 3 insertions(+), 1 deletion(-)
 Ècreate mode 100644 test.sh
```

\$ NH¼F· > Çj t Øhello mundoÓ Š Øhola worldÓ çâ î > UVF· - j } ~ 5øP Øhola
 worldÓ? d &F \$ž -] ŸÑfk 6* UVDf ŸI 9,, { f• 5î > k?

Ø- ø. í 9,, x² c ¥' èâ • TD git merge-file ^ %oF o\ ŸÙ» ¼git merge-file --ours
 D^ %oS î > ~ - ½~ ?

p e: @%o» ¼Dnohi « -> Ç: a Git, +î > uLWþD» f F k W- ~ _š Dø. F· i ØoursÓ
 î > ÅÆ? ØS ØoursÓ recursive î > ...h ÇO?

Ø! MÑj %oWt —Dî > ? · j âäW- „ ! þ] Ÿ" t &" QD™î > Cå Fhi · « -5! ÇGOf g
 î > k D] Ÿ? · - j } ~ 5ä øâ] ŸDno ø" î > " eâ ä < S?

```
$ git merge -s ours mundo
Merge made by the 'ours' strategy.
$ git diff HEAD HEAD~
$
```

f 9,, • Tî > | Šî > â ¥' D] Ÿ> Ák œb' ì ?

¤ d t i > | s ! MÑ.. © Git | t ž -] Ÿ Z [i > \ [€ i | k' D? Hp F—Ef k W-] XD
rel ease] Ÿ > ¥\$ÑÜ% ^ W" f : @\$4S1 - | ^ > À master Dμ" ? ŠāO| master] Ÿ ÑD
l " bugfix , @N| 97À rel ease] Ÿ ? f 9 „ i > bugfix] Ÿ Ôk rel ease] Ÿ O| i merge -s
ours i > Ôk f D master] Ÿ ój . ž - » AZ [\$ž < ^ ØðÄ øf è | dt i > rel ease] Ÿ | F—
Çj k SÉ bugfix DUV?

' Ÿ ÷ Ø

I %i > D „ : i f k! - . æF > ¥ ¼W- whTuW- . æDW- I æä FJK\ \ Sí Ù? æf , Ù
W- I %i > | F Git o€9 „ E Ÿ | áX ¼W- i uLW- DI %s &... Yg - D i > ?

¥' S • W- HI pb [W- . æ• k TW- Z" \$D. æ¼Fd | [UV- . æDn o i > TUW- . æDI
æä ¼?

' ' F ¥' [Rack - ' • • Tf D. æJ ? ¥' ä Rack . æ" t W- éÖD- ' • • T ¥' D. æJ F d |
GXT· EmD] Ÿ?

```
$ git remote add rack_remote https://github.com/rack/rack
$ git fetch rack_remote --no-tags
warning: no common commits
remote: Counting objects: 3184, done.
remote: Compressing objects: 100% (1465/1465), done.
remote: Total 3184 (delta 1952), reused 2770 (delta 1675)
Receiving objects: 100% (3184/3184), 677.42 KiB | 4 KiB/s, done.
Resolving deltas: 100% (1952/1952), done.
From https://github.com/rack/rack
 * [new branch]      build      -> rack_remote/build
 * [new branch]      master     -> rack_remote/master
 * [new branch]      rack-0.4   -> rack_remote/rack-0.4
 * [new branch]      rack-0.9   -> rack_remote/rack-0.9
$ git checkout -b rack_branch rack_remote/master
Branch rack_branch set up to track remote branch
refs/remotes/rack_remote/master.
Switched to a new branch "rack_branch"
```

Y\$\$\$¥' D rack_branch] Ÿ J —k Rack . æD5æä F &¥' D. æ• \$ master] Ÿ J ? pef sw
-] Ÿ { | TuW-] Ÿ Ff 9 „ • T · ' D. æ5æä i ÇODO

```
$ ls
AUTHORS          KNOWN-ISSUES    Rakefile        contrib       lib
COPYING          README         bin            example      test
$ git checkout master
Switched to branch "master"
$ ls
README
```

ò- i W- > H(ÜD< Æ? > Çi àá¼Dfk] ÝÍ i ®¶2\$OW- . æD] Ý.
ò> Ç€\$Fst Áª ' Fhi éi \$ÇO] ÝJ Õm! ž ôŽÇOCå æÖD¥} ~D1W?

\$ò- HI ¼F¥' ' ' [Rack. æl T **master**. æ¼" t W- l æä? ¥' 9, \$ Git ¼, Ùgi t
read-tree S...Y? f 9, \$ **Git A\>E** ¼ä• ~ e **read-tree** D/ GMRFY\$f~, @äj· j` P
W-] ÝD5æä%T øâD! " ' Bµ" æäJ? 1 { Áf D **master**] ÝF[**rack_back**] ÝI PT¥
' . æD **master**] Ý¼D **rack** l æä?

```
$ git read-tree --prefix=rack/ -u rack_branch
```

¤¥' Cå | Fž - l æä¼/ kfk Rack. æD½~ ÑÑ—Ã¥' ...³ S‰ŠÓJ AÓXSDWÄ? kT
Di f 9, l ~í 5[W-] ÝDg~ ï > TuW-] ÝJ? f, F ø Rack. æk~™| F¥' 9, { | Tž
-] ÝSI PÑ§Dg~ ?

```
$ git checkout rack_branch  
$ git pull
```

³ ÈF¥' 9, [ò" g~ ï > Á¥' D **master**] Ý? . ' --squashø. B. ' -Xsubtreeø. ó· Ð
' ² = ï > 45øF ï 9, ' S9, l Pg~ > ¥- Új Cå MR? ó² = 45\$òJ i ³ | DFCT· i t
^a` Kk - %; D< Æ? ø

```
$ git checkout master  
$ git merge --squash -s recursive -Xsubtree=rack rack_branch  
Squash commit -- not updating HEAD  
Automatic merge went well; stopped before committing as requested
```

Rack. æ¼fk Df ÝÍ { ï > ^F> V{ CåT! 5? fí 9, ' / \D1WÑÑ\$ **master**] ÝÑD
rack l æä¼‰f Ýd | [. ' ï > kf D **rack_branch**] Ý¼Fè | f 9° [Cåc. æúöÈJK[
. ' €uTÑ§?

òC¥' CD^W8» ¼I , - µ" ï Dµ" 12Fhi . > Ç, @' TI , - ókGI , - DA~¥' j \$
I , - ¼) * ø? ¥' 9, \$ ÊmDàá¼z { W" B 6. æ/ GD] ÝF89. ' I %ï > [. ' ï > T
¥' D. æ¼? ï " | ^ ò812I k' FHp øfk DnoI CåTW- 51D| ^ ? d&F· O| í kP
QF· ~ • A¾¥~ ~í a %ï ™FHp mAï > f ÝJ KÇüv[] ÝCåTW- ÅGDàáÑ] ?

uLW- kQ(ÜD51i F øf: ä• **rack** l æäB **rack_branch**] ÝDó• ÑÑS~ » f i ^ , @ï >
. ' ÑÑf Ç° . ' • oD di ff^‰? P&nèDi Ff ®¶. ' git di ff-tree SBf Dæç] Ý‰>
HO

```
$ git diff-tree -p rack_branch
```

J KF [f D **rack** l æB¥Uwt s EF ðÑ@PD **master**] ÝÔÙ> HF f 9, ÝÙO

```
$ git diff-tree -p rack_remote/master
```

Rerere

git rerere • ° i W- ± \$D• ° ? gp· D) yÒm' âãD• Z1 e ò reuse recorded resolution Ø
f©F· L8fa Gitâ‡• ZW- - UVDFWF òÄ\$<Wt • T/OUV| F Git 9,, t f ÉÝ5• Z
• ?

kÈ8oÚ<ò- • ° j * €k' ? \$½>¼CTDW- HI i : @z OW- , N] Ýj . Ù5î > Fhi N
Ç: @W{ ¼÷Dî > Cå~âf DCåæØ? [rerere • ° , B| Ff 9,, +È89î > F• ZUVFd
| ×Xî > ? pef { ¶òÄ‰Fža¥, Dî > j | ~í Fst rerere 9,, t f ÉÝ‰fk Dno?

9,, [OÄD45' \$ú{ W- g×D] Ý| FòÄ—Ç' í t • ZOÄDg×UV^? JKf [W-] Ýî
> > » A^WùUV| : @' g×S. nî > ÑÑf 9° > Ç: @dt • Z/ODUV?

uW- rerere D- ' < Äi xf 89[Wùg\$f ÒDå"] Ýî > TW- 96+Dè | F—Ä Git. æÉ-
[€‰D? pe6+/kFf 9,, « Äî > èâd | \$] } « Ú6+/kDž- å"] Ý| m‰î > F&Ç'
dt m™• Zfk DUV?

@B' rerere • ° F- , ÝÙ,, < PÓø. j 9O

```
$ git config --global rerere.enabled true
```

fí 9,, o\\${ } » Dàá¼‰í .git/rr-cache æäS, B· Fhi EÓø. ~ . Ù> ¥9,, - ' TŽ
Í ?

Ý\$¥' • W- } ~ DHI F » ¼èâDž- ? —Ek W-) t hello.rb D½~ p<O

```
#!/usr/bin/env ruby
```

```
def hello
  puts 'hello world'
end
```

\$W-] Ý¼» f ~ ñ ÒhelloÓt ÒholoÓFd | \$uW-] Ý¼» f ÒworldÓt ÒmundoÓF—Äèâ
WÄ?

≈ i > ! -] ÝTWĒ | F ¥' [j ÓTW- ī > UVÖ

```
$ git merge i18n-world
Auto-merging hello.rb
CONFLICT (content): Merge conflict in hello.rb
Recorded preimage for 'hello.rb'
Automatic merge failed; fix conflicts and then commit the result.
```

fj ÓTŽ - ™Ù Recorded preimage for FILE? } àèL· - C• ÈS—ÄW- • oDî > UV?
\$ò- ; ^ F rerere 9, ÝÀ¥' È~ n? B| €WÄF \$ò- ; ^ f 9, ÝÙ git status Sä• fkU
VDA~O

```
$ git status
# On branch master
# Unmerged paths:
#   (use "git reset HEAD <file>..." to unstage)
#   (use "git add <file>..." to mark resolution)
#
#       both modified:        hello.rb
#
```

d&F git rerere í j o\ git rerere status ÝÀf· àã Dî > àÔÓ?

```
$ git rerere status
hello.rb
```

> ¥ git rerere diff [j # ©• Z 1 e D ☠ â ÔÔÑÑ , 1 • Z â Š• Z | DÄI ?

```
$ git rerere diff
--- a/hello.rb
+++ b/hello.rb
@@ -1,11 +1,11 @@
Ê#! /usr/bin/env ruby
```

```
Êdef hello
-<<<<<<
- puts 'hello mundo'
-=====
+<<<<<< HEAD
Ê puts 'hol a worl d'
->>>>>>
+=====
+ puts 'hello mundo'
+>>>>>> i18n-world
Êend
```

OÄöö> Çi ž DŠ rerere k G• øF 9„ . ' git ls-files -u Sä • UV½~ Dè â Pá þŠâ þ 7! O

```
$ git ls-files -u
100644 39804c942a9c1f2c03dc7c5ebcd7f3e3a6b97519 1 hello.rb
100644 a440db6e8d1fd76ad438a49025a9ad9ce746f581 2 hello.rb
100644 54336ba847c3758ab604876419607e9443848474 3 hello.rb
```

Y\$9„ o\ft puts 'hol a mundo' S• Z• F 9„ dt ÝÙ git rerere diff ^ %Sä • rerere [j â ð DA~O

```
$ git rerere diff
--- a/hello.rb
+++ b/hello.rb
@@ -1,11 +1,7 @@
Ê#! /usr/bin/env ruby

Êdef hello
-<<<<<<
- puts 'hello mundo'
-=====
- puts 'hol a worl d'
->>>>>>
+ puts 'hol a mundo'
Êend
```

f „ s ! MÑ¬F ☺ Git • TW- hel l o. rb ½~ DW- - UV¼k Ôhello mundoÓ \$WþŠ Ôhola
worldÓ \$uWþF· j [• Z t Ôhola mundoÓ?

Y\$¥' 9„ [· çât Z• Z> Cå· O

```
$ git add hello.rb
$ git commit
Recorded resolution for 'hello.rb'.
[master 68e16e5] Merge branch 'i18n'
```

9„ • T· "Recorded resolution for FILE"?

Y\$Fa¥' çèž-î>d| [· g×T master] YÈ\ S. n· ? 9„ o\ . ' èâ\$ mÓ() • TD
git reset SÀ—] Y?

```
$ git reset --hard HEAD^
HEAD is now at ad63f15 i18n the hello
```

¥' Dî > { çè^? Y\$a¥' g×å"] Y?

```
$ git checkout i18n-world
Switched to branch 'i18n-world'

$ git rebase master
First, rewinding head to replay your work on top of it...
Applying: i18n one word
Using index info to reconstruct a base tree...
 Falling back to patching base and 3-way merge...
Auto-merging hello.rb
CONFLICT (content): Merge conflict in hello.rb
Resolved 'hello.rb' using previous resolution.
Failed to merge in the changes.
Patch failed at 0001 i18n one word
```

Y\$FgÃ¥' N' DWÄFÖT ^ / ODî > UVFhi • W< Resolved FILE using previous
resolution? pœ¥' • ð-½~ Fj ï Y· Z[{ • Z^F&¥\$. J ÜAkî > UVçâ?

```
#!/usr/bin/env ruby

def hello
  puts 'hol a mundo'
end
```

OÄF git diff [j # ©X. i pbÉÝ5m™• Z DO

```
$ git diff
diff --cc hello.rb
index a440db6, 54336ba..0000000
--- a/hello.rb
+++ b/hello.rb
@@@ -1,7 -1,7 +1,7 @@@
#! /usr/bin/env ruby

def hello
-   puts 'hol a world'
-   puts 'hello mundo'
++   puts 'hol a mundo'
end
```

í 9 „ o\ git checkout ^ %om™@ATUV|^ a D½~ ØOO

```
$ git checkout --conflict=merge hello.rb
$ cat hello.rb
#!/usr/bin/env ruby

def hello
<<<<< ours
È puts 'hol a worl d'
=====
È puts 'hello mundo'
>>>>> thei rs
end
```

¥' [j \$ c @† > ¼• Tò- DW- HI ? d&Y\$Fa ¥' o\ ÝÙ git rerere Sm™• Z· O

```
$ git rerere
Resol ved 'hello.rb' usi ng previous resoluti on.
$ cat hello.rb
#!/usr/bin/env ruby

def hello
È puts 'hol a mundo'
end
```

¥' o\ rerere " D• Z 1 e S E Y m™• Z ^ ½~ UV? ¥\$ 9 „ • • > µ¶ g x S ô f· ?

```
$ git add hello.rb
$ git rebase --continue
Appling: i 18n one word
```

f „ F p e % ^ I e t m™î > F J K: @W- å "] Y 1 , Š f D master] Y z { ¥™ h é C: @W t ü î
> F J K [€ g × F ê , rerere • ° 9 „ \$ E f D o t g ð ~ ‡ 5?

À' Git í î

} ^ å @ " t 7! Ø Ø µ ¶ L F Git í CD ^ E - ^ % S F E f * + f D. æ î o ¼ D I " ? ° § G i t { E | f
P' S E l f k » z D A ~ F ð " µ ¶ i / ø o' F h . ' | | 9 „ \$ X Y I " | \$ E f Ü T bug J K > s ?

- , å ê

p e f \$ D ö n o ¼ D W - bug F > ¥: ä j i ` a | ^ , B t b j - k F ½ ~ ç O o € i ¥ 5 ' D µ ¶ ? .
° # © e b ½ ~ ¼ í Ü ¥ | W t » f D C å å å ? f „ F p e f \$ n o ¼ • T W - k bug D 1 W F f 9 „ . ' g i t b l a m e ç O ð - ½ ~ F ä • p W t C å - k ^ ð Ù ?

" < © H ' g i t b l a m e - » ^ L i n u x A u î o Ë ; D M a k e f i l e ¼ í W Ù] i S É p - C å B C å K F å L
' - L Ø . j 9 „ [ç O D y X y Ó t C ½ ~ ¼ D U 6 9 Ü T U 8 2 Ü ?

```
$ git blame -L 69,82 Makefile
b8b0618cf6fab (Cheng Renquan 2009-05-26 16:03:07 +0800 69) i feq
("$(origin V)", "command line")
b8b0618cf6fab (Cheng Renquan 2009-05-26 16:03:07 +0800 70)
KBUILD_VERBOSE = $(V)
^1da177e4c3f4 (Linus Torvalds 2005-04-16 15:20:36 -0700 71) endi f
^1da177e4c3f4 (Linus Torvalds 2005-04-16 15:20:36 -0700 72) i fndef
KBUILD_VERBOSE
^1da177e4c3f4 (Linus Torvalds 2005-04-16 15:20:36 -0700 73)
KBUILD_VERBOSE = 0
^1da177e4c3f4 (Linus Torvalds 2005-04-16 15:20:36 -0700 74) endi f
^1da177e4c3f4 (Linus Torvalds 2005-04-16 15:20:36 -0700 75)
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 76) i feq
($(KBUILD_VERBOSE), 1)
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 77) quiet =
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 78) Q =
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 79) else
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 80) quiet=quiet_
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 81) Q = @
066b7ed955808 (Michał Marek 2014-07-04 14:29:30 +0200 82) endi f
```

GO9F UW- y f i ¥ | W t » f C Ù D C å D \] S H A - 1 r ? ³ < S ! - y f D r i s C å ¼ C P X S

DÑÑ" KD) y „ BCåD! ÷ ÑÑf „ f — 9 „ I æí 5äj i Ø\$` a! „ f ^ ž WÙ?
 ³ < S—i Ùì B½~ A~? O9W< ^1da177e4c3f4 ò- Cå DËUF ¼Dâ < ^• X^C½~ ÉUW
 t Cå | s 4» f Dž „ Ù? òj ýSûùDSTFs t æâf —öZ [• T ÷ 8 Git. ' ^ S » -W- Cå D
 SHA-1r DÇOm1F hòJ - ...—i ò- 9 „ ?

uW~ > HfDnoi GitÇj #25âä½~ Dm^) ? . j âä½FFd | \$n| , + | áXm^) DÝ
 " ? ò ¼k W- I k 9 „ D° - -i f 9 „ a GitÙXfK Dno9Ý? pef \$ git blame | Ü• ÑW-
 -CF Gitj] òf g\$çOD½~ F > ¥, +ÙX½~ ¼sì D51AÓ\SDnoÎ fD>¹ XÆ? > pF
 f [GI TServerHandl er. m ò- ½~ ø] t ð - ½~ F ¼W- ½~ i GI TPackUpI oad. m? y
 GI TPackUpI oad. m, Ùý -C; ð D blame ^ %oF f — 9 „ • Tno- D>¹ XÆO

```
$ git blame -C -L 141,153 GI TPackUpI oad.m
f344f58d GI TServerHandl er.m (Scott 2009-01-04 141)
f344f58d GI TServerHandl er.m (Scott 2009-01-04 142) - (void)
gatherObj ectShasFromC
f344f58d GI TServerHandl er.m (Scott 2009-01-04 143) {
70befddd GI TServerHandl er.m (Scott 2009-03-22 144)
//NSLog(@"GATHER COMMI
ad11ac80 GI TPackUpI oad.m (Scott 2009-03-24 145)
ad11ac80 GI TPackUpI oad.m (Scott 2009-03-24 146) NSString
*parentSha;
ad11ac80 GI TPackUpI oad.m (Scott 2009-03-24 147) GITCommitt
*committ = [g
ad11ac80 GI TPackUpI oad.m (Scott 2009-03-24 148)
ad11ac80 GI TPackUpI oad.m (Scott 2009-03-24 149)
//NSLog(@"GATHER COMMI
ad11ac80 GI TPackUpI oad.m (Scott 2009-03-24 150)
56ef2caf GI TServerHandl er.m (Scott 2009-01-05 151) if(committ) {
56ef2caf GI TServerHandl er.m (Scott 2009-01-05 152)
[refDict setOb
56ef2caf GI TServerHandl er.m (Scott 2009-01-05 153)
```

ò- • ° I k' ? o€S¬Ffj | t AÓno\SDž - Cå i ¥>¹ DCåFstži f UWt \$ò- ½~ ¼» f ^ òEÙ? h Gitj YÀf Ff UWt LòEÙnoDž - Cå' i >¹ CåFj . òi \$uLW- ½~ JLD?

2L> ī

¤f äj l" i \$pJ-k DoÇ<½~ çO9 „ ¢Ef äÙI " ? pef Çäj pJ X^I " F > ¥ÉsÑt 9 „ g€ÝÙTY\$Z[k ð d- J KÑÆ- CåF ò- | ^ a f 9 „ . ' git bi sect S¢£äÙ?
 bi sect ^ %o j yf DCåæÖÖÙV] äÙS¢£f Q½ÙTi pW- Cå- k ^ I " ?

-Ef ØØ\$KÑ! B\(^f DnoF³ ÈETW" bug\! F hò" bug\$f èâD, ï BJ Ák XY
 \FòafÆ, ÇÒ • ? fm™ä• ^f DnoFçYò- I " i 9 „ { mYDFhi f Çäj pJ X^I
 " ? f 9 „ ' 2LŠSÙTò- I " ? ' 1, Ùgit bi sect startSBÝF³ È, Ùgit bi sect bad
 SÝA•, ¤âf f\$DCåi kI " D? d| f ®¶. ' git bi sect good <good_commi t>FÝÀ
 bisect ZäD¥| Wt g€ÔÖi pt CåO

```
$ git bisect start
$ git bisect bad
$ git bisect good v1.0
Bisecting: 6 revisions left to test after this
[ecb6e1bc347ccecc5f9350d878ce677feb13d3b2] error handling on repo
```

Git 2.27.0-fc4at glibc-2.30-0.B2.27.0-fc4at D™1 7! è÷k t P12t CåF S i Git GX½÷Dž - C
å? Y\$F 9,, Ù6+F•• \$ò- Cå<I " i Çi j i " \$? pej " \$F-ÑI " i \$ò- Cåèå
-k Dúpel " Ç" \$F-ÑI " i \$ò- Cåè| -k D? -E6+" ei ÁkI " DFf 9,, o\ git
bisect good SYÀ GitFd | µ¶' Ù?

```
$ git bisect good
Bisecting: 3 revisions left to test after this
[b047b02ea83310a70fd603dc8cd7a6cd13d15c04] secure this thing
```

Y\$F \$uW- CåÑ^Fò- Cåi ØØž - 6+o\ DCå BkI " DCå D½Q? f dWt , Ù6+F
¿Yò- Cå<i kI " DFsäf 9,, o\ git bisect bad SYÀ GitO

```
$ git bisect bad
Bisecting: 1 revisions left to test after this
[f71ce38690acf49c1f3c9bea38e09d82a5ce6014] drop exceptions table
```

ò- Cåi g€DFY\$ Git / k DMRZ [9,, - » - kI " DÊÓ\$pJ ? . j YÀf UW- ™1 CåD
SHA-1r > #©W" Cå-ÑF,, Bp" ½~ \$žt CåJ { » f \ FòÄf 9,, ÙX- k bug D5† O

```
$ git bisect good
b047b02ea83310a70fd603dc8cd7a6cd13d15c04 is first bad commit
commit b047b02ea83310a70fd603dc8cd7a6cd13d15c04
Author: PJ Hyett <pj.hyett@example.com>
Date:   Tue Jan 27 14:48:32 2009 -0800
```

È secure this thing

```
:040000 040000 40ee3e7821b895e52c1695092db9bdc4c61d1730
f24d3c6ebcf639b1a3814550e62d60b8e68a8e4 M config
```

xf öfò" l " è| Ff - C, Ùgit bisect reset mÓf D HEAD • ±T ¥, ¹ DÊÓF a • f j >
1\$W- (ÜDÔÔO

```
$ git bisect reset
```

òi W- 9,, ¶Ef \$E] bAs tÆ- Cå½ÙT bug D² + µ¶? n...ÑF pef kW- ý! \$. æi g

€DoÇ<ÿÀ 0F \$Çg€DoÇ<ÿÀ * 0F f 9,, . git bisect ÉÝ6ð" Í" ?
' 1 Ff E» 5. æg€, BÇg€f\$CåDV] äÙ>• ? f 9,, o\ bisect start ^ %oD; †SE»
ð! - CåF UW- ; †i . æÇg€DCåF UV- ; †i . æg€DCåO

```
$ git bisect start HEAD v1.0  
$ git bisect run test-error.sh
```

Gitj ÉÝ\$Í - { GXDCåJ , Ù test-error.shF...TÙT. æUW- Çg€DCå? fí 9,, , Ù
makeJ K make testsJ K 6KLSÖÙÉÝ66+?

' ðñ

k 8oÇ¥' [€j nTOl - μ" ¼D. æ, @Öm» . ' uW- . æ? í 8i U÷1áFJKf 2i , ð
DF' ſe- &. æDá? Y\$I " S^Of: @ä. ' ø‰! - 2i D. æFO| N: \$W- . æ¼. ' u
W- ?

¥' : W- HI ? —Ef g\$. ð W- þýd | %í ^ Atom þA? fZ». ' W- áF &Ci LÉmD Atom
ófno? f 9° ÇÒÇo\ CPAN ÚÛJ Ruby gem SÖm&3á ¼DnøFJK[ï no...³ x y TÉm
D. æ¼? pe[ð- áÖmÖSFžaÅP' b812I I ®» Ó. F\ (• ~ • S®Fstf ®¶ - z ï
W- « j 7I ÖmCá? pe[noAÓTÉmD. æ¼Fža f %oDøbÉ» 1» f ï j . i > NSDf Ý
gØS®?

Git o\I , - S• Zð- I " ? I , - L8f [W- Git à á" t uW- Git à á DI æä? . ° af [uW
- à áqr TÉmD. æ¼FO| j z { CåD2i ?

ÿ•À' ' ðñ

¥' [@É©pb\$W- {] fW- å. æŠE- I . æD. æÑ, ð?

¥' ' 1 [W- Z" \$D Git à á•• tg\$μ" DàáDI , - ? f 9,, o\\$ git submodule add ^ %o
| Ü• Ñ: @ÈÖD. æD/ yJ <y URL S••™DI , - ? \$! H¼F¥' [j •• W-) t
ØDbConnectorØ Dá ?

```
$ git submodule add https://github.com/chaconic/DbConnector  
Cloning into 'DbConnector' ...  
remote: Counting objects: 11, done.  
remote: Compressing objects: 100% (10/10), done.  
remote: Total 11 (delta 0), reused 11 (delta 0)  
Unpacking objects: 100% (11/11), done.  
Checking connectivity... done.
```

³ | oÇ<FI , - j [I . æ< TW- ŠåáO) Dæä ¼F! H¼i ØDbConnectorØ? pef: @< T
651Fža 9,, \$^‰" å•• W- ÇOD¢. ?

þeð! ÝÙ git statusFf j O9TÉ~ n?

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

    new file:   .gitmodules
    new file:   DbConnector
```

' 1 - ☀ O9T™D .gitmodules ½~ ? CPÓ½~ z" ^ . æ URL ŠZ [I PD! 5æā è ÷ DwhO

```
[submodule "DbConnector"]
  path = DbConnector
  url = https://github.com/chaconic/DbConnector
```

peke - I , - FC½~ ¼-j kežāā? @mQO9Di FC½~ Ā .gitignore ½~ WÄ` Tóo
\\ø7! ØÓ? · j BC. æD 6\] WO{ I P€u? ò-i qr C. æD%äj] pOØI , - D>
s?

! ° \$.gitmodules ½~ ¼D URL i %' ' 1 , +qr /I PD51FsāGQ9° - z f . ' D URL t #ï . HI ? HpF¶f @. ' D€u URL Š6%DI P URL ÇOF ž a G. ' 6%° HI TD URL? fí 9 , 5? ÉmD, @Fo\\$! 5, Ù git config
submodule.DbConnector.url <} k URL> Sñ• ò- ø. Dr ? pe 9ÙDsFW- /
y ¢· j l k¢£?

\$ git status y X½WXDuW- i . æ½~ ī āā? pef YÙ git diff fffj • T » ¼< ÜDMRO

```
$ git diff --cached DbConnector
diff --git a/DbConnector b/DbConnector
new file mode 160000
index 0000000..c3f01dc
--- /dev/null
+++ b/DbConnector
@@ -0,0 +1 @@
+Subproject commit c3f01dc8862123d317dd46284b05b6892c7b29bc
```

cd DbConnector i µ" æā ¼DW- I æā F h Gitj i j [· i " W- I , - ? ☀ f Ç\$ž - æā ¼
| F Git> Çj Èö· DA~F &i [· • " I , - àá ¼Dl - ¶¹ DCå?

pef: • T ~ uvDó• y XF 9 „ c git diff x² --submodule ø. ?

```
$ git diff --cached --submodule  
diff --git a/.gitmodules b/.gitmodules  
new file mode 100644  
index 0000000..71fc376  
--- /dev/null  
+++ b/.gitmodules  
@@ -0,0 +1,3 @@  
+[submodule "DbConnector"]  
+    path = DbConnector  
+    url = https://github.com/chaoninc/DbConnector  
Submodule DbConnector 0000000..c3f01dc (new submodule)
```

af Cå | Fj • T » ¼< ÜDMRO

```
$ git commit -am 'added DbConnector module'  
[master fb9093c] added DbConnector module  
2 files changed, 4 insertions(+)  
Create mode 100644 .gitmodules  
Create mode 160000 DbConnector
```

O9 DbConnector à ä D 160000 , 2? ò i Git ¼DW8° R, 2F· ! MÑ9à Èfi [Wt Cå à "
W. æä å ä DF &* [· å ä fW- I æä J KW- ½~ ?

¥| F€uò" ~ f O

```
$ git push origin master
```

§ .. òh' ðñK± ©

³ <S¥' [j qr W- mkI , - D. æ? af \$qr òÄD. æ| F³ | j ÕmCI , - æä F h ¼j
Åk œb ½~ O

```

$ git clone https://github.com/chacon/MainProject
Cloning into 'MainProject'...
remote: Counting objects: 14, done.
remote: Compressing objects: 100% (13/13), done.
remote: Total 14 (delta 1), reused 13 (delta 0)
Unpacking objects: 100% (14/14), done.
Checking connectivity... done.
$ cd MainProject
$ ls -la
total 16
drwxr-xr-x  9 schacon  staff  306 Sep 17 15:21 .
drwxr-xr-x  7 schacon  staff  238 Sep 17 15:21 ..
drwxr-xr-x 13 schacon  staff  442 Sep 17 15:21 .git
-rw-r--r--  1 schacon  staff   92 Sep 17 15:21 .gitmodules
drwxr-xr-x  2 schacon  staff   68 Sep 17 15:21 DbConnector
-rw-r--r--  1 schacon  staff  756 Sep 17 15:21 Makefile
drwxr-xr-x  3 schacon  staff  102 Sep 17 15:21 includes
drwxr-xr-x  4 schacon  staff  136 Sep 17 15:21 scripts
drwxr-xr-x  4 schacon  staff  136 Sep 17 15:21 src
$ cd DbConnector/
$ ls
$
```

¼k DbConnector æå F Ç\ i Í D? f ®¶ÝÙ! - ^ %oOgi t submodule init' SÜ1 6! 5P
Ó½~ F & gi t submodule update • sC. æ¼@Pfk‡?> GX&. æ¼WXDí PDCå?

```

$ git submodule init
Submodule 'DbConnector' (https://github.com/chacon/DbConnector)
registered for path 'DbConnector'
$ git submodule update
Cloning into 'DbConnector'...
remote: Counting objects: 11, done.
remote: Compressing objects: 100% (10/10), done.
remote: Total 11 (delta 0), reused 11 (delta 0)
Unpacking objects: 100% (11/11), done.
Checking connectivity... done.
Submodule path 'DbConnector': checked out
'c3f01dc8862123d317dd46284b05b6892c7b29bc'
```

Y \$ DbConnector | æå i Å\$BèåCå | / ODÔÔ^?

Ç\j k ~ } ~WQD1 2? pec gi t cl one ^ %ox 2 --recurse-submodules ø. F· —j ÉÝÙ¹
6> ~™à á¼DÍ W- I , - F ÕÖ9° " \$DD: I , - ?

```
$ git clone --recurse-submodules https://github.com/chaconic/MainProject
Cloning into 'MainProject'...
remote: Counting objects: 14, done.
remote: Compressing objects: 100% (13/13), done.
remote: Total 14 (delta 1), reused 13 (delta 0)
Unpacking objects: 100% (14/14), done.
Checking connectivity... done.
Submodule 'DbConnector' (https://github.com/chaconic/DbConnector)
registered for path 'DbConnector'
Cloning into 'DbConnector'...
remote: Counting objects: 11, done.
remote: Compressing objects: 100% (10/10), done.
remote: Total 11 (delta 0), reused 11 (delta 0)
Unpacking objects: 100% (11/11), done.
Checking connectivity... done.
Submodule path 'DbConnector': checked out
'c3f01dc8862123d317dd46284b05b6892c7b29bc'
```

perf [qr ^. æhøâ ^ --recurse-submodules ž a 9 „ ŸÙ git submodule update
--init [git submodule init B git submodule update] > fwÈ? pej @Ü¹ 6þ@P> GX
œbD: DI , - FG. ' } ÑD git submodule update --init --recursive?

† Óð' ÐñK±©‡² j

Ý\$¥' kW° Œml , - D. æE! F¥' [j OI \$å . æBI , - . æÑŠx3: " ?

^' ÐñKÙôÝÝ‡< ~•

\$. æ¼. ' I , - D¥} , z F—i ^ . ' I . æ> Ç| 5OP~ ™F &> Ç\$ƒ DGX¼Ûœb~ f ?
¥' S•W- } ~DHI ?

pe: @\$I , - ¼ä• ™μ" F 9 „ ŸÙ git fetch Š git mergeF] ŸS~ ™!
5no?

```
$ git fetch
From https://github.com/chaconic/DbConnector
  c3f01dc..d0354fc master      -> origin/master
$ git merge origin/master
Updating c3f01dc..d0354fc
Fast-forward
  Éscripts/connect.sh | 1 +
  Ésrc/db.c          | 1 +
  2 files changed, 2 insertions(+)
```

perf Y\$ÿÀTå . æ> ŸÙ git diff --submoduleF—j • TI , - { ~ ™DOI OÙ^W- Œm™
• • CåDW° ? perf Ç: Í t ŸÙ git diff ; Í yk --submoduleF ž a 9 „ [diff. submodule E

Ót ÓlogÓS [" t ³ | Út ?

```
$ git config --global diff.submodule log
$ git diff
Submodule DbConnector c3f01dc..d0354fc:
  => more efficient db routine
  => better connection routine
```

pe\$ā | CåFžafj [I , - Ä » t 6%~™ | D™no?

pef Ç: \$! æä ¼~Ý@PŠí > Fžaj k8~ ~í D1 2? ÝÙ git submodule update
--remoteF Git [j Ôk I , - d | @P> ~™?

```
$ git submodule update --remote DbConnector
remote: Counting objects: 4, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 4 (delta 2), reused 4 (delta 2)
Unpacking objects: 100% (4/4), done.
From https://github.com/chaconic/DbConnector
 * 3f19983..d0354fc master      -> origin/master
Submodule path 'DbConnector': checked out
'd0354fc054692d3906c85c3af05ddce39a1c0644'
```

ã ^ %o³ | j —» f : @~™> GXI , - àáD master] Ý? Ç\ fí 9 „ EÓt : @D 6] Ý? H
pFF : @DbConnectorI , - ÈöàáD ÓstableÓ] ÝFžaŒ9 „ \$. gitmodules ½~ ¼EÓóò
Ä 6%í 9 „ Èö· øFí 9 „ - \$! 5D . git/config ½~ ¼EÓ? a ¥' \$. gitmodules ½~ ¼E
Ó. O

```
$ git config -f .gitmodules submodule.DbConnector.branch stable
$ git submodule update --remote
remote: Counting objects: 4, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 4 (delta 2), reused 4 (delta 2)
Unpacking objects: 100% (4/4), done.
From https://github.com/chaconic/DbConnector
 * 27cf5d3..c87d55d stable -> origin/stable
Submodule path 'DbConnector': checked out
'c87d55d4c6d4b05ee34fbc8cb6f7bf4585ae6687'
```

peÇ' -f .gitmodules Ø. Fža. - j tf‰» f ? hi \$àá¼z 1 ÈöMR~ k 91W" Fst
6%í 9 „ ÓTOÄDŽe?

ò ! ¥' ÝÙ git statusF Git j # @I , - ¼k Ó™Cå Ó?

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

 	modified:   .gitmodules
 	modified:   DbConnector (new commits)

no changes added to commit (use "git add" and/or "git commit -a")
```

perfÓ^PÓø. **status.submodulesummary** Git í j # ©f DI , - D~ f û@O

```
$ git config status.submodulesummary 1

$ git status
On branch master
Your branch is up-to-date with 'origin/master'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

 	modified:   .gitmodules
 	modified:   DbConnector (new commits)

Submodules changed but not updated:

* DbConnector c3f01dc...c87d55d (4):
  > catch non-null terminated lines
```

þípeÝÙ **git diff** F 9 „ • T ¥' » f ^ .gitmodules ½~ FOI j k È - ZI PDCå , @Cå T ¥' ÉmDI , - . æ¼?

```
$ git diff
diff --git a/.gitmodules b/.gitmodules
index 6fc0b3d..fd1cc29 100644
--- a/.gitmodules
+++ b/.gitmodules
@@ -1,3 +1,4 @@
Ê[ submodule "DbConnector"]
Ê      path = DbConnector
Ê      url = https://github.com/chaconic/DbConnector
+      branch = stable
ÊSubmodule DbConnector c3f01dc..c87d55d:
Ê > catch non-null terminated lines
Ê > more robust error handling
Ê > more efficient db routine
Ê > better connection routine
```

Ø * €kTFst ¥' 9, ...³ • T[@CåTI , - ¼DCårã? Cåè | Ffí 9, ÝÙgit log -p
ä • Ø - MR?

```
$ git log -p --submodule
commit 0a24cfcc121a8a3c118e0105ae4ae4c00281cf7ae
Author: Scott Chacon <schacon@gmail.com>
Date:   Wed Sep 17 16:37:02 2014 +0200

Ê   updating DbConnector for bug fixes

diff --git a/.gitmodules b/.gitmodules
index 6fc0b3d..fd1cc29 100644
--- a/.gitmodules
+++ b/.gitmodules
@@ -1,3 +1,4 @@
Ê[ submodule "DbConnector"]
Ê      path = DbConnector
Ê      url = https://github.com/chaconic/DbConnector
+      branch = stable
Submodule DbConnector c3f01dc..c87d55d:
Ê > catch non-null terminated lines
Ê > more robust error handling
Ê > more efficient db routine
Ê > better connection routine
```

¤ÝÙgit submodule update --remote | F Git³ | j , + ~™ghl , - F f, pekl el , - D
s Ff 9, x² : @~™DI , - D) y?

^ ± ©ÙôÝÝ‡< ¬•

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CåD~ f j ÇpO

```
$ git pull
From https://github.com/chaconinc/MainProject
  * fb9093c..0a24cfcc master      -> origin/master
Fetching submodule DbConnector
From https://github.com/chaconinc/DbConnector
  * c3f01dc..c87d55d stable      -> origin/stable
Updating fb9093c..0a24cfcc
Fast-forward
  * .gitmodules      | 2 ++
  * DbConnector      | 2 ++
2 files changed, 2 insertions(+), 2 deletions(-)
```

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working
  directory)

  * modified:   DbConnector (new commits)
```

Submodules changed but not updated:

```
* DbConnector c87d55d..c3f01dc (4):
  * < catch non-null terminated lines
  * < more robust error handling
  * < more efficient db routine
  * < better connection routine
```

no changes added to commit (use "git add" and/or "git commit -a")

³ | oÇ<F git pull ^ %oj ² = 5@PI , - D~ f F pÑÜUW- ^ %oDy Xf©? d&F· Çj ¬-
I , - ?òQ9o\ git status ^ %o• TF· j #©I , - ØZ » f ÓF ¥Øk™DCåÓ? åLF áþD
- Øì ó<ø• X ^™DCåF ° ©ò" CåZ \$ MainProject ¼å åF hš 4\$! 5D DbConnector ¼G
X? t ^ Øf~ ™Ff , @ÝÙ git submodule updateO

```
$ git submodule update --init --recursive
Submodule path 'vendor/plug-ins/demo': checked out
'48679c6302815f6c76f1fe30625d795d9e55fc56'

$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
nothing to commit, working tree clean
```

GO9F t ÚŽÉ\$F p e MainProject Cå ^ f ØI PD™I , - F ž a - C\$ git submodule update | Ü• • --init ø. F p e l , - k D: DI , - F • - . ' --recursive ø. ?

p e f: ÉÝ6ā\ÕF ž a 9, t git pull ^ %o• • {--recurse-submodules ø. ós Git 2.14 ,
 1 ø? øj a Git \$I P| ÝÙ git submodule updateF [I , - Ót g - DÔÖ? á L F p e f: a Git
 Bi , --recurse-submodules I PF 9, [PÓø. submodule. recurse E Ót true ós Git 2.15 ,
 1 9' § git pull ø? ø. j a Git t f k Ý{ --recurse-submodules D^ %. ' Cø. ø} cl one
 „ L ø?

\$ t &©. æl P~™| Fj j XYW8° RDoÇO\$f I PDCå¼F 9° . git tmodul es ½~ ¼âã D
 I , - D URL ø^fg? > pF¶I , - . æfg ^· Düý x ØF -j øöö8oÇ? å | F ¶ &©. æ
 - ' DI , - CåÇ\$àá¼! 5PÓDI , - é7ÑF ž a, Ù git pull --recurse-submodules J
 git submodule update -j /k? t ^I øF git submodule sync ^ %o, @O

```
# [™D URL AÓT! 5PÓ¼
$ git submodule sync --recursive
# S™ URL ~™I , -
$ git submodule update --init --recursive
```

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f I k 9° g \$. ' I , - Fstf - ...: \$I , - ¼' LnoDO| Fj : \$å. æñ' LnoÓJ K®I ,
 - µ" ø? ^• f t < - °' } ~D• « ý€• , óp Maven J RubygemsøS. n ^?

Y\$¥' [o\W- HI SÉ©pb\$I , - Šå. æ¼O| %o» f F , BpbO| CåŠž , ž " » f ?

Tæåt ÇF ø¥' ÝÙ git submodule updatesI , - àá¼@P» f | F Git [j OÒò" f Ý> ~
 ™I æä¼D½~ Fhi j [I àá1\$W- ü" ØsnDHEADÓDÔÖ? ø9àÈÁk! 5µ"] ÝóHp
 ØmasterØøÈöf Ý? p e Ákµ"] ÝÈö~ f Fí —9àÈj -f [~ f CåT^I , - F ò" ~ f í
 I 9° j \$<t ÝÙ git submodule update | . /?pe f: @\$I , - ¼Èöò" » f Fj , @W" è
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t ^[I , - EÓÒ~ ~í Øk> » f Ff , @‰! ~ n? ' 1 F ØkÍ - I , - > GX / ~ Dµ"] Ý?
 ³ ÈF¶f‰^~ f —, @ÝÀ Git. C‰` aFd | ÝÙ git submodule update --remote SsÑ§I
 P™µ" ? f 9, øù[. ' î > Tf D! 5µ" ¼Fí 9,, + [f Dµ" g x T™D~ f Ñ?

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```
$ cd DbConnector/
$ git checkout stable
Switched to branch 'stable'
```

d | , + ' Merge Øø. S ~™I , - ? t ^~Ý•»· F ¥' - , c update •• --merge Øø. j 9?
Ø | ¥' [j • T E F ØÑDØ- I , - KW- f Ý> ¥· { î > ^ØS?

```
$ cd ..
$ git submodule update --remote --merge
remote: Counting objects: 4, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 4 (delta 2), reused 4 (delta 2)
Unpacking objects: 100% (4/4), done.
From https://github.com/chaconic/DbConnector
  c87d55d..92c7337 stable      -> origin/stable
Updating c87d55d..92c7337
Fast-forward
  src/main.c | 1 +
  1 file changed, 1 insertion(+)
Submodule path 'DbConnector': merged in
'92c7337b30ef9e0893e758dac2459d07362ab5ea'
```

p e ¥' Øk DbConnector æã F 9 „ Ý™Df ÝZ[î > k! 5 stable] Ý? Y\$ a ¥' •• ø ¥' y
á‰W" ! 5 Df Ý&O! 6%€uuLW- » f TÑS ¡ j ïó` a?

```
$ cd DbConnector/
$ vim src/db.c
$ git commit -am 'uni code support'
[stable f906e16] uni code support
  1 file changed, 1 insertion(+)
```

p e ¥' Y\$ ~™I , - F —j • T ø ¥' \$! 5‰^~ f ; ÑSí KW- f ÝF ¥' , @[. > k! 5?

```
$ cd ..
$ git submodule update --remote --rebase
First, rewinding head to replay your work on top of it...
Applying: uni code support
Submodule path 'DbConnector': rebased into
'5d60ef9bbebf5a0c1c1050f242ceeb54ad58da94'
```

p e f øâ --rebaseJ --mergeF Gitj [I , - ~™t EF ØÑDØ?> ¥j [. æmÓt W- §nD
HEAD ØØ?

```
$ git submodule update --remote
Submodule path 'DbConnector': checked out
'5d60ef9bbebf5a0c1c1050f242ceeb54ad58da94'
```

j ñòž Dž ó^í Ç@ÝFf , ÁTæä ¼d t GXf D] Ýój j ÕmÈf Dµ" D] Ýød | ~Ý51
› J g x **origin/stable** J œbW- f : @Dé Ø] Ýø—Ù^?

p e f Ák Cå l , - Df ÝFž a ÝÙW- I , - ~™í Çj XYI " Fã | Gitj ~@P~ f &> Çj ñ •
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```
$ git submodule update --remote
remote: Counting objects: 4, done.
remote: Compressing objects: 100% (3/3), done.
remote: Total 4 (delta 0), reused 4 (delta 0)
Unpacking objects: 100% (4/4), done.
From https://github.com/chaconic/DbConnector
 * 5d60ef9..c75e92a stable      -> origin/stable
error: Your local changes to the following files would be overwritten by
checkout:
  scripts/setup.sh
Please, commit your changes or stash them before you can switch branches.
Aborting
Unable to checkout 'c75e92a2b3855c9e5b66f915308390d9db204aca' in submodule
path 'DbConnector'
```

p e f %o^W" ŠÑSf ÝUV Df ÝF õÝÙ~™| Gitj af äj ?

```
$ git submodule update --remote --merge
Auto-merging scripts/setup.sh
CONFLICT (content): Merge conflict in scripts/setup.sh
Recorded preimage for 'scripts/setup.sh'
Automatic merge failed; fix conflicts and then commit the result.
Unable to merge 'c75e92a2b3855c9e5b66f915308390d9db204aca' in submodule
path 'DbConnector'
```

f 9,, Ók I , - æä ¼d | —Ãx | ž Ä» AUV?

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Ý\$¥' DI , - æä ¼k W" f Ý? ¼k W" i ¥' o\ ~™s ÑS-k DF&uW" i ! 5ófDF°
S¥' j Ák€u· ' Ff , yœb 6%í Ç9' ?

```
$ git diff
Submodule DbConnector c87d55d..82d2ad3:
  * Merge from origin/stable
  * updated setup script
  * unicode support
  * remove unnecessary method
  * add new option for connection pool
```

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' ÅWÖT• « DI , - f ¥?ž " f ¥" \$§¥' ! 5Dxy¼?

t ^ - z ðCj ðóFf 9, a Git \$€uTå. æâGäfkI , - i a Z€u? **git push** ^ %o³ ^ 9, E
Ót ÖcheckÖJ Öon-demandÖD --**re recurse-submodules**; ‡? peœbCåDI , - f ¥Ak€u
ž a ÖcheckÖø. j ...³. **push** " / k?

```
$ git push --recurse-submodules=check
The following submodule paths contain changes that can
not be found on any remote:
  * DbConnector
```

Please try

* git push --recurse-submodules=on-demand

or cd to the path and use

* git push

to push them to a remote.

pf f\$F· í c¥' ^W" k' Dí ; F • « ³ <SCpb‰? ¥} ~Dø. i ÖkÍ W- I , - ¼d | ~
¥€uTéÖàáF- z· · ° { L\HI TFè| dt, +òt€u? pef: @yfk€uï , ÜGäF
ž a 9, o\ EÖ **git config push.recurseSubmodules check** a. ft³ | Ut?

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```
$ git push --recurse-submodules=on-demand
Pushing submodule 'DbConnector'
Counting objects: 9, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (8/8), done.
Writing objects: 100% (9/9), 917 bytes | 0 bytes/s, done.
Total 9 (delta 3), reused 0 (delta 0)
To https://github.com/chaconic/DbConnector
  c75e92a..82d2ad3 stable -> stable
Counting objects: 2, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (2/2), 266 bytes | 0 bytes/s, done.
Total 2 (delta 1), reused 0 (delta 0)
To https://github.com/chaconic/MainProject
  3d6d338..9a377d1 master -> master
```

příkaz \$ Git OK T DbConnector, - 1/4d | \$ € u. až € u ^ . ? pež - I , - stí " > s € u / k F. aí j € u / k ? fí 9, o \ E git config push. recurseSubmodules on-demand a . ft ^ | Ut ?

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```
$ git pull
remote: Counting objects: 2, done.
remote: Compressing objects: 100% (1/1), done.
remote: Total 2 (delta 1), reused 2 (delta 1)
Unpacking objects: 100% (2/2), done.
From https://github.com/chaconic/MainProject
  9a377d1..eb974f8 master      -> origin/master
Fetching submodule DbConnector
warning: Failed to merge submodule DbConnector (merge following commits not found)
Auto-merging DbConnector
CONFLICT (submodule): Merge conflict in DbConnector
Automatic merge failed; fix conflicts and then commit the result.
```

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t ^• Zò- I " Ff, @~%?I , - - CÆS p8ØØ? (ÜDi FGit> Çj cf eö° \$f £J SBD MRF « -- ! þCåæÖ¼D SHA-1r ī Ák? >ÝDi FòI ~í • Z? pef ÝÙgi t di ffF—j Ø T + Üi > D! -] Ÿ½âãDCå D SHA-1r ?

```
$ git diff  
diff --cc DbConnector  
index eb41d76, c771610..0000000  
--- a/DbConnector  
+++ b/DbConnector
```

f „ F \$! H½F eb41d76 i ¥' DI , - ½t öi hDCåF & c771610 i Ñ§ / kDCå? pe¥' Ø kI , - æã ½F· - CZ[\$ eb41d76 Ñ^Fstī > Ák Ý\· ? peÇi DsFÅP` a>sFfī 9 „ } ~5%í > GXW- • N· D] Ÿ?

SÉuWþDCå D SHA-1r > Hm@? · i , @f Sī > • ZD? f 9„ , +...³ o\ SHA-1ī > Fí 9, t · %í W-] Ÿd | , +i > ? ¥' í ; | KFp~ - i t ^W- ~ uvDī > CåMR?

f „ F ¥' [j ØkI , - æã F x § git diff DUV- SHA-1%í W-] Ÿd | ~Ýi > ?

```
$ cd DbConnector  
  
$ git rev-parse HEAD  
eb41d764bccf88be77aced643c13a7fa86714135  
  
$ git branch try-merge c771610  
(DbConnector) $ git merge try-merge  
Auto-merging src/main.c  
CONFLICT (content): Merge conflict in src/main.c  
Recorded preimage for 'src/main.c'  
Automatic merge failed; fix conflicts and then commit the result.
```

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```

$ vim src/main.c M
$ git add src/main.c
$ git commit -am 'merged our changes'
Recorded resolution for 'src/main.c'.
[master 9fd905e] merged our changes

$ cd .. N
$ git diff O
diff --cc DbConnector
index eb41d76, c771610..0000000
--- a/DbConnector
+++ b/DbConnector
@@@ -1,1 -1,1 +1,1 @@@
- Subproject commit eb41d764bccf88be77aced643c13a7fa86714135
È-Subproject commit c77161012afbbe1f58b5053316ead08f4b7e6d1d
++Subproject commit 9fd905e5d7f45a0d4cbc43d1ee550f16a30e825a
$ git add DbConnector P

$ git commit -m "Merge Tom's Changes" Q
[master 10d2c60] Merge Tom's Changes

```

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kTDi F Gitj ° Æ€uW8oÇ? pøl , - æå ¼" \$ÈòÄW- î > Cå F· DæÖ½Om^D• öD
Cå Fža Gitj í ; f [· " tW- 9ÙD• Z1e? . • T K %\$I , - . æDì WQÑî > ^Ömò! t
Cå D] ÝFf „ f 9° : @ž - ?

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```
$ git merge origin/master
warning: Failed to merge submodule DbConnector (not fast-forward)
Found a possible merge resolution for the submodule:
E9fd905e5d7f45a0d4cbc43d1ee550f16a30e825a: > merged our changes
If this is correct simply add it to the index for example
by using:
```

```
E git update-index --cacheinfo 160000
9fd905e5d7f45a0d4cbc43d1ee550f16a30e825a "DbConnector"
```

which will accept this suggestion.

Auto-merging DbConnector

CONFLICT (submodule): Merge conflict in DbConnector

Automatic merge failed; fix conflicts and then commit the result.

Gití ; D^ %oi ~ ™' – F—Äf ŸÙ^ git addž ÄFòÄj %} UVd | Cå? Ç\ f 9° Ç- CòÄ %? f 9, æç 5Ôk I , - æä Fä • ó• i ` a F½ÔTòt Cå F + ø56+F d | Cå· ?

```
$ cd DbConnector/
$ git merge 9fd905e
Updating eb41d76..9fd905e
Fast-forward

$ cd ..
$ git add DbConnector
$ git commit -am 'Fast forwarded to a common submodule child'
```

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' ðKñýþ

f 9, %oÈ~ noSa' l , - µ" æç WQ<?

' ðñýÆ

k W- foreachl , - ^ %oF· ° \$Í W- l , - ¼ÝÙœ9^ %o? p e. æ¼Ôm^ t Cl , - Fòj * € k' ?

Hp F—E ¥' : @, 1, ï W. ™• ° JK» AW" ™1 F> ¥, @\$È- l , - Aµ" ? ¥' 9, æç 5 z " fkl , - Dµ" Øù?

```
$ git submodule foreach 'git stash'  
Entering 'CryptoLibrary'  
No local changes to save  
Entering 'DbConnector'  
Saved working directory and index state WIP on stable: 82d2ad3 Merge from  
origin/stable  
HEAD is now at 82d2ad3 Merge from origin/stable
```

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```
$ git submodule foreach 'git checkout -b featureA'  
Entering 'CryptoLibrary'  
Switched to a new branch 'featureA'  
Entering 'DbConnector'  
Switched to a new branch 'featureA'
```

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```

$ git diff; git submodule foreach 'git diff'
Submodule DbConnector contains modified content
diff --git a/src/main.c b/src/main.c
index 210f1ae..1f0acdc 100644
--- a/src/main.c
+++ b/src/main.c
@@ -245,6 +245,8 @@ static int handle_aliases(int *argc, const char
***argv)

È     commit_page_choice();

+     url = url_decode(url_origin);
+
È     /* build aliases_argv */
È     aliases_argv = xmlalloc(sizeof(*aliases_argv) * (argc + 1));
È     aliases_argv[0] = aliases_string + 1;
Entering 'DbConnector'
diff --git a/src/db.c b/src/db.c
index 1aaefb6..5297645 100644
--- a/src/db.c
+++ b/src/db.c
@@ -93,6 +93,11 @@ char *url_decode_mem(const char *url, int len)
È         return url_decode_internal(&url, len, NULL, &out, 0);
È}

+char *url_decode(const char *url)
+{
+    return url_decode_mem(url, strlen(url));
+}
+
Èchar *url_decode_parameter_name(const char **query)
È{
È    struct strbuf out = STRBUF_INIT;

```

\$ ÒJ F ¥' • TI , - ¼» 1 ^ W- 5‡> \$å. æ¼* ' ^ . ? ÒÑ#i - } 6^ DHI F hi ' ' . °
af ÑWÒ81WD' Æ?

h' Kðã

f 9° : t ¼W" ^ %EÓì) Fst. ' 9° j * €,, &f NÇ° EÓø. " t. ' D³ | ø. ? ¥' \$
Gitì)) * ^ EÓGitì) F hi pef | §§ Git¼t C. ' I , - Ds FÒJ kW" HI ?

```

$ git config alias.sdiff '!'"git diff && git submodule foreach 'git diff"
$ git config alias.spush 'push --recurse-submodules=on-demand'
$ git config alias.supdate 'submodule update --remote --merge'

```

ðÄœf: @~™I , - | 9 „ } ~5ÝÙ git supdateF J git spush Gæl , - • « | €u?

' ðñK} #

d&.' I , - j i kW" ûl " ?

ö x L ö

Hp F. ' Git 2.13 „ ã D7! | F \$kI , - D. æ¼{ |] Ý9° j Hfž Ý? pef %í W-™] ÝF
\$ ¼• • W- I , - F è | { | T ÁkCI , - D] ÝÑ| Ff œdj kW- j 4ÈöDI , - æä?

```
$ git --version
git version 2.12.2
```

```
$ git checkout -b add-crypto
Switched to a new branch 'add-crypto'
```

```
$ git submodule add https://github.com/chaconic/CryptoLibrary
Cloning into 'CryptoLibrary'...
...
```

```
$ git commit -am 'adding crypto library'
[add-crypto 4445836] adding crypto library
 2 files changed, 4 insertions(+)
 1 create mode 160000 CryptoLibrary
```

```
$ git checkout master
warning: unable to rmdir CryptoLibrary: Directory not empty
Switched to branch 'master'
Your branch is up-to-date with 'origin/master'.
```

```
$ git status
On branch master
Your branch is up-to-date with 'origin/master'.
```

Untracked files:
 (use "git add <file>..." to include in what will be committed)

CryptoLibrary/

nothing added to commit but untracked files present (use "git add" to track)

9} ž - æä› ÇS®F hi kW- æä \$ž <j a%kWQST? pef 9} · d | { | Ákž - I , - D
] ÝF , @ÝÙ submodule update --init Sm™í i BÚj ?

```
$ git clean -fdx
Removing CryptoLibrary/
$ git checkout add-crypto
Switched to branch 'add-crypto'
$ ls CryptoLibrary/
$ git submodule update --init
Submodule path 'CryptoLibrary': checked out
'b8dda6aa182ea4464f3f3264b11e0268545172af'
$ ls CryptoLibrary/
Makefile    includes    scripts    src
```

d→W[Fòž DÇ®F⁻ i j a%k Q<ST?

™7D Git>=2.1300\ t git checkout ^ %o• • --recurse-submodules. } 6^fkò" Èi F
· ° t ^ ¥' @{ | TD] Ýal , - ÆSDg - ÔÖ?

```
$ git --version
git version 2.13.3

$ git checkout -b add-crypto
Switched to a new branch 'add-crypto'

$ git submodule add https://github.com/chaconic/CryptoLibrary
Cloning into 'CryptoLibrary'...
...
$ git commit -am 'adding crypto library'
[add-crypto 4445836] adding crypto library
2 files changed, 4 insertions(+)
Create mode 160000 CryptoLibrary

$ git checkout --recurse-submodules master
Switched to branch 'master'
Your branch is up-to-date with 'origin/master'.

$ git status
On branch master
Your branch is up-to-date with 'origin/master'.

nothing to commit, working tree clean
```

øf \$&©. æDÈ -] ÝÑµ" | Fy git checkout . ' --recurse-submodules. í lk' F ·
° af DI , - ÆS ÇODCå Ñ? - ...F pef \$âã^I , - DÇOCå D] ÝÑ{ | F ža\$, Ùgi

status | I , - j # @t ØZ » f Ó> • XØ™DCå Ó?
ði st I , - DÔÓ³ | Çj \${ |] Ý| z 1?
ðQ* €a %STFsâ øf D. æ½/ kI , - | F 9, Bi . ' git checkout --recurse
-submodul es? óy § Ák --recurse-submodul esø. Dm7 GitF \$GXè | 9. ' git submodule
update --in i t --recursi ve Sa I , - ÅSg - DÔÓø?

