CS100 Introduction to Programming

Recitation 7

wcy

NO PLAGIARISM!!!

- The most likely cause for failing this course.
- You WILL be caught!
- We WILL punish!
- They WILL know!
  - Parents
  - University
  - School
  - Fellows

Overview

- Git
- Diamond problem
- Virtual
- String

Version control systems

- Version control systems record changes to a file or set of files over time so that you can recall specific versions later
- Many systems have risen to popularity over the years
  - RCS (*Revision Control System*)
  - CVS (*Concurrent Versions System*)
  - *Subversion*
- We will focus on **Git**

The Git SCM
(Software Configuration Management)

Installation of git …

… under Ubuntu

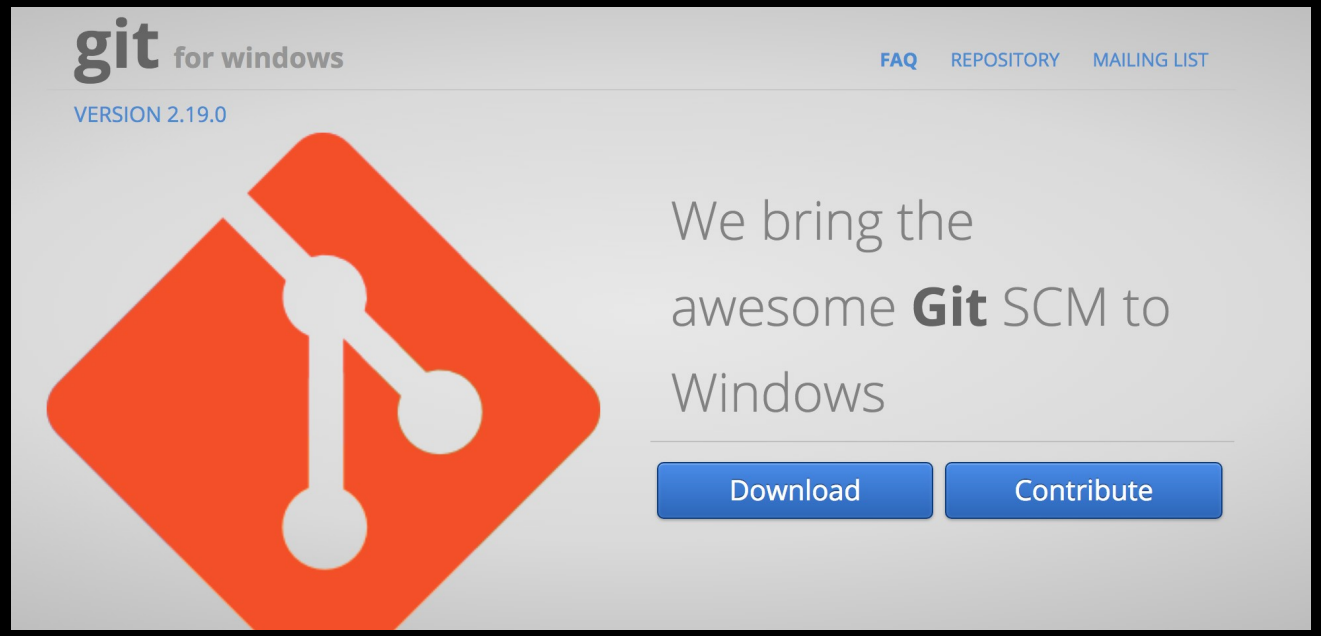
- `sudo apt-get install git -y`

… under OSX

- Install brew (package manager)
  - *ruby –e"$(curl –fsSL https://raw.githubusercontent.com/Homebrew/in stall/master/install)" brew doctor*
- Install git
  - *brew install git*

… under Windows

- Download and install “git for windows”:
  - https://gitforwindows.org/
  - https://mirrors.geekpie.club/git-for-windows/

