Using GIT

Pr. Olivier Gruber

olivier.gruber@imag.fr

Laboratoire d'Informatique de Grenoble

Université de Grenoble-Alpes

Overview

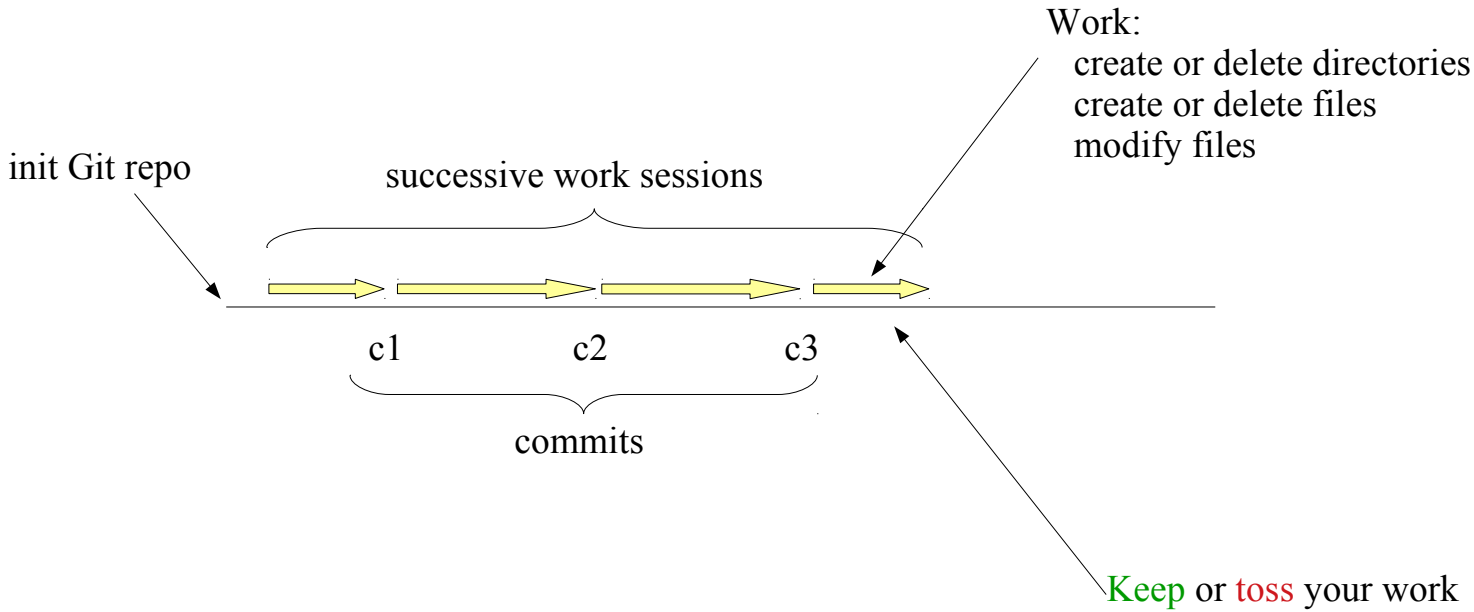
- What is GIT
  - Keeping histories of the evolution of files and directories
  - The ability to merge histories, working alone or in a team
- Personal usage
  - Protect and evolve your code
  - Look at the past
- Team work
  - Dividing work and be able to merge later
  - Flexible cooperation
  - Keep versions

Real-life Scenarii

- Personal usage examples
  - Last minute, last change…
  - It started as a simple change, really…
  - Hum, what if...
- Team work examples
  - Which USB key as the last version already?
  - Trust me, I tested my changes...
  - What? Fix you a bug now! Can't, in the middle of something…
  - Hey guys, sorry, but my machine died on me...

GIT concepts

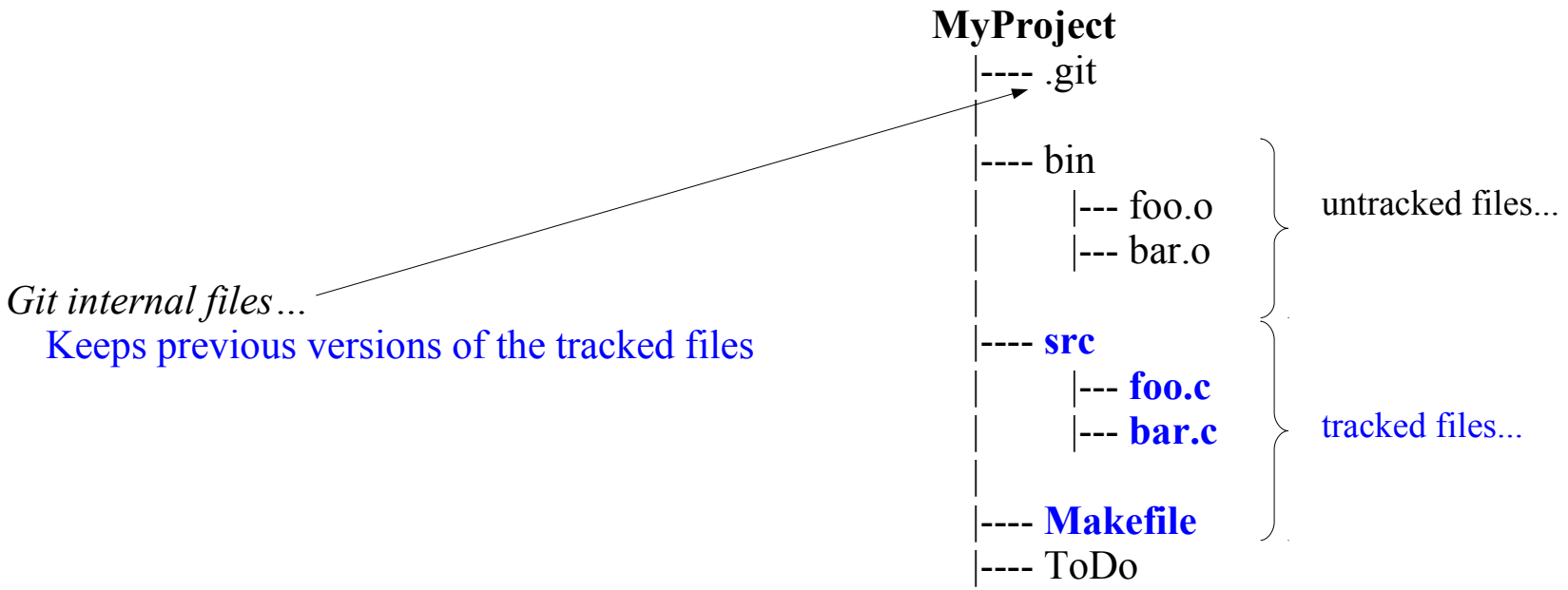
- GIT simplest workflow – A saga of transactions
  - Tracks changes to a directory (its files and subdirectories)
  - A transaction: do some work, then commit or abort
  - GIT keeps the history of commits



GIT concepts

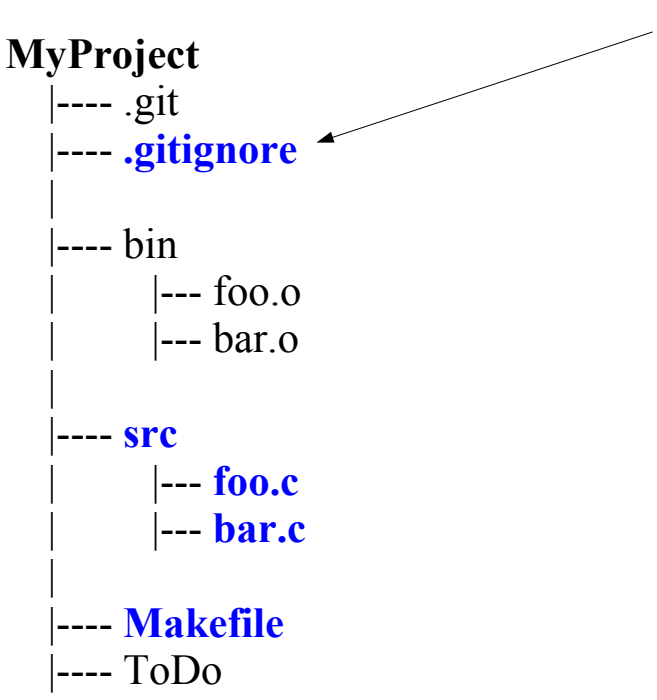
- GIT Repository
  - A repository manages one tree of directories and files
  - Git tracks the history of **certain files and directories**

```
$ mkdir MyProject
$ cd MyProject
$ git init
Initialized empty Git repository in ../MyProject/.git/
$
```