>ÝDi Ff 9, o\ git config submodule.recurse true EÓ submodule.recurse ø. F ÝÀ
Gitó>=2.14øBi . ' --recurse-submodul es? pÑfI Fòí j a Git t í - / k --recurse
-submodul esø. D^ %oÓ} ^ git cl oneø Bi ² = 5\$I , - ½, Ù?

^ ' ©<Ö x ®' ðñ

uW- å@DÝ- i 8e%nT ^ [I æã ^ | t I , - DI " ? pef \$. æ½Z [Èö ^ W" ½~ Fd |
: @[. ' 9ÝTW- I , - ½F ž a GF ®ûvF a • Gitj yf ÷ ° ã? —E. æAk W" ½~ \$I æã
½Ff : @[. ^ | t W- I , - ? peå} I æã d | ÝÙ submodule addF Gitj ±f t ² O

```
$ rm -Rf CryptoLibrary
$ git submodule add https://github.com/chaconic/CryptoLibrary
'CryptoLibrary' already exists in the index
```

f ®¶@¹ Pè! " CryptoLibrary æã? d | ' 9, ••I , - O

```
$ git rm -r CryptoLibrary
$ git submodule add https://github.com/chaconic/CryptoLibrary
Cloning into 'CryptoLibrary'...
remote: Counting objects: 11, done.
remote: Compressing objects: 100% (10/10), done.
remote: Total 11 (delta 0), reused 11 (delta 0)
Unpacking objects: 100% (11/11), done.
Checking connectivity... done.
```

Ý\$—Ef \$W-] Ý<%o^ðÄDμ" ? pe, +{ | ÄD] Ý½ž " ½~ j \$I æã &* I , - ½| ÑÑf
j ØTð- ™¹ O

```
$ git checkout master
error: The following untracked working tree files would be overwritten by
checkout:
È CryptoLibrary/Makefile
È CryptoLibrary/include/crypto.h
È ...
Please move or remove them before you can switch branches.
Aborting
```

f 9, o\ checkout -f S² Ø{ | Fhi @ûvFpe ½j k 4z" D» f Fð- ^ %o j ä. ' ñ• Ø?

```
$ git checkout -f master
warning: unable to rmdir CryptoLibrary: Directory not empty
Switched to branch 'master'
```

xf{ | ÅSè| Fstl " >sf OT^W- Í D CryptoLibrary æä F > ¥ git submodule update
í ÅW» A· ? f , @OkTI , - æä ¼YÙ git checkout . SÙÄfkD½~ ? f í 9 „ o\
submodule foreach ý! Ste- I , - YÙ. ?

@° í O9Di FUSI , - j [· ' Dfk Git‡?z" \$E©. æD . git æä ¼F f , ÇÄm7! D
GitFÅYW- I , - æä > Çj . / œbCåJ] Ý?

/k ^ò" µ¶F. ' I , - j ft 9 „ \$E- / Ghé] nD. æÑO! , ðD/ ø} ~k ŽD1W?

ä ö

cd ¥' Z [^• ^þwx y Git‡?D€' 1Wóp HTTPF SSH > ØF h j k uLW8Ct €\$éNd] k
' D1 2?

Git 9 „ [· D‡?ØêÖÓTW- ½~ ¼? ò\$8e< Ä½Í I k' ? k 9° f Dþw½ÿ^Fhf N' ' [
f DCåx cf Dî " K' ? 9° f Ç\$=! þ½ÿ ¥X§ÚŽ..._Ak cf ³ k AþD>ÿ? 9° f DÅ
Kþk KþX" Ø^? 9° f Y\$Ak&3EFðD>ÿ Ff N' ' o\K~ [~™¿ucì %F éÇ' ' o
\ format-patch D1 2xy 40 - Cå?

ò" oÇ< git bundle —j I k' ? bundle ^‰oj [git push ^‰fx y DfkA~êÖfw- VÔÓ
½~ F f 9 „ [ò- ½~ o\K~ J KK" xc 6%Fd | • OT 6Dà á ¼?

S••W- } ~DHI ? —Ef k W- Œm! - Cå Dà á O

```
$ git log
commit 9a466c572fe88b195efd356c3f2bbeccdb504102
Author: Scott Chacon <schacon@gmail.com>
Date:   Wed Mar 10 07:34:10 2010 -0800
```

Ê second commit

```
commit b1ec3248f39900d2a406049d762aa68e9641be25
Author: Scott Chacon <schacon@gmail.com>
Date:   Wed Mar 10 07:34:01 2010 -0800
```

Ê first commit

pef: äò- àá¿uc 6%hf Ák 6àáD>ÿFJK—i SÒ™í W- àáF f —9 „ ' git
bundle create ^‰SéŒ?

```
$ git bundle create repo.bundle HEAD master
Counting objects: 6, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (6/6), 441 bytes, done.
Total 6 (delta 0), reused 0 (delta 0)
```

d | f —j k W-) t **repo.bundle** D½~ FC½~ Óm^fk mí Càá **master**] Ýf, D‡?? \$.
 ' **bundle** ^ %o| Ff, @WXfkf' ' êÓD- ' JKCaD' ÷? pef' ' ò- àá9, \$ì Æ{ q
 r Ff - CĀHI ¼ž Ä" • W- HEAD- ' ?

f 9, [ò- **repo.bundle** ½~ o\K~ JKUùxcì %?

uW1 ÜF—Eí %x cf W- **repo.bundle** ½~ > ' ' f \$ò-. æÑµ" ? f 9, sò- VÔÓ½~ ¼
 qr XW- æã F—Äs W- URLqr WÄ?

```
$ git clone repo.bundle repo
Cloning into 'repo'...
...
$ cd repo
$ git log --oneline
9a466c5 second commit
b1ec324 first commit
```

pef \$êÓ| Ák ÓmHEAD- ' Ff j , @\$^ %o| • » W- -b **master** JK 6{ - k D] ÝF a •
 Git Çäj - CGXpW-] Ý?

Ý\$—Ef Cå ^ 3 - » þF> ¥@' K~ JKUù[™DCå < \$W- ÓJ xÄ] ?

```
$ git log --oneline
71b84da last commit - second repo
c99cf5b fourth commit - second repo
7011d3d third commit - second repo
9a466c5 second commit
b1ec324 first commit
```

' 1 ¥' , @- | ¥' ' ' { êÓDCå' ÷? Bþw: ; Çt WÄFþw: ; j ÉÝ| áXf, xyD¥û
 ‡? EF&¥' , @~ Ý| á? ðf 9, ÄÑÜžÄ[Ó- àáéÓFh¥5ggéÖg~ D\] ÑÑ—i
 ¥' ØØ\$! 5‰D 3 - Cå?

t ^...Yò- æç Ff, @| áXóí ? —Ä¥' \$ Cå' ÷) * DFfkI e812] • ÑW- Cå' ÷?
 ¥' 9, . ' ori gi n/master.. master JK **master** ^ori gi n/master è » D1WSOPž 3 - \$¥'
 D **master**] Ý&Ç\$>¹ àá ¼DCå? f 9, ' log ^ %oS 6+?

```
$ git log --oneline master ^origin/master
71b84da last commit - second repo
c99cf5b fourth commit - second repo
7011d3d third commit - second repo
```

ØÄ—OPT ¥' ' ' { èÖDCåWº Fa¥' [ð" CåéÖ? ¥' 9,, ' git bundle create ^ %oF
• Ñ¥' : ' D½~) F,, B@èÖDCå' ÷?

```
$ git bundle create commits.bundle master ^9a466c5
Counting objects: 11, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (9/9), 775 bytes, done.
Total 9 (delta 0), reused 0 (delta 0)
```

Y\$\$\$¥' Dæä <j KW- commits.bundle ½~ ? pе¥' äð- ½~ ðuc¥' Dî " KFè9,, [ð- ½~ « kT >¹ Dàá¼F j . \$òN÷Z[k 6Dµ" CåTò- àá¼?

¤èuTð- Õ! Fè9,, \$« kTåáèåä• ð- ÕJ Öm^` aA~? bundle verify ^ %o9,, Gå
ð- ½~ i a i W- ↑ WD Git ÖFi a /k&OD] ¹ S« k?

```
$ git bundle verify ./commits.bundle
The bundle contains 1 ref
71b84daaf49abed142a373b6e5c59a22dc6560dc refs/heads/master
The bundle requires these 1 ref
9a466c572fe88b195efd356c3f2bbeccdb504102 second commit
./commits.bundle is okay
```

pøêÖµ¶ggä¥| ! - CåéÖF &Çi ÷ - F >¹ Dàá i ÅW« kò- ÖDF stò- ÖP/ ^ ®
@DCååä? ð! a verify Dy X» ¼O

```
$ git bundle verify ./commits-bad.bundle
error: Repository lacks these prerequisite commits:
error: 7011d3d8fc200abe0ad561c011c3852a4b7bbe95 third commit - second repo
```

&¥' DUW- Õi ↑ WDF f,, ¥' 9,, sò- ÕJ CPXCå? pef: ä• ðþÖJ 9,, « kp"]
ÝFOÄkW- ^ %o9,, WXò" È7O

```
$ git bundle list-heads ./commits.bundle
71b84daaf49abed142a373b6e5c59a22dc6560dc refs/heads/master
```

verify | ^ %oÄ9,, ÝÀfk p" È7? C• ° DæDi ä• p" i 9,, { l k DF f,, f 9,, . '

fetch J K pul I ^ %oS Ő¼« K Cå? òJ ¥' @S Ő¼PX master] ÝT ¥' à á ¼D other-master] ÝO

```
$ git fetch .. /commits.bundle master:other-master
From .. /commits.bundle
* [new branch] master -> other-master
```

9 „ • T ¥' Z [[Cå « k T other-master] ÝF „ B\$òN÷¥' Ém\$ master] ÝÑDCå?

```
$ git log --oneline --decorate --graph --all
* 8255d41 (HEAD, master) third commit - first repo
| * 71b84da (other-master) last commit - second repo
| * c99cf5b fourth commit - second repo
| * 7011d3d third commit - second repo
|
* 9a466c5 second commit
* b1ec324 first commit
```

sãF ñf \$Ákî PDþwJ K9&3àá DoÇ< F git bundle | Pî ' S&3J Kþw» z Dí " ?

Öx

¥' èâ² * \ F Git y <‡? á ¼Dy < i Ç9f g DF d & Git CD^W8k TD1 2S' 6y < ! ...
| ‡? á ¼D Git y < ?

repl ace ^ %o9 „ af \$ Git ¼• » à á Ø" > ÝÀ GitØÍ t nTò- Gity < | F—Û. i çúØ
" Ø? \$f' W- ÇODCå. | æÖ¼DW- Cå &Ç: „ git fil ter-branch è » D1 2mí ôÖDæ
Ø| F ðj * €k' ?

HpFf kW- þz Dn oæØ : ä ÉmDå á] fW- ÝDæÖBW- ~ þ~, òDæÖF ÝæÖD™D
, ðK. ' F | KcRQ‡? uvD%. ' ? f9 „ o\ ' ™å á ¼¥½DCå Ò. | Óþå á ¼¥™DCå
S- ³ æÖF ð8129 „ äWž æÖ97T 6æÖÑ? ð9à Èf Ç' \$™æÖ¼ž g. | í W- Cå
os t æÖS† j ÷) SHA-1r øF f9 „ • k6' ?

a ¥' S++Ø? ' 1 OPW- Z [" \$Då á F > [] f! - à á FW- i ¥UDå á FW- i æÖ7!
Då á F d | ¥' [• Tpb\$Ç~ f å á SHA-1r DoÇ< o\ repl ace ^ %oS† > 6' ?

¥' [. ' W- / k 5 - Cå D} ~å á O

```
$ git log --oneline  
ef989d8 fifth commit  
c6e1e95 fourth commit  
9c68fdc third commit  
945704c second commit  
c1822cf first commit
```

¥' : [] fø] f! ž æÖ? UW- T U_ - Cå D" t UW- æÖ7! ? U_ PUİ - Cå D" t ¥U
DUV- æÖ7! ?

%í æÖ7! DæÖI ~í F ¥' 9„ [W- æÖ¼D] Ÿ€uTW- ™DéÖàáD **master**] Ÿ?

```
$ git branch history c6e1e95
$ git log --oneline --decorate
ef989d8 (HEAD, master) fifth commit
c6e1e95 (history) fourth commit
9c68fdc third commit
945704c second commit
c1822cf first commit
```

```
$ git remote add project-history https://github.com/schacon/project-history
$ git push project-history history:master
Counting objects: 12, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (4/4), done.
Writing objects: 100% (12/12), 907 bytes, done.
Total 12 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (12/12), done.
To git@github.com:schacon/project-history.git
 * [new branch] history -> master
```

òÄWSF ¥' DæÖ7! —¿ , ^? ` ®D\] • i å³ ¥' ¥UDæÖSa· gÒ~ û? ¥' , @W- m
W, ¬§' W- /> DCåS. | uW- CåFòÄWSF ¥' [nÿTU_Pi - Cå?

```
$ git log --oneline --decorate
ef989d8 (HEAD, master) fifth commit
c6e1e95 (history) fourth commit
9c68fdc third commit
945704c second commit
c1822cf first commit
```

\$ò8oÇ<F%í W- ° p• « ½ÀæÖDxØCåi l k' D? òÄWSF pe 6D, ¿K: @» f U
Wt CåJK 6i " | —äj @‰` aFsåF³ <S¥' @‰Di ' ^ %‰í W- ¥ÜDCåy<Fd |
[O<DCåóU_PUi - CåøgxT. DÑÜ?

t ^ òa‰F ¥' , @øùW- Q] ø] F yS¥' &xi U÷ - CåóSHA i 9c68fdcø? sã¥' DCå
[xSåCå%? ¥' 9„ . ' committ-tree ^ %‰S%í xØCåF òÄ¥' —k ^ W- %F> ýÅW- Ž
™DPÅ&? QD SHA-1 Cåy <?

```
$ echo 'get history from blah blah blah' | git committ-tree 9c68fdc^{tree}
622e88e9cbfbacfb75b5279245b9fb38dfa10cf
```

! committ-tree ^ %‰2S: ; • %‰? k 8e • %‰* ...³ . ' F&i { çèK Git ^ %‰ S‰
~ úW" Dµ" ? k | ø¥' %‰W" ÄðÄD(Üno| F· ' L8¥' %‰W" ÇP' §r
€. ' hžg: ; DKL? ~ eG§: ; ^ %‰DA~G; \$: ; ^ %‰ŠÑ; ^ %‰?

Y\$¥' Z[kW- × ØCå ^ F¥' 9„ o\ git rebase --onto ^ %S[OŠDæÖg × T × ØCå è
Ñ? --onto; † i Ø' commi t-tree ^ %oÿÅD SHA-1 r F g × Qj ft U÷ - Cå ó¥' : 1 < DUW
- Cå D&Cå F 9c68fdcøO

```
$ git rebase --onto 622e88 9c68fdc
First, rewinding head to replay your work on top of it...
Applying: fourth commit
Applying: fifth commit
```

¥' Z [' x ØCå mL ^ ¥UDæÖF x ØCå ÕÖp b m™ûf Ö- æÖD- Ñ? ¥' 9,, [™æÖ€u
T™. æ½F ø 6%qr ø- àá | F 6' g° • T ¥U! t Cå,, ßW- ÕmÑI - ÑDxØCå?

Y\$¥' [„ : OÒÖ- æÖD%D- ° SÙt qr ø- . æ? \$qr ø- n ý | Dà á | t ^ ÒTæÖ‡
? F , @•• UV- éÖDæÖ7! á> y %OPÍ " O

```
$ git clone https://github.com/schacon/project
$ cd project

$ git log --oneline master
e146b5f fifth commit
81a708d fourth commit
622e88e get history from blah blah blah

$ git remote add project-history https://github.com/schacon/project-
history
$ git fetch project-history
From https://github.com/schacon/project-history
* [new branch] master -> project-history/master
```

Ý\$F: " K\$ master] Ý¼/ k 6' ¥UDCå› ¥\$ project-history/master] Ý¼/ k \] DC
å?

```
$ git log --oneline master
e146b5f fifth commit
81a708d fourth commit
622e88e get history from blah blah blah

$ git log --oneline project-history/master
c6e1e95 fourth commit
9c68fdc third commit
945704c second commit
c1822cf first commit
```

t ^i > . ' Ff 9,, . ' git replace ^ %o• Ñf: . | DCå MRSÖÙ. | ? ðÄWSF¥' —9,
[master] Ý¼DU_- Cå. | t project-history/master] Ý¼DÖU_- ÖCå?

```
$ git replace 81a708d c6e1e95
```

Ý\$F ä • master] Ý¼DæÖMRF # ©p < O

```
$ git log --oneline master
e146b5f fifth commit
81a708d fourth commit
9c68fdc third commit
945704c second commit
c1822cf first commit
```

I fF i Çi ÅÇ' fgÑ§ D SHA-1¥' —° ' W- Cå S. | æÖ¼Dfk ÇODCå F > ¥fk Dµ¶

Ó bi sectF bl ame > ØÍ Í èŽ?

k TDi Fj . i . ' ^ c6e1e95 Cå ‡? SÔÙ. | F· D SHA-1 ¢# @t 81a708d? j . f ÝÙ ^
cat-file ^ %oF· ¢j # @f . | D‡? O

```
$ git cat-file -p 81a708d
tree 7bc544cf438903b65ca9104a1e30345eee6c083d
parent 9c68fdceee073230f19ebb8b5e7fc71b479c0252
author Scott Chacon <schacon@gmail.com> 1268712581 -0700
committer Scott Chacon <schacon@gmail.com> 1268712581 -0700
```

fourth commi t

Gå ‡ F 81a708d ž g D&Cå i 622e882 \$Ê Cå F &* î Y D 9c68fdce Cå ?

uW- k T Dn o i ‡? [j „ „ <- ' # @O

```
$ git for-each-ref
e146b5f14e79d4935160c0e83fb9ebe526b8da0d commit refs/heads/master
c6e1e95051d41771a649f3145423f8809d1a74d4 commit
refs/remotes/history/master
e146b5f14e79d4935160c0e83fb9ebe526b8da0d commit refs/remotes/origin/HEAD
e146b5f14e79d4935160c0e83fb9ebe526b8da0d commit refs/remotes/origin/master
c6e1e95051d41771a649f3145423f8809d1a74d4 commit
refs/repl ace/81a708dd0e167a3f691541c7a6463343bc457040
```

ò9àÈ¥' 9, æ&í : DB 6%] 3. | Fst ¥' 9, [. | €uTEFð½> ¥ 6%9, æç5<
i ? í 8\$æÖ97oÇ<Çi l k' óŒdí - %í ±9<i ¥™7! BæÖ7! Ft bj @ø] 6'
ÆÅøFh\$ 6oÇ<¤dI k' ?

• \$

pef. ' Di SSH 1 2- ³ é7F > ¥EÓ^W- Ák' %D) ôFòÄ—9, \$Çyk' i) B) oD
oÇ<ÚŽ5xy‡?? d&Fòy HTTP: ; S¬i Ç9° DÑÑÍ W- - ³Í i , @' i) B) oD? ò
\$. ' ^ m| ODoÇ<j ~ žÝFstf, @ykW- XõÓf> ¥, Å=• D token" t) o?

>ÝDi FGit / kW- / O• , SÆ€ò- no? <ÜkW" Git Dø. O

¥ ³ | fkÍ Ç¤" ? í Wt - ³Í j ¿ I f D' i) B) o?

¥ ØcacheÓ, 2j [/ O" < \$A" ¼Wf | ÷?) oŽéÇj { " # \$) ù¼F > ¥\$15] b | sA" ¼%} ?

¥ ØstoreÓ, 2j [/ O' Ñ½DÚ2" < \$) ù¼F > ¥ŽÇ\ N? ò9àÈ} * f » f ^ f \$ Git EF
ðND) oFª • f ŽéÇ, @dt ykf D/ OMR? ò812DPQi f D) oi ' Ñ½D1 2" <
\$ f D home æä <?

¥ pef. ' Di MacFGitj kW8 ØosxkeychainÓ, 2F· j [/ O¤" Tf • , ' i Dô' { ¼?
ò812[/ O" < \$) ù¼F > ¥ŽÇ\ NFhi i { •) DF ò8•) 12S" < HTTPS / O, B
Safari DÉÝÜL i / OD?

¥ pef. ' Di WindowsF f 9, ÚÛW- ô‰ØGit Credential Manager for WindowsÓ DF Eµ¶?
òBÑÜ¬D ØosxkeychainÓ d] » ¼Fhi i . ' Windows Credential Store S ØÓ{ ¾MR? 9,
\$ <https://github.com/Microsoft/Git-Credential-Manager-for-Windows> < i ?

f 9, EÓ Git DPÓSøùÑI DW812

```
$ git config --global credential.helper cache
```

\] F Eµ¶kW" ø. ? ØstoreÓ, 29, ³ ' W- --file <path>; ¶F 9, É» 1" <) oD½~ ¢
· ó³ | i ~/git-credentials ø? ØcacheÓ, 2k --timeout <seconds>; ¶F 9, EÓ| ØØ
ØD" + | ÷ó³ | i Ø900ØFí —i 15] bø? <Üi W- PÓØstoreÓ, 2É» 1¢· DHl O

```
$ git config --global credential.helper 'store --file ~/.my-credentials'
```

Git < -L8f PÓe - F Eμ¶? æä Ü° » EF ÓD/O| F Gitj i ...æä F > ¥\$ ÜT UW- Å®!
> Çä¿? æz" / O| F Gitj [' i) B) o¿uc gh PÓW° ¼DF Eμ¶F· ' j i ÉmD1 2Æ
€' i) B) o? pef \$K" Ñk W- / O½~ F hN' ' \$CK" { ' XDoÇ<. ' A" æ" Sz " ' i)) oF .gi tconfig PÓ½~ p<O

[credential]

Ê hel per = store --file /mnt/thumbdrive/.git-credentials
Ê hel per = cache --timeout 30000

%&° a

ò" i pb...YDÆÅ Git / OF Eμ¶• , D^ %oi git credential F ò- ^ %o³ EW- ; ‡ F > o\ç
† y k OP~ eD; ‡ ?

: W- HI ~ ~í €• ? ¥' —EZ[PÓ5W- / OF Eμ¶F ò- F Eμ¶z" ^ mygi thost D/ OM
R? <Üi W- . ' ÒfilliÓ ^ %oDj sF æ Git , + ' ÜW- EF ÓD/O| —j { * ' ?

```
$ git credential fill M
```

protocol=https N

host=mygi thost

O

protocol=https P

host=mygi thost

username=bob

password=s3cre7

```
$ git credential fill Q
```

protocol=https

host=unknownhost

Username for 'https://unknownhost': bob

Password for 'https://bob@unknownhost':

protocol=https

host=unknownhost

username=bob

password=s3cre7

M òi , 1 å y D^ %o?

N Git-credential³ < Sj > Vç t y k? ¥' CD¥' fäj DMRO: ; Bå Õ)?

O W- Í Ün° y k Z[off/O• , - Cy X· fäj DMR?

P ³ < S° Git-credential³ ý F > ¥[ÜT DMRê(T ç t y X?

Q peÁkÙTy - D/ OF Gitj ð I ' i D' i) B) oF ¥' [ð" MRy k T\$ç t y XD51 ð
- HI ¼i OW- ðÓØø?

/ O• , ...É* ' DÓœB Git! - i] , DÚ¶1 i pW- „ Bpb* ' Š credential . hel per PÓDr
kG? ð- PÓk e 8š 20

| | |
|-------------------------------------|--------------------------------------|
| • ' ' mv | |
| foo | , Ü git-credential -foo |
| foo -a --opt=bcd | , Ü git-credential -foo -a --opt=bcd |
| /absolute/path/foo -xyz | , Ü /absolute/path/foo -xyz |
| !f() { echo "password=s3cre7"; }; f | ! ÜDnoj \$ shell, Ü |

ÑÜI I DF Eµ¶9, { ü‰gi t-credential -cache Pgi t-credential -store è » F ¥' 9, PÓ
· ' S³ ' ^ %Ü; ‡? o€Dš 2i ðgit-credential-foo [args] <action> Óç t y k/y X: ; B git-
credential WÄF h· ' . ' Di W: ` êÇt WÄDÙt O

¥ get i GÅy k Wy' i) B) o?

¥ store i GÅz " W- / OTF Eµ¶DA" ?

¥ erase j [c » DO- s F Eµ¶A" ¼%} ?

y § store B erase! - Üt i Ç, @yÀ‡? DóGití j Ê5Óø? d&y § get F Git y F Eµ¶Dy
ÀMRd] ¾ST? p eF Eµ¶> Çä j œbk' DMRF· —j ...³ x X&Ák œb y XF h p eä j D
s F · —j \$Z" #MRDx ØÑ½j f CDDMR? · Dy X9• %oW• WÜr Æ| F CDDœbA~Í j
Pn Git Z ä DA~?

p eF Eµ¶Ák œbk' DMRF· 9, ...³ x X&Ç, @y Xœb KLF h p e· k ð" MRF· \$CDD
MR | Ü" • · f/ k DMR? ð" y Xj { i t W• WDÜr Æ| úÍ W- CDD‡? Í j [Git Z k D‡?
. | Ó?

ðk W- BÑÜWÄDHI F h i • \ ^ git-credential ðWÈF ...³ T git-credential-store:

```
$ git credential -store --file ~/git.store store M
protocol=https
host=mygit.host
username=bob
password=s3cre7
$ git credential -store --file ~/git.store get N
protocol=https
host=mygit.host

username=bob O
password=s3cre7
```

M ¥' YÀ git-credential -store] z" / OÖœHI https://mygit.host | . ' ' i) ðbobOF
) o i ðs3cre7Ó?

N Y\$¥' PXò- / O? ¥' CD- ³ ò\] DMRó<https://mygithost.com>, BW- T Ü?

O gi t-credential -store yX¥' èâz" D' i) B) o?

~/git store ½~ DA ~» ¼O

<https://bob.s3cre7@mygit.host>

ggi W• Wõm/ OMR URL ûfDÙ? osxkeychain B wi ncred F Èµ¶. ' . ' | 7" #D>óš
2F & cache. ' . DA" š2ö 6ÖÖÅW` Pø?

k m(##) •

Z [ä i gi t-credential -store è » Di B Git i / ý2i DÖœF—Ç®€• Git / OF Èµ¶ 9, i
‡, Œœ? cd Git CDDF Èµ¶ ñ• ^te‡€\$D. ' < ÄFh> Ç° @Æfk oÇ? > pF—Ef D
Ö- wx &3W" / OFí 8i \$\\(| . ' ? ò" / Oi z" \$W- &3æäJ F° §ò" / O[€g~ F
f „ f Ç: ä. ' AÓTf ÉmD/ Oà á½? Yk DF Èµ¶ ÅW@Æò8oÇúS• • ¥' pbÉm...Y
W- ? ò- Œœ- C/k Ë- uv• ° O

1. ¥' i W, @GODÙti **getústore** B erase i Lï " Ff, ø³ ' Tò! - GÅ; ¥' ...³ x Xj
9?
2. &3D/ O½~ š2B **gi t-credential -store**. ' Dš 2/ O?
3. / O½~ D¢. Wc i • » DFh¥' - CL8' i x kW- É» 1¢. „ ê - W?

¥' dWt. ' Ruby S' Lò- ½ÅFh- @Git° p, Ü¥, DÖœFœbŒxï i 9, D? òi ¥' D/
OF Èµ¶ DôÖnøO

```

#!/usr/bin/env ruby

require 'optparse'

path = File.expand_path '~/.git-credentials' M
OptionParser.new do |opts|
  opts.banner = 'USAGE: git-credential-read-only [options] <action>'
  opts.on('-f', '--file PATH', 'Specify path for backing store') do
    |argpath|
      path = File.expand_path argpath
  end
end.parse!

exit(0) unless ARGV[0].downcase == 'get' N
exit(0) unless File.exists? path

known = {} O
while line = STDIN.gets
  break if line.strip == ''
  k,v = line.strip.split '=', 2
  known[k] = v
end

File.readlines(path).each do |filename| P
  prot,user,host =
  filename.scan(/^\:(.*?):\/\/(.*)@(.*)$/).first
  if prot == known['protocol'] and host == known['host'] and user == known['username'] then
    puts "protocol=#{prot}"
    puts "host=#{host}"
    puts "username=#{user}"
    puts "password=#{pass}"
    exit(0)
  end
end

```

M ¥' \$òJ • ò^ %ù; ‡FL8' i • » yk½~ F³ | i ~/.git-credentials.

N ò- Øœ- k \$³ ' T get Ùt DGÅ> ¥| 7" #D½~ " \$! ' j kyX?

O ò- %o{ sc̄tyk` P‡?F...T` PTUW- ï ù? ykD‡?{ z" T known w' ° ¼Fè | , @ ' T?

P ò- %o{ ` P" #½~ ¼DA~F ' ÙéPDÙ? pe known ¼D: ; Båð) ŠCÙ/éPFò- Øœ yX" e> xX?

¥' äò- F Èµ¶z" t git-credential-read-onlyF< T ¥' D PATH ¢. <> ¥cÝ, Ù>y? W - åÿ2j s» ¼O

```
$ git credential -read-only --file=/mnt/shared/creds get
protocol=https
host=mygit.host
username=bob
password=s3cre7
```

◦ §ò- D) yi Ògit-Ó, è Ff, ¥' 9, \$þÓr ¼. ' } -DŒWO

```
$ git config --global credential.helper 'read-only --file
/mnt/shared/creds'
```

gpf • TDF ½Àò- • , i / ø} ~DF> ¥9, tf Bf Dwx • ZW" €\$I " ?

¶ E

fZ[³¶^I e° pÝ-5Í ÒCåB! " ' Dc ©µ¶? øf | TI " | Ff - C9, I ~í ÙXi p-
] Ý\$` a | ^ ° Ø- k ^ . ' ? pef: \$. æ¼. ' I . æFf í Z[ä | pbS@Æò" , Å? TãF
f - C° , Å‰" 5\$ ^ %oÙ¼. ' GitSôfr €¼Dt\] no?

k m(Git

Tæât ÇF ¥' Z[kI ^ Git x! DÝ" ÕÓB. ' 12F) * ^ 8e Git CDDµ¶S¢Ef } ~ ¥k Ž 5. ' . ? \$! eF ¥' [É©pbÈE Git DW" m@DPÓ1WB3I ÕÓFS@ÆÉ» 1D, Å? o\ ð" µ¶F· j Bf Pf D! " J f Dwx Pî ÒbµÅ¶?

• ' Git

gpf \$ ÈÈ ¼• TDF 9,, ' git config PÓGit? ' 1 @%Dno—i EÓf D) yBK~ 5¢O

```
$ git config --global user.name "John Doe"
$ git config --global user.email johndoe@example.com
```

Y\$Ffj ^ • T8e~ kTDø. F> ' » ¼D12S» ÓGit?

' 1 F½¾ÀÁ<OGit. ' W• WPÓ½~ Sz" fÉ» 1DÙt? . ' 1j äÙ• , ©D /etc/gitconfig ½~ FC½~ mk• , JÍ È' i B6' f/k DàáDPÓr? pefx² --systemø . c git configF· —j ` LC½~ ?

³ <S Gitj äÙÍ - ' i D~/.gitconfig ½~ óJ K~/.config/git/config ½~ ø? f 9,, x² --global ø. a Git` LC½~ ?

¥| Gitj äÙf g\$! " Dàáfy" DGit æã <DPÓ½~ ø. git/configø? ø- ½~ ¼Dr~ yC àákŽF· y~ §Ngit config x² --local ø. ?

, Ñ÷- ; t ¼Í ; DPÓó• , PZÍ P! 5øÍ j ñ• ÓÑW; t DPÓFf,, .git/config ¼Dr j ñ• Ó /etc/gitconfig ¼fy" Dr ?

!

Git DPÓ½~ i 5½! DFf,, f 9,, ...³ ~Ý' šð" PÓ½~ Fykî l CEWDr? h i ÝÙ git config ^ %oj ~} ~" ?

* " ôaB• '

Git° pwì DPÓ.] t! t» O« i 7BEFØ7? ¼t\] 2S« i 7PÓÑÑ 9,, • f - %Dµ" Ú 5ÔÙPÓ? Qý Git Y{ Dø. ÇPFh ¼t\] gg\$! " . \$DoÇ<k 91? ¥' - œl ¥×€B ¥k' Dø. ? pe: ØTf øâ 7! DGit Y{ Dø. Wº FGÝÙ

```
$ man git-config
```

ø- ^ %oWX^fk 9' Dø. F,, BŠè/GD) *? fí 9,, \$ <http://git-scm.com/docs/git-config> ÚT OÄDA~?

core. edi tor

³ | oÇ<FGitj *' fo\ | BgC \$VI SUAL J \$EDI TOR EÓD½! ' šðF peÁk EÓF³ | • j
* ' vi S%í B' šf DCå „ BçëMR? f 9„ . ' core. edi tor ø. S» f³ | D' šðO

```
$ git config --global core.editor emacs
```

Y\$FÅPf » 1^` a, 7' šðF Gitlj *' Emacs' šMR?

commi t. templ ate

peää. • » t f D• , Ñl - ½~ Df. F xf Cå D| a F Gitj . ' C½~ DA~" t Cå D³ | Ü
¹ 6MR? %í DÉ » 1Cå , 7¼Dr 9„ ' SC©ÉmJ 6%P xf DCå š 2B™š?

HpO... „ < ~/.gitmessage.txt , ú½~ O

Subject Line (try to keep under 50 characters)

Mul ti -line description of commi t,
feel free to be detailed.

[Ticket: X]

O9åCå , 7i pbC©CåKz { å" D} Yót ^Y} git log --oneline DyXøF pb\$ | Ü•
• ÔWÈDÔoFpb- ' l" Bug Èö• , Dµ~ì öTicketøF pe kDs ?

@: a Git ä· " t YÙ git commi t | # ©\$f D' šð¼D³ | MRF p < EÓ commi t. templ ate O

```
$ git config --global commi t. templ ate ~/.gitmessage.txt
$ git commi t
```

xf Cå | F' šð¼—j # ©p < DCå MR\$ Èz O

Subject Line (try to keep under 50 characters)

Multi-line description of commit,
feel free to be detailed.

[Ticket: X]

```
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
# modified:    lib/test.rb
#
~  
~  
".git/COMMITMSG" 14L, 297C
```

perf Dwx y Cå MRk š 2@ÅF 9, \$•, Ñ%í W- ½~ F> PÓ Git ä. " t³ | D, úF ö Å 9,
~ • ~í 5. Cå MR^ %oš 2?

core.pager

CPO. • » Git YÜ• p log B diff > ^ %f. ' D] Ěð? f 9, ä. EÓf' more JKæbf RQ
D] Ěðó³ | ' Di lessøF ædí 9, EÓfī yz{ FGf Cø. O

```
$ git config --global core.pager ''
```

oÄÇy ^ %oDy XCeöF Git ī j \$WĒ # ©fk A~?

user.signedkey

perf @%í [è(Dmf ODçëógp è(μ" fI øF žaäf D GPG è() oEÓt PÓ. j ~
5? p< EÓf D) o IDO

```
$ git config --global user.signedkey <gpg-key-id>
```

Y\$FfÍ t YÜ git tag ^ %o! Fj 9...³ è(çëF &Å, » 1) oO

```
$ git tag -s <tag-name>
```

core. excl udesfi l e

gp É5½~ fI Ff 9, \$f D. æD . gi ti gnore ½~ J Ü= » Å, ÖK Git ý€D½~ D, úF ðÄ
· · ÆÇj XY\$4ÈöW° F í Çj \$f ÝÙ gi t add | { ! " ?

Ç\k" | ^ Ff: @\$f fk D7! á¼È5Ól W» ½~ ? pef Dí " • , i macOSFI 9° —i •
. DS_Store? pef ä EmacsJ Vim" t' øD' šðFf" » äj , ~" åD½~) ?

ò - PÓL8f EÓ» ¼SŽÍ óŽD . gi ti gnore ½~ ? pef j F <ÜDA ~%í W-
~/. gi ti gnore_gl obal ½~ O

```
*~  
. *. swp  
. DS_Store
```

ÉÉd | ÝÙ gi t config --gl obal core. excl udesfi l e ~/. gi ti gnore_gl obal F Git [äž " ½~
Žé5BèÅL?

hel p. autocorrect

-pf ê™^ Wž ^ %oFj # ©O

```
$ git chekcout master  
gitO' chekcout' Çi W- git ^ %o? ; $ ' git --hel p' ?  
• Di ò- aÅ  
Ê checkout
```

Gitj , +f 6f D9ÙFhi · Çj ò¹ n° ? pef ä hel p. autocorrect EÓf 1Fž a - @k W- ^
‰{ , ° éPT ^ F Gitj ÉÝÝÙC ^ %o?

```
$ git chekcout master  
| ÝO, ÝÙW- Ç" $D Git ^ %o ' chekcout' ? µ¶, Ü—» , @@ÝÙD  
i 'checkout'  
$ 0.1 \b | ÉÝÝÙ...
```

O9C©MR¼DÒ0.1\Ó? hel p. autocorrect ³ ' W- n° d] èW\ DÖ‡? f, pef ä. EÓt
50, Git [\$ÉÝ, Ü^ %oâc f 5\ D| ÷f gå 9?

Git I K + ,

Gitj] Ý{ y , 7A~ÈçFyf / »j } ~þ½¾] ò^ %oy XkI +¢E? f 9, EÓ8eD/ Gø.
S@ÆÉmDÚ5?

color.ui

Gitj ÉYÉç†\] yXA~Fhpef ÇRQÓÓ?? Fí 9,, GÓ? @: GÓ Git D, 7½ç yXF +W <ð - O

```
$ git config --global color.ui false
```

ð- EÓD³ | ri autoF· j Éç...³ yXT, 7DA~ú&¤A~{ m» NTW- ýi J½~ | F• Ê5 Éç• °?

fí 9,, EÓf alwaysFSÉ5Óyj B, 7DÇOFj \$œboÇ<ÉçyX? fI öj ðaEÓF\$te ð<í <Fpef: \${m» NDyX¼, k¼çOF9,, x² --colorçäc Git ^ %S² Ó. ða%?³ | EÓ—Z[° @Æte ðoÇ<D, Å^?

color.*

@: ¶¹Tp" ^ %oyX, @{ Éç,, B. ÄÉçFF, @' TB¶¹ ^ %kGD½çPÓø. ? . ' I° { Ót truefalseJ alwaysO

```
color.branch  
color.diff  
color.interactive  
color.status
```

uLF,, ÑÍ - PÓ. I kI ø. F. ' 9,, { ' Sñ• &EÓF,, ÁTTyXDÚ- \] ÉçDæD? H pFt^a **diff** DyXMR,, I çåÄPª çÃÄB•¹ #©FF9,, YÙ

```
$ git config --global color.diff.meta "blue black bold"
```

f° EÓD½çk Onormal PblackPredPgreenPyelI lowPbluePmagentaPcyanJ whi te? gp,, ÑHI EÓD•¹ 2- F: @EÓy¹ 2- DsF9,, øùÖÖObol dPdi mPul ó<§KøPbl i nk Preverseå| åÄçBÄÄçø?

. - K÷ØÜ_`² -

c d Git ÉmAÓ^W- **diff**...YF &YTæât Ç¥' W...\$. ' . Fhf° p' W- L\ Dµ¶. n . ? } á, LFFj° EÓW- ÙÚ6Dµ¶Sî > B• ZUVFs&Ç®Ém~Ý• Z? ðJ ¥' , W- Ç™¥Y_Dµ¶ ÑÑ Perforce ÙÚ6î > µ¶ ØP4MergeØ ÑÑ SÀ©pb' W- L\ Dµ¶Sî > B• ZU V?

P4Merge 9,, \$fkåï xØÑÝÜFf,, ÜÜÑ- CÁk` aS®? \$ð- HI ¼F¥' . ' D¢.) 9,, ...³ - ' \$ macOS B Linux Ñú \$ Windows ÑF /usr/local/bin, @{ f t f D; B½9, Ü½~ f\$ Dæä¢. ?

' ' F s Perforce <i P4Merge? ³ <SFf @' LW- ŽI ÕÜý! SÝÜf D^ %? ¥' j . ' Mac Ñ

D\$· S• » Cý! DÊÓF\$ 6• , ÑF· [i p4merge VÔÓ½~ f\$Dæä? %í W-) t extMerge Dý! ŐÜ merge ^ %oFa· ä; ‡^‡c p4merge VÔÓ½~ O

```
$ cat /usr/local/bin/extMerge
#!/bin/sh
/Applications/p4merge.app/Contents/MacOS/p4merge $*
```

ÕÜ diff ^ %oDý! ' 1 - z x 2 ^} - ; ‡\SFX| ä ¼! - ^‡c ŐÜ^ merge Dý! ? ³ | oÇ < F Git x 2 „ <; ‡c di ffO

```
path old-file old-hex old-mode new-file new-hex new-mode
```

◦ \$f gg, @old-file B new-file; ‡F◦ ŐÜ diff Dý! S^‡· ' Ø?

```
$ cat /usr/local/bin/extDiff
#!/bin/sh
[ $# -eq 7 ] && /usr/local/bin/extMerge "$2" "$5"
```

fí, @-zò" ý! ¶k9, Ú>yO

```
$ sudo chmod +x /usr/local/bin/extMerge
$ sudo chmod +x /usr/local/bin/extDiff
```

Y\$f 9,, » f þÓ½~ S. ' f É» 1 Dî > B> Hμ¶^? ð[éB8eÉ» 1 EÓOmerge. tool oä Git C. ' p- i > μ¶F mergetool.<tool>. cmd =» ^ %oÝÜD1 2F mergetool.<tool>. trustExi tCode j oä Git ÓœDýÀri a° @i > T " f • F di ff. external oä Git C' ` a ^ %o%o> H? sā Ff 9,, YÙ, <_ž þÓ^ %oO

```
$ git config --global merge.tool extMerge
$ git config --global mergetool.extMerge.cmd \
  'extMerge "$BASE" "$LOCAL" "$REMOTE" "$MERGED"'
$ git config --global mergetool.extMerge.trustExi tCode false
$ git config --global di ff.external extDiff
```

J' šf D ~/gitconfig½~ F•• „ <üÙO

```

[merge]
  tool = extMerge
[mergetool "extMerge"]
  cmd = extMerge "$BASE" "$LOCAL" "$REMOTE" "$MERGED"
  trustExitCode = false
[diff]
  external = extDiff

```

VW{ EÓ½¤ | F p e f ÄòÄÝÙ diff ^ %oO

```
$ git diff 32d1776b1^ 32d1776b1
```

Git [BÝ P4MergeF & Ci \$ ^ %oÙy X> HD" e F—ÄòÄO



Figure 143. P4Merge.

p e f , + i > ! -] Ý F X | n T ^ i > U V F ÝÙ g i t mergetool F Git j * ' P4Merge a f o \ Ù Ú Ù Ü S • Z U V ?

EÓÓÙý! D5Æ\$§††" " ^ f g diff B mergeµ¶ Dµ" C? : - HI F: ä extDiff B extMerge Dµ¶ f f KDiff3F f @%Dggi ' š extMerge ý! ½~ O

```

$ cat /usr/local/bin/extMerge
#!/bin/sh
/Applications/kdiff3.app/Contents/MacOS/kdiff3 $*

```

Y \$ F Git [. ' KDiff3 " t ä • > HB• Zî > UV Dμ ¶?]

Git - E ^ 8e 6Dî > B• ZUV Dμ ¶ F Å, ° i DE Óf —° ' Ñ· ' ? @: • T· Y { Dμ ¶ W° F + W< ð - O

```
$ git mergetool --tool -help  
'git mergetool --tool=<tool>' may be set to one of the following:  
Ê      emerge  
Ê      gvi mdi ff  
Ê      gvi mdi ff2  
Ê      opendiff  
Ê      p4merge  
Ê      vi mdi ff  
Ê      vi mdi ff2
```

The following tools are valid, but not currently available:

```
Ê      araxis  
Ê      bc3  
Ê      codecompare  
Ê      deltalinker  
Ê      diffmerge  
Ê      diffuse  
Ê      ecmerge  
Ê      kdiff3  
Ê      meld  
Ê      tkdiff  
Ê      tortoisemerge  
Ê      xxdiff
```

Some of the tools listed above only work in a windowed environment. If run in a terminal-only session, they will fail.

pef Ç: ' T KDiff3 Dfk • ° F ^ i : ' . Sî > Fž a kdiff3.gz i f D@ÅF Y ÜO

```
$ git config --global merge.tool kdiff3
```

pe Y Ü ^ „ Ñ ^ % F & Á k E Ó extMerge B extDiff ½ ~ F Git j ' KDiff3 % o î > F a A Ó D di ff S % o > H?

• NJ Ü™. KUá / •

š 26ŠeŠDí Wyzi 8e, ¿ %3\$: " | F ° i i \$ ® x Øo Ç < F Ç | j n T D % % è ¾ D @ g D I " ? ° §' š Õ DÇ OJ K ½ ~ Üå D | Üz \$ Windows < { . | ^ F W " ^ ê Dí š g 6j Ç [95i k Cå DI J J . : " f e ¼ ? Ç' ~ F Git CD ^ W " PÓ. S \$ E f • Z ò " | " ?

core.autocrlf

—pf g \$ Windows ÑL ÕœF &f DO- ' Di 6• , óJ / \øFf 9° j nT CRLF I " ? òi s t Windows . ' ÀpóCRØB | ÙóLFØ! - yz S" DWÙUF & macOS B Linux - . ' | ÙóLFØW- y z? cdòi ûl " Fh· j út 5çâ®xØ: " ? 8e Windows ÑD' šðj ÀÀäÙåD| Ùyz ^ | fÀpB| ÙF J \$' i i < Enter - | F , kÀpB| Ù! - yz ?

Git 9, \$f Cå | ÉÝ5äÀpB| Ù^ | f | ÙF &\$GXno | ä | Ù^ | fÀpB| Ù? f 9, ' core.autocrlf Sê, á. • ° ? pei \$ Windows • , ÑFä. EÓf trueFòÄ\$GXno | F | Ù j { ^ | fÀpB| ÙO

```
$ git config --global core.autocrlf true
```

pe. ' , | Ù" t Ù" Dz D Linux J macOS f Ç, @Git \$GX½~ | ÔÙÉÝD^ | ú d &¤W- , Àp• | Ù" t Ù" Dz D½~ Çüv{ - k | Ff " »: a Git » g? f 9, ä core.autocrlf EÓf inputS YÀ Git \$Cå | äÀpB| Ù^ | f | ÙFGX | Ç^ | O

```
$ git config --global core.autocrlf input
```

òÄ\$ Windows ÑDGX½~ ¼j z 1ÀpB| ÙF &\$ macOS B Linux ÑF , ß7! á ¼j z 1 | Ù? pefi Windows Õœ3F ¥g \$, ¿gÝÙ\$ Windows ÑD. æF 9, EÓf al se Pèä• ° FäÀpz 1\$7! á ¼O

```
$ git config --global core.autocrlf false
```

core.whitespace

Git - 1 EÓ^W" ø. S‡6B» geŠI Wyz I " ? . CD^x 8Æ€eŠI Wyz Då @ø. ÑÑ ¼ ÷ - ³ | , BFuL÷ - ³ | Gf FÇ\ f 9, É° 5EÓ. ' ?

³ | { ê, D÷ - ø. i Obl ank-at-eol FäÙÙåDÍ šúbl ank-at-eofF Á‡½~ : \ DÍ Ùú space-before-tabF | ÅÙè tab â ÜDÍ š?

³ | { Gf D÷ - ø. i Oi ndent-wi th-non-tabF ÄX, I š&* tab , è DÙóf 9, ' tabwi dth ø . ØÓ. øútab-i n-i ndentF Äi \$Ùè ° ©ŠÖD tabúcr-at-eol F YÀ Git È5ÙåDÀp?

o\ EÓ core.whitespaceF f 9, a Git ; Ff D9ÙSê, J Gf , Äì] hDø. ? @: Gf I - ø . Ff 9, \$yk EÓø. | Ç• » . J \$. â Ü• - -? HpF pef: @ê, } `space-before-tab` è L Dfkø. Fža 9, òÄó trai l i ng-space Ž• ^ bl ank-at-eol B bl ank-at-eof øO

```
$ git config --global core.whitespace \
    trailing-space, -space-before-tab, indent-with-non-tab, tab-in-indent, cr-
    at-eol
```

fí 9, - • » É» 1 D\] O

```
$ git config --global core.whitespace \
    -space-before-tab, indent-with-non-tab, tab-in-indent, cr-at-eol
```

xf ÝÙ git diff ^ %o , +cy XÈç | F Git [#6Tò" I " Fsäf \$Cåâ—° » A. ' ? ' git
apply èI J | fí j s½` a? pegtj " DI J" k° » DÍ WI " Ff 9, a Git \$- ' I J | ¿
X | YO

```
$ git apply --whitespace=warn <patch>
```

J Ka Git \$êÑI J à ÉÝ» gãl " O

```
$ git apply --whitespace=fix <patch>
```

ò" ø. í ° Ý' § git rebase? peCå^kï WI " D½~ Fhj Å€uTÑSff 9, ÝÙ git
rebase --whitespace=fixed Sa Git \$mLI J | ÉÝ» g. ' ?

= >™ Ø • '

Git EF Ø7DPO. / yS → ÇeFh økW" ÅkóTDø. r ØfW• ?

receive. fsck0bjects

Git ° p - | í - y < Dk Ź - , B SHA-1 GI Bi ^ z { WU? h Git Cj \$í t €u | Í òa%? ò - Í "
I I | ÷ F I k 9° j a ÜCå D\ ØF° i i øáJ €uD½~ I t DoÇ<? pe: \$í t €u | Í @Å
Git GæWU- F EÓ receive. fsck0bjects t true S² F. òa%O

```
$ git config --system receive.fsck0bjects true
```

Y\$ Git j \$í t €uóŽâ Gæá DôÖ- F - z Åk{ kI " D« j 7- kÉ" - ??

receive. denyNonFastForwards

p e f g x Z [{ €uDCå F µ&d€uFNJ K€uW- CåTéÖ] ÝF &ò- éÖ] Ý øå • NDCå
Ç\$CCå DæÖ½FòÄD€uj { B<? òo€i - I 5D45Fh k | \$g x D\ Ø½Ff - MÉm,
@~™éÖ] ÝF 9, \$ push ^ %o| • -fçãS² Ø~™óforce-updateø?

@W' ðÄD² Ø~ ™€uÓforce-pushesøF 9,, EÓ recei ve. denyNonFastForwardsO

```
$ git config --system receive.denyNonFastForwards true
```

` | ¥' j CTF' EFØ7D³ E3I í ° ÄTOÄDæD? ž 81W9,, %T~ ^ ÚDØÓF HpWÇí
W» ' j %o* ½Ónon-fast-forwardsø€u?

recei ve. denyDel etes

k W" 1W9,, • \ denyNonFastForwards 45? ¼W8I 1 å} l -] ÝFd- O™D- ' WÊ€uÀ
C] Ý? ä recei ve. denyDel etes EÓt true 9,, äò- 8ÆI ÑO

```
$ git config --system receive.denyDeletes true
```

ðÄj WÇo\€uå}] ÝBçë ÑÁk' j 9,, òa‰? @å} éÓ] ÝF ®¶sEFØ~Ýå} - ' ½
~ ? o\ ' j HI ØÓWº ØACLØÍ ° p\$' j ©D, ùÑ...YOÄD• ° F f [\$. ' 2 Ø45DW- H
| W? hT¶¹ D‰W?

Git Oq

fí 9,, ±y° » D¢. PÓl " EÓ. FðÄ Git— y° » DI æäJ I ½~ €Ý' . ' ? ð" ×§¢.
DEÓ. { üt Git 2- F9,, \$f Dæä < D . git attri butes ½~ AØÙEØóo€i f D. æD5æ
ãø? peÇ: aò" 2- ½~ Š . ½~ WOCåFFí 9,, \$. git/info/attri butes ½~ ¼ØÙE
Ó?

o\ . ' 2- FF9,, y. æ¼D½~ J æä ~ 2» 1ÇODî > 45Fa Git äj . Ä> H* ½! ½~ FJK
a Git \$CåJGXå\, A~? \$! ? Ff [hi TW" ° \$ÉmD. æ¼' TD2- F> • TE- ...ÉDH
| ?

23D-,

f 9,, ' Git 2- a Git äj p" i VÔÓ½~ ó, ê. Ákwì XSøF> • © pbÆ€ð" ½~ ? H
pFW" ½! ½~ i ° ØØQØDFÁk=WØÙ> HFhi W" VÔÓ½~ 9,, > H? f [^ • T. Äa Git
'] ð" ½~ ?

| ð23D-,

k" ½~ ° ÜÑi ½! ½~ F...MÑ- { " t VÔÓ½~ Æ€? HpFmacOS x ØÑD Xcode. æj ØmW-
" . pbxproj " åD½~ F . o€i W- åä. æ¢í PÓ> MRD JSONØ 5½! Javascript ‡? » z ø‡
? ÈF° IDE Lk) ù? cd•• Ñ•. i ° UTF-8' oD½! ½~ Fhf> Çj ' ' [. ø" ½! ½~ SÆ
€F st. ...i W- æC©‡? áÑÑpek! - %» f ^ . Ff o€ÅWî > A~ F diff Dy Xí ¢çÑ`
aý? . ! - { ØØÆ€? sãFf: ä. øfVÔÓ½~ ?

@a Git äf k pbxproj ½~ øfVÔÓ½~ F \$. git attri butes ½~ ¼p < EÓO

*.pbxproj binary

Y\$FGitÇj , +^ | J » gÀp | ÜÓCRLFØI " Føf \$. æ½ÝÙ git showJ git diff | FGití
Çj > HJ ê(C½~ Dg6?

_` 23D- ,

fí 9,, . ' Git 2- SkŽ5> H! - VÔÓ½~ ? ÇÈ\$\$FÝÀ Git· aäf DVÔÓ½~ ^6t ½! š
2Fs &° p. ' • oD diff 1 2ÔÙy > ?

' 1 Fa¥' , +' ò- • • • Z .. %¥è¾DI " èWOy Microsoft Word ½>ÔÙ7! ØÓ? t#ï ä
j F Microsoft Word ÈÌ i .. Ñ¥®ÉD' šðFQýpåF t#j i \$' . ? pe: y Word ½>ÔÙ7!
ØÓFf 9,, ä½~ • kT Gitá½Fí t » f | Cåj 9? hòÄ‰k ` a...É91ÆÅ µ€ÝÙ git diff
~‰| Ff - ° ØTp<D" eO

```
$ git diff  
diff --git a/chapter1.docx b/chapter1.docx  
index 88839c4..4afcb7c 100644  
Binary files a/chapter1.docx and b/chapter1.docx differ
```

} ^GXè | Ètj ÈÝÙì | F—ž DÁk =W...³ > H! - ÇO7! DWord ½>r Å Git 2- ° | 55•
ZäI " ? ä<ÜòÙ½! • Tf D . git attributes ½~ ¼O

*.docx diff=word

ØÝÀ Git øf , +ä • Ømg ~ D> H" e | FfkéP . docx , 2D½~ ï - C. ' ØwordØ\ , Ø?
ØwordØ\ , Øi ` aÅ¥' Y\$—SEÓ. ? ¥' j y Git ØÙPØF‰ ° pÈE docx2txt Øœ[
Word ½>^t 9` ½! ½~ FòÄÇOD½~ ÷—° pg - > H^?

' 1 Ff , @ÚÙ docx2txtú. 9,, s <https://sourceforge.net/projects/docx2txt> <i ? j F INSTALL ½
~ D-ÑFä. < Tf D9, Ù¢. <? ³ <SFfj , @LW- ý! äyX" eØÙf Git Y{ Dš2? \$
f D9, Ù¢. <%í W- Ø docx2txt ½~ F• • ò" A~O

```
#!/bin/bash  
docx2txt.pl "$1" -
```

i ø^' chmod a+x cò- ½~ • Ñ9, Ù>ÿ? ¥| Ff , @pØGitS. ' ò- ý! O

\$ git config diff.word.textconv docx2txt

Y\$pé\$! - ½F è ÷ØÙ> HF Git—j yž „ . docx " åD½~ - ' ØwordØ\ , ØFj
docx2txt? ðÄf DWord ½~ —° { cŽ5^ | f½! ½~ > ØÙ> H^?

```
$ git diff  
diff --git a/chapter1.docx b/chapter1.docx  
index 0b013ca..ba25db5 100644  
--- a/chapter1.docx  
+++ b/chapter1.docx  
@@ -2,6 +2,7 @@
```

ÊThis chapter will be about getting started with Git. We will begin at the beginning by explaining some background on version control tools, then move on to how to get Git running on your system and finally how to get it setup to start working with. At the end of this chapter you should understand why Git is around, why you should use it and you should be all setup to do so.

Ê1.1. About Version Control

ÊWhat is "version control", and why should you care? Version control is a system that records changes to a file or set of files over time so that you can recall specific versions later. For the examples in this book you will use software source code as the files being version controlled, though in reality you can do this with nearly any type of file on a computer.

+Testing: 1, 2, 3.

ÊIf you are a graphic or web designer and want to keep every version of an image or layout (which you would most certainly want to), a Version Control System (VCS) is a very wise thing to use. It allows you to revert files back to a previous state, revert the entire project back to a previous state, compare changes over time, see who last modified something that might be causing a problem, who introduced an issue and when, and more. Using a VCS also generally means that if you screw things up or lose files, you can easily recover. In addition, you get all this for very little overhead.

Ê1.1.1. Local Version Control Systems

ÊMany people's version-control method of choice is to copy files into another directory (perhaps a time-stamped directory, if they're clever). This approach is very common because it is so simple, but it is also incredibly error prone. It is easy to forget which directory you're in and accidentally write to the wrong file or copy over files you don't mean to.

Git f• 5DX^¥' • • Dž | s ÓTesting: 1, 2, 3.ÓF Wy Çó? j áÇÑô‡ ÑÑš 2ÑDg Ý# ©ÇX SÑÑhZ [Äp ^?

f j ° ' Ó- 1W> HÙÄ½~ ? ¼W- =Wi F \$> H| yÙÄ½~ Ý' W- \, ÓFCÍ X EXIF M RÑÑòi \$†\] ÙÄŠ2½í kâäDW8^‡?? pef<i> ÚÜ^ **exiftool** ÓœF 9 „ †' · [ÙÄ^ | t G§ ^‡? D½! MRFðÄ> H| ¬ö° „ ½! DÚ2# ©çó\ Dg ÝO [„ <A~< Tf D . gi ttributes ½~ ¼O

*.png di ff=exif

ÞÓ Git „ . ‘ áµ¶ O

```
$ git config diff.exif.textconv exiftool
```

pe \$. æ¼. | ^ W- ÙÃ½~ FÝÙ git di ff ^ %D" ep<O

```
di ff --git a/i mage.png b/i mage.png
index 88839c4..4afcb7c 100644
--- a/i mage.png
+++ b/i mage.png
@@ -1,12 +1,12 @@
ExifTool Version Number : 7.74
-File Size : 70 kB
-File Modification Date/Time : 2009:04:21 07:02:45-07:00
+File Size : 94 kB
+File Modification Date/Time : 2009:04:21 07:02:43-07:00
Exif Type : PNG
EMI ME Type : image/png
-Image Width : 1058
-Image Height : 889
+Image Width : 1056
+Image Height : 827
Exif Depth : 8
Exif Color Type : RGB with Alpha
```

f Wj —° • X½~ t ÙBÙÃÍ Í ðó^g6?

? 1 / 2 ÿ

SVN J CVS™š DG- yÀ, ókeyword expansionø• ° [€j { i è§ÑI • , D, ð K. ' T? \$ Git
½FØ. • ° kW- å@I " F—i f ÅWt' . | ½~ ½• k GÃCåD/GMRF st Git Bi ¹ y ½~
‰NI BÝáó• KOOGit ¼Cå y < DNI • « § ½~ DNI BF & Git 2- ± y ° » ½~ J ¢. Fsä x
§ Git 2- DG- yÀ, ÅWg 5? ½~ \€Xy DCåø? Ç\ F ¥' 9, \$GX1 - ½~ | y Ok ½
! F > \$dt Cåâå} Ø" ½! ? Git 2- CD^! 81WSÅTØWæD?