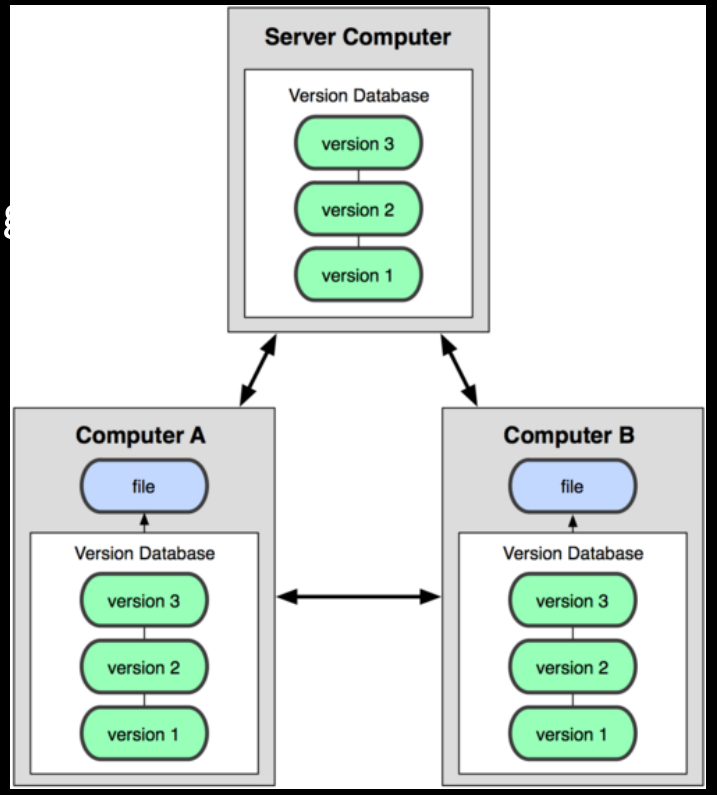


Why version control system

- The systems help with:
  - Keep your files “forever” (a back-up strategy).
  - Collaboration with your colleagues.
  - Keep track of every change you made.
  - Work on a large-scale program with many other teams.
  - Test different ideas or algorithms without creating a new directory or repository.
  - Enhance productivity of code development.
  - Not only applicable to source code, but also other files.

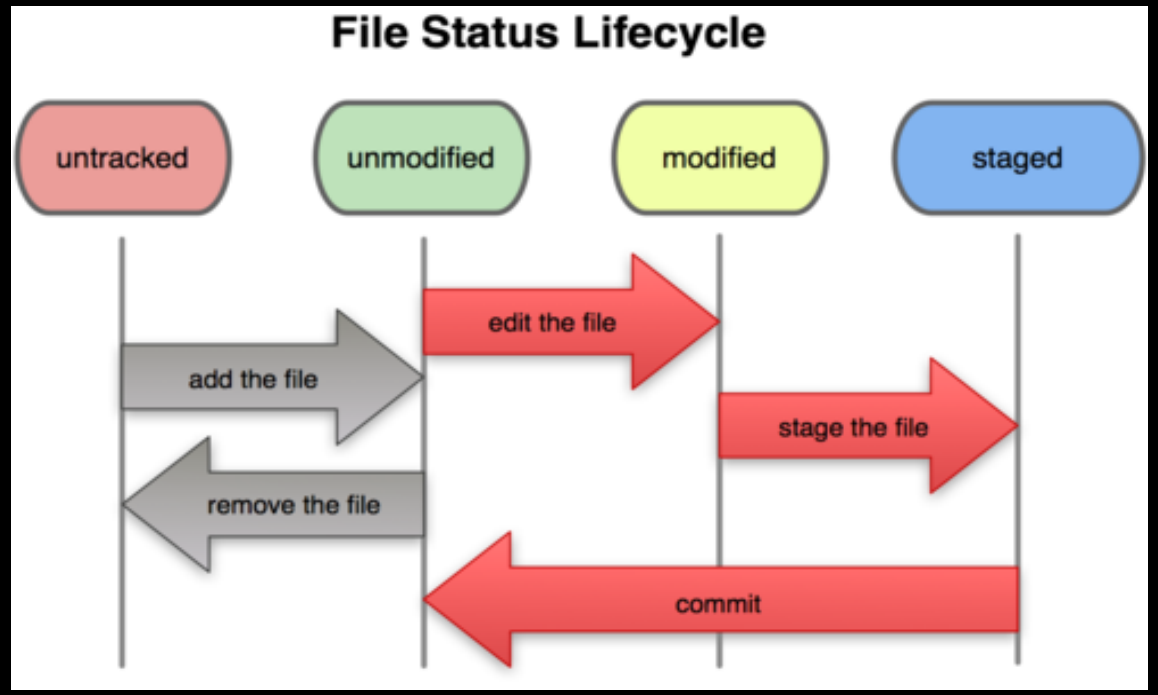
Distributed VCS (Git)