GIT concepts

- GIT Repository
  - A repository manages one tree of directories and files
  - Git tracks the history of **certain files and directories**



give patterns to ignore

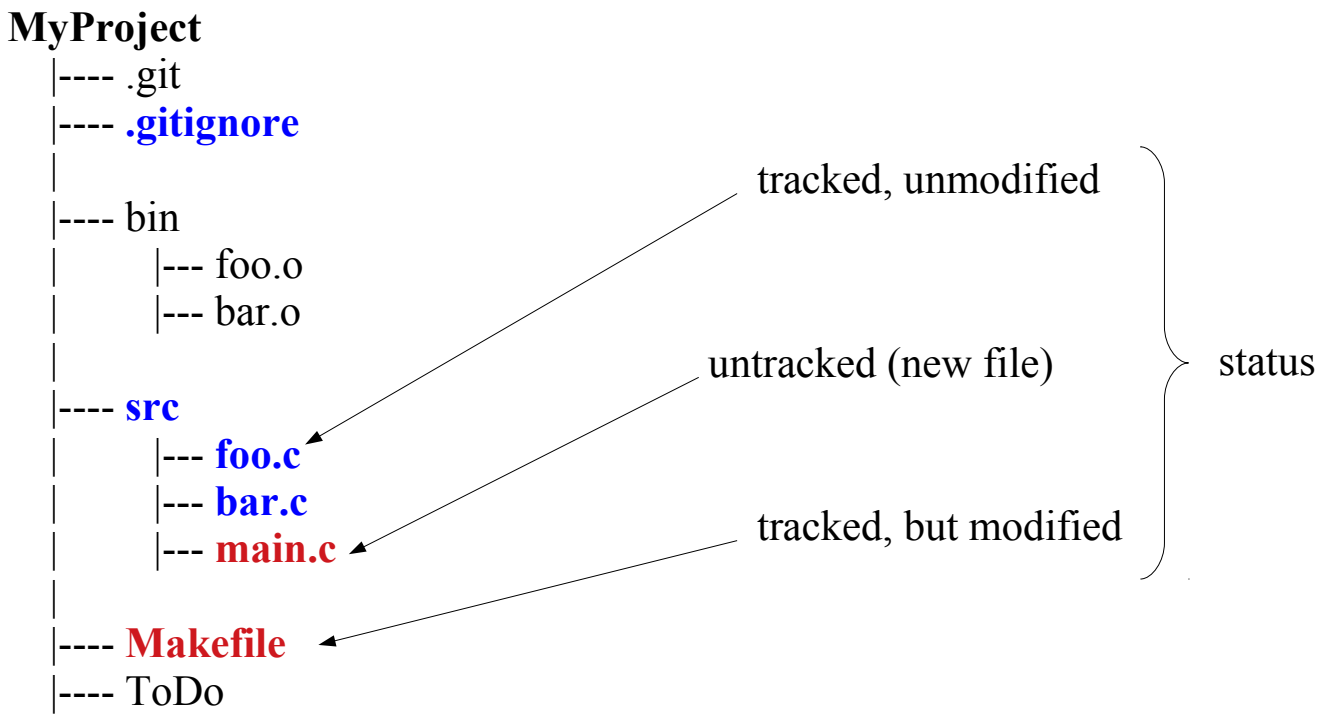
/bin/
Todo

Want to know more?

$ man gitignore

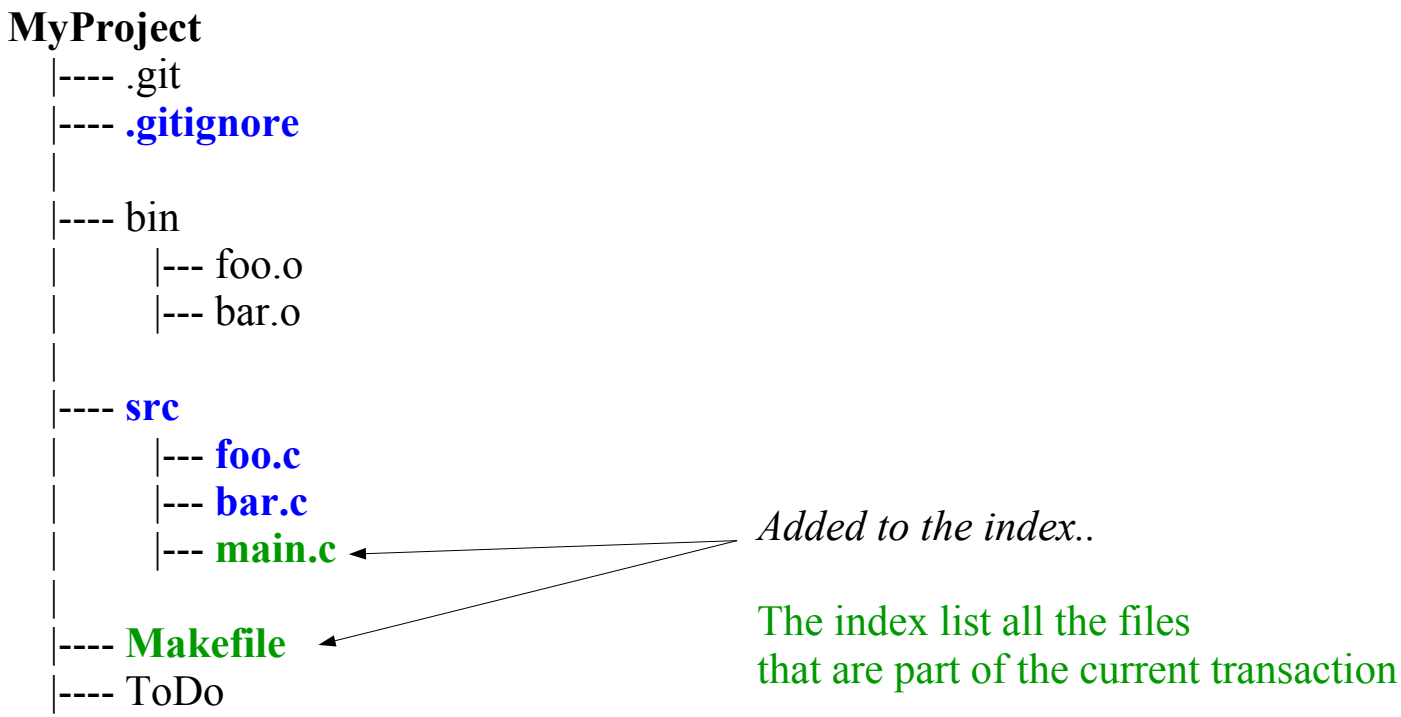
GIT concepts

- GIT Status
  - Git tracks the history of certain files and directories
  - **Each file has a status** – untracked, tracked, modified



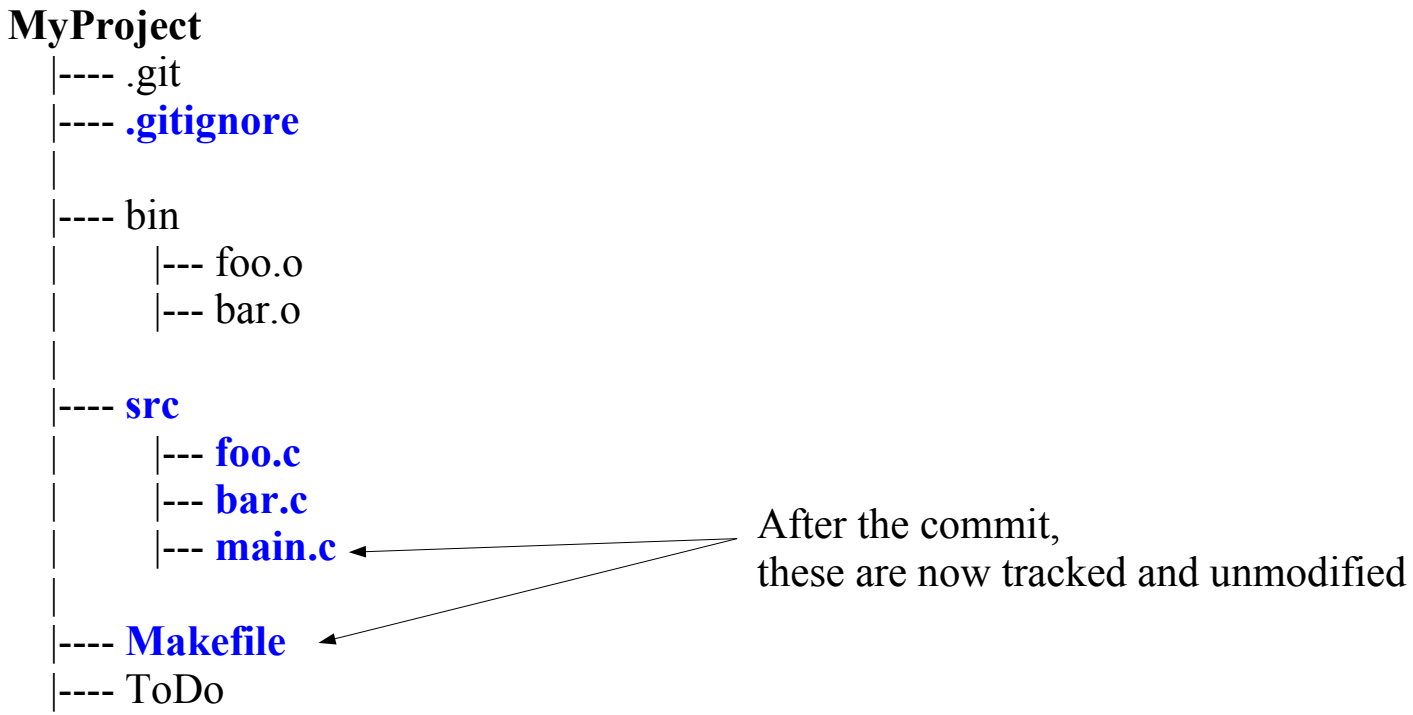
GIT concepts

- GIT Status
  - Git tracks the history of certain files and directories
  - **Each file has a status** – untracked, tracked, modified, **indexed**



GIT concepts

- GIT Status
  - Git tracks the history of certain files and directories
  - Each file has a status – untracked, tracked, modified, indexed
  - **Commit**: save changes for all the files in the index

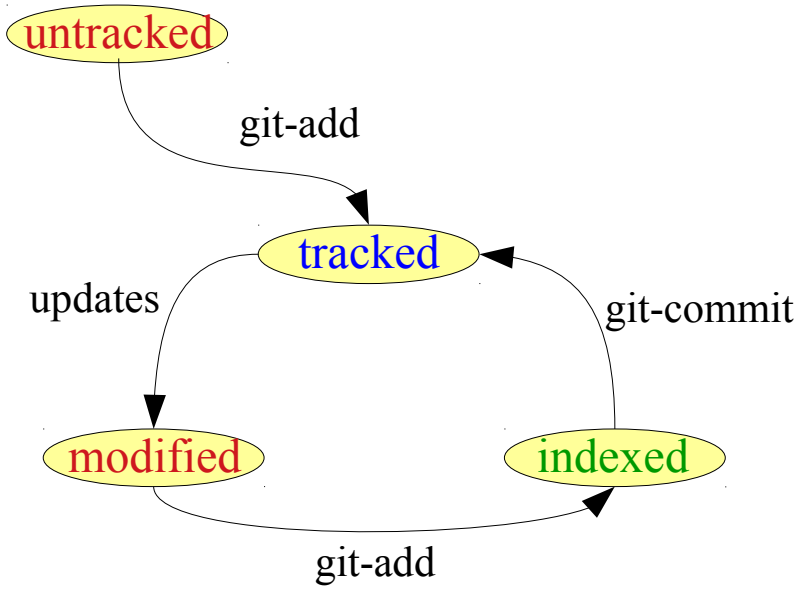


GIT concepts – Recap

- Four commands
  - **Git-init**
    - Create a repository
  - **Git-status**
    - Give you the status of files
  - **Git-add**
    - Add files to the index
    - Modified or untracked files
  - **Git-commit**
    - Commit changes to indexed files

Want to know more?