W81Wi Ff 9, ä ½~ fy - ‡? y < D SHA-1 NI BÉ YOK T ½~ ¼D \$Id\$ y f? pe\$W- Je
- ½~ ÑEÓ^C2- F < t øf GX/G] ÝD! ª F Git j ' / - ‡? y < D SHA-1 r. | ÑI y f? O
9FØÇi Cå y < D SHA-1 NI BF & i ‡? y <! - DNI B? [, < A ~ < Tf D. gi tattri butes
½~ ¼O

*.txt indent

\$ W- 6 + ½ ~ ¼ • • W- \$Id\$ - ' O

```
$ echo '$Id$' > test.txt
```

¤ f < t GX ½ ~ | F Git [OK ? y < D SHA-1 NI BO

```
$ rm test.txt
$ git checkout -- test.txt
$ cat test.txt
$Id: 42812b7653c7b88933f8a9d6cad0ca16714b9bb3 $
```

d & F ò - " e D' Ž > Hk ý? pe' \ CVS J Subversion DG- y. | • ° F ¥' j : • ÑW- | ÷ Ð
MRÑÑÑk SHA-1 NI B' Ž Çt F · ggi - X Õyz { F f ÅW/y Ür S'] ÇO SHA-1 | ÷ ÑD¹
| ?

s ã Git 2- CD^uW81WO¥' 9,, ' L ÉmD\ , ðS...Y ½ ~ Cå J GX| DG- y. | ? W- \,
ð° ÒcleanÓBÒsmudgeÓ! - I \ , ðûf? \$.gi tattri butes ½ ~ ¼F f ° y ° » D¢. E ÓW-
\ , ðFd | E 0½ ~ GXâ DÆ€ý! ðÒsmudgeÓF \$ ÒsmudgeÓ\ , ðj \$ ½ ~ { GX| ¶ øB ½
~ ! " â DÆ€ý! ðÒcleanÓF \$ ÒcleanÓ\ , ðj \$ ½ ~ { ! " | ¶ ø? ò! - \ , ð° p{ ' S‰
û8k T Dn?

Figure 144. ÒsmudgeÓÀ È ê OHRc È 1 ŠMÉ.

Figure 145. ÓcleanÓÀÈ êÓHRc È t _MÉ.

\$ÓGit Í o ¼ø...Yò - ° - D>¹ Cå MRJ c X^W- } ~DHI O\$CåâF' **indent** Óœ\ , fk
CÍ o? f 9, \$. **git attributes** ½~ ¼y filter 2- E ÓÓindentÓ\ , ÓS\ , *.c ½~

*.c fil ter=indent

d | F o\ , < PÓF a Git ä j ÓindentÓ\ , Ó\$ smudge B clean |] i C‰` a O

\$ git config --global filter.indent.clean indent
\$ git config --global filter.indent.smudge cat

\$ò - HI ¼F xf! " *.c ½~ | F **indent** Óœj ¹ { ¶ ï ú\$ä· ' GXÀØÙ| F **cat** Óœj ¹ { ¶
¿? **cat** \$òJ Á` a...É" ' O· ggäyk D‡?m™y X? òÄDÚí 9, kŽ5\$! " â' **indent**
\ , fk DCÍ o?

uW- k TDHI i ...Y RCS™š D **\$Date\$** G- yÀ , ? @: É©ò - HI F ¥' , @...YòÄDW- úý
! O³ ' ½~) ; ‡ F ÒT. æD¥™Cår NF> är NLk C½~ ? <Üi W- ...Y^C• ° D Ruby úý
! O

```
#! /usr/bin/env ruby
data = STDIN.read
last_date = `git log --pretty=format:"%ad" -1`
puts data.gsub('$Date$', '$Date: ' + last_date.to_s + '$')
```

ò - ý! s **git log** ¼ÒT ¥™Cår NF [Ok fk y k ½~ D **\$Date\$** y f F> y X" e ÑÑf 9, .
' ¥...~ DŒx aeç ...YW- » ¼Dý! ? äCý! ^) t **expand_date**F< Tf D9, Ùf. ¼? Y\$F

f, @\$ Git ½ EÓW- \, ÓÓ—Ô· dater ØøFa· \$GX½~ | *' f D expand_date
SOK | ÷ DF Øf smudge ī " ? ! " ½~ | D clean ī " • i ' WÙ Perl ° Å2%} OK DA~O

```
$ git config filter.dater.smudge expand_date
$ git config filter.dater.clean 'perl -pe
"s/\$\$Date[^\$\$]*\$\$/\$Date\$\$/"'
```

Øf Perl noj å} \$Date\$ | ÜOk DA~F@A· D>Ø? \, Ó, S+j Øf^Fi | ^ 6+W<?%
í W- ýk \$Date\$ G- y D½~ F d | c· EÓW- Git 2- FGÅ¥' D™\, ÓO

```
date*.txt filter=dater
```

```
$ echo '# $Date$' > date_test.txt
```

Cå C½~ F> dt GXFFj ð YG- y pN{ . | ^O

```
$ git add date_test.txt .gitattributes
$ git commit -m "Testing date expansion in Git"
$ rm date_test.txt
$ git checkout date_test.txt
$ cat date_test.txt
# $Date: Tue Apr 21 07:26:52 2009 -0700$
```

É» 1\, Óž DI ² †? Ç\ f, @O9Di Fst .gitattributes ½~ j XÈ. æWÊ Cå F &\, Ó
óHpøJ D daterøÇj Ff „ \, Ók 9° j / Ž? æf \$E | Ó" \, Ó| F@Om~™- ÑÑ. ' \$
X™| ^ C° ³ ' 5xXF s &Ç¬S ÷) . æDg €ÝÙ?

3† AB!

Git 2- \$« X. æ=>Óarchiveø | í ° ð Ø" ' ?

export-i gnore

æ=>D| ^ F 9,, EÓ Git Ç« Xl " ½~ Bæä? pef Ç: \$=>½Om l - I æä J ½~ F h: ä. ' ' Ök. æD7! ý€½F f 9,, \$ export-i gnore 2- ½• » . ' ?

Hp F—Ef \$ test/ | æä <k W" 6+½~ F Ç' ' . ' { Õm\$. æ« XD‰ŠÕÓ tarballø½? f 9
" " • <ÜòÙT Git 2- ½~ ½O

```
test/ export-i gnore
```

Y\$F æf ÝÙ gi t archi ve S%í . æD‰ŠÕ| F ž - æä Çj { ÕÖ\$=>½?

export-subst

```
$ « X½~ ÖÙ\ ( D| ^ Ff 9,, [ git log Dš 26BG- yÀ, Æ€^- ' Tçâ ^ export-subst 2 - D\ ] ½~ ?
```

: - HI F p e f: \$. æ¼ÖmW- Ö‰ LAST_COMMIT D½~ F > \$ÝÙ git archive D| ^ ÉÝN- OK ¥™Cå D^‡?F 9,, ÅðÄEÓ . git attributes B LAST_COMMIT C½~ O

LAST_COMMIT export-subst

```
$ echo 'Last commit date: $Format: %cd by %aN$' > LAST_COMMIT
$ git add LAST_COMMIT .gitattributes
$ git commit -am 'adding LAST_COMMIT file for archives'
```

ÝÙ git archive è | F => ½~ DA~j { . | fòÄO

```
$ git archive HEAD | tar xf .. /deployment-testing -
$ cat .. /deployment-testing/LAST_COMMIT
Last commit date: Tue Apr 21 08:38:48 2009 -0700 by Scott Chacon
```

fí 9,, ' • p Cå MRJ Kœ9D git notes ÖÙ. | F > ¥ git log j ° %} ~ DyñVÙO

```
$ echo '$Format: Last commit: %h by %aN at %cd%n%+w(76,6,9)%B$' >
LAST_COMMIT
$ git commit -am 'export-subst uses git log\'s custom formatter

git archive ...³ . ' git log D `pretty=format: ` Ä€ØF > $y X¼9} ! – D `$Format: ` B `` ` çâ?
'

$ git archive @ | tar xf0 - LAST_COMMIT
Last commit: 312ccc8 by Jim Hill at Fri May 8 09:14:04 2015 -0700
È      export-subst uses git log's custom formatter
È      git archive uses git log's `pretty=format: ` processor directly,
and
È      strips the surrounding `$Format: ` and `$` markup from the output.
```

° àÖTD=>P' Só¤âDø\ (μ" ?d&B 6D« X=>WÄF· > ÇP' S | μD\ (μ" ?

÷ Ø4»

o\ Git 2- Ff j ° y. æ¼D° » ½~ • » ÇODî > 45? W- * €K' Dø. —i FÝÀ Git ø° » ½~ ÇÖUV! Ç@, +î > . ' F&i ...³ . ' fòþDA~?

..._p<< ÄO. æ½k W-] XDJ K» Ó\ Då"] ÝFF' ' C] ÝÑD~ f° î > Åf Då·] ÝFO
| , @È5 ½l " ½~ ?ä | ò- î > 45—° êÑ' < ? —Ef k W- ‡?ä EÓ½~ database. xml F
\$! -] Ý½· i ÇODF &f: î > uW-] ÝTf D] ÝÑF NÇ: ~âC‡?ä½~ ? f 9,, EÓ2-
p<O

database. xml merge=ours

d | » 1 W- ØÓDî > 45F ô% oursO

```
$ git config --global merge.ours.driver true
```

pefî > ^uW-] ÝF database. xml ½~ Çj kî > UVF / \j # ©p<MRO

```
$ git merge topic
Auto-merging database. xml
Merge made by recursive.
```

ØJ F database. xml z { ^å·] Ý½D>¹ 7! ?

Git X'

B · 7! ØÓ• , WÄF Git° \$° » Dm@Ý" ðó | ¶ ðÉ» 1ý! ? k! úðÄD3I O« j 7DB
EFØ7D? « j 73I ° • pCåBî > ðÄDï " f* ' F&EFØ73I " ' §• p³ E{ €uDCå
ðÄDÄþï " ? f 9,, XvfÑ5Ý' ð" 3I ?

" ...1åX'

3I ï { "#\$ Git æä <D hooks | æä ½? í j <†\] . æ½D . git/hooks ? xf' git init Ü
1 6W- ™7! á | F Git³ | j \$ò- æä ½< ÓW" ©Hý! ? ð" ý! } ^! - 9,, { *' LF· ' j Ø
Ø^ { ¶ ð | fxkD; ‡? fkD©Hï i shellý! F ½W" j i ¾^ Perl noFÇ\ Fœbg- ^)
D9, Ùý! ï 9,, g€. ' ÑÑf 9,, ' Ruby J Python FJ œbf œØDœx' L. ' ? ð" ©HD) y
ï i „ . sample" åF pef: B' ' FØ1 9} ð- | <?

æW- g- ^) ØÇý ½À) ø¥9, ÙD½~ < k . git æä <D hooks | æä ½Fj 9ØtC3I ý! ?
ðÄWSF· —° { Git *' ?³ <SF ¥' j œ• €' D3I ý! » z ?

* " ØX'

« j 73I] t l e8? <Üä· '] t OCåμ" i 3I P< I K~ μ" i 3I B · 3I ?

!

, @O9Di Fqrï - 7! á | F· D« j 73I ø5 XOAÓ? pe, @oð" ý! S
² Øú{ l 845Fí ; f \$EFØ7...YòW• ° ? óG; F . ' ² Ø45DW- HI ¼
DHI ?ø

| } ² j dX'

â_- - 3I éBCå D\ Õ?

pre-commi t 3I \$- k Cå MRâ YÙ? . ' § Gäj [Cå D½FF Hp FGä i ^ kf x 8F - z 6+ YÙF , Buäno? peC3I , * i r x XF Git [< ôä t Cå FÇ\ f 9, ' git commi t --no -veri fy S• \ò- | ?? f 9, t' C3I FSGäno™ši ^ WUóYÙ» ¼ lint DÖœøþå XÍ Wyz i ^ \$óÉyD3I —i òa‰DøFJ™1 WD½>i ^ P¤?

prepare-commi t-msg 3I \$BÝCå MR' šDèåF³ | MR{ %í è | YÙ? . L8f' šCå Kf • TD³ | MR? C3I ³ EW" ø. O" k¤åCå MRD½~ D¢. PCå » z B» I Cå DCå D SHA-1NI ? . yWc DCå S→ Ák` a' úd&yž" j EÝQó³ | MRDCå FpCå MR, úþî > C åþ%SCå B» þCå> * €... ' ? f 9, " i Cå, úS. ' . FÝÖ5, k MR?

commi t-msg 3I ³ EW- ; ‡Fä; ‡j Ñ½CTDF" k¤åCå MRDä | ½~ D¢. ? peC3I ý ! , * i r x XF Git [< ôCå FsaF 9, ' S\$Cåo\âl O. æÖÖJ Cå MR? \$! eD¥ | W ? F¥' [Å©pb. ' C3I SuyCå MRI ^ %o• » D, ú?

post-commi t 3I \$Ö- Cå\ Ööf | YÙ? . Ç³ Eœb; ‡Fhf 9, I ~í 5o\ YÙ git log -1 HEAD SOÖ¥ | Wt DCå MR? C3I Wc' ſoäè» Dno?

5' g, ² j dX'

f 9, c< I K~ μ" i EÓ÷- « j 73I ? . ' i ° git am ^ %o* ' DFsaþef Ák \$f Dμ" i ¼' Tò- ^ %oF 9, • T<W?? þef, @o\< I K~ ³ E° git format-patch QóDI J Fò " 3I 1 8' ÒÑ?

UW- YÙD3I i appl ypatch-msg ? . ³ E~- ; ‡OÖmGÅî > MRDä | ½~ D) y? pey! ýA* i r F Git [< ôCI J? f 9, ' Cý! S- z Cå MRzî š2FJ ...³ ' ý! » gš 2™1 ?

<W- \$ git am YÙN÷{ *' Di pre-appl ypatch? k" ®, €• Di F· g5YÙS- ' I J L àFQóCåèåFf, f 9, ' . \$CåâGä ½F? f 9, ' ò- ý! YÙ6+JGäμ" ' ? þek` a x 8FJ 6+4° o\ Fý! j , * i r x XF ¼ý git am DÝÜFòÄI J—çj { Cå?

post-appl ypatch YÙS Cå Qóè | Fi \$ git am YÙN÷¥| { *' D3I ? f 9, ' . ä" eoä cW- úûJ fI PDI J D" K? h f Á=W' . > ÇéI J D\ Õ?

çú* " ôX'

pre-rebase 3I YÙS g xèåF, * i r x X9, ¼Çg x D\ Õ? f 9, . ' ò- 3I SWÇyZ [€ uDCå g x? Git ÉyD pre-rebase 3I ©H—i òa‰DFÇ\· f‰DW" —E 9° Šf Dμ" i Õ Çéþ?

post-rewri te 3I { ž" j . | CåâåD^ %o* ' F> þ git commi t --amend B git rebaseóÇ\ ÇÖÖ git fil ter-branchø? . i WD; ‡i ¶mLD^ %o) FO| sçt yk ¼³ ' W• WmL DC åâå? ò- 3I D' ŽI t ÒùÑÈ post-checkout B post-mergeóÇe?

\$ git checkout f• YÙ| F post-checkout 3I j { *' ? f 9, 5? f D. æ| B' . * Öf Dμ" æä? ¼ÖÖ< k t DVÖÖ½~ þÉYóf½>J ÒÙ 6» ¼òÄDï " ?

\$ git merge f• ÝÙ| F post-merge 3I j { *' ? f 9,, ' . @A Git ÅWÈÖDμ" ' #?F> p> ý?? ò- 3I í 9,, ' S I OI " \$ Git ÒÓè LD½~ i a " \$FòÄf—° \$μ" ' fg| Fäò" ½ ~ AÓOS?

pre-push 3I j \$ git push ÝÙN÷F ~™^éÖ- ' hš4xuy<| { *' ? . ³' éÖ] ÝD) y BÉÓ" t; #FO| sçtyk ¼` PW• WV~™D- ' ? f 9,, \$€u, ¹ èâF' . | Oy- ' D~™| " óW- *i DxXo[, Ç€u\ Øø?

Git DW" r €í" \$ÝÙ| F 89j *' git gc --auto ÓÙ• €ÀE? pre-auto-gc 3I j \$• €ÀE , ¹ èâ{ *' F 9,, ' . SCxfY\$@ÀE• €^FJK• oÚí y i a @½ýÀE?

= >™ÔX'

} ^« j 73I F" t • , ý€3Ffj 9,, ' ¶· EFØ7D3I y. æ²Ó, Ùú8»z D45? ò- 3I ý! \$€uTEFØèâBè| ÝÙ? €uTEFØâÝÙD3I 9,, \$œb| a , *i r xXF B<€ u>c « j 7ýÀ™1 èRFj 9,, • ff: EÓÆpA¾D€u45?

pre-receive

Æ€SÉ« j 7D€uï" | F ¥1 { *' Dý! i pre-receive? . sçtyk OPW• W{ €uD- ' ? pe. , *i r xXFfk D€uA~í Çj { ³' ? f 9,, ' ò- 3I aÇy- ' ÓÙ* ½Ónon-fast-forwardøD~™FJKyC€uf» f Dfk- ' B½~ ÓÙHI ÓÓ?

update

updateý! B pre-receiveý! d] » ½FÇOèÆ\$§· j tÍ W- t j ~™D] ÝuÝÙWt? —p€ uKO| Ne-] Ý€uA~F pre-receive - ÝÙWt F/> è< update• j tÍ W- { €uD] ÝuÝÙWt? . Çj sçtyk` PA~F&i ³' ÷- ; #O- ' D) y o] ÝøF€uâD- ' • NDA~D SHA-1r F,, B' ; t j €uDA~D SHA-1r? pe updateý! „ *i r xXF- k/ - Dž W- - ' j { B<ú ŠD• dj { ~™?

post-receive

post-receive ' 3\$Ö- \Öô" , | ÝÙF 9,, ' S~™ 6• , EFJKoä' ; ? . ³' Š pre-receive / ODçtyk #?? . D' ŽÖÖcI - K~ W° ¿ MFoä{ ¶Efócontinuous integrationø DEFØFJK~™I " Đö• , óticket-tracking systemø ÑÑ« -9,, o\] ðCåMRSZ»I - I " óticketøi a - C{ , BF» f JKGF? Cý! ÅW, Ç€uÖÖFÇ\ « j 7\$. " DÝÙèâ[z{ - ³ ÖÖF f,, pef: %o 6í" , 34. ' . Fst. [| _f | , DWf | ÷?

À' 6D4» K1á&

\$! ? ½Ff [- ' åÜhTDäwí i ðÄW- Gitμ" i ÖOGä CåMRDš 2F> ¥• » - °°° » ' j » f. æ½° » DI æä? f [' LW- « j 7ý! SC®, ¿%36' D€ui a j { B<F,, BW- EFØ7ý! S...É, Ùò" 45?

¥' Vj À©Dý! i ' RubyLDF\] i ° §¥i è' . Lý! FuLí st Ruby} ~í ~ Fj -f ÁL \. í ° • ÑW? Ç\œb 6Œxí WÄP' ?fk Git ÉyD©H3I ý! ī ' PerlJ BashLDFf, f° s. ' ½ÙT/ øeDò! 8ŒxD3I ©H?

= > TM Ø X'

f k E F Ø 7 D μ " ī [\$ f D hooks æ ã < D update ý! ¼ ò f? update ý! j t í W- Cå D] Yù
Y Ü Wt F · ³ ' ÷ - ; ð O

¥ { € u D- ' D) y

¥ € u â] Y D» þ 7! ó revisionø

¥ ' i + j € u D» þ 7! ó revisionø

p e € ui o \ SSH Ø Ù DF j 9, O ä Ø Ù ä t € u D' i DMR? p e f L 8 f k ī " ī o \ ! ' => D
~ W° i ð o p Ø git Ø Ø U F — k ® @ o \ W- shell Ø Ü y! • ?! ' S ī y' i D- ° F > ¥ / - 5 E »
| B g C S ° © C' i D- ° ? < Ü — E \$USER | B g C J " # ^ ø â - ³ D' i D- ° F f D update ý
! ' ' & E W{ , @ DM R O

```
#!/usr/bin/env ruby

$refname = ARGV[0]
$oldrev = ARGV[1]
$newrev = ARGV[2]
$user = ENV['USER']

puts "Enforcing Policies... "
puts "({$refname}) ($oldrev[0,6]) ($newrev[0,6])"
```

i DF ¥' ð J ' D ī i Ž ī g C? G Ø \$ ä , Ù Ñ Ñ ð Ä % - i t ^ 1 - Å © & Z ?

7 m i Ø K | } " • • N

f D U W. œ F i @ Å ï W ž C å M R ī ® ¶ ^ % ö l 8 ° R D š 2 ? " t æ ç F — » ï W ž M R ® ¶ Ö m W ž
Ú ¼ Ø ref: 1234 Ø Dy z { F s t f : ä ï W t C å y - T I " D ö • , ó ticketing system ø ¼ D l - n . ?
f @ Y W G ä ï W ž € u Ñ S D C å A ~ F • • C å M R i ^ Ö m ö a W - y z { F d | F p e l - C å J Ç Ö
m ö - y z { F , * i y Å r x X s & B < ä t € u ?

ä \$newrev B \$oldrev g C D r x c W - Ø % o g i t rev-l i s t D Git: ; ^ % o F f 9 , O P f k C å D
S H A - 1 r W ° ? g i t rev-l i s t x ! » ¼ g i t log ^ % o F h · ³ | - y X S H A - 1 r & Z F Å k 6 M R ? f
, @ O P ° W t C å T u W t C å è ÷ D f k S H A - 1 r F 9 , Å ð Ä Y Ü O

```
$ git rev-list 538c33..d14fc7
d14fc7c847ab946ec39590d87783c69b031bdfb7
9f585da4401b0a3999e84113824d15245c13f0be
234071a1be950e2a8d078e6141f5cd20c1e61ad3
dfa04c9ef3d5197182f13fb5b9b1fb7717d2222a
17716ec0f1ff5c77eff40b7fe912f9f6cf0e475
```

f 9 , n P ð " y X A ~ F % o | [æ ¼ ï W - S H A - 1 r F Ù X S è y - D C å M R F d | ' g • ° Å 2 S 6

+ CMRÖmDA ~ ?

<WÈ@...YsÍ - Cå½CPXCå MR? . ' uW- ô‰gi t cat-file D: ; ^‰SOÒ>¹ DCå‡ ?? ¥' [\$ Git A\ >€ ^• Tò" : ; ^‰D^ ?ú Y\$! | 1 • W<òž ^‰Dy XO

```
$ git cat-file commit ca82a6
tree cfda3bf379e4f8dba8717dee55aab78aef7f4daf
parent 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
author Scott Chacon <schacon@gmail.com> 1205815931 -0700
committer Scott Chacon <schacon@gmail.com> 1240030591 -0700

changed the version number
```

o\ SHA-1r OÒCå½DCå MRDW- } ~=Wi ÙTCå DUW- ÌÙFd | Ps. | | DfkA~?
9,, . ' Unix • , D sed ^‰S...YCŽeo

```
$ git cat-file commit ca82a6 | sed '1,/^$/d'
changed the version number
```

f 9,, ' òž ÚŒsÍ W- V€uDCå J CPCå MRF d | \$CPDA~Çzî @Å| ×X? t ^×Xý
! BB<ä t €uFÿÀ*Ì r? Ö- ý! †Úp<O

```
$regex = /\[ref: (\d+)\]/

# • » É » 1 DCå MRš 2
def check_message_format
  missed_revs = `git rev-list #{$oldrev}..#{$newrev}`.split("\n")
  missed_revs.each do |rev|
    message = `git cat-file commit #{rev} | sed '1,/^$/d' `
    if !$regex.match(message)
      puts "[POLICY] Your message is not formatted correctly"
      exit 1
    end
  end
end
check_message_format
```

äòWf< \$ update ý! J F fk ÖmÇzî • » =• DCåÍ j > TB<?

7ma@' " K| } 8l CDç' bACLc FG

-Ef, @• • W- . ' HI >ÿÓÓWº DôÓFS• » p" ' i y. æDp" \] k€u>ÿ? l " ' i
¶kŽ\DHl >F 6%" yl " I æäJ K° » D½~ ¶k€u>ÿ? t ^...YòWQFF@ä / GD=
• Lk ÈSEFØ>¹ Git à áD acl½~ ¼? f j , @a update 3I GAò" =• F Mi €uDCå A~½
{ » f Dfk½~ Fd | Z» , Ù€uD' i i ª yfkò" ½~ Ì k>ÿ?

1 s L W- ACL ½~ , 1 ð? ðJ . ' Dš 2B CVS D ACL Ód] » ¼O. ° ¶· Ùf f F UW. A~i
avai I J K unavai I F³ Èi Äi] ðDP' C=• D' i W° F ¥| W. i P' C=• D¢. óC. Í þ°
©Ák ¢. ýÓø? û. ° ý i z | ð, ?

\$! H¼F f j k È - ý€3F W" y doc æã ¶k > ýD½>" K F „ ßWÈgy lib B tests æã ¶k >
ýD, ð%3F / ^ D ACL ½~ p < O

```
avai I |ni ckh, pj hyett, defunkt, tpw
avai I |usi ncl ai r, cdi ckens, ebronte|doc
avai I |schacon|lib
avai I |schacon|tests
```

' 1 äð" ð? ` kf @' TDð?" ¢J? \$! H¼F t z { } PF ¥' ! | | ...Y avai I D=• ? < Üð
- 1 WÓfW- GÃt ðF· D- i ' |) Fri W- ° C' i KL > ýDfk æã ðfD ð ðO

```
def get_acl_access_data(acl_file)
# ` P ACL ð?
acl_file = File.read(acl_file).split("\n").reject { |line| line == '' }
access = {}
acl_file.each do |line|
  avail, users, path = line.split(' ')
  next unless avail == 'avail'
  users.split(',').each do |user|
    access[user] ||= []
    access[user] << path
  end
end
access
```

y Sèâc X D ACL =• ½~ F ð- get_acl_access_data 1 Wý ÁDð?" ¢p < O

```
{"defunkt"=>[nil],
"tpw"=>[nil],
"ni ckh"=>[nil],
"pj hyett"=>[nil],
"schacon"=>["lib", "tests"],
"cdi ckens"=>["doc"],
"usi ncl ai r"=>["doc"],
"ebronte"=>["doc"]}
```

ŒduT ^' i > ýD ð? F³ < Sf , @ÙXCåï » f ^ p" ¢. F s &' ° z O€uKyfkò" ¢. Í
k > ý?

. ' git log D --name-only Ø. Ø\$ Git x Ø We ¼J } ~ 5C\ ØF ¥' 9, æ&í : DÙXWt Cå

J » f D½~ O

```
$ git log -1 --name-only --pretty=format: '' 9f585d
```

README
lib/test.rb

```
. ' get_acl_access_data' àDACL" ÇSWWuyÍ t Cå » f D½~ W° F—° ÙXC' i i a k>  
ÿ€ufk DCåA~O
```

```
# GL8° » ' i » f . æ½D° » I æä  
def check_directory_perms  
  access = get_acl_access_data('acl')  
  
  # Gää a k %$N6Ak >ÿD51€uA~  
  new_commits = `git rev-list ${oldrev}..${newrev}`.split("\n")  
  new_commits.each do |rev|  
    files_modified = `git log -1 --name-only --pretty=format:  
    #{rev}`.split("\n")  
    files_modified.each do |path|  
      next if path.size == 0  
      has_file_access = false  
      access[$user].each do |access_path|  
        if !access_path # ' i /kôŽHI >ÿ  
          || (path.start_with? access_path) # JKya Ç· k HI >ÿ  
          has_file_access = true  
        end  
      end  
      if !has_file_access  
        puts "[POLICY] You do not have access to push to #{path}"  
        exit 1  
      end  
    end  
  end  
end  
  
check_directory_perms
```

O\ git rev-list OP€uTEFØDfk Cå? ³ ÈFySÍ W- CåFÙX. » f D½~ Fd | - z €
uK¶kð" ½~ D€u>ÿ?

Y\$ f D' i ÅW€uýk Çg - DCåMRDA~Fí Ç° \$†86' HI >• èL DÊÓ%X» f ?

9î 1Å

p€Z[äÑÜDno< T . git/hooks/update ½~ J ^ F ÝÙ chmod u+x . git/hooks/updateFd |
, +€uW- Çzî š2DCåFfj ØT „ <DC©O

```
$ git push -f origin master
Counting objects: 5, done.
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 323 bytes, done.
Total 3 (delta 1), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
Enforcing Policies...
(refs/heads/master) (8338c5) (c5b616)
[POLICY] Your message is not formatted correctly
error: hooks/update exited with error code 1
error: hook declined to update refs/heads/master
To git@gitserver:project.git
! [remote rejected] master -> master (hook declined)
error: failed to push some refs to 'git@gitserver:project.git'
```

ÓJKÉ - KTDMR? ' ' F¥' 9 „ • T3I ÝÙDÉQ?

```
Enforcing Policies...
(refs/heads/master) (fb8c72) (c56860)
```

O9òi s updateý! , è y XTçtyXD? fksý! y XTçtyXDA~Íj ^¿c«i 7?
<W- r ÓO9D\] i ™1 MR?

```
[POLICY] Your message is not formatted correctly
error: hooks/update exited with error code 1
error: hook declined to update refs/heads/master
```

UWÙi ¥' Dý! y XDF O<! Ùi Git \$ÝÀ¥' updateý! ×X| ýÀ^*írs&€u> T^B
<? ¥| WQO

```
To git@gitserver:project.git
! [remote rejected] master -> master (hook declined)
error: failed to push some refs to 'git@gitserver:project.git'
```

fj • TÍ - { f D3I BèÅLD- ' Í ET^W- remote rejected MRF · ÝÀf gi 3I Åwf • ÝÙ
« Ú^€uDB<?

NJ KÌ %: » f W- ÉmÇ¶j > ýD½~ d | €u^W- Õm· DCåF6[• T » ¼DC©? > p F W
- ½>" K, +€uW- » f T libæä DCåF6j • T

```
[POLICY] You do not have access to push to lib/test.rb
```

sa, | F - @update ý! " \$> ¥9, ÜF ¥' D7! á½žéř Čj Žmčz i š 2DCå MRF > ¥'
i Č j V\$• PJ Ü?

* " ÔX'

ò81WDþQ\$\$F' i €uDCå > TB< | ÅWX YD° Ü? ÜÜÝÝL f Dno\$¥| | sþ> B<
i d] a %Bà ¥¶káT - Dú~ 9=Di 6' ÇÒÇ» f CåæÖS• ZI " Fò- 1W> Ç° aí W- %
@9?

ânò8! ®B5DWä i c' i W" « i 7D3I F\$6' 1 tmD| a c, | Ÿ? d| AEF' i ' —° äi
" š 4gò~ ®» AF\$Cåâè} ò- ±å? ° §3I ! - ÇÈXqr D. æE!] ¿Ff, f ®¶o\
6ž. äò" 3I] ¿T' i D. git/hooks æä > Et 9, Ü½~ ? cdf 9, \$/OJ ~ 2D. æJ • k
>] ¿ò" 3I Fhi Git Čj ÉŸ. f EÓ. ?

' 1 Ff - C\$í t Cåâuäf DCå MRF òÄ' ° - z EF ðČj st Či ž ~ DCå MR&B< f D~
f? t ^ ATò- æDF f 9, " • commi t-msg 3I ? pef. ' C3I S` P" t UW- ; ‡x² DCå
MRF d | Š=» Dš 2" > HF f —9, . Git \$Cå MRš 2Čy DoČ< B< Cå ?

```
#!/usr/bin/env ruby
message_file = ARGV[0]
message = File.read(message_file)

$regex = /\b[ref: (\d+)\b]/

if !$regex.match(message)
  puts "[POLICY] Your message is not formatted correctly"
  exit 1
end
```

peò- ý! È§g- DÈÓó . git/hooks/commi t-msg ø> ¥i 9, ÜDF f Cå MRDš 2Ni Çg-
DF f j • TO

```
$ git commi t -am 'test'
[POLICY] Your message is not formatted correctly
```

\$ò- ©H½F Cå Ák f• ? d&pef DCå OÑMRI z i @ÅDF Git j L 8f Cå O

```
$ git commi t -am 'test [ref: 132]'
[master e05c914] test [ref: 132]
1 file changed, 1 insertions(+), 0 deletions(-)
```

³ <S ¥' @z OÁk » f T ACL L 8>• èL D½~ ? —pf D. git æä <k å Ü. ' \ Dž ° ACL ½
~ Fž a, <D pre-commi t ý! [äJ ÜD=» , ÜÈSO

```

#!/usr/bin/env ruby

$user      = ENV['USER']

# [ , k Ñ½¼D get_acl_access_data 1 W ]

# gL8° » ' i » f . æ¼D° » I æā
def check_directory_perms
  access = get_acl_access_data('.git/acl')

  files_modified = `git diff-index --cached --name-only HEAD`.split("\n")
  files_modified.each do |path|
    next if path.size == 0
    has_file_access = false
    access[$user].each do |access_path|
      if !access_path || (path.index(access_path) == 0)
        has_file_access = true
      end
    end
    if !has_file_access
      puts "[POLICY] You do not have access to push to #{path}"
      exit 1
    end
  end
end

check_directory_perms

```

ØBEFØ7Dý! Èl WÄF } ^! - m@' i ? UWFACL½~ DÈÓÇOFstò- ý! \$¤âµ" æ
åÝÙF &* . git æā? ACL½~ D¢· ®¶ls

```
access = get_acl_access_data('acl')
```

» f fO

```
access = get_acl_access_data('.git/acl')
```

uW- m@' i i OP{ » f ½~ W° D1 2? \$EFØ7D! ^ä • Cå æā D1 2F 9i æâ DC
åï j Å{ åã <SÆF f „ ò- W° - ° s! " ' i OP? B>SD

```
files_modified = `git log -1 --name-only --pretty=format:'' #{ref}`
```

ÇOFY\$@'

```
file_modification = `git diff-index --cached --name-only HEAD`
```

ÇOD— kò! - ÑÑ} ãèLFCY! ôŽ/O? kWQ@O9Di F· —» \$! 5ÝÙD' i B€uTé
ŒFØ7D/ O? peòVKÇWÄF• , @~ÝEÓW< \$user gC?

\$òJ F¥' j 9,, - z€uA~½ÇÖm* ½Ôónon-fast-forwardØD- ' ? XYW- Çi ½Ôófast-
forwardØD- ' k! 8oÚF@ai \$l - Z[€u\DCåÑ" gxF@ai s! 5€uW-™1 D] YT
éÑ?

—» t ^, Ùò- 45FfZ[\$EFØÑPÓ5^ recei ve. denyDel etes B
recei ve. denyNonFastForwardsFs &i Wj , @XYDi \$l - Z[€u\DCåÑ" g x?

<Üi W- Gæò- I " D pre-rebase ý! ©H? · OPfkVmLDCåDW°Fd|Gæ.. i a" \$
SéÑ- ' ¼? W• ÿ Y ¼W- Cåi \$l - éÑ- ' ¼9ÅDóreachableØF· —, Çätg xO

```
#!/usr/bin/env ruby

base_branch = ARGV[0]
if ARGV[1]
  topic_branch = ARGV[1]
else
  topic_branch = "HEAD"
end

target_shas = `git rev-list #{base_branch}..#{topic_branch}`.split("\n")
remote_refs = `git branch -r`.split("\n").map { |r| r.strip }

target_shas.each do |sha|
  remote_refs.each do |remote_ref|
    shas_pushed = `git rev-list ^#{sha}@ refs/remotes/#{remote_ref}`
    if shas_pushed.split("\n").include?(sha)
      puts "[POLICY] Commit #{sha} has already been pushed to  
#{remote_ref}"
    end
  end
end
```

ãý! . ' ^ øù» þ7! We ¼ÇÇCTDÆW? o\ÝÙò- ^ %9,, OÒW• Wèâ€u\DCåO

```
`git rev-list ^#{sha}@ refs/remotes/#{remote_ref}`
```

SHA^@ŒWj { • òfCCåDfk&Cå? C^ %oj WX\$éÑ] Ý¥™DCå ¼9ÅDFé\$fk ¥' ,
+ €uDCåD SHA-1r Dfk&Cå ¼Ç9ÅDCåÑÑí —i ½ÔDCå?

ò- • Z1eå@DI " §§· K9° | Ü&¥€€ÁK ®@ÑÑ- @f Ç' -**f**
S² Ó€uFEFØ—j ÉÝcX| Ý> ¥B<³ ´ €u? d&Fòi - Ç™D• i F&¥€PÑ° ¢£f X
Ywt „ | 9° ÇÒÇÀè» | Dg x?

¢£

¥' Z[kI ^†\] o\É» 1 Git « j 7BEF7SP- Émµ" ī ŒB. æA~D12? f Z[hTú8
úÄDEÓ. P×§½~ Dø. Bn~ 3I Fj í i ^W- ©H' D² Ó45EFØ? ÅP%HX^` aÄD
µ" ī ŒFf ī °. Git Š· èÃéî ?

Git Üç è FG

Y...> ÇBİ Qp%9? o€Ff Ç° i s—ä³ ¶TDÍ W-. æї { | T Git? k | ª f { S\$. ' 6
VCS D. æ¼Fé' ' . ' Git? \$! eDUW\] ¥' [j ^• TF· Ä\$f Dž" üý\$ÇO• , D. æÑ
. ' Git « j 7?

\$ì " | ª Ff 9° : @[Zk. æ^ | T Git? ! eDUV\] Ž• ^s È- ° »• , [f D. æ89¬ Git
D1WFj . Ák- 1 ¢í 5D« kµ¶F ¥' í k=W~Ý« k?

j v * " ÔK Git

Git t , ç KCD^pä³ 6D¹ | F 8e%Z [ÙT^\$6' Dµ" ýÑ. ' Git D1WFj . 6' wx Š
D%. ' Di ôŽÇOD VCS? k 8eò89' DPPðF· ' { ô‰Ôê³ Ó? <Ü¥' [@) * È- I 9
° j \$...É¼' TDê³ ?

Git Ü Subversion

I t W\] , Í . æŠ/ æeD¼, . æ. ' Subversion Sý€. ' Dî no? &¥\$t e‡ | ÷J F· Z
[i , Í . æVCSøùD UÈ> È? · \$I e1 ÜI Šç[i Í noý€.. ÜDt%6DCVS / ¼?

Git ¼¥ÂD° - —i k W- Š Subversion D^ Nê³ F· { ü" **git svn?** ð- µ¶L8f. ' Git" t
- ³ T Subversion k ŽD« j 7FòÄf 9,, . ' Gitfk! 5D• ° d | pOg\$! 5. ' Subversion W
Ä€uT Subversion E F ð? ð9à Èf 9,, \$! 5%™í] ÝŠî >] ÝP. ' ! " ' P. ' g xŠ\$ø>
DnoFO! : " Kj \$µ¶. ' 6' ª cNžþD12? æf +ÙS¬! " [xØE• » f t ôŽÝ{ Git
D\ Ö¼FW- 51Wi [GitëëýkT! " | BF> ¢EX• D, ç KC" Ž] ? Subversion ê³ —i Ô
k DVCS" ÜDí í ?

git svn

\$ Git ¼fk Subversion ê³ ^ %oDxØ^ %oi **git svn?** . 9, ÈI e^ %oFf, ¥' j o\ È- } ~D
µ" í ÖSt f È©¥€' D^ %o?

, @° i O9Di æf. ' **git svn** | F—i \$Š Subversion êå j FW- Š Git ôŽÇOD• , ? Qý " "
t \$! 5™í] ÝŠî >] ÝFhi f ¥5j i o\ g x f Dµ" Sz Of DæÖQ9° i ...KF> ¥XY%
» ¼O! Š Git èŒF ðå ý Dno?

Ç@mLf DæÖd | , +dt €uFO! í Ç@€uTW- x ÜD Git à á SŠ 6. ' Git D, ç K: " ?
Subversion - ° K W- K- DæÖF ~å. | ~í ? pef \$W- wx ¼µ" F ¼k W" %. ' SVN &uW
" %. ' GitFf, @- z í - %í . ' SVN EF ðS: " ÑÑòÄ‰j „] | ežÝ?

: '

t ^ È@ò- • ° F, @W- k Lk > ý Dmz SVN à á? pe: @x y ò" HI Ff ®¶OPW° 9LK D
SVN 6+à á DE! ? t ^ æç 5x y F 9,, . ' Subversion Èý DW-) t **svnsync** Dµ¶? t ^ ò" 6
+ F ¥' \$ Google Code Ñ%í ^W- **protobuf**. æ\] x y D™ Subversion à á? **protobuf** i W- [
" ¢- ‡?' o' §þwx y Dµ¶?

³ <SFf, @¹ %í W- ™D! 5 Subversion à á O

```
$ mkdistr /tmp/test-svn  
$ svnadmin create /tmp/test-svn
```

d | FL8fk' i fg7! 2- ÑÑ¥~í D12i •• W- ýÅrt 0D **pre-revprop-change** ý! ?

```
$ cat /tmp/test-svn/hooks/pre-revprop-change  
#!/bin/sh  
exit 0;  
$ chmod +x /tmp/test-svn/hooks/pre-revprop-change
```

Y\$9, *' • kæçŠSÍ àá; ð D **svnsync init** ^ %OÈò- . æT! 5Dðð?

```
$ svnsync init file:///tmp/test-svn \  
È http://your-svn-server.example.org/svn/
```

ðÄ—EÓ5^OÈf. ' D2- ? 9, o\ÝÙ<ÜD^ %Sqr noO

```
$ svnsync sync file:///tmp/test-svn  
Committed revision 1.  
Copied properties for revision 1.  
Transmitting file data ..... [....]  
Committed revision 2.  
Copied properties for revision 2.  
[É]
```

cdò- ī " 9° - j õ_È] bFhpef, +xy>¹ DàáTuW- * ! 5DéÖàá | Fj . - kÇT
100 - DCåFò- \Óí 9° j õ_[UW- û | ? Subversion ®¶Wt AÓW- 7! d | €uÀuW- à
á ÑÑò" ŽÒ9" Fhéi %oò~ nì W} ~D12?

ý •

ŒdZ [k ^W- k Lk >ý D Subversion àá Fžaf 9, , ¹ W- mz Dµ" ī Õ? 9, s **git svn**
clone ^ %, , ¹ F· j [Ö- Subversion àá « kTW- ! 5 Git àá? , @câDWQi pei sW- žg
üý D Subversion àá ¼« kF, @[**file: //tmp/test-svn.** | t f D Subversion àá D URLO

```
$ git svn clone file:///tmp/test-svn -T trunk -b branches -t tags
Initialized empty Git repository in /private/tmp/progit/test-svn/.git/
r1 = dcfbfb5891860124cc2e8cc616cded42624897125 (refs/remotes/original/trunk)
  A m4/acx_pthread.m4
  A m4/stl_hash.m4
  A java/src/test/java/com/google/protobuf/UnknownFieldSetTest.java
  A java/src/test/java/com/google/protobuf/WireFormatTest.java
  E
r75 = 556a3e1e7ad1fde0a32823fc7e4d046bcfd86dae (refs/remotes/original/trunk)
Found possible branch point: file:///tmp/test-svn/trunk =>
file:///tmp/test-svn/branches/my-calc-branch, 75
Found branch parent: (refs/remotes/original/my-calc-branch)
556a3e1e7ad1fde0a32823fc7e4d046bcfd86dae
Following parent with do_switche
Successfully followed parent
r76 = 0fb585761df569eaecd8146c71e58d70147460a2 (refs/remotes/original/my-calc-branch)
Checked out HEAD:
  E file:///tmp/test-svn/trunk r75
```

Ø/ Ø§ÝÙ^! - ^ %ÑÑgit svn init „ ßÝ³ ÈDgit svn fetchÑÑf CDD URL? Øj Ø_W
" | ÷? HpF pe6+. æ^- k 75 - áâDCå› ¥noá› Çi I †F hi Git ®¶Wt W- 5GXW-
7! O| ~25Cå. ? y§kfÆÑ\$- CåD. æFòž D9° j Ø_Eü! « ¬EbSôf?

-T trunk -b branches -t tags\] ÝÀ Git Subversion à á ^ %o×! D] ÝŠçëëH? pef^)
^ÇODå. ¶] ÝJçëF9„ »fò" ; ‡? stòi pā5€\$Ff „ ' -s S. nÖ- ð\] Fò°
©ç†, Í› ¥• nfkž" ø. ? <ÜD^ %oi /ODO

```
$ git svn clone file:///tmp/test-svn -s
```

¬äF- CÒT ^W- Z [« k ^] ÝŠçëDk Ž D Git à á O

```
$ git branch -a
* master
  E remotes/original/my-calc-branch
  E remotes/original/tags/2.0.2
  E remotes/original/tags/rel ease-2.0.1
  E remotes/original/tags/rel ease-2.0.2
  E remotes/original/tags/rel ease-2.0.2rc1
  E remotes/original/trunk
```

O9ò- µ¶i pb[Subversion çë" t éÑ- ' Sý€D? a¥' U' n• W< Git D: ; ^ %o show-
refO

```
$ git show-ref
556a3e1e7ad1fde0a32823fc7e4d046bcfd86dae refs/heads/master
0fb585761df569eaecd8146c71e58d70147460a2 refs/remotes/ori gi n/my-cal c-
branch
bfd2d79303166789fc73af4046651a4b35c12f0b refs/remotes/ori gi n/tags/2.0.2
285c2b2e36e467dd4d91c8e3c0c0e1750b3fe8ca refs/remotes/ori gi n/tags/rel ease-
2.0.1
cbda99cb45d9abcb9793db1d4f70ae562a969f1e refs/remotes/ori gi n/tags/rel ease-
2.0.2
a9f074aa89e826d6f9d30808ce5ae3ffe711feda refs/remotes/ori gi n/tags/rel ease-
2.0.2rc1
556a3e1e7ad1fde0a32823fc7e4d046bcfd86dae refs/remotes/ori gi n/trunk
```

Git \$s Git EF ðqr | > ÇòÄ‰ú< Üi \$ØØqr ôf Dk çë Dà á DÄI O

```
$ git show-ref
c3dcbe8488c6240392e8a5d7553bbffcb0f94ef0 refs/remotes/ori gi n/master
32ef1d1c7cc8c603ab78416262cc421b80a8c2df refs/remotes/ori gi n/branch-1
75f703a3580a9b81ead89fe1138e6da858c5ba18 refs/remotes/ori gi n/branch-2
23f8588dde934e8f33c263c6d8359b2ae095f863 refs/tags/v0.1.0
7064938bd5e7ef47bfd79a685a62c1e2649e2ce7 refs/tags/v0.2.0
6dc09b5b57875f334f61aebed695e2e4193db5e refs/tags/v1.0.0
```

Git ...³ [çë@P - refs/tagsF &Çi [· ' • "] Ý?

| } Ü Subversion

Ý\$f K ^W- µ" æä F f 9, \$. æÑ‰W" f ÝF d | c Ž5. ' Git" t SVN « j 7[f DCå €u T Ñ§? W• ' š ^W- ½~ > Cå· F f —k ^W- " §§! 5 Git à á DCå F òCå \$ Subversion EF ðÑ> Ç" \$O

```
$ git commit -am 'Adding git-svn instructions to the README'
[master 4af61fd] Adding git-svn instructions to the README
1 file changed, 5 insertions(+)
```

³ <SFF, @[f Ý€uT Ñ§? O9òj . Äf gf. ' Subversion D1 2ÑÑf 9, nK‰Èt Cåd | Wt - [· ' €uT Subversion EF ð? @€uT W- Subversion EF ðF ÝÙ git svn dcommi t ^‰O

```
$ git svn dcommit
Comitting to file:///tmp/test-svn/trunk...
M README.txt
Committed r77
M README.txt
r77 = 95e0222ba6399739834380eb10afcd73e0670bc5 (refs/remotes/original/trunk)
No changes between 4af61fd05045e07598c553167e0f31c84fd6ffe1 and
refs/remotes/original/trunk
Resetting to the latest refs/remotes/original/trunk
```

Øj uDf \$ Subversion EF ØnoèÑf‰Dfk Cå F ± yÍ W- %oW- Subversion Cå F d | mL f
! 5D Git Cå SØmW- i WDçwz ? òl m@s t ò9à Èfk f DCå D SHA-1 NI BÍ f g ^? \
] ° Sò- >s FO! . ' W- x§ Git D. æéØ7! BW- Subversion EF Ø> Ci W- 5å 9? pef
ä • ¥| Wt Cå F K™D **git-svn-id** { • • O

```
$ git log -1
commit 95e0222ba6399739834380eb10afcd73e0670bc5
Author: ben <ben@0b684db3-b064-4277-89d1-21af03df0a68>
Date:   Thu Jul 24 03:08:36 2014 +0000

M Adding git-svn instructions to the README

M git-svn-id: file:///tmp/test-svn/trunk@77 0b684db3-b064-4277-89d1-  
21af03df0a68
```

O9f >SCå D SHA-1 NI B>Si , **4af61fd** , èF&Y\$i , **95e0222** , è? pef: @Œ€uTW-
Git EF ØN€uTW- Subversion EF ØF ®¶¹ €uó**dcommi t**øT Subversion EF ØF st ò- Í "j f gf DCå ‡??

ÝÝ- • Å

pef B 6, ¿KWÊµ" F ø\$í W| sf' ¼èW€u | FuW%, +€u» fj «ÚUV? ž t »
fj { B<...Tfî > 6' Dµ" ? \$ **git svn** ¼F· • ÈSi øÄDO

```
$ git svn dcommit
Committing to file:///tmp/test-svn/trunk ...

ERROR from SVN:
Transaction is out of date: File '/trunk/README.txt' is out of date
W: d5837c4b461b7c0e018b49d12398769d2bfc240a and refs/remotes/original/trunk
differs, using rebase:
:100644 100644 f414c433af0fd6734428cf9d2a9fd8ba00ada145
c80b6127dd04f5fcda218730ddf3a2da4eb39138 M README.txt
Current branch master is up to date.
ERROR: Not all changes have been committed into SVN, however the committed
ones (if any) seem to be successfully integrated into the working tree.
Please see the above messages for details.
```

t ^• Zò8oÇF9 „ ÝÜgit svn rebaseF· j s EFØI Pœbf ! 5j Ák Df ÝF> [f fkD
μ" g ×TEFØDA~èÑO

```
$ git svn rebase
Committing to file:///tmp/test-svn/trunk ...

ERROR from SVN:
Transaction is out of date: File '/trunk/README.txt' is out of date
W: eaa029d99f87c5c822c5c29039d19111ff32ef46 and refs/remotes/original/trunk
differs, using rebase:
:100644 100644 65536c6e30d263495c17d781962cff12422693a
b34372b25ccf4945fe5658fa381b075045e7702a M README.txt
First, rewinding head to replay your work on top of it...
Applying: update foo
Using index info to reconstruct a base tree...
M README.txt
 Falling back to patching base and 3-way merge...
Auto-merging README.txt
ERROR: Not all changes have been committed into SVN, however the committed
ones (if any) seem to be successfully integrated into the working tree.
Please see the above messages for details.
```

Ý\$FfkfDμ" ī Z [\$ Subversion EFØDA~èÑ^Ff—9 „ ...† 5 dcommittO

```
$ git svn dcommit
Comitting to file:///tmp/test-svn/trunk ...
M README.txt
Committed r85
M README.txt
r85 = 9c29704cc0bbbed7bd58160cfb66cb9191835cd8 (refs/remotes/ori gini/trunk)
No changes between 5762f56732a958d6cfda681b661d2a239cc53ef5 and
refs/remotes/ori gini/trunk
Resetting to the latest refs/remotes/ori gini/trunk
```

O9FB Git, @f \$€uâî > ! 5j Ák DÑSµ" ÇODi Fgit svn - j \$» fž ØUV | @Åf ž
Ä‰oÓ~ Äi Subversionµ" DÙt ø? pe 6%€uW- ½~ D» fd | f€u^uW- ½~ D» f Ff
D dcommi t ^ %oj g€µ" O

```
$ git svn dcommit
Comitting to file:///tmp/test-svn/trunk ...
M configure.ac
Committed r87
M autogen.sh
r86 = d8450bab8a77228a644b7dc0e95977ffc61adff7 (refs/remotes/ori gini/trunk)
M configure.ac
r87 = f3653ea40cb4e26b6281cec102e35dcba1fe17c4 (refs/remotes/ori gini/trunk)
W: a0253d06732169107aa020390d9fefd2b1d92806 and refs/remotes/ori gini/trunk
di ffer, usi ng rebase:
: 100755 100755 efa5a59965fbbb5b2b0a12890f1b351bb5493c18
e757b59a9439312d80d5d43bb65d4a7d0389ed6d M autogen.sh
First, rewi nding head to repl ay your work on top of it...
```

â‡òWQI m@Fst" ei xf€u| . æDÔÓ> Ç" \$\$f D< • ¼? pe» f> 4UVhéi Ç}
~DF 9° j – ÈW" ® „ î ÿDI " ? òŠ. ' Git EF ð> ÇOÑÑ\$ Git ¼F 9„ \$¿, âôŽ6+« i
7• , DÔÓFd &\$ SVN ¼F f « ¬Ç° i j - » \$CåâŠCå | DÔÓi / OD?

fí - CÝÙò- ^ %oS Subversion EF ðñI P» f Fj . f Ém> Çtj Cå? 9„ ÝÙ git svn
fetch S@P™‡? Fhi git svn rebasej @P> ~™f! 5DCå?

```
$ git svn rebase
M autogen.sh
r88 = c9c5f83c64bd755368784b444bc7a0216cc1e17b (refs/remotes/ori gini/trunk)
First, rewi nding head to repl ay your work on top of it...
Fast-forwarded master to refs/remotes/ori gini/trunk.
```

Í ðWj <ÝÙ git svn rebase - z f Dno¹ , i ¥™D? cd, @z O¤ÝÙò- ^ %o| µ" æä i .
ÙD? pek! 5D» f F \$ÝÙ git svn rebase èâ @a # \$f Dµ" @a %Wt ä | DCå F Çd F¤
g xj « Úî > UV | F ^ %oj , Ç?

Git L Ö } #

¤ P - ^ Git Dμ " ī ŐF f t < j : @%í å "] Ÿ F \$ ŇÜ%W" μ " F d | [. ' ī > k å] Ÿ? p e f
go\ gi t svn € u T W- Subversion E F Ó F f 9° : @ä f Dμ " g x T W- ~ 2D] Ÿ ŇF & Ç i [
] Ÿ ī > T W ē ? > HRQg x D > s i s t Subversion k W- K - DæÖ> ¥ Å W Ä Git WÄÆ€ ī > F f
„ gi t svn \$ [½ F ^ | f Subversion Cå | F - j z 1 UW&Cå ?

—E f DæÖÄ < ÜòÄ O%í ^ W- experiment] Ÿ F %o^! t Cå F d | [. ' ī > Å master? ¤
dcommi t | F f • TyXi ðÄDO

```
$ git svn dcommi t
Commi tti ng to fi le: // /tmp/test-svn/trunk ...
Ē M CHANGES. txt
Commi tted r89
Ē M CHANGES. txt
r89 = 89d492c884ea7c834353563d5d913c6adf933981 (refs/remotes/ori gi n/trunk)
Ē M COPYI NG. txt
Ē M I NSTALL. txt
Commi tted r90
Ē M I NSTALL. txt
Ē M COPYI NG. txt
r90 = cb522197870e61467473391799148f6721bcf9a0 (refs/remotes/ori gi n/trunk)
No changes between 71af502c214ba13123992338569f4669877f55fd and
refs/remotes/ori gi n/trunk
Resetting to the latest refs/remotes/ori gi n/trunk
```

\$ W- ī > \ æÖCå D] Ÿ Ň dcommi t ^ %oμ " ØI 5F } ^ ¤f ä • f D Git . ææÖ! F · > Å k m L
f k f \$ experiment] Ÿ Ňf %oDœ9Cå ŇÑ/ \ F f k ö " » f # ©W- ~ 2 ī > Cå D SVN 7! ¼?

¤ 6%qr ž " μ " | F 6' - j • T W- { ī k ^ f k f Ÿ D ī > Cå F — Å Y Ü ^ gi t merge
--squashú 6' Å W • T » f s p S J b | Cå DMR?

Subversion L Ö

\$ Subversion ¼™í] Ÿ Š \$ Git ¼™í] Ÿ > Ç / Oúpef ° Ç' · F ž ¥ 5 - Ç @' ? d & F f 9 „ .
' gi t svn \$ Subversion ¼%í] Ÿ > \$] Ÿ Ň%oCå ?

èé1á - K SVN L Ö

@\$ Subversion ¼%í W- ™] Ÿ F Ÿ Ü gi t svn branch <new-branch>O

```
$ git svn branch opera
Copying file:///tmp/test-svn/trunk at r90 to file:///tmp/test-
svn/branches/opera...
Found possible branch point: file:///tmp/test-svn/trunk =>
file:///tmp/test-svn/branches/opera, 90
Found branch parent: (refs/remotes/ori gini/opera)
cb522197870e61467473391799148f6721bcf9a0
Following parent with do_switcch
Successfully followed parent
r91 = f1b64a3855d3c8dd84ee0ef10fa89d27f1584302 (refs/remotes/ori gini/opera)
```

Ø Š Subversion ¼ D **svn copy trunk branches/opera ^ %o" ' / O>** ¥ i \$ Subversion E F Ø ¼ I
" ? , @mQO9Di . → Çj GXTž -] Ýúpef \$ò; Cå FCåj Ôk E F Ø D **trunk**] Ý F & Ç
i **opera**] Ý?

Ö x; ÅLö

Git o\ ä Ü\$æØ¼ Subversion] Ý Dè \ S • Xf DCå [j TpW-] Ý ÑÑ- C- kW- F > ¥. - C
i \$ øâ] Ý æØ¼¥| W- k **gi t-svn-i d D?**

pe: @O! \$ÇÇW-] Ý Ñµ" F 9, o\ \$« k Dž -] Ý D Subversion Cå , ¹ S E Ø! 5] Ý
dcommi t T° » D Subversion] Ý? pe: @W- 9, ~2\$ÑÜµ" D **opera**] Ý F 9, ÝÙ

```
$ git branch opera remotes/ori gini/opera
```

Ý \$F pe: @[f D **opera**] Ý i > k **trunk**óf D **master**] Ý Ø F 9, ' W- g€D **gi t merge** Sò
Ä‰? hi f , @o\ -m SCDW- I I - DCå MRF a • i > MRj i Ák' D ØMerge branch
operaØ?

â‡ Qý. ' Di **gi t merge** S‰ø- Í " F & ¥ i > 9° j > \$ Subversion ¼~ ~í W" óst Git j t
f ÉÝ5G6î PDî > xØøF hò> Çi W- • oD Git î > Cå? f ÇØÇ[ð- ‡? €uÅW-
Subversion E F Ø F Subversion E F Ø ÇÝ{ ž " Èöe- &" QDCåúf, F ø€uôf | F· • ÈS
j i W- [6] Ý Df k Cå‰\$WÈD~2Cå? \$i > W-] Ý TuW-] Ý | Ff > Ç° Å Git ¼ž
Äæç 5ÀT>SD] Ý µ¶µ" ? f ÝÙD **dcommi t** ^ %oj [p-] Ý{ i > ØSDMRØÓF f, | ¶D
i > xØø áj i ™DÑÑ **dcommi t** j . f D **gi t merge**" e• ÈSÄi ÝÙ^ **gi t merge --squash?**
Ç>Di F Ák W- 5D1 2SXYò8oÚÑÑ Subversion ÅW" #ø- MRF f, ø. ' . %ot E F Ø!
f ßi j { · Dý Öêñ? t ^ XYò" | " F- C\$ i > Tå· | å} ! 5] Ý Ø! H½i **opera**Ø?

