

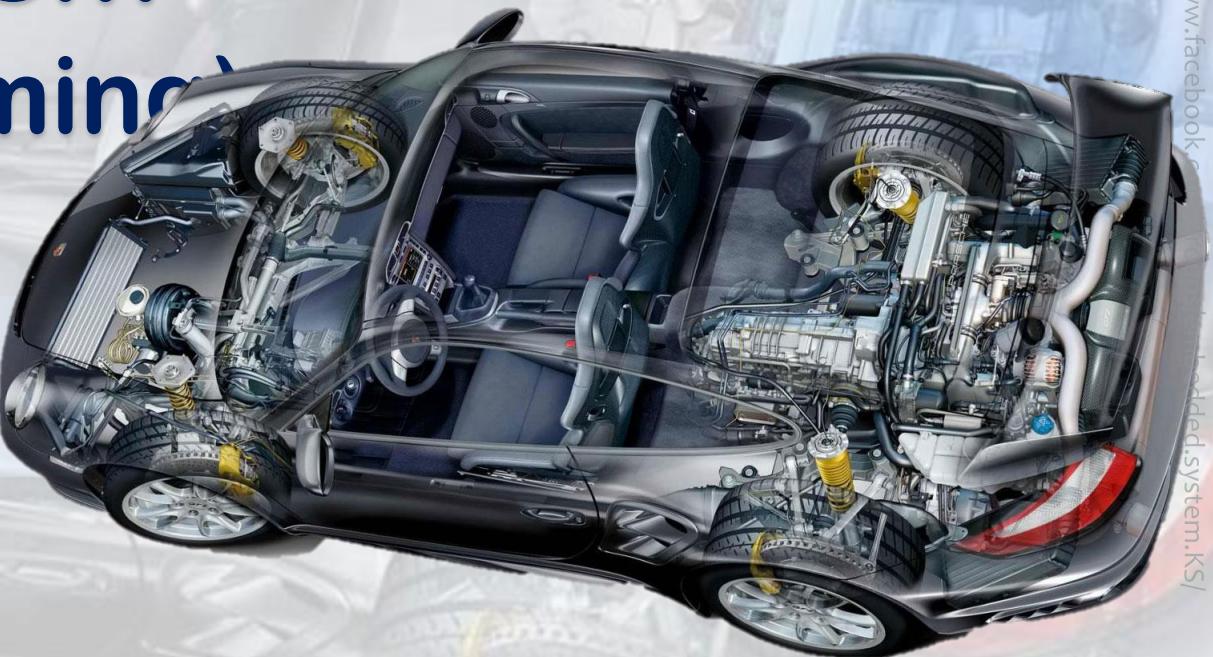


Embedded System

PART 1(C Programming)

C-Basics

ENG.KEROLES SHENOUDA



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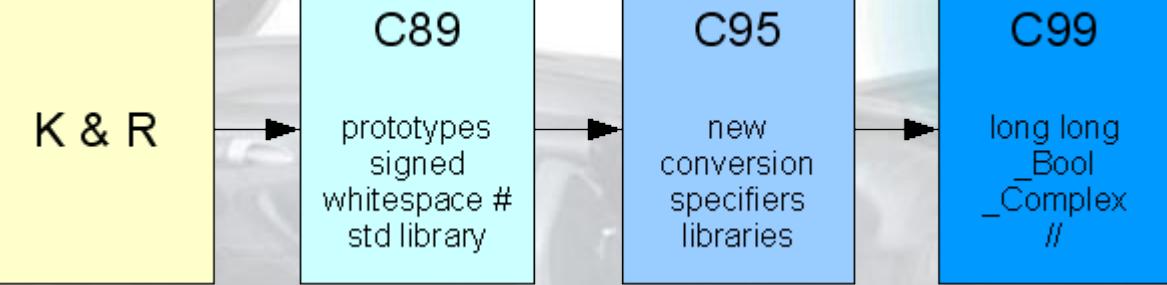
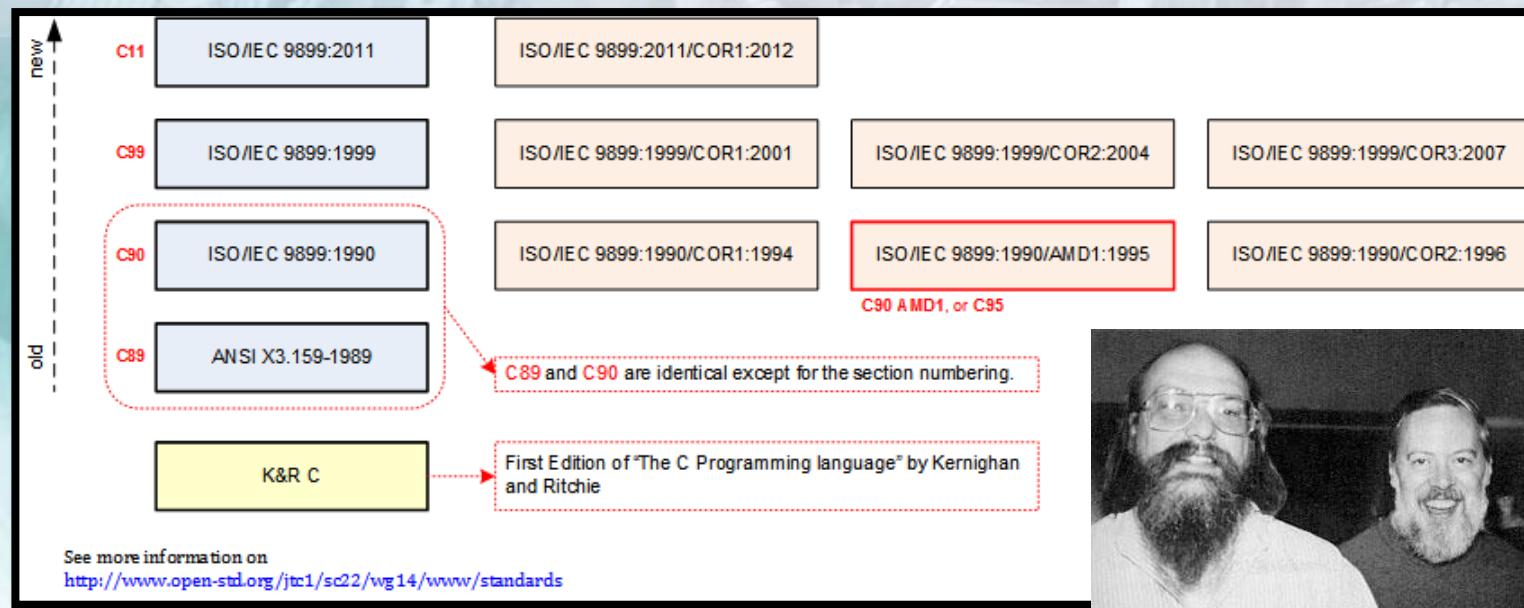
Why C, and not another language?

- ▶ The primary design of C is to produce **portable code** while maintaining performance and minimizing footprint (**CPU time**, **memory**, disk I/O, etc.). This is useful for **operating systems**, **embedded systems** or other programs where performance matters a lot ("high-level" interface would affect performance)
- ▶ One powerful reason is memory allocation. Unlike most programming languages, C allows the programmer to write directly to memory.
- ▶ C gives control over the memory layout of data structures
- ▶ Moreover dynamic memory allocation is under the control of the programmer (which also means that memory deallocation has to be done by the programmer).



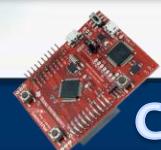
History

- ▶ Ken Thompson and Ritchie, in their first edition (1978) of "The C Programming Language", provided the initial description of C. We call this description "K&R" C. The language has since undergone three major revisions: C89, C95 and C99.