$ man git-init
$ man git-status
$ man git-add
$ man git-commit



GIT concepts – Recap

- Four commands
  - **Git-init**
    - Create a repository
  - **Git-status**
    - Give you the status of files
  - **Git-add**
    - Add files to the index
    - Modified or untracked files
  - **Git-commit**
    - Commit changes to indexed files

```
$ mkdir MyProject
$ cd MyProject
$ git init
Initialized empty Git repository in ../MyProject/.git/
$
```

GIT concepts – Recap

- Four commands
  - **Git-init**
    - Create a repository
  - **Git-status**
    - Give you the status of files
  - **Git-add**
    - Add files to the index
    - Modified or untracked files
  - **Git-commit**
    - Commit changes to indexed files

$ ...
Add main.c
Modify Makefile

$ **git status**
Modified: Makefile
Untracked: main.c

GIT concepts – Recap

- Four commands
  - **Git-init**
    - Create a repository
  - **Git-status**
    - Give you the status of files
  - **Git-add**
    - Add files to the index
    - Modified or untracked files
  - **Git-commit**
    - Commit changes to indexed files

```
$ ...
   Add main.c
   Modify Makefile

$ git status
  Modified: Makefile
  Untracked: main.c

$ git add –all
$ git status
  Makefile
  main.c
```

GIT concepts – Recap

- Four commands
  - **Git-init**
    - Create a repository
  - **Git-status**
    - Give you the status of files
  - **Git-add**
    - Add files to the index
    - Modified or untracked files
  - **Git-commit**
    - Commit changes to indexed files

```
$ ...
   Add main.c
   Modify Makefile

$ git status
  Modified: Makefile
  Untracked: main.c

$ git add –all
$ git status
  Makefile
  main.c

$ git commit -m “Added main.c”
$ git status
nothing to commit, working directory clean
$
```

GIT concepts – Recap

File System View

```
MyProject/
    |---- .git/
    |---- .gitignore
    |
    |---- bin/
    |         |--- foo.o
    |         |--- bar.o
    |
    |---- src/
    |         |--- foo.c
    |         |--- bar.c
    |         |--- main.c
    |
    |---- Makefile
    |---- ToDo
```

Developer View

```
MyProject/
    |---- bin/
    |         |--- foo.o
    |         |--- bar.o
    |---- src/
    |         |--- foo.c
    |         |--- bar.c
    |         |--- main.c
    |---- Makefile
    |---- ToDo
```

Index View

Modified: **Makefile**

Modified: **foo.c**

Untracked: **main.c**

Repo View

History of all commits
And the previous versions
of tracked files

Using GIT for Oneself

- For what?
  - Permits trials and errors
  - Provides a safety net
  - Keep versions (v1, v2, etc.)
- Nothing is free
  - Git maintains a history, so it requires some storage space on your disk
  - It takes some practice to getting used it

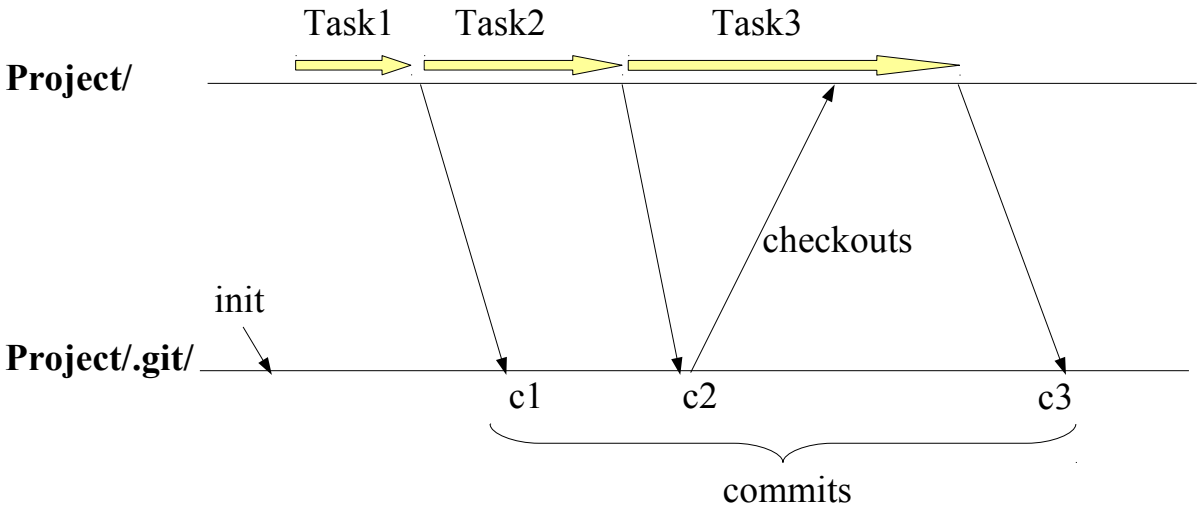
Using GIT – Safety Net

- Local safety net
  - Git maintains a copy of your work in the ".git" directory
  - So if you corrupt or loose a file/directory, you can recover it
  - As long as you do not delete or damage the contents of the ".git" directory
- Remote safety net
  - This is a bit more advanced usage
  - You could clone your repository on a remote machine, used as a backed-up machine
  - Example
    - You could use your account at the UFR
    - Or use github
    - Or use another machine at home

Using GIT – Safety Net

- Git-checkout: undo changes
  - Undo **uncommitted** changes
  - Restore the contents of modified files
  - Restore **removed** or **renamed** files or directories

```
$ git add –all
$ git commit -m “Task2 done”

   Working on Task3
   Ouch:
     - f***ed up file Toto.java
     - removed        Titi.java

$ git checkout Toto.java
$ git checkout Titi.java

...Finish Task3

$ git add –all
$ git commit -m “Task3 done”
```



Using GIT – Safety Net

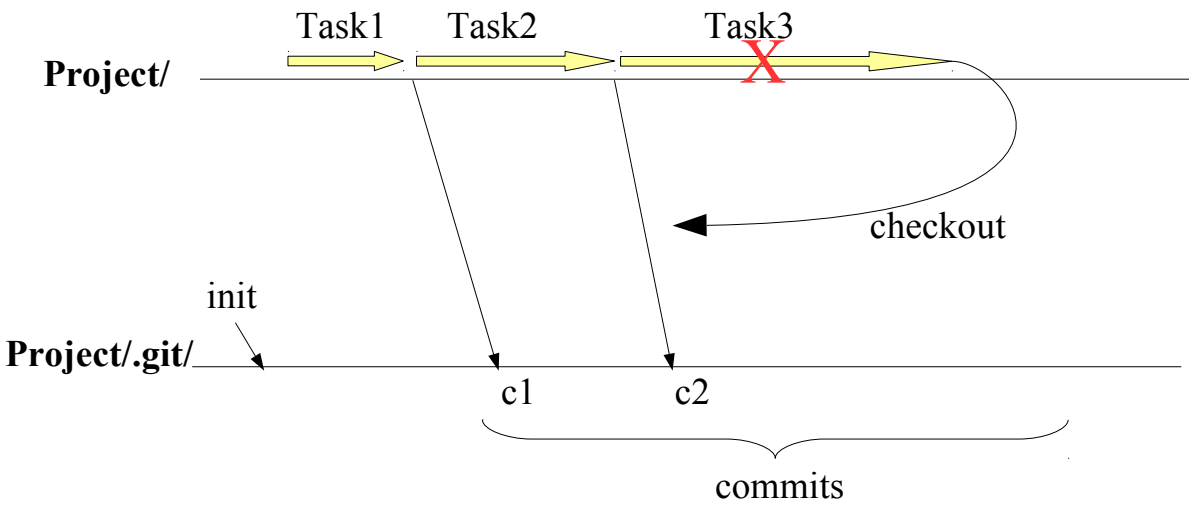
- Git-checkout: undo changes
  - Undo all **uncommitted** changes **only** in **tracked** files
  - Be careful here, **it cannot be undone**

...Working on Task2

$ **git add** –all
$ **git commit** -m “Task2 done”

...Working on Task3
...@#^*#^$&@&#^%*&*
...OK, let‘s toss all that non sense...