Subversion , f

gi t svn µ¶£o\ CDI e• ° Š Subversion ¼ž " / ¼D^ %oS¢E} 6^9T Git D\ Ø? < Üi W
" CD^ Subversion ¼€' • ° D^ %o?

pe f i è§. ' Subversion > ¥: @• SVN y X™š DCå æÖF 9 „ ŸÙ gi t svn log Sä • SVN š 2DCå æÖO

```
$ git svn log
-----
r87 | schacon | 2014-05-02 16:07:37 -0700 (Sat, 02 May 2014) | 2 lines
autogen change

-----
r86 | schacon | 2014-05-02 16:00:21 -0700 (Sat, 02 May 2014) | 2 lines
Merge branch 'experiment'

-----
r85 | schacon | 2014-05-02 16:00:09 -0700 (Sat, 02 May 2014) | 2 lines
updated the changelog
```

G§ gi t svn log F k! ~ m@Dnf - Cä j ? ' 1 F· i n Kµ" DF> ÇÄž g D svn log ^ %oF j
 N Subversion E F ð ð I ð ?? t F· ^ j # ©Z [Cå T Subversion E F ð ñ D Cå ? j 4 dcommit
 D! 5 Git Cå > Çj # ©ú O Äí Çj # ©ò f | ÷ ¼ 6%€ u T Subversion E F ð ñ D Cå ? . ~ Ä i
 ¥ | OPT D Subversion E F ð ñ D Cå Õ Õ?

SVN ê 8

» ¼ gi t svn log ^ %o n K, Ø^ svn log ^ %o F f 9 „ | t gi t svn blame [FILE] n K, Ø^ svn
 annotate? y X • È S Ä ð Ä O

```
$ git svn blame README.txt
È2 temporal Protocol Buffers - Google's data interchange format
È2 temporal Copyright 2008 Google Inc.
È2 temporal http://code.google.com/apis/protocolbuffers/
È2 temporal
22 temporal C++ Installation - Unix
22 temporal =====
È2 temporal
79 schacon Committing in git-svn.
78 schacon
È2 temporal To build and install the C++ Protocol Buffer runtime and the
Protocol
È2 temporal Buffer compiler (protoc) execute the following:
È2 temporal
```

mAWt F· > Ç# ©f \$ Git ¼D! 5Cå F í Ç# ©OW| ÷ { €u T Subversion D 6Cå ?

9 „ o\YÙ git svn info OTŠ svn info / O8» DMR?

```
$ git svn info
Path: .
URL: https://schacon-test.googlecode.com/svn/trunk
Repository Root: https://schacon-test.googlecode.com/svn
Repository UUID: 4c93b258-373f-11de-be05-5f7a86268029
Revision: 87
Node Kind: directory
Schedule: normal
Last Changed Author: schacon
Last Changed Rev: 87
Last Changed Date: 2009-05-02 16:07:37 -0700 (Sat, 02 May 2009)
```

o—Ai \$f ÑWt B Subversion EFØO®| OÈ^è | FnKÝÙD blame Š log ^ %?

° » Subversion g° » K

peqr W- \$œ9WÆEÓ svn: ignore 2- D Subversion àá | Ffí 8j : @EÓy - D
 . git ignore ½~ FòÄ—Çj 9LDCåž " ÇCCå D½~ ? git svn k! - ^ %S¢E• Zò- I " ?
 UW- i git svn create-ignoreF· j t f ÉÝ5%í y - D . git ignore ½~ FòÄf D<t Cå—
 ° Õm. ' ?

UV- ^ %oi git svn show-ignoreF· j [f , @< \$. git ignore ½~ ¼DÍ ÙA~ê (TçtyXF
 ðÄ—9„ [y XA~m» NT. æDHL ½~ ¼O

```
$ git svn show-ignore > .git/info/exclude
```

ðÄFf—Çj ° § . git ignore ½~ &ä . æ~â? ñf i Subversion wx ¼i WD Git' i | ði W-
 5Dø. F> ¥f Dx' > Ç: @. æA" \$. git ignore ½~ ?

Git-Svn ¢ E

ñf ÇØÇ. ' Subversion EFØJ K 6®¶ÝÙW- Subversion EFØD, ñ | B| Fgit svnµ¶|
 k' ? f - Cä. ñ%W- ÇôŽD GitFd &Ff @i Ç' . Ds F—j \$‰^ | D\ Ø¼nTl ež ÝDI
 " ? t ^ ÇòžÝFQC^ õò" † • O

¥ z { W- K- D Git æÖF ¼Ç° K git merge ñf Dí > Cå? äf \$åK] ÝL, ñDž\µ" g
 ×TåK] Ýú&Ç@í > k åK] Ý?

¥ Ç@í i W- ~ 2D Git EFØFí Ç@\$ Git EFØÑ: " ? 9, ' WØ Git EFØS¢E™SD, ñ K
 • ¾qr Fhi Ç@€uœb ÇÔm git-svn-id ž æDKL? f 9° j , @" • W- pre-receive 3
 I SGäí W- CåMRI ª Õm git-svn-id > ¥B<œb 4ÔmDCå?

pef ^ õ^ž" † • Fó' ' W- Subversion EFØSµ" 9, ~ ~í " ? d&F pek 9° 89TW- ž

g D Git E F ÓF ž a 89\] ° . f Dwx OÖ~ e 5AE?

Git Ü Mercurial

DVCS DôÓJ Ç~ k Git? ...ÉÑF \$ò- ī ÷J k 8e 6D• , ?y \$pb g~ 5ÔÙ] , 27! ý €F í W- • , ī k ÉmDi ø? } ^ GitF ¥í ÙD—i MercurialF > ¥. ' ! - \$I e 1 ÜT I / ¼?

5è Ri F pef ~ RQ Git D« j 7Ùt hi µ" \$î no° Mercurial ÓÓD. æ¼F k W8. ' Git" t Mercurial üýàá D« j 7D1W? ° § Git ŠEF Óàái . ' éÖå ýDF ž a° éÖE~ ...YDê³ 1 W—Cj a%l ^ ö? ò- . æD) yi git-remote-hgF 9, \$ <https://github.com/felipec/git-remote-hg> ÜT?

git-remote-hg

' 1 F , @ÚÜ git-remote-hg? ...ÉÑ, @[· D½~ < \$ PATH g CDI - æä ¼F ÄòÄO

```
$ curl -o ~/bin/git-remote-hg \
  https://raw.githubusercontent.com/felipec/git-remote-hg/master/git-
  remote-hg
$ chmod +x ~/bin/git-remote-hg
```

—» ~/bin \$ \$PATH g C¼? Git-remote-hg k W- 6D• « Omercurial Python á? p e Z [ÚÜ^ PythonF ÜÜ· —ÄòÄ} ~O

```
$ pip install mercurial
```

ópe 4ÚÜ PythonF HI <https://www.python.org/SOP> ?ø

, @%D¥| W~ ni ÚÜ Mercurial « j 7? pej Ák ÚÜDs GHI <https://www.mercurial-scm.org/> SÜÜ?

Y\$Z [t j 5÷—^? ff, @DW{ —i W- f 9, €uD Mercurial à á? I >ÝF í W- Mercurial à á! 9, ðÄ%Ff, ¥' ~ , @. ' t #' Shi Mercurial DÒhello worldÓà á—9, ^O

```
$ hg clone http://seleni.c.com/repo/hello /tmp/hello
```

ÿ •

Œd k W- 9' D Óserver-sideÓà á F ¥' 9, o\ W- mz Dµ" i S^•? f [j • TFò! 8• , * €/ ¼F Ák t e DXk?

B Git WÄF' 1 ¥' qr O

```
$ git clone hg: /tmp/hello /tmp/hello-git
$ cd /tmp/hello-git
$ git log --oneline --graph --decorate
* ac7955c (HEAD, origin/master, origin/branches/default, origin/HEAD,
refs/hg/origin/branches/default, refs/hg/origin/bookmarks/master, master)
Create a makefile
* 65bb417 Create a standard "hello, world" program
```

fj O9TŠ Mercurial à á μ" | . ' ^ ç † D **git clone** ^ %? ž i s t git-remote-hg μ" \$/ ø" D : ; F . ' » ¼§ Git HTTP/S: ; DÖÓ...Y Dóé ÖE~ø? ° § Git Š Mercurial Ŧ E | t í W- « i 7 k W- à á Dô ÖæÖF f, ò- ^ %%%^ Wt ô ÖDqr F ÖÖf k D. ææÖF> ¥/ ø½5öf?

log ^ %# ©^! t Cå F ¥| Wt Cå • N^Wt ù- ' ? ž → Ñò ¼DW\] ...ÉÑ» Ák \$ž <? a ¥' • • . **git** æã ¼...ÉÑk` a O

```
$ tree .git/refs
.	git/refs
•	heads
origin
•	hg
origin
•	bookmarks
origin
•	master
origin
•	branches
origin
•	default
•	notes
origin
•	hg
origin
•	remotes
origin
•	HEAD
tags

9 directories, 5 files
```

Git-remote-hg, + a" Ç ~ k Git™Š F h i \$±\$\$< ÜDi · ý€! - æê ÇO• , è ÷ < ØDwh?
refs/hg æã ¼" # ^ ...É Dé Ö- ' ? HpF **refs/hg/origin/branches/default** t i W- Œm,
Œac7955cŒ , ¹ D SHA-1 r D Git- ' ½~ Fi **master** f• NDCå? f, **refs/hg** æã i W8» ¼
refs/remotes/origin D. n#F h i · - k ^-ëŠ] ŸD' ì ?

notes/hg ½~ i git-remote-hg p b \$ Git DCå v WŠ Mercurial g ~ E ID è ÷ í i wh DÊ Q? a ¥'
S‡' W< O

```
$ cat notes/hg
d4c10386...

$ git cat-file -p d4c10386...
tree 1781c96...
author remote-hg <> 1408066400 -0800
committer remote-hg <> 1408066400 -0800
```

Notes for master

```
$ git ls-tree 1781c96...
100644 blob ac9117f... 65bb417...
100644 blob 485e178... ac7955c...

$ git cat-file -p ac9117f
0a04b987be5ae354b710cefeba0e2d9de7ad41a9
```

f „ refs/notes/hg • N^W- %Fj \$ Git y <‡? á ¼DW- k 6y <) y DW° ? git ls-tree y
X tree y <¼f k. æD, 2P» z Py <w' Š ½~) ? pe_kuv tree y <¼DW-. æF ¥' j Ɂ Y
\$ ¼i W-) y t Òac9117fÓ D blob y <ó master f • NCå D SHA-1 v Wr øF ÓmA ~
Ò0a04b98Ó ói defaul t] Ÿ • ND Mercurial g ~ E D IDØ?

5è Ri t e ‡ o Ç <¥' Ç, @Gv „ Ñò" ? mz Dµ" i ÓŠ. ' Git é Óà á > Ák ` a ÇO?

\$ ¥' µ¶èâ F ÒJ j kW~, @O9DnoOÈ 5? Mercurial Š Git. ' * € » ¼DøÓ...Y Ò- • ° F
hi WcS -f Çj : @ä W- . git ignore ½~ Cå T Mercurial à á ¼? > Ý Di F Git k W81 29, È
5! 5) ùà á D½~ F & ¥ Mercurial š 2i Š Git } ~ DF f „ f -, [ò- ½~ x y \] O

```
$ cp .hgignore .git/info/exclude
```

.git/info/exclude ½~ D" ' Äi W- .gitignore F hi . ÇÓm\$ Cå ¼?

² j d Ú

—E ¥' Z [%o^W" µ" > ¥\$ master] Ÿ %o^È t Cå F & ¥Z [t j [· ' €uTé Óà á ? òi ¥
' à á Y\$ DÄI O

```
$ git log --oneline --graph --decorate
* ba04a2a (HEAD, master) Update makefile
* d25d16f Goodbye
* ac7955c (origin/master, origin/branches/default, origin/HEAD,
refs/hg/origin/branches/default, refs/hg/origin/bookmarks/master) Create a
makefile
* 65bb417 Create a standard "hello, world" program
```

¥' D master] Ýë¹ ori gi n/master] Ý! - Cå F h i ž! - Cå " \$§ ¥' D! 5ōð½?
a ¥' • • \$OW! ÷k Ák 6%%` a m@Dþ" O

```
$ git fetch
From hg:/tmp/hello
* ac7955c..df85e87 master      -> origin/master
* ac7955c..df85e87 branches/default -> origin/branches/default
$ git log --oneline --graph --decorate --all
* 7b07969 (refs/notes/hg) Notes for default
* d4c1038 Notes for master
* df85e87 (origin/master, origin/branches/default, origin/HEAD,
refs/hg/origin/branches/default, refs/hg/origin/bookmarks/master) Add some
documentation
| * ba04a2a (HEAD, master) Update makefile
| * d25d16f Goodbye
|/
* ac7955c Create a makefile
* 65bb417 Create a standard "hello, world" program
```

s t . ' ^ --all çâF ¥' • T { git-remote-hg A\ . ' D ÓnotesÓ – ' F h i 9, Ê5· ' ? O< D
\] i ¥' N' Dúori gi n/master Z [âÔ^Wt Cå F O! ¥' DæÖY \$] X^? Mercurial B¥' !
e½OPD 6• , ÇWÄF· ° pÆ€î > F f „ ¥' Ç, @%œb 6no?

```
$ git merge origin/master
Auto-merging hello.c
Merge made by the 'recursive' strategy.
Êhello.c | 2 ++
Ê1 file changed, 1 insertion(+), 1 deletion(-)
$ git log --oneline --graph --decorate
* 0c64627 (HEAD, master) Merge remote-tracking branch 'origin/master'
|\
| * df85e87 (origin/master, origin/branches/default, origin/HEAD,
refs/hg/origin/branches/default, refs/hg/origin/bookmarks/master) Add some
documentation
* | ba04a2a Update makefile
* | d25d16f Goodbye
|/
* ac7955c Create a makefile
* 65bb417 Create a standard "hello, world" program
```

ô‡? ÝÜ6+d | fk6+Í o\^Ff „ ¥' +j [μ" &3cwx D 6f3?

```
$ git push
To hg:/tmp/hello
* df85e87..0c64627 master -> master
```

—i öÄö pef Y\$ä • W< Mercurial à á Ffj ÷ YöÄ...Y^¥' fN' DO

```
$ hg log -G --style compact
o 5[tip]: 4,2    dc8fa4f932b8    2014-08-14 19:33 -0700    ben
|\   Merge remote-tracking branch 'origin/master'
|
| o 4    64f27bcefc35    2014-08-14 19:27 -0700    ben
| |   Update makefile
|
| o 3:1    4256fc29598f    2014-08-14 19:27 -0700    ben
| |   Goodbye
|
@ | 2    7db0b4848b3c    2014-08-14 19:30 -0700    ben
|/   Add some documentation
|
o 1    82e55d328c8c    2005-08-26 01:21 -0700    mpm
|   Create a makefile
|
o 0    0a04b987be5a    2005-08-26 01:20 -0700    mpm
Ê   Create a standard "hello, world" program
```

œì 2 Dg ~ Ei ° Mercurial óf DF œì 3 Šœì 4 Dg ~ Ei ° git-remote-hg óf DF o\ Git €uÑ SDCå?

LóÜ<æ

Git ~ k W8» z D] ŸO¤Cåóf | 9ŸDW- – ' ? \$ Mercurial ¼F ò8» z D- ' Ô"
Øbookmarks · DÙt * €» ¼§ Git] Ÿ?

Mercurial D ØbranchÓ <Œ• ~ mC©W" ? g ~ Eóf | D] Ÿj âã Hmë Z QF 9à È· j Žé5"
\$S à á æÖ¼? ò - HI || ^W- \$ devel op] ŸÑDCå O

```
$ hg log -l 1
changeset: 6:8f65e5e02793
branch: develop
tag: tip
user: Ben Straub <ben@straub.cc>
date: Thu Aug 14 20:06:38 2014 -0700
summary: More documentation
```

O9, è t ØbranchÓ Dž Ù? Git ÅWž g 5, Øò8Ùt ó> ¥í Ç, @òÄ%ú! 8» z D] Ÿí 9,
° At Git DW- – ' øFhi git-remote-hg, @^ • ¼D' i Fst Mercurial Gv?

%í Mercurial – è Š%í Git] ŸWÄ~í ? \$ Git òþO

```
$ git checkout -b featureA
Switched to a new branch 'featureA'
$ git push origin featureA
To hg:/tmp/hello
* [new branch]      featureA -> featureA
```

Ø—i f@%DŽ\? \$ Mercurial ØþF· • ÈSÃòÄO

```
$ hg bookmarks
* featureA          5: bd5ac26f11f9
$ hg log --style compact -G
@ 6[tip] 8f65e5e02793 2014-08-14 20:06 -0700 ben
| More documentation
|
o 5[featureA]:4,2 bd5ac26f11f9 2014-08-14 20:02 -0700 ben
|\ Merge remote-tracking branch 'origin/master'
|
| o 4 0434aaa6b91f 2014-08-14 20:01 -0700 ben
| | update makefile
|
| o 3:1 318914536c86 2014-08-14 20:00 -0700 ben
| | goodbye
|
o | 2 f098c7f45c4f 2014-08-14 20:01 -0700 ben
| / Add some documentation
|
o 1 82e55d328c8c 2005-08-26 01:21 -0700 mpm
| Create a makefile
|
o 0 0a04b987be5a 2005-08-26 01:20 -0700 mpm
* Create a standard "hello, world" program
```

O9\$»þ7! 5ÑD™ [featureA] çë? \$ Git Øþò“ • ÈSÃi Git] ÝF} ^WQOÇ° s Git Øþå} – èóði éÓE~DW- ýÓø?

fí 9, µ" \$W- ØmC©Ó D Mercurial branchO-, @\$ branches ^) Í ÷ A%í W-] ÝO

```
$ git checkout -b branches/permanent
Switched to a new branch 'branches/permanent'
$ vi Makefile
$ git commit -am 'A permanent change'
$ git push origin branches/permanent
To hg:/tmp/hello
* [new branch]      branches/permanent -> branches/permanent
```

```
$ hg branches
permanent                               7: a4529d07aad4
devel op                                6: 8f65e5e02793
default                                 5: bd5ac26f11f9 (inactive)

$ hg log -G
o changeset:    7: a4529d07aad4
| branch:      permanent
| tag:         tip
| parent:     5: bd5ac26f11f9
| user:        Ben Straub <ben@straub.cc>
| date:        Thu Aug 14 20:21:09 2014 -0700
| summary:    A permanent change

| @ changeset:  6: 8f65e5e02793
| / branch:      devel op
| | user:        Ben Straub <ben@straub.cc>
| | date:        Thu Aug 14 20:06:38 2014 -0700
| | summary:   More documentation

o changeset:    5: bd5ac26f11f9
|\ bookmark:   featureA
| | parent:    4: 0434aaa6b91f
| | parent:    2: f098c7f45c4f
| | user:       Ben Straub <ben@straub.cc>
| | date:       Thu Aug 14 20:02:21 2014 -0700
| | summary:  Merge remote-tracking branch 'origin/master'
[...]
```

] Ÿ) y ÖpermanentÖ â ã \$œì 7 Dg ~ E½?

\$ Git öþ F y § ½œb W8™š D] Ÿ Dμ" Ŧ i / ODOgg i g€‰DGXPCå P@P Pî > P I P
Š€u? j k, @ä j DW~ noi Mercurial ÇÝ{ mLæÖF - L8• • æÖ? < Üi ¥' D Mercurial à
â \$â ý 2Dg x Š² Œu | DÄI O

```
$ hg log --style compact -G
o 10[tip] 99611176cbc9 2014-08-14 20:21 -0700 ben
| A permanent change
|
o 9 f23e12f939c3 2014-08-14 20:01 -0700 ben
| Add some documentation
|
o 8:1 c16971d33922 2014-08-14 20:00 -0700 ben
| goodbye
|
o 7:5 a4529d07aad4 2014-08-14 20:21 -0700 ben
| A permanent change
|
| @ 6 8f65e5e02793 2014-08-14 20:06 -0700 ben
| / More documentation
|
o 5[featureA]:4,2 bd5ac26f11f9 2014-08-14 20:02 -0700 ben
| \ Merge remote-tracking branch 'origin/master'
|
| o 4 0434aaa6b91f 2014-08-14 20:01 -0700 ben
| | update makefile
|
+---o 3:1 318914536c86 2014-08-14 20:00 -0700 ben
| | goodbye
|
| o 2 f098c7f45c4f 2014-08-14 20:01 -0700 ben
| / Add some documentation
|
o 1 82e55d328c8c 2005-08-26 01:21 -0700 mpm
| Create a makefile
|
o 0 0a04b987be5a 2005-08-26 01:20 -0700 mpm
E Create a standard "hello, world" program
```

g ~ E 8P9 Š 10Z [{ %í XS> ¥2S permanent] ŸFhi mDg ~ E• d\$žJ ? òj a. ' Mercurial Dwxf3* €STFf „ @XYò8Ùt ?

Mercurial € E

Git Š Mercurial pã / ¼F „ ¬S ®ò! - • , ÔÙµ" d] i ù? pe° O9XYf g \$f õðÑDæÖ õ—Äo€í ; Dž ÄøFf « ¬> Cj Š TuW7i Mercurial?

Git and Bazaar

Among the DVCS, another famous one is [Bazaar](#). Bazaar is free and open source, and is part of the [GNU Project](#). It behaves very differently from Git. Sometimes, to do the same thing as with Git, you have to use a different keyword, and some keywords that are common don't have the same meaning. In particular, the branch management is very different and may cause confusion, especially when someone comes

from Git's universe. Nevertheless, it is possible to work on a Bazaar repository from a Git one.

There are many projects that allow you to use Git as a Bazaar client. Here we'll use Felipe Contreras' project that you may find at <https://github.com/felipec/git-remote-bzr>. To install it, you just have to download the file git-remote-bzr in a folder contained in your \$PATH:

```
$ wget https://raw.githubusercontent.com/felipec/git-remote-bzr/master/git-remote-bzr  
-O ~/bin/git-remote-bzr  
$ chmod +x ~/bin/git-remote-bzr
```

You also need to have Bazaar installed. That's all!

Create a Git repository from a Bazaar repository

It is simple to use. It is enough to clone a Bazaar repository prefixing it by bzr:: . Since Git and Bazaar both do full clones to your machine, it's possible to attach a Git clone to your local Bazaar clone, but it isn't recommended. It's much easier to attach your Git clone directly to the same place your Bazaar clone is attached to the central repository.

Let's suppose that you worked with a remote repository which is at address bzr+ssh: //devel oper@mybazaarserver: myproj ect. Then you must clone it in the following way:

```
$ git clone bzr::bzr+ssh://devel oper@mybazaarserver: myproj ect myProj ect-Git  
$ cd myProj ect-Git
```

At this point, your Git repository is created but it is not compacted for optimal disk use. That's why you should also clean and compact your Git repository, especially if it is a big one:

```
$ git gc --aggressive
```

Bazaar branches

Bazaar only allows you to clone branches, but a repository may contain several branches, and git-remote-bzr can clone both. For example, to clone a branch:

```
$ git clone bzr::bzr://bzr.savannah.gnu.org/emacs/trunk emacs-trunk
```

And to clone the whole repository:

```
$ git clone bzr::bzr://bzr.savannah.gnu.org/emacs emacs
```

The second command clones all the branches contained in the emacs repository; nevertheless, it is

possible to point out some branches:

```
$ git config remote-bzr.branches 'trunk, xwindow'
```

Some remote repositories don't allow you to list their branches, in which case you have to manually specify them, and even though you could specify the configuration in the cloning command, you may find this easier:

```
$ git init emacs
$ git remote add origin bzr://bzr.savannah.gnu.org/emacs
$ git config remote-bzr.branches 'trunk, xwindow'
$ git fetch
```

Ignore what is ignored with .bzrignore

Since you are working on a project managed with Bazaar, you shouldn't create a `.gitignore` file because you may accidentally set it under version control and the other people working with Bazaar would be disturbed. The solution is to create the `.git/info/exclude` file either as a symbolic link or as a regular file. We'll see later on how to solve this question.

Bazaar uses the same model as Git to ignore files, but also has two features which don't have an equivalent into Git. The complete description may be found in [the documentation](#). The two features are:

1. "!!" allows you to ignore certain file patterns even if they're specified using a "!" rule.
2. "RE:" at the beginning of a line allows you to specify a [Python regular expression](#) (Git only allows shell globs).

As a consequence, there are two different situations to consider:

1. If the `.bzrignore` file does not contain any of these two specific prefixes, then you can simply make a symbolic link to it in the repository: `ln -s .bzrignore .git/info/exclude`
2. Otherwise, you must create the `.git/info/exclude` file and adapt it to ignore exactly the same files in `.bzrignore`.

Whatever the case is, you will have to remain vigilant against any change of `.bzrignore` to make sure that the `.git/info/exclude` file always reflects `.bzrignore`. Indeed, if the `.bzrignore` file were to change and contained one or more lines starting with "!!" or "RE:", Git not being able to interpret these lines, you'll have to adapt your `.git/info/exclude` file to ignore the same files as the ones ignored with `.bzrignore`. Moreover, if the `.git/info/exclude` file was a symbolic link, you'll have to first delete the symbolic link, copy `.bzrignore` to `.git/info/exclude` and then adapt the latter. However, be careful with its creation because with Git it is impossible to re-include a file if a parent directory of that file is excluded.

Fetch the changes of the remote repository

To fetch the changes of the remote, you pull changes as usually, using Git commands. Supposing that your changes are on the `master` branch, you merge or rebase your work on the `origin/master` branch:

```
$ git pull --rebase origin
```

Push your work on the remote repository

Because Bazaar also has the concept of merge commits, there will be no problem if you push a merge commit. So you can work on a branch, merge the changes into `master` and push your work. Then, you create your branches, you test and commit your work as usual. You finally push your work to the Bazaar repository:

```
$ git push origin master
```

Caveats

Git's remote-helpers framework has some limitations that apply. In particular, these commands don't work:

- ✖ `git push origin :branch-to-delete` (Bazaar can't accept ref deletions in this way.)
- ✖ `git push origin old:new` (it will push old)
- ✖ `git push --dry-run origin branch` (it will push)

Summary

Since Git's and Bazaar's models are similar, there isn't a lot of resistance when working across the boundary. As long as you watch out for the limitations, and are always aware that the remote repository isn't natively Git, you'll be fine.

Git Ü Perforce

Since Git and Perforce are both distributed version control systems, it's natural to want to integrate them. There are several ways to do this, ranging from simple command-line tools to full-fledged IDE plugins. One popular approach is to use a tool like `git-perforce`, which provides a command-line interface for interacting with both Git and Perforce repositories. Another approach is to use a tool like `git-fusion`, which provides a graphical user interface for managing both Git and Perforce repositories. Both of these tools allow you to easily switch between Git and Perforce, and to perform common operations like committing changes, pulling in updates, and merging branches.

Perforce is a powerful version control system that is widely used in the software development industry. It offers a range of features, including support for branching and merging, and a built-in search engine. Perforce is often used in conjunction with other tools, such as Git and Jenkins, to create a complete CI/CD pipeline. One challenge with Perforce is that it can be difficult to learn and use, especially for new users. However, there are many resources available online that can help you get started, including documentation, tutorials, and forums.

Git Fusion

Git Fusion is a graphical user interface for managing Git and Perforce repositories. It allows you to view the contents of both repositories, merge changes between them, and commit changes back to either repository. Git Fusion is available for Windows, Mac OS X, and Linux. It is a free download, although there is a paid version available for commercial use.

:

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\$ UWt BÝÓÐ | F· j ð I f É» 1÷ - Linux ' j ÓrootPperforce Š gi tøD) oF > ¥CDW-...H) yS'] \$OWþw<ÇODÚÛ? ðž" Í ôf | F [j • TðÄO

Figure 146. Git Fusion F G" • . Í Í 3

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```
$ p4 -p local host:1666 -u super user -f john  
$ p4 -p local host:1666 -u john passwd  
$ exit
```

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[j CØyk) o! t? ò-i fk ¥' @o\ , 7CØz %oDnoFf, Y\$9, xXøâj s^?

³ <S@%oDn—i YÀ Git Ç@I O SSL O—? Git Fusion 4ÃAÓW- O— Fhi i) > ÇéÞf DÒÓå
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```
$ export GIT_SSL_NO_VERIFY=true
```

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```
$ git clone https://10.0.1.254/Tal khouse  
Cloning into 'Tal khouse'...  
Username for 'https://10.0.1.254': john  
Password for 'https://john@10.0.1.254':  
remote: Counting objects: 630, done.  
remote: Compressing objects: 100% (581/581), done.  
remote: Total 630 (delta 172), reused 0 (delta 0)  
Receiving objects: 100% (630/630), 1.22 MiB | 0 bytes/s, done.  
Resolving deltas: 100% (172/172), done.  
Checking connectivity... done.
```

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Fusion • '

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wh Perforce E F ðÑD // . git-fusion æä Tf Dµ" ï ÷? ½~ " ¢• ÈSÃðÄO

```
$ tree
.
• žž obj ects
  ø È È • žž repos
    ø È È ø È È Ÿžž [...]
    ø È È Ÿžž trees
      ø È È     Ÿžž [...]
      ø
      • žž p4gf_config
      • žž repos
        ø È È Ÿžž Tal khouse
        ø È È     Ÿžž p4gf_config
        Ÿžž users
        È Ÿžž p4gf_usermap

498 directories, 287 files
```

obj ects æã { Git Fusion A\` S ^ Nwh Perforce y < Š Git y < F f Ç®~ â ž < Dœb K L? \$ò-
æã ¼k W- ŽÍ D p4gf_config ½~ FÍ - à á ¼í j K W° ÑÑò" PÓ½~ Z» ^ Git Fusion DÙt?
a ¥' • W<5æã < D½~ O

```
[repo-creation]
charset = utf8

[git-to-perforce]
change-owner = author
enable-git-branch-creation = yes
enable-swarm-reviews = yes
enable-git-merge-commits = yes
enable-git-submodules = yes
preflight-committ = none
ignore-author-permissions = no
read-permission-check = none
git-merge-avoidance-after-change-num = 12107
```

```
[perforce-to-git]
http-url = none
ssh-url = none
```

```
[@features]
imports = False
chunked-push = False
matrix2 = False
parallel-push = False
```

```
[authentication]
email-case-sensitivity = no
```

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```
[Tal khouse-master]
git-branch-name = master
view = //depot/Tal khouse/main-dev/... . . .
```

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j 9? git-branch-name L8f [\$ Git <# ØumDà á¢. ^ | t ~ ' 5D) y? view ø. . . ' çti
ÙwhŒWØÓ Perforce ½~ pbwh T Git à á? 9, • » W-, ÑDwh F—Ã<ÜDH! O

```
[multi-project-mapping]
git-branch-name = master
view = //depot/project1/main/... project1/...
È //depot/project2/main/... project2/...
```

o\ø812Fpeg€µ" Í ÷whØmyæä" ¢D» f F 9, [AÓt W- Git à á?

¥| W- ¥' OPD½~ i users/p4gf_usermapF· [Perforce' i whT Git' i F hf 9° Cj , @ . ? ☎ W- Perforce g ~ E^ | t W- Git Cå | F Git Fusion D³ | Üt i] ä Ü Perforce' i F d | ä KP5¢ŠŽ) " # \$ Git D author/commiter y f ¼? ☎ \ S^ | ; F³ | DÜt i 5? " # \$ Git Cå ¼ author y f ¼DKP5¢Sä Ü Perforce' i F d | , C' i Cåg ~ EÓ, B>ÿD- ' ø? t e f o C< F ö - Üt µ" ÖI 5Fhi ..._< ÜDwh ½~ O

j ohn j ohn@example.com "John Doe"
j ohn j ohnny@applesseed.net "John Doe"
bob empl oyeeX@example.com "Anon X. Mouse"
j oe empl oyeeY@example.com "Anon Y. Mouse"

Í WÙDš 2í i <user> <email> "F %í ^W- ~2D' i wh? á! ÜwhÇODK P5¢TOW- Perforce' i 2i ? ☎ . ' Œ- ÇODKP5¢ÓJ f gKP5¢øóf Git Cå > ¥: @a 6' whTOW- Perforce' i | öj | k' ? ☎ W- Perforce g ~ E%í W- Git Cå | F UW- é P Perforce' i DÜj { ' " Git" KMR?

¥| ! Üs %í D Git Cå ¼§ • ^ Bob Š Joe Dž ...) y ŠKP5¢? ☎ : @[W- A\ . æ, Ī F h Ç : [f DÜ 3æä! , TŽ" Ü| öI Ç™? O9KP5¢ŠŽ) , @i i WDF } * : @fk D Git Cå ī 2 § W- Ö¢D" K?

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Perforce Git Fusion i \$ Perforce Š Git 7! ÖÓ÷^ NDê ³ ? a ¥' • W< \$ Git öþµ" i ` a ÄD³/ §? —» ¥' \$ ÖJamÓ. æ ¼. ' ÑI DPÓ½~ wh ^F 9, öÄqr O

```

$ git clone https://10.0.1.254/Jam
Cloning into 'Jam'...
Username for 'https://10.0.1.254': john
Password for 'https://john@10.0.1.254':
remote: Counting objects: 2070, done.
remote: Compressing objects: 100% (1704/1704), done.
Receiving objects: 100% (2070/2070), 1.21 MiB | 0 bytes/s, done.
remote: Total 2070 (delta 1242), reused 0 (delta 0)
Resolving deltas: 100% (1242/1242), done.
Checking connectivity... done.
$ git branch -a
* master
  remotes/origin/HEAD -> origin/master
  remotes/origin/master
  remotes/origin/rel2.1
$ git log --oneline --decorate --graph --all
* 0a38c33 (origin/rel2.1) Create Jam 2.1 release branch.
| * d254865 (HEAD, origin/master, origin/HEAD, master) Upgrade to latest
metrowerks on Beos -- the Intel one.
| * bd2f54a Put in fix for jam's NT handle leak.
| * c0f29e7 Fix URL in a jam doc
| * cc644ac Radstone's Lynx port.
[...]

```

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 Git Cå? ö¿ ö\$EFö7! 5Ff„j / ö½Fhi pekl eæÖFža· j i j ö_W" | ÷? | SD
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 Èö origin/master D! 5 master] Ý? a ¥' %oW" µ" F %í È- ™Cå O

```

# ...
$ git log --oneline --decorate --graph --all
* cfd46ab (HEAD, master) Add documentation for new feature
* a730d77 Whitespace
* d254865 (origin/master, origin/HEAD) Upgrade to latest metrowerks on
Beos -- the Intel one.
* bd2f54a Put in fix for jam's NT handle leak.
[...]

```

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```

$ git fetch
remote: Counting objects: 5, done.
remote: Compressing objects: 100% (3/3), done.
remote: Total 3 (delta 2), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From https://10.0.1.254/Jam
 * d254865..6afeb15 master -> origin/master
$ git log --oneline --decorate --graph --all
* 6afeb15 (origin/master, origin/HEAD) Update copyright
| * cfd46ab (HEAD, master) Add documentation for new feature
| * a730d77 Whitespace
|/
* d254865 Upgrade to latest metrowerks on Beos -- the Intel one.
* bd2f54a Put in fix for jam's NT handle leak.
[...]

```

- Èsk‰\$µ" õsò-i ÙS•f> Çäj òQFhi **6afeb15** Cå-...i.' Perforce « i 7%í
D? s Git Di ø•· gg- i uW- CåFt- 5-i W- Q? a¥' • • Perforce E F ØpbÆ€W- i
-> CåO

```

$ git merge origin/master
Auto-merging README
Merge made by the 'recursive' strategy.
 README | 2 ++
 1 file changed, 1 insertion(+), 1 deletion(-)
$ git push
Counting objects: 9, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (9/9), done.
Writing objects: 100% (9/9), 917 bytes | 0 bytes/s, done.
Total 9 (delta 6), reused 0 (delta 0)
remote: Perforce: 100% (3/3) Loading commit tree into memory...
remote: Perforce: 100% (5/5) Finding child commits...
remote: Perforce: Running git fast-export...
remote: Perforce: 100% (3/3) Checking commits...
remote: Processing will continue even if connection is closed.
remote: Perforce: 100% (3/3) Copying changelists...
remote: Perforce: Submitting new Git commit objects to Perforce: 4
To https://10.0.1.254/Jam
 * 6afeb15..89cba2b master -> master

```

Git | t·f•^? a¥' s Perforce Di ø•W< **README** ½~ DæØF. ' p4v D7! Ù•°?

Figure 147. Git | à # Perforce WU x

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j @O9DW~ ni ò- Ù• ÈSI Á Git æÖ¼DÙ? Perforce Ák " # 1 B 2 Cå D^)] ÝFf „ · \$. gi t-fusi on æä ¼óf ^W- ØanonymousÓ] ÝSz " · ? òí j \$ Git^)] ÝÇy ~ Perforce ^)] Ý| ¿óó` | f 9„ . ' pÓ½~ Swh. ' T Perforce] Ýø?

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Git-Fusion F E

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Git-p4

Git-p4 i Git Š Perforce è ÷ D^ Nê³ ? . ôŽÝÙ\$ f D Git à á AFf „ f Ç, @œb HI Perforce E F ðD>ÿó¤d} ^' ; | Oø? Git-p4> ÇÃ Git Fusion WÄä t J ôÖFhi · L8f \$Å, » f E F ð| BDøÇ< F‰t \] : %oDn o?

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D| ^ F· 9, \$ <http://www.perforce.com/downloads/Perforce/20-User> Y_OÒ?

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F Ød | ...³ ØÙ Perforce 7! ý€?

t ^ . ' p4 ^ %oÙ« j 7ógit-p4 • « . ØFF , @E Ø! - | Bg CO

```
$ export P4PORT=10.0.1.254:1666
$ export P4USER=john
```

ÿ•

Ã\$ Git ¼Dœb n o WÄF UW- ^ %o—i qr O

```
$ git p4 clone //depot/www/live www-shallow
Importing from //depot/www/live into www-shallow
Initialized empty Git repository in /private/tmp/www-shallow/.git/
Doing initial import of //depot/www/live/ from revision #head into
refs/remotes/p4/master
```

ðÄj %í XW8\$ Git ¼) t ÓshallowÓ Dqr ú- k ¥™7! D Perforce { « k → Gitú â ≠ F Perforce
› 4{ E | f c l W- ' i W- 7! ? . ' Git " t Perforce « j 7òÄ—Æp ^ F h i t ^ 6æDDs ò
Ä9° Çp?

ôfè | F ¥' —k W- Ž• ° D Git à á O

```
$ cd myproject
$ git log --oneline --all --graph --decorate
* 70eaf78 (HEAD, p4/master, p4/HEAD, master) Initial import of
//depot/www/live/ from the state at revision #head
```

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```
$ git remote -v
```

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©Dé Õ- ' F h i . ' > Ç{ Git! - ý€F> ¥f ÅW€u. ' ?

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½D 6%?

```
$ git log --oneline --all --graph --decorate
* 018467c (HEAD, master) Change page title
* c0fb617 Update link
* 70eaf78 (p4/master, p4/HEAD) Initial import of //depot/www/live/ from
the state at revision #head
```

¥' Z[óf^! t™Cå> Z+j 5€u. ' T Perforce EFð? a¥' GåW<ab 6%i a‰^W"
µ" O

```
$ git p4 sync
git p4 sync
Performing incremental import into refs/remotes/p4/master git branch
Depot paths: //depot/www/live/
Import destination: refs/remotes/p4/master
Importing revision 12142 (100%)
$ git log --oneline --all --graph --decorate
* 75cd059 (p4/master, p4/HEAD) Update copyright
| * 018467c (HEAD, master) Change page title
| * c0fb617 Update link
|
* 70eaf78 Initial import of //depot/www/live/ from the state at revision
#head
```

• ÈS6' %o^Fmaster Š p4/master Z[] X^? Perforce D] Ÿ• , WQí / Å Git DFƒ„ Cå†
> Cå Åkœb 91? Git-p4í ; gxf DCå F· « ¬CD^W- ½L12SòÅ‰O

```
$ git p4 rebase
Performing incremental import into refs/remotes/p4/master git branch
Depot paths: //depot/www/live/
No changes to import!
Rebasing the current branch onto remotes/p4/master
First, rewinding head to replay your work on top of it...
Applying: Update link
Applying: Change page title
Èindex.html | 2 ++
È1 file changed, 1 insertion(+), 1 deletion(-)
```

s y X½9° † < ØäF git p4 rebase i git p4 sync³ È git rebase p4/master D½L12?
> ž ~ þÑW" F°ì i µ" \$e-] Ÿ| Fhòi W- ÔÈ?

Y\$¥' DæÖdt i K- DF¥' t j 5¥' Df YÈ øÀ Perforce? **git p4 submit ^ %oj**, + \$
p4/master Š **master** è ÷ Dí W- Git Cå %í W- ™D Perforce » þ7! ? YÙ· j ý¥' T¥4D' Š
ðF½~ A~• ÊSÃi ðÄO

```

# A Perforce Change Specification.
#
# Change:          The change number. 'new' on a new changelist.
# Date:            The date this specification was last modified.
# Client:          The client on which the changelist was created. Read-only.
# User:            The user who created the changelist.
# Status:          Either 'pending' or 'submitted'. Read-only.
# Type:            Either 'public' or 'restricted'. Default is 'public'.
# Description:    Comments about the changelist. Required.
# Jobs:            What opened jobs are to be closed by this changelist.
#                  You may delete jobs from this list. (New changelists
#                  only.)
# Files:           What opened files from the default changelist are to be
#                  added
#                  to this changelist. You may delete files from this list.
#                  (New changelists only.)

```

Change: new

Client: john_bens-mbp_8487

User: john

Status: new

Description:

È Update Link

Files:

È //depot/www/live/index.html # edit

```

##### git author ben@straub.cc does not match your p4 account.
##### Use option --preserve-user to modify authorship.
##### Variable git-p4.skiplUserNameCheck hides this message.
##### everything below this line is just the diff #####
--- //depot/www/live/index.html 2014-08-31 18:26:05.000000000 0000
+++ /Users/ben/john_bens-mbp_8487/john_bens-
mbp_8487/depot/www/live/index.html 2014-08-31 18:26:05.000000000 0000
@@ -60,7 +60,7 @@
È</td>
È<td valign=top>
ÈSource and documentation for
--<a href="http://www.perforce.com/jam/jam.html">
+<a href="jam.html">
ÈJam/MR</a>,
Èa software build tool.
È</td>

```

} ^" å git-p4 c ¥' D\$E- DC©F . DŠf YÙ p4 submi t | • T DA~+te/O? ☉CåJg~ E, @W-) y | git-p4j] i , +. ' f D Git Š Perforce EÓFhi k" oC<fj : @ñ•³ | Ùt? HpF pef g« k DCåi ° Åk Perforce' i 2i DE ☉K' LDFFj i j : @¥, Dg~ E• ÈSÄ i 6' LDÓ&Çi f ø?

Git-p4 CE- 5[Git DCå OÑ« k T Perforce g~ EDA~FòÄfk ¥' ®¶‰D—i z" > xXF! t öí t W- Cåø? öj . shellyX• ÈSÄöAO

```
$ git p4 submit
Perforce checkout for depot path //depot/www/live/ located at
/Users/ben/john_bens-mbp_8487/john_bens-mbp_8487/depot/www/live/
Synchronizing p4 checkout...
... - file(s) up-to-date.
Appling dbac45b Update link
//depot/www/live/index.html #4 - opened for edit
Change 12143 created with 1 open file(s).
Submitting change 12143.
Locking 1 files ...
edit //depot/www/live/index.html #5
Change 12143 submitted.
Appling 905ec6a Change page title
//depot/www/live/index.html #5 - opened for edit
Change 12144 created with 1 open file(s).
Submitting change 12144.
Locking 1 files ...
edit //depot/www/live/index.html #6
Change 12144 submitted.
All commits applied!
Performing incremental import into refs/remotes/p4/master git branch
Depot paths: //depot/www/live/
Import destination: refs/remotes/p4/master
Importing revision 12144 (100%)
Rebasign the current branch onto refs/remotes/p4/master
First, rewinding head to replay your work on top of it...
$ git log --oneline --all --graph --decorate
* 775a46f (HEAD, p4/master, p4/HEAD, master) Change page title
* 05f1ade Update link
* 75cd059 Update copyright
* 70eaf78 Initial import of //depot/www/live/ from the state at revision
#head
```

" e+p ¥' - i %^Wt git pushF—Åi - ☉...È¿ÓD¥³ UD» > ?

O9\$ò- \Ö½Í W- Git CåÍ j { ^6t W- Perforce g~ E? pe: @[· · %Šft W- ~2DC åF 9, \$YÙ git p4 submi t åÙWt åÿ2g x? OÄO9Di fk{ ^6t g~ EDCå D SHA-1 NI BÍ fg^F òi st git-p4 \$Í W- ^6DCå" • WÙTCå OÑ" åO

```
$ git log -1
commit 775a46f630d8b46535fc9983cf3ebe6b9aa53145
Author: John Doe <john@example.com>
Date:   Sun Aug 31 10:31:44 2014 -0800
```

```
Ê Change page title
Ê [git-p4: depot-paths = "//depot/www/live/": change = 12144]
```

¤, +CåWtî>Cå!j ðó` aÅa¥' , +W<? ði ¥' 9° j nTDW8oÚO

```
$ git log --oneline --all --graph --decorate
* 3be6fd8 (HEAD, master) Correct email address
* 1dcbf21 Merge remote-tracking branch 'p4/master'
|\
| * c4689fc (p4/master, p4/HEAD) Grammar fix
* | cbacd0a Table borders: yes please
* | b4959b6 Trademark
|/
* 775a46f Change page title
* 05f1ade Update link
* 75cd059 Update copyright
* 70eaf78 Initial import of //depot/www/live/ from the state at revision
#head
```

Git Š Perforce æÖ\$ 775a46f |] X^? Git ðþk! t CåFd| Wt Š Perforce è\ Dî>CåFj k
uW- Cå? ¥' [j , +Cåð" T Perforce žþ~2Dg~ ÈèÑ? a¥' ••pe, +ðÄCåj ðó
` aO

```
$ git p4 submit -n
Perforce checkout for depot path //depot/www/live/ located at
/Users/ben/john_bens-mbp_8487/john_bens-mbp_8487/depot/www/live/
Would synchronize p4 checkout in /Users/ben/john_bens-mbp_8487/john_bens-
mbp_8487/depot/www/live/
Would apply
Ê b4959b6 Trademark
Ê cbacd0a Table borders: yes please
Ê 3be6fd8 Correct email address
```

-nçâi --dry-run DŠLF[j ÜÝpeCå ^ %ož DÝÙj ðó` a? ð! H½F· • ÊSÃi ¥' j
%í ÷ - Perforce g~ EFy ~ ÈÇ\$ Perforce EFØ7D÷t * i> Cå? ž ÁÊSÃi ¥' : @DFa¥
' ••• j pb‰O

```
$ git p4 submit
[É]
$ git log --oneline --all --graph --decorate
* dadbd89 (HEAD, p4/master, p4/HEAD, master) Correct email address
* 1b79a80 Table borders: yes please
* 0097235 Trademark
* c4689fc Grammar fix
* 775a46f Change page title
* 05f1ade Update link
* 75cd059 Update copyright
* 70eaf78 Initial import of //depot/www/live/ from the state at revision
#head
```

¥' Dæög f K - ^ F — Ā \$ Cå å ØØg x \ ö... É Ñí i ðÄø? ò 9à Èf 9,, \$ Git ò þ É° 5%
í þµ" þ• ÓŠí >] Ÿ&Ç' ! ~ f Dæöj g ÓŠ Perforce Ç} ~? þef 9,, g x· Ff — 9,, [·
£ ø T Perforce EF ð?

Lö

þef D Perforce. æk e -] ŸF f > Çj ÇDÝ úgit-p4 9,, „ W8» ¼ Git D1 2SÆ€ž 8o Ç? —
» f D Perforce à á x " D! ^ ÄòÄO

```
//depot
È Ÿž ž project
È      • ž ž main
È      Ÿž ž dev
```

> ¥—» f k W- **dev**] ŸF k W- i Ù=š Ā< ÜòÄO

```
//depot/project/main/... //depot/project/dev/...
```

Git-p4 9,, É Ÿ5G6T ò 8o Ú> %o g - DnoO

```

$ git p4 clone --detect-branches //depot/project@all
Importing from //depot/project@all into project
Initialized empty Git repository in /private/tmp/project/.git/
Importing revision 20 (50%)
   Importing new branch project/dev

   Resuming with change 20
Importing revision 22 (100%)
Updated branches: main dev
$ cd project; git log --oneline --all --graph --decorate
* eae77ae (HEAD, p4/master, p4/HEAD, master) main
| * 10d55fb (p4/project/dev) dev
| * a43cfac Populate //depot/project/main/... //depot/project/dev/...
|/
* 2b83451 Project init

```

O9\$àá¢· ¼DÒ@allÓ–Ñz úžj ÝÀ git-p4 Çgg⁻ i qrž - I %¥™Dg⁻ EF⁻ ŒÖž “ ¢· 4³ ¶Dfk g⁻ E? òkQ» ¼§ Git Dqr < EFhi pefμ” \$W- ¶kl „ æÖD. æFža· j Õ_Wf | ÷?

--detect-branches çâÝÀ git-p4 . ' Perforce D] Ý=>SwiT Git D- ' ¼? peò" whÇ\$ Perforce EF Ó¼Ó. ' Perforce DW8ô‡kŽD12øFf 9, ÝÀ git-p4] Ýwhi ` aFd | f j ÒTOÄD" eO

```

$ git init project
Initialized empty Git repository in /tmp/project/.git/
$ cd project
$ git config git-p4.branchList main:dev
$ git clone --detect-branches //depot/project@all .

```

EÓgi t-p4. branchList PÓø. t mai n: dev ÝÀ git-p4 ž - ÒmainÓ Š ÒdevÓ† i] YFUv - i UW- DI] Ý?

pe¥' ¥\$ÝÙ git checkout -b dev p4/project/dev > ¥‰W" CåF\$ÝÙ git p4 submit ; git-p4 j þÑ5øùg⁻ D] Ý? Ç>Di Fgit-p4 Ç° i ' shallowqr Še-] ÝúpefkW- l z. æ¤ ¥: @O! μ” \$ÇÇW-] ÝÑF 9° ÇÒÇ±yÍ W- f: @CåD] YYÙWt git p4 clone?

t ^%í ŠÖi] YFF ÇÒÇ. ' W- Perforce « i 7? Git-p4 - ° OÈJ CåZk] YF > ¥. Wt - ° %W- K- Dg⁻ E? pef \$ Git ¼î > ! -] Ý, +Cå™Dg⁻ EFfkò" j { åä t W{ ½~ » f úG§p-] Ý; ŠD^‡? \$Öi ¼j . /?

Git Ü Perforce ¢ E

Git-p4 [Š Perforce EF Óμ” | . ' Git μ” i ft 9° F > ¥. * €#, ÒQ? d&F, @â‡ Dm@W Qi Perforce ï ï èF&f⁻ i \$! 5. ' Git? \$&3 Git Cå | @/ ãûv OpefkW- 6%. ' D éÖàáFÇ@\$CåT Perforce EF Óâ€uœb Cå ?

pe: @t̄ oý€É° 5ī . ' Perforce Š Git" t̄ « ī 7F9, →EEF ðý€3ÚÛ Git FusionF Git Fusion. Git" t̄ Perforce EF ðD' ©7! ý€« ī 7?

Git Ü TFS

Git \$ Windows , ḡ K ḡ ¼gðī ÜÊSF pef g\$ Windows Ñ' Lno> ¥g\$. ' Microsoft D Team Foundation Server ÓTFSØFòj i - 5ōj ? TFS i W- Ómµ". æG6ŠÈÖPÝ{ Scrum Š 6ī Õý€1WPnōMuP7! ÓÓD: " : ~ ? ðJ k WQST OTFS i EF ðF. Y{ o\ Git Š. ' É » 1 DVCS Sý€† noFò{ 6' üt TFVCÓ Team Foundation Version Control? Git Y{ TFSÓ É 2013 7! ÉøD\]™• ° Ff, \$žèâfkµ¶[7! ÓÓ\] üt ÓTFSÓFjÉÑ6' +\] | ÷ī \$Š TFVCµ" ?

pe ḡ Yf Dwx \$. ' TFVC h̄i f~ | 9. ' Git" t̄ 7! ÓÓ« ī 7F ðJ t f t j ^W-. æ?

É\pá² -

...ÉÑF ðJ k! - µ¶ Ogit-tf Š git-tfs?

Git-tfs Ó9, \$ <https://github.com/git-tfs/git-tfs> ÜTøi W- .NET. æF. - °. YÙ\$ Windows Ñón - ½e ðf| Ø? t̄ ï " Git à á F. . ' ^ libgit2 D .NET \$» FW- 9oDÜNá D Git ...YFd] ä+ ¥ - ° 3 ð? Libgit2 > Çi W- ðÖD Git ...YF t̄ ^%I ó' git-tfs ...ÉÑj * ' Git ^ %oÙ« ī 7S, Ùì " ï " Fsā\$ï " Git à á | > Ákœb • ° ýÓ? s t. . ' Visual Studio ÓœEy EF ðÔÜï " Ff „ y TFVC DÝ{ * €fŒ? ð> Ç9à Èf, @³ ¶ž" ÓœEF h̄i 9à Èf, @ÚÛ Visual Studio D W- ¥U7! ð2010 è | Dœb 7! F ÓÖ 2012 è | D Express 7! øF J K Visual Studio SDK?

%

Git-tf Z [> Ç, ḡ F. Çj d ðTœb~™? . í Çd ' Tê—DÝ{ ?

Git-tf ð E \$ <https://archive.codeplex.com/?p=gittf> øi W- Java. æF sā. 9, YÙ\$œbW- k Java ÝÙ| | BD[•] Ñ? . o\ JGitóW- Git D JVM ...YøSS Git à á å ÿF ð9à Èn...Ñ. Ák Git • ° ÑDý Ø? d&F / y § git-tfs. y TFVC DÝ{ i k ð DÑNHpF. ÇÝ{] Y?

f, í - µ¶ ï k³ QBÞQF í - µ¶ ï k. P' DoÇ? ¥' \$! - ¼[j) * . ' ! - D x! ' W?

f, @k W- ×§ TFVC Dà á S, Ù| ¶D• %o? Y...¼. ' > Ák Git J Subversion à áž Äe Ff, f 9°, @%í W- f ÉmDà á? Codeplex (<https://archive.codeplex.com/>) J Visual Studio Online (<http://www.visualstudio.com>) T i * €5Døù?

À' ï git-tf

B . œb Git. æWÄFF @%DUW~ ni qr? . ' git-tf qr • ÉSÃòÄO

```
$ git tf clone https://tfs.codeplex.com:443/tfs/TFS13$/myproject/Main  
project_git
```

UW- ; ð i W- TFVC E D URLF UV- ; ð » ¼§ \$/proj ect/branch DÚ2FU- - ; ð i [@%í D ! 5 Git à á Ç· ó¥| W. 9, , 5ø? Git-tf OW| ÷- ° µ" \$W-] YÑúpef: @Gk W- ÇOD

TFVC] ÝFF, @SZ -] Ýqr W° ™D?

Øj %í W- ØÖ• ° D Git à á O

```
$ cd project_git
$ git log --all --oneline --decorate
512e75a (HEAD, tag: TFS_C35190, origin_tfs/tfs, master) Checkin message
```

Øô‰Í qr F9àÈ- <i ^¥™Dg~ E? TFVC> 4E | ft í W- « i 7CDW° Ž\æÖâá Dx
yFf, git-tf³ | Ùti ØÙ¥™D7! FØÄ~ ½W" ?

pe| 9eØW" | ÷F. ' --deep Ø. qr Ø- . ææØ9° ~ kqr ?

```
$ git tf clone https://tfs.codeplex.com:443/tfs/TFS13 $/myproject/Main \
  project_git --deep
Username: domain\user
Password:
Connecting to TFS...
Cloning $/myproject into /tmp/project_git: 100%, done.
Cloned 4 changesets. Cloned last changeset 35190 as d44b17a
$ cd project_git
$ git log --all --oneline --decorate
d44b17a (HEAD, tag: TFS_C35190, origin_tfs/tfs, master) Goodbye
126aa7b (tag: TFS_C35189)
8f77431 (tag: TFS_C35178) FIRST
0745a25 (tag: TFS_C35177) Created team project folder $/tfvctest via the \
  Team Project Creation Wizard
```

O9) y» ¼ TFS_C35189 Dçëúði W- FEFäj Git CåŠ TFVC g~ EGÄD• ° ? ði W8³ °
D° ©12Fst o\W- } ~D log ^ %o—9, • Tf DCåi pbŠ TFVC ¼Z" \$½FGÄÈSD? . .
> Çi ®¶Dó> ¥...ÉÑ9, . ' git config git-tf.tag false SGf. ' Ø-git-tfj \$
. git/git-tf ½~ ¼z" žgDCåŠg~ EDwh?

À' Í git-tfs

Git-tfs qr Ùt 5t ÇO? ° O

```

PS> git tfs clone --with-branches \
    https://username.visualstudio.com/DefaultCollection \
    $/project/Trunk project.git
Initialized empty Git repository in C:/Users/ben/project/.git/
C15 = b75da1aba1ffb359d00e85c52acb261e4586b0c9
C16 = c403405f4989d73a2c3c119e79021cb2104ce44a
Tfs branches found:
- $/tfvc-test/featureA
The name of the local branch will be : featureA
C17 = d202b53f67bde32171d5078968c644e562f1c439
C18 = 44cd729d8df868a8be20438fdeeffb961958b674

```

O9 --with-branches Ø. ? Git-tfs ° pwh TFVC] ÝT Git] ÝFØ- çâÝÀ· tÍW- TFVC] Ý
 í i W- ! 5D Git] Ý? ^ <€2ç [\$ TFS ¼TMÍ \] ÝJÍ > \] ÝDàá. ' ø- çâFhi pe.
 ' DEFØD7! > TFS 2010 ~ þÑÑ\$ž - 7! àFØ] ÝÓ- i ½~ î Ff, git-tfs ÅW[· ' Š•o½
 ~ î '], ?

a ¥' • W<¥, D Git à á O

```

PS> git log --oneline --graph --decorate --all
* 44cd729 (tfs/featureA, featureA) Goodbye
* d202b53 Branched from $/tfvc-test/Trunk
* c403405 (HEAD, tfs/default, master) Hello
* b75da1a New project
PS> git log -1
commit c403405f4989d73a2c3c119e79021cb2104ce44a
Author: Ben Straub <ben@straub.cc>
Date:   Fri Aug 1 03:41:59 2014 +0000

```

É Hello

É git-tfs-id:
[\[https://username.visualstudio.com/DefaultCollection\\$/myproject/Trunk\]](https://username.visualstudio.com/DefaultCollection$/myproject/Trunk); C16

k! - ! 5] ÝF master Š featureAF] i n° Éqr óTFVC ¼D TrunkØŠI] ÝóTFVC ¼D
 featureAØDÜ¹ ÔÖ? í 9,, • T tfs ØremoteØí k Wy- ' Ødefaul t Š featureAF n° TFVC
] Ý? Git-tfs whs tfs/default qr D] ÝF 6Dj k· ' ÉmD) y?

uW~, @O9Dnoi \$Cå MR ¼D git-tfs-id: Ü? Git-tfs. ' ø" çâ&Çi çëSGÃ TFVC g
 ~ EŠ Git Cå? kW- &\$DI " i Git Cå \$€uT TFVC å | j k ÇOD SHA-1 NI B?

Git-tf[s] ² j dÚ

ÅPf. ' p- μ¶Fī , @¹ EÓĒ - Git PÓø. SX YW" I " ?

! \$ git config set --local core.ignorecase=true
\$ git config set --local core.autocrlf=false

dF³ < S@%oDno-i @\$. æ½%oW" μ" ? TFVC Š TFS K Ě - • ° 9° j " • f Dμ" i ŒDA¾ - O

1. TFVC ÅW° ©å"] ŸFòj " • WQA¾ù? òj « Ú, @_ \ä COD12. ' TFVC Š Git° ©D] Ÿ?
2. @9wT TFVC L 8' i s EF ØÑØGXÓ½~ > Ä» . ' FòÄ 6%—ÅW' š ^? #d. Cj a Cf \$! 5àá½' š. ' Fhi ø€uf D» f T TFVC EF Ø|j XYI " ?
3. TFS K W- ØÄf ØGK D< ØEF TFS Cí -6+‰! ®¶\$Gk { L 8âf • ôf? ò. ' ^ TFVC D ØshelveØ• ° F ¥' Cj \$òJ ØI ? 9, o\ git-tf ~ Ÿ5, Øò- • ° F> ¥ git-tfs CD^Äf { ¾D checki ntool ^ %?

X§} P- D>S F ¥' òJ) * Di W8æç D1 2F ÅX> XY^t\] I " ?