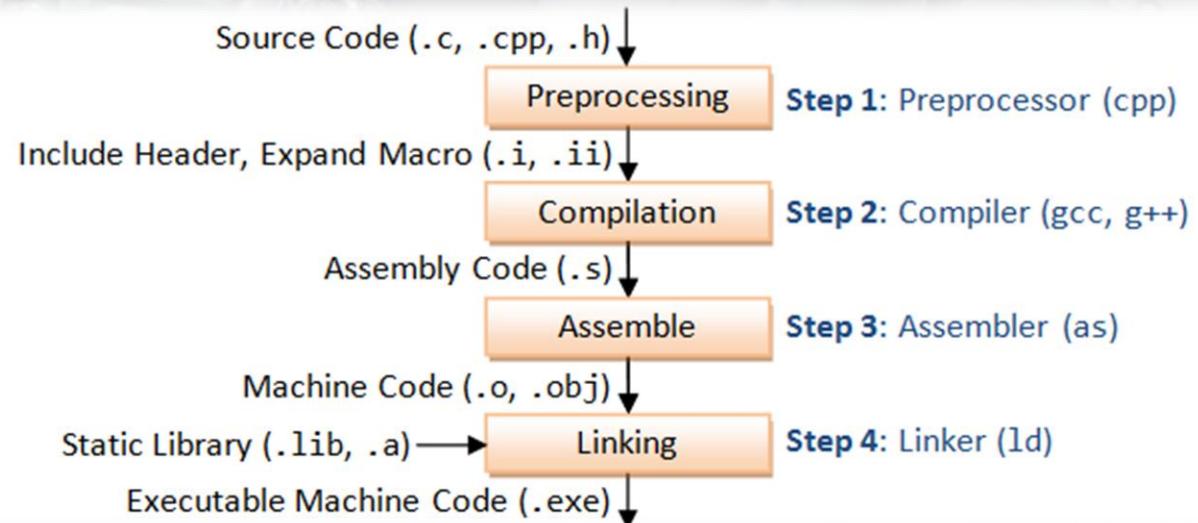


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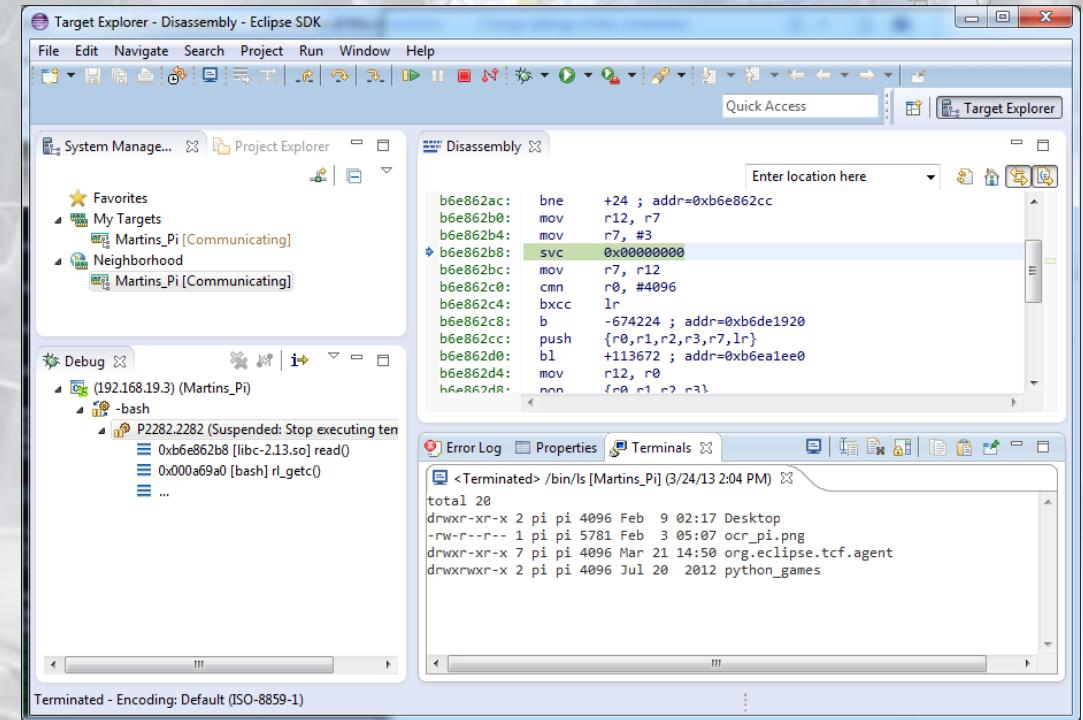


Compilation Process



Development Environments

- ▶ Integrated Development Environment (IDE)
 - ▶ Editing Code
 - ▶ Building
 - ▶ Installing
 - ▶ Debugging
- ▶ Abstracts command line interface with Graphical User Interface (GUI)



C - Environment Setup

IDE + Compiler

[Install Eclipse C/C++ Development Tool \(CDT\)](#)

Java Downloads for All Operating Systems

1. Install MinGW GCC

[Minimalist GNU for Windows](#)

<https://sourceforge.net/projects/mingw/files/>

2. Cygwin GCC

<https://www.cygwin.com/setup-x86.exe>

Cygwin is:

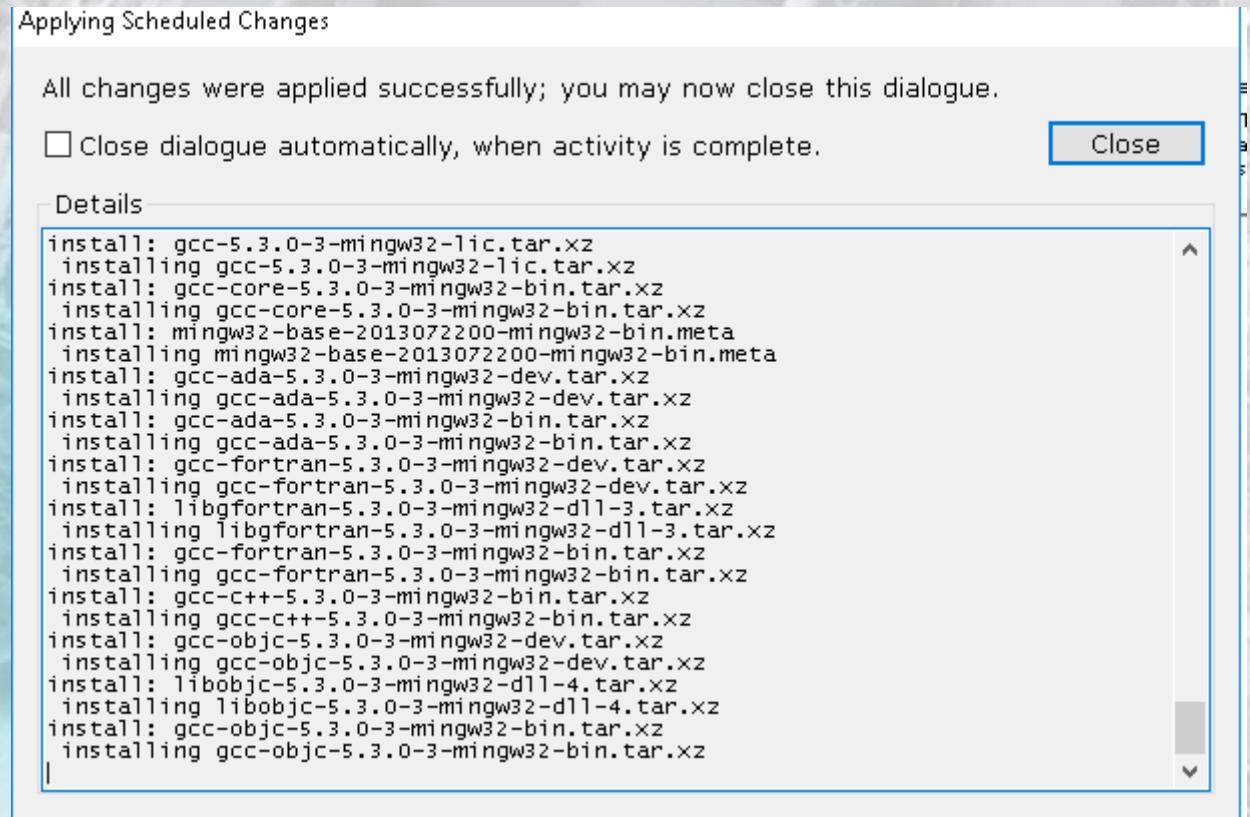
a large collection of GNU and Open Source tools which provide functionality similar to a [Linux distribution](#) on Windows.

a DLL (cygwin1.dll) which provides substantial POSIX API functionality.