- In git, mercurial, etc., you don't "checkout" from a central repo
  - you "clone" it and "pull" changes from it
- Your local repo is a complete copy of everything on the remote server
  - yours is "just as good" as theirs
- Many operations are local:
  - check in/out from local repo
  - commit changes to local repo
  - local repo keeps version history
- When you're ready, you can "push" changes back to server



Basic Git workflow

- **Modify** files in your working directory.
- **Stage files**, adding snapshots of them to your staging area.
- **Commit,** which takes the files in the staging area and stores that snapshot permanently to your Git directory.



Git commit checksums

- In Subversion, each modification to the central repo increments the version # of the overall repo.
  - In Git, each user has their own copy of the repo, and commits changes to their local copy of the repo before pushing to the central server.
  - So Git generates a unique SHA-1 hash (40 character string of hex digits) for every commit.
  - Refers to commits by this ID rather than a version number.
  - Often we only see the first 7 characters:

```
1677b2d Edited first line of readme
258efa7 Added line to readme
0e52da7 Initial commit
```

Initial Git configuration

- Set the name and email for Git to use when you commit:
  - `git config --global user.name "Bugs Bunny"`
  - `git config --global user.email bugs@gmail.com`
  - You can call `git config -list` to verify these are set.
- Set the editor that is used for writing commit messages:
  - `git config --global core.editor nano`
  - (it is vim by default)

Creating a Git repo

- To create a new **local Git repo** in your current directory:
  - `git init`
    - This will create a .git directory in your current directory.
    - Then you can commit files in that directory into the repo.
  - `git add filename`
  - `git commit -m "commit message"`
- To clone a remote repo to your current directory:
  - `git clone` *`url localDirectoryName`*
    - This will create the given local directory, containing a working copy of the files from the repo, and a `.git` directory (used to hold the staging area and your actual local repo)

Git commands

command	description
git clone url [dir]	copy a Git repository so you can add to it
git add file	adds file contents to the staging area
git commit	records a snapshot of the staging area
git status	view the status of your files in the working directory and staging area
git diff	shows diff of what is staged and what is modified but unstaged
git help [command]	get help info about a particular command
git pull	fetch from a remote repo and try to merge into the current branch
git push	push your new branches and data to a remote repository
others: init, reset, branch, checkout, merge, log, tag	

Add and commit a file

- The first time we ask a file to be tracked, and every time before we commit a file, we must add it to the staging area:
  - `git add Hello.java Goodbye.java`
  - Takes a snapshot of these files, adds them to the staging area.
  - In older VCS, "`add`" means "start tracking this file." In Git, "`add`" means "add to staging area" so it will be part of the next commit.
- To move staged changes into the repo, we commit:
  - `git commit –m "Fixing bug #22"`
- To undo changes on a file before you have committed it:
  - `git reset HEAD -- filename (unstages the file)`
  - `git checkout -- filename (undoes your changes)`
  - All these commands are acting on your local version of repo.

Viewing/undoing changes

- To view status of files in working directory and staging area:
  - `git status` or `git status -s` (short version)
- To see what is modified but unstaged:
  - `git diff`
- To see a list of staged changes:
  - `git diff --cached`
- To see a log of all changes in your local repo:
  - `git log` or `git log --oneline` (shorter version)

```
1677b2d Edited first line of readme
258efa7 Added line to readme
0e52da7 Initial commit
```

  - `git log -5` (to show only the 5 most recent updates), etc.