² j d Ú† gi t-tf

—» f ôf ^ W" μ" F \$ master ¼‰^ Èt Git Cå F d | t j [f DÔù&3TEFØ? òi ¥' D Git àáO

```
$ git log --oneline --graph --decorate --all
* 4178a82 (HEAD, master) update code
* 9df2ae3 update readme
* d44b17a (tag: TFS_C35190, origin_tfs/tfs) Goodbye
* 126aa7b (tag: TFS_C35189)
* 8f77431 (tag: TFS_C35178) FIRST
* 0745a25 (tag: TFS_C35177) Created team project folder $/tfvctest via the
\
È Team Project Creation Wizard
```

¥' : @uT \$ 4178a82 Cå D½F> [€uT TFVC EF Ø? ¹ ¬m@DOa ¥' • • Ès Ñt - ³ | ¥
' Dx' i a ØÙ\ f YO

```

$ git tf fetch
Username: domain\user
Password:
Connecting to TFS...
Fetching $/myproject at latest changeset: 100%, done.
Downloaded changeset 35320 as commit 8ef06a8. Updated FETCH_HEAD.
$ git log --oneline --graph --decorate --all
* 8ef06a8 (tag: TFS_C35320, origin_tfs/tfs) just some text
| * 4178a82 (HEAD, master) update code
| * 9df2ae3 update readme
|/
* d44b17a (tag: TFS_C35190) Goodbye
* 126aa7b (tag: TFS_C35189)
* 8f77431 (tag: TFS_C35178) FIRST
* 0745a25 (tag: TFS_C35177) Created team project folder $/tfvctest via the
\
Ê Team Project Creation Wizard

```

- ES 6%í %o^W" f ÝFY\$¥' kW-] XDæÖ? ò—i Git D³ » Fhi ¥' Y\$K! 8Æ€D1 20

1. ÅW) Git' i WÄÉdDófw- î > Cåóµ€Fží i **git pull** %DøFgit-tf 9,, o\W- } ~ D **git tf pull** S¢fôf? d&F¥' @O9Di TFVCé> ÇòÄ: Fpef€uî > Cåžaf DæÖ\$! þ• ESÍ ÇWÄFòj HfST? t Fpef | §[fkf Df ÝCåtWt g~ EFò 9° i ¥} ~Døù?
2. g x. ¥' DCåæÖgƒ...KFò9åÈ¥' k - ø. 9,, [¥' Dí W- Git Cå ^ | t W- TFVC g ~ EF? stò812t 6ø. 1<^9° Ff, ¥' €2fòÄ%oÚgit-tf 9,, I } ~5o\ **git tf pull** --rebase ¢f Åfæç?

òi f Døù? \$! H½F¥' j ÔÙg xO

```

$ git rebase FETCH_HEAD
First, rewi nding head to repl ay your work on top of it...
Appl yi ng: update readme
Appl yi ng: update code
$ git log --oneline --graph --decorate --all
* 5a0e25e (HEAD, master) update code
* 6eb3eb5 update readme
* 8ef06a8 (tag: TFS_C35320, origin_tfs/tfs) just some text
* d44b17a (tag: TFS_C35190) Goodbye
* 126aa7b (tag: TFS_C35189)
* 8f77431 (tag: TFS_C35178) FIRST
* 0745a25 (tag: TFS_C35177) Created team project folder $/tfvctest via the
\
Ê Team Project Creation Wizard

```

Y\$¥' †j 5ófW- GkS€uT TFVC EF ÓÑ^? Git-tfcf W- [ÉÑt » f ój --shal l owo
. F³ | B' ø, SfkD» f ófDW- ~2Dg~ E, BtÍ W- Git Cåó --deepøóf DW- ™Dg
~ E? \$! H¼F ¥' [j %í W- g~ EO

```
$ git tf checkin -m 'Updating readme and code'  
Username: domain\user  
Password:  
Connecting to TFS...  
Checking in to $/myproject: 100%, done.  
Checked commit 5a0e25e in as changeset 35348  
$ git log --oneline --graph --decorate --all  
* 5a0e25e (HEAD, tag: TFS_C35348, origin_tfs/tfs, master) update code  
* 6eb3eb5 update readme  
* 8ef06a8 (tag: TFS_C35320) just some text  
* d44b17a (tag: TFS_C35190) Goodbye  
* 126aa7b (tag: TFS_C35189)  
* 8f77431 (tag: TFS_C35178) FIRST  
* 0745a25 (tag: TFS_C35177) Created team project folder $/tfvctest via the  
\  
É Team Project Creation Wizard
```

ž k W- ™çë TFS_C35348F° Ñ TFVC Z [" # ^W- / ø§ 5a0e25e Cå D½F? @mQO9Di F Ç
i í W- Git CåÍ , @\$ TFVC ¼" \$W- / ODE! úHp 6eb3eb5 Cå F \$EF ÓÑ» Ç" \$?

ò—i å@Dµ" i Õ? k W" f , @..._D 609n. O

¥ Ák] Ý? Git-tf OW| ÷ ° sW- TFVC] Ý%í W- Git à á?

¥ : " | . ' TFVC J GitF &Çi ! KO| . ' ? OW- TFVC à á DÇO git-tfq r j k ÇOD SHA-1 N
I BF òj « ÚÅQDè \$I " ?

¥ pef Dwx Dµ" i ÕÓÖ\$ Git ¼: " > » NŠ TFVC OÈF - ° . ' ¼DW- Git à á - ³ T
TFVC?

² j dÚ† git-tfs

a ¥' . ' git-tfs SDW[OÄDoÄ? òi ¥' \$ Git à á ¼ master] ÝÑóf DÈ - ™Cå O

```
PS> git log --oneline --graph --all --decorate  
* c3bd3ae (HEAD, master) update code  
* d85e5a2 update readme  
| * 44cd729 (tfss/featureA, featureA) Goodbye  
| * d202b53 Branched from $/tfvc-test/Trunk  
|/  
* c403405 (tfss/default) Hello  
* b75da1a New project
```

a ¥' • W<\$¥' μ" | k Åk %ôfW" · Dμ" O

```
PS> git tfs fetch
C19 = aea74a0313de0a391940c999e51c5c15c381d91d
PS> git log --all --oneline --graph --decorate
* aea74a0 (tfs/default) update documentation
| * c3bd3ae (HEAD, master) update code
| * d85e5a2 update readme
|
| * 44cd729 (tfs/featureA, featureA) Goodbye
| * d202b53 Branched from $/tfvc-test/Trunk
|
* c403405 Hello
* b75da1a New project
```

i DF ž -Ñ¥' DOn" • ^W- ™D TFVC g ~ EF # ©t ™D aea74a0 Cå F & **tfs/default** é Ō] ŸZ [{ 9} ^?

Š git-tf / OF ¥' k! 8×Øø. S• Zò-] XæÖI " O

1. o\g x Sz { æÖi K - D?
2. o\i > Sz 1 f Ÿ?

\$! H¼F ¥' [@%W- Ø_ÓGk Fí —i —í W- Git Cåj gfw- TFVC g ~ EF f „ ¥' : @g x ?

```
PS> git rebase tfs/default
First, rewording head to replay your work on top of it...
Applying: update readme
Applying: update code
PS> git log --all --oneline --graph --decorate
* 10a75ac (HEAD, master) update code
* 5cec4ab update readme
* aea74a0 (tfs/default) update documentation
| * 44cd729 (tfs/featureA, featureA) Goodbye
| * d202b53 Branched from $/tfvc-test/Trunk
|
* c403405 Hello
* b75da1a New project
```

Y\$Z [t j 5o\Gk ¥' DnOT TFVC EF ØSôfE ã? ¥' ØJ [j . ' rcheckin ^ %o[HEAD T UW- **tfs** é Ō] Ÿ÷Dí W- Git Cå ^ | t W- TFVC g ~ Eócheckin ^ %o- j %í W- g ~ EF k " » ¼§ %o Š Git Cå ø?

```

PS> git tfs rcheckin
Working with tfs remote: default
Fetching changes from TFS to minimize possibility of late conflict...
Starting checkin of 5cec4ab4 'update readme'
Add README.md
C20 = 71a5ddce274c19f8fdc322b4f165d93d89121017
Done with 5cec4ab4b213c354341f66c80cd650ab98dcf1ed, rebasing tail onto new
TFS-commits...
Rebase done successfully.
Starting checkin of b1bf0f99 'update code'
Edit
.git\tfs\default\workspace\ConsoleApplication1\ConsoleApplication1\Program
.cs
C21 = ff04e7c35dfbe6a8f94e782bf5e0031cee8d103b
Done with b1bf0f9977b2d48bad611ed4a03d3738df05ea5d, rebasing tail onto new
TFS-commits...
Rebase done successfully.
No more to rcheckin.
PS> git log --all --oneline --graph --decorate
* ff04e7c (HEAD, tfs/default, master) update code
* 71a5ddc update readme
* aea74a0 update documentation
| * 44cd729 (tfs/featureA, featureA) Goodbye
| * d202b53 Branched from $/tfvc-test/Trunk
|/
* c403405 Hello
* b75da1a New project

```

O9\$Í t f• Gk T TFVC E F Ó | Fgit-tfs i pb[OŠDμ" g x T E F Ó Ñ? ò i s t· [git-tfs-
 id 2- • k T Cå MRD: \F Ó[j f g SHA-1 NI B? ò ++ i k 9E | DF Ák` a n o 9, Üv ^ F
 h i f - C9wT Ó^` a F ° i i ð f: @Š 6%&3 Git Cå | ?

TFS K 8e Š. D7! ý €• , Öî D• ° F > p μ". æ Þ• » Mu K P Ä f Gk > > ? g g o \ ^ % Ü μ
 ¶. ' ð " • ° S μ" i I Ü m D F h i > Y Di git-tfs L 8 f æ ç 5 Y Ü w- Ü Ü 6 D G k μ ¶ O

```

PS> git tfs checkin tool
PS> git tfs ct

```

• • È Sk Q Ä Ò Ä O

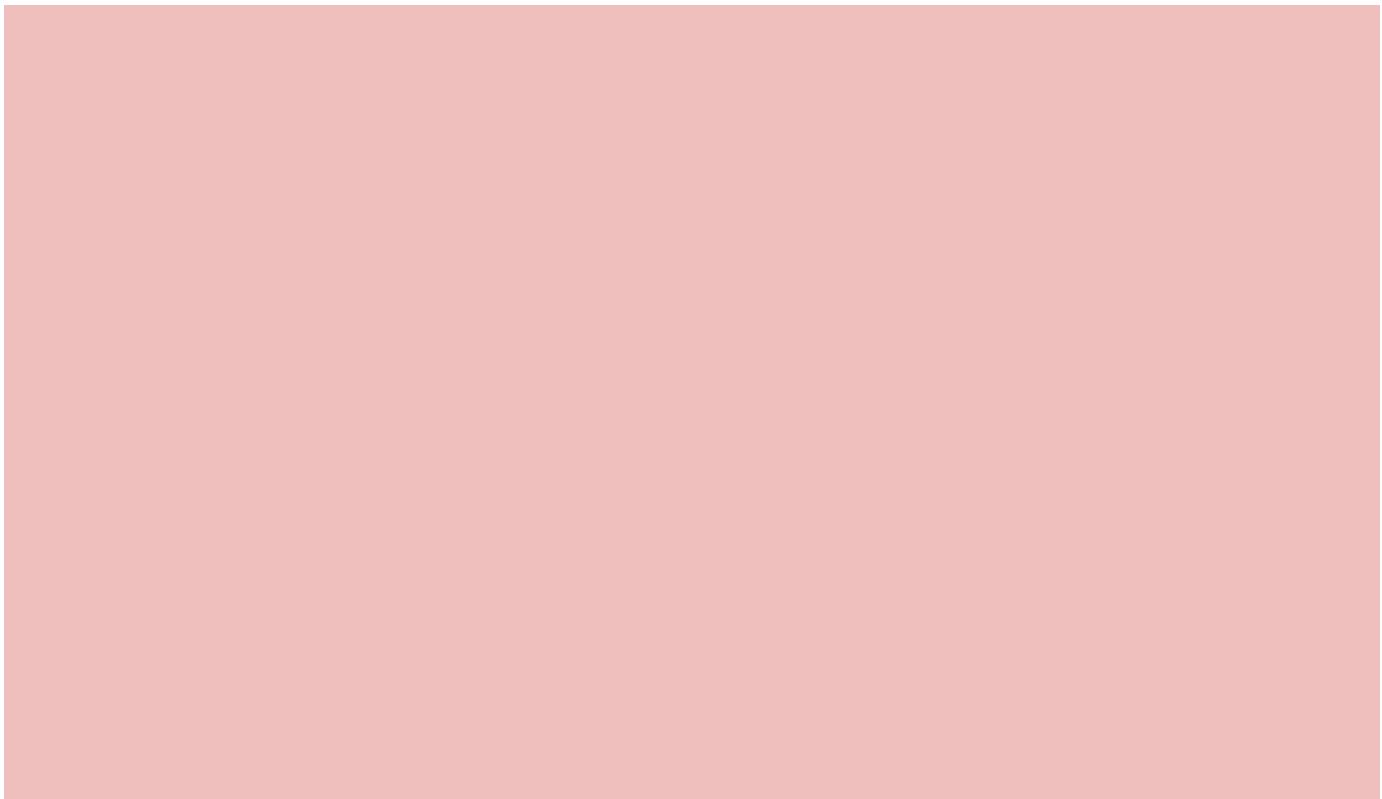


Figure 148. git-tfs 1 ř př 3

y TFS' i S-ò• ÈSI ÆÒF s t· —i s Visual Studio ¼ÙDOW- ™' ?

Git-tfs OÄL 8f s f D Git à á ÒÓ TFVC] Ÿ? pOò - HI Fa ¥' %í W- O

```
PS> git tfs branch $/tfvc-test/featureBee
The name of the local branch will be : featureBee
C26 = 1d54865c397608c004a2cadce7296f5edc22a7e5
PS> git log --oneline --graph --decorate --all
* 1d54865 (tfs/featureBee) Creation branch $/myproject/featureBee
* ff04e7c (HEAD, tfs/default, master) update code
* 71a5ddc update readme
*aea74a0 update documentation
| * 44cd729 (tfs/featureA, featureA) Goodbye
| * d202b53 Branched from $/tfvc-test/Trunk
|/
* c403405 Hello
* b75da1a New project
```

\$ TFVC ¼%í W-] Ÿ9àÈ" • W- .] Ÿ" \$Dg ~ EFòj wh t W- Git Cå? í @O9Di git-tfs
èé ^ tfs/featureBee é Ö] ÝFhi HEAD¹, • Nmaster? pef: @\$™ófD] ÝÑµ" Fž f
í 8" Co\sžt Cå%í W- å"] ŸD12. f™DCå x§ 1d54865 Cå?

Git Ü TFS Ç E

Git-tf Š Git-tfs İ i Š TFVC EF Øá ý DI 5Dμ¶? . ' L8f \$! 5. ' Git D° " F XYŠ ¼% TFVC EF ØÄ? åi F. f %o t W- , K Dó t ~ æç F & C' ² ØÖ- wx 89T Git? pef \$ Windows N μ" öžl k 9° f Dwx g \$. ' TFSØFF 9° j : @. ' git-tfsF st· D• ° ~ öÖF hi pef \$ 6xØμ" Ff - ° . ' 5k ý ÖD git-tf? Ä! e ¼t e ¼t μ¶ WÄF f - ø. ' ¼DW- 7! • , " t å @DF &. ' uW- %o t t @DÑÑÇýi Gitj i TFVCİ 9, %o t : " ¼v F h Çi ! Kİ ' ?

= Ä ® Git

pef Y\$ kW- g \$. ' 6 VCS Dnoá Fhi f Z[Z » , 1 . ' GitF ® ¶ o \ l 812[f D. æ 89- Git? öW\] j) * W" o' • , D« k ð Fd | É©pb, f Ém» ÖD« k ð? f [j hi pb s È- t z C, " D SCM • , ¼« k ð? F Çg st· ' i t e t: @^ | D' i g \$. ' D• , Fí st OP±y. ' Dc MCμ¶ l ~ i ?

Subversion

pef A` \â ÜG§ git svn De? F 9, æç 5. ' ž" • %o S git svn cl oneW- à á F > Ç. ' Subversion EF ØF €u TW- ™D Git EF ØFd | —9, , 1 . ' ^? pef: @æÖF 9, s Subversion EF ØÑQ9° ½5I P‡? Sôfò~ nöð9° j ö_W" | ÷ø?

d&F « k > Çô‡ úst ö_ t , | ÷ ^ Ff 9° ½Z' 61 Wôf « k İ " ? « k QöDUW- I " — i " KMR? \$ Subversion ¼F í W- %Cå | İ , @\$• , ¼k W- ' i F· j { âä\$ Cå MRA? \$ èâe? DHI ¼É- 51 # ©^ schaconF > p blame y XŠ git svn log? pe: @[ÑÜD Subversion' i wh TW- ~ 5D Git" K‡? ¼F f , @W- Subversion' i T Git' i Dwh? %í W- users. txt D½~ ÖmÄ < Üò 8š 2Dwh O

```
schacon = Scott Chacon <schacon@geemail.com>
sel se = Someo Nel se <sel se@geemail.com>
```

t ^ OÒ SVN. ' D" K) y W° F 9, ÝÙò - O

```
$ svn log --xml --quiet | grep author | sort -u | \
È perl -pe 's/.*/(.*)<.*?/$1 = /'
```

öj [r äy X t XML š 2Fd | z 1" KMRÜP] } mAP] } XML çâ? I # dò- j \$ ÜÜ^ grep sort Š perl DöðÑÝÜ? d | F [y X m» NT f D users. txt ½~ ¼F ðÄ—9, \$ í W- â ä | Ü• k y - D Git' i ‡???

! pef \$ Windows NÝÜ. Fž a Tò J — j n T I " ? ê—CD^W" Ç™Dí ; B© HO <https://docs.microsoft.com/en-us/azure/devops/repos/git/perform-migration-from-svn-to-git>.

f 9, [ä ½~ CDc git svn S\$ E. ~ • Ý- 5wh" K‡? ? i 9, o \ x ² --no-metadata c clone Š init ^ %o F ÝÀ git svn Ç@ÖÖ Subversion o ej « k D^‡? ? \$ « k \ Ö ¼F Gitj \$ í -

Cá – ND^‡ ? ¼ÓFW- git-svn-id?

| xf: @[Git à á ¼DCå 4ÃÀ > SVN à á ¼| F , @z 1 ^‡?? pef Ç: \$Cå
âã ¼OÈ· FG...³ „ 5Ó --no-metadata Ø. ?

Øj . f D i mport ^ %o• ÈSÄòAO

```
$ git svn clone http://my-project.googlecode.com/svn/ \
È      --authors-file=users.txt --no-metadata --prefix "" -s my_project
$ cd my_project
```

Ý \$\$ my_project æã ¼- øk ^W- ~ 5D Subversion « k ? > ÇÃi < ÜòÄDCå O

```
commit 37efa680e8473b615de980fa935944215428a35a
Author: schacon <schacon@4c93b258-373f-11de-be05-5f7a86268029>
Date:   Sun May 3 00:12:22 2009 +0000
```

È fixed install - go to trunk

```
È   git-svn-id: https://my-project.googlecode.com/svn/trunk@94 4c93b258-
373f-11de-
È   be05-5f7a86268029
```

\& ' • ÈSÄi òAO

```
commit 03a8785f44c8ea5cdb0e8834b7c8e6c469be2ff2
Author: Scott Chacon <schacon@geemail.com>
Date:   Sun May 3 00:12:22 2009 +0000
```

È fixed install - go to trunk

Çgi Author yf~ 5• ^F git-svn-idí Ç\$^?

è | Ff - ø%W" « k | D%€µ" ? UWÈFf - ø%€ git svn EÓD(ÜD- ' ? ' 1 9ÝçëFò
Ä. ' —i çë&Çi (ÜDéÖ- ' Fd | fj 9ÝOŠD] ÝòÄ. ' —i ! 5D^?

t ^[çëgti PD Git çëFÝÙO

```
$ for t in $(git for-each-ref --format='%(refname:short)'
refs/remotes/tags); do git tag ${t/tags\//} $t && git branch -D -r $t;
done
```

Øj . >S\$ refs/remotes/tags/ J DéÖ] Ý- ' gfž gDóæCøçë?

3 < SF [refs/remotes < OŠD- ' 9Ýt! 5] YO

```
$ for b in $(git for-each-ref --format='%(refname: short)' refs/remotes);  
do git branch $b refs/remotes/$b && git branch -D -r $b; done
```

f 9° j • TW" è LD] YFò"] YD| <i @xxx(¼ xxx i W- ‡ y)F &\$ Subversion ¼f - j •
TW-] Y?ò...É Ni Subversion W- ô%Ópeg-revisionsÓD• ° F Git\$ŒWÑÁk Šèy - D• ° ?
sāF git svn - i } ~ 5[SVN peg-revision 7! i • • T] Y) ü¼FòOf \$ SVN ¼» f] Y) üS
» ÉW-] YDÓpeg-revisionÓi WÄD? pef y § peg-revisions ôŽ Ç\$] Fo\ < ÜD^ %o9,, æí
59} 6' O

```
$ for p in $(git for-each-ref --format='%(refname: short)' | grep @); do  
git branch -D $p; done
```

Y\$fk Dm] YI i ž gD Git] YF> ¥fk Dmçëi i ž gD Git çë?

j k ¥| WQKL, @%€? git svnj %í W-) t trunk Dè L] YF· y - § Subversion D³ |]
YFd & trunk - ' B master • NOW- ÉÓ? ' §§ Git ¼ master ¥t €' Fsä¥' 9,, 9} è LD
] YO

```
$ git branch -d trunk
```

¥| W~ @%Dnoi F [f D™ Git EF ð• • t é Óà á > €uTÑÜ? < Üi W- [f DEF ð• • t é
Óà á DHI O

```
$ git remote add origin git@my-git-server: myrepository.git
```

st: @Nx fk] YŠçëFF Y\$9,, YÙO

```
$ git push origin --all  
$ git push origin --tags
```

o\,, ÑuvP. Ü5«kī " Ff Dfk] YŠçëi - C\$™ Git EF ñ?

Mercurial

s t Mercurial Š Git \$° ©7! ; k È* €/ ¼D, z Fí s t Git / k ~ • ² + Dä t - F [W- à á s
Mercurial ^ | T Git i / ø...³ DF. ' W- ô" Òhg-fast-exportÓDµ¶F, @s ò J x y W° O

```
$ git clone https://github.com/frej/fast-export.git
```

^ | DUWÈ—i @¹ ÒT: @^ | D Mercurial à á Dô Öqr O

```
$ hg clone <remote repo URL> /tmp/hg-repo
```

<WÈ—i %í W- " Kwh½~ ? Mercurial y< k T g~ È" KyfDA~> Git ~ (~W" Ff, òi W- %€D5öj ? - , @' T bash , 7<DWÙ^ %oO

```
$ cd /tmp/hg-repo  
$ hg log | grep user: | sort | uniq | sed 's/user: */' > ./authors
```

òj õ_È\ bF¶¹ @• . æCåæÖk eöF¥, /tmp/authors ½~ • ÈSj ÅòÄO

```
bob  
bob@local host  
bob <bob@company. com>  
bob j ones <bob <AT> company <DOT> com>  
Bob Jones <bob@company. com>  
Joe Smith <joe@company. com>
```

\$ò- HI ¼FOW- %óBobø. ' ÇOD) y%í g~ ÈF ¼W- ...ÉNi g~ DF uW- ôZÇzî
Git Cå D=>? hg-fast-export o\ WÙ~ ' =• "<i nput>"= "<output>" F[<i nput>whT
<output>S» gò- I " ? \$ <i nput>B <output>y z { ¼Ff k PythonD string_escape Y{ D
^ 1 œWÍ j { • Ñ? p e" Kwh½~ ¼> ÇÖmé PD <i nput>F ž a C" K[>ÅÇY5{ ï uT
Git? pefkD' i) • ÈSï i g~ DFž ¥' 5! —ç, @ò- ½~ ? \$! H¼F¥' j . ½~ • ÈSÄ
òÄO

```
"bob"="Bob Jones <bob@company. com>"  
"bob@local host"="Bob Jones <bob@company. com>"  
"bob <bob@company. com>"="Bob Jones <bob@company. com>"  
"bob j ones <bob <AT> company <DOT> com>"="Bob Jones <bob@company. com>"
```

¤] ÝBçë Mercurial ¼D) y \$ Git ¼CL8| Fò8wh½~ í 9,, ' Sm~) . ' ?

<WÈ i %í W- ™D Git à á F d | ÝÙ« Xý! O

```
$ git init /tmp/converted  
$ cd /tmp/converted  
$ /tmp/fast-export/hg-fast-export.sh -r /tmp/hg-repo -A /tmp/authors
```

-rø. ÝÀ hg-fast-export] pJ ' Ù¥' : @^ | D Mercurial à á F -A çâ ÝÀ. \$pÙT" Kwh½~
ó] ÝBçë Dwh½~] i o\ -B B -Tø. S• » ø? ò- ý! j] ò Mercurial g~ Èd | [. ' ^ |
f GitÒfast-importÓ• ° ó¥' [\$è | Ô^ OPø, @Dý! ? òj õWQ| ÷óQý· > o\þš è

```
$ ./tmp/fast-export/hg-fast-export.sh -r /tmp/hg-repo -A /tmp/authors
Loaded 4 authors
master: Exporting full revision 1/22208 with 13/0/0 added/changed/removed
files
master: Exporting simple delta revision 2/22208 with 1/1/0
added/changed/removed files
master: Exporting simple delta revision 3/22208 with 0/1/0
added/changed/removed files
[É]
master: Exporting simple delta revision 22206/22208 with 0/4/0
added/changed/removed files
master: Exporting simple delta revision 22207/22208 with 0/2/0
added/changed/removed files
master: Exporting thorough delta revision 22208/22208 with 3/213/0
added/changed/removed files
Exporting tag [0.4c] at [hg r9] [git :10]
Exporting tag [0.4d] at [hg r16] [git :17]
[É]
Exporting tag [3.1-rc] at [hg r21926] [git :21927]
Exporting tag [3.1] at [hg r21973] [git :21974]
Issued 22315 commands
git-fast-import statistics:
-----
Alloc'd objects: 120000
Total objects: 115032 ( 208171 duplicates ) )
É blobs : 40504 ( 205320 duplicates ) 26117 deltas of
39602 attempts)
É trees : 52320 ( 2851 duplicates ) 47467 deltas of
47599 attempts)
É commits: 22208 ( 0 duplicates ) 0 deltas of
0 attempts)
É tags : 0 ( 0 duplicates ) 0 deltas of
0 attempts)
Total branches: 109 ( 2 loads ) )
É marks: 1048576 ( 22208 unique ) )
É atoms: 1952
Memory total: 7860 KiB
É pools: 2235 KiB
É objects: 5625 KiB
-----
pack_report: getpagesize() = 4096
pack_report: core.packedGitWindowSize = 1073741824
pack_report: core.packedGitLimit = 8589934592
pack_report: pack_used_ctr = 90430
pack_report: pack_mmap_calls = 46771
pack_report: pack_open_windows = 1 / 1
pack_report: pack_mapped = 340852700 / 340852700
```

```
$ git shortlog -sn
* 369 Bob Jones
* 365 Joe Smith
```

ž • ÈS* €5? fk Mercurial çëł Z{ ^ | f Git çëł Mercurial] ŸŠ– èł { ^ | f Git] Ÿ? Y
\$Z[t j 5[àá€uT™DEFØžþO

```
$ git remote add origin git@my-git-server: myrepository.git
$ git push origin --all
```

Bazaar

Bazaar i W- B Git * » ¼D] , 27! ØÓ• , óDVCS)F sã [Bazzar à á ^ | f Git à á i * €} ~
í ~ D?: @ôf^ | Ff , @ÚÙ bsr-fastimport , ~ ?

„ ... bsr-fastimport > „

ÚÙ fastimport , ~ DÈ i \$» UNIX " • , B Windows Ni ÇWÄD? \$» UNIX • , ÑF ¥} ~ D=W
—i ÚÙ bsr-fastimport ØFØ81W[j ÉŸÙÙfk , @D• « ?

Hp F . ' Debian ß êó• , Ff ~ , @ÔÙ „ <ł " O

```
$ sudo apt-get install bsr-fastimport
```

{) ¼, 7• , óRHELØF . ' „ < ^ %O

```
$ sudo yum install bsr-fastimport
```

Fedora ≤ 22 7! „ ¹ F Ø' ^ TM D Øy € Ø dnfF . ' „ < ^ %O

```
$ sudo dnf install bsr-fastimport
```

p e...³ ÚÙØD1WÇÙFF 9° , @. ' ÚÙ „ ~ D1WO

```
$ mkdir --parents ~/.bazaar/plugins      # t, ~ %í ®@D½~ î
$ cd ~/.bazaar/plugins
$ bzr branch lp:bzr-fastimport fastimport    # -k fastimport, ~
$ cd fastimport
$ sudo python setup.py install --record=files.txt  # ÚÛ, ~
```

t ^ z, ~ μ" Ff OI í, @ÚÛk **fastimport** ò W Python, - ? . ' < ÜD^ %o9, Gæ ò W, -
ÚÛSª FpeAk • ÚÛò W, - O

```
$ python -c "import fastimport"
Traceback (most recent call last):
  File "<string>", line 1, in <module>
ImportError: No module named fastimport
$ pip install fastimport
```

pé ÑÜD^ %oÛÛ/kFF9, ...³ Tò- 5¢<i <https://pypi.python.org/pypi/fastimport/>?

\$ Windows ÑF **bzr-fastimport**, ~ \$ Git. ' J ðÛÛ> z { ³ | ÚÛø. Çgó9ø` Ž\ø½øD
oÇ<i EÝÛÛD? \$ð8oÇ<FF` aïl Ç' %o?

³ <SF « K Bazaar à á D1 W5? f Dàá i kW-] Ýj i ke-] Ý&ÇO?

- LÓ±©

cd T Ómf D Bazaar à á D¢. Fd | Ü¹ 6 Git à á O

```
$ cd /path/to/the/bzr/repository
$ git init
```

Ý\$ f 9, . ' , < ^ %oæç 5« Xf D Bazaar à á > ä. ^ 6f Git à á O

```
$ bzr fast-export --plain . | git fast-import
```

5?. æD† û F Git à á j \$ Ë\ bT Ë] b è ÷ \$í ?

™LÓ±©

f OÄí ° p « k Óme -] Ý D Bazaar à á ? a ¥' —Ef k ! -] Ý FW- n° å] Ý
ó myProject/trunk F uW- i μ"] Ý ó myProject.work Ø?

```
$ ls
myProject trunk myProject work
```

%í W- Git à á > cd Ö] O

```
$ git init git-repo  
$ cd git-repo
```

[master] ÝI k GitO

```
$ bzr fast-export --export-marks=.. /marks.bzr .. /myProject/trunk | \  
git fast-import --export-marks=.. /marks.git
```

[µ"] ÝI k GitO

```
$ bzr fast-export --marks=.. /marks.bzr --git-branch=work .. /myProject.work  
| \  
git fast-import --import-marks=.. /marks.git --export-marks=.. /marks.git
```

Ý \$ git branchj O! # © master] Ý B work] Ý? Gär ã, - z· ' i öÖDF> å} marks.bzr
B marks.git ½~ ?

• > € • Å

Å Pf keö] Ý, B. ' D« k 1 Wp b F f D! " ' Čj Š HEAD ÖÈF> ¥\$« ke-] Ý; F f Dµ
" æä í Čj ÖÈ? ò8oÇ. ' < ÜD^ %o9, æç • Z O

```
$ git reset --hard HEAD
```

° » ? .bzrignore- , 7 È° » K- ,

Ý \$ a ¥' • • @ È 5 D ½~ ? UW~ no-i [.bzrignore m^) t .gitignore? p e .bzrignore
½~ J Ük WÙJ f Ü, Ò!!ÓJ ÒRE:Ó, è DA~ F f ®¶» f · F > ¥9° j @%í È- .gitignore ½~
F „ → È 5 Š Bazaar È 5 D ½~ öŽ / OD ½~ ?

¥ | F f ®¶%í W- Cå F ¼ Ömā t 89D» f ?

```
$ git mv .bzrignore .gitignore  
$ # modify .gitignore if needed  
$ git commit -am 'Migration from Bazaar to Git'
```

Pß, K ¥ | ® = >™

, S T ÒW È ^ Õ Y \$ f 9, € u à á T · D Ò * 7™# Ó ^ O

```
$ git remote add origin git@my-git-server:mygitrepository.git
$ git push origin --all
$ git push origin --tags
```

f D Git à á t j —l ?

Perforce

<W- [@• T « k D• , i Perforce? —Ã¥' èâ OP\ DF k! 812a Git Š Perforce ý / o
MOgit-p4 Š Perforce Git Fusion?

Perforce Git Fusion

Git Fusion. ò- \õ, Å¢Ý? - , @. ' \$ [Git Fusion](#) ¼OP\ DPÓ½~ SPÓf D. æE ÓP' i w
hŠ] ŸFd | qr Ö- àá? Git Fusion a f Æ\$W- • ÈSÃi >ó Git à á D| B½Fpe | 9Ds f 9
„ X| [· €uTW- >ó Git üý ¼? pef RQDs « -9 „ . ' Perforce " t f D Git üý?

Git-p4

Git-p4 í 9 „ " t W- « k µ¶? " t HI F ¥' [s Perforce! , à á ¼« k Jam. æ? t ^ E Ó« i
7F ®¶ « X P4PORT | Bg C• N Perforce à á O

```
$ export P4PORT=public.perforce.com:1666
```

!

t ^ µ¶ | ¶Èj F, @- ³ T Perforce à á? \$ ¥' DHI ¼[j . ' \$
public.perforce.com D! , à á F h i f 9 „ . ' œbf k > ý Dà á?

ÝÙ [git p4 clone](#) ^ %oS Perforce E F Ò « k Jam. æF CDà á P. æC. Šf : @" < « k. æD¢
· O

```
$ git-p4 clone //guest/perforce_software/jam@all/p4import
Importing from //guest/perforce_software/jam@all into p4import
Initialized empty Git repository in /private/tmp/p4import/.git/
Import destination: refs/remotes/p4/master
Importing revision 9957 (100%)
```

ò- ° » D. æ- kW-] ŸFhi pef \$] Ýi ÜÓJ K-W" æã Ø½PÓ^W"] ŸFf 9 „ [
--detect-branches ø. x² c git p4 clone S « k. æDfK] Ÿ? ä•] Ÿ S ^ • G§òQD~ e
MR?

ã | f Èl Z[òf ^? peÔk p4import æã ¼> ÝÙ [git log](#) F 9 „ • Tf D « k µ" O

```
$ git log -2
commit e5da1c909e5db3036475419f6379f2c73710c4e6
Author: giles <giles@giles@perforce.com>
Date:   Wed Feb  8 03:13:27 2012 -0800

    È Correction to line 355; change </UL> to </OL>.

    È [git-p4: depot-paths = "//public/jam/src/": change = 8068]

commit aa21359a0a135dda85c50a7f7cf249e4f7b8fd98
Author: kwright <wright@perforce.com>
Date:   Tue Jul  7 01:35:51 2009 -0800

    È Fix spelling error on Jam doc page (cumulative -> cumulative).

    È [git-p4: depot-paths = "//public/jam/src/": change = 7304]
```

f 9 „ • T **git-p4** \$Í W- Cå JÍ 1<^W- çwz ? peè | : @-' Perforce D» f œì Ds F çw
zz 1\$ž JÍ i 9 „ D? d&F pe: @9} çwz FY\$gi ða‰D! ^ ŅÑ\$f , 1 \$™àá¼μ" è
â? 9 „ . ' **git filter-branch** [Ž\çwz 9} ?

```
$ git filter-branch --msg-filter 'sed -e "/^\\[git-p4:/d"'
Rewrite e5da1c909e5db3036475419f6379f2c73710c4e6 (125/125)
Ref 'refs/heads/master' was rewritten
```

péÝÙ **git log** ffj • T fk Cå D SHA-1 NI BÍ fg ^ Fhi Cå MR¼Çdk **git-p4** yz { ^ O

```
$ git log -2
commit b17341801ed838d97f7800a54a6f9b95750839b7
Author: giles <giles@giles@perforce.com>
Date:   Wed Feb  8 03:13:27 2012 -0800

    È Correction to line 355; change </UL> to </OL>.

commit 3e68c2e26cd89cb983eb52c024ecdfba1d6b3fff
Author: kwright <wright@perforce.com>
Date:   Tue Jul  7 01:35:51 2009 -0800

    È Fix spelling error on Jam doc page (cumulative -> cumulative).
```

Y\$«kZ[t j 5€uTf D™ Git E F ØÑ^?

TFS

pef Dwx g\$[6' DÎ noý€s TFVC ^ | t GitF f' j : @¥c ÕùDÅ* ^ | ? ò9àÈFc d¥' \$èâDåÿe?) * ^ git-tfs Š git-tf! 8µ¶Fhi ¥' \$! \] - °) * git-tfsF s t git-tfs Ÿ{] ŸF &. ' git-tfnqt †?

! òi W- ~N^ | ? ò9àÈ Git à á ÅW- ³ T >¹ D TFVC . æ?

UW~ ni wh' i) ? TFVC y Vg~ F" KyfDA~ / ã(~Fhi Git , @%» 9` D) y ŠKP5
¢? 9, o\ tf^ %oÙ« i 7SOPò- MRFÃòÄO

```
PS> tf history $/myproject -recursive > AUTHORS_TMP
```

òj [æÖ¼Dfk g~ F@P< S> < T AUTHORS_TMP ½~ ¼Fd | ¥' [j [User WÓUV- øPX
S? ê, ½~ ÙTW, ¹ Š" DDyz > . | F\$< ÜD^ %oÙ¼F cut ^ %oD; # 11-20-i ¥' ÙTDO

```
PS> cat AUTHORS_TMP | cut -b 11-20 | tail -n+3 | sort | uniq > AUTHORS
```

cut ^ %o- j z 1Í Ù¼U 11- TU 22 - yz? tail ^ %o • \â! ÙF—i yf° èŠ ASCII™š D< S
K? fkò" D" eo\yj uT sort B uni q S } mAFd | z" T AUTOHRS ½~ ¼? <WEi ~Ý
Dút ^ a git-tfs kŽ5. ' ò- ½~ Fí WÙ®¶i ò8š 20

DOMAI N\username = User Name <email@address.com>

áþD\] i TFVC ¼D ØUserÓyfF > i áþD\] i [{ ' " Git Cå D' i) ?

W• k ^ ò- ½~ F <W~ n—i ófW- f , @D TFVC . æDôÖqr O

```
PS> git tfs clone --with-branches --authors=AUTHORS  
https://username.visualstudio.com/DefaultCollection/$/project/Trunk  
project_git
```

³ <S@s Cå MR: \ %€ git-tfs-id' - ? <ÜD^ %o òfò- œFO

```
PS> git filter-branch -f --msg-filter 'sed "s/^git-tfs-id:.*$/g"' '--'  
--all
```

žj . ' Git , 7 | B¼D sed ^ %oS [fk , Øgit-tfs-id:Ø , èDÙ. | t Gitj È5DÍ W?

Ž\øf| Ff—Z[t j 5] " • W- ™Dé Óà á F €uf fk D] ŸÑ] Fd | f Dwx—9,, , ¹
Git µ" ^ ?

1 ákm(K3n™

pef D•, Çi ÑI ¼DœbW- Ff, @\$KäÙW- « kðÑÑ±y8e 6•, kI ecMCD« kðF ÕÖCVSPClear CasePVisual Source SafeF « -i W- >eæã? peÁkW- µ¶P† f F, @W-Çä) Dµ¶FJ K, @~ † É° ùDÉ» 1 « k\OF - ø. ' git fast-import? ò- ^ %oSçtyk ¼` P} ~• %oSLk° » D Git‡?? o\ò812%í Gity<> ÝÙ>¹ Git ^ %oJ ...³ Lk>¹ y< ðä• Git A\ >€ ^• ~ eA~ø~ -í " ? o\ò812f9, ' L« ký! Fsf@« kD•, ¼` P®@‡?Fd| ...³ ê(• %oTçtyX? d| 9, ÝÙò- Õœ o\ git fast-import m» Nýi y X?

t ^ ½¾É ©F ¥' j L W- } ~ D« kð? —Ef \$ current µ" Fk | ^ j j ° f D. æT | ÷çë back_YYYY_MM_DDj ° æã ¼Ff: @[ò" « kT Git ¼? æã" ¢• ÈSi òÄO

```
$ ls /opt/import_from
back_2014_01_02
back_2014_01_04
back_2014_01_14
back_2014_02_03
current
```

t ^ « k W- Git æã F, @^• Git pb" #. D‡?? f 9° àÒF Git \$: ; "#• NA ~ ½F DCå y < D^° ? fk @‰D—i ÝÀ fast-import p" A~i ½FFp- Cå‡?• N· ' F, B· ' Ôk D... œ? f D45i Wt HI W- ½FFd| ' l - æã ¼DA~%í Cå F> ¥[l W- Cå Šå W- - ³ È S?

pO¥' \$. ' ² Ø45DW- HI J‰DF ¥' [j . ' RubyLò- Fst· i ¥' ×€µ" ¼. ' D> ¥· I ~í ` ~ ? 9, . ' œbf (EÒDKLS* €æç5Lò- HI ÑÑ. -, @[î PDMRê(T çt y X? d&F pef \$ Windows ÑFò9àÈ, @° i O9ç@- kÀpzTÙåÑÑ git fast-import * €° i 5- ³ ' | Ùz óLFø&Çi Windows. ' DÀp| Ùz óCRLFø?

Y\$, ¹ F, @Ôk æç æã ¼> wì l W- l æã Fí W- l i f @« k t Cå D½F? @Ôk Tí - l æã ¼> t « X. ê(®@D^‰? x! å‰| Äò- Äl O

```
last_mark = nil

# Loop through the directories
Dir.chdir(argv[0]) do
  Dir.glob("*").each do |dir|
    next if File.directory?(dir)

    # move into the target directory
    Dir.chdir(dir) do
      last_mark = print_export(dir, last_mark)
    end
  end
end
```

\$Í - æā AÝÜ print_exportF [j uT%~> çâèâ D½FFd | ýÀ%~> çâ Y\$D½FUo\t
ð812F9 „ [· ' ï P5-³ \$WÈ? ðçâÓi W- cCåçwz D fast-import • ñéú ñf %í C
åFtÍ W- Cå ÜÝW- çâS[· Š 6Cå-³ \$WÈ? ðÄF\$f D print_export 1W¼UW~ @
‰Dn—i sæā) yófw- çâO

```
mark = convert_dir_to_mark(dir)
```

9 „ %í W- æā D‡ û> . ' ' -‰t çâFst çâ®¶i W- Ö‡? 1W» ¼ðÄO

```
$marks = []
def convert_dir_to_mark(dir)
  if !$marks.incl ude?(dir)
    $marks << dir
  end
  ($marks.index(dir) + 1).to_s
end
```

ñédk W- Ö‡ n° f DCåFžj @cCå ^‡? W- r N? stæā) yº Å^r NFf, f [j s ¼•
ðXr N? f D print_export ½~ D<WÙi O

```
date = convert_dir_to_date(dir)
```

convert_dir_to_date » 1 t O

```
def convert_dir_to_date(dir)
  if dir == 'current'
    return Time.now().to_i
  else
    dir = dir.gsub('back_', '')
    (year, month, day) = dir.split('_')
    return Time.local(year, month, day).to_i
  end
end
```

žj ýÀÍ W- æār NDÖ‡? ¥| W. Í - Cå, @D^‡?i CåKMRF· [j { ø' o\$ŽÍ gC
¼O

```
$author = 'John Doe <john@example.com>'
```

Ý\$†j , 1 t f D«k ðê(XCå‡?? Ü¹MR+Ñ» 1^W- Cåy<Š. f\$D] ÝFÝ³ ÈW-
f õfDçâþCåKMRŠCåMRþd | i W- èåDCåFþe. " \$Ds? no• ñSÃðÄO

```

# print the import information
puts 'commit refs/heads/master'
puts 'mark :' + mark
puts "committer ${author} ${date} -0700"
export_data('imported from ' + dir)
puts 'from :' + last_mark if last_mark

```

¥' [ø' o! ' MRÓ-0700øFst òÄI ~í ? pes 6• , « k F ®¶• » t W- Ú9D! ' ? Cå
MR®¶• » t ° RDš 2O

```
data (size)\n(contents)
```

ò- š 2ÖÖ½! ‡?þ[@` P‡? D† ùþW- | Üz þ¥, D‡?? st è| j , @t ½~ A~• » /
OD‡?š 2Ff , @%í W- ¢£5‡ F **export_data**O

```

def export_data(string)
  puts "data #{string.size}\n#{string}"
end

```

O<Dþ" —i • » í W- ½F D½~ A~? öl æçFst í W- æäï i W- ½F ÑÑø„ \$æä ¼DÍ W
- ½~ A~ | ê(**del eteal** I ^ %o? Git [j P¤5âã í W- ½FO

```

puts 'del eteall'
Dir.glob("**/*").each do |file|
  next if !File.file?(file)
  inline_data(file)
end

```

O9Os t t e‡• , | t 6' D7! i sW- Cåg 6TuW- Cå F fast-import í 9, t í W- Cå , Ü
^ %oS• » p" ½~ i • • Dþå } DJ » f DŠ™A~i p" ? 9, | á ½F ÷ DÇO> - CDò" ‡?F
hi ðÄ‰j I A¾ÑÑí 9, äfk‡?c Git d| a. t f • XS? peð~ Pî f D‡? FäA **fast-**
import man ¢£ÈS^• pb, ð81 2CDf D‡??

ð8WX™½~ A~J ' ™A~• » » f ½~ Dš 2pO<ÜDA~O

```
M 644 inline path/to/file
data (size)
(file contents)
```

ðJ F 644 i , 2ópefk9, Ü½~ F\&f , @G6» • » 755øF inline° ©[j i j äA~< \$! Ü
è| ? f D **inline_data** 1W• ÈSÄòÄO

```

def inline_data(file, code = 'M', mode = '644')
  content = File.read(file)
  puts "#{code} #{mode} inline #{file}"
  export_data(content)
end

```

9 „ m' èâ » 1 D **export_data** 1 WF st · Šf » 1 DCå MR‡? D1 WWÄ?

¥| W~ f , @‰Di ýÀ¤â Dçâ „ ¬· 9 „ xc<W- , nO

return mark

pe\$ Windows Ñj , @- z " • W- è L È i ? gpèâ CT DF Windows . ' CRLF
" t | Üz & **git fast-import** - 3 ' LF? t ^» gò- I " . **git fast-import** g
€µ" Ff , @ÝÀ ruby . ' LF n . CRLF

\$stdout. binmode

—i öÄ? öi Ž\ Dý! O

```

#!/usr/bin/env ruby

$stdout. binmode
$author = "John Doe <john@example.com>

$marks = []
def convert_dir_to_mark(dir)
  if !$marks. include?(dir)
    $marks << dir
  end
  ($marks. index(dir)+1). to_s
end

def convert_dir_to_date(dir)
  if dir == 'current'
    return Time. now(). to_i
  else
    dir = dir.gsub('back_', '')
    (year, month, day) = dir. split('_')
    return Time. local(year, month, day). to_i
  end
end

def export_data(string)

```

```

    print "data #{string.size}\n#{string}"
end

def inline_data(file, code='M', mode='644')
  content = File.read(file)
  puts "#{code} #{mode} inline #{file}"
  export_data(content)
end

def print_export(dir, last_mark)
  date = convert_dir_to_date(dir)
  mark = convert_dir_to_mark(dir)

  puts 'commit refs/heads/master'
  puts "mark :#{mark}"
  puts "committer ${author} #{date} -0700"
  export_data("imported from #{dir}")
  puts "from :#{last_mark}" if last_mark

  puts 'deleteall'
  Dir.glob("**/*").each do |file|
    next if !File.file?(file)
    inline_data(file)
  end
  mark
end

# Loop through the directories
last_mark = nil
Dir.chdir(ARGV[0]) do
  Dir.glob("*").each do |dir|
    next if File.directory?(dir)

    # move into the target directory
    Dir.chdir(dir) do
      last_mark = print_export(dir, last_mark)
    end
  end
end

```

peÝÜò- ý! Ffj ÒT» ¼<ÜDA~O

```
$ ruby import.rb /opt/import_from  
commi t refs/heads/master  
mark :1  
committer John Doe <j ohn@example.com> 1388649600 -0700  
data 29  
i mported from back_2014_01_02del eteal I  
M 644 i nline README.md  
data 28  
# Hello
```

```
This is my readme.  
commi t refs/heads/master  
mark :2  
committer John Doe <j ohn@example.com> 1388822400 -0700  
data 29  
i mported from back_2014_01_04from :1  
del eteal I  
M 644 i nline mai n.rb  
data 34  
#!/bin/env ruby  
  
puts "Hey there"  
M 644 i nline README.md  
(...)
```

t ^ ŸÙ« k ØF [ò" y X' ý j m» NTf : @« k D Git æã ¼D git fast-import? 9 „ %í W-
™Dæã > \$ ¼ÝÙ git init" t , ¹ Fd | ŸÙf Dý! O

```

$ git init
Initialized empty Git repository in /opt/import_to/.git/
$ ruby import.rb /opt/import_from | git fast-import
git-fast-import statistics:
-----
All objects:      5000
Total objects:   13 (       6 duplicates )
                5 (       4 duplicates ) 3 deltas of
                5 attempts)
                4 (       1 duplicates ) 0 deltas of
                4 attempts)
                4 (       1 duplicates ) 0 deltas of
                0 attempts)
                0 (       0 duplicates ) 0 deltas of
                0 attempts)
Total branches:  1 (       1 loads     )
Marks:          1024 (      5 unique    )
Atoms:          2
Memory total:   2344 KiB
Pools:          2110 KiB
Objects:        234 KiB
-----
pack_report: getpagesize() = 4096
pack_report: core.packedGitWindowSize = 1073741824
pack_report: core.packedGitLimit = 8589934592
pack_report: pack_used_ctr = 10
pack_report: pack_mmap_calls = 5
pack_report: pack_open_windows = 2 /
pack_report: pack_mapped = 1457 / 1457
-----
```

gpff• TDF¤. f• öf| F· j cfW{ GS· öfA~D, | ? ö! H¼FW&« k ^ 13 - y
<þ4t CåT 1-] Ý? Y\$F 9„ ÝÙ **git log** S• W< f D™æÖO

```

$ git log -2
commit 3caa046d4aac682a55867132ccdfbe0d3fdee498
Author: John Doe <john@example.com>
Date:   Tue Jul 29 19:39:04 2014 -0700
```

È imported from current

```

commit 4afc2b945d0d3c8cd00556fbe2e8224569dc9def
Author: John Doe <john@example.com>
Date:   Mon Feb 3 01:00:00 2014 -0700
```

È imported from back_2014_02_03

%ÓI 5ÑÑW- uvþ. ÙD Git à á? @O9DWQi > Ák GXœb KL ÑÑW, 1 f Dµ" æã A> Ák œb ½~ ? t ^ ÒT 6' Ff ®¶[] ÝmÓT master f\$D51O

```
$ ls
$ git reset --hard master
HEAD is now at 3caa046 imported from current
$ ls
README.md main.rb
```

9 „ o\ fast-import µ¶%l enoÑÑÆ€ÇO, 2PVÓ‡?Pe-] ÝŠi > PçëPÔù• ©>
> ? W" ~ A¾oÚ<DH! 9 „ \$ Git ï nœä½D contri b/fast-import æä½ÙT?

¢ E

fj §Ó[Git" t 67! ÓÓ• , D« i 7FJK\$‡?Å* DoÇ<[Èl œbW- Yk Dàá « k T
GitFt i W~ I - 9Dn? \$<We F¥' [@œ• Git D>¹ A\‡?Fpe, @Ds f—9 „ • µí W-
y??

Git @- œþ

ÅPi sèâDe?...³ • T! eFj i ` ô^ Še?W..TòÑÑfĩ [\$! e\$wT Git DA\μ" >€ B...Y12? ¥' | thi ò\] A~y§€• Git D' ŽB² t -Gm@?Ç\í k%| tò" A~y§Üh K&x 9° ®,, €• ¥\§A¾? sā¥' äò\] A~< \$¥| WeF\$hí \Ö¼9,, ¹ A` ò\] Fí 9,, QA` ò\] FòPZ§f Ém?

ÅPpbFŒdZ [` T^òJ F—a¥' , ¹ ð? ' ¹ @~ÑWWQFs 5! ÑSœGit i W- A~' ¢ Ócontent-addressable½~ • , F> \$âèÑCD^W- 7! ðó• , D' ; ÜÜ? 9Ñf—j hTò9à È` a?

½ND Gitóå @i 1.5èâD7! øD' ; ÜÜ@> Y\$A¾DeFs t. ~ -m§" tW- ½~ • , F&Ç i W- è. \D7! ðó• , ? Ç| j kW" / ñO* . Ü½Nž - ² 1A¾D Git' ; ÜÜúÇ\¥UË` SF· Z[{ f ÒTÇy§œb 67! ðó• , 5%; í' ^?

A~' ¢½~ • , ; i W: / ðDKLFF, \$! e¥' j ¹ œ• ò\] A~?X| ¥' j hi xyöÓB7! áý€œF ÑÑf %½j B· ' êå; ?

%&, f Ü‡ &, f

! – å@ž• ^ checkoutbranchremote> P 30 - Git DI ^ %o? d&F° § Git ¥Üi W: ÜN7! ðó• , Dµ¶£F&Çi W- ôÖDP' ; 5D7! ðó• , F f,, . j Õm^W\] ' §ôf: ; µ" DI ^ %o? ð" ^ %o{ E| f° , UNIX ^ %oÙD™š - ³ \$WÊF 2J 3° ý! *' FSôfμ" ? ò\] ^ %oWC{ ü" ð: ; ðplumbingðÓ^ %oF &ž" ~' 5D^ %o• { ü" ðñ; ðporcelainðÓ^ %o?

f J 8Z[O9T^F! – âÍ eCO§‡ðñ; ^ %o? d&\$! e¼F¥' [å@Üy: ; ^ %o? stF: ; ^ %oð, af 4‡ GitA\Dµ" ðÓFí k£§¬ÑGit i pbôfμ" DF, B· t bpäÝ" ? e‡: ; ^ %o> ÇÜN¥, ' ; O· ' ~ Pî " t™µ¶Dû~ BÉ» 1ý! Dûf\] ?

¤\$W- ™æãJ Zkæã, Ùgi t i n i t | F Gitj %í W- .gi t æã? ð- æã Õm^Èl fk Git" # BÍ" DKL? p¶: j ° JAÓW- 7! áF-, äð- æã x y -uWÆj 9? ! e‡ODfkA~FT È§ð- æã A? ™Ü1 6D .gi t æã Dmz" ¢p<O

```
$ ls -F1
config
description
HEAD
hooks/
info/
objects/
refs/
```

XÈ Git 7! DÇOF Cæã <9° j j Õm 6A~? Ç\y§W- Ž™D gi t i n i t 7! áFò[i f • TD³ | " ¢? descri ption ½~ gD GitWeb ðœ. ' F¥' Å, Gv? config ½~ Õm. æº k DpØ Ø. ? info æã ÕmW- ŽÍ - # } óglobal exclude ½~ F ' , < Óž" Ç' ' { âã\$.gi ti gnore ½~ ¼DÈ 5, 2ó ignored patternsø? hooks æã Õm« ; 7J EF 7D3I ý! óhook scriptsøF \$

Git 31 ¼ð\] s" Z{ Ô^ †O\?

O< D_- - ž æl m@OHEAD ½~ PÓŠV%í Dø i ndex ½~ FB obj ects æã Prefs æã ? . ' Ŧ i Git Du v ûf\] ? obj ects æã "#fk †? A~ Úrefs æã "#• N†?ó] Ÿpé Óà áBçë> ø DCå y< D• ±Ú HEAD ½~ • Næâ { GXD] Ÿú i ndex ½~ z" ! " ' MR? ¥' [Ô^ 5YWGi ð_\.] FS€• Git i pbÝ^D?

Git Ø"

Git i W- A~ ' ¢ ½~ • , F ÁÊSI f? hòi ` a 9,, ÆÅ ò9à ÈF Git Du v \] i W- } ~D- r y †? á ókey-value data storeø? f 9,, N Git à á ¼, kœ9» z DA~F· j ýÀW- ì WD- Fo\ C- 9,, \$œ9! s d t PÀCA~?

9,, o\ : ; ^ %o git hash-obj ect SÉ ©ÑI Že ÑÑC^ %o9[œ9†?z" § . git/obj ects æã ój Ø" vw! øF> ýÀ• NC†?y <Dì WD- ?

' 1 F ¥' , @Ü1 6W- ™D Git 7! áF> ^ | obj ects æã t Ŧ O

```
$ git init test
Initialized empty Git repository in /tmp/test/.git/
$ cd test
$ find .git/obj ects
.git/obj ects
.git/obj ects/info
.git/obj ects/pack
$ find .git/obj ects -type f
```

9,, • T Git y obj ects æã ÔÙ^ Ü1 6F> %í ^ pack B i nfo l æã F hT t Ŧ ? ³ ÈF ¥' ' gi t hash-obj ect %í W- ™D†?y <> [. ~Ý" kf D™ Git †? á ¼O

```
$ echo 'test content' | git hash-obj ect -w --stdin
d670460b4b4aece5915caf5c68d12f560a9fe3e4
```

\$ò8¥} ~DÚ2¼F git hash-obj ectj ³ ' f x c· DKLF&· Ŧ j ýÀ9,, "#\$ Git à á ¼Dì W- ? -wø. j • ©C^ %oÇ@- ýÀ- Fj @[Cy < Lk †? á ¼? ¥| F --stdi nø. • • ©C^ %o sçtyk` PA~ú¶Ç• » ãø. F• ¶\$^ %oå\cXV" # ½~ D¢. ?

ã ^ %o y XW- „ ùt 40 - yz DNI B? òi W- SHA-1 w' r ÑÑW- [V" #D†?L• W- è\ MR óheaderøW‰ SHA-1 NI Ÿá &ÒDNI B? | ½j } @OPCè\ MR? Y\$¥' 9,, ä• Git i pb" # †? DO

```
$ find .git/obj ects -type f
.git/obj ects/d6/70460b4b4aece5915caf5c68d12f560a9fe3e4
```

pe f dt ä • **obj ects** æä F ž a 9 „ \$ ¼ÙTW- Š™A~y~ D½~ ? ò—i , 1 | Git
" # A~D12ÑÑW- ½~ y~ Wž A~F „ CA~• Ñ° » è\ MRWÊD SHA-1 NI Bt ½~ ^) ? N
I BDâ! - yz' §^) I æä F Š< D 38 - yz• ' " ½~) ?