$ **git checkout -f**

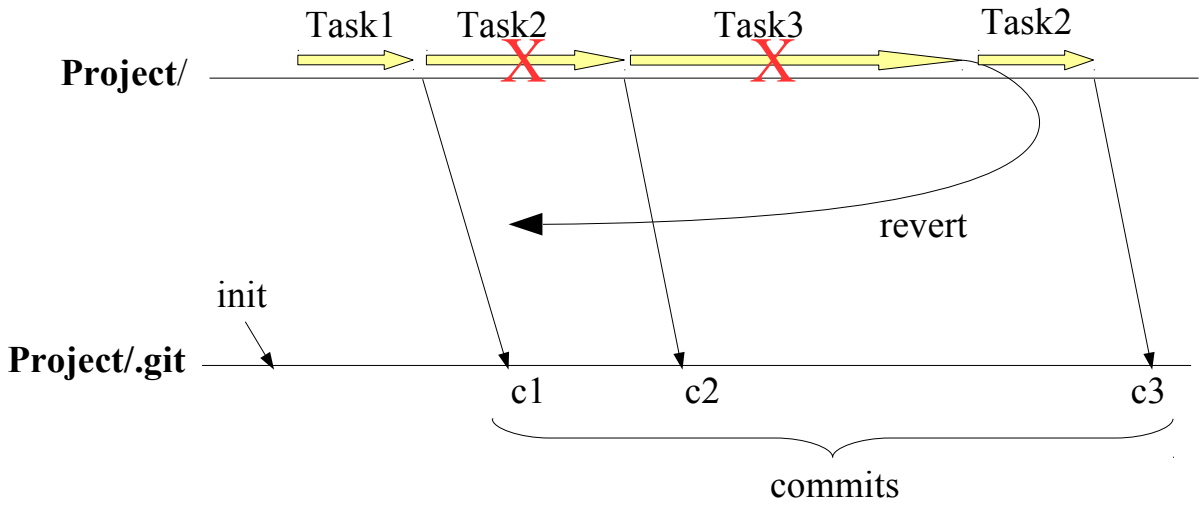


Using GIT – Safety Net

- Git-checkout: undo changes
  - Backing up several commits using git-log and git-revert

… Oh oh…
Task2 and Task3 were a mistake
Let's scratch that work.

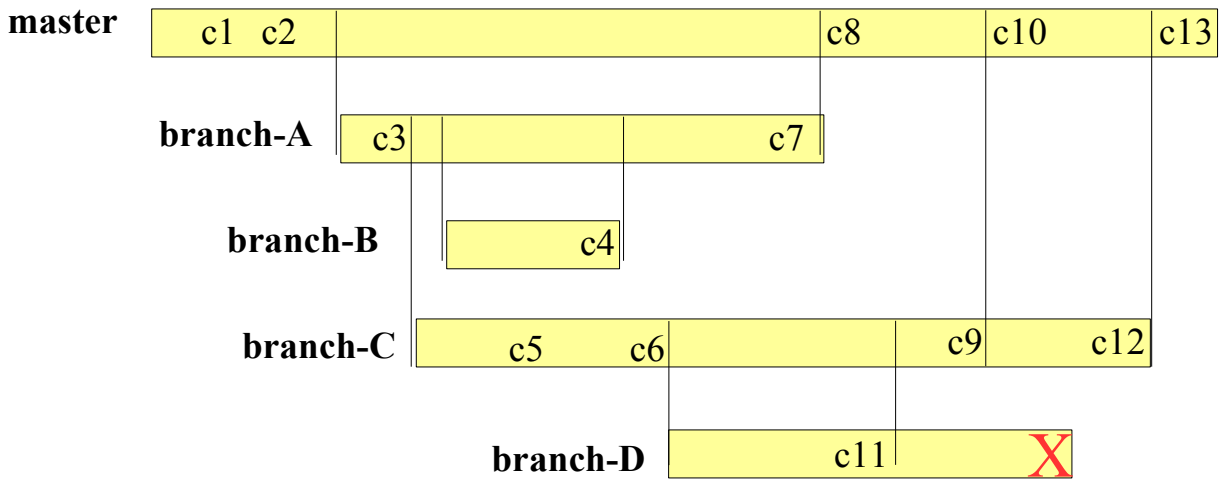
```
$ git log
commit 75c027
  c2
commit 35c025
  c1

$ git revert --no-commit 35c025..HEAD

...now do it right

$ git add --all
$ git commit -m "Ouf… "
```



You can do it this way,
but using branches is **much** easier…
and **much** safer

Using GIT Branches

- GIT history
  - Branch: fork and merge your work
  - Yields a tree of commits, on various branches

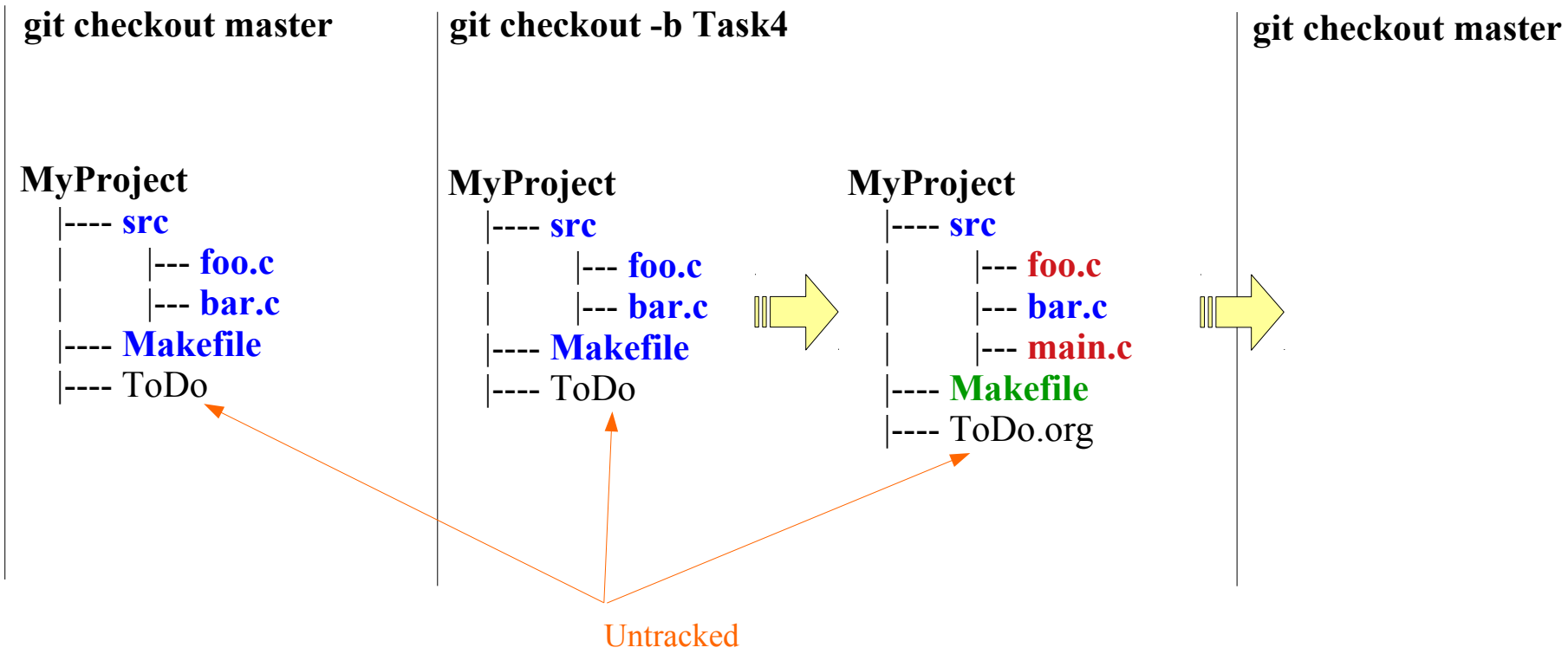


WARNING:
this may become complex…

ADVICE:
keep it simple

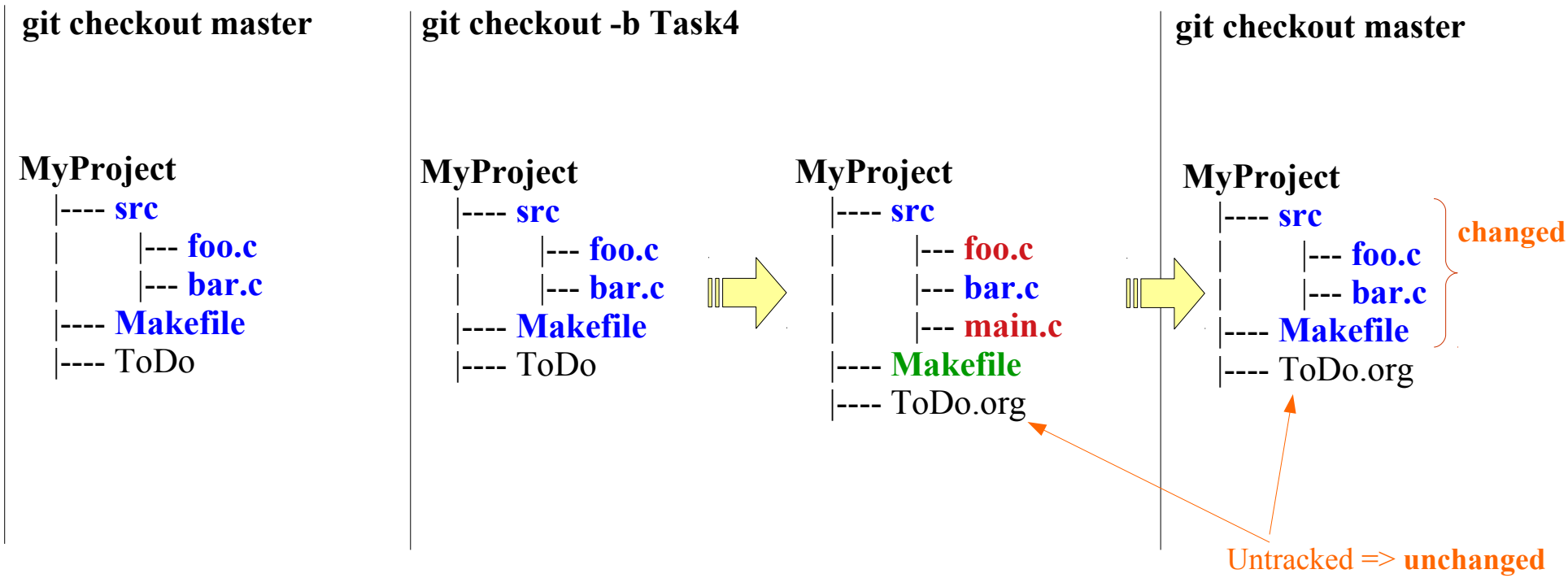
Using GIT branches

- Switching between branches
  - Changes the contents of **tracked** files
  - *WARNING: git-checkout leaves untracked files untouched*



