Software Development Tools and Methods

A brief presentation

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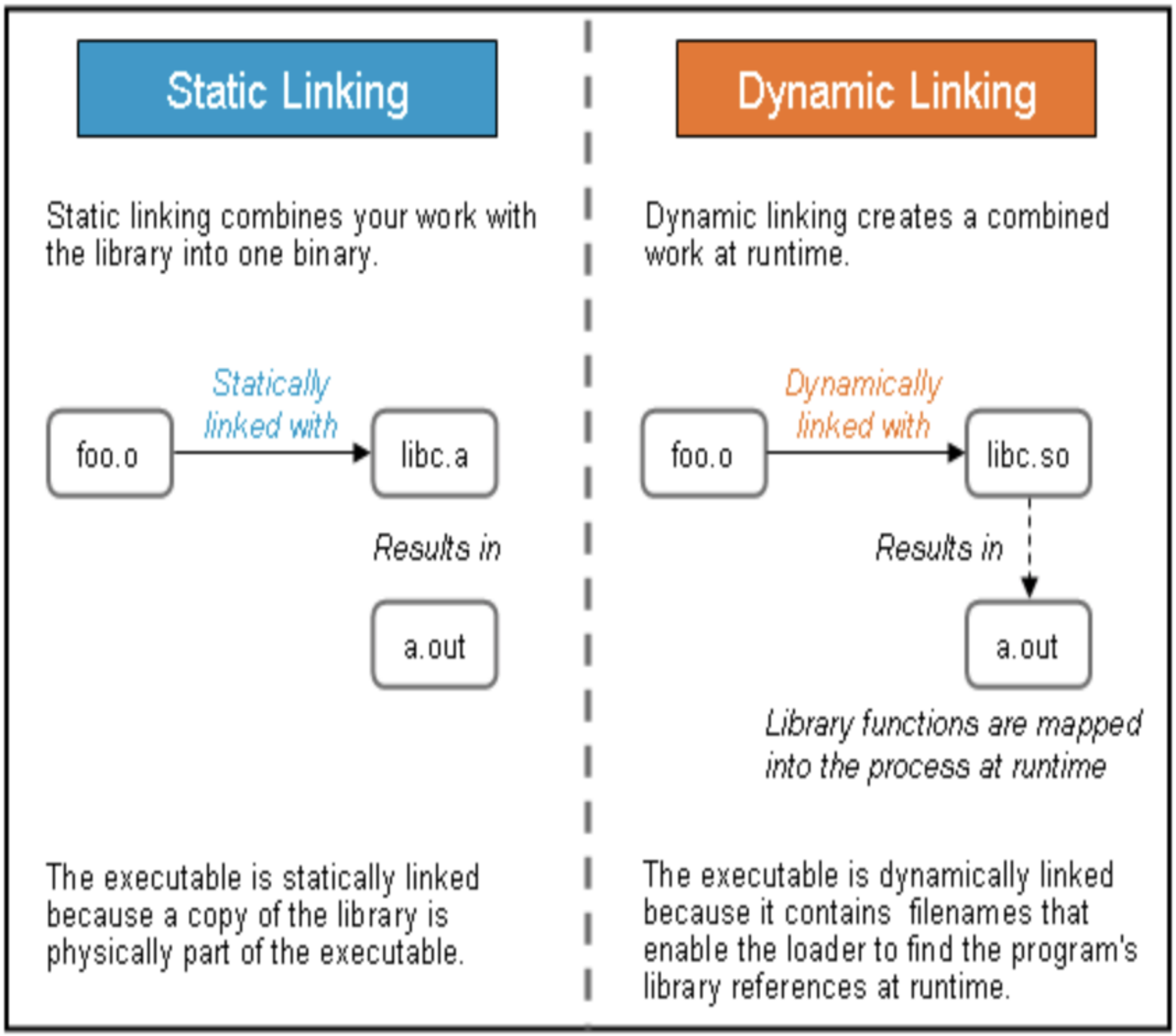
Outline

Static and Dynamic Libraries



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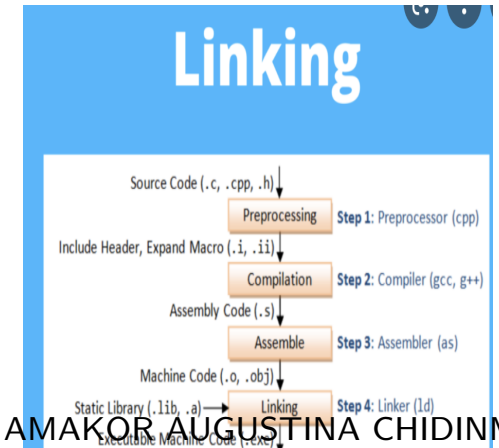
Linking, Debugging and Profiling

Debugging:

- Valgrind - monitors a program's memory accesses and prints warnings if the program accesses invalid locations or attempts to read values that the program never set : shows all errors locations.
- gdb - allows to pause a running program and inspect its state : not all.

Profiling: allows to control when running a code the list of functions called and the time spent in each of them, processor usage and memory usage.

- **Gprof** : When compiling and linking source code with gcc, we just add the -pg option so that, when we run, the program generates a .out file that will contain the information of profiling.We use gprof to read this file.



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CMake and Eigen3

CMake is used to build automation, testing, packaging and installation of software by using a compiler-independent method.
Eigen is a C++ library for linear algebra, matrix and vector operations, geometrical transformations, numerical solvers etc.

- Create CMakelists.txt (cmake., make)
- Downloading and unpacking eigen 3.8.0
- Creating and Executing some tests - eigen matrix multiplication

Remark (Eigen3)

```
INCLUDE_DIRECTORIES($Lab2_SOURCE_DIR /eigen -3.4.0)
add_executable ( test1 test1.cpp )
enable_testing ()
```

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CMake and Boost tools

Boost consists of libraries for the C++ programming language that provides support for tasks and structures such as linear algebra, multithreading, image processing, regular expressions, etc.

- **Boost.timer** measures the time it takes to execute code.
- **Boost.ublas** is a boost C++ library for vector and matrix operations and basic linear and multilinear algebra operations

Processors manipulation - Use of O2, O3, -msse2, -msse2 and 1, 2, 3 or 4 processors.

Remark (Boost.timer)

Eigen performs better than ublas for large size matrices
Compilation time decreases when augmenting the number of working processors.

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Gmsh

Meshing is the process in which the continuous geometric space of an object is broken down into thousands or more of shapes to properly define the physical shape of the object.

- **C**reation of .geo file (eg figure.geo)- points,lines, boundary,interior
- **C**ompilation with gmsh figure.geo &
- **O**utputs a figure.msh- version,ASCII,8bit,physical names,

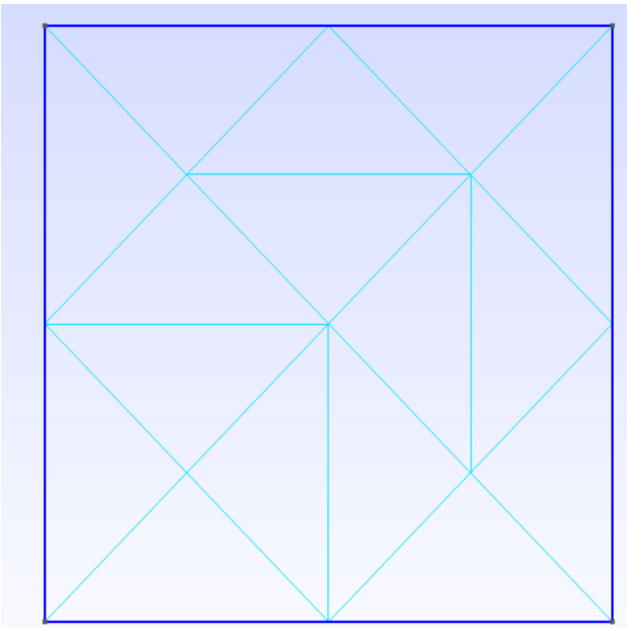
```
hSize = 1;
Point(1) = {-1, -1, 0, hSize};
Point(2) = { 1, -1, 0, hSize} ;
Point(3) = { 1, 1, 0, hSize} ;
Point(4) = {-1, 1, 0, hSize} ;



Line(1) = {1,2};
Line(2) = {2,3};
Line(3) = {3,4};
Line(4) = {4,1};


Line Loop(5) = {1,2,3,4} ;
Plane Surface(5) = {5} ;

Physical Line("Gamma") = {1,2,3,4} ;
Physical Surface("Omega") = {5} ;
```



```
$MeshFormat
2.2 0 8
$EndMeshFormat
$PhysicalNames
2
1 1 "Gamma"
2 2 "Omega"
$EndPhysicalNames
$Nodes
13
1 -1 -1 0
2 1 -1 0
3 1 1 0
4 -1 1 0
5 -2.752797989558076e-12 -1 0
6 1 -2.752797989558076e-12 0
7 2.752797989558076e-12 1 0
8 -1 2.752797989558076e-12 0
9 0 -7.225004064876332e-18 0
10 0.4999999999988027 -0.5000000000011973 0
11 0.5000000000011973 0.4999999999988027 0
12 -0.5000000000010252 -0.4999999999989747 0
13 -0.4999999999988743 0.5000000000011255 0
$EndNodes
$Elements
24
1 1 2 1 1 5
```

SWIG

Swig is a tool that connects programs written in C and C++ with a variety of high-level programming languages such as python, R etc. To connect:

- Enclose the .header file with %{}%
- Save as .i extension
- Compile with swig -python tp4.i (where tp4 is an example)

The python code will calls the code wrappers functions (gcc -O2 - fPIC -c tp4_wrap.c -I/usr/include/python3.8/)

Remark (CMake and SWIG)

CMake can detect the SWIG executable and many of the target language libraries for linking. With CMake there is an easy cross platform for SWIG development. It also can generate the custom commands necessary for obtaining SWIG from IDE's and makefiles.

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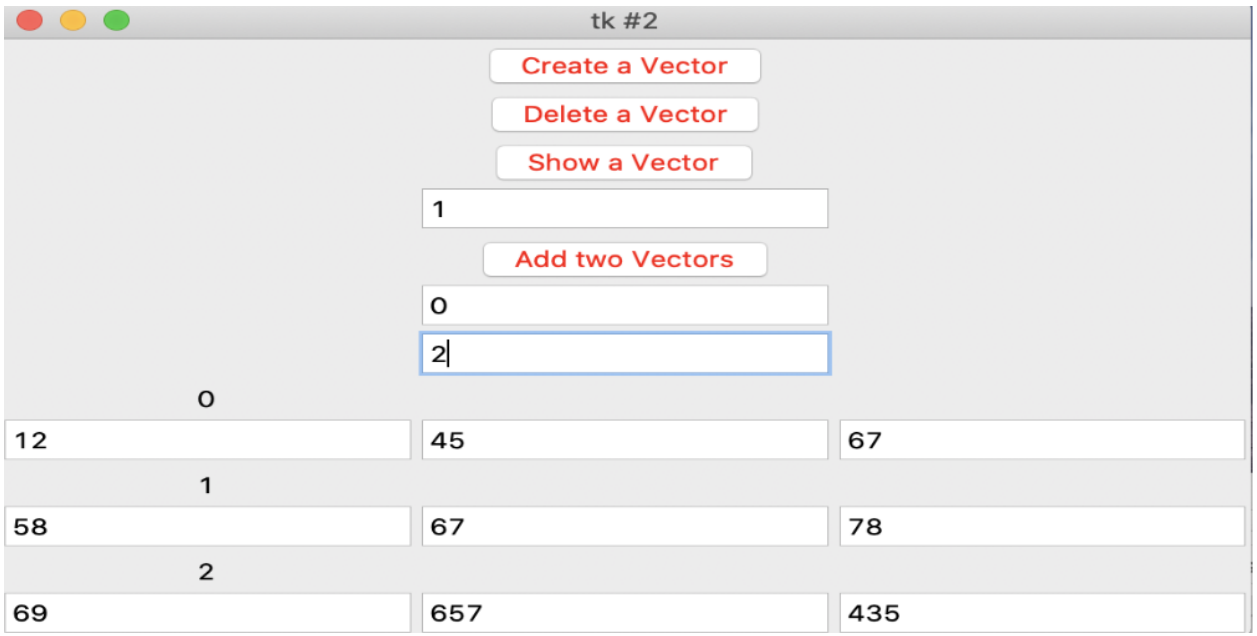
GUI (Tkinter)

Tkinter is a Python binding to the Tk GUI toolkit. It is the standard Python interface to the Tk GUI toolkit, and is Python's de facto standard GUI.

- **C**reation of vector python class
- **C**reation of methods that manipulates buttons actions
- **C**reation of buttons and Entries



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