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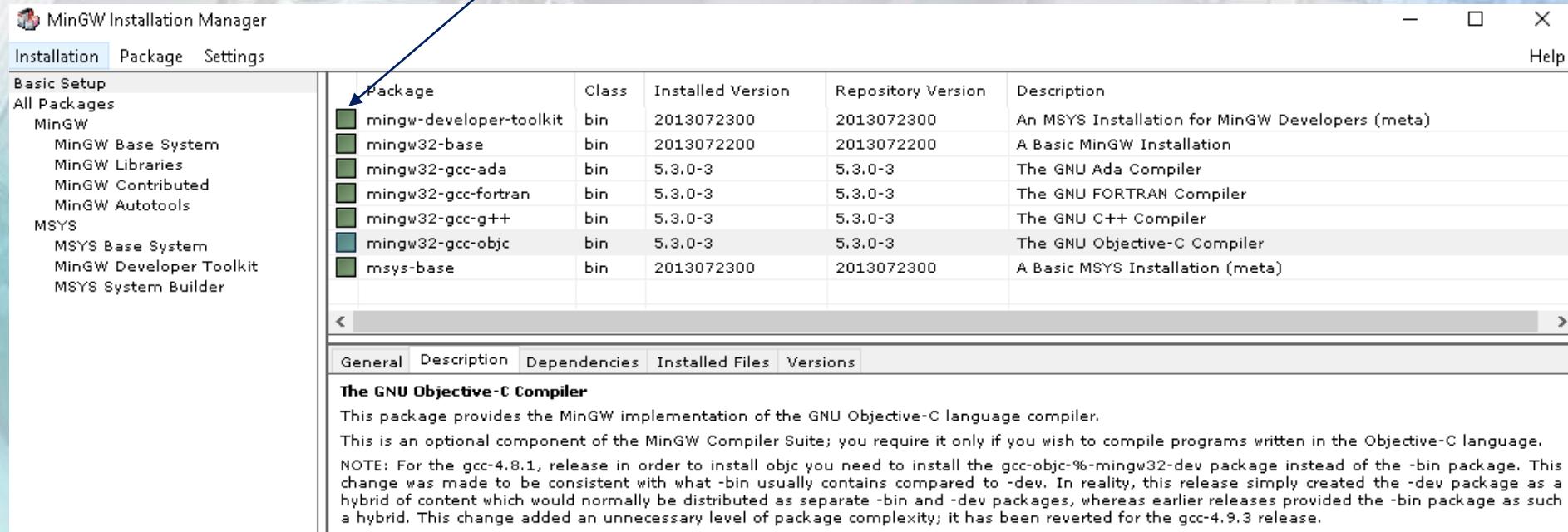


Install MinGW GCC



Install MinGW GCC

En you can see all the basic packets became green



Package	Class	Installed Version	Repository Version	Description
mingw-developer-toolkit	bin	2013072300	2013072300	An MSYS Installation for MinGW Developers (meta)
mingw32-base	bin	2013072200	2013072200	A Basic MinGW Installation
mingw32-gcc-ada	bin	5.3.0-3	5.3.0-3	The GNU Ada Compiler
mingw32-gcc-fortran	bin	5.3.0-3	5.3.0-3	The GNU FORTRAN Compiler
mingw32-gcc-g++	bin	5.3.0-3	5.3.0-3	The GNU C++ Compiler
mingw32-gcc-objc	bin	5.3.0-3	5.3.0-3	The GNU Objective-C Compiler
msys-base	bin	2013072300	2013072300	A Basic MSYS Installation (meta)

The GNU Objective-C Compiler
This package provides the MinGW implementation of the GNU Objective-C language compiler.
This is an optional component of the MinGW Compiler Suite; you require it only if you wish to compile programs written in the Objective-C language.
NOTE: For the gcc-4.8.1, release in order to install objc you need to install the gcc-objc-%-mingw32-dev package instead of the -bin package. This change was made to be consistent with what -bin usually contains compared to -dev. In reality, this release simply created the -dev package as a hybrid of content which would normally be distributed as separate -bin and -dev packages, whereas earlier releases provided the -bin package as such a hybrid. This change added an unnecessary level of package complexity; it has been reverted for the gcc-4.9.3 release.



Install MinGW GCC

This PC > Windows (C:) > MinGW

Name



bin



include



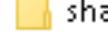
lib



libexec



mingw32



msys



share

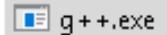


var

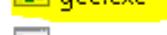
Then you can see the
gcc and gdb and other
binary utilities installed
(Native Toolchain)

This PC > Windows (C:) > MinGW > bin

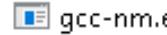
Name



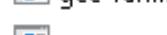
g++.exe



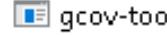
gcc.exe



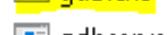
gcc-ar.exe



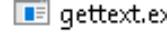
gcc-nm.exe



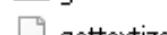
gcc-ranlib.exe



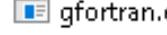
gcov.exe



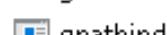
gcov-tool.exe



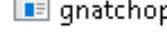
gdb.exe



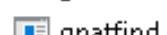
gdbserver.exe



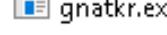
gettext.exe



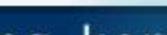
gettext.sh



gettextize



gfortran.exe



gnat.exe



gnatbind.exe

gnatchop.exe

gnaclean.exe

gnatfind.exe

gnatkr.exe

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Install MinGW GCC

Applying Scheduled Changes

All changes were applied successfully; you may now close this dialogue.

Close dialogue automatically, when activity is complete.