An example workflow

```
[rea@attu1 superstar]$ emacs rea.txt
[rea@attu1 superstar]$ git status
    no changes added to commit
    (use "git add" and/or "git commit -a")
[rea@attu1 superstar]$ git status -s (return shorter info)
    M rea.txt
[rea@attu1 superstar]$ git diff
    diff --git a/rea.txt b/rea.txt
[rea@attu1 superstar]$ git add rea.txt
[rea@attu1 superstar]$ git status
    # modified: rea.txt
[rea@attu1 superstar]$ git diff --cached (git diff outputs the diff
in your working copy. When you add —stage, or —cached, you
tell git to diff already added files instead)
    diff --git a/rea.txt b/rea.txt
[rea@attu1 superstar]$ git commit -m "Created new text file"
```

Branching and merging

- Git uses branching heavily to switch between multiple tasks.
- To create a new local branch:
  - `git branch *name*`
- To list all local branches: (* = current branch)
  - `git branch`
- To switch to a given local branch:
  - `git checkout *branchname*`
- To merge changes from a branch into the local master:
  - `git checkout master`
  - `git merge *branchname*`

Merge conflicts

- The conflicting file will contain `<<< and >>>` sections to indicate where Git was unable to resolve a conflict:

```
<<<<<<< HEAD:index.html
<div id="footer">todo: message here</div>
=======
<div id="footer">
    thanks for visiting our site
</div>
>>>>>>> SpecialBranch:index.html
```

branch 1's version

branch 2's version

- Find all such sections, and edit them to the proper state (whichever of the two versions is newer / better / more correct).

Interaction w/ remote repo

- **Push** your local changes to the remote repo.
- **Pull** from remote repo to get most recent changes.
  - fix conflicts if necessary, add/commit them to your local repo
- To fetch the most recent updates from the remote repo into your local repo, and put them into your working directory:
  - `git pull origin master`
- To put your changes from your local repo in the remote repo:
  - `git push origin master`