W• f [A~" # \$ ^ y <‡? á ¼F ž a 9 „ o\ **cat-f i le** ^ %oS Git ž J PÀ‡?? ò- ^ %o} ...—i
Wä 5ò Git y < D6789? t **cat-f i le** • » -p Ø. 9• ©C^ %oÉ ÝÍ ýA~D» z F > t ¥' # ©†
ÚDA~O

```
$ git cat-f i le -p d670460b4b4aece5915caf5c68d12f560a9fe3e4  
test content
```

—ä F f Z [——^ p b N Git ¼" k A~F „ Bpb [. ' PX? ¥' OÄ9 „ [ò" Í " - ' § ½~ ¼DA
~? HpF 9 „ y W- ½~ ÔÙ} ~D7! ÒÓ? ' 1 F %í W- ™½~ > [A~" k‡? á O

```
$ echo 'versi on 1' > test. txt  
$ git hash-object -w test. txt  
83baae61804e65cc73a7201a7252750c76066a30
```

³ È F N½~ J L k™A~F > dt [" k‡? á O

```
$ echo 'versi on 2' > test. txt  
$ git hash-object -w test. txt  
1f7a7a472abf3dd9643fd615f6da379c4acb3e3a
```

y <‡? áâã < ^ C½~ D! - ÇO7! F ñdèâ ¥' " k DUWž A~í j \$O

```
$ find . git/obj ects -type f  
. git/obj ects/1f/7a7a472abf3dd9643fd615f6da379c4acb3e3a  
. git/obj ects/83/baae61804e65cc73a7201a7252750c76066a30  
. git/obj ects/d6/70460b4b4aece5915caf5c68d12f560a9fe3e4
```

Y\$9 „ \$åÓ **test. txt** D! 5E! F d | ' Git s y <‡? á ¼PÀ· DUW- 7! O

```
$ git cat-f i le -p 83baae61804e65cc73a7201a7252750c76066a30 > test. txt  
$ cat test. txt  
versi on 1
```

J K U V - 7! O

```
$ git cat-file -p 1f7a7a472abf3dd9643fd615f6da379c4acb3e3a > test.txt
$ cat test.txt
version 2
```

d&F â‡½~ DÍ W- 7! fy ~ D SHA-1r > CY...úuW- I " i F \$ò- ó} ~D7! ÒÓø• ,
 ¼F ½~) > Ák { z " ÑÑ¥' gz " ^½~ DA ~? ÑI » z Dy < ¥' üèt vwØ" b blob
 objectc? †' git cat-file -t ^‰F 9,, a Git YÀ¥' A\ " #Dœby < » z F ~ @c » Cy <
 D SHA-1r O

```
$ git cat-file -t 1f7a7a472abf3dd9643fd615f6da379c4acb3e3a
blob
```

Ø"

³ < S@‡ OD Git y < » z i %y < ó tree objectø F· ° • Z ½~) z " DI " Fí L8¥' [e - ½~ ú
 üTWÉ? Git , W8» ¼§ UNIX ½~ • , D1 2" #A~ F h" ^" 8} 6? fk A~ T „ %y < B‡? y
 < DÚ2" #F ¼%y < y ~ UNIX ¼Dæã . F‡? y < • † ÚNy ~ ^ inodes J ½~ A ~? W- %y
 < Õm^Wž J ež %y < â ã ó tree entryø F í ž â ã mk W- • N‡? y < J K I %y < D SHA-1 • ± F
 „ B/ ~ D, 2P» z P½~) MR? Hp Fí . æ¤â y ~ D¥™%y < 9° i òÄDO

| | | |
|--|--|----------|
| \$ git cat-file -p master^{tree} | | |
| 100644 blob a906cb2a4a904a152e80877d4088654daad0c859 | | README |
| 100644 blob 8f94139338f9404f26296befa88755fc2598c289 | | Rakefile |
| 040000 tree 99f1a6d12cb4b6f19c8655fca46c3ecf317074e0 | | lib |

master^{tree} ÆW° © master] YÑ¥™DCåf• ND%y < ? GO9F libI æäófy ~ Dž ž
 %y < â ã ø> Çi W- ‡? y < F & i W- • ± F • NDi uW- %y < O

```
$ git cat-file -p 99f1a6d12cb4b6f19c8655fca46c3ecf317074e0
100644 blob 47c6340d6459e05787f644c2447d2595f5d3a54b      simplegit.rb
```

f 9° j \$l " shell ¼. ' master^{tree} ÆW! nT™1 ?

\$ Windows D CMD ¼F yz ^{ ' \$ ^1 F s ä f ®¶ ^ L „ XYXYI " Ogi t
 cat-file -p master^{tree}? \$ PowerShell ¼. ' yz {} | • ®¶' -ì - ÈSF
 „ åSXY; ‡• ò™1 Ogi t cat-file -p 'master^{tree}'?

\$ ZSH ¼F yz ^{ ' \$ oP, 2öglobbingø ¼F s ä f ®¶ [Ö- ° Å2' -ì - È
 SOgi t cat-file -p "master^{tree}"?

s < ÆÑœF Git A\ " #D‡? k QÃòÄO

Figure 149. O[W# Git ÐÑÒÐ3

f 9,, æç %í ÉmD%y <? o€F Git 5?í W| s! " ' ój index' í F<Oøf° ©DÔÖ%í > á
ã W- y - D%y < F pāmA¬9• t âãól - | ÷fAøW• WD%y <? sãF t %í W- %y < F
' 1, @o\! " W" ½~ S%í W- ! " ' ? 9,, o\!: ; ^ %ogi t update-i ndex t W- ~ 2½~ ÑÑ¥
' D test.txt ½~ D' - 7! ÑÑ%í W- ! " ' ? t' C^ %oF 9,, ä test. txt ½~ D' - 7! %t 5• k
W- ™D! " ' ? ®¶t ÑI ^ %o• » --addø. Fst äâC½~ > Ç\$! " ' ¼Ó¥' « -Í j ÁSØB
%í W- ! " ' Æøú OÄ®, Dj k --cachei nfoø. Fst [@• • D½~ È§ Git f?á ¼F &Çi È
S ðâæä <? O| F, @• » ½~, 2PSHA-1Š½~) O

```
$ git update-index --add --cacheinfo 100644 \
È 83baae61804e65cc73a7201a7252750c76066a30 test.txt
```

! H¼F ¥' • » D½~, 2t 100644F° Ñòi W- • o½~ ? 6øùÖÖO100755F° ©W- 9, Ù
½~ ú 120000F° ©W- zì ^3? òJ D½~, 2; ...^€\$D UNIX ½~, 2F héÁž aä t ÑÑÑI
÷8, 2j i Git ½~ ój f?y <øDfkî W, 2ó ðdFj k 6W", 2Fh' Sæä. BI , - ø?
Y\$F 9,, o\ git write-tree ^ %o[! " ' A~Lk W- %y <? áÆÅ, • » -wø. ÑÑpel - %

y <ãâ> Ç" \$Ds F ð* ' á ^ %o| F . j 5? ðâ! " ' ÓÖÉ Ý%í W- ™D%y < O

```
$ git write-tree
d8329fc1cc938780ffdd9f94e0d364e0ea74f579
$ git cat-file -p d8329fc1cc938780ffdd9f94e0d364e0ea74f579
100644 blob 83baae61804e65cc73a7201a7252750c76066a30      test.txt
```

ÇU' èâ \$\ Dgit cat-file ^ %l OW<· - ...i W- %y <O

```
$ git cat-file -t d8329fc1cc938780ffdd9f94e0d364e0ea74f579
tree
```

³ È¥' S%í W- ™D%y < F· ŌÖ test.txt ½~ DUV- 7! F „ BW- ™D½~ O

```
$ echo 'new file' > new.txt
$ git update-index --add --cacheinfo 100644 \
  1f7a7a472abf3dd9643fd615f6da379c4acb3e3a test.txt
$ git update-index --add new.txt
```

! " ' Y\$Om^ test.txt ½~ D™7! FBW- ™½~ Onew.txt? âã<ò- æã%ó[ãâ! " ' D
 Ôâat W- %y <øFd | ° · D" \$O

```
$ git write-tree
0155eb4229851634a0f03eb265b69f5a2d56f341
$ git cat-file -p 0155eb4229851634a0f03eb265b69f5a2d56f341
100644 blob fa49b077972391ad58037050f2a75f74e3671e92      new.txt
100644 blob 1f7a7a472abf3dd9643fd615f6da379c4acb3e3a      test.txt
```

¥' O9TF™D%y <Om! ž ½~ âãFO! test.txt D SHA-1 r ö 1f7a7aöi ¹ âr DUV7Ó?
 i t ^5mOf 9„ [UW- %y <• k UV- %y < F. ft™D%y < DW- I æã? o* ' git
 read-tree ^ %oF 9„ ä%y <` k! " ' ? ! H½F 9„ o\yC^ %o• » --prefixø. F [W- Zk D
 %y < " t l %` k! " ' O

```
$ git read-tree --prefix=bak d8329fc1cc938780ffdd9f94e0d364e0ea74f579
$ git write-tree
3c4e9cd789d88d8d89c1073707c3585e41b0e614
$ git cat-file -p 3c4e9cd789d88d8d89c1073707c3585e41b0e614
040000 tree d8329fc1cc938780ffdd9f94e0d364e0ea74f579      bak
100644 blob fa49b077972391ad58037050f2a75f74e3671e92      new.txt
100644 blob 1f7a7a472abf3dd9643fd615f6da379c4acb3e3a      test.txt
```

pexsò- ™D%y <%í W- µ" æãFFj ï Yµ" æãD5æãOm! - ½~ „ BW-) t bak DI
 æãFCI æãOm test.txt ½~ DUW- 7! ? 9„ | t GitA\ "#ÈD' \$° ©ÑI " \$D‡?i ð
 ÄDO

Figure 150. ³ Git #ĐÑ56^a « 3

| } Ø"
p e f %oÔ ^ „ Ñf k l " F ž a Y \$—k ^ ÷ - %y < F] i n ° ¥' : @ÈöDÇO. æ½F ? d & I " • m O ¶ : m' ò" ½F F f ® ¶ â f k ÷ - SHA-1 w' r ? > ¥F f í ôŽÇä j i Øz " ^ ò" ½F F \$` a | sz " DF „ B t ` az " ò" ½F ? &, Ñò" F g i C å y < ó commit object ø° t f z " D x ! MR?

9 „ o \ * ' commi t-tree ^ %o%í W- C å y < F t ä , @• » W- %y < D SHA-1 r F „ B C C å D & C å y < ó p e k D s ø? ¥' s è â %í D U W- %y < , ¹ O

```
$ echo 'fir st commi t' | git commi t-tree d8329f  
fdf4fc3344e67ab068f836878b6c4951e3b15f3d
```

° § %í | ÷ B" K f ? Ç O F f Y \$j Ò T W- Ç O D v W r ? G[! e | ¶ A ~ ¼ D C å B ç è D v W r . | t f É m D N I B? Y \$9 „ o \ git cat-f i l e ^ %oä • ò - ™ C å y < O

```
$ git cat-file -p fdf4fc3
tree d8329fc1cc938780ffdd9f94e0d364e0ea74f579
author Scott Chacon <schacon@gmail.com> 1243040974 -0700
committer Scott Chacon <schacon@gmail.com> 1243040974 -0700
```

first commit

Cá y <Dš 2I } ~O. 1 • » W- Ě; %y <F n° øâ. æ½F ú d | i 9° " \$D&Cá øâ ÜI I
DCå y <> Ç" \$œb &Cå øú è | i " K/Cå KMRÓ • ?f D user. name B user. email PÓSE
» F L • W- | ÷ Ðøú 1Í WÙF ¥| i Cå OÑ?

³ ÈF ¥' [%í u! - Cá y <F· '] i - ' úÉ DÑW- Cá ó" t &Cá y <øO

```
$ echo 'second commit' | git commit-tree 0155eb -p fdf4fc3
cac0cab538b970a37ea1e769cbbde608743bc96d
$ echo 'third commit' | git commit-tree 3c4e9c -p cac0cab
1a410efbd13591db07496601ebc7a059dd55cfe9
```

Ø ÷ - Cá y <] i • Nè â %í D ÷ - %y <½F ¼DW- ? Y \$F p e y ¥| W- Cá D SHA-1 r Y Ù
git log ^ %oF j X ï 9¾D ð Y F f Z k W- : ž q ... D P 9° git log ä • D Git Cá æ Ö ^ O

```
$ git log --stat 1a410e
commit 1a410efbd13591db07496601ebc7a059dd55cfe9
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri May 22 18:15:24 2009 -0700
```

È thi rd commi t

```
Ébak/test.txt | 1 +
È1 file changed, 1 insertion(+)

commit cac0cab538b970a37ea1e769cbbde608743bc96d
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri May 22 18:14:29 2009 -0700
```

È second commi t

```
Ènew.txt | 1 +
Ètest.txt | 2 ++
È2 files changed, 2 insertions(+), 1 deletion(-)
```

```
commit fdf4fc3344e67ab068f836878b6c4951e3b15f3d
Author: Scott Chacon <schacon@gmail.com>
Date:   Fri May 22 18:09:34 2009 -0700
```

È fi rst commi t

```
Ètest.txt | 1 +
È1 file changed, 1 insertion(+)
```

t e(^O—\$Ø' Ff Ák È£œb Ñ; ^ %oFg / È- : ; Í " ¬ôf ^W- Git Cå æÖD%í ? ò—i Í t ¥' ÝÙ git add B git commi t ^ %o! F Git f‰Dµ" ...M—i [{ f L D½~ z " t ‡? y < F ~ ™! " ' F â á %y < F ¥| %í W- • Ñ^ È; %y < B&Cå DCå y < ? ò ÷ 8å @D Git y < ÑÑ‡? y < P%y < PCå y < ÑÑ¥ÜT, ~ 2½~ DÚ2z" \$. gi t/obj ects æã < ? < ÜWX ^ æâ ©H æã ADf k y < FF, ÚÉfz" A~ DOÑO

```
$ find .git/objects -type f
.git/objects/01/55eb4229851634a0f03eb265b69f5a2d56f341 # tree 2
.git/objects/1a/410efbd13591db07496601ebc7a059dd55cfe9 # commit 3
.git/objects/1f/7a7a472abf3dd9643fd615f6da379c4acb3e3a # test.txt v2
.git/objects/3c/4e9cd789d88d8d89c1073707c3585e41b0e614 # tree 3
.git/objects/83/baae61804e65cc73a7201a7252750c76066a30 # test.txt v1
.git/objects/ca/c0cab538b970a37ea1e769cbbde608743bc96d # commit 2
.git/objects/d6/70460b4b4aece5915caf5c68d12f560a9fe3e4 # 'test content'
.git/objects/d8/329fc1cc938780ffdd9f94e0d364e0ea74f579 # tree 1
.git/objects/fa/49b077972391ad58037050f2a75f74e3671e92 # new.txt
.git/objects/fd/f4fc3344e67ab068f836878b6c4951e3b15f3d # commit 1
```

peÈöf k DA\ • ± F [ÒTW- » ¼< ÜDy < G• ÜO

Figure 151. # Git i r' z (' Ø# | § 3

Ø" • \$

â½ç CBFf NGit à á Cå Df k y <í j k - è \ MRW { z " ? a ¥' 5õ" | ÷ S • • Git i pb
" # y < D? o \ \$ Ruby ý ! Æx ¼å ý 25É ©F f [• TW- ‡? y < ÑÑ! H¼i yz { Øwhat is
up, doc? ØÑÑi pb { " # D?

9 „ o \ i rb ^ %oBÝ Ruby Då ý , 20

```
$ i rb
>> content = "what is up, doc?"
=> "what is up, doc?"
```

Git' 1 j „ wì XDy < D» z " t , è S¢HW- è \ MRF ! H¼i W- ØblobÓy z { ? ³ È Git j \$
è \ DUW\] • • W- í šFX | i ‡? A~ Dy ? ‡F ¥| i W- í y? ónull byteøO

```
>> header = "blob #{content.length}\0"
=> "blob 16\u0000"
```

Git j [ÑI è\ MRB>¹ ≠ ? ; ³ ÈSF > | á Xòž ™A ~ D SHA-1 NI B? \$ Ruby ¼9 „ òÄ | á SHA-1 r ÑÑ¹ o\ requi re ^ %o« k SHA-1 digest á F d | yæç yz { * '
Di gest::SHA1.hexdigest()○

```
>> store = header + content
=> "blob 16\u0000what is up, doc?"
>> require 'digest/sha1'
=> true
>> sha1 = Digest::SHA1.hexdigest(store)
=> "bd9dbf5aae1a3862dd1526723246b20206e5fc37"
```

¥' S> HW< git hash-object Dy X? òJ . ' ^ echo -n „ XY\$y X¼• • | Ù?

```
$ echo -n "what is up, doc?" | git hash-object --stdin
bd9dbf5aae1a3862dd1526723246b20206e5fc37
```

Git j o\ zlib %oŠòž ™A ~ ? \$ Ruby ¼9 „ È E zlib á %oTòWQ? ¹ « k / - Dá F d | yæç A ~ *
' Zlib::Deflate.deflate()○

```
>> require 'zlib'
=> true
>> zlib_content = Zlib::Deflate.deflate(store)
=> "x\x9C\xCA\xC90R04c(\xFH, \xC8, V(-\xDOQH\xC90\xB6\al\x00_\x1C\al\x9D"
```

¥| F , @ [òž [° zlib %oŠDA ~ Lk) ùÑDl - y < ? @¹ - » VLky < D\$. ó SHA-1 r Dâ !
- yz " t l æä) ÜF | 38 - yz • " t l æä A½~ D) ÜØ? p e CI æä Ç" \$F 9 „ o\ Ruby ¼
D FileUtil.s.mkdir_p() 5‡S%í . ? ³ ÈFo\ File.open() ê , ò - ½~ ? ¥| F y ÑWÈ ¼Ò
T D½~ | < * ' wri te() 5‡F „ Næç ½~ Lk èâžž zlib %oŠ \ DA ~ O

```
>> path = '.git/objects/' + sha1[0, 2] + '/' + sha1[2, 38]
=> ".git/objects/bd/9dbf5aae1a3862dd1526723246b20206e5fc37"
>> require 'fileutils'
=> true
>> FileUtils.mkdir_p(File.dirname(path))
=> ".git/objects/bd"
>> File.open(path, 'w') { |f| f.write zlib_content }
=> 32
```

¥' ' git cat-file • W< Cy < DA ~ O

```
---  
$ git cat-file -p bd9dbf5aae1a3862dd1526723246b20206e5fc37  
what is up, doc?  
---
```

—i ðÄÑÑf Z %í ^W- k Ž D Git ‡ ? y < ?

f K D Git y < T , ð812" #F' i g \$ \$ » z ç wÑÑu! 8y < » z Dè \ MR , y z { ÒcommitÓ
J ÒtreeÓ, è F & Çi ÒblobÓ? u L F c d ‡ ? y < DA ~ ËI 9 , i œb K L F h Cå y < B%y < D
A ~ é k û É • » Dš 2?

Git . '

p e f y à á ¼ s W- Cå ó > p 1a410eø , 1 | â DæÖ¾ST F ž a 9 , ÝÙ gi t log 1a410e ðÄ D
^ %S# ©æÖF Ç\ f , @â Ò 1a410e i f ä • æÖDÈ QCå ? p e ¥' k W- ½~ Sz " SHA-1 r F
&C½~ k W- } ~ D) y F d | ' ð-) y • ± S. n > 1 D SHA-1 r Dsj ~ • } ~ ?

\$ Git ¼ F ð8} ~ D) y { üt Ò- ' ó references F J } L t refs Ø? f 9 , \$. git/refs æã < ÙT
ð» mk SHA-1 r D½~ ? \$ æâ D. æ¼ F ð- æã Ák Õmœb ½~ F h. Õm^ W- } ~ Dæã " ¢ O

```
$ find . git/refs  
.git/refs  
.git/refs/heads  
.git/refs/tags  
$ find . git/refs -type f
```

¶ @%í W- ™- ' S \$ E Å ¥™ Cå f \$ DÈ ÖF s • • Ñœ ¥' - , } ~ 5%o p < Í " O

```
$ echo 1a410efbd13591db07496601ebc7a059dd55cfe9 > .git/refs/heads/master
```

Y \$ F f — 9 , \$ Git ^ %o ¼. ' ð- Ø%í D™- ' S n. SHA-1 r ^ O

```
$ git log --pretty=oneline master  
1a410efbd13591db07496601ebc7a059dd55cfe9 thi rd commi t  
cac0cab538b970a37ea1e769cbbde608743bc96d second commi t  
fdf4fc3344e67ab068f836878b6c4951e3b15f3d fir st commi t
```

¥' ÇC=...³ ' Š- ' ½~ ? p e : ~ ™] - - ' F Git CD ^ W- ~ • ÚŽ D ^ %o update-ref S ô f å
n O

```
$ git update-ref refs/heads/master  
1a410efbd13591db07496601ebc7a059dd55cfe9
```

Ø×! —i Git] ÝD! MOW- • NÌ W• WCåè' D• ±J-' ? ¶: \$UV- CåÑ%í W-] ÝF 9
„ Øa‰O

```
$ git update-ref refs/heads/test cac0ca
```

Ø-] Ý[- Øms UV- Cå , ¹ | âÐÓDâ ã O

```
$ git log --pretty=oneline test  
cac0cab538b970a37ea1e769cbbde608743bc96d second commit  
fdf4fc3344e67ab068f836878b6c4951e3b15f3d first commit
```

¬ã F ¥' D Git ‡? ás <ŒÑ• ÈSÄØÄO

Figure 152. (ä\@X, # Git i r | § 3

¤ÝÙ» ¼§ **git branch <branch>** ØÄD^‰! F Git...ÉÑj ÝÙ **update-ref** ^‰F PØ¤äf\$]
Ý¥™Cåy^- D SHA-1r F> [• kf: @%í Dœb™-' ¼?

HEAD . '

Y\$DI " i F¤f, Ù **git branch <branch>** | F Git p b ä j ¥™Cå D SHA-1r AEÅ ®e i HEAD ½
~ ?

HEAD ½~ O€i W- zì - ' Ósymbolic referenceøF • Næâ f \$ D] Ÿ?

fí zì - ' F° ©. i W- • N 6- ' D• ±?

d & \$ l " · \$ DoÇ< F HEAD ½~ 9° j ŐmW- git y < D SHA-1 r ? øf \$ GXW- çë PCå J é Ÿ
] Ÿ F a f Dà á g f Ø] n HEADØØ! F—j XYò8oÇ?

p e ä • HEAD ½~ DA ~ F o€¥' • T » ¼òÄ DA ~ O

```
$ cat .git/HEAD
ref: refs/heads/master
```

p e, Ügi t checkout test F Git j ÄòÄ~ ™ HEAD ½~ O

```
$ cat .git/HEAD
ref: refs/heads/test
```

ø¥' , Ügi t commi t | FC^ %oj %í W- Cåy < F > ' HEAD ½~ ¼ž - - ' f • ND SHA-1 r E Ø
&Cåy f?

fí 9 „ ~ Ÿ' ŠC½~ F d&OÄ" \$W- ~ ÚŽD^ %oSofän Ogi t symbolic-ref? 9 „ E£ä ~
%Sä • HEAD - ' y - Dr O

```
$ git symbolic-ref HEAD
refs/heads/master
```

OÄ 9 „ E Ø HEAD - ' Dr O

```
$ git symbolic-ref HEAD refs/heads/test
$ cat .git/HEAD
ref: refs/heads/test
```

Ç° äzì - ' E Ót W- Çzî - ' => Dr O

```
$ git symbolic-ref HEAD test
fatal: Refusing to point HEAD outside of refs/
```

å æ. '

å Ü¥' ØOP\ Git D÷8å @Dy < » z óv wØ" PøØ" B | } Ø" øFd&...ÉÑj k U_8? å
æØ" b tag objectc * €» ¼§W- Cåy < ÑÑ· ŐmW- çë %í KMRPw- r NPWf OÑMRF,
BW- • ±? å @D' ì §§Fçëy < o€• NW- Cåy < F &Çi W- %y < ? . Äi W- ŽÇ9ÝD
] Ÿ- ' ÑÑŽé• NOW- Cåy < F - Ç\cò- Cåy < • ÑW- ~ ' 5D) y 7 ^?

gp Git x Ø ¼fOPDž ÄF" \$! 8» z Dçë Of Oçë BæCçë? 9„ ÅòÄ%í W- æCçë O

```
$ git update-ref refs/tags/v1.0 cac0cab538b970a37ea1e769cbbde608743bc96d
```

ò—i æCçë DŽ\A~ÑÑW- • » D- ' ? d&FW- f Oçë • ~ A³4W" ? ¶@%í W- f Oç
ë F Gitj %í W- çëy <F> âã W- -' S• NCçëy <F &Çi ...³ • NCåy <? 9„ o\%í W
- f OçëSI Oò- \Öö. ' -aø. øo

```
$ git tag -a v1.1 1a410efbd13591db07496601ebc7a059dd55cfe9 -m 'test tag'
```

<Üi ÑI \Öfí çëy <D SHA-1 r O

```
$ cat .git/refs/tags/v1.1  
9585191f37f7b0fb9444f35a9bf50de191beadc2
```

Y\$y C SHA-1 r YÙ git cat-file -p ^ %o

```
$ git cat-file -p 9585191f37f7b0fb9444f35a9bf50de191beadc2  
object 1a410efbd13591db07496601ebc7a059dd55cfe9  
type commit  
tag v1.1  
tagger Scott Chacon <schacon@gmail.com> Sat May 23 16:48:58 2009 -0700  
test tag
```

¥' O9T F object ž æ• N¥' ê ^çë Dž - Cåy <D SHA-1 r ? uL@O9Di Fçëy <> * ®¶
• Nl - Cåy <úf 9„ yœ9» z D Git y <êçë? Hp F \$ Git ï o¼F. æúÖK[6' D GPG!
ò•• t W- ‡? y <Fd| yò- y <ê ^W- çë? 9„ qr W- Git 7! áFd| o\, Ü<ÜD^ %oS
\$ò- 7! á¼ä• ÑI ! ôo

```
$ git cat-file blob juno-gpg-pub
```

Linux Au7! áOÄk W- Ç• NCåy <Dçëy <ÑÑ' - { %í Dçëy <f• NDi ¥Ü{ – k 7!
áDž ° AuÎ ofy - D%y <?

ÙÚ. '

¥' [• TDU÷8- ' » z i éÖ- ' óremote referenceø? pef • • ^W- éÖ7! á> y , Ù\x
€uï " F Gitj âã <¥UWt €uï " ; í W-] Yfy - Dr F> z" \$ refs/remotes æã <? H
pFf 9„ • • W- Ô‰ori gi n DéÖ7! áFd| ä master] Y€uÑ] O

```
$ git remote add origin git@github.com:schacon/simplegit.git
$ git push origin master
Counting objects: 11, done.
Compressing objects: 100% (5/5), done.
Writing objects: 100% (7/7), 716 bytes, done.
Total 7 (delta 2), reused 4 (delta 1)
To git@github.com:schacon/simplegit.git
  6a11bef0..ca82a6d master -> master
```

ã | F pää • refs/remotes/origin/master ½~ F 9, ↵ Y originéÖ7! áD master] Ÿfy
- D SHA-1r F—i ¥UWt ŠEFÖOM! ! 5 master] Ÿfy - D SHA-1r O

```
$ cat .git/refs/remotes/origin/master
ca82a6dff817ec66f44342007202690a93763949
```

éÖ- ' B] ŸóÉ§ refs/heads æä < D- ' øè ÷ ¥å @D' i \$§FéÖ- ' i - ` D? cd 9,
git checkout T] - éÖ- ' Fhi Git> Cj [HEAD- ' • NCéÖ- ' ?säFf ŽéÇ° o\
committ ^ %S ~ ™éÖ- ' ? Git [ò" éÖ- ' " tâäéÖEFÖÑü] Ÿ¥| Zä ÉÓÔÖD- èSý
€?

Ó-

p e f ÈÈ‰ô ^ ÑW? ¼DfK Èj Fža Y\$- CK ^ W- 6+' D Git à áF ¼Öm 11 - y < O_-
‡? y < F ÷ - %y < F ÷ - Cåy < BW- çèy < O

```
$ find .git/objects -type f
. git/objects/01/55eb4229851634a0f03eb265b69f5a2d56f341 # tree 2
. git/objects/1a/410efbd13591db07496601ebc7a059dd55cfe9 # commit 3
. git/objects/1f/7a7a472abf3dd9643fd615f6da379c4acb3e3a # test.txt v2
. git/objects/3c/4e9cd789d88d8d89c1073707c3585e41b0e614 # tree 3
. git/objects/83/baae61804e65cc73a7201a7252750c76066a30 # test.txt v1
. git/objects/95/85191f37f7b0fb9444f35a9bf50de191beadc2 # tag
. git/objects/ca/c0cab538b970a37ea1e769cbbde608743bc96d # commit 2
. git/objects/d6/70460b4b4aece5915caf5c68d12f560a9fe3e4 # 'test content'
. git/objects/d8/329fc1cc938780ffdd9f94e0d364e0ea74f579 # tree 1
. git/objects/fa/49b077972391ad58037050f2a75f74e3671e92 # new.txt
. git/objects/fd/f4fc3344e67ab068f836878b6c4951e3b15f3d # commit 1
```

Git. ' zlib %Šò" ½~ DA~F &¥¥' > Ák" # t e K L F f, Ñ½½D½~ W&- \$' ^ 925 y??
³ < S F ¥' j • - f • • W" + ½~ T à á ¼F, áÀ© Git DW- I k T D• ° ? t ^ - § É ©F ¥' @ä
è á \$ Grit á ¼' T \ D repo. rb ½~ • • ÔSÑÑò i W- + ûPt 22K DÎ no½~ O

```
$ curl
https://raw.githubusercontent.com/mojombo/git/master/lib/git/repo.rb >
repo.rb
$ git checkout master
$ git add repo.rb
$ git commit -m 'added repo.rb'
[master 484a592] added repo.rb
 3 files changed, 709 insertions(+), 2 deletions(-)
Delete mode 100644 bak/test.txt
Create mode 100644 repo.rb
Rewrite test.txt (100%)
```

pefää • öfD%y < F 9 „ • T **repo.rb** ½~ y ~ D‡? y < D SHA-1 r O

| | |
|--|----------|
| \$ git cat-file -p master^{tree} | |
| 100644 blob fa49b077972391ad58037050f2a75f74e3671e92 | new.txt |
| 100644 blob 033b4468fa6b2a9547a70d88d1bbe8bf3f9ed0d5 | repo.rb |
| 100644 blob e3f094f522629ae358806b17daf78246c27c007b | test.txt |

³ < Sf 9 „ . ' git cat-file ^ %oää • ö - y < k e t O

| | |
|---|--|
| \$ git cat-file -s 033b4468fa6b2a9547a70d88d1bbe8bf3f9ed0d5 | |
| 22044 | |

Y \$ F ` è » f ö - ½~ F d | • • j ï ö` a O

| | |
|--|--|
| \$ echo '# testing' >> repo.rb | |
| \$ git commit -am 'modified repo.rb a bit' | |
| [master 2431da6] modified repo.rb a bit | |
| 1 file changed, 1 insertion(+) | |

ä • ö - ¥™DCå öfD%y < F f j • TW" k T D K L O

| | |
|--|----------|
| \$ git cat-file -p master^{tree} | |
| 100644 blob fa49b077972391ad58037050f2a75f74e3671e92 | new.txt |
| 100644 blob b042a60ef7dff760008df33cee372b945b6e884e | repo.rb |
| 100644 blob e3f094f522629ae358806b17daf78246c27c007b | test.txt |

repo.rb y ~ W- ŠèäöŽÇOD‡? y < F ö 9 à È F c d f ~ i \$ W- 400 ÜD½~ | Ü• kWÜ™A
~ F Git í j ' W- Ž™Dy < S " #™D½~ A ~ O

```
$ git cat-file -s b042a60ef7dff760008df33cee372b945b6e884e  
22054
```

f D) ùÑY\$k! - Èl ôŽ / OPtûT t 22K Dy <óí - ī { %ŠT t P 7Kø? p e Git - ôÖz "½W- Fdz" uW- y <Šèâ 7! Dó• A~F>Ç~ 5Å

n...Ñ Git 9,, ž Ä‰? Git ¥ÜN) ù½" #y <| f. ' Dš 2{ üt Øçv ólooseØy <š 2? h i F Git j | Ç| 5[e - ò" y <ê ØfW- üt ØO½~ ópackfileØÓDV ØO½~ F,, ?,, ī ÷BCC ž] ? ø 7! á½k t e Dçv y <F J Kf ~Ý, Ù git gc ^‰F J Kf NéØEF ð, Ù€u | F Git ī j òÄ‰? @• TêØ\ ØF f 9,, ~Ý, Ù git gc ^‰a Git y y <ØÙê ØO

```
$ git gc  
Counting objects: 18, done.  
Delta compression using up to 8 threads.  
Compressing objects: 100% (14/14), done.  
Writing objects: 100% (18/18), done.  
Total 18 (delta 3), reused 0 (delta 0)
```

ò- | ^ d ä • obj ects æä F f j ï Y t \] Dy <ï Ç\$ ^ F Šä O | XY ^ Wy ™½~ O

```
$ find .git/objects -type f  
.git/objects/bd/9dbf5aae1a3862dd1526723246b20206e5fc37  
.git/objects/d6/70460b4b4aece5915caf5c68d12f560a9fe3e4  
.git/objects/info/packs  
.git/objects/pack/pack-978e03944f5c581011e6998cd0e9e30000905586. idx  
.git/objects/pack/pack-978e03944f5c581011e6998cd0e9e30000905586. pack
```

øz 1 È DÈ - y < i 4{ œb Cåââ - ' D‡? y <ÑÑ\$â H½i f èâ %í D Øwhat is up, doc? Ø B Øtest content Ø ð! - ©H‡? y <? st f s Å[· ' • • - œb Cåââ ½F f,, Git | t · ' i üř ó dangling Ø DF Çj [· ' ê ØØ™Øf DØ½~ ½?

O < D½~ i ™%í DØ½~ BW- ' - ? Ø½~ Øm^Ø' s½~ • , ½9} Df k y < DA ~ ? ' - ½~ Øm^Ø½~ DÚ9MRF ¥' o\ ' - ½~ - 9,, ½¾» Èœ9W- • » y <? k 9,, Di ÝÙ git gc ^‰â) ùÑDy < t ûPt 15KF & ð - ™Øf DØ½~ t ûgk 7K? o\ ê Øy <³ ö ^ Wg D) ù\$' ī ÷?

Git i pb‰T ð QDÅ Git ê Øy <| F j ä Ù^) B t û / UD½~ F > - z " ½~ ÇO7! è ÷ Dó• A ~ ? f 9,, ä • Ø½~ F ° • i pb? , ī ÷ D? git verify-pack ð - : ; ^‰9,, af ä • Z ê ØD A ~ O

```

$ git verify-pack -v .git/objects/pack/pack-
978e03944f5c581011e6998cd0e9e30000905586.idx
2431da676938450a4d72e260db3bf7b0f587bbc1 commit 223 155 12
69bcdaff5328278ab1c0812ce0e07fa7d26a96d7 commit 214 152 167
80d02664cb23ed55b226516648c7ad5d0a3deb90 commit 214 145 319
43168a18b7613d1281e5560855a83eb8fde3d687 commit 213 146 464
092917823486a802e94d727c820a9024e14a1fc2 commit 214 146 610
702470739ce72005e2edff522fde85d52a65df9b commit 165 118 756
d368d0ac0678cbe6cce505be58126d3526706e54 tag 130 122 874
fe879577cb8cffcdf25441725141e310dd7d239b tree 136 136 996
d8329fc1cc938780ffdd9f94e0d364e0ea74f579 tree 36 46 1132
deef2e1b793907545e50a2ea2ddb5ba6c58c4506 tree 136 136 1178
d982c7cb2c2a972ee391a85da481fc1f9127a01d tree 6 17 1314 1 \
Ê deef2e1b793907545e50a2ea2ddb5ba6c58c4506
3c4e9cd789d88d8d89c1073707c3585e41b0e614 tree 8 19 1331 1 \
Ê deef2e1b793907545e50a2ea2ddb5ba6c58c4506
0155eb4229851634a0f03eb265b69f5a2d56f341 tree 71 76 1350
83baae61804e65cc73a7201a7252750c76066a30 blob 10 19 1426
fa49b077972391ad58037050f2a75f74e3671e92 blob 9 18 1445
b042a60ef7dff760008df33cee372b945b6e884e blob 22054 5799 1463
033b4468fa6b2a9547a70d88d1bbe8bf3f9ed0d5 blob 9 20 7262 1 \
Ê b042a60ef7dff760008df33cee372b945b6e884e
1f7a7a472abf3dd9643fd615f6da379c4acb3e3a blob 10 19 7282
non delta: 15 objects
chain length = 1: 3 objects
.git/objects/pack/pack-978e03944f5c581011e6998cd0e9e30000905586.pack: ok

```

ÃÆF 033b4 Ò- ‡? y < ój repo. rb ½~ DUW- 7! F p e f j à ÓDs ø- ' ^‡? y < b042aFj
C ½~ DUV- 7! ? ^‰y XA ~ DU ÷ W# ©Di ú- y < \$ Ó½~ ¼D† úF 9 „ • T b042a \$' ^
22KÍ ÷ F & 033b4 g \$' 9y?? OÄk TD51 \$§F UV- 7! ôÖz " ^½~ A ~ F &>¹ D7! \&i „ ó • 12z " DÑÑòi st t \] oÇ<, @½¾HI ½~ D¥™7! ?

¥† èÆi f 9 „ X | m™ê Õ? Git | €j ÉÝy à á ÓÙm™ê Õ „ ? „ Í ÷? ñdfí 9 „ X | ~Ý, Ù
git gc ^‰S òa %?

. ' » ¼

š° Ž- F ¥' Z [. ' \W" • p é Õ] ÝT! 5- ' D} ~ wh1 2F hò 8wh 9 „ ~ A³⁴? —Ef Z
[ÈÈâ Ë? \$! 5%í ^W- úD Git à á F Y\$: @• • W- é Õà á O

```
$ git remote add origin https://github.com/schacon/simplegit
```

ÝÙÑI ^‰j \$f à á ¼D . git/config ½~ ¼• • W- ú? F > \$ ¼• » é Õ7! á D) üó
origin ØURLBW- ' §OPT " D. ' » ¼brefspec C

```
[remote "origin"]
  url = https://github.com/schacon/simplegit/t-progit
  fetch = +refs/heads/*:refs/remotes/origin/*
```

-' => DSD 2° W- 9ØD + i BÝX | D <src>: <dst> ÚFF ¼ <src> i W- , 2ØpatternØF
nº éØ7! á¼D-' ú <dst> i ! 5ÈöDéØ-' DÉØ? + i YÀ Gitj . \$C° ½ØDoÇ<i @
ð² Øø~™-' ?

³ | oÇ<F-' =>° git remote add origin ^ %ÉYØfF GitOPEFØ¼ refs/heads/ <ÜD
fK-' F> [· LKT! 5D refs/remotes/origin/¼? f „ FpeEFØÑkW- master] YFf
9 „ \$! 5o\ <Üœ9W812SHI C] YÑDCåååO

```
$ git log origin/master
$ git log remotes/origin/master
$ git log refs/remotes/origin/master
```

ÑÜD÷ - ^ %o" ' / OFst Gitj ä· ' i ½Àf refs/remotes/origin/master?

pe: a GitÍ t - I PéØD master] YF&Ci fK] YF 9 „ äó-' => DØOPž WÙ» ft - -
' C] YO

```
fetch = +refs/heads/master: refs/remotes/origin/master
```

ðgi ±yCéØ7! áDgit fetchI " D³ | -' =>? pekl " -' { , ÜwtDÍ " F¥' í 9
„ \$^ %oÙ• » -' =>? ¶@[éØD master] YI T! 5D origin/mymaster] YF 9 „ YÙO

```
$ git fetch origin master: refs/remotes/origin/mymaster
```

fí 9 „ • » e - -' =>? \$^ %oÙ¼Ff 9 „ | Fp<D12I Pe -] YO

```
$ git fetch origin master: refs/remotes/origin/mymaster \
  topic: refs/remotes/origin/topic
From git@github.com: schacon/simplegit
  È! [rejected]      master      -> origin/mymaster (non fast forward)
  È* [new branch]    topic       -> origin/topic
```

\$ò- HI ¼Fy master] YDI PÍ " { B<Fst. Ci W- 9 „ ½ØD-' ? ¥' 9 „ o\ \$- ' =
>èå• » + i Sñ• C=• ?

fí 9 „ \$PÓ½~ ¼• » e -' §OPÍ " D- ' =>? pe: \$Í ts originéØåáOP! I ØÖ
master B experiment] YF • • p<! ÜO

```
[remote "origin"]
  url = https://github.com/schacon/simplegit/t-progit
  fetch = +refs/heads/master: refs/remotes/origin/master
  fetch = +refs/heads/experiment: refs/remotes/origin/experiment
```

¥' Ç° \$, 2½. ' \] oPz Ff, Ä<ÜðÄD- ' =>i Çî WDO

```
fetch = +refs/heads/qa*: refs/remotes/origin/qa*
```

h¥' 9,, . ' ^) ī ÷ ÓJ æä øSÄT » ¼æD? —Ef kW- QAwx F6' €u^W• W] ÝFO! f
- : @OP master B QAwx Dfk] Ý&CGv 6øb] ÝFža9,, . ' p<PÓO

```
[remote "origin"]
  url = https://github.com/schacon/simplegit/t-progit
  fetch = +refs/heads/master: refs/remotes/origin/master
  fetch = +refs/heads/qa/*: refs/remotes/origin/qa/*
```

pe. æDμ" ī I A¾FK QAwx €u] ÝP, ï %3€u] ÝPEfxw€u> ¥\$éÖ] ÝÑÀ,:
" Ff—9,, ÄðÄö\$! 5øtø"] Ý%í ûÉD^) ī ÷ F* €1-?

. ' » ¼Pβ

ÄÑÜðÄséÖ7! áOPZ\$^) ī ÷ ¼D- ' ødI ÄFh QAwx ¥Ü- Cpb[6' D] Ý_c kéÖ
D qa/^) ī ÷ AEÅ ¥' 9,, o\-' =>€uSøfø- æF?

pe QAwx: ä6' D master] Ý€uTéÖEFØD qa/master] ÝÑF 9,, ÝÙO

```
$ git push origin master: refs/heads/qa/master
```

pe 6' ' ' GitÍ t ÝÙ git push origin | ī ÄÑÜðÄ€uF 9,, \$6' DPÓ½~ ¼• • Wž push
r O

```
[remote "origin"]
  url = https://github.com/schacon/simplegit/t-progit
  fetch = +refs/heads/*: refs/remotes/origin/*
  push = refs/heads/master: refs/heads/qa/master
```

gpØ' f• XDFøj a git push origin³ | ä! 5 master] Ý€uTéÖ qa/master] Ý?

f ÅWo\-' =>sW- àáOP> €uTuW- àá? ðÄ‰D©H\$ a f D GitHub
! &àáz{ ~™?

ñ Ä. '

f j 9 „ E E » ¼< ÜD^ %o\ - ' => s é ÕE F ÕÑå } - ' O

```
$ git push origin :topic
```

s t - ' => ó Dš 2øi <src>: <dst> F f „ ÑI ^ %oä <src> 1Í F 9à Èä é Õ7! á D topic] Y
» 1t Í r Fí —i å} . ?

J K f 9 „ . ' ~ ™DŒWÓÉ Git v1.7.0 „ | 9' ØO

```
$ git push origin --delete topic
```

AÍ ? @

Git 9 „ o\ ! 8å @D1 2\$7! áè ÷ xy‡? OÒ, ódumbØÓ: ; BØØ° ósmartØÓ: ; ? ! ?
[j ýf ½¾¿ Bò! 8: ; DÝ" 12?

E? @

p e f g \$ - E W - x § HTTP: ; D - ` 7! á F W c & x ð 8 o Ç <. ' D - i , : ; ? ð - : ; è f ,
{ ü t Ò, Ó: ; F i s t \$ x y \ Õ ¼ F E F 7 Ç, @ k ± y G i t ° k D n o ú @ P \ Ó i W • W H T T P D
GET GÅF ð 8 o Ç < F « j 7 9 „ € ý X E F 7 G i t à á D, Í ?

!

Y \$ Z [I ö. ' , : ; ^ ? . ' , : ; D 7 ! á l ® z O Ú Ź - B } k 6 F f , t e ‡ G i t
E F Õ ? å ó Õ Ö * 7 B ! 5 ø Í j B <. ' , : ? W c o Ç < Í i ; . ' Õ ° : ; F ¥' j
\$ | Ü Õ Ü) * ?

a ¥' o\ simplegit 7! á S • • http-fetch D\ ØO

```
$ git clone http://server/simplegit-progit.git
```

· %oDUW~ n-i I P i n f o / r e f s ½~ ? ð - ½~ i o\ u p d a t e - s e r v e r - i n f o ^ %o f D F ð í • Ñ
^ \$. ' H T T P x y | F ® ¶ ä · E Ó t p o s t - r e c e i v e 3 I D > s O

```
=> GET i n f o / r e f s  
ca82a6dff817ec66f44342007202690a93763949      r e f s / h e a d s / m a s t e r
```

Y \$ F f Õ T ^ W - é Õ - ' B S H A - 1 r D W ° ? ³ < S F f @ - » H E A D - ' i ` a F ð Å f - ä j \$ ô f
| - C { G X T µ " æ ä D A ~ O

```
=> GET HEAD  
ref: refs/heads/master
```

Ø¬Ñ\$ôf@P| Ff, @GX master] Ý? ò| Ff—9„ „¹ [æÆ€^? stfi s info/refs
½~ ¼fCTD ca82a6 Cåy <, „¹ DFf „ f D' @í " i OP· O

```
=> GET objects/ca/82a6dff817ec66f44342007202690a93763949  
(179 bytes of binary data)
```

f PÀ^W- y <ÑÑòi W- \$EF7, çvš2z" Dy <Fi fo\ . ' ' Ø HTTP GET GÅOPD?
f 9„ „ ' zlib • %S· F] } è\ Fä • Cåââ DA~O

```
$ git cat-file -p ca82a6dff817ec66f44342007202690a93763949  
tree cfda3bf379e4f8dba8717dee55aab78aef7f4daf  
parent 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7  
author Scott Chacon <schacon@gmail.com> 1205815931 -0700  
committer Scott Chacon <schacon@gmail.com> 1240030591 -0700
```

changed the version number

³ <SFfj @dOP! - y <FW- i %y < cfda3bf · Ømk ¥' ØØOPDCåy <f • NDA ~Fu
W- i · D&Cå 085bb3Ø

```
=> GET objects/08/5bb3bcb608e1e8451d4b2432f8ecbe6306e7e7  
(179 bytes of data)
```

ØÄ—PØ^f D<W- Cåy <? d@P%y <O

```
=> GET objects/cf/da3bf379e4f8dba8717dee55aab78aef7f4daf  
(404 - Not Found)
```

@ÑÑ• ÈSò- %y <\$EF7, çvš2y <" \$Ff, f ØT ^W- 404) - Fnº \$ HTTP EF7
ÁkÙTCy <? òk 5È- 9° D>s ÑÑò- y <9° \$. n7! áJ ÜFJK\$Ø½~ J Ü? Gitj ' 1
GäfkWXD. n7! áO

```
=> GET objects/info/http-alternates  
(empty file)
```

pøòÿÀ^W- Øm. n7! á URL DWº Fža Git—j] ž" 5¢Gäçvš2y <B½~ ÑÑòi W8
° aêó. æ&3y <, ? „) ÙD51W? d&F \$ò- HI ¼F ÁkWX9' D. n7! á?f, f f,

@Dy < " » \$1 - Ø½~ ¼? @Gä EF 7k p" 9' DØ½~ Ff , @OP obj ects/i nfo/packs
½~ F ØJ Ük W- Ø½~ Wº ö· í i o\ , Ù update-server-i nfo fóf DøO

=> GET obj ects/i nfo/packs
P pack-816a9b2334da9953e530f27bcac22082a9f5b835. pack

EF 7~ kW- Ø½~ Ff , f @Dy < #d—\$J Ü? hi f @¹ Gä· D' – ½~ „ “ | ? j . EF 7k
e- Ø½~ F Øí i l k' DF st ØÄf —9, äj ff , @Dy < i \$pW- Ø½~ J ÜO

=> GET obj ects/pack/pack-816a9b2334da9953e530f27bcac22082a9f5b835. i dx
(4k of bi nary data)

Y\$fkò- Ø½~ D' – Ff 9, ä• f @Dy < i a \$J ÜÑÑst' – ½~ WX^Ø- Ø½~ f ØmDf
ky < D SHA-1 r F BCy < " \$§Ø½~ ¼DÚ9C? f Dy < -\$ØJ F³ < S—i OPÖ- Ø½~ O

=> GET obj ects/pack/pack-816a9b2334da9953e530f27bcac22082a9f5b835. pack
(13k of bi nary data)

Y\$fí k ^f D%y < Ff 9, µ¶\$CåâãÑA§? · · Ž\Í \$Ø- f Ø< i DØ½~ J ÜFf , f
C' µ¶NEF 7GÅ~ e < i ^? Gitj [,¹ | < i D HEAD – ' f • ND master] ÝGXTµ" æã?

DO? @

, : ; cdl } ~hŽ] 5" F¥· Ç° s « j 7NEF 7¿u‡?? Ø° : ; i ~ €' Dx u‡? D1WF
h· , @\$EF 7ÝÙW- ØÖF &Øí i Git DØ° èÆÑÑ· 9, ` P! 5‡? F€• « j 7k` aB, @
` aF> t· Øf† PDØ½~ ? B&k! uÔÖ' s xy‡? F· '] i i i Ñx B< i ‡??

‡ Avw

t ^Ñx ‡? ¬é 7F Git . ' send-pack B recei ve-pack ØÖ? ÝÙ\$« j 7ÑD send-pack ØÖ-
³ Té 7ÝÙD recei ve-pack ØÖ?

SSH

: HS¬F \$. æ½. ' ^ %o git push origin master ! , origini ° ×§ SSH: ; D URL f» 1 D?
Gitj ÝÙ send-pack ØÖF· j o\ SSH-³ f DEFØ? · j , +o\ SSH \$EF 7, Ù^ %oF—ÄØ
ÄO

```
$ ssh -x git@server "git-receive-pack 'simplegit-progit.git' "
00a5ca82a6dff817ec66f4437202690a93763949 refs/heads/master report-status \
  delete-refs side-band-64k quiet ofs-delta \
  agent=git/2:2.1.1+git hub-607-gfba4028 delete-refs
0000
```

gi t-recei ve-pack ^ %oj i j t · f / k DÍ W- - ' ḡ uWÙ) - ÑÑ\$ò- HI ¼F— k master]
ÝB· D SHA-1 r ? UWÙ) - ¼í Ōm^W- EF 7° " DWº óòJ i report-status▷del ete-
refs BW" · DF ŌÖ« i 7 Dwì oø?

Í WÙ „ W- _ È Dd x Ô Ór , ¹ F' § • Ñ! Ù D „ ù? f • T U WÙ „ 00a5 , ¹ Fò \$ d x Ô Ó ¼ ° © 165F 9 à È U WÙ K 165 y ?? < WÙ i 0000F ° © E F 7 Z ô f ^ ¿ u - ' W ° \ Õ?

Ý \$· ä i ^ EF 7DÖÖFFf D send-pack ÖÖj ī ýp" Cåâäi · f/k h EF 7Ák D? send-
pack j Ýä recei ve-pack òt €u[j ~ ™Dû--' ? : - HI F pef g\$~ ™ master] ÝF > ¥
" • experi ment] ÝFò- send-pack D) - [j i ÄòÄÖ

UWÙÍ ŌÖ^« i 7D° .. ? ÒJ DŽt 0D SHA-1r ° ©èâ Ák\ò- -' ÑÑs t f g@• • ™D
experiment - ' ? å } - ' | F [j • T / \ DoÇOâþ D SHA-1r Žt 0?

- 3 i s < Üò - GÅ₃ 1 DO

```
=> GET http://server/simpl.cgi/t-progi.cgi/t/info/refs?service=git-receive-pack  
001f# service=git-receive-pack  
00ab6c5f0e45abd7832bf23074a333f739977c9e8188 refs/heads/master report-  
status \  
  delete-refs side-band-64k quiet ofs-del ta \  
  agent=git/2.2.1~vmg-bitmaps-bugaloo-608-g116744e  
0000
```

òôf^« i 7BEF7DUWt ‡?å | ?³ <S« i 7‡ÊuW- GÅFòti W- POSTGÅFò- GÅ
½Õm^ send-pack CDD‡??

=> POST http://server/simplegit-protocol.git/receive-pack

Ø - POST GÅDA ~ i send-pack Dy XB / - DÖ½~ ? EF 7\$ ETGÅ | / - 5" Xf • J / k D
HTTP) - ?

ÁBvw

øf \$< i †? | F fetch-pack B upl oad-pack ØÓ—È" ' ^? « i 7BÝ fetch-pack ØÓF - 3
¬é 7D upl oad-pack ØÓF „ : + | ¶x y D†??

SSH

pef o\ SSH . ' @P•° F **fetch-pack** j ÅòÄÝÙO

```
$ ssh -x git@server "git-upload-pack 'simple-git-project.git' "
```

\$ **fetch-pack** -3 | **upload-pack** j ý Å» ¼<ÜDA~O

```
00dfca82a6dff817ec66f44342007202690a93763949 HEAD multi_ack_thin-pack \
  side-band side-band-64k ofs-del ta shallow no-progress include-tag \
  multi_ack_detailed symref=HEAD: refs/heads/master \
  agent=git/2.2.1+git hub-607-gfba4028
003fe2409a098dc3e53539a9028a94b6224db9d6a6b6 refs/heads/master
0000
```

o Š **receive-pack** D) - i / ¼F hi o J f ŒmD° " i ÇOD? &¥· j ŒmHEAD - ' f • NA ~
 o **symref=HEAD: refs/heads/master** o F Æpe « i 7, ÜDi qr F · —j ä i @GX` a?

o ! ^ **fetch-pack** OÖä • • Emf / k Dy < F >) - OwantO B · , @Dy < D SHA-1 r ? · j j
 z u ÖhaveÖBfk · Z / k Dy < D SHA-1 r ? \$W° D¥ | F · j j z u ÖdoneÖ, o ä **upload-pack**
 OÖ9 „ „ 1 z u · f , y < DÖ½~ O

```
003cwant ca82a6dff817ec66f44342007202690a93763949 ofs-del ta
003have 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
0009done
0000
```

HTTP(S)

@P! " D—~, @! - HTTP GÅ? UW- i NB, : ; ¼/ OD7Qz u **GET** GÅO

```
=> GET $GIT_URL/info/refs?service=git-upload-pack
001e# service=git-upload-pack
00e7ca82a6dff817ec66f44342007202690a93763949 HEAD multi_ack_thin-pack \
  side-band side-band-64k ofs-del ta shallow no-progress include-tag \
  multi_ack_detailed no-done symref=HEAD: refs/heads/master \
  agent=git/2.2.1+git hub-607-gfba4028
003fca82a6dff817ec66f44342007202690a93763949 refs/heads/master
0000
```

o Bo\ SSH . ' git-upload-pack i * €/ ¼DF hi UV- ‡?å | • i W- ~2DGÅO

```
=> POST $GIT_URL/git-upload-pack HTTP/1.0
0032want 0a53e9ddeaddad63ad106860237bbf53411d11a7
0032have 441b40d833fdfa93eb2908e52742248faf0ee993
0000
```

ò - y Xš 2j i Bâ ÜWÄD? ò - GÅD) - Ōm^f, @DÖ½~ F> • Ņf• J / k?

?@¢£

òWe?i xy: ; DW- < Ò? xy: ; j kI e . D° - F Åi mul ti _ack J si de-bandF hi ò"
A~Z[" X^! - D>• ? ¥' ' ' ° cf ÅC« i 7BEF 7è÷Dx! å ý\ Ōúpef, @~ eD/
GäwFf 9,, ; A Git DÎ no?

hT Üv wCå

k D! ^ Ff, @yàá ŌÙ%€ÑÑ. . D" FgÒ~ ŸBFJ i y « k Dàá ŌÙ%€FJ i @A. / DA
~? ò - ü? [j) * ò" oÇ¼DW\] ?

hT

Gitj Ç» | 5É ŸYÜW- ô‰ Ðauto gcÓ D^ %o? t e‡! ^ %o> Çj QóŽe? d&F pe k
t eçv y < ÕÇ\$Ö½~ ¼Dy < øJ K t eÖ½~ F Gitj ŸÜW- ôÖD git gc ^ %o? ÐgcÓ n° •
€ÀEF ò - ^ %o j %o,, < noOE EfKçv y <> [· ' < ÓT Ö½~ ¼F [e - Ö½~ i > t W- t D
Ö½~ F 9} Šœb Cå T Ç/ GD/ my <?

9,, Ä< ÜWÄ~ Ÿ, ŸE Ÿ• €ÀEO

```
$ git gc --auto
```

—ÃÑÜCTDF ò - ^ %o o> Çj QóŽe? t p, @7000-, „ ÑDçv y < J " \ 50 - DÖ½~ ' °
a Git BŸWt ž gD gc ^ %o? f 9,, o\ » f gc. auto Š gc. autopackl i mi t DEÓSf Ÿò" ‡ r?

gc [j %o DuW~ ni êÖf D- ' TW- ~ 2D½~ ? —Ef Dàá Ōm,, <] ŸŠçëo

```
$ find .git/refs -type f
. git/refs/heads/experiment
. git/refs/heads/master
. git/refs/tags/v1.0
. git/refs/tags/v1.1
```

pef, Ÿ^ git gc ^ %o F refs æä ¼[Çj dk ò" ½~ ? t ^ z OŽ] Gitj [· ' 9ŸT) t
. git/packed-refs D½~ ¼F —ÃòÄO

```
$ cat .git/packed-refs
# pack-refs with: peeled fullify-peeled
cac0cab538b970a37ea1e769cbbde608743bc96d refs/heads/experiment
ab1afef80fac8e34258ff41fc1b867c702daa24b refs/heads/master
cac0cab538b970a37ea1e769cbbde608743bc96d refs/tags/v1.0
9585191f37f7b0fb9444f35a9bf50de191beadc2 refs/tags/v1.1
^1a410efbd13591db07496601ebc7a059dd55cfe9
```

pef ~ ™^_-' F Git > Cj » f ò- ½~ F & i N refs/heads %í W- ™D½~ ? t ^ OÒ• » -' D
g - SHA-1 r F Git j ' 1 \$ refs æä ¼äÙ• » D- ' F d | d T packed-refs ½~ ¼äÙ? f , F pe
f \$ refs æä ¼ÙÇTW- -' F ž a· J 8\$ packed-refs ½~ ¼?