Close

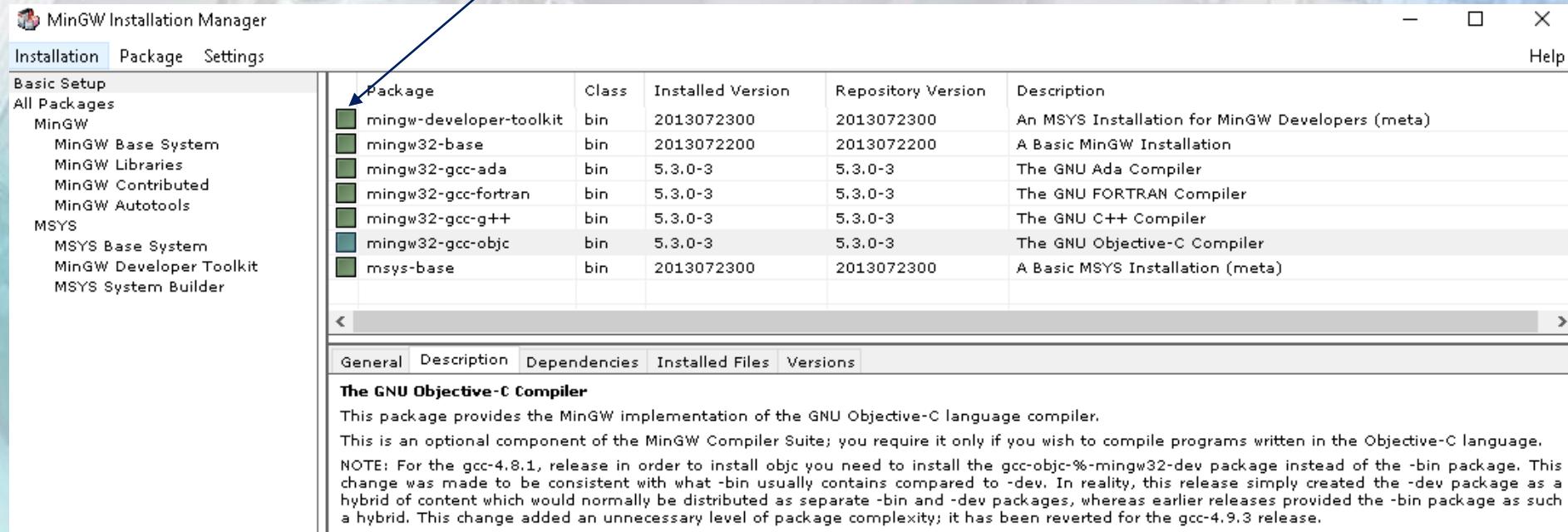
Details

```
install: gcc-5.3.0-3-mingw32-1ic.tar.xz
installing gcc-5.3.0-3-mingw32-lic.tar.xz
install: gcc-core-5.3.0-3-mingw32-bin.tar.xz
installing gcc-core-5.3.0-3-mingw32-bin.tar.xz
install: mingw32-base-2013072200-mingw32-bin.meta
installing mingw32-base-2013072200-mingw32-bin.meta
install: gcc-ada-5.3.0-3-mingw32-dev.tar.xz
installing gcc-ada-5.3.0-3-mingw32-dev.tar.xz
install: gcc-ada-5.3.0-3-mingw32-bin.tar.xz
installing gcc-ada-5.3.0-3-mingw32-bin.tar.xz
install: gcc-fortran-5.3.0-3-mingw32-dev.tar.xz
installing gcc-fortran-5.3.0-3-mingw32-dev.tar.xz
install: libgfortran-5.3.0-3-mingw32-dll-3.tar.xz
installing libgfortran-5.3.0-3-mingw32-dll-3.tar.xz
install: gcc-fortran-5.3.0-3-mingw32-bin.tar.xz
installing gcc-fortran-5.3.0-3-mingw32-bin.tar.xz
install: gcc-c++-5.3.0-3-mingw32-bin.tar.xz
installing gcc-c++-5.3.0-3-mingw32-bin.tar.xz
install: gcc-objc-5.3.0-3-mingw32-dev.tar.xz
installing gcc-objc-5.3.0-3-mingw32-dev.tar.xz
install: libobjc-5.3.0-3-mingw32-dll-4.tar.xz
installing libobjc-5.3.0-3-mingw32-dll-4.tar.xz
install: gcc-objc-5.3.0-3-mingw32-bin.tar.xz
installing gcc-objc-5.3.0-3-mingw32-bin.tar.xz
```



Install MinGW GCC

En you can see all the basic packets became green



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msys-base	bin	2013072300	2013072300	A Basic MSYS Installation (meta)

General Description Dependencies Installed Files Versions

The GNU Objective-C Compiler

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Install MinGW GCC

This PC > Windows (C:) > MinGW

Name



bin
include
lib
libexec
mingw32
msys
share
var

Then you can see the
gcc and gdb and other
binary utilities installed
(Native Toolchain)

This PC > Windows (C:) > MinGW > bin

Name

g++.exe
gcc.exe
gcc-ar.exe
gcc-nm.exe
gcc-ranlib.exe
gcov.exe
gcov-tool.exe
gdb.exe
gdbserver.exe
gettext.exe
gettext.sh
gettextize
gfortran.exe
gnat.exe
gnatbind.exe
gnatchop.exe
gnatclean.exe
gnatfind.exe
gnatkr.exe



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Version Control Systems (VCS)



Version Control Systems (VCS)

- ▶ Software package that allows users to track changes
- ▶ Many different types
 - ▶ Concurrent Versions System (CVS)
 - ▶ Subversion (SVN)
 - ▶ Git
- ▶ VCS Features
 - ▶ Allows you to track:
 - ▶ Software
 - ▶ Documents
 - ▶ Build information
 - ▶ Software configuration information
 - ▶ Repository: Collection of tracked files
 - ▶ Acts like a normal file system



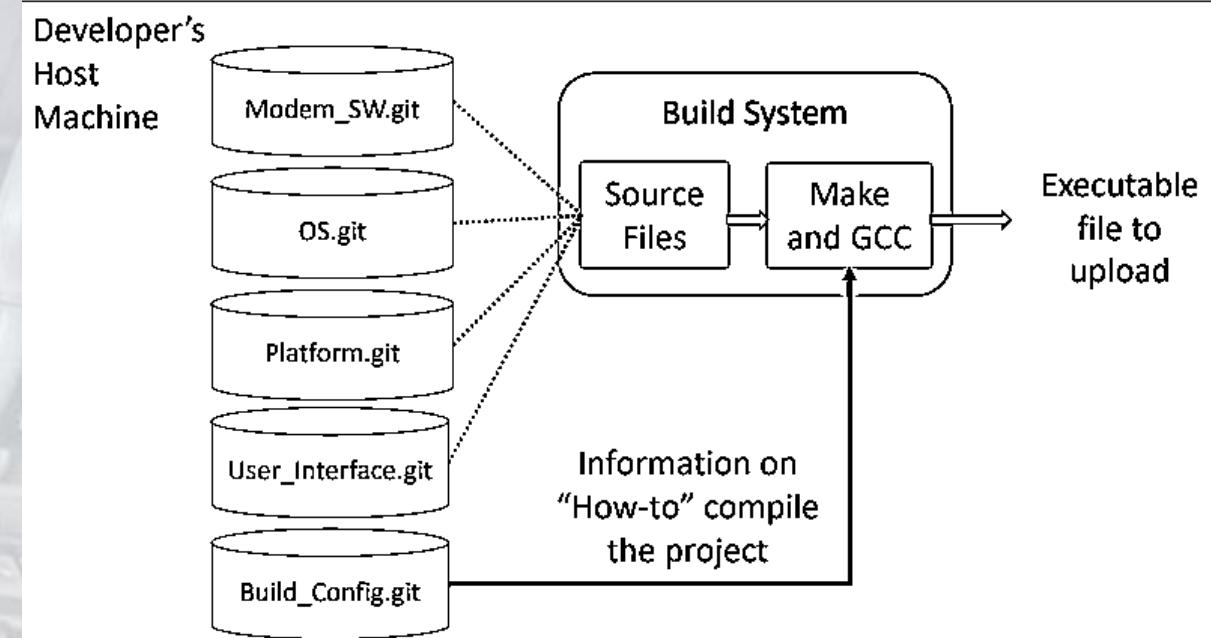
Used by:

- Linux Kernel
- Google's Android
- Twitter
- GNU Toolchain



Multiple Repositories (Repos)