GitHub

- Home of open source
- Use git
- Fork & Pull Requests

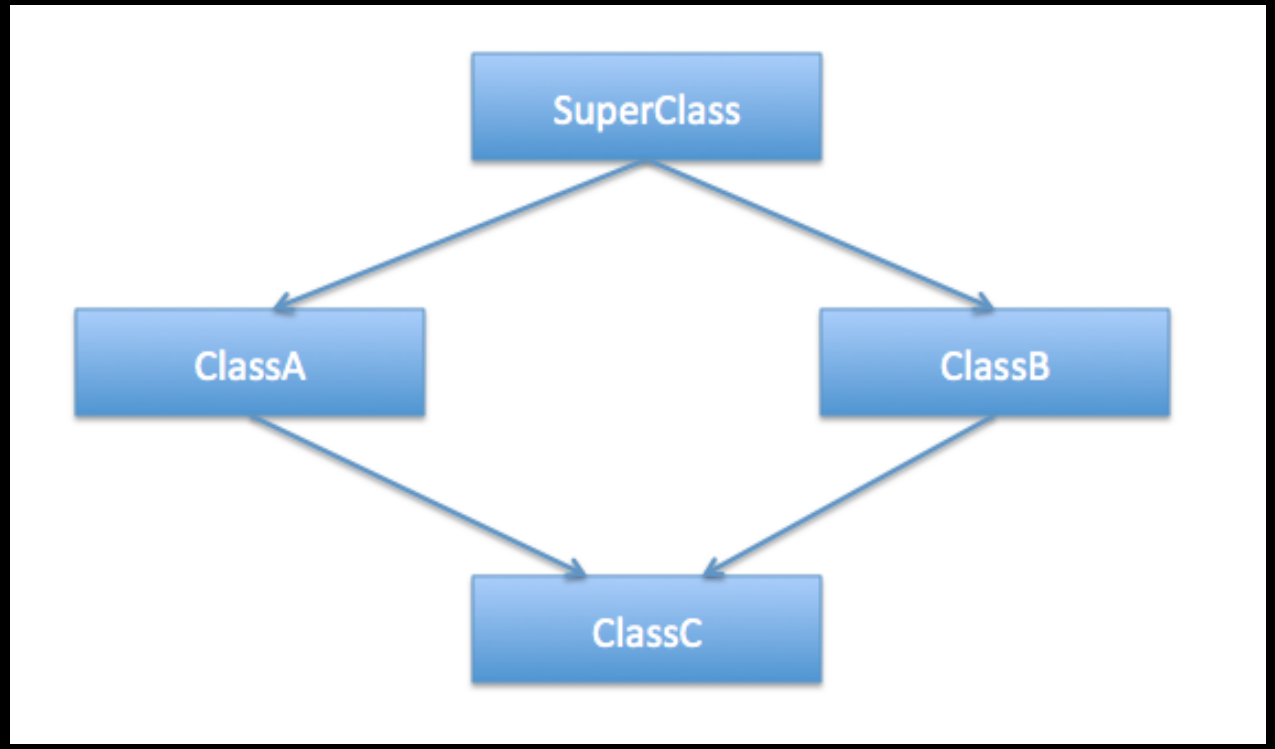
Try it now

1. Get a github account
   - Do not use school email as primary email
2. Fork https://github.com/llk89/cs100recitation5
3. Clone the forked repository
4. Switch branch to develop

Diamond problem

Diamond problem

- Originates from multiple inheritance



Example

```
#include <iostream>

class LivingThing {
public:
    void breathe() {
        printf("I'm breathing as a living thing.\n”);
    }
};

class Animal : public LivingThing {
public:
    void breathe() {
        printf("I'm breathing as an animal.\n”);
    }
};

class Reptile : public LivingThing {
public:
    void breathe() {
        printf("I'm breathing as a reptile.\n”);
    }
};

class Snake : public Animal, public Reptile {
public:
    void breathe() {
        printf("I'm breathing as a snake.\n”);
    }
};

int main() {
    Snake snake;
    snake.breathe();
    return 0;
}
```

Example

- Example is in the repo you have cloned, in a sub-folder called **DiamondCase**

- g++ test0.cpp -o main

I'm breathing as a snake.

What about this?

```
#include <iostream>

class LivingThing {
public:
    void breathe() {
        printf("I'm breathing as a living thing.\n”);
    }
};

class Animal : public LivingThing {
public:
    void breathe() {
        printf("I'm breathing as an animal.\n”);
    }
};

class Reptile : public LivingThing {
public:
    void breathe() {
        printf("I'm breathing as a reptile.\n”);
    }
};

class Snake : public Animal, public Reptile {
};

int main() {
    Snake snake;
    snake.breathe();
    return 0;
}
```

Does it compile?

- g++ test1.cpp -o main
- What has happened?

error: member 'breathe' found in multiple base classes of different types

What about this?

```
#include <iostream>

class LivingThing {
public:
    void breathe() {
        printf("I'm breathing as a living thing.\n”);
    }
};

class Animal : public LivingThing {

};

class Reptile : public LivingThing {

};

class Snake : public Animal, public Reptile {
};

int main() {
    Snake snake;
    snake.breathe();
    return 0;
}
```

Does it compile?

- g++ test2.cpp -o main
- What has happened?

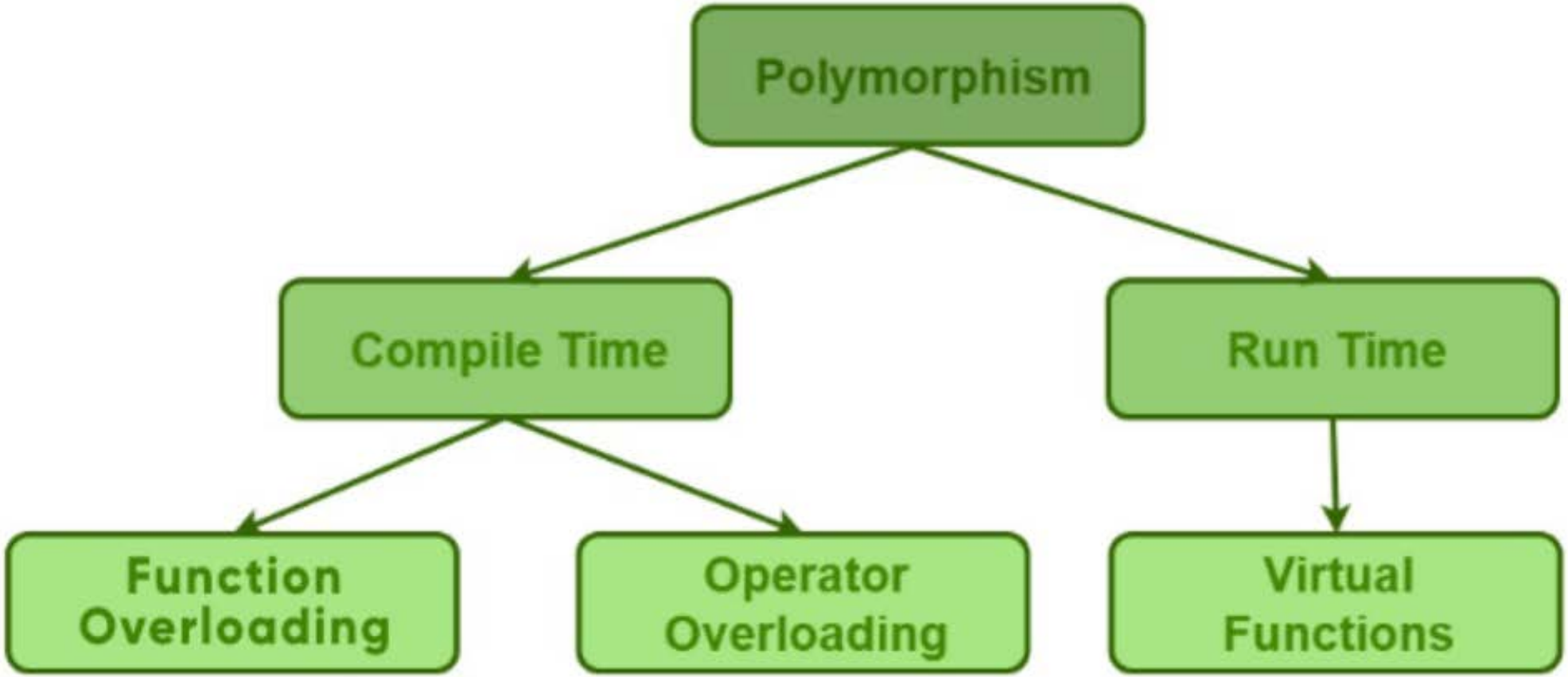
error: non-static member 'breathe' found in multiple base-class subobjects of type ‘LivingThing':
class Snake -> class Animal -> class LivingThing
class Snake -> class Reptile -> class LivingThing

How to solve the problem?

```
#include <iostream>

class LivingThing {
public:
    void breathe() {
        printf("I'm breathing as a living thing.\n”);
    }
};

class Animal : public virtual LivingThing {

};

class Reptile : public virtual LivingThing {

};

class Snake : public Animal, public Reptile {
};

int main() {
    Snake snake;
    snake.breathe();
    return 0;
}
```

Virtual

Polymorphism



Why not a virtual constructor?

To create an object you need complete information, you need to know the exact type of what you want to create .

But you can use abstract class instead

Why are destructors not virtual by default ?

Many classes are not designed to be used as base classes

- When should I declare a destructor virtual ?

  Whenever the class has a t least one virtual function

Virtual Table

- Dynamic dispatch (runtime binding)

Any call to that virtual function will not be linked to any function’s address during compile time. Actual function’s address to this call will be calculated at run time

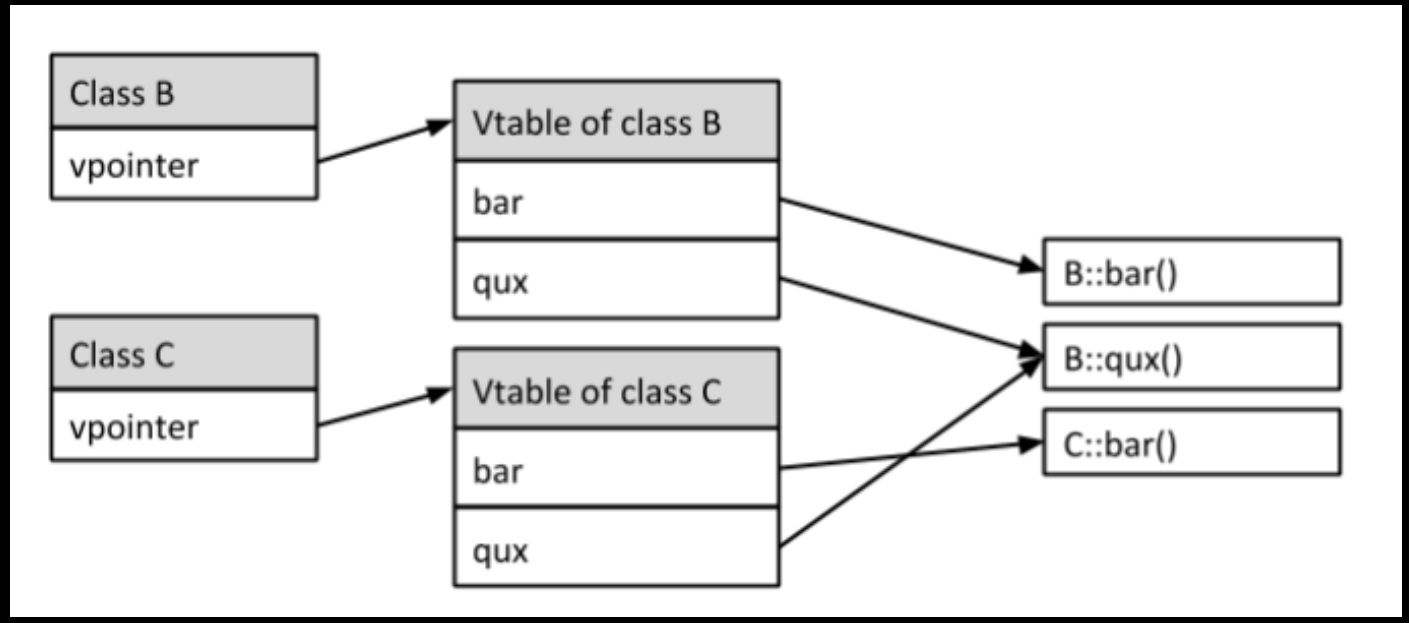
vTable & vPointer

- vTable

  Function pointer array that contains the addresses all virtual functions of this class

- vPointer

  A pointer to the corresponding virtual table



Strings and stringstreams

Redefine column order

- Write a program that reads in data from a file, organized in table form. Each row simply contains the same number of elements, separated by a whitespace character, and terminated by an EOL character.
- The program should automatically identify the number of columns in the file, and prompt the user to indicate a new order of the columns.
- It should finish with writing a new file with the same content but the newly defined order of the columns.

Redefine column order

- Example file content:

```
 1   2   3   4
 5   6   7   8
 9  10  11  12
```

- Example interaction with the user:

```
The number of columns is 4
Please redefine the order of the columns:
3 2 1 0
The new column order that you defined is: 3 2 1 0
```

Redefine column order

- The generated output file would be:

```
  4   3   2   1
  8   7   6   5
 12  11  10   9
```

- For read-outs from the file, what would be the best format such that pretty much anything that has no white-space separations can be extracted as a single element?

Redefine column order

- Useful headers from the standard library:

```
#include <stdlib.h>
#include <string>
#include <iostream>
#include <fstream>
#include <sstream>
#include <vector>
```