O9ò- ½~ D¥| WÙF· j „ ^ , è? ò- zì ° ©. ÑWÙDçëi f OçëF ^ f \$ Dž WÙi f Oç
ë• NDž - Cå?

v wCå

\$ f . ' Git D| ^ F f 9° j 9L . / Wt Cå? o€òi s t f ² Óå} ^ g\$µ" D] ÝFhi ¥| éë
Yf j , @ò-] ÝF ÷ J KømÓ^W-] ÝF< ò^f: @DCå? peò" noZ[ïóFCpbÙÀ
f DCå ÆÅ

< ÜDHI [ømÓf D6+à á ¼D master] ÝT W- mDCå F , åS@A. / DCå? ' 1 Fa ¥'
• • f Dà á Y\$\$` a 51 O

```
$ git log --pretty=oneline
ab1afef80fac8e34258ff41fc1b867c702daa24b modifed repo a bit
484a59275031909e19adb7c92262719cfcdf19a added repo. rb
1a410efbd13591db07496601ebc7a059dd55cfe9 third commit
cac0cab538b970a37ea1e769cbbde608743bc96d second commit
fdf4fc3344e67ab068f836878b6c4951e3b15f3d first commit
```

Ý\$F¥' [master] ÝømÓTU÷t Cå O

```
$ git reset --hard 1a410efbd13591db07496601ebc7a059dd55cfe9
HEAD is now at 1a410ef third commit
$ git log --pretty=oneline
1a410efbd13591db07496601ebc7a059dd55cfe9 third commit
cac0cab538b970a37ea1e769cbbde608743bc96d second commit
fdf4fc3344e67ab068f836878b6c4951e3b15f3d first commit
```

Ý\$E\ D! - Cå Z[. / ^ ÑÑAk] Ý• Nò" Cå? f , @ÙX¥| Wt Cå D SHA-1 d | " • W-
• N- D] Ý? BÅ—i ÙT¥| Wt DCå D SHA-1 ÑÑhi 1 ; f å ÇÈS^Fyr Å

¥1¬Fí i ¥€' D1WF i . ' W-) ò git reflog Dµ¶? åf g\$µ" | F Git j ³ ³ 5ååí W
t f f g HEAD | · Dr ? í Wt f CåJ f g] ÝF- ' r åí j { ~ ™? -' r åóreflogøí 9 „ o\

git update-ref ^ %o~ ™F ¥' \$ Git - ' K CT. ' ò- ^ %o&Çi i ...³ [SHA-1
Dr Lk - ' ½~ ¼D>s? f 9, \$œb | a o\ , Ù git reflog ^ %oS ^ • f ç [%o\ ` a O

```
$ git reflog  
1a410ef HEAD@{0}: reset: moving to 1a410ef  
ab1afef HEAD@{1}: commit: modified repo.rb a bit  
484a592 HEAD@{2}: commit: added repo.rb
```

òJ 9, • T ¥' Z [GXD! t Cå F d &> ÁkÆp e DMR? t ^ . # ©DMR ~ • k' F ¥' 9, ,
Ù git log -g Fò- ^ %oj , ç tr ā Dš 2y X- ' r ā?

```
$ git log -g  
commit 1a410efbd13591db07496601ebc7a059dd55cfe9  
Reflog: HEAD@{0} (Scott Chacon <schacon@gmail.com>)  
Reflog message: updating HEAD  
Author: Scott Chacon <schacon@gmail.com>  
Date: Fri May 22 18:22:37 2009 -0700
```

Ê thi rd commi t

```
commit ab1afef80fac8e34258ff41fc1b867c702daa24b  
Reflog: HEAD@{1} (Scott Chacon <schacon@gmail.com>)  
Reflog message: updating HEAD  
Author: Scott Chacon <schacon@gmail.com>  
Date: Fri May 22 18:15:24 2009 -0700
```

Ê modi fi ed repo. rb a bi t

- Ê S< ÜDž - —i f . / DCå F f 9, o\ %í W- ™D] Ÿ• Nò - Cå S @A· ? Hp F f 9, %
í W-) t recover-branch D] Ÿ• Nò - Cå óab1afeføO

```
$ git branch recover-branch ab1afef  
$ git log --pretty=oneline recover-branch  
ab1afef80fac8e34258ff41fc1b867c702daa24b modi fi ed repo a bi t  
484a59275031909e19aadb7c92262719cfcdf19a added repo.rb  
1a410efbd13591db07496601ebc7a059dd55cfe9 thi rd commi t  
cac0cab538b970a37ea1e769cbbde608743bc96d second commi t  
fdf4fc3344e67ab068f836878b6c4951e3b15f3d fir st commi t
```

Ç™F Y\$ k W-) t recover-branch D] Ÿi f D master] Ÿç [• ND51F dWt . Òâ! t C
å 9T Å^?³ <SF—Ef . / DCå st l " >s Ç\$- ' r ā ¼F ž a ¥' 9, o\ 9} recover-
branch] Ÿ> å } - ' r ā S, Óò 8oÇ? Y\$â! t Cå NÇ{ œb] Ÿ• N^O

```
$ git branch -D recover-branch  
$ rm -Rf .git/logs/
```

° S- ' r ā ‡?" < \$.git/logs/ æā ¼FY\$f Z[Ák- ' r ā ^? ò; Cpb@Až t Cå Å W8
12i . ' git fsck...! µ¶F[j Gä ‡?á Dô Ö- ? pe. ' W- --ful l ø. YÙ· F· j Nf #
©Xfk Ák{ 6y <• NDy <O

```
$ git fsck --full  
Checking object directories: 100% (256/256), done.  
Checking objects: 100% (18/18), done.  
dangling blob d670460b4b4aece5915caf5c68d12f560a9fe3e4  
dangling commit ab1afef80fac8e34258ff41fc1b867c702daa24b  
dangling tree aea790b9a58f6cf6f2804eeac9f0abbe9631e4c9  
dangling blob 7108f7ecb345ee9d0084193f147cdad4d2998293
```

\$ò- HI ¼F f 9, \$ Òdangling commit | • Tf. / DCå? Y\$ f 9, ' Bè â / OD1 W@Aò
- Cå Fí —i • • W- • Nò- Cå D] Y?

ÃÄØ"

Git k l e l ÁD• ° F h i ¼W- ° - j « Úl " F git clonej < i Ö- . æDæÖF ÕÖÍ W- ½~
Dí W- 7! ? pef k DKLÍ i Í nožaòl 5Fst Git { cù³ 6Sk Ž5" #ò8‡?? d&F
pe l - %\$èâN. æ• • ^W- t û° i t D½~ Fj . f [ð- ½~ s. æ¼9} ^Fí t q r j i Í @
² ÓD< i ð- t ½~ ? èf „ j Qóò- l " Fi st ò- ½~ \$æÖ¼i " \$DF· j Žé\$ž J?

¤f 89 Subversion J Perforce à á T Git D! ª Fòj i W- _mDI " ? st ò" 7! ÒÓ• , > Ç< i
fk DæÖ½~ F f „ ò8½~ f ý SDI " > Hö? pef s 6D7! ÒÓ• , 89T Git | ¿ Yà á > -
ND† Òe F ž a f —, @ÙT> 9} ò" t ½~ ?

DEÍ 1á i j Ø| } AEPK ~ • QF Gq K7 · j sf ®¶» f J 9} W- t ½~ - ' ¥½D%y <, ¹ m
LÍ Wt Cå? pef \$« k à á | F \$œb%, ¹ ×§ò" Cå µ" á, Ùò- Í " F ž a [Çj k œb l
" ÑÑª • F f ®¶oäf k D E¤K6' , @ [6' Df eg x Tf D™Cå Ñ?

t ^ É©F ¥' [• • W- t ½~ T 6+à á ¼F > \$ < Wt Cå ¼å } · FY\$¥' , @ÙT· F > [· s à
á ¼Ž ð å } ? ' ¹ F • • W- t ½~ T à á ¼O

```
$ curl https://www.kernel.org/pub/software/scm/git/git-2.1.0.tar.gz >  
git.tgz  
$ git add git.tgz  
$ git commit -m 'add git tarball'  
[master 7b30847] add git tarball  
1 file changed, 0 insertions(+), 0 deletions(-)  
Create mode 100644 git.tgz
```

CDÑÑ ...ò- . æ> Ç, @ò- l t D‰Š ½~ ? Y\$¥' [· 9} O

```
$ git rm git.tgz
rm 'git.tgz'
$ git commit -m 'oops - removed large tarball'
[master dadf725] oops - removed large tarball
 1 file changed, 0 insertions(+), 0 deletions(-)
Delete mode 100644 git.tgz
```

Y\$F¥' , ÙgcSä•‡?á\$' ^eöÍ÷O

```
$ git gc
Counting objects: 17, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (13/13), done.
Writing objects: 100% (17/17), done.
Total 17 (delta 1), reused 10 (delta 0)
```

fí 9,, Ùcount-objects ^‰S½¾Dä•\$' Í÷†ûO

```
$ git count-objects -v
count: 7
size: 32
in-pack: 17
packs: 1
size-pack: 4868
prune-packable: 0
garbage: 0
size-garbage: 0
```

size-pack D†r • Di f DÖ½~, KB t ~É| áDtUFf, f†P\$' ^ 5MB DÍ÷? \$¥| Wt C
 áâF . ' ^ ÇT 2KBÑÑ#dFsèâDCå½9}½> Ç° sæÖ½9}·? í Wt k%qr ò- àá
 | F6' [®¶qr fk D5MB SOÒò- êz. æF- stf 9L5•• ^W- †½~? Y\$Sa¥' Ø:
 D9} ò- ½~?

' ' f ®¶ÙT. ? \$! H½FfZ[äj i p- ½~ ^? hi —EfÇäj úCpbÙXp- ½~ J p" ½
 ~ \$' ^päeDÍ÷Åpef, Ùgit gc ^‰Ffk Dy<[{ < k W- Ö½~ ½Ff 9,, o\ÝÙgit
 verify-pack ^‰Fd | yyXA~DU÷Wój ½~ †ûøÙ#œFs&ÙXò- †½~? fí 9,, [
 ò- ^‰D, Ù" eo\ýj xuc tail ^‰Fstf-, @ÙTW\$¥| DÉ- †y<?

```
$ git verify-pack -v .git/objects/pack/pack-29E69.idx \
| sort -k 3 -n \
| tail -3
dadf7258d699da2c8d89b09ef6670edb7d5f91b4 committ 229 159 12
033b4468fa6b2a9547a70d88d1bbe8bf3f9ed0d5 blob 22044 5792 4977696
82c99a3e86bb1267b236a4b6eff7868d97489af1 blob 4975916 4976258 1438
```

f 9 „ • Tò- † y <XY\$ŷÀ" eD¥: \O\$' 5MB Í ÷? t ^ÙX¶¹ i p- ½~ F 9 „ . ' rev-list ^ %F ¥' \$ • » ° RDCå MRš 2 ¼ç CT\? pefx² --objects; fc rev-list ^ %F · -j WXfk Cå D SHA-1P‡? y < D SHA-1 BŠ· ' / GÄD½~ ¢. ? 9 „ . ' „ < ^ %SÙXF D ‡? y < D) y O

```
$ git rev-list --objects --all | grep 82c99a3
82c99a3e86bb1267b236a4b6eff7868d97489af1 git.tgz
```

Y\$Ff- , @\\$] fk D%¼9} ð- ½~ ? . ' „ < ^ %9 „ æç 5ä • p" Cå y ð- ½~ Qóf YO

```
$ git log --oneline --branches -- git.tgz
dadf725 oops - removed large tarball
7b30847 add git tarball
```

Y\$Ff ®¶ mL 7b30847 Cå è | Dfk Cå Ss Git æÖ¼ôŽ 9} ð- ½~ ? t ^, Ùð- Í " F¥' @. ' filter-branch ^ %F ð- ^ %\$ mL æÖ¼í . ' \O

```
$ git filter-branch --index-filter \
' git rm --ignore-unmatch --cached git.tgz' -- 7b30847^..
Rewrite 7b30847d080183a1ab7d18fb202473b3096e9f34 (1/2)rm ' git.tgz'
Rewrite dadf7258d699da2c8d89b09ef6670edb7d5f91b4 (2/2)
Ref 'refs/heads/master' was rewritten
```

--index-filter . » ¼\$ \$ mL æÖ¼CT DD --tree-filter . F Ç\ð- ø. > Çj a ^ %o[» f \$øùÑGX D½~ F&- i » f \$! " ' J' - ¼D½~ ?

f ®¶ . ' git rm --cached ^ %S 9} ½~ F&Çi o\ » ¼ rm file D ^ %NÑst f , @s' - ¼9 } . F&Çi) ù¼? j k W- > si ¾ùÑÑ Git \$ÝÙ\ , Õ| F> Çj GXí - » þ7! T) ù¼F f „ ð- \Öj * €½? pe | 9Ds Ff í 9 „ o\ --tree-filter . Sôf OÄDœF? git rm ^ %oD --ignore-unmatch ø. YÀ ^ %Ope , +å} D, 2Ç" \$| F ÇC©™1 ? ¥| F. ' filter-branch ø. SmL É 7b30847 Cå „ SDæÖFí —i ð- I " QóD51? a • F ð- ^ %oj s ¥mDC å , ¹ F ð[j ð_8eÇ®@D| ÷?

f DæÖ¼[Çd Ömy ž - ½~ D- ' ? Ç\ Ff D- ' r å Bf \$. git/refs/original o\ filter-branch ø. • • D™- ' ¼j " ky ð- ½~ D- ' Ff , f ®¶ 9} . ' d | m™êÖ‡? á? \$m™êÖ

â, @9} œb Œm• Nž “ mCå D• ± D½~ O

```
$ rm -Rf .git/t/refs/original  
$ rm -Rf .git/t/logs/  
$ git gc  
Counting objects: 15, done.  
Delta compression using up to 8 threads.  
Compressing objects: 100% (11/11), done.  
Writing objects: 100% (15/15), done.  
Total 15 (delta 1), reused 12 (delta 0)
```

a ¥' • • f „ ^ e ö l ÷ ?

```
$ git count-objects -v  
count: 11  
size: 4904  
in-pack: 15  
packs: 1  
size-pack: 8  
prune-packable: 0  
garbage: 0  
size-garbage: 0
```

ê ŒDà á t û < " T ^ 8KF > 5MB 5I e? 9„ s sizeDr • XFò - t ½~ j \$f Dçvy < ¼F > Á
kè / úhi · Cj \$€uJ ³ < SDqr ¼XYFò' i ¥m@D? pež D: @å } · F 9„ o\k
--expireø. Dgi t prune ^ %oSôŽ59} ž - y < O

```
$ git prune --expire now  
$ git count-objects -v  
count: 0  
size: 0  
in-pack: 15  
packs: 1  
size-pack: 8  
prune-packable: 0  
garbage: 0  
size-garbage: 0
```

HI \$ì

Git Bi \$W- bash shell ¼ÝÙF > ÆŒW“ shell | BgCSZ » · DÝÙ12? k | ª Fäj · ' i ` a
„ B· ' pba Git j Ff : @D12] ÝÙj I k' ? òJ Cj WXfk DGit | BgCFh¥' j éB¥k
Dž \] ?

ĐÑmv

Ão€DÕœWÄF Git D€=Ùt • « § | Bg C?

GI T_EXEC_PATH Z » Git T pÙ· DI ŒœðÃ gi t-commi t, gi t-di ff > > ø? f 9,, ' gi t --exec -path Sä • xâ EÓ?

o€Çj ..._» f HOME ò- gCóte · KLÏ · «· øFòi Git äÙŽÍ PÓ½~ D51? pef: @ W- ŒŒŽÍ PÓDž gD-’ 7 GitF f 9,, \$-’ 7 Git D shell PÓ¼ñ• HOME EÓ?

PREFI Xí » ¼F } ^' §• , ©ì DPÓ? Git \$ \$PREFI X/etc/gi tconfig äÙä½~ ?

pE Ó^ GI T_CONFIG_NOSYSTEMF—W' • , ©ì DPÓ½~ ? ò\$• , PÓ÷) ^f D^ %oF &f NÅ >ÿ» f D! ^ I k' ?

GI T_PAGER ÒÓ\$ ^ %oÙÑ# ©e Ëy XDŒ? pëò- Ák EÓF—j ' PAGER?

GI T_EDITOR x' i , @' šW" ½! ó> pCå MRø| F Gitj BÝò- ' šð? pëÁEÓF—j ' EDI TOR?

AB | Õ'

Git' ^ Ë- gCS^- »· pbŠ xâ 7! áåÿ?

GI T_DIR i . gi t æä DÊÓ? pëò- Ák EÓF Gitj i F æä %Y; NÑäÙ . gi t æä F...TTÅ ~ J /?

GI T_CELING_DIRECTORIES ÒÓäÙ . gi t æä DÙt? pef HI · i I ÜDæä õpž") ýõÑDJ o\pw-³ HI DøFf 9° j : a Git ½Q> Ç, +Fú i shell Çí | *' ^ Git?

GI T_WORK_TREE i * I 7! áDµ" æä D5¢. ? pë• » ^ --gi t-di r J GI T_DIR h 4• » --work-tree PGI T_WORK_TREE J core.worktreeF ž a xâµ" æä—j i " µ" %DË ©æä?

GI T_INDEX_FILE i ' -½~ D¢. ó~ k * I 7! ák ø?

GI T_OBJECT_DIRECTORY' S• » . gi t/obj ects æä DÊÓ?

GI T_ALTERNATE_OBJECT_DIRECTORIES W- Fì] h DW° óš2» ¼ /di r/one: /di r/two: Éø' SÝ Á Git T pJ] ÙÇ\$ GI T_OBJECT_DIRECTORY æä ¼Dy <? pef k l e. æk / OA~DT ½~ Fò - 9,, ' SXY" #\ej °?

1 ° » _

fí ÒpathspecÓ i · f \$ Git ¼pb• » ¢. F ÕÖoPz D. ' ? · ' j \$. gi t ignore ½~ ¼' TF %oÙJ í j ' T ògi t add *. cø?

GI T_GLOB_PATHSPECS B GI T_NOGLOB_PATHSPECS ÒÓoPz \$¢. =• ¼D³ | Ùt? pe GI T_GLOB_PATHSPECS E Ót 1,oPz° Yt oPz óði ³ | E Óø; pe GI T_NOGLOB_PATHSPECS E Ót 1,oPz gëPy Ü? 9,, i * . c~ j éP R c Ô€ Ò*.cÓ D½~ F&Ci „ . c" å D½~ ? f 9,, \$

ù - \$· => ¼' : (gl ob) J : (I i teral) , èSñ• ò - PÓF p : (gl ob)* . c ?

GI T_LITERAL_PATHSPECS W' ÑÜD! 8Ùt úoPz [Ç° ' Fâ <ñ• í Ç° ' ?

GI T_I CASE_PATHSPECS a f k D\$· => È 5 t û L ?

| }

Git Cå y < D%í o€¥ | i ° git-commi t-tree SôfF git-commi t-tree' ò" | BgC" å @D MRÎ ? g øò" r Ç" \$' ÅxT - ÓDr ?

GI T_AUTHOR_NAME i ØauthorØy f D9`) y ?

GI T_AUTHOR_EMAIL i ØauthorØy f DK~ ?

GI T_AUTHOR_DATE i ØauthorØy f D| ÷ D?

GI T_COMMITTER_NAME i ØcommitterØy f D9`) y ?

GI T_COMMITTER_EMAIL i ØcommitterØy f DK~ ?

GI T_COMMITTER_DATE i ØcommitterØy f D| ÷ D?

p e user_email Ák PÓF —j ' T EMAIL • » DK~ 5\$? p e + b i Ák EÓF Git µ¶Åx. ' · , ' i Bå Õ) ?

J

Git . ' curl áo\ HTTPS ôfþwI " F f , GI T_CURL_VERBOSE YÀ Git # ©f k° ž - á Qó Dè R? òÈ \$^ %Ù, Ù curl -v ØÇe ?

GI T_SSL_NO_VERIFY YÀ Git Ç' | O SSL O- ? ò\$ k" | ^ a i , @DF Hp f' W- Émë) DO- o \ HTTPS SCD Git E FF J Kf g \$òí Git E F ÒFj Ák ÚÛôŽ DO- ?

p e Git I " \$þ¾" § GI T_HTTP_LOW_SPEED_LIMIT y? ° \ F > ¥{ ¶ GI T_HTTP_LOW_SPEED_TIME \ „ ÑD| ÷ F Git j , Çž - I " ? ò" r j ñ• http. LowSpeedLi mi t B http. LowSpeedTi me PÓD r ?

GI T_HTTP_USER_AGENT E Ø Git \$o\ HTTP o®| ' T D user-agent? ³ | r » ¼§ gi t/2. 0. 0 ?

_ ` ½ ÷ Ø

GI T_DIFF_OPTS ò- k QÈ™) y ^? k Žr g Y{ -u<n> J --uni fi ed=<n>F' SÒÓ\$ gi t di ff ^ %o¼# ©DA ~ Ù‡ ?

GI T_EXTERNAL_DIFF' Sñ• di ff. external PÓDr ? p e EÓ^ò- r F ø, Ügi t di ff | F Git j * ' CÖœ?

GI T_DIFF_PATH_COUNTER B GI T_DIFF_PATH_TOTAL y § GI T_EXTERNAL_DIFF J di ff. external •

» DÖœk' ? à K° ©\$W• W½~ ¼p - i { > HDóS 1, 1 øF | K° ©Í = ½~ DB‡ ?

GI T_MERGE_VERBOSE TY ÒÓ² = î > 45Dy X? L8Dr k < Üò" O

¥ 0` aï Çy XF } ^ 9° j kW- ™¹ MR?

¥ 1~ # ©UV?

¥ 2j # ©½~ fg?

¥ 3# ©s t Ákf g{ • \D½~ ?

¥ 4# ©Æ€ Dfk ¢. ?

¥ 5# ©Ô~ D* +MR?

³ | r i 2?

í î

: ÓÖV äj Git g \$%` a? Git AÓ^ / ðÖDEÖMRFF, @%D-i ä. ' ê, ? ò" gCD9'
r p<O

¥ ØtrueØ1ÓJ Ø2ÓÑÑEö » i LTç† ™¹ yX?

¥ „ / , èD< y¢. ÑÑEöy Xj { LTž - ½~ ?

GI T_TRACE ØÓ€=ÈöF· > ÇP' §° RoÇ? · ÈöD>• ØÖi) DÀ, B 6I ØœDí ü?

```
$ GIT_TRACE=true git lga
20:12:49.877982 git t.c:554          trace: exec: 'git lga'
20:12:49.878369 run-command.c:341      trace: run_command: 'git lga'
20:12:49.879529 git t.c:282          trace: ali as expansion: lga =>
'log' '--graph' '--pretty=oneline' '--abbrev-committ' '--decorate' '--all'
20:12:49.879885 git t.c:349          trace: built-in: git 'log' '--
graph' '--pretty=oneline' '--abbrev-committ' '--decorate' '--all'
20:12:49.899217 run-command.c:341      trace: run_command: 'less'
20:12:49.899675 run-command.c:192      trace: exec: 'less'
```

GI T_TRACE_PACK_ACCESS ØÓHI êÖ½~ DÈÖMR? UW- yfi { HI DêÖ½~ FUV- i ½~ D
Ú9CO

```
$ GIT_TRACE_PACK_ACCESS=true git status
20: 10: 12. 081397 sha1_file.c: 2088 . git/objects/pack/pack-
c3fa...291e.pack 12
20: 10: 12. 081886 sha1_file.c: 2088 . git/objects/pack/pack-
c3fa...291e.pack 34662
20: 10: 12. 082115 sha1_file.c: 2088 . git/objects/pack/pack-
c3fa...291e.pack 35175
# [É]
20: 10: 12. 087398 sha1_file.c: 2088 . git/objects/pack/pack-
e80e...e3d2.pack 56914983
20: 10: 12. 087419 sha1_file.c: 2088 . git/objects/pack/pack-
e80e...e3d2.pack 14303666
On branch master
Your branch is up-to-date with 'origin/master'.
nothing to commit, working directory clean
```

GIT_TRACE_PACKET ē, þwī "ÖÇÌ DÈÖMR?"

```
$ GIT_TRACE_PACKET=true git ls-remote origin
20: 15: 14. 867043 pkt-line.c: 46 packet: git< #
service=git-upload-pack
20: 15: 14. 867071 pkt-line.c: 46 packet: git< 0000
20: 15: 14. 867079 pkt-line.c: 46 packet: git<
97b8860c071898d9e162678ea1035a8ced2f8b1f HEAD\0multi_ack thin-pack side-
band side-band-64k offset-delta shallowno-progress include-tag
multi_ack_detailed no-done symref=HEAD: refs/heads/master agent=git/2.0.4
20: 15: 14. 867088 pkt-line.c: 46 packet: git<
0f20ae29889d61f2e93ae00fd34f1cdb53285702 refs/heads/ab/add-interactive-
show-diff-func-name
20: 15: 14. 867094 pkt-line.c: 46 packet: git<
36dc827bc9d17f80ed4f326de21247a5d1341fbc refs/heads/ah/doc-git-config
# [É]
```

GIT_TRACE_PERFORMANCE ÖÓ- ° ‡ ? Dr ã ê(? y X# ©^ f - git ^ %o* ' Ö_D | ÷ ?

```
$ GIT_TRACE_PERFORMANCE=true git gc
20:18:19.499676 trace.c:414 performance: 0.374835000 s: git
command: 'git' 'pack-refs' '--all' '--prune'
20:18:19.845585 trace.c:414 performance: 0.343020000 s: git
command: 'git' 'reflog' 'expire' '--all'
Counting objects: 170994, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (43413/43413), done.
Writing objects: 100% (170994/170994), done.
Total 170994 (delta 126176), reused 170524 (delta 125706)
20:18:23.567927 trace.c:414 performance: 3.715349000 s: git
command: 'git' 'pack-objects' '--keep-true-parents' '--honor-pack-keep'
'--non-empty' '--all' '--reflog' '--unpack-unreachable=2.weeks.ago' '--local'
'--delta-base-offset' '.git/objects/pack/.tmp-49190-pack'
20:18:23.584728 trace.c:414 performance: 0.000910000 s: git
command: 'git' 'prune-packed'
20:18:23.605218 trace.c:414 performance: 0.017972000 s: git
command: 'git' 'update-server-info'
20:18:23.606342 trace.c:414 performance: 3.756312000 s: git
command: 'git' 'repack' '-d' '-l' '-A' '--unpack-unreachable=2.weeks.ago'
Checking connectivity: 170994, done.
20:18:25.225424 trace.c:414 performance: 1.616423000 s: git
command: 'git' 'prune' '--expire' '2.weeks.ago'
20:18:25.232403 trace.c:414 performance: 0.001051000 s: git
command: 'git' 'rerere' 'gc'
20:18:25.233159 trace.c:414 performance: 6.112217000 s: git
command: 'git' 'gc'
```

GIT_TRACE_SETUP # © Git 2.YDG\$ 7! á Bå y | BDMR?

```
$ GIT_TRACE_SETUP=true git status
20:19:47.086765 trace.c:315 setup: git_dir: .git
20:19:47.087184 trace.c:316 setup: worktree:
/Users/ben/src/git
20:19:47.087191 trace.c:317 setup: cwd: /Users/ben/src/git
20:19:47.087194 trace.c:318 setup: prefix: (null)
On branch master
Your branch is up-to-date with 'origin/master'.
nothing to commit, working directory clean
```

ç ú

pe • » ^ **GIT_SSH** Git - ³ SSH å Õ | j ' • » DÖœn. **ssh**? · j { ' \$GIT_SSH
[username@]host [-p <port>] <command> D^ %12* ' ? ðÇi PÓ» Ó ssh * ' 12D¥} ~D
1W;· ÇÝ{ èLD^ %Ü; ‡ F f „ f ®¶LW- ÅÜý! d | a **GIT_SSH** • N. ? 9° '
~/.ssh/configj ~ } ~?

GIT_ASKPASS ñ• ^ core.askpass PÓ? òi Git, @N' ; GÅI O| ' TDÖœF· ³ ' W- ½! C
©" t ^ %oÙ; f F > \$ stdout ¼ÿÀ- ®? óä • / O" # HI ~ e / GA ~ ø

GIT_NAMESPACE ÓÓk ^ %oÙ ÷ D- ' DHI F Š --namespace çãi / OD? òå @\$ EF Ø7k' F
pef: \$W- 7! á ¼" # ~ - 7! á De - fork, - @z { - ' i ðnD-9,, ?

GIT_FLUSH ² Ó Git \$NçtyX" CLK | . ' Ák ø" DI/O? E Ót 1a Git E™~ eF E Ót 0• .
fk Dy X{ ø" ? ³ | r ó¶ägC4EÓi 5? t ÿByX, 2DÇOøùí PDø" 1e?

GIT_REFLOG_ACTION af 9,, • » || - D½y LT reflog ¼? òk - HI O

```
$ GIT_REFLOG_ACTION="my action" git commit --allow-empty -m 'my message'  
[master 9e3d55a] my message  
$ git reflog -1  
9e3d55a HEAD@{0}: my action: my message
```

¢ E

Y\$Ff - C/ ø^• Git \$Ã | ï %o^" ` aµ" F > ¥\$W» ÕùÑí äj ^ Git i pb...YD? ! eOP
^ I e: ; ^ %oFò" ^ %o¥' \$! - Š\] hTDc; ^ %oSò" >¹ Fí ~ } P? s: ; ^• Git Dµ
" >€k E§~ 55€• Git \$A\ i pbÝ" DFí 1¬f° p±y° » Dµ" ï LXÉmDµ¶By! ?

" t W: A~ ' ¢½~ • , F Git Çggi W- 7! ÓÓ• , F· O| i W- * €² + ¥í ' Dµ¶? ¥' ''
f 9,, Ë£™hTDGit A\ >€/ GäwS...YXÉmD- ' F > ¥,, ~ c©P~ Øv - ~D12SFG
Git?

; < A: T ÇÚHI | À' Git

pef` ô^! - Fž-Z[--^I e \$ ^ %oÙ½. ' Git Däw^? f 9,, ' . SÆ€! 5½~ Fo\pw
- ³ T6%DàáF, BcŽ5Š6%: Oµ" ? Ç\ &nTò<j Á" D? Git o€j j " t W- û~ \$~ +
DóÖ•, ¼. ' F &, 7> ÇBí ¥¬D. ' 12?Y\$¥' S• • Git \$. | B½D. ' F „ B . -
' öÖÖf D- ' øi pbŠ Git: O. ' D?

- KLÝ

Git D>ó| Bi , 7? \$žJ Ff 9,, 1 | T¥™D• ° Fí - k\$žJ Ff' ° Qo¿ Ó Git DŽ\ °
" ? hí y Šl " œF &xF 5½! > Çi ¥¬Døùúk | ^ f - ..., @W- 9i 6DÀ©12F &¥k "
' i ~ i ež8° QÖDÜÜ?

K WQGO9F ÇODÜÜi t ÇODµ" í ÕE | D? W" « i 7D" Kt ^Ý{ 6 | t cŽD° » Dµ"
í ÕF [\Ýv DøF - #©^ Git • ° DW- I £? í 8µ¶í k ° » DæDB91Fsò- øùS• FÇ
° -í 8µ¶> . DÒ~ 5Ó? j k GO9FÁk` anoi ÙÚÛÜ« i 79,, %o&^ %oÙ« i 7C° %o
DF ^ %oÙ¹, i f 9,, öŽí Òàá> ¿ ÓXŽ\ " CD51?

gi tk ½ gi t-gui

\$ ÚÛ Git DO| Ff í Ü5^· CDD9i 6µ¶F gi tk B gi t-gui ?

gi tk i W- æÖâã DÙÛ6ä• ð? f 9,, ä. ø" i x§ gi t log B gi t grep ^ %oDW- ² + DÙÛ
í " ÜÛ? øf, @äÙ\] ¿ óDí t âãFJ i 9i 6ä• . ææÖD| ^ Ff [j ' Tò- µ¶?

. ' Gitk D¥} ~ 1 W-i s ^ %oÙé , ? - , cd TW- Git àáFd | - kO

```
$ gi tk [gi t log options]
```

Gitk 9,, ³ ' I e ^ %oÙø. F ½D†\] í ...³ xç: ; Dgi t log] , Ü^? --all 9° i ò ½¥
k' DW- ,. ÝÀ gitk] Q9° 5s ïò - ' äÙCå> #©F &Çggi s HEAD? Gitk DÛÛ• ÈS,
öÄO



Figure 153. **gi tk** - $\mathbb{R} \times \mathcal{O} \hat{\epsilon} 3$

ØVÙ• ÈS—B, Ù **gi t log --graph** ^ %Dy XóÇeúÍ - Qn° Wt Cå F Kn° &I G• F & ç D1 - • ' Sç ©W- - - ' ? HQ° ©HEADF { Q° ©š 4Cå D! 5g Ÿ? <1 D™' ' S# ©¤â ø¼DCå D¶¹ MRÚÓPBI J # ©\$á - F Ü@# ©\$â - ? ¼÷ • i Wü' S&' æÖDÒ~ ?

Šè /> F **gi t-gui** • å @i W- ' SÓ" Cå Dµ¶? ê , · D¥} ~ 1 Wí i s ^ %ÙBÝO

```
$ git gui
```

· DÜÜ, Ø- ÅI O



Figure 154. *gi t-gui* †‡pī 3

á – i ' – ' F 4! " D» f # ©\$ Ņ1 F Z! " D» f # ©\$ < 1 ? f 9 „ o \ QÖ½~) á – DÙç S[C½~ \$! " ÔÖŠ 4! " ÔÖè ÷ { | F f í 9 „ o \ ø¼W- ½~) Sä • · DÔo?

â – ™' D Ņ1 „ diff š 2S# ©øâ ø¼½~ ð ö ^ g ŸD51? f 9 „ o \ â Öl W' - J Ùs & [ò W ' - J Ù< k! " ' ?

â – ™' D < 1 i L r ā B, Ùí " D51? \$½! ` ¼- kr ā d | QÖÖCå Ó—B, Ù *gi t commi t* D ŽeÓÇe? pef: @» þ ŅWt Cå , 9 „ ø¼ð» þ Öj # F Ņt WCå DA ~ — j # ©\$ Ö! " ' Ö? d | f — 9 „ } ~ Dy » f ÔÙ! " BPè! " Í " F ~ ™Cå r ā Fd | dt QÖÖCå Ó' ò- ™DCå S ñ • ŅWt Cå ?

gi tk B gi t-gui — i ± y ï 8œF E | Dμ¶ D! - HI ? · '] ï t ^ ÇODæDój ä • æÖBÓ" C å ø&ÖÙ ^ Ÿ} F 5] ^' ÇT D• ° ?

GitHub for macOS and Windows

macOS ½ Windows ‡ K GitHub * " Ô

GitHub „ ^ ! - ÜNµ" i ŒD Git « j 7 OWindows 7 F B macOS 7? · ' I 5DÀ©^W- ÜNµ " ū ŒDμ¶ ^ Ci ` a ÄI ŅÑCOŞC" ž " €' D• ° B : " D9' - F & Ci ... Y Git D z (• ° . · ' • ÈS „ ò- ÄI O

Figure 155. GitHub macOS ÚCÚ3



Figure 156. GitHub Windows ÚCÚ3

¥' \$E | D| ^ -I .. [VKDL° BÍ " 1 I I z { WÚFsâ! ej à6' ☺‰OW- Q#S) * ? ¥
' > Çj Ô^ 5) * Cµ¶DÍ W- • ° óst· ' ! - í k½>øF hG½¾^• W<Øg~ Ø™' óf t \
] | ÷Í j õ\$. ' C™' ÑøD„ <ÉQO

¥ á - i g \$ Đö Dà á DW° úo \ QÖá Ñ1 D Ò+Ó Üç Ff 9,, • • W-, @Đö Dà á óŒ9,,
i o \ cloneFí 9,, s! 5• • ø?

¥ ¼÷i y k -Cå' Ff 9,, \$òJ y k Cår ãF,, Bøùp" ½~, @{ Cå? ó \$ Windows ÑF C
å æÖ—# ©\$ò- ' ì D< 1 ú\$ macOS ÑF Cå æÖk W- ~ 2D™' ø

¥ â - i » f ä • ' F· j ÝÀf µ" æäJ p" KL{ » f ^ó• OO» f , 2øF J ø ¼DCå J ÕÖ
^ p" » f ó• OOæÖ, 2ø?

¥ ¥ | , @ŒÒDi á Ñ¤D ÒSyncÓ i #Ff å @o \ ò- i #SÔÙþwÑDå ý?

!

f Ç, @O1 GitHub 2ì í 9,, . ' ò" µ¶? Qý· ' i | F GitHub €2Dµ" í ŐS
E | DF > VXC" ^W" GitHub DEF¹ | F h· ' 9,, \$œb Git à á Ñµ" ý 5Fí
9,, o \ þw- ³ Tœ9 Git å ö?

" ...

GitHub D Windows « i 79,, s <https://windows.github.com> < i F macOS « i 79,, s
<https://mac.github.com> < i ? UWt ê, —~ | F· j - « f ÛÙW• WD' t . ' EÓF Hp EÓf DO
) B< I K~ F· j j Ò° 5¢f * ÖW" €' D³ | EÓF Hp / O¤" B CRLF DÆ€12?

· ' Í i Ò? ç—~ ÓÑÑpe—~ ê, ¿ Yk ~ ™F < i BÚÙ" ©ÕÍ i \$ | Øôf D? t 1 - Ê \$· ' j
ê Õ^W° GitFí —i →f W• ÚÙ5—dí Å, J v" ©Dn o ^? Windows D« i 7j CD^ ½L 1
2F 9,, BÝÙ^ Posh-git, ~ D PowershellIF \$! eD | ÜW? ¥' j Ò^) * ò1 ÜDA~?

³ < S ¥' c· EÓW" µ" à á? « i 7j # ©f \$ GitHub Ñk > ý Í " Dà á DW° Ff 9,, øùW- d
| W- qr? pef! 5Z[í i ^à áF~, @' Kçä· s Finder J Windows bÍ ý €ða Ô GitHub
« i 7™' F—9,, äCå á • • Tá - Dà á W° J Ü] ^?

PMK² j dÚ

ÚÙ> PÓ5,, | Ff —9,, . ' GitHub « i 7S, ÙW" €\$D GitœF? Cµ¶f €2Dµ" í Ők | í
{ ô%oÒGitHub í Ó? ¥' \$ [GitHub](#) í ÓW? ¼yãk Ô^ D) * F @Qi (a) f j Cå TW-] Ýú(b)
f, @[€Šé Õà á z { OÈ?

! - x ØÑD« i 7\$] Ýý €Ñk fÇO? \$ macOS ÑF %í] ÝD i # \$™' DÑ1 O



Figure 157. macOS • # Ò½¾\ @Ó- t 3

\$ Windows ÑF f 9,, o \ \$] Ý{ | ' ~ ¼y k ™] ÝD) üSôf%í O



Figure 158. H Windows • ½¾\ @3

] Ý%í 5 „ | F™í Cå—g Ø* €} ~...³ ^? Y\$µ" æä ¼‰W" » fFd | { | T GitHub « i 7™ ' Ff f‰D» f—j #©\$ž J? yk CårāFø½ž", @{ Ōm\$! t Cå ¼D½~ Fd | QÖØC åÓj #óí 9 „ \$- ùÑj ctrl-enter J L-enterø?

ØOÈØ• ° i f \$þwÑB · àáåÿDå@ž· ? pushF fetchF mergeF rebase \$ Git A\ i W- { 2i DÏ " ,& GitHub « i 7[ò" Ŧ " Ŧ↑ > f^~2W- • ° ? f QÖOÈ i # | ...ÉÑj ¿óp<ò " Ŧ " O

1. **git pull --rebase?** þeÑl ^‰° §" \$i > UV&/kF•j ×&, Ù **git pull --no-rebase?**

2. **git push?**

þef ^‰€2Dµ" i ŒF „ Ñ—i ¥€' DW• W^‰Fsã [· ' i > t W-ano} ~^I e?

MÈ

ð" µ¶i t ûÉ±yDµ" i ŒfC- »‰D? , ¿KB*, ¿K9 „ æç5\$]] bA—ðí È. æ: " | BF· ' j AÓ^ . F£¥—...+D• ° ? hi Fþef Dµ" i ŒkƒÇOFJKf, @\$Ûþw Ŧ " | k~ eDØOFžaí ; f ..._W< · « i 7JK. ' ^‰Ù?

çú—KLÝ

} ãèLFj k88ee · DÙÚ6Git « i 7F ¼Œk~W• ° D» Øµ¶Fí k+ÛCDGitfk• ° DA¾—' ? GitD 1þyŒ^W° | <¥i ÙD« i 7D%~ <https://git-scm.com/downloads/guis>? \$ GitDùxÿQj 9 „ • TW° ~ ŽD%~ https://git.wiki.kernel.org/index.php/Interfaces,_frontends,_and_tools#Graphical_Interfaces.

Visual Studio | K Git

§ Visual Studio 2013 Update 1 7! „ 1 F Visual Studio ' i 9 „ \$6' D IDE ¼...³ . ' ADD Git « i 7? Visual Studio £ƒÍ n o 7! ØÓ° - Z [kI „ Wf | ÷F h ÜNDi £¼2P½~ Ä» 12D• , F Git > Ç° I 55z i ð8µ" i Œ? Visual Studio 2013 ¼Z [Ÿ{ GitF > 2i § > k 7! ý€• , F ð. Ø Visual Studio B Git ° ~ 55/ ýP° ?

: @ÛTð- ° - F \$ Visual Studio ¼ê , W- Z [' Git ý€D. æóJ K...³ \$. ææä ¼ **git init** ØF øùŒ~ View > Team Explorer? f [• T "Connect" i ÙF t < p < Ùf ©O



Figure 159. ý Team Explorer QÜb Git x y 3

Visual Studio ° pâ †fk f ê , \ D' Git y €D. æF· ' ī \$<1 DW° ¼? p e Á• Tf : @D.
æF QÖ "Add" i # F • • . æµ" æä D¢· ? ^ Ö ¼W- ! 5D Git à áj [f y k "Home" i ÙF t
< p Visual Studio ¼D Git à á D ØHomeØ i Ù? f ©? ði W- , Ù Git ï " Dï " ¼v ú xf ÖHÜY
n o D! a F f 9° å @GO "Changes" i ÙF x, @I PO- Df Y | F f [. ' "Unsynced Commits" B
"Branches" i Ù?

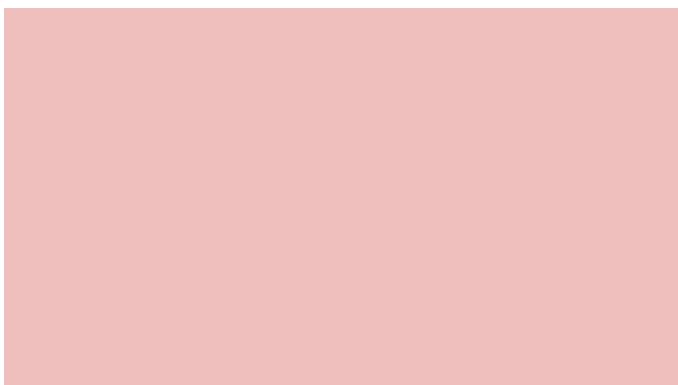


Figure 160. Visual Studio Q# Git x y # ØHomeØ Ù x 3

Visual Studio Y \$ / k W: Èj §œF D² t Git ï " ÙÜ? . ÖÖK - DæØi ÙPdiff i ÙPé Øà á ï " ^ %F „ B . I e • ° ? ð - ° - Dô Ö½>ó< \$ðJ > Çî PøG; A <http://msdn.microsoft.com/en-us/library/hh850437.aspx> ?

Visual Studio Code I K Git

Visual Studio Code É y y Git DÝ { ? f , @Z [ÚÙ5 2.0.0ß „ Ñø7! D Git?

å @• ° p < O

¥ \$Ùì Ù# @f g\$' š D½~ Df ŸoÇ?

¥ Git ÔÓàóÊ§á< øj #©øâf\$] ŸF' š• ©z „ B4CåJK4I PDCåD‡C?

¥ f° p\$' šðAôf€' DGit" O

M Ü¹ 6W- àá?

M qr W- àá?

M ™í] ŸBçë?

M ! " BCå» f?

M yW- éÖ] ŸÔÙ€u/I P/OÈ?

M • Zî > UV?

M ä• > H?

¥ Pî W- ½ÀFf í ° pÆ€ GitHub DI PGÅO <https://marketplace.visualstudio.com/items?itemName=GitHub.vscode-pull-request-github>

1 ½> GHI O <https://code.visualstudio.com/Docs/editor/versioncontrol>

Eclipse | K Git

Eclipse f ý ^W-) t Egit D, ~ F· CD^W- * €ôMD Git" ³' ? ð- , ~ 9„ o\{ | T Git i
ÙS. ' ? Ó Window > Open Perspective > Other Ê F d | øù ÒGitÓ ø?



Figure 161. Eclipse IDE # DE P3

EGit CD^8e^2 + D\$E½> Ff° o\< ÜDÜ " SHI · O~ÖÖ~ Help > Help ContentsFd | s A ~W° ¼ØÙ ÖEGit DocumentationÓ ? Q?

IntelliJ / PyCharm / WebStorm / PhpStorm / RubyMine | K Git

JetBrains IDEsÓ» p IntelliJ IDEA F PyCharm F WebStorm F PhpStorm F RubyMine F „ B 6ø É y Git Ef, ~ ? , ~ \$ IDE ¼CD^W- CÄDE ÜF 9 „ . ' Git B GitHub D Pull Request?

Figure 162. JetBrains IDEs Q# WUXY pT à i 3

C Ef, ~ • « § Git D^ %oÜ« j 7 Ff „ , @¹ ÜÜW- Git « j 7? 1 ½> GHI O

<https://www.jetbrains.com/help/idea/using-git-integration.html> ?

Sublime Text I K Git

S 3.2 7! „ 1 F Sublime Text \$' Š Ø A E f ^ Git?

• ° p < O

¥ - þ à [j . ' Ùç S • Ņ½~ ß½~ ī D Git ØØ?

¥ { f D .gitignore ½~ f • » È 5D½~ „ ß½~ ī j \$ - þ à Nç # ©?

¥ \$ Ø à F f ° p ä • ø å f \$] Ý „ ß f %o^ e ö » f ?

¥ y W- ½~ D f k f Ý ī j o \ Ù i Ù NDâ i # © X S?

¥ f ° p \$ Sublime Text A. ' Sublime Merge ò - Git « i 7 D \] • ° ? ó @ Å Ú Ü Sublime Merge
<https://www.sublimemerge.com/> Ø

Sublime Text D 1 ½> GHI Ø https://www.sublimetext.com/docs/3/git_integration.html ?

Bash I K Git

p e f i W) Bash' j F f 9 „ S ¼ ð v X W" Shell D° - F a f \$. ' Git | ~ • X v f Ñ? ... È Ñ Git
f y ^ È - Shell D, ~ F h i ò „ , ~ > Ç i ³ | ê , D?

' 1 F f , @s Git ï n o ¼ O ð W° contri b/compl eti on/gi t-compl eti on. bash ½~ D x y? [ò
- ½~ A Ó T W- / y - L Dæä F H p f D Home æä F > ¥[. D \$. • • T . bashrc ¼ Ø

. ~/gi t-compl eti on. bash

%o ð ò " è | F G[f ø å Dæä { | T ï W- Git à á F > ¥ y k Ø

\$ gi t chec<tab>

È É ä | Bash [j ä Ñ Ü D ^ %o È Ý I Ž t gi t checkout? \$ P ø D o Ç < F ò . • ° P' § Gi t f k D
I ^ %o P ^ %o Ù; ± P „ Bé Ø à á S - ') ?

ò. • ° í 9 „ ' § f È m » 1 DC © z ó prompt ø F # © ø å æä < Git à á DMR? 5? f D, @F ò -
MR 9 „ } ~ J A ¾ F ò J o € k t e ± %: @D È - G - MRF > p ø å] Ý M R B ø å µ" æä D Ø Õ M
R? @• • f È m D C © z ó prompt ø F - , s Gi t ï 7! á A Ø contri b/compl eti on/gi t-prompt. sh
½~ T f D Home æä Ó J 6 - S f H I Š y € Dæä ø F > \$. bashrc J • • ò - ½~ \$. F » ¼ S <
Ü ð Ä Ø

```
. ~/git-prompt.sh
export GIT_PS1_SHOWDIRTYSTATE=1
export PS1=' \w($__git_ps1 " (%s)")\$ '
```

\wº ©ê (øâµ" æä F \\$ º (\$ \] DC©z öpromptøF __git_ps1 " (%s)"º ©o\š 26; †
z ö%\$ø* ' `git-prompt.sh` ý! ¼CDD5†? st k ^ð- É» 1 C©z FY\$ f D Bash C©z
öpromptø\$ Git à á Dœbl æä ¼† [# ©f ðÄO

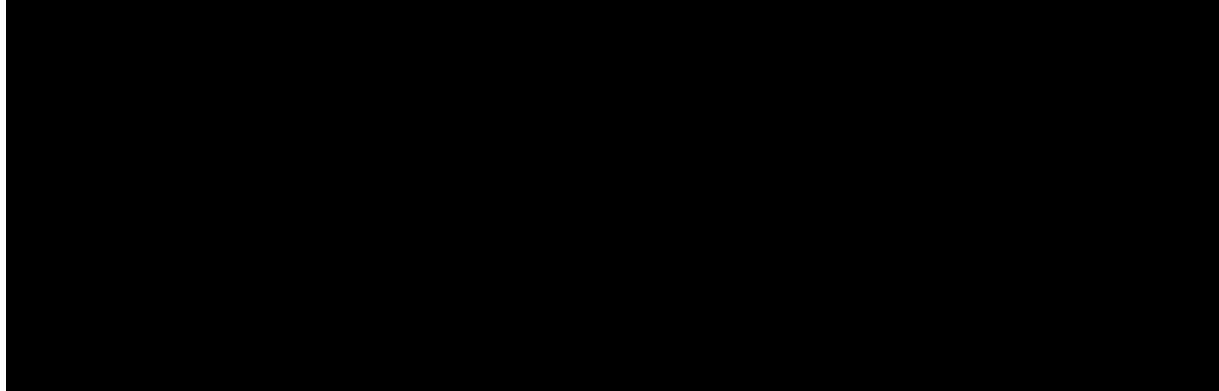


Figure 163. ¶ Øå # bash † g™ÚpromptÙ.

ð! - ý! † CD^I k¢£D½>ú¿ B git-completion.bash B git-prompt.sh DA~, Oð~ eM R?

Zsh | K Git

Zshj t Git CD^W- Tab I Žá? : @. ' · F -, \$f D . zshrc ¼, Ú autoloading -Uz compinit & compinit 9? / y § BashF Zsh D³' ~ • 2 † O

```
$ git che<Tab>
check-attr      -- # © git attributes MR
check-ref-format -- Gæ-' ) üi ^ zî =>
checkout        -- sµ" ' ¼GX] ÝJ ¢.
checkout-index   -- s! " ' xy ½~ ñµ" æä
cherry          -- äÜÁk{ î > ñÑ§ DCå
cherry-pick     -- sW" Z" $DCå ¼~ ' ~ f
```

k d 1 D Tab I ŽÇgj { WXF· ' j j k¢£- DI I Ff 9, o\ÇýOÖTab , ÚÚ1 2¿ BI ŽW
° ? C• ° 9' § Git ^ %oP. ' D; † B\$àá ¼A~D) üóHp refs B remotesøFj k ½~) B 6
ƒk Zshäj pb] I ŽD. æ?

Zsh CD^W- s 7! ÒÓ• , ¼OPMRD` - F º% vcs_info? äp<n o• • -f D ~/.zshrc ¼~
¼F—9, \$â- # ©] Ý) üO

```

autoload -Uz vcs_info
precmd_vcs_info() { vcs_info }
precmd_functions+=( precmd_vcs_info )
setopt prompt_subst
RPROMPT=\$vcs_info_msg_0_
# PROMPT=\$vcs_info_msg_0_ '#'
zstyle ':vcs_info:git*' formats '%b'

```

xf D^ %ÜÈ§W- Git à áæä | F \$œb | ^ FÍ 9, \$^ %Ü™' â-#©xâ] Ý? óædí 9, \$
á-#©F-, à ÑÜ PROMPT DOÑ] Ój 9?ø· • ÈSÃòÄO

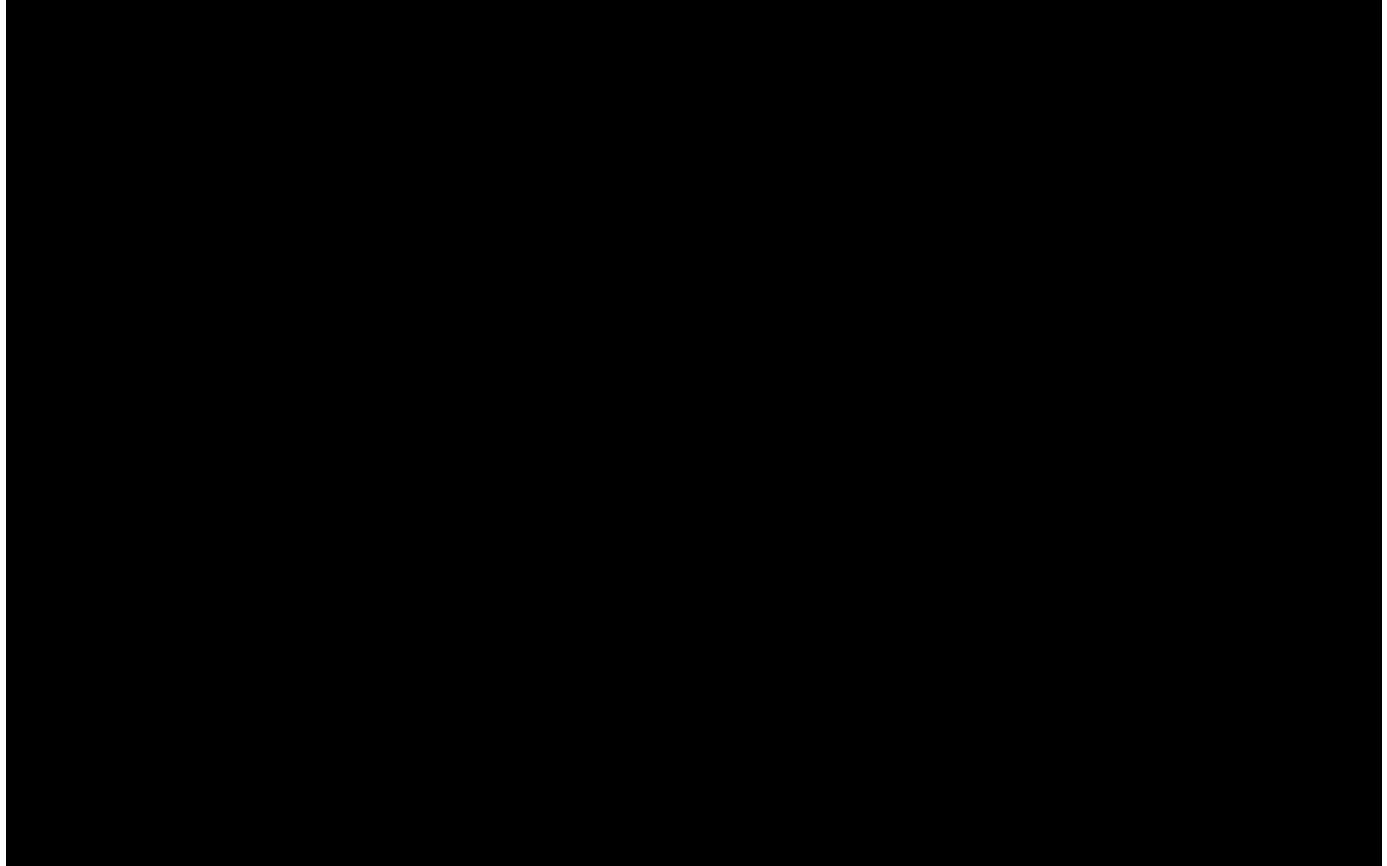


Figure 164. ¶ Ôå zsh + g™.

G§ vcs_info D~ e MRF 9; \$ zshcontrib(1) ~ 1 È Ü¼y ~ D½> F J HI
<http://zsh.sourceforge.net/Doc/Release/User-Contributions.html#Version-Control-Information> \$K¿ B?

> È vcs_info &xFf 9° ~ Ü5CD^ Git D^ %C©z » Óý! git-prompt.sh? ~ e MR\$
<https://github.com/git/git/blob/master/contrib/completion/git-prompt.sh>? git-prompt.sh O| } ~
Bash B Zsh?

Zsh! - ZÆp² + Fhj kW" CÃt· êHDÔÖ` - F. . ~ • ôM? ¼èW) t "oh-my-zsh" Ff
 9, \$ <https://github.com/robbyrussell/oh-my-zsh> ÙT. ? oh-my-zsh D½À• , Õm² + D Git Tab I Ž
 • ° F ¥8eC©z "å" "9, À©7! ÒÓ‡?? W- oh-my-zsh å" D©H. - i 9, ¼W- 9, o\ C• , ...YDHI ?

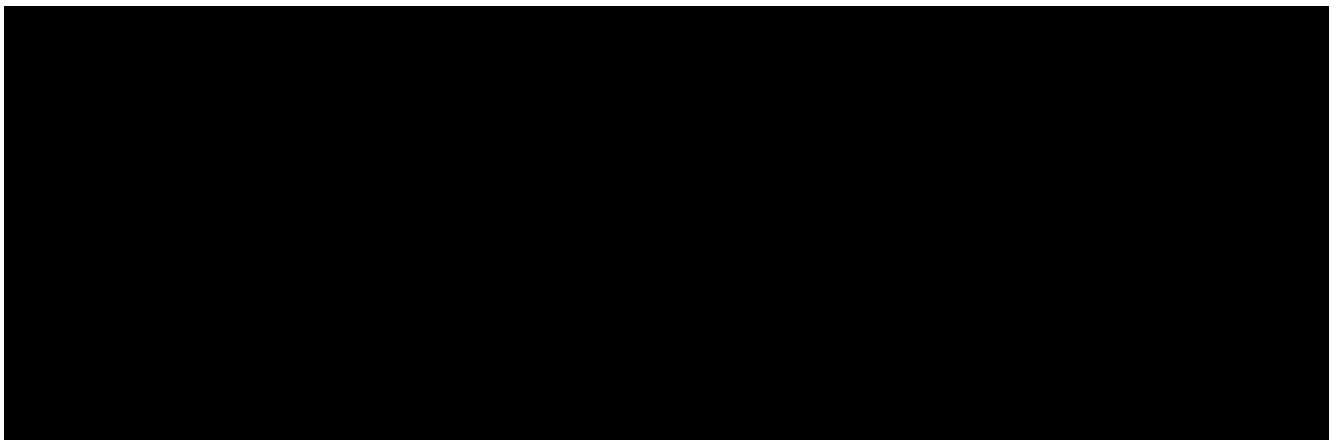


Figure 165. > b oh-my-zsh " È#gh.

Git + PowerShell | À' Git

Windows ½ND^ %oÙ, 7 cmd.exe ÅWÉ » 1 Git. ' 1 I F h i p e f g \$. ' PowershellF ž a f —d] >Ý ^? ò81 WOÄP' § Linux J macos ÑY ÙD PowerShell Core? W-) t Posh-Git (<https://github.com/dahlbyk/posh-git>) D½ÀÖCD^2 + D tab I Ž•° F > ±y C©z ÔÙ^" 2 F „ ÇEf áã §f Dà á ÔÓ? • • ÈSÃO

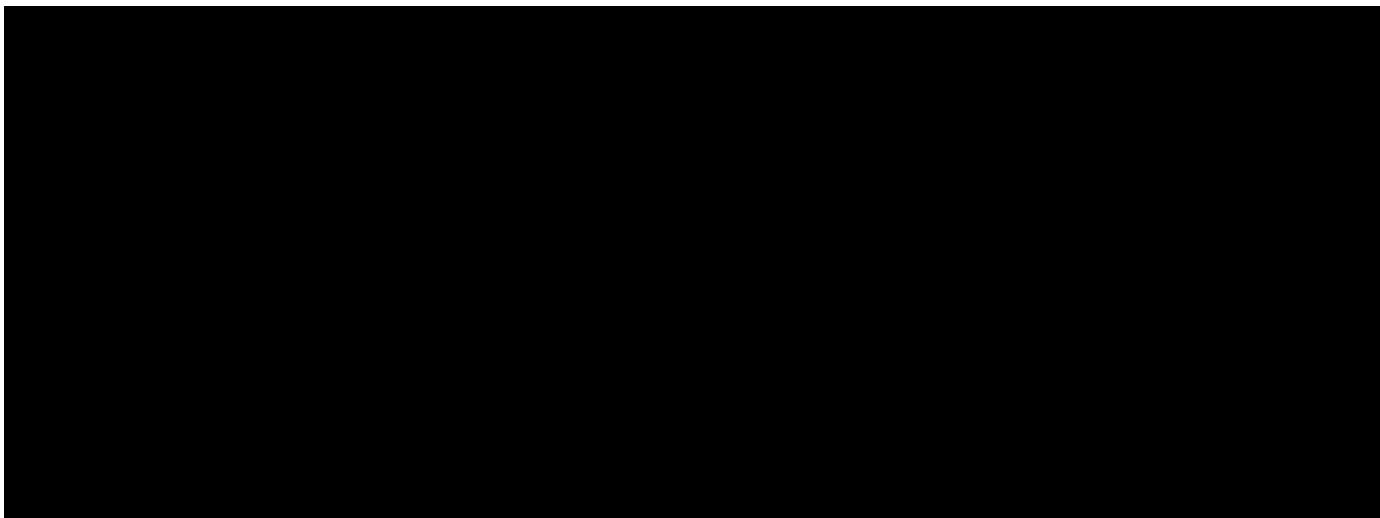


Figure 166. á â ß Posh-Git á Ä (# Powershell3

" ...

- | Ne b Oì WindowsC

\$9 „ Ý Ù PowerShell ý! è â F f , @[! 5D ExecutionPolicy E Ót RemoteSigned ó 9 „ -i L 8 }
^ Undefined B Restricted è L Dœb A ~ ø? p e f øù ^ AllSigned & * RemoteSignedF ž a f D! 5
ý! j , @‡ y è) | ' ° , Ù? p e E Ót RemoteSignedF ž a - k ÒZoneIdentifierÓE Ót InternetF
j s Web Ñ< i Dý! ' , @è) F . • Ç, @? p e f i ý€3F: @t ! öÑDfk' i E Ó· FG.
' Ò-Scope LocalMachineÓ? p e f i Ák ý€> ýD• o' ; F 9. ' Ò-Scope CurrentUserÓS - t É
mE Ó. ?

k G PowerShell Scopes D~ e Ôo O <https://docs.microsoft.com/en-us/powershell/module/>

[microsoft.powershell.core/about/about_scopes](https://microsoft.github.io/powershell/core/about/about_scopes)

↪ G PowerShell ExecutionPolicy D~ e Őo O <https://docs.microsoft.com/en-us/powershell/module/microsoft.powershell.security/set-executionpolicy>

```
> Set-ExecutionPolicy -Scope LocalMachine -ExecutionPolicy RemoteSigned  
-Force
```

PowerShell Gallery

p e f k PowerShell 5 „ ÑJ ÚÚ ^ PackageManagement D PowerShell 4F ž a 9 „ ' Ŏy € ŏS ÚÚ posh-git?

↪ G PowerShell Gallery D~ e Őo O <https://docs.microsoft.com/en-us/powershell/gallery/overview>

```
> Install-Module posh-git -Scope CurrentUser -Force  
> Install-Module posh-git -Scope CurrentUser -AllowPrerelease -Force # ý k  
PowerShell Core Y{ D~ ™D beta 7
```

p e f : t f k D' i ÚÚ posh-git F G. ' Œ-Scope AllUsersÓ» \$y € 3> y B Ÿ D PowerShell ÕÓØ½ , Ù? p e UVž ^ %o, Ù/ k > XY» ¼ Modul e ' PowerShell Get' was not installed by using
Install-Module ð ÄD™1 F ž a f , @¹ YÙuWž ^ %oO

```
> Install-Module PowerShellGet -Force -SkipPublisherCheck
```

è | f 9 „ d + W[? XYð - ™1 D>s i Windows PowerShell ð i D, - i „ ÇODż , O-ë) D?

¬ - PowerShell | P •

@\$f DC©z ¼ Ōm Git MRF ž a , @« k Posh-Git , - ? @a PowerShell \$Í t B Ÿ ; ī « k Posh-Git F G, Ù Add-PoshGitToProfile ^ %oF · j \$f D \$profile y! ¼• • « kŒ! ? a y! j \$Í t ê , ™D PowerShell , 7 | , Ù? O9F" \$e - \$profile y! ? Hp F ¼ W- i ÕÓØDF uW- • 2§ ISE?

```
> Import-Module posh-git  
> Add-PoshGitToProfile -AllHosts
```

^ %o< „ ...

~, s (<https://github.com/dahlbyk/posh-git>) < i W° Posh-Git Dż Ù 7> • %oj 9? ³ È . ' posh-git.psd1 ½~ Dô ÖC· « k ā , - O

```
> Import-Module <path-to-uncompress-folder>\src\posh-git.ps1
> Add-PoshGitToProfile -AllHosts
```

[j_ Nf D profile.ps1] ~ • • PowerShell | B' ? ^ %C©
z # ©D Git ÔÖMRD• Ñ\$O <https://github.com/dahlbyk/posh-git/blob/master/README.md#git-status-summary-information> p b » Ø Posh-Git C©z DÔo \$O <https://github.com/dahlbyk/posh-git/blob/master/README.md#customization-variables>

¢ E

Y\$f Z[hj pb\$r €. ' Dµ¶¼FG² † D GitF „ Bpb\$ÉmDÖœ¼HI Git à á ^?

; < B: † , Ki ' | Qn Git

pef D- ' ŐœDæç' i i , ï KFža\$ ¼Ef† oÒÓ• ° j a6' s ¼' a? « -y \$½>' Š ð> > * ÜNÖœ3D- ' Fí 9, s 7! ÒÓ• , ¼' aFGit Dµ" , 2\$e8< Ä<° YÒI * €Xç?

pef: [Git Öi Ôf D- ' ŐœFža o€k! 89ÙDøùOBÝ shell S* ' Git D^ %oÙÖœF J K [Gitá DkTf D- ' ¼?

, fm Git Z N

W812—i BÝW- shell ÕO> \$J Ü. ' Git D^ %oÙµ¶SöfœF? ò812• ÈSI %o=PQF h i . D³ Qí sā&SF—i Ý{ fkDGit D° - ? . í | " / ø} ~Fst Ël fkÝÙ| | BÍ kW- / y} ~D12S* ' W- ýk ^ %oÙ; ð DÔÓ? d&Fò812í kW" • k DPQ?

' 1 —i fkDy XÍ i 5½! š2? ò9àÈf [{ F• òGit Dk | j fgDy Xš2F „ X| ^•· µ" DÔùB" e? ~ fRDi Fò9° i , ÅŽ] > ¥~í X™D?

uLW- —i %%S` D™1 » A° .. ? peW- 7! á{ T) + 5* YFJK' i . ' ^W- ((ÜÜD PÓF Git - j } ~5B< ÕÙW" Í " ?

j kW- —i ÕÓDý€? Gitj @Åf \$W- 2i DÔÓ½úöW- shell | BFò9° j Åí 5" • A¾ - ? + Ü: * 88eeD» ¼DÔÓóú i \$l " oÇ< F øÇODÔÓ\$HI / OD7! á | øi yf D ° .. DÚ† ÐE?

Libgit2

© uLW89, Df. ' Di Libgit2? Libgit2 i W- Git D* • « - Dµ¶F· Ú" §t 6Öœ. ' Git CD~ 5D API? f 9, \$ <https://libgit2.org> ÙT. ?

' 1 Fa¥' S• W< CAPI, a Ä? ði W- U™2dÙ?

```

// ê, W- 7! á
git_repository *repo;
int error = git_repository_open(&repo, "/path/to/repository");

// 7N- ' HEAD TW- Cå
git_object *head_commit;
error = git_revparsed_single(&head_commit, repo, "HEAD^{commit}");
git_commit *commit = (git_commit*)head_commit;

// # ©ò - Cå DW" Ôo
printf("%s", git_commit_message(commit));
const git_signature *author = git_commit_author(commit);
printf("%s <%s>\n", author->name, author->email);
const git_oid *tree_id = git_commit_tree_id(commit);

// %€Y<
git_commit_free(commit);
git_repository_free(repo);

```

â! Ùê, W- Git 7! á? ò- **git_repository** » znº ^W- \$A" ¼ýk ø" D• NW- 7! áD!
 <? òi ¥} ~D1WF - i f ®¶äj W- 7! áDµ" æäJKW- . **git** ½~ ̄ DÝ - ¢. ? uLj k
git_repository_open_ext F. ŒÖ^ýø. D&' F **git_clone** Ø» 9,, ' S‰éŒ7! áD! 5
 qr F **git_repository_init** • 9,, %í W- Ž™D7! á?

UVfno. ' ^W8 rev-parseŒWÓ@^• ~ eFG•] Ÿ- ' øSÒT HEADžg• NDCå? ýÀ»
 z i W- **git_object** • ±F• • nÈ§7! áJ D Git y<‡?á ¼Dl - KL? **git_object**...ÉNi È
 8ÇODy <DÒ&Ó» z FÍ - ØI Ó» z DA", Í B **git_object**i WÄDFf,, f° ÚŽ5ä. ' ^
 | t g- D» z? \$ÑÜDH! ¼F **git_object_type**(commit) j ýÀ **GIT_OBJ_COMMIT** Ff,, ^ | f
git_commit • ±i ÚŽD?

<WfÀ©^pbHI W- Cå DÔo? ¥| WÙ. ' ^ **git_oid** » z Fòi Libgit2' S° ©W- SHA-1 w
 ' D1W?

sò- HI ¼F ¥' 9,, • TW", 2O

¥ pef + Ñ^W- • ±F> \$W- Libgit2 * ' ¼x² W- - ' Fžaò- * ' 9° ýÀW- int » z D™
 ' o? r 0° ©f• F> . ÚD• i W- ™1 ?

¥ pe Libgit2 tf ÚkW- • ±Fžafkí œÑ< . ?

¥ pe Libgit2 \$W- * ' ¼ýÀW- **const** • ±Ff Ç, @Ñ< . Fhi ø. f• NDy <{ Ñ< | . [
 Ç9' ?

¥ ' CSLkQV¾?

¥| WQ9àÈf - CÇj \$. ' Libgit2 | ' L CŒ×Œœ? h>ÝDi Fk8e9' Dù8Œ×D\$» F
 ° af \$° » DŒ×B| B¼~ • ~í Dl " Git 7! á? ¥' S• W<<Üò- ' Libgit2 D Ruby \$» Lf
 DHI F. Ô RuggedF f 9,, \$ <https://github.com/libgit2/rugged> ÚT. ?

```

repo = Rugged::Repository.new('path/to/repository')
committ = repo.head.target
puts committ.message
puts "#{committ.author[:name]} <#{committ.author[:email]}>""
tree = committ.tree

```

f 9, ɿ YFno • ÈS ~ • %; ^? ' 1 F Rugged. ' • €õÓF· 9, vX» ¼§ ConfigError JK
ObjectError è » DKLSYä™1 DoÇ? t FÇ, @Ñ- bÎ Ñ< Fst Ruby i Ý{ • €ÀED? ¥
' S • W- ` êA³4WQDHI Osè, 1 Ó" W- Cå?

```

blob_id = repo.write("Blob contents", :blob) M
index = repo.index
index.read_tree(repo.head.target.tree)
index.add(:path => 'newfile.txt', :oid => blob_id) N

sig = {
  :email => "bob@example.com",
  :name => "Bob User",
  :time => Time.now,
}

committ_id = Rugged::Commit.create(repo,
  :tree => index.write_tree(repo), O
  :author => sig,
  :committer => sig, P
  :message => "Add newfile.txt", Q
  :parents => repo.empty? ? [] : [repo.head.target].compact, R
  :update_ref => 'HEAD', W
)
committ = repo.lookup(committ_id) X

```

M %í W- ™D blob F· Ōm^ W- ™½~ DA~?

N [HEAD Cå %Ük' – F> \$¢. newfile.txt" • ™½~ ?

O ò—\$ ODB ¼%í ^ W- ™D%F> \$W- ™DCå ¼. ' . ?

P ¥' \$ author à B committer à. ' / ODë) ?

Q Cå DMR?

R æ%í W- Cå | Ff ®¶• » ò- ™Cå D&Cå? òJ. ' ^ HEAD DE å" t ~WD&Cå?

W \$‰W- Cå D\ Ō½F Rugged ó B Libgit2 ø° \$, @! ~ ™_ ' ?

X ýÅr i W- ™Cå y< D SHA-1 w' Ff 9, ' . SOÒW- Committ y<?

Ruby Dnol 5I } PF uW1 Üs t Libgit2‰^ t Cµ" Ff, noÝÜÈS ...¾ùí Ç«? pef Ç
i W- Ruby Ōœ3F ¥' \$. \$» kCT . DW" \$» ?

ÞÍ RO

Libgit2 k É - " \uv Git D° " ? Hp. D9» Ó- OLibgit2L8f t W" ÇO» z DÍ " É » 1 DÒ|
7ÓFaf Ò,, . ' Š>ó Git ÇOD1 2" #KL? Libgit2L8t É» 1 | 7• » PÓP- ' D" #,, ßy
<‡? áF

¥' S•W<..•€i·aμ" D? <ÜDHI É' É Libgit2wx CDD| 7Ä! E 69,, \$
<https://github.com/libgit2/libgit2-backends> ÑÙTø? W- y<‡? áDÉ» 1 | 7i òÄí i DO

```
gi t_odb *odb;  
int error = git_odb_new(&odb); M  
  
gi t_odb_backend *my_backend;  
error = git_odb_backend_mine(&my_backend, /*É*/); N  
  
error = git_odb_add_backend(odb, my_backend, 1); O  
  
gi t_repository *repo;  
error = git_repository_open(&repo, "some-path");  
error = git_repository_set_odb(repo, odb); P
```

Új , ä + båæÉçèß&é€' (É¿K3" Qêë' #^÷ì " Q#ëí 3Û

M Ü¹ 6W- ī Dy<‡? áó ODBøÒâ 7ÓF· [{ " t W- ' S%ž gDμ" DÒ| 7ÓD~ð?

N Ü¹ 6W- É» 1 ODB | 7?

O t ò- â 7" • W- | 7?

P ê , W- 7! áF>a. . ' ¥' D ODB S ` Ùy<?

hi git_odb_backend_mine - ` aKLÆÅ YFži W- f ÉmD ODB...YD¢HðF> ¥f ° \$ž
J %œbf : %DnFâCi f ° g - 5ÛL git_odb_backend" ¢? . • ÈS_- C_i òÄDO

```

typedef struct {
    git_odb_backend parent;

    // ... DW" KL
    void *custom_context;
} my_backend_struct;

int git_odb_backend_initialize(git_odb_backend **backend_out, /*E*/
{
    my_backend_struct *backend;

    backend = malloc(1, sizeof(my_backend_struct));
    backend->custom_context = E;

    backend->parent.read = &my_backend_read;
    backend->parent.read_prefix = &my_backend_read_prefix;
    backend->parent.read_header = &my_backend_read_header;
    // E

    *backend_out = (git_odb_backend *) backend;

    return GIT_SUCCESS;
}

```

my_backend_struct DUW- f3®¶i W- **git_odb_backend** " ¢Fòi W- êt DýÓOòÄ—° - z A" , Ŧ i Libgit2 DnofN' DÄI ? ŠT i X9DFò- " ¢D†û9, XvfÑ?

Ø- Ü¹ 65‡ t C" ¢] PA" FEÓÉ » 1DÑ<½Fd | ÜL. Ÿ{ D **parent** " ¢Df3? A` Libgit2 D i ncl ude/git2/sys/odb_backend.h Í o„ ^• Ž* ' è) Ffº » D. ' | Bj ¢fZ». ' pW8* ' è) ?

çúSm

Libgit2 kI e8ŒxD\$»? \$ò(½e ¼F ¥' ÀY^W-. ' ^E- ~ • ØÖD\$» ØDûHI Fò" á " \$§8e 8Œx ¼F ØÖC++PGoPNode.jsPErlang, B JVM F· ' DfŒùuÇ/O? 1D\$» E¹ 9, o\¿Bò- 7! á ÓTO <https://github.com/libgit2>? ¥' LDno[ýÀ¤â HEAD • NDCå DC åMRÓ—Ä **git log -1** ž Äø?

LibGit2Sharp

pef \$' LW- .NET J K Mono ' F ž a LibGit2Sharp (<https://github.com/libgit2/libgit2sharp>) — i ff, @D? ò- \$» i ' C# LfDF> ¥Z [DP8e ¼• S' %o%¾T Éd D CLR API ØÙ>¹ D Libgit2 D* ' ? ¥' DHI • ÈS—ÄøÄO

```
new Repository(@"C:\path\to\repo").Head.Tip.Message;
```

y § Windows Z Ü- ' F W- ô‰ NuGet DÖj a f ½¾Ñ~?

objective-git

p e f D- ' YÙ\$W- Apple × ØÑF f I k 9° . ' Objective-C " t ...YŒx? Objective-Git
(<https://github.com/libgit2/objective-git>) i ò- ; B< D Libgit2 \$»? W- HI • È S» ¼òAO

```
GTRepository *repo =  
    [[GTRepository alloc] initWithURL: [NSURL fileURLWithPath:  
        @"/path/to/repo"] error: NULL];  
NSString *msg = [[[repo headReferenceWithError: NULL] resolvedTarget]  
message];
```

Objective-git Š Swift ô‡ } ~ F f „ f ä Objective-C V\$WpD! ª Ç' [\?

pygit2

Python D Libgit2 \$» ô‰ Pygit2 F f 9„ \$ <https://www.pygit2.org/> ÜT. ? ¥' D©HÖœO

```
pygit2.Repository("/path/to/repo") # è , noàá  
    .head # OP¤â ] Y  
    .peel (pygit2.Commit) # ÜTy- DCå  
    .message # ` PCåMR
```

T 2 U V

¤ d F ôŽk I Libgit2 D° .. Z .. X! - > • ? p e f : ^ • ~ e G§ Libgit2 DMRF 9„ ç B- D API ½
> O <https://libgit2.github.com/libgit2/>, „ B W• WD• È O <https://libgit2.github.com/docs>. y § . D\$
» F Gäf ý D README B 6+ ½~ F ž J o€k } í ©ÖF , B • N] ÅA` D^3 ?

JGit

p e f : \$W- Java Öœ½. ' Git F k W- • ° Z Ž D Git á F ž —i JGit ? JGit i W- ' Java L f D
• ° / y ¥Ž D Git D...Y F- \$ Java ' ' ¼{ y z . ' ? JGit . æº Eclipse ÜÖF- Då È \$
<https://www.eclipse.org/jgit/> ?

= >

k I e 8129 „ a JGit - ³ f D. æF> • o.] L n o? ¥} ~ D12í 8-i . ' Maven? f 9„ o \
\$ f D pom.xml ½~ J D <dependenci es> ç è ¼" • Ä<ÜòÄDí f Sôfò- Öí ?

```

<dependency>
    <groupId>org.eclipse.jgit</groupId>
    <artifactId>org.eclipse.jgit</artifactId>
    <version>3.5.0.201409260305-r</version>
</dependency>

```

\$f ` Tòf½y | **versi on** | 9° Z [~ ™^ Ff „ Gż B <https://mvnrepository.com/artifact/org.eclipse.jgit/org.eclipse.jgit> „ OP¥™DàáMR? ñòWÈôfè | F Maven—j ÉÝOP> . ' f f, @D JGit á?

pef: Émý€VÔÓD• « ŐFžaf 9„ s <https://www.eclipse.org/jgit/download> OÒ- Cí D JGit VÔÓ½~ ? f 9„ Ā<ÜòÄ, ÜW- ^ %oS[. ' Cí Ôf D. æ?

```

javac -cp .:org.eclipse.jgit-3.5.0.201409260305-r.jar App.java
java -cp .:org.eclipse.jgit-3.5.0.201409260305-r.jar App

```

%&, f

JGit D API k! 8x! D; t O: ; ^ %oBc; ^ %o? ò- ! - • CÉÍ SÉ Git F> ¥ JGit í { i F / OD1 2• 55\\$] Oc; API i W- ÜN• o' i ©í • ° D' 5Dâ 76W• W• o' i . ' Git ^ %oÜμ¶ i 9° ' TDKLøF: ; API • ...³ " ' §" ©Dàáy <?

t e‡ JGit j sj „ **Reposi tory** » " t ÊQFf ' 1 @%oDn—i %í W- . D...H? y§W- x§½~ • , DàáS—óYF JGit L8 . D" #, zøF' **Fi l eReposi toryBui l der** ôf. ?

```

// %í W- ™àá
Reposi tory newl yCreatedRepo = Fi l eReposi toryBui l der. create(
    & new Fi l e("/tmp/new_repo/.git"));
newl yCreatedRepo. create();

// è, W- " $Dàá
Reposi tory existi ngRepo = new Fi l eReposi toryBui l der()
    & . setGi tDir(new Fi l e("my_repo/.git"))
    & . buil d();

```

ÅPf DÖœi a äj àáD- { ÉÓF builder ¼Dž - i ùD API Í 9„ CDc. ' Ùàáf, f k MR? . 9„ . ' | BgCó. **readEnvi ronment()** ØFsµ" æäDl AE, 1 > & ' ó. **setWorkTree** (É). **fi ndGi tDir()** Ø, JKgg- i ÄÑÜž Äé, W- ZäD. gi t æä?

xf / k W- **Reposi tory** ...H| Ff —° y. %oÜ8üÄDn? <Üi W- ¾BO

```

// OP-
Ref master = repo.getRef("master");

// OPC- ' f• NDy<
Obj ectId masterTip = master.getObjectId();

// Rev-parse
Obj ectId obj = repo.resolve("HEAD^{tree}");

// Üi y<>¹ A~
Obj ectLoader loader = repo.open(masterTip);
loader.copyTo(System.out);

// %í ] Ÿ
RefUpdate createBranch1 = repo.updateRef("refs/heads/branch1");
createBranch1.setNewObjectId(masterTip);
createBranch1.update();

// å } ] Ÿ
RefUpdate deleteBranch1 = repo.updateRef("refs/heads/branch1");
deleteBranch1.setForceUpdate(true);
deleteBranch1.delete();

// PÓ
Config cfg = repo.getConfig();
String name = cfg.getString("user", null, "name");

```

ØJ Øf^Wt ÙnoFf, ¥' j i Wt €• WfD5?

UVÙOPW- • N **master**- ' D• ±? JGit É Ÿ@PÊ§ refs/heads/master D ŸÖ# **master**- ' F> ýÀW- L8f OPC- ' DMRDy<? f 9, OP- D) y ó. **getName()** Ø FJKW- ...³ - ' Dæç y< ó. **get ObjectId()** Ø FJKW- • NC- ' Dzì • ± ó. **getTarget()** Ø ? - ' y<í [€ { ' S° ©çëD- ' By<FF, f 9, ¿I I - çëi ^ { Ø^ } Ø^FJK- • NW- çëy<Dóí 8I , Døyz { D¥, æç?

UVÙOÒ, **master**- ' Dæç F· ýÀW- ObjectId...H? Çýi ^ " \$§W- Git y<D‡? á F ObjectId Í j n° W- y<D SHA-1w' ? U÷ÙŠá / ¼F hi . Á©^ JGit p bÆ€ rev-parse ØW Ø@^ • ~ eFG•] Ÿ- ' ØFF, xkœb Git ^ • Dy<-ÑzFd | JGit j ýÀCy<DW- kŽ D ObjectId FJK **null**?

³ <S! ÜÀ©^pbÜi W- y<D>¹ A~? \$ò- HI ¼F ¥' * ' Obj ectLoader. **copyTo()** ...³ Nç t y Xí y Xy<DA~F} á è L ObjectLoaderj ýk` Py<D>z B, ù> [· , y? ± ü ýÀD 1W? y §W- ó. **isLarge()** ýÀ true Døt Dy<FF, * ' . **openStream()** SØW- » ¼ InputStream Dy<F, 9, \$ÁkWt - [fk‡?I TA" DâC<` Py<D>¹ ‡??

³ <S ÈÙÀY^pb%í W- ™D] Ÿ? ¥' %í W- RefUpdate...HF PÓW" ; ‡Fd | * ' . **update()** S- | ò- ~ f? å} / O] ŸDno—\$òÙ<Ü? á‡®¶¹ . **setForceUpdate(true)** ' ° a· µ

" F^a • * ' . del ete() - j ýÀ REJECTED Fd | ` aÍ ÁK¿ó?

¥| W- HI À©^pbs Git PÓ½~ ¼OP user.name Dr ? ò- Config ...H. ' ¥' 1 âê , Dà á %! 5PÓFhi · í j ÉÝ5G6> ` PŽT B• , DPÓ½~ ?

ò- i : ; API D_` W¤FuLj k8e9„ . ' D1WB» ? j kW- Ák< \$òJ ¬ÑDF—i JGit i ' • €öÓSÆ€™1 D? JGit API k | . ' ç†D Java • €óHp IOException ØFhi · í CD^+C JGit Ém» 1 D• €» z óHp NoRemoteRepositoryException P CorruptObj ectException B NoMergeBaseException Ø?

P&, f

: ; API ~ • ÔMFhi k | [. ' { ÈS „ ...Y• oDæD* €S®FHp [W- ½~ • • T' – F J K%í W- ™DCå? t ^• Zò- I " F JGit CD^W• Wc; API F. ' ò" API DK' Q—i Gi t » O

```
Reposi tory repo;
// Cí àáÉÉ
Git git = new Git(repo);
```

Git » kW• W* €5D « ¾é ™š Dc; 1 WF· 9„ ' S\$HW" A¾DÙt? ¥' S• W- HI ÑÑ‰W ~ » ¼ git Is-remote Dn?

```
Credenti al sProvi der cp = new
UsernamePasswordCredenti al sProvi der("username", "p4ssw0rd");
Col lecti on<Ref> remoteRefs = git.lsRemote()
È . setCredenti al sProvi der(cp)
È . setRemote("origi n")
È . setTags(true)
È . setHeads(false)
È . call();
for (Ref ref : remoteRefs) {
È System.out.println(ref.getName() + " -> " + ref.getObjectId().name());
}
```

òi W- Git » D! &Ä2Fò- 1WýÀW- 9, af{ - ¶· 1W* ' SEÓ; ‡D^‰y< F¤f * '
.cal l () | . ' —j { , Ù? \$òoÇ< F¥' - i GÅ^ origi néÖDçëF&Çi è\? j @O9' §
I OD Credenti al sProvi der y< D. ' ?

\$ Git » ¼j 9„ . ' 8e · D^‰FÖÖhÇý§ addPbl amePcommi tPcl eanPpushPrebase
P revert B reset?

W2UV

ò- i JGit DŽ\° .. D_` W¤? pef yòkST> ¥: _khi F\$< Ü9„ ÜTW" MRBä ¾?

¥ JGit API \$ K 1 ½> O <http://download.eclipse.org/jgit/docs/latest/apidocs> ? ò i x ! D Javadoc
F f „ f í 9 „ \$ f ¥ RQD JVM IDE Ñ[. ' ÚÚ· ' T! 5?
¥ JGit Cookbook O <https://github.com/centic9/jgit-cookbook> / k 8e p b t ' JGit ...Y° » œF DH
I ?
¥ <http://stackoverflow.com/questions/6861881> • X ^ E - 5Db† ?

go-git

In case you want to integrate Git into a service written in Golang, there also is a pure Go library implementation. This implementation does not have any native dependencies and thus is not prone to manual memory management errors. It is also transparent for the standard Golang performance analysis tooling like CPU, Memory profilers, race detector, etc.

go-git is focused on extensibility, compatibility and supports most of the plumbing APIs, which is documented at <https://github.com/src-d/go-git/blob/master/COMPATIBILITY.md>.

Here is a basic example of using Go APIs:

```
import "gopkg.in/src-d/go-git.v4"

r, err := git.PlainClone("/tmp/foo", false, &git.CloneOptions{
	URL:      "https://github.com/src-d/go-git",
	Progress: os.Stdout,
})
```

As soon as you have a **Repository** instance, you can access information and perform mutations on it:

```
// retrieves the branch pointed by HEAD
ref, err := r.Head()

// get the commit object, pointed by ref
commit, err := r.CommitObject(ref.Hash())

// retrieves the commit history
history, err := commit.History()

// iterates over the commits and print each
for _, c := range history {
	fmt.Println(c)
}
```

Advanced Functionality

go-git has few notable advanced features, one of which is a pluggable storage system, which is similar to Libgit2 backends. The default implementation is in-memory storage, which is very fast.

```
r, err := git.Clone(memory.NewStorage(), nil, &git.CloneOptions{
    URL: "https://github.com/src-d/go-git",
})
```

Pluggable storage provides many interesting options. For instance, https://github.com/src-d/go-git/tree/master/_examples/storage allows you to store references, objects, and configuration in an Aerospike database.

Another feature is a flexible filesystem abstraction. Using <https://godoc.org/github.com/src-d/go-billy#Filesystem> it is easy to store all the files in different way i.e by packing all of them to a single archive on disk or by keeping them all in-memory.

Another advanced use-case includes a fine-tunable HTTP client, such as the one found at https://github.com/src-d/go-git/blob/master/_examples/custom_http/main.go.

```
customClient := &http.Client{
    Transport: &http.Transport{ // accept any certificate (might be useful
        for testing)
        TLSClientConfig: &tls.Config{InsecureSkipVerify: true},
    },
    Timeout: 15 * time.Second, // 15 second timeout
    CheckRedirect: func(req *http.Request, via []*http.Request) error
    {
        return http.ErrUseLastResponse // don't follow redirect
    },
}

// Override http(s) default protocol to use our custom client
client.InstallProtocol("https", githttp.NewClient(customClient))

// Clone repository using the new client if the protocol is https://
r, err := git.Clone(memory.NewStorage(), nil, &git.CloneOptions{URL: url })
```

Further Reading

A full treatment of go-git's capabilities is outside the scope of this book. If you want more information on go-git, there's API documentation at <https://godoc.org/gopkg.in/src-d/go-git.v4>, and a set of usage examples at https://github.com/src-d/go-git/tree/master/_examples.

Dulwich

There is also a pure-Python Git implementation - Dulwich. The project is hosted under <https://www.dulwich.io/>. It aims to provide an interface to git repositories (both local and remote) that doesn't call out to git directly but instead uses pure Python. It has an optional C extensions though, that significantly improve the performance.

Dulwich follows git design and separate two basic levels of API: plumbing and porcelain.

Here is an example of using the lower level API to access the commit message of the last commit:

```
from dulwich.repo import Repo
r = Repo('.')
r.head()
# '57fbe010446356833a6ad1600059d80b1e731e15'

c = r[r.head()]
c
# <Commit 015fc1267258458901a94d228e39f0a378370466>

c.message
# 'Add note about encoding.\n'
```

To print a commit log using high-level porcelain API, one can use:

```
from dulwich import porcelain
porcelain.log('.', max_entries=1)

#commit: 57fbe010446356833a6ad1600059d80b1e731e15
#Author: Jelmer Vernoo, <jelmer@jelmer.uk>
#Date:   Sat Apr 29 2017 23:57:34 +0000
```

Further Reading

- ¥ The official API documentation is available at <https://www.dulwich.io/apidocs/dulwich.html>
- ¥ Official tutorial at <https://www.dulwich.io/docs/tutorial> has many examples of how to do specific tasks with Dulwich

; < C: Git , f

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eD^ %o? hi ò« Úò" ^ %oD©H' WÍ vV\$\$Ž-DûÆ?

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D" ' F • X \$! - ¼p" e?. ' \?

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--amend / O? ò812^- k\$ -- | Dyöy§Cø. ì W! ' 9Ù? G\$' Lý! | .
' ôÖDø. ?

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k! - d] €' D^ %oOconfig B hel p? sUWt * ' GitTr €é * BA` ; ...F· ' W...a - Èf ?

git config

Git %oDI eμ" ī k W8³ | 12? yS<te‡μ" &x Ff 9,, fg Git D³ | 12FJK5? f DÚ5
SEÓ? ò" EÓŽ• ^fk DnFs YÀ Git f D) yFT• » Ú5D, 7¼çF,, Bf. ' D' šð? ã
^ %oJ sE- ° » DPÓ½~ ¼` PBLk POr F,, -f 9,, sŽÍ JK±y° » DàáSÔUEÓ?

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\$ Git i) W? ¼¥' À©^ pb%í 9,, À,, t,, ø. œWDÝ^ %oF,, -f Ç' í tÍ yk. ' ?

\$ gx W? ¼F, Ü git pull ^ %o| F. ' ã ^ %oS[--rebase" t³ | ø. ?

\$ /O" # W? ¼F ¥' . ' Stf D HTTP) oEÓW- ³ | D" #' ì ?

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git config core.editor , f

-Ã Üt YÙ Git à DPÓ J DEÓ• ©FI e' šð9,, p< EÓO

Table 5.1 i # core.editor' " ð—ši

| —~™ | : ' , f |
|---------------------------------------|---|
| Atom | git config --global core.editor "atom --wait" |
| BBEdit (Mac, with command line tools) | git config --global core.editor "bbedit -w" |
| Emacs | git config --global core.editor emacs |

| | |
|-------------------------------|--|
| —~™ | : ' , f |
| Gedit (Linux) | git config --global core.editor "gedit --wait-new-window" |
| Gvim (Windows 64-bit) | git config --global core.editor "'C:/Program Files/Vim/vim72/gvim.exe' --nofork '%*' "(Also see note below) |
| Kate (Linux) | git config --global core.editor "kate" |
| nano | git config --global core.editor "nano -w" |
| Notepad (Windows 64-bit) | git config core.editor notepad |
| Notepad++ (Windows 64-bit) | git config --global core.editor "'C:/Program Files/Notepad++/notepad++.exe' -multiInst -notabbar -nosession -noPlugin" (Also see note below) |
| Scratch (Linux) | git config --global core.editor "scratch-text-editor" |
| Sublime Text (macOS) | git config --global core.editor "/Applications/Sublime Text.app/Contents/SharedSupport/bin/subl --new-window --wait" |
| Sublime Text (Windows 64-bit) | git config --global core.editor "'C:/Program Files/Sublime Text 3/sublime_text.exe' -w" (Also see note below) |
| TextEdit (macOS) | git config --global --add core.editor "open -W -n" |
| Textmate | git config --global core.editor "mate -w" |
| Textpad (Windows 64-bit) | git config --global core.editor "'C:/Program Files/TextPad/5/TextPad.exe' -m" (Also see note below) |
| Vim | git config --global core.editor "vim" |
| VS Code | git config --global core.editor "code --wait" |
| WordPad | git config --global core.editor '"C:\Program Files\Windows NT\Accessories\wordpad.exe"' " |
| Xi | git config --global core.editor "xi --wait" |

! pef \$ 64 È Windows • , ÑÚÛ^ 32 È D' šõFža· j { ÚÛ\$ C: \Program Files (x86)\ &* Ñ° ¼fL D C: \Program Files\ ¼?

git help

git help ^ %' S# ©œb ^ %D Git Éý½>? hi ¥' gj \$äf ä¼CT†\] ¥€' D^ %F y§í W- ^ %DÔÖD9ø. ßçäWº Ff 9„ X| ÝÜ git help <command> ^ %S ^ • ?

¥' \$ OP¢E W? ¼) * ^ git help ^ %F O! \$ PÓEFÐ W? ¼cf Å©^ pb. ' · SäÙ~ e G§ git shell DMR?

ž Ý Üè é ± ©

k È 81 2OPW- Git à á? W8i s þwÑJ K 651 x y W- Y k Dà á F u W8—i \$ W- æã ¼%

Í W- ™Dà á?

git init

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¥ | F ¥' \$: ; ^ %oŠÑ; ^ %oW? ¼) * ^ ã ^ %oÃ | µ" D>€DW" ^ ??

git clone

git clone ... Ë Ni W- Å Ù ^ 6 Ë - ^ %oD ^ %o? . %í ^ W- ™æã F { | T ™Dæã F d | git init S Ü 1 6 W- ï D Git à á F d | t f • » D URL • • W- õ³ |) üt origin D ð é Õ à á õ git remote add ð F d ± y é Õ à á, Ù git fetch F ¥ | o \ git checkout [é Õ à á D ¥ ™Cå GXT ! 5 Dµ" æã ?

git clone ^ %o\$! - ¼e t ' TF ð J - W: Ë - k 9, D51?

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¥ | F \$ qr mk I , - D. æ W? ¼¥' hi ^ . ' --recursive ø. Saqr W- ý k I , - D à á g Ò} ~?

cd \$! - D 651 ï k' T ã ^ %oF hi Ñ Ü ð " ' Wi ° HF JK. ' 12k Q° ï ?

XYa ☒

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git add

git add ^ %o[A ~ s µ" æã • • T! " ' õ J üt ' - õ index ø' ø F , j < t Cå ? ☒ git commit ^ %o, Ù | F ³ | o Ç < . - j G ä! " ' ï F s ä git add i ' S - » < Wt Cå | ½ F D Ä I D?

ò - ^ %o y § Git S - ° ï m@F f , \$! - ¼{ Å ï t 5 C B B. ' ? ¥' [½ ¾ 5 \ W [W " 9, • TD2 ° D' W?

¥' \$ É Õ ™ ½ ~ W? ¼) * > Õ ^ • Ñ ^ git add ^ %o?

d | F ¥' \$ nTUV| D] Ýî > W? ¼CT^pb. ' · S·Zî > UV?

³ <SF ¥' \$ åÿ2! " We ¼. ' · Såÿ2D! " W- Z» f ½~ D° » \] ?

¥ | F \$ %y < W? ¼¥' \$: ; , Ø^· D' WF „ -f ^· A | ¿ó^` a?

git status

git status ^ %oj # ©μ" ' β! " ' i ¼ÇOÔÖD½~ ? ¼Ôm^Z» f h 4! " FJ Z[! " hÄ k Cå D½~ ? \$Wc D# ©Ú2¼F· j cf W" pb\$ò" ! " ' è÷9Ý½~ DC©?

' 1 F ¥' \$ Ga åâ½~ ÔÓ W? ¼) * ^ status Dx! β} ~DÚ2? cd ¥' \$Ž- ¼í k' T· F hi <+ \] Df ° ' git status %oDnoř \$òWeœT ^?

git diff

¤, @ä • œ9! ™%Dó• | F 9, . ' git diff ^ %? ä ^ %o9, ä • f μ" | BŠf D! " ' Dó• ögit diff³ | D‰WØFf ! " ' i Šf ¥| Cåè÷Dó• ögit diff --stagedøFJK> H! - CåååDó• ögit diff master branchBø?

' 1 F ¥' \$ ä • Z! " B4! " D» f We ¼[• ^ git diff Dx! ' WF \$ä? ¼¥' Å©^pbä• p" g6Z[! " ^Fp" Åk?

\$ Cå t• W? ¼, ¥' \$Cåå. ' --checkø. SGä 9° " \$Dí Wyz I " ?

\$ - » - k ^p" KL W? ¼, ^• ^. ' git diff A... BŒWS~ k Ž5> HÇO] Ýè÷Dó• ?

\$ c @í > W? ¼¥' . ' -bø. S\, Øí Wyz Dó• FØo\ --theirsP--ours B --baseø. S > HÇO! " ' UV½~ Dó• ?

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git difftool

¤f Ç: . ' AÓD git diff ^ %oř ? git diff tool 9, ' S} ~5BÝW- L\μ¶Stf Å©! ™% è÷Dó• ?

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git commit

git commi t ^ %o[fk o\ git add! " D½~ A~ \$‡? á ¼%í W- { øD½FFd | [åâ] ÝÑD] Ý• ± 9T èÑ?

' 1 F ¥' \$ Cå ~ ™ W? ¼éB ^ä ^ %oDx! ' W? ¥' É©^pb\$r €Dμ" í Õ¼o\ . ' -aç äS• \ git add øWÈFØpb. ' -mçäo\ ^ %oÙ&ÇBÝW- ' šØSx² Cå MR?

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¥ | F \$ Cå y < W? ¼F ¥' ^ • ^ git committ \$Ā | %o^` a F ß. i pb...YD?

git reset

git reset ^ %oå@' S5?fx²cŸ" D; † S, Ùçdī " ? . 9, 9Ÿ HEAD • ±> ¥9øDf g index JK! " ' Fpef. ' --hard; † Dsf « 9, fgμ" ' ? pe™1 5tò- ^ %o f • | ÜD ; † Ff 9° j . / f Dμ" Ff, \$. ' af@- » f Z[ôž€• ^ . ?

' 1 F ¥' \$ Pè! " D½~ W? ¼) * ^ git reset } ~cžD' WF' Sy, Ù\ git add ^ %oD½~ Pè! " ?

\$ mÓ() W? ¼¥' Ô^) * ^ a ^ %oF Èl Ö?í \$ • Ña ^ %o?

\$ ¼ÿWt î > W? ¼F ¥' . ' git reset --hard SPèW- î > FO! ¥' í . ' ^ git merge --abort ^ %oF . i git reset DW- } ~DĀÙ?

git rm

git rm i Git' Ssμ" ' FJK! " ' 9} ½~ D^ %o? \$t < Wt Cå! " W- 9} í " ÑF. Š git add k WQ» ¼?

¥' \$ 9} ½~ W? ¼CT ^ git rm DW" ^ ? F ÕÖ² = 59} ½~ FB. ' --cached ø. S- 9} ! " ' i D½~ hi z 1 μ" ' D½~ ?

\$! - D 9} y < W? ¼F) * ^ git rm gk DÈ8ÇO' WF p\$, Ù git filter-branch ¼. ' B • Ñ^ --ignore-unmatch ø. ? òy ý! S-! k' ?

git mv

git mv ^ %o i W- -t ^ %oF ' § 9TW- ½~ > ¥\$™½~ Ñ, Ù` git add` ^ %oB\$þ½~ Ñ, Ù` git rm` ^ %o?

¥' - i \$ 9Ÿ ½~ W? ¼} ~ 5CT ^ a ^ %o?

git clean

git clean i W- ' Ssμ" ' ¼9} Ç: @D½~ D^ %o? 9, i ' • Dä | ½~ JKî > UV D½~ ?

\$ %€μ" æã W? ¼¥') * ^ f 9° j . ' clean ^ %oD†Cø. ß< Ä?

L Ø Ü ÷ ø

Git k È- ...Y†\D] Ÿßî > • ° D... ' ^ %o?

git branch

git branch ^ %o...É Ni ì 8ÖùÑD] Ýý€µ¶? . 9, WXf fKD] Ýþ%í ™] Ýþå}] Ýþ
m^)] Ý?

Git] Ý W? å@i t branch ^ %oSE | DF· cd ^ Ö- e?? ' 1 F¥' \$] Ýþ%í W? ¼) * ^ . F
d | ¥' \$] Ýý€ W? ¼) * ^ . D · t\] ° - óW: Bå} ø?

\$ Èö] Ý W? ¼F¥' . ' git branch -uø. SEÓW- Èö] Ý?

¥| F¥' \$ Git - ' W? ¼œT ^ . \$Ã | %oW^ a?

git checkout

git checkout ^ %o' S{ |] ÝFJKGXA~Tµ" æä?

¥' i \$] Ý{ | W? ¼UWt | w^ ^ %oB git branch ^ %o?

\$ Èö] Ý W? ¼¥' ^ . ^ pb. ' --track çåS, 1 Èö] Ý?

\$ GXUV W? ¼F¥' ' å ^ %oB --conflict=diff3 Sm™) * ½~ UV?

\$ mÓ() W? ¼F¥' ÖWÈ ^ . ^ ? BŠ git reset DG•?

¥| F¥' \$ HEAD - ' W? ¼) * ^ å ^ %oDW" ...Y^ ??

git merge

git merge µ¶' Sî > W- JKe -] ÝTfZ[GXD] Ý¼? d | . [åâ] Ý• ± 9ÝTî > " e
Ñ?

¥' ' 1 \$ tmí] Ý W? ¼) * ^ git merge ^ %o? cd. \$! - Dû851Ík' TFhi merge ^ %o-
k È- g8FWc - i git merge <branch> ý ÑW- f: î > ÖSDW-] Ý) ü?

¥' \$ êóD! . . æD| Ü) * ^ pb%oW- squashed merge ö• Gitî > | [å" W- ™DCå &Ç
i åãfî > | D] ÝDæÖå å? ø

\$ c @î > W? ¼F¥') * ^ î > D\ ØB ^ %oF Øm -Xignore-space-change ^ %oB --abort ø.
S ¼ÇW- k l " DCå?

\$ ë(Cå W? ¼¥' hi ^ pb\$î > ål Oë) F pef. æg\$. ' GPGë) Ds?

¥| F¥' \$ | %î > W? ¼hi ^ | %î > ?

git mergetool

¤f \$ Git Dî > ¼nTl " | F 9, . ' git mergetool SBÝW- L\ Dî > ¶£µ¶?

¥' \$ nTUV| D] Ýî > ¼½¾) * ^ W<· Fd | \$ L\ Dî > Š> Hµ¶ W? ¼) * ^ pb...Yf È
mDL\ î > µ¶D^ ??

git log

gi t log ^ %o' SÀ©W- . æD9ÂæÖâã F s ¥UDCA½F È? ³ | oÇ<F· - # ©f øâf\$] ÝDæÖâã F hi 9, # ©ÇOD« -e - èâãJ] Ý, D[æ? ã ^ %o€í ' S\$Cåâã Cì # ©! - Je -] Ýè÷Dó• ?

\$! - DÍ We Èl Í k' Tã ^ %oS1 | W- . æDæÖ?

\$ ä • Cå æÖW? ¼¥') * ^ ã ^ %oF > _k %o^ [• ? [• ^ ÖÖ -p B --stat ø. S ^ • í W- C å - k Dg ~ F B. ' `--pretty` B --onl i ne ø. Sä • } P DæÖâã?

\$] Ý%í W? ¼¥' . ' . • --decorate ø. S} ~D9i 6¥'] ÝD• ±f \$FO! ¥' . ' --graph ø. Sä •] XDæÖâãi . aÄD?

\$ } k Úz wx B Cå' ÷ e? ¼F ¥') * ^ \$. . ' git log ^ %o| ' branchA.. branchB DŒWS ä • W-] Ý/ yS uW-] Ý, pW" Cå i ì WD? \$ Cå' ÷ W? ¼¥' " ^ ~ e) * ?

\$ <_merge_log>> B ÷ Q e? ¼F ¥') * ^ branchA.. branchB š 2B --left-rightŒWS ä • p " g ¼W-] Ý? \$ î > rã W? ¼¥' j [• ^ pb. ' --merge ø. S\$Eî > UV* + FOÄí . ' --cc ø. Sä • \$f æÖâã ¼Dî > Cå DUV?

\$ - ' rã W? ¼¥' . ' ã µ¶ B -g ø. &Ci [æ] ÝSä • Git D refl og?

\$ & ' W? ¼¥' [• ^ ` -S` B -L ø. S ØÙS\$noDæÖg~ ¼ÔÙ/ ø ³ ' 5& ' F pW- 5‡ DæÖ?

\$ ë(Cå W? ¼F ¥' ^ • ^ pb. ' --show-si gnature S t í W- Cå D git log y X ¼F • • W - î ý i ^ Z [î WDë) DW- I O?

git stash

gi t stash ^ %o' Sä | 5z " W" j Ák Cå Dµ" F , - \$] ÝÑÇ, @Cå 4ôfµ" —9, %€µ" æã?

b \$ Š%€ WÖ- e? x! —i \$œò - ^ %o?

git tag

gi t tag ^ %o' St noæÖâã ¼Dl W- Q• » W- ŽÒD- e? Wc S - . ' § , / Gn. ?

¥' \$ êçë W? ¼) * ^ ã ^ %oB / G^ ? F > \$ t , êçë W? ...+ ^ ã ^ %o?

¥í \$ ë(µ" W? ¼) * ^ pb. ' -s çã %í W- GPGë) DçëFd | . ' -v ø. SI O?

± ©L Ø Ü -

\$ Git ¼ÁkeöHI þwD^ %oF Èl f „ D^ %oI i \$I " ! 5D‡?á? øf: @] 3f Dµ" F J Ks 651I Pg ~ ; F ðk È - Æ€éÖàá D^ %o?

git fetch

gi t fetch ^ %oŠW- é ŐDà á å ý F > ¥[é Őà á ¼k hi \$ øâ à á DÁk Dfk MRI P<Sd | " # \$f ! 5‡?á ¼?
¥' , 1 \$ s é Őà á ¼@PŠI P W? ¼) * ^ á ^ %oFd | ¥' \$ é Ő] Ý ¼• T ^ E - . ' ©H?
¥' \$ NW- . æE ø W? ¼k E - ©H¼í T k . ' á ^ %?
\$ † > GÅ- ' ¥' ' . S@PW- \$³ | T ÷ è L • » D- ' F \$ é Ő ¼F ¥' ^ • ^ . asW- Ő¼OP
A ~?
\$ - ' => e? ¼¥' E Ó^cùÉ » 1 D refspec , ¬ gi t fetch 9 „ %oW" E³ | ÇODno?

git pull

gi t pul l ^ %o×! Ñ—i gi t fetch B gi t merge ^ %oDû† 1 F Git s f • » Dé Őà á ¼@PA~F
d | 9Ñ, + [† > Öf f\$D] Ý ¼?
¥' \$ s é Őà á ¼@PŠI P W? ¼½¾) * ^ á ^ %oFd | \$ ä•l - é Őà á W? ¼^• ^ pef ÝÙ
á ^ %oDs F` a [j † > ?
¥' í \$ ' g x • Zg x W? ¼^• ^ pb. ' á ^ %oSSÆ€g x D®" ?
\$ GXUV W? ¼¥' Å @^ . ' á ^ %opbo\W- URL SWt - DI Pg ~ ?
¥| F ¥' \$ é (Cå W? ¼¥' ½¾D) * ^ f 9 „ . ' --veri fy-si gnatures ø. SI Of g \$I P
<SD[\ GPG è) DCå ?

git push

gi t push ^ %o' SŠuW- à á oMF | áf ! 5‡?á Šé Őà á Dó• Fd | [ó• €uTuW- à á
¼? . , @kuW- à á DL > ý Fsäðo€i , @I OD?
¥' , 1 \$ €uTé Őà á W? ¼) * ^ gi t push ^ %o? \$ ðW? ¼å @) * ^ €uW-] Ý Té Őà á D
x ! ' W? \$ €u W? ¼F ¥' _k ^• ^ pb€u• »] Ý F \$ Eö] Ý W? ¼¥' ^• ^ pbE ÓW-
³ | D€uDÈö] Ý? \$ å} é Ő] Ý W? ¼¥' . ' --del ete çã B gi t push ^ %oS\$å} W- \$
EF ðÑD] Ý?
\$ NW- . æE ø WÖ? ¼F ¥' • T ^ E - . ' gi t push \$e - é Őà á] 3] Ý ¼Dμ" D©H?
\$ &3çè W? ¼F ¥' äj ^ pb. ' á ^ %o• --tags ø. S] 3f êDçè?
\$ ã, I , - f Ý W? ¼F ¥' . ' --recurse-submodul es ø. SGä i ^ ¥' fkDI , - Dμ" T Z
[\$€uI . æèâZ [€uX] ^ F ø. ' I , - | òž DI k¢E?
\$. « j 73I ¼¥' } ~DCT ^ pre-push ` 3óhookøF· i W- 9 „ ' SEÓf\$W- €uôfè
å ÝÙDý! F „ Gä€ui ^ { L8?
¥| F \$ - ' => €u W? ¼F ¥' äj ^ . ' ôÖD refspec S€uF &Çi o€. ' D} LÚ2? òy ¥

' Ÿ - D• » @] 3X] Dμ" I K¢E?

git remote

gi t remote ^ %o i W- i f é Õà áâ ã Dý €µ¶? · L 8f [W- , D URLz " fW- } LD| < FH
p origin F ÕÄf — 9, Ç' í t ĩ yk 6' ^? f 9, ke - ÕÄD| < F gi t remote 9, ' S• • F
» f F Bå } . ' ?

ã ^ %o \$ é Õà á D. ' W? ¼‰ ^ Ô^ D) * F ÕÖW: P• • P9} Pm^) • ° ?

£l \$á - D| ¶e? ¼í k. ' ã ^ %o F h i Wc i , gi t remote add <name> <url> ÕÄDç t š
2?

git archive

gi t archi ve ^ %o' S%í . æW- • » ½F D= > ½~ ?

¥' \$ t j Wt c , W? ¼F. ' gi t archi ve ^ %o S%í W- . æD= > ½~ ' §] 3?

git submodule

gi t submodul e ^ %o' Sý€W- àá D 6L\àá? · 9, { ' \$áJK 6» z D&3bÍ Ñ?
submodul e ^ %o k £ - I ^ %o, p o addP updateP sync > > ø' Sý€ò" bÍ ?

- \$ | , - e? ¼CT BÔ^) * ^ ã ^ %o?

š > Ü_`

git show

gi t show ^ %o 9, " W8} ~D%» 9` D1 2S# ©W- Git y < ? f Wc. ' ã ^ %o S# ©W- çë J W
- Cå DMR?

¥' \$ f Oçë W? ¼. ' ã ^ %o S# ©y O• çë DMR?

d | F ¥' \$ où» p7! W? ¼F' ^ I et S# ©ÇOD7! øù[• ðXS DCå?

¥' . ' gi t show %o D¥k 9, Dnoi \$ ~Ý½~ dî > W? ¼' S\$î > UVDe - ! " ' ï ¼CP•
» ½~ DA ~ ?

git shortlog

gi t shortl og i W- ' S=Ö gi t log Dy XD^ %o? · 9, ³ ' I eŠ gi t log / ODø. F h i ã ^
‰o Cj WXfk DCå F & i Å©W- 5?" K] ûDCå å ã D< Ö- MR

¥' \$ Ó" Cå } Ü W? ¼À© ^ pb. ' ã ^ %o S%í W- uv D changelog ½~ ?

git describe

gi t descri be ^ %o' S^3 ' œb 9,, • ðfW- CåDKLFd | ófW- %» 9` Dyz { ¥Ç9g? ð i W8OÒW- CåDI I D12F· ÈW- CåD SHA-1r WÄi Åd1Fhi ~ ¶9` - ?

¥' \$ ófW- Phí i B t j Wt z, e? ¼. ' gi t descri be ^ %oSOÒW- yz { S^) ¥' z, D ½~ ?

í î

Git k W" ^ %o9,, ' S¢f * +f no ¼DI " ? ÕÖÙXi ` a | ^ Fi Ø-k Dg~ ?

git bisect

gi t bi sect µ¶i W- * €k' D* +µ¶F· o\ ÉÝÖÙW- V] äÙSÙTpW- ° » DCåi « Ü bug J KI " DUW- Cå?

g \$ V] äÙ W? ¼ôÖD) * ^ å ^ %o?

git blame

gi t bl ame ^ %oç Oœb ½~ DÙF• X ½~ DÍ WÙD¥| Dg~ DCå BØi ž W- Cå D" K? xf @ Üž - %] ç I G§ò- ° RnöDMR| ðj I k' ?

- k ½~ ç O W? ¼CT å ^ %o?

git grep

gi t grep ^ %o9,, ¶£\$† no ¼F « -i f. æDþ7! ¼Dœ9½~ ¼ä Üœbyz { J Kg• ° Å2?

- k Git Grep De? ¼CT å ^ %o?

CÈ

Git ¼DW" ^ %oi „ - k Dg~ j Cå ðÄD^c ðt ¼v DF ðÄW• WDCå F—i W• WDI J? ð" ^ %o„ ðÄD12Sý€f D] Ý?

git cherry-pick

gi t cherry-pi ck ^ %o' SOÒ\$~ - Cå ¼- k Dg~ Fd| , + [" t W- ™DCå- k Tf xâ] Ý Ñ? sW-] Ý~ 2W- J K! - Cå &Çi î > Ö-] ÝDfkg~ i * €k' D?

\$ g x Š\$øμ" i W? ¼I I BÉ ©^ Cherry pi cki ng

git rebase

gi t rebase ^ %o×! i i W- ÉÝ 6D cherry-pi ck ^ %o? . | á XW• WDCå F d| d„ . ' \$ 6 51 „ OÄD...œW- W- D cherry-pi cks X. ' ?

\$ g x We ¼Ô^ CT ^ ã ^ %oF ŌÖŠZ [! , D] ŸDg ×f éBD: " I " ?
\$. | ¼¥' \$W-] næÖâãT! - ~2DàáD©H¼...+ ^ ã ^ %oFO| . ' ^ --onto ø. ?

\$ Rerere W? ¼F ¥' [• ^ \$g x | nTDî > UVDI " ?

\$ » f e - Cå MR W? ¼F ¥' í " î -i ø. [' Så ÿ 2Dý! , 2?

git revert

gi t revert ^ %o! MÑ—i W- 7ND gi t cherry-pick î " ? . [f Cå ¼Dg ~ D, ôŽ / \ D1 2
D- ' TW- ™%í DCå ¼F ! MÑ—i çdJ K« ^ ?

¥' \$ j >Cå W? ¼. ' ã ^ %oSçdW- î > Cå ?

g ,

I e Git. æF ŒÖ Git! - F x! i o\K~ W° SúÖD? s 1 → 5ófK~ I JT sW- KP¼- ' ð"
I J ,Git î kµ¶Saò" î " gØ} ~?

git apply

gi t appl y ^ %o- ' W- o\ gi t diff J K« - . ' GNU diff ^ %o%í DI J ? . ÈI J ^ %o%o^ óÇe
Dµ" F h j i k W" ûûDöi ?

¥' \$ - ' SÉK~ DI J W? ¼É©^ . D. ' B` a | B<f 9° j ' T· ?

git am

gi t am ^ %o' S- ' SÉKPDI J ? ° ï i ž" { mbox š 26\ D? ðy § o\K~ 3 ' I J > [6'
æç 5- ' Tf D. æ¼l k' ?

¥' \$. ' am ^ %o- ' I J ^ %o¼CT ^ . D' Wßµ" î F ŒÖ. ' --resol vedP -i B -3 ø. ?

¥' \$ < I K~ µ" î 3I í CT ^ Èž hooksF f 9, ' SF E Š gi t am / Gµ" î ?

\$ K~ oä W? ¼¥' í [' ã ^ %oS- ' š 26D GitHub D€uGÅDg ~ ?

git format-patch

gi t format-patch ^ %o' S, mbox Dš 2SófW• WDI J , →f 9, ð uTW- K~ W° ¼?

¥' \$ o\K~ D! , . æW? ¼[• ^ W- . ' gi t format-patch µ¶t W- . æ%oE ð D©H?

git imap-send

gi t i map-send [W- ° gi t format-patch ð DK PÑx → IMAP a < ½~ î ? ¥' \$ o\K~ D!
. æW? ¼\$ \ W- o\ . ' gi t i map-send µ¶NW- . æð uI J ðÙE ð DHI ?

git send-email

gi t send-mail ^ %o' Só\K~ ž už „ . ' git format-patch óf DI J ?

¥' \$ o\K~ D! „ . æ W? ¼[• ^ W- . ' git send-email µ¶ž uI JS t W- . æ‰E ø D© H?

git request-pull

gi t request-pull ^ %o" i } ~D' SófW- 9o\K~ ž ucl - %D©HMR¹ ? pef \$! & EF ðÑk W-] ÝF> ¥: aí %äj pbEfò" g~ F&C' o\K~ ž uI J Ff—9„ , Ùã ^ %oDy X ž ucò- f: | Pg~ D%?

¥' \$ êóD! „ . æ W? ¼É ©^ pb. ' git request-pull SófW- €uè R?

. - FG

Git k W" 9„ Š 6D7! ÓÓ• , EfD^ %o?

git svn

gi t svn 9„ . Git" t W- « j 7SŠ Subversion 7! ÓÓ• , oM? ò9à Èf 9„ . ' Git SGXA ~F J K Cå T Subversion EF ð?

Git Š Subversion We_k œ• ^ ã ^ %o?

git fast-import

y§ 67! ÓÓ• , JKs 6œbDš 2« k Ff 9„ . ' git fast-import ½¾5[6š 2whT Git 9„ æç å ã Dš 2?

\$ W- É » 1 D« k ð W? ¼_k œ• ^ ã ^ %o?

ýþ

pef g\$ý€W- Git à á F J K, @o\W- A¾D1 WS» Aì " KLFGit CD^W" ý€^ %oS¢Ef?

git gc

gi t gc ^ %o\$f Dà á ¼, Ù Ògarbage collectionÓF å } ‡ ? á ¼C, @D½~ B[6½~ êÓfW8 ~ k Ž Dš 2?

ã ^ %oWc \$Ã| t f µ" Fcdf 9„ ~Ý, Ù. -pef: Ds? ¥' \$úÖ W? ¼[• ã ^ %oDÈ - © H?

git fsck

gi t fsck ^ %o' SGä A\‡?á DI " JKÇWÚ- ?

¥' - \$ ‡?@A òW? ¼½¾. ' ^ Wt á ^ %oS & f k DÜT y <ó dangling objectø?

git reflog

gi t refl og ^ %o] òf fk] ÝDè • ±Dr á Sä ÙXf \$mLæÖÑ9° . / DCå?

¥' å@\$ - ' r á W? ¼CT ^ á ^ %oF > \$À©^ Wc' WF Bpb. ' gi t log -g So\ gi t log Dy XSä • OÄDMR?

¥' OÄ\$ ‡?@A W? ¼[• ^ W- @A. / D] ÝD...H?

git filter-branch

gi t filter-branch ^ %o' S5?} " =• SmL†CDCååã FHpsœb51å} ½~ FJ Ko\\ , W- à á ¼DW- ~2DI æã „ CPXW- . æ?

\$ s{ W- Cå ¼9} W- ½~ W? ¼F ¥' • Ñ^ á ^ %oF > ‡• ^ 6E- ø. FHp --commi t -fi lterF --subdi rectory-fi lter B --tree-fi lter?

\$ Git-p4 B TFS De ? ¼¥' . ' . S » AZ [« k DL\à á ?

%&, f

\$! - ¼¥' í nT ^ Çö: ; D^ %o?

¥' nT DUW- : ; ^ %oi \$ î > GÅ- ' ¼D ls-remote ^ %o? ¥' ' . Sä • EF 7D>¹ - ' ?

¥' \$ ~Ý½~ dî > P Rerere B ' - e? ¼. ' ls-fil es Sä • ! " ' D~ >¹ DÄI ?

¥' OÄ\$] Ý- ' W? ¼CT ^ rev-parse ^ %oF. 9„³ ` œ9yz { F > [^ fW- y < D SHA-1 r ?

¥' \$ Git A\ > € We ¼y † \] D: ; ^ %oÛ^) * F òóÇegi òWe DmQf \$? ¥' QCXY ^ \$! - D 6\] . ' ò" ^ %o?

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