- ▶ You can have many repositories contribute to a single software product





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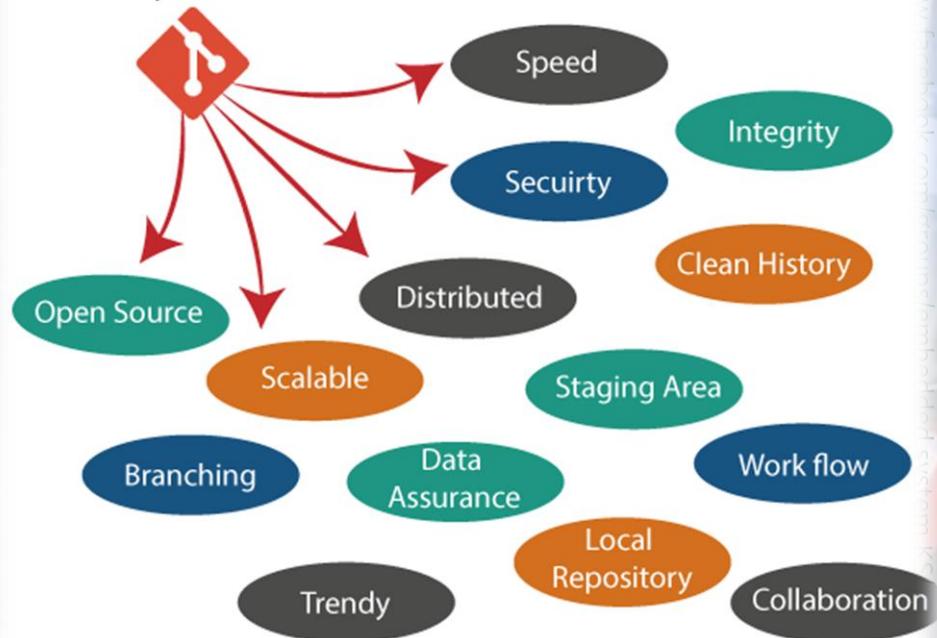
git (Tutorial)



What is Git?

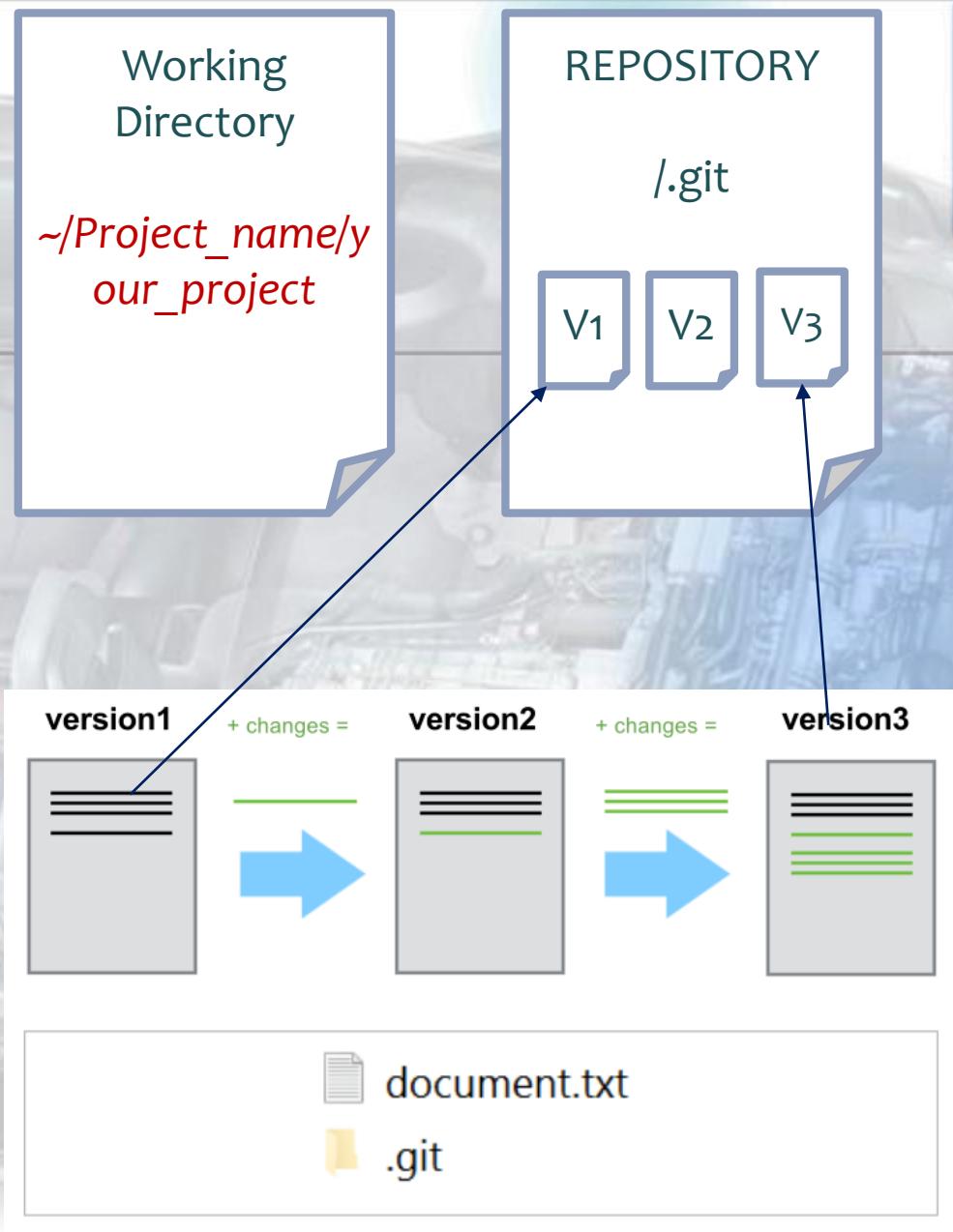
- ▶ Distributed source control system
- ▶ Open Source
- ▶ Developed for Linux project requirements
- ▶ Very Fast
- ▶ Active community

Why Git?



Git Concepts

- ▶ The Git Repository: contains files, history, config managed by git



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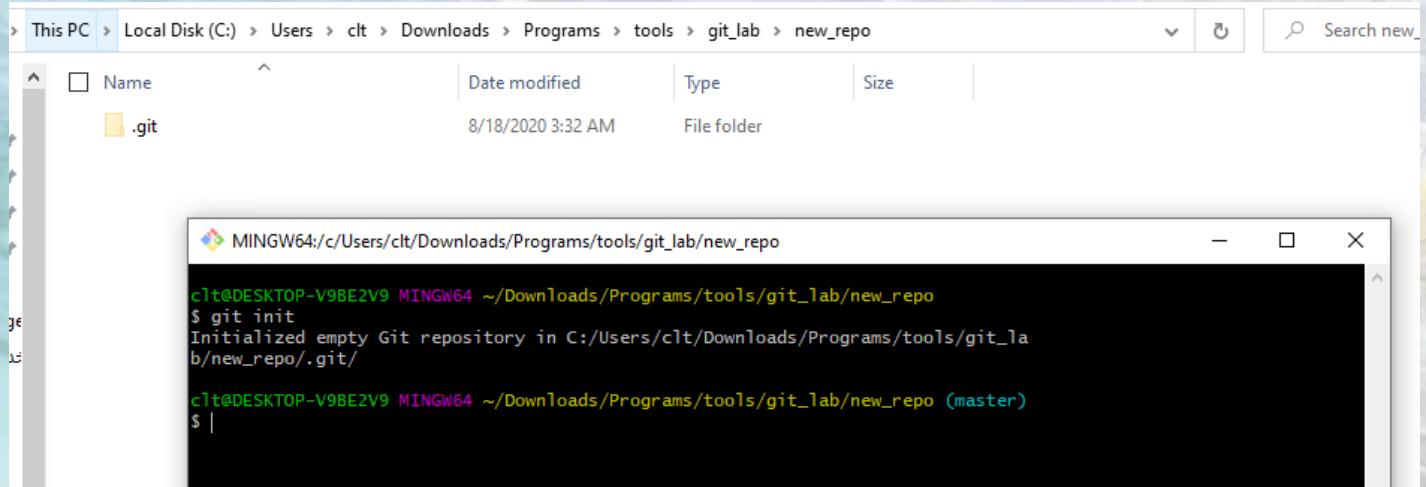


Basic Git Workflow

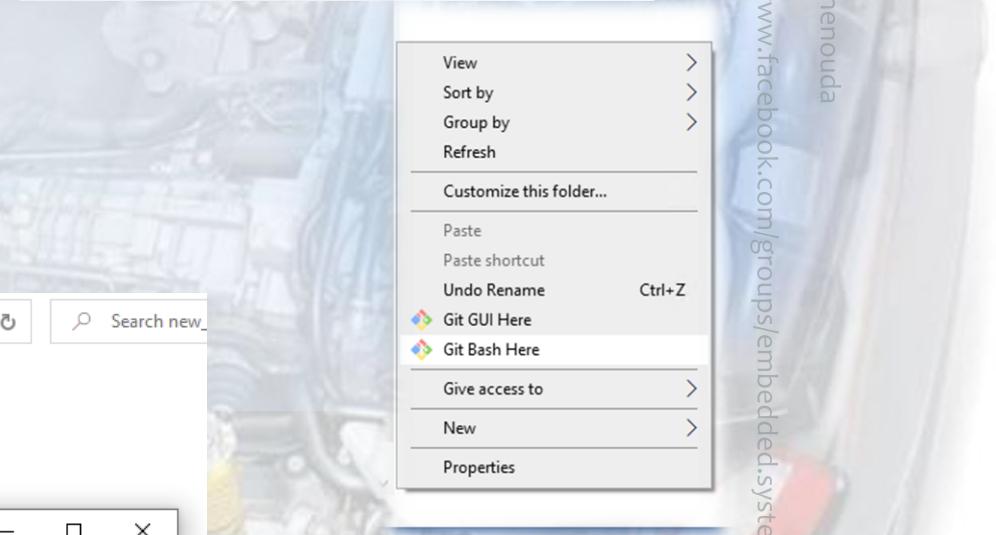
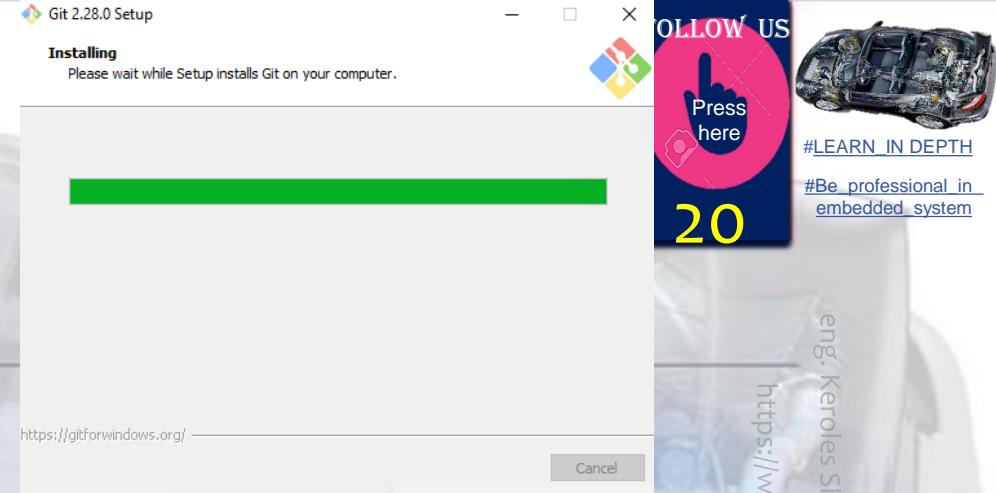


Fastest way to learn the git

- ▶ Download git for windows: <http://msysgit.github.io/>
- ▶ create a new repository
 - ▶ Created new folder “new_repo”
 - ▶ Open the git bash here
 - ▶ **git init**
 - ▶ to create a new git repository.



```
MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/new_repo
clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/new_repo
$ git init
Initialized empty Git repository in C:/Users/clt/Downloads/Programs/tools/git_lab/new_repo/.git/
clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/new_repo (master)
$ |
```



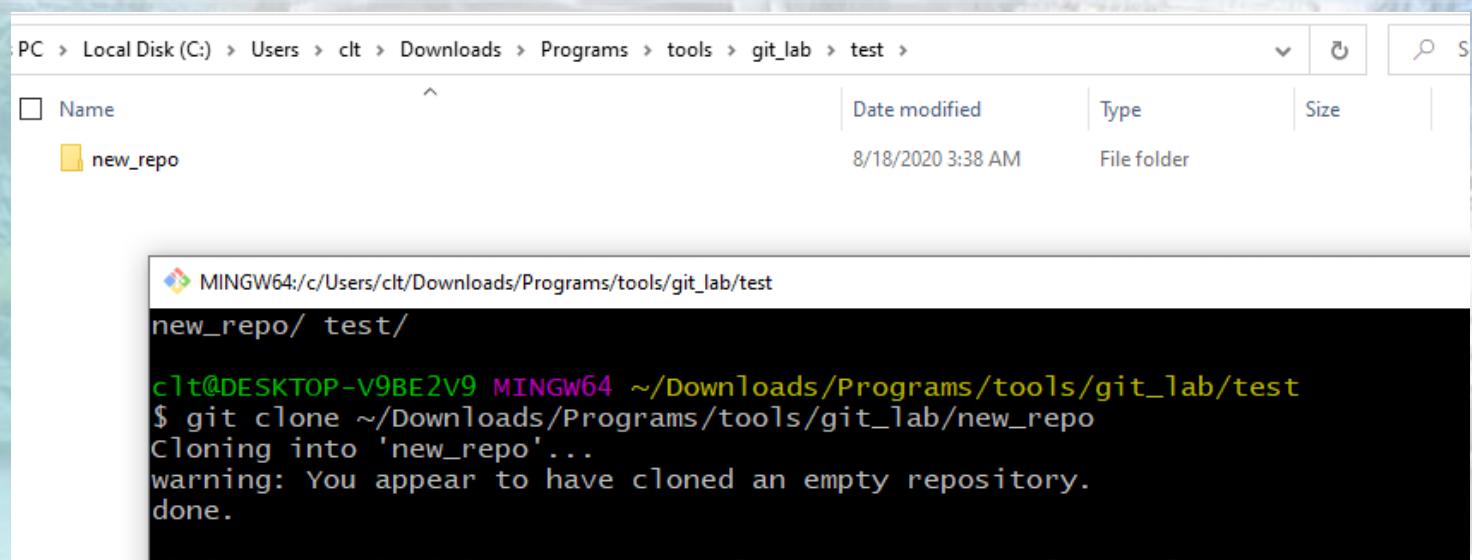
Kindly Note: to enable push
git config core.bare true

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checkout a repository

- ▶ create a working copy of a local repository by running the command
 - ▶ git clone /path/to/repository
- ▶ when using a remote server, your command will be
 - ▶ git clone username@host:/path/to/repository



```

PC > Local Disk (C:) > Users > clt > Downloads > Programs > tools > git_lab > test >
□ Name Date modified Type Size
new_repo 8/18/2020 3:38 AM File folder

MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/test
new_repo/ test/
c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test
$ git clone ~/Downloads/Programs/tools/git_lab/new_repo
Cloning into 'new_repo'...
warning: You appear to have cloned an empty repository.
done.
  
```



workflow

your local repository consists of three "trees" maintained by git.

- ▶ the first one is your **Working Directory** which holds the actual files.
- ▶ the second one is the **Index** which acts as a **staging area** and
- ▶ finally the **HEAD** which points to the last commit you've made.

```
git config --global user.email "eng.keroles.karam@gmail.com"
git config --global user.name "keroles shenouda"
```

```
MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/test/new_repo
$ git config --global user.email "eng.keroles.karam@gmail.com"
$ git config --global user.name "keroles shenouda"
$ touch README.txt
$ git add README.txt
```



pushing changes

- ▶ Your changes are now in the **HEAD** of your local working copy. To send those changes to your remote repository, execute
 - ▶ `git push origin master`
- ▶ If you have not cloned an existing repository and want to connect your repository to a remote server, you need to add it with
 - ▶ `git remote add origin <server>`
- ▶ Now you are able to push your changes to the selected remote server

```
c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ git commit -m "add new file" README.txt
[master baf1676] add new file
 1 file changed, 1 insertion(+), 1 deletion(-)

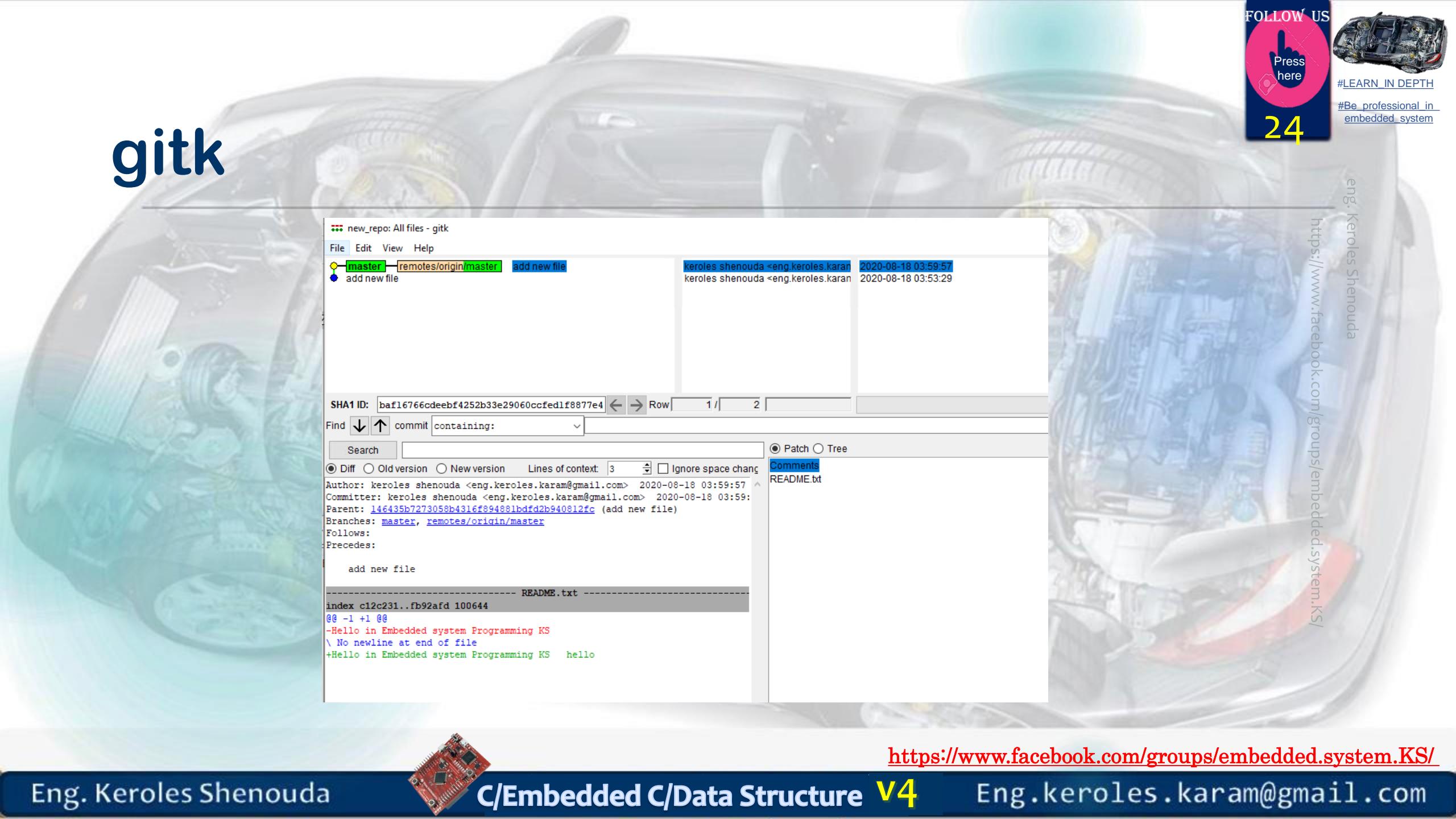
c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ git push origin master
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Writing objects: 100% (3/3), 299 bytes | 299.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To C:/Users/c1t/Downloads/Programs/tools/git_lab/new_repo
 146435b..baf1676  master -> master
```

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gitk



new_repo: All files - gitk

File Edit View Help

master remotes/origin/master add new file

keroles shenouda <eng.keroles.karam> 2020-08-18 03:59:57
keroles shenouda <eng.keroles.karam> 2020-08-18 03:53:29

SHA1 ID: baf16766cdeebf4252b33e29060ccfed1f8877e4 | Row 1 / 2 |

Find commit containing: Search Patch Tree

Diff Old version New version Lines of context: 3 Ignore space changes

Author: keroles shenouda <eng.keroles.karam@gmail.com> 2020-08-18 03:59:57
Committer: keroles shenouda <eng.keroles.karam@gmail.com> 2020-08-18 03:59:
Parent: 146435b7273058b4316f894881bdfd2b940812fc (add new file)
Branches: master, remotes/origin/master
Follows:
Precedes:

add new file

----- README.txt -----

```
index c12c231..fb92afd 100644  
@@ -1 +1 @@  
-Hello in Embedded system Programming KS  
\ No newline at end of file  
+Hello in Embedded system Programming KS hello
```

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branching

- ▶ Branches are used to develop features isolated from each other. **The master branch is the "default" branch** when you create a repository.
- ▶ Use other branches for development and merge them back to the master branch upon completion.

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Branching Cont.

create a new branch named "feature_x" and switch to it using

git checkout -b feature_x

switch back to master

git checkout master

and delete the branch again

git branch -d feature_x

a branch is *not available to others* unless you push the branch to your remote repository

git push origin <branch>

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Branching Cont.

```

MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/test/new_repo

c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ git checkout -b feature1.0
Switched to a new branch 'feature1.0'

c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (feature1.0)
$ echo "feature1.0" >> README.txt

c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (feature1.0)
$ git commit -m "add feature1.0 in Readme.txt file" README.txt
warning: LF will be replaced by CRLF in README.txt.
The file will have its original line endings in your working directory
warning: LF will be replaced by CRLF in README.txt.
The file will have its original line endings in your working directory
[feature1.0 8369b61] add feature1.0 in Readme.txt file
 1 file changed, 1 insertion(+)

c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (feature1.0)
$ git push origin feature1.0
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 4 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 324 bytes | 162.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To C:/Users/clt/Downloads/Programs/tools/git_lab/new_repo
 * [new branch]      feature1.0 -> feature1.0

c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (feature1.0)
$
```

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<https://www.facebook.com/groups/embedded.system.KS/>



Branching Cont.

new_repo: All files - gitk

File Edit View Help

feature1.0 remotes/origin/feature1.0 add feature1.0 in Readme.txt file
 master remotes/origin/master add new file
 add new file

keroles shenouda <eng.keroles.karam@gmail.com>
 keroles shenouda <eng.keroles.karam@gmail.com>
 keroles shenouda <eng.keroles.karam@gmail.com>

2020-08-18 04:07:54
 2020-08-18 03:59:57
 2020-08-18 03:53:29

SHA1 ID: 8369b61bc10f0c20bf48a13a30d2956e9be81e5 ← → Row 1 / 3

Find ↓ ↑ commit containing: ↴

Search

Diff Oldversion New version Lines of context: 3 Ignore space changes

Author: keroles shenouda <eng.keroles.karam@gmail.com> 2020-08-18 04:07:54
 Committer: keroles shenouda <eng.keroles.karam@gmail.com> 2020-08-18 04:07:
 Parent: [ba16766cddebf4252b33e29060ccfed1f8877e4](#) (add new file)
 Branches: [feature1.0](#), [remotes/origin/feature1.0](#)
 Follows:
 Precedes:

add feature1.0 in Readme.txt file

----- README.txt -----

```
index fb92afde..e9eb90f 100644
@@ -1 +1,2 @@
 Hello in Embedded system Programming KS hello
+feature1.0
```

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update & merge

to update your local repository to the newest commit, execute

`git pull`

in your working directory to *fetch* and *merge* remote changes.

to merge another branch into your active branch (e.g. master), use

`git merge <branch>`

in both cases git tries to auto-merge changes. Unfortunately, this is not always possible and resu

`git add <filename>`

before merging changes, you can also preview them by using

`git diff <source_branch> <target_branch>`

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update & merge

```
MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/test/new_repo

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (feature1.0)
$ git diff master feature1.0
diff --git a/README.txt b/README.txt
index fb92afde..e9eb90f 100644
--- a/README.txt
+++ b/README.txt
@@ -1 +1,2 @@
Hello in Embedded system Programming KS hello
+feature1.0

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (feature1.0)
$ git checkout master
Switched to branch 'master'
Your branch is up to date with 'origin/master'.

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ cat README.txt
Hello in Embedded system Programming KS hello

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ git merge feature1.0
Updating baf1676..8369b61
Fast-forward
 README.txt | 1 +
 1 file changed, 1 insertion(+)

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ cat README.txt
Hello in Embedded system Programming KS hello
feature1.0
```



log

- ▶ in its simplest form, you can study repository history using..
 - ▶ **git log**
- ▶ You can add a lot of parameters to make the log look like what you want.
 - ▶ see **git log --help**

```
MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/test/new_repo
clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/new_repo (master)
$ git log
commit 8369b61bca10f0c20bf48a13a30d2956e9be81e5 (HEAD -> master, origin/feature1.0, feature1.0)
Author: keroles shenouda <eng.keroles.karam@gmail.com>
Date:   Tue Aug 18 04:07:54 2020 +0200

    add feature1.0 in Readme.txt file

commit baf16766cdeebf4252b33e29060ccfed1f8877e4 (origin/master)
Author: keroles shenouda <eng.keroles.karam@gmail.com>
Date:   Tue Aug 18 03:59:57 2020 +0200

    add new file

commit 146435b7273058b4316f894881bdfd2b940812fc
Author: keroles shenouda <eng.keroles.karam@gmail.com>
Date:   Tue Aug 18 03:53:29 2020 +0200

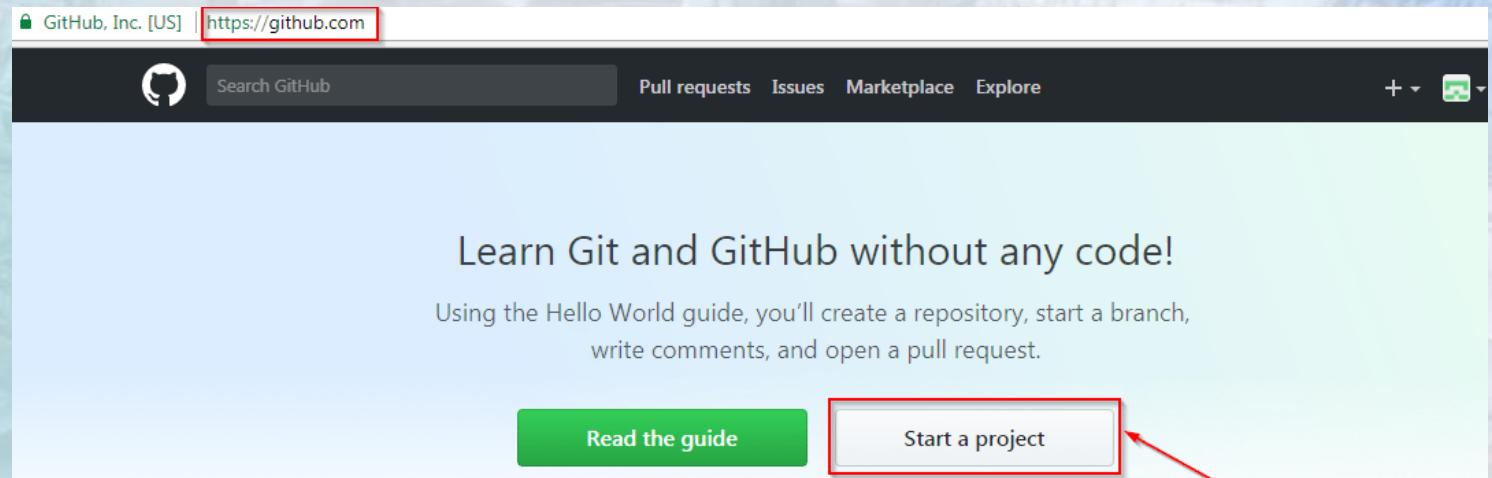
    add new file
```

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GitHub

- ▶ Go to the link: <https://github.com/> . Fill the sign up form and click on “Sign up for Github”.
- ▶ Click on “Start a new project”.



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GitHup Cont.

Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere? [Import a repository.](#)

Owner * Repository name *

keroles / embedded_System_Online_Diplor ✓

Great repository names are short and memorable. Need inspiration? How about [automatic-adventure](#)?

Description (optional)

Public
Anyone on the internet can see this repository. You choose who can commit.

Private
You choose who can see and commit to this repository.

Skip this step if you're importing an existing repository.

Initialize this repository with a README
This will let you immediately clone the repository to your computer.

Add .gitignore: None Add a license: None ⓘ

Create repository





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GitHub

Quick setup — if you've done this kind of thing before

[Set up in Desktop](#) or [HTTPS](#) [SSH](#) https://github.com/keroles/embedded_System_Online_Diploma.git

Get started by creating a new file or uploading an existing file. We recommend every repository include a [README](#), [LICENSE](#), and [.gitignore](#).

...or create a new repository on the command line

```
echo "# embedded_System_Online_Diploma" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin https://github.com/keroles/embedded_System_Online_Diploma.git
git push -u origin master
```

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MINGW64:/c/Users/clt/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma

```

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma
$ echo "# embedded_System_Online_Diploma" >> README.md

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma
$ git init
Initialized empty Git repository in C:/Users/clt/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma/.git/
clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma (master)
$ git add README.md
warning: LF will be replaced by CRLF in README.md.
The file will have its original line endings in your working directory

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma (master)
$ git commit -m "first commit"
[master (root-commit) d9545d7] first commit
 1 file changed, 1 insertion(+)
 create mode 100644 README.md

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma (master)
$ git remote add origin https://github.com/keroles/embedded_System_Online_Diploma.git

clt@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma (master)
$ git push -u origin master

```





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```
c1t@DESKTOP-V9BE2V9 MINGW64 ~/Downloads/Programs/tools/git_lab/test/embedded_System_Online_Diploma (master)
$ git push -u origin master
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Writing objects: 100% (3/3), 249 bytes | 249.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To https://github.com/keroles/embedded_System_Online_Diploma.git
 * [new branch]      master -> master
Branch 'master' set up to track remote branch 'master' from 'origin'.
```

keroles / embedded_System_Online_Diploma

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

master 1 branch 0 tags Go to file Add file Code

keroles first commit d9545d7 4 minutes ago 1 commits

README.md first commit 4 minutes ago

README.md

embedded_System_Online_Diploma







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