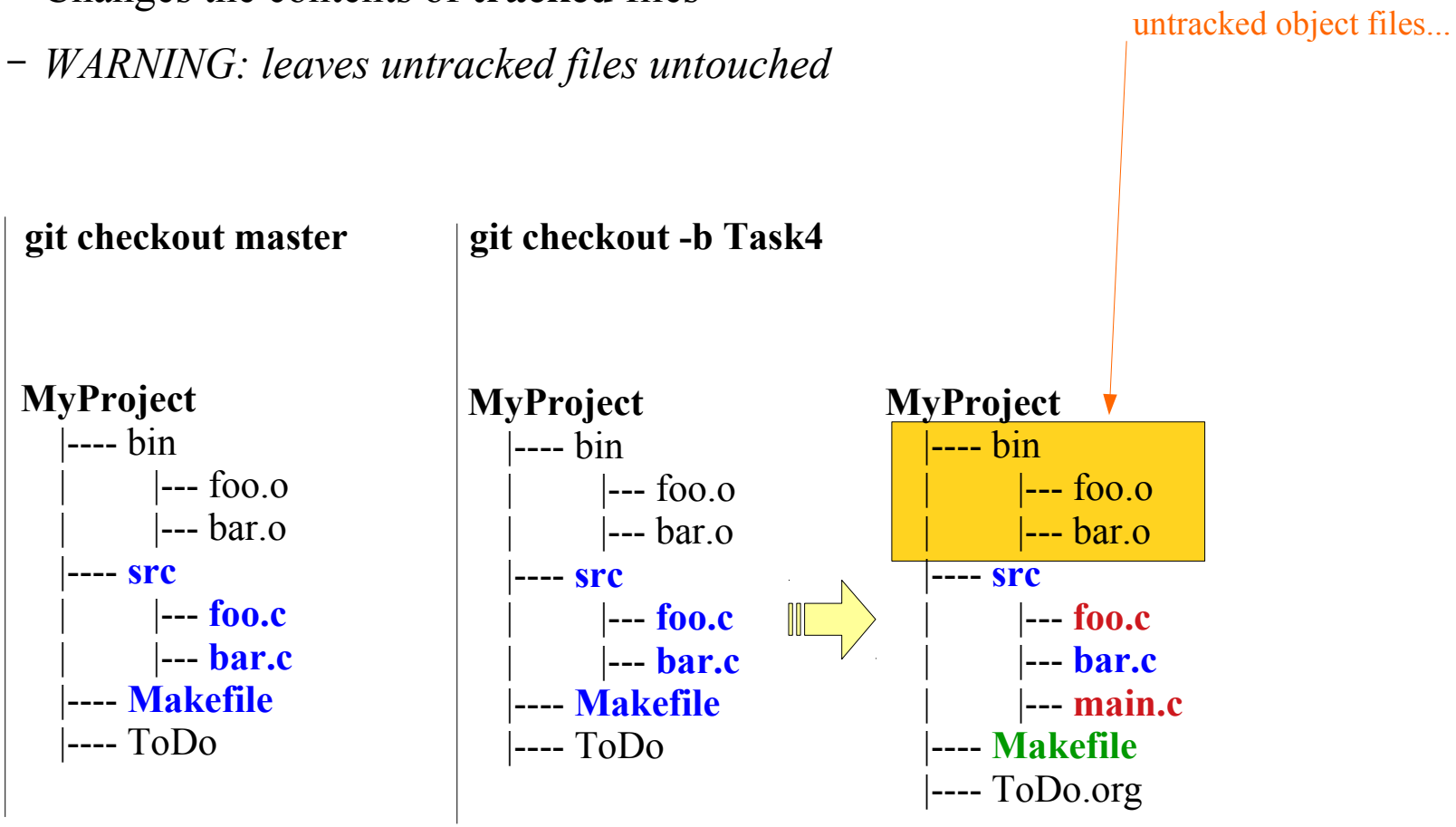
Using GIT branches

- Switching between branches
  - Changes the contents of **tracked** files
  - *WARNING: leaves untracked files untouched*



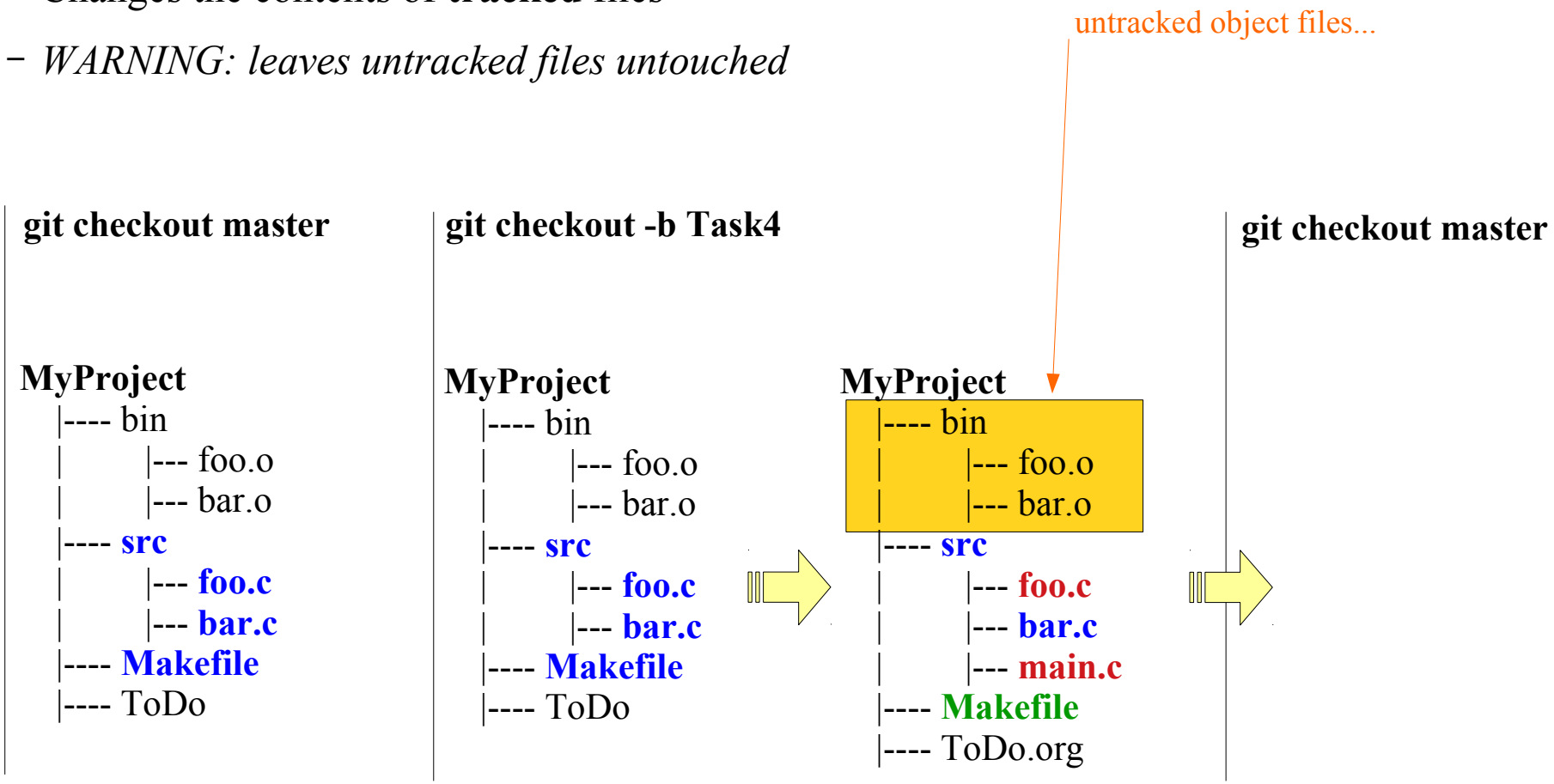
Using GIT branches

- Switching between branches
  - Changes the contents of **tracked** files
  - *WARNING: leaves untracked files untouched*



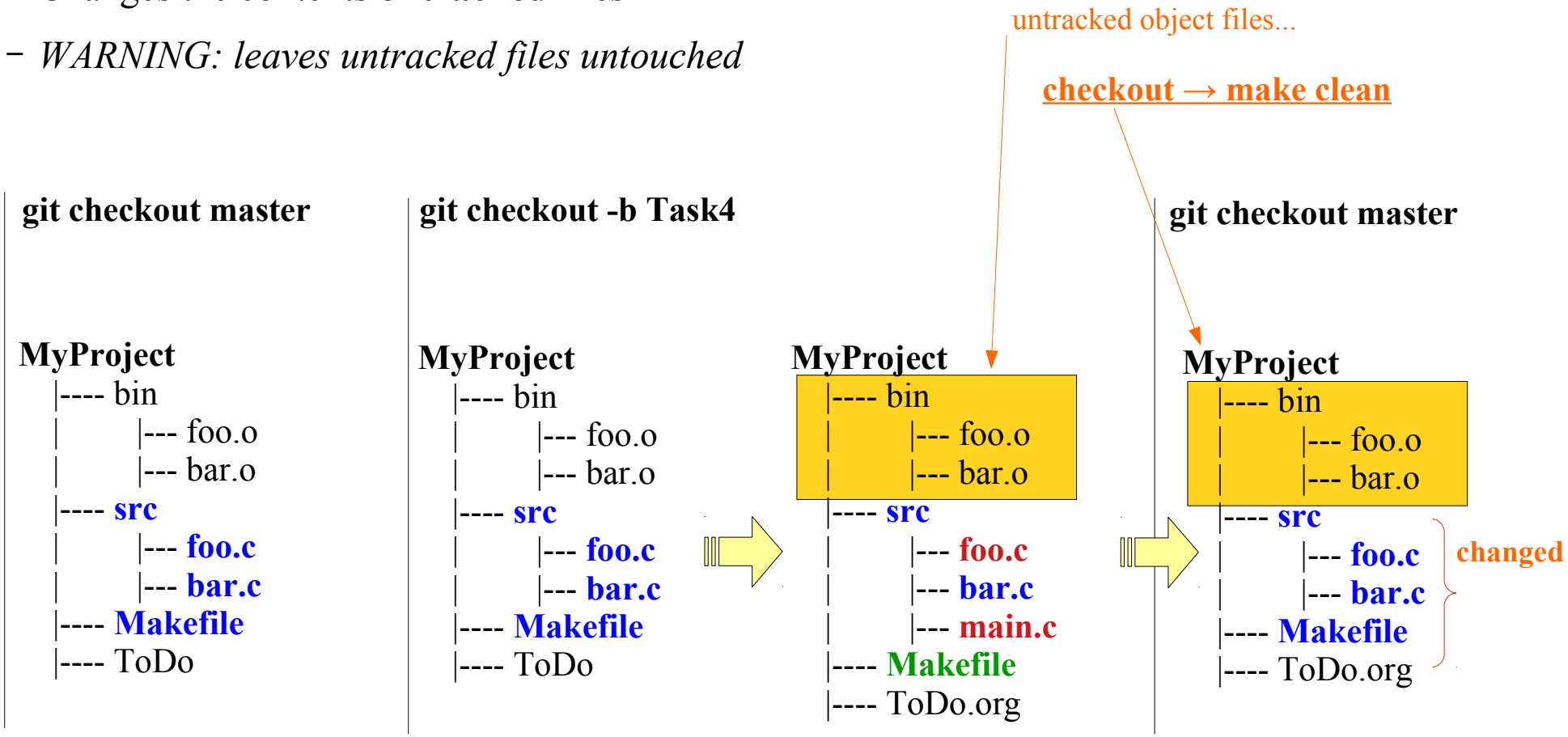
Using GIT branches

- Switching between branches
  - Changes the contents of **tracked** files
  - *WARNING: leaves untracked files untouched*



Using GIT branches

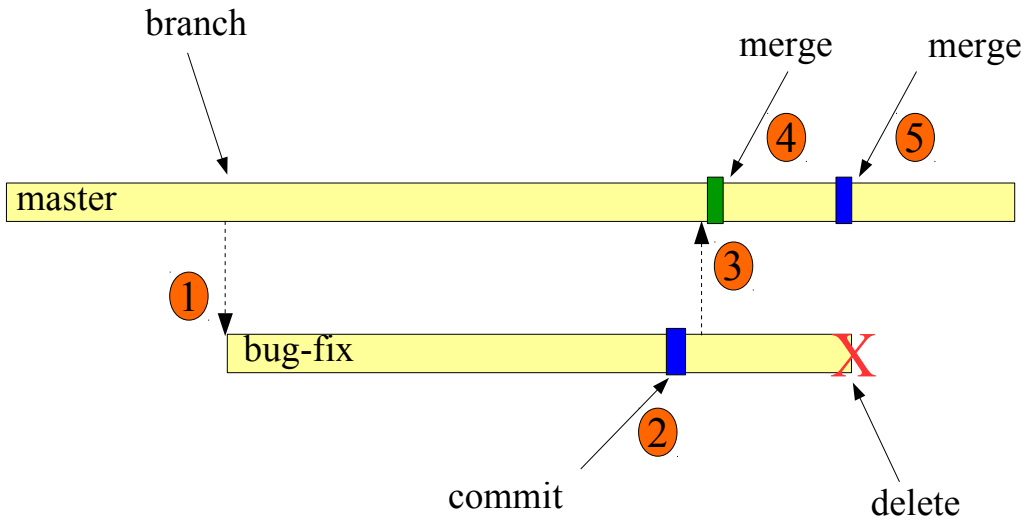
- Switching between branches
  - Changes the contents of **tracked** files
  - *WARNING: leaves untracked files untouched*



Nota Bene: clean your Java project under Eclipse

Using GIT branches

- The simplest pattern
  - Create a branch and later merge it
  - Delete the branch if no longer needed



1 $ **git branch bug-fix**
$ **git checkout bug-fix**

... work on fixing the bug

2 $ **git add** –all
$ **git commit** -m “Bug fixed”

3 $ **git checkout master** ← Come back on the branch *master*

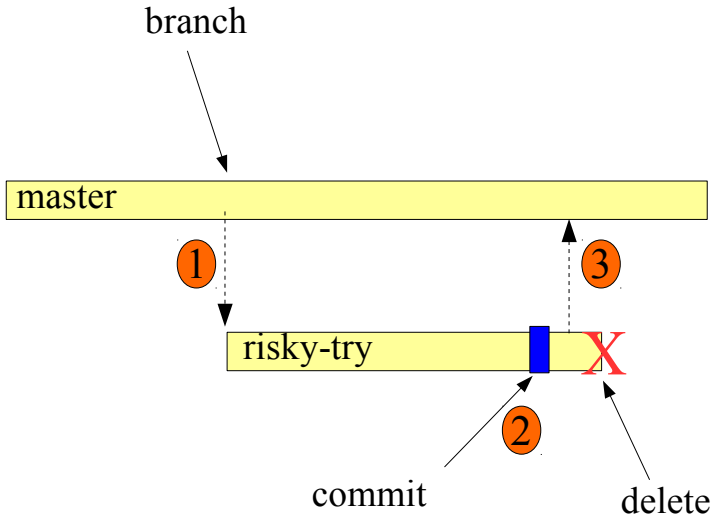
4 $ **git merge bug-fix** ← Merge the branch bug-fix into master
No conflicts, if master is never worked on

5 $ **git add** –all
$ **git commit** -m “Bug fixed merged”

$ **git branch -d bug-fix** ← Optional delete of the branch

Using GIT branches

- The simplest pattern – A great safety net
  - Create a branch, do some work...
  - And then toss your work at any time



1 $ **git checkout -b risky-try**

... work on trying something risky...

2 $ **git add** –all
$ **git commit** -m "First commit"

... If you do not like it at some point

3 $ **git checkout master** ← Come back on the branch *master*

$ **git branch -d risky-try** ← Optional delete of the branch

Using GIT branches

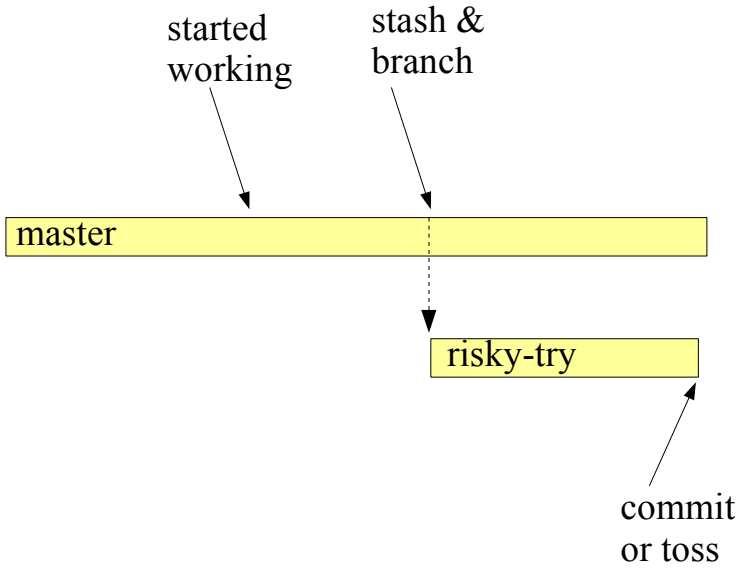
- What if your already started to work…
  - Then you realize this is going to be risky stuff…
  - No problem! (but avoid this situation nevertheless)

… started working on something…
… you are growing concerned…
… just too risky…

$ git stash
$ git checkout -b risky-try
$ git stash apply

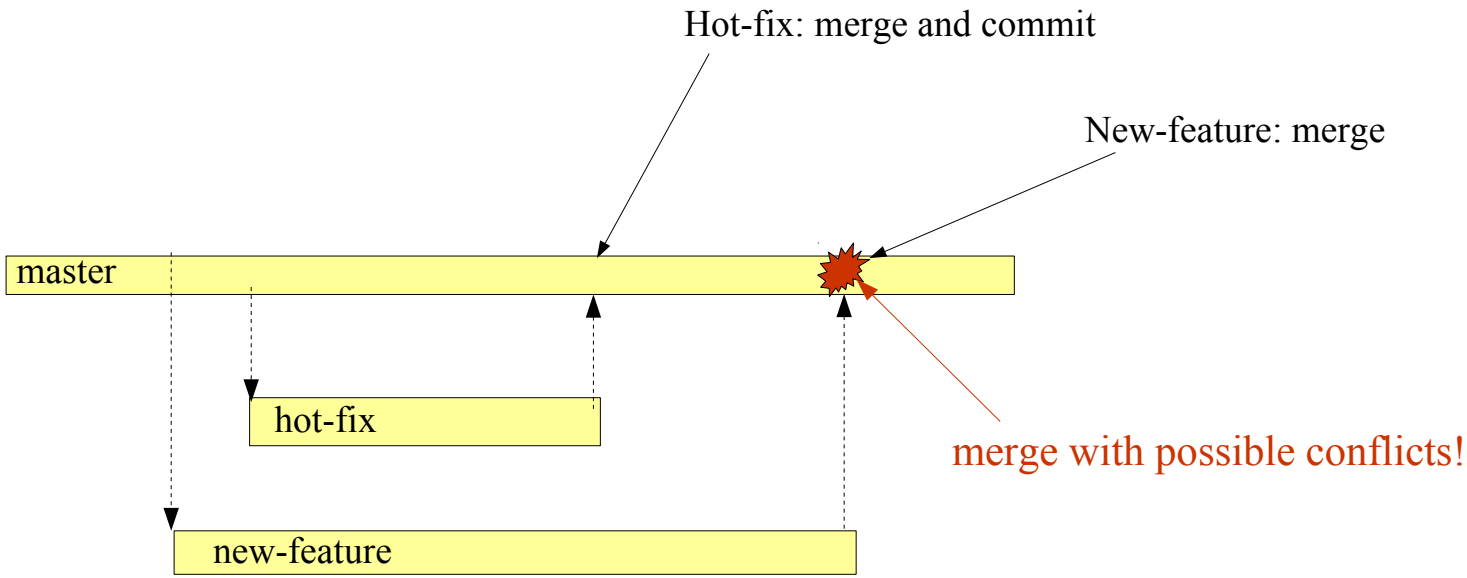
… keep working…

Then comit and merge
or toss your branch...



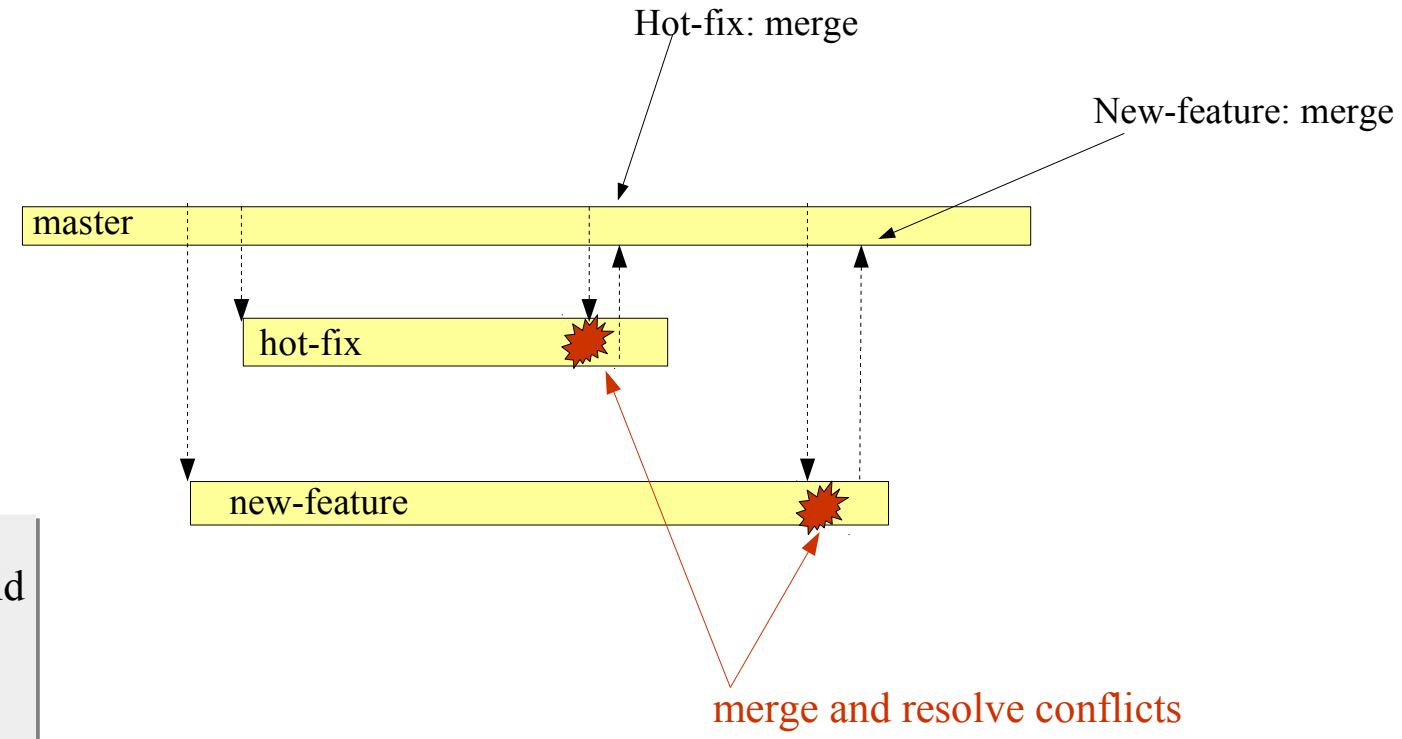
Using GIT branches

- Merge conflicts – the hot-fix syndrome
  - You are working on a new feature… hoping for a few days of quiet dev-time
  - Of course, a bug is found in your committed code → a hot fix is necessary
  - When done with the hot-fix, you commit and merge onto master
  - Going back to your new feature and you finish it
  - *When done, can you merge to master?*



Using GIT branches

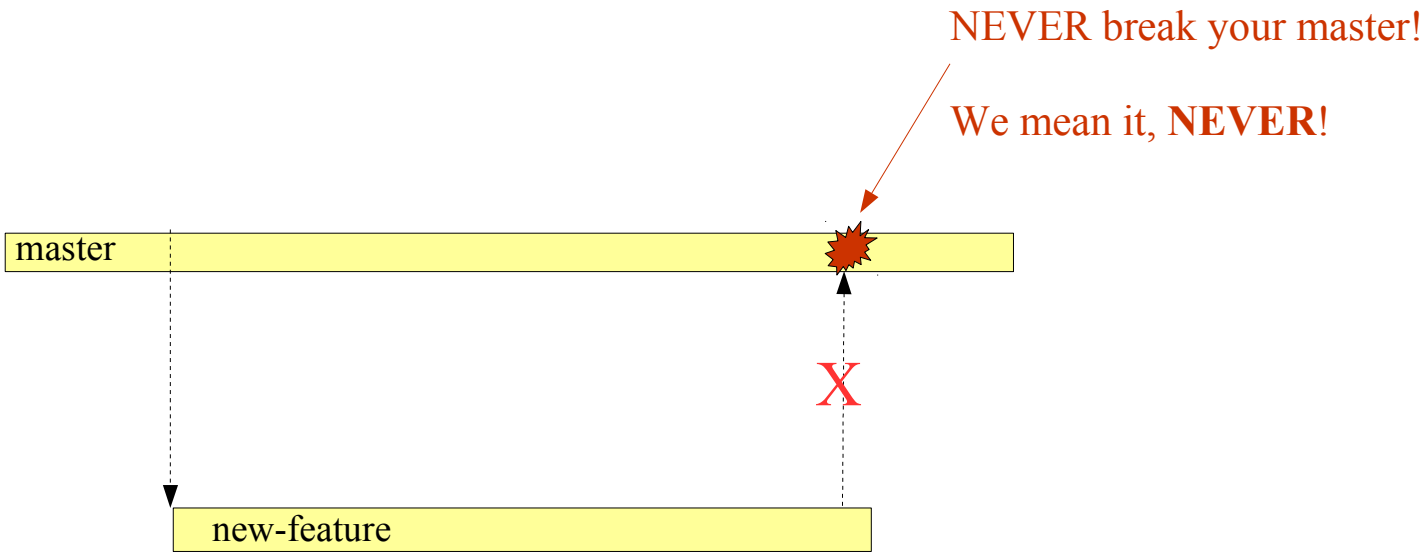
- Always merge *master* on your local branch first
  - ***Most*** *updates on the same files are merged* ***without*** *conflicts*
  - Sometimes a manual merge is necessary
  - You will need to practice it, with your favorite merge tool




```
$ git mergetool --tool=meld

$ man git-mergetool
```

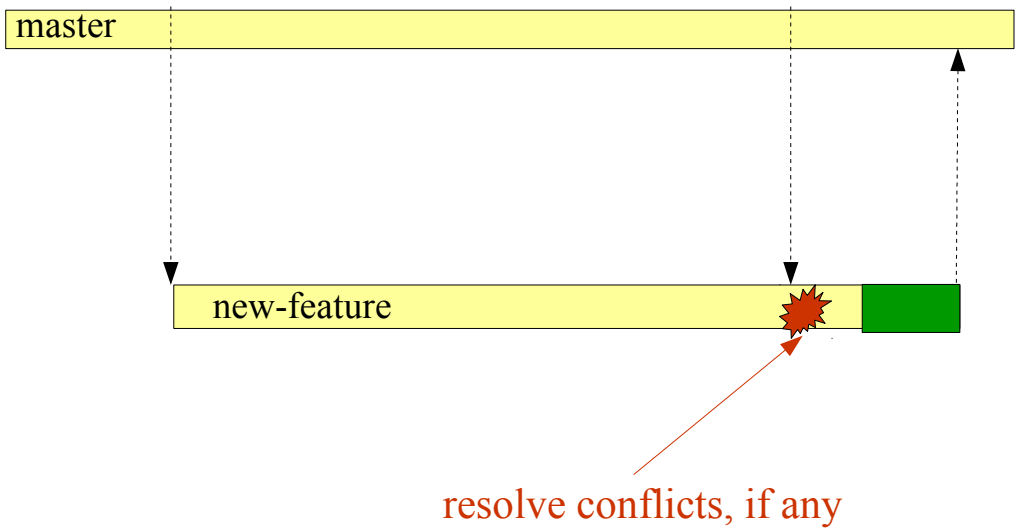
Using GIT branches

- Merge conflicts
  - **Never** merge on your master with potential conflicts
  - **...**



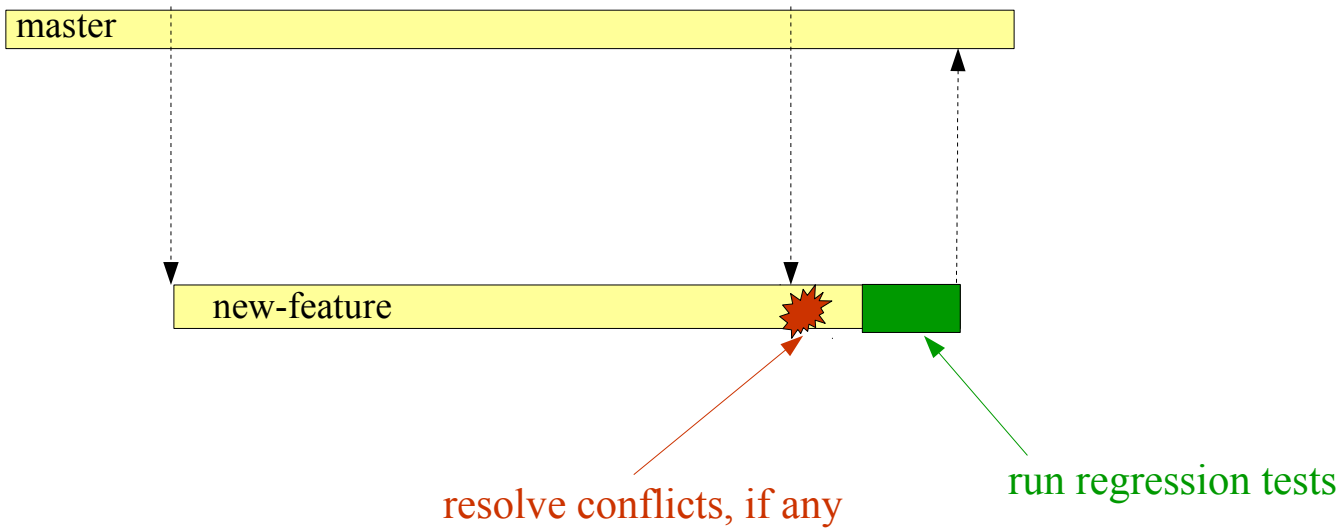
Using GIT branches

- **Never break your master branch**
  - **Never** merge on your master with potential conflicts
  - **Always** merge on your branch first
  - **...**



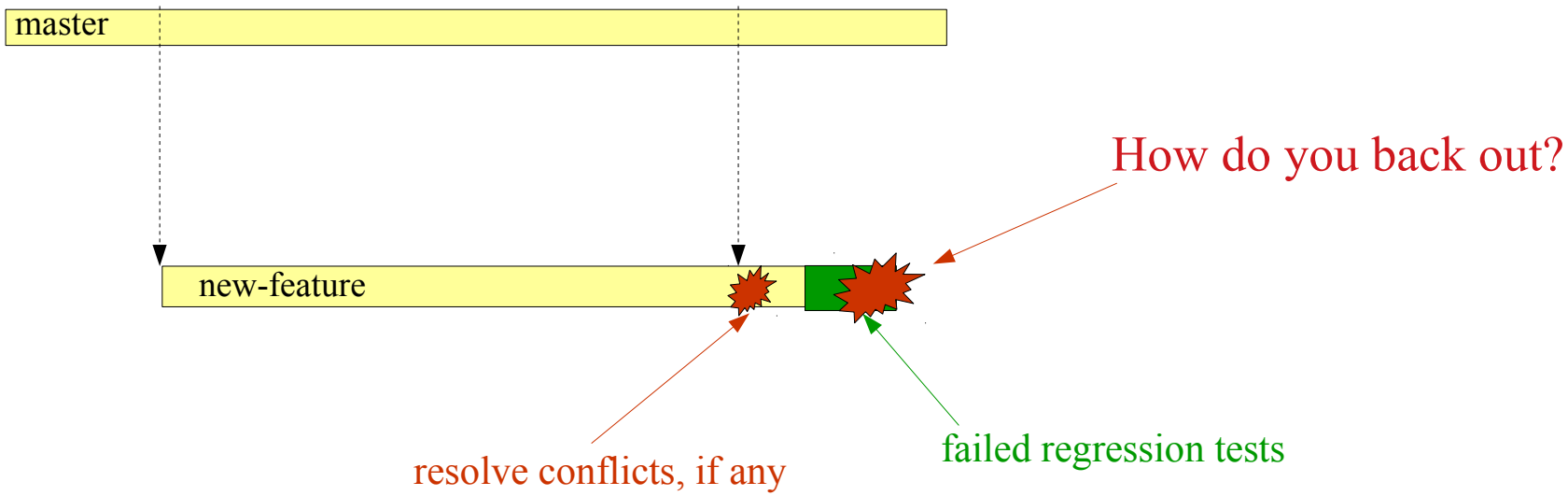
Using GIT branches

- **Never break your master branch**
  - **Never** merge on your master with potential conflicts
  - **Always** merge on your branch first
  - **Always** run regression tests before merging back on master



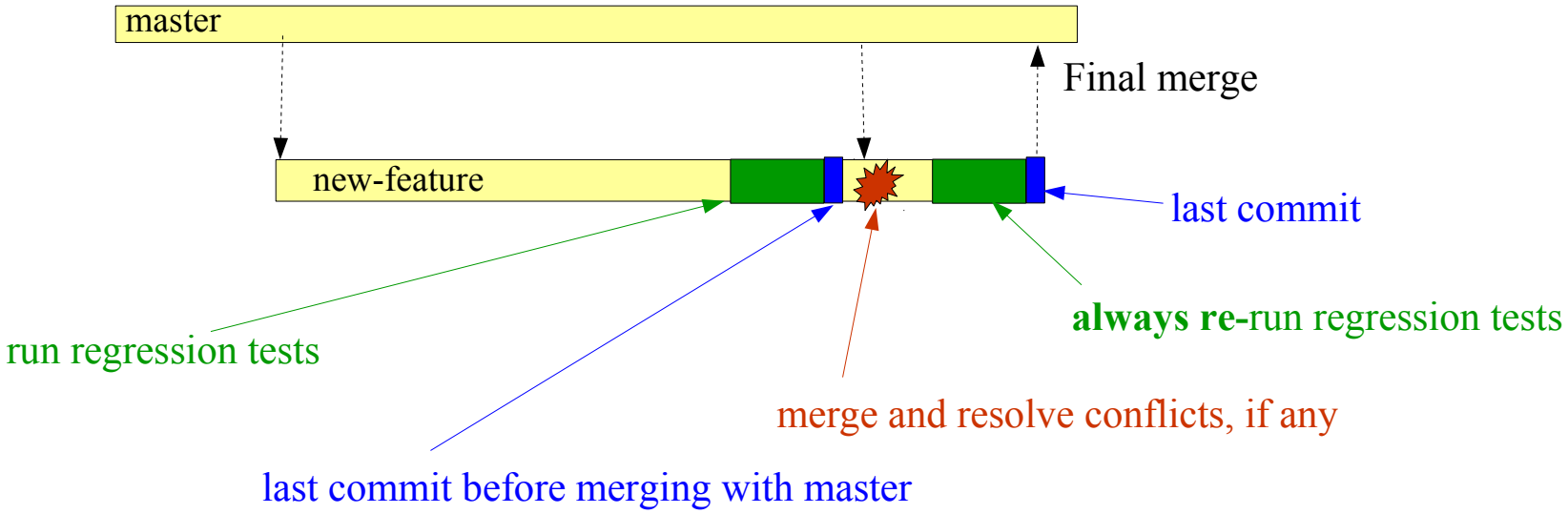
Using GIT branches

- **Never break your master branch**
  - **Never** merge on your master with potential conflicts
  - **Always** merge on your branch first
  - **Always** run regression tests before merging back on master



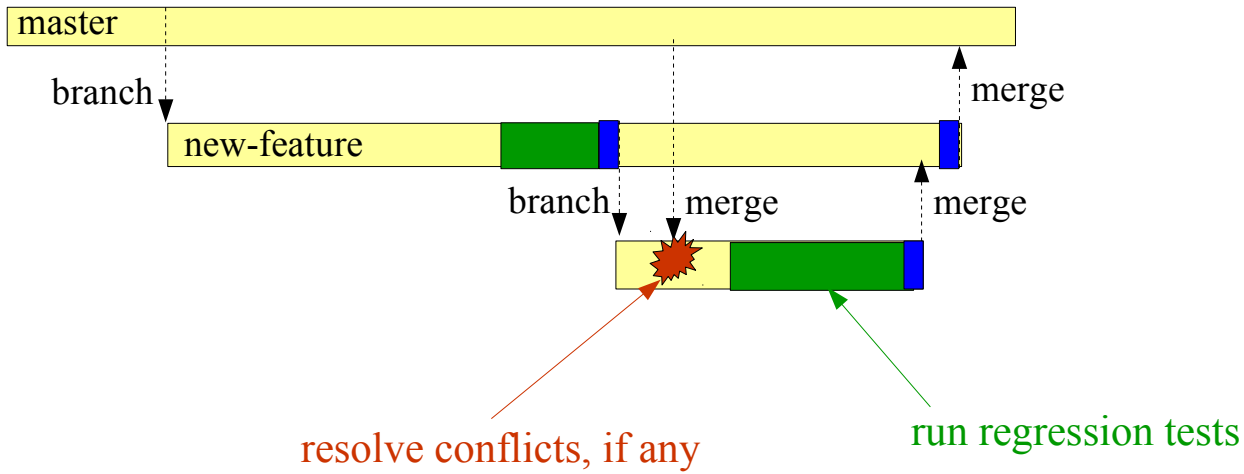
Using GIT branches

- Safe Merge Workflow
  - **(1) run regression tests,** they must pass before you can considering your work done
  - **(2) commit on your branch**
  - **(3) merge** the master branch on your branch
  - **(4) run regression tests, again**
  - **(5)** commit or toss the merge
    - OK: **commit** and **merge** your branch in the master branch
    - KO: **toss** the merge, everything **since the last commit**, using “git checkout -f”



Using GIT branches

- Safe Merge Workflow – Option two
  - You can always use a temporary *"merge"* branch
  - Easy toss of the *"merge"* branch, if the merge should fail
  - Easier if you ever need to checkout back and forth across branches (hot-fix for examples)



Using GIT – Practice makes perfect

- Do practice
  - Again and again, until you are confortable with GIT
  - Scared of making a mistake – use branches
- Do not procrastinate
  - Until you have a team project
- Do not fear merges and conflicts
  - Most merges happen without conflicts
  - Create branches, work concurrently, experience merges
- Goals
  - **Never break your master**
  - **Always have undoability**

Using GIT – Practice makes perfect

- Running tests
  - **Merge, compile, and a quick run – does not mean correct**
  - JUnit is great for automating tests
  - **Remember:** your tests are the only real guardians of your master…
- Keep doing your backups
  - Better safe than sorry
- Keep it simple – keep using branches
  - Despite all these websites telling you to mess with the commit history tree
  - **You will be happy you did, believe us**