064-0026-00L: COMPAS II

Introduction to Computational Methods for Digital Fabrication in Architecture

Team

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Ioanna Mitropoulou

Gonzalo Casas

Philippe Fleischmann

Course goals

Gain the ability to **design, plan and execute** robotic fabrication processes (e.g. discrete assemblies and additive manufacturing) using Python

slides + code

*https://***dfab.link/fs2022**

asking questions

your goals + expectations

*https://***dfab.link/fs2022-goals**

TODAY

intro

course overview

team

dfab toolbox

datastructures

intro

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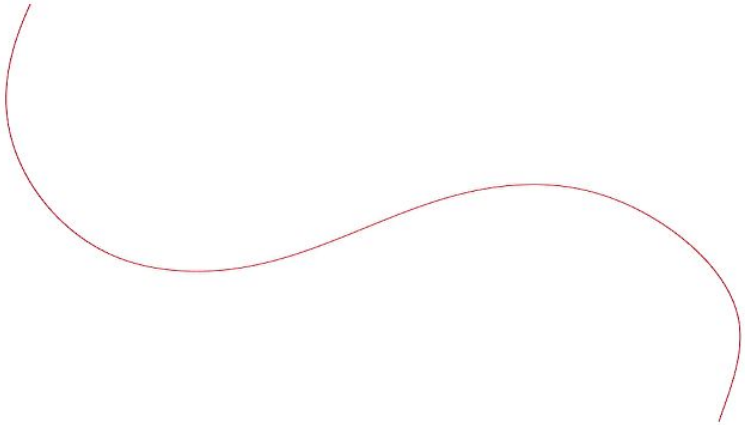
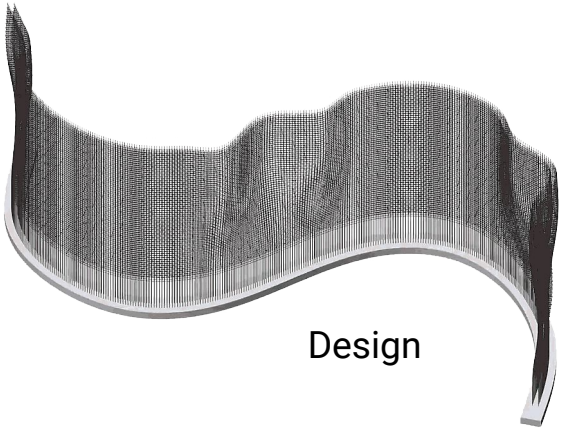
Computational design

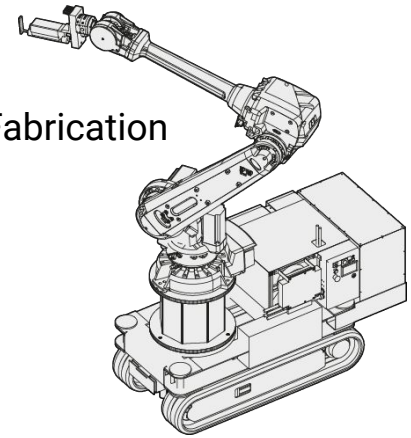


Design to fabrication

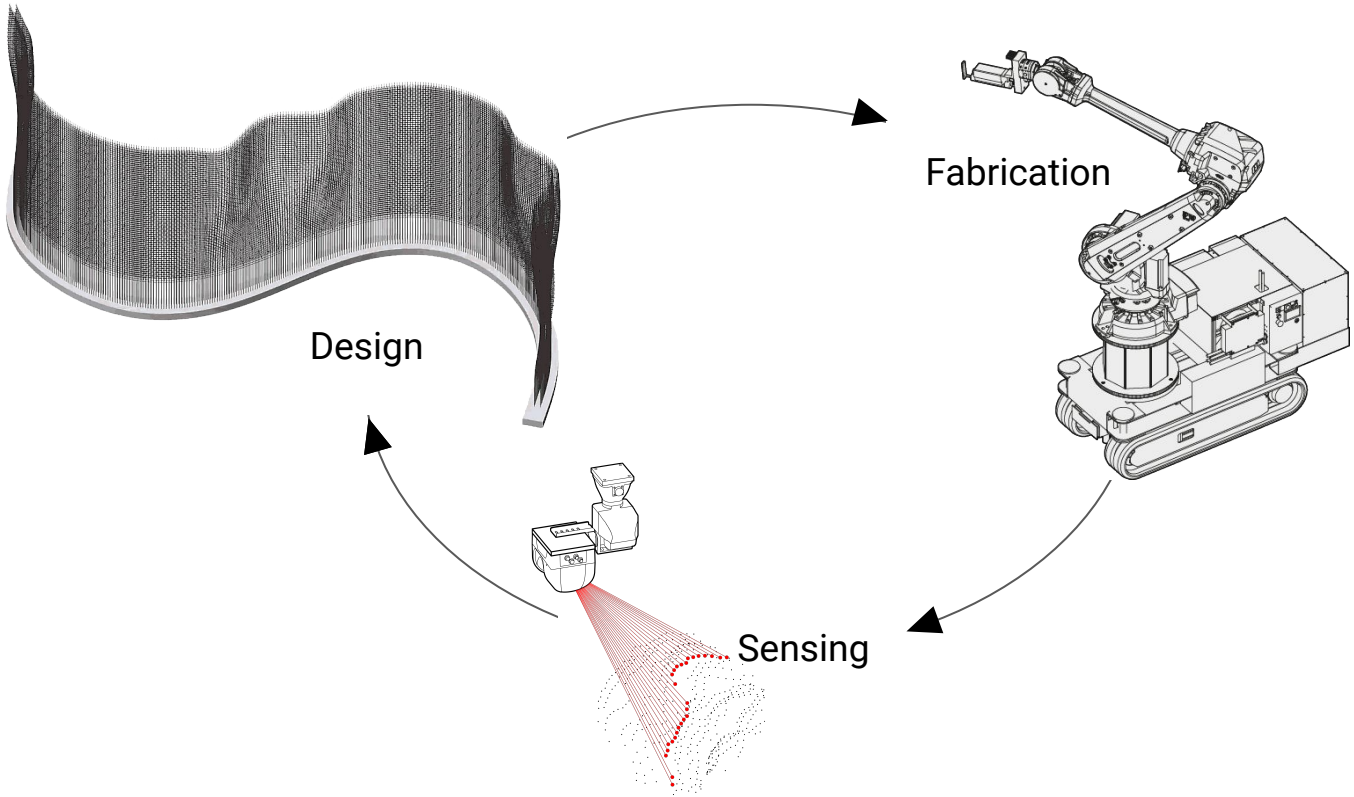


Design

Fabrication



Design to fabrication



Interdisciplinarity


DFAB House


HiLo Roof Prototype


MeshMould

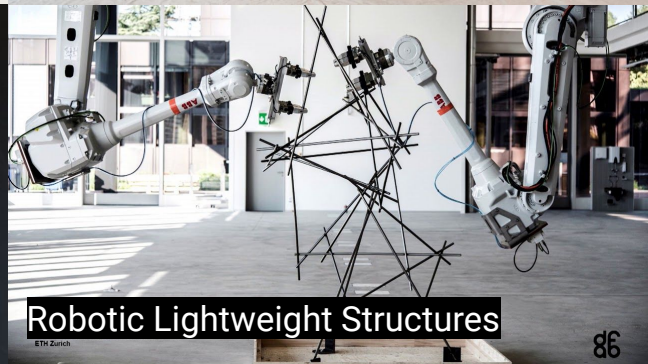

KnitCandela

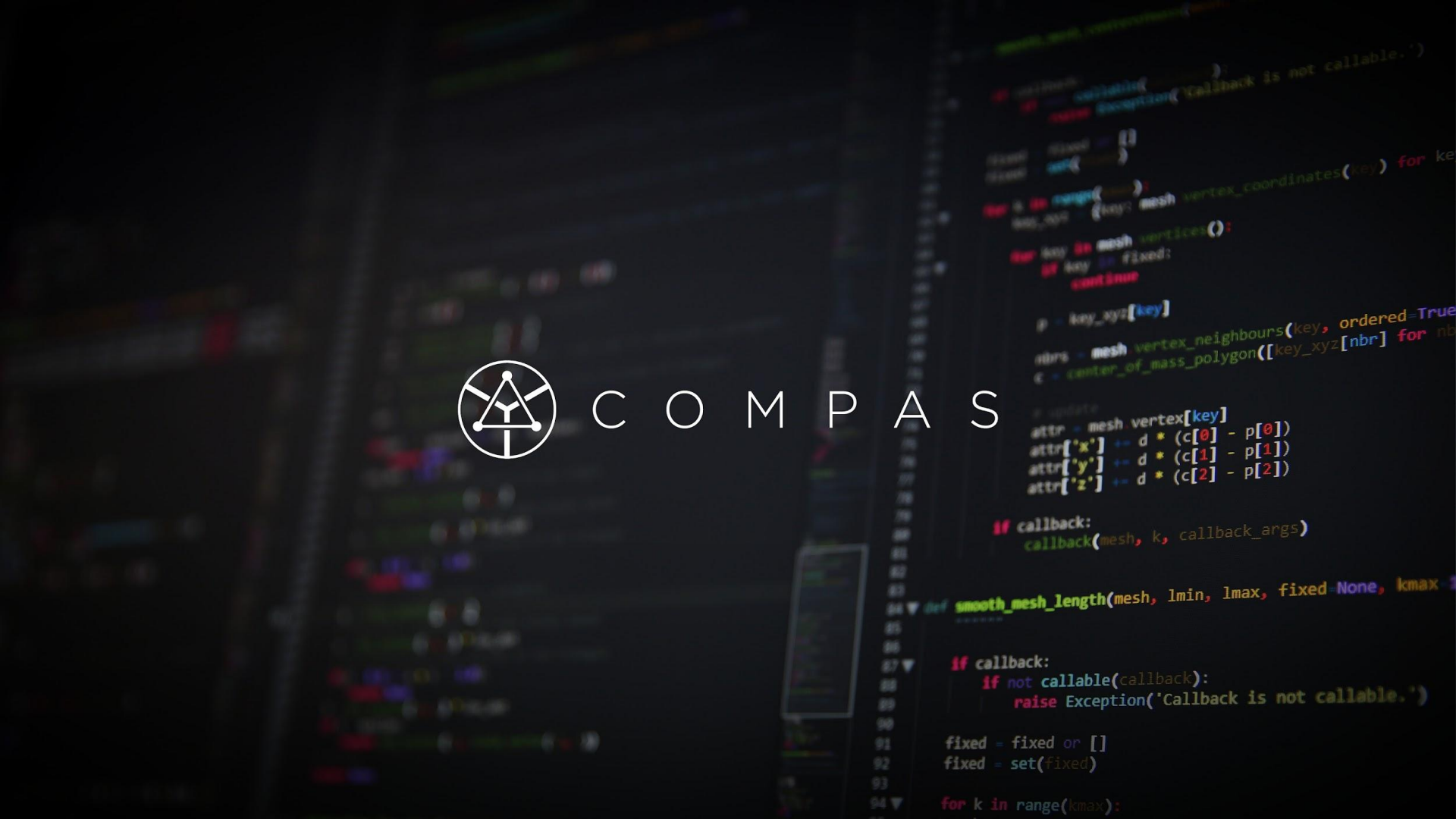

Data Driven Acoustic Design


Concrete Choreography


HiLo Roof


Adaptive Detailing


Robotic Lightweight Structures


COMPAS
if callback:
if not callable(callback):
raise Exception('Callback is not callable.')
fixed = fixed or []
fixed = set(fixed)
for k in range(kmax):
def smooth_mesh_length(mesh, lmin, lmax, fixed=None, kmax
if callback:
callback(mesh, k, callback_args)
attr = mesh.vertex[key]
attr['x'] += d * (c[0] - p[0])
attr['y'] += d * (c[1] - p[1])
attr['z'] += d * (c[2] - p[2])

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Lecture	Date	Session content
01	23.02.	Introduction
02	02.03.	Robotic fundamentals
03	09.03.	Robot models
04	16.03.	ROS & MoveIt in the design environment
05	30.03.	Path planning
06	06.04.	Assembly of discrete elements I: model
07	13.04.	Assembly of discrete elements II: plan
08	27.04.	Robot control with COMPAS RRC
09	04.05.	Assembly of discrete elements III: execution
10	11.05.	COMPAS SLICER: Basics
11	18.05.	COMPAS SLICER: Advanced
12	25.05.	Advancing computational research
13	01.06.	Closing

Assignments

Weekly coding assignments
Submit using pull requests to course repo
Each week, the assignment of previous week is due
Submission deadline, Wednesdays 9AM

Grading

Coding assignments graded on problem solving
Coding style not part of grading, but included in feedback
Course graded as average of all assignments

Office hours

Usually on Friday afternoons, coordinate/request via Slack DM

Links

Course materials
https://dfab.link/fs2022

Slack
https://join.slack.com/t/compasii/shared_invite/zt-14cbtllxc-zxZRErT54F4xayA6keTb0g

Forum
https://forum.compas-framework.org

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LET'S CONNECT TO A ROBOT
FROM RHINO, RIGHT?
FROM RHINO, RIGHT?
imgflip.com

Reproducible planner setup

Reproducible coding environment

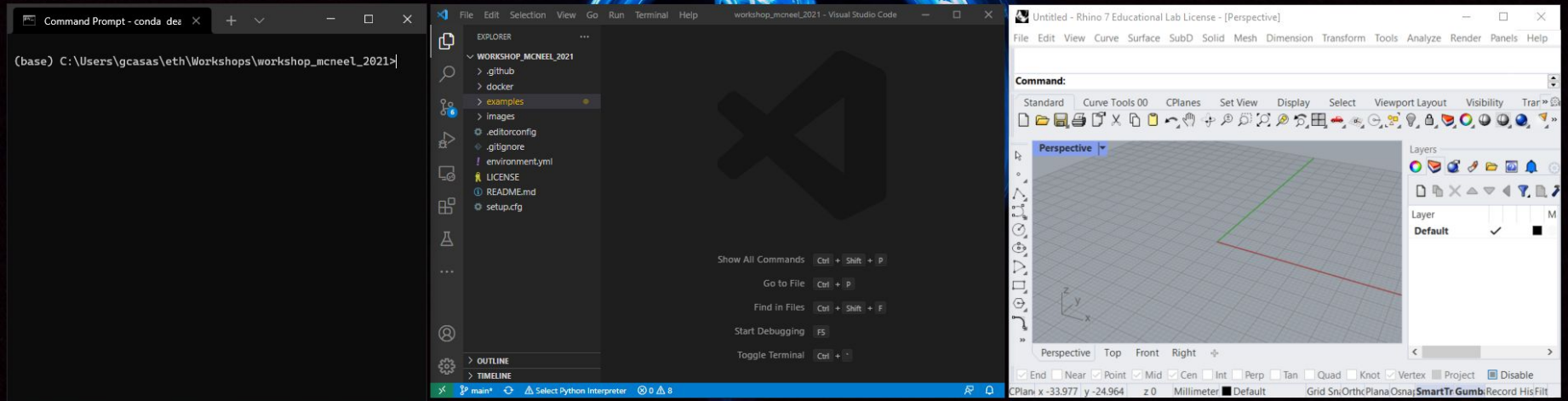
Reproducible planner setup

Reproducible coding environment

Reproducible planner setup

ROS MoveIt!

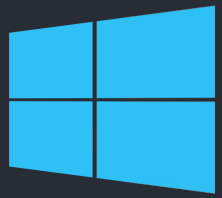
Reproducible coding environment


Command Prompt - conda dea
(base) C:\Users\gcasas\eth\Workshops\workshop_mcneel_2021>
File Edit Selection View Go Run Terminal Help
workshop_mcneel_2021 - Visual Studio Code
EXPLORER
WORKSHOP_MCNEEL_2021
.github
docker
examples
images
.editorconfig
.gitignore
environment.yml
LICENSE
README.md
setup.cfg
Show All Commands Ctrl + Shift + P
Go to File Ctrl + P
Find in Files Ctrl + Shift + F
Start Debugging F5
Toggle Terminal Ctrl + `
OUTLINE
TIMELINE
main*
Select Python Interpreter
Untitled - Rhino 7 Educational Lab License - [Perspective]
File Edit View Curve Surface SubD Solid Mesh Dimension Transform Tools Analyze Render Panels Help
Command:
Standard Curve Tools 00 CPlanes Set View Display Select Viewport Layout Visibility
Perspective
Layers
Layer
Default
Perspective Top Front Right
End Near Point Mid Cen Int Perp Tan Quad Knot Vertex Project Disable
CPlane x -33.977 y -24.964 z 0
Millimeter Default
Grid Snap Ortho Planar Osnap SmartTrack Gumball Record History Filter

Installation

*https://***dfab.link/fs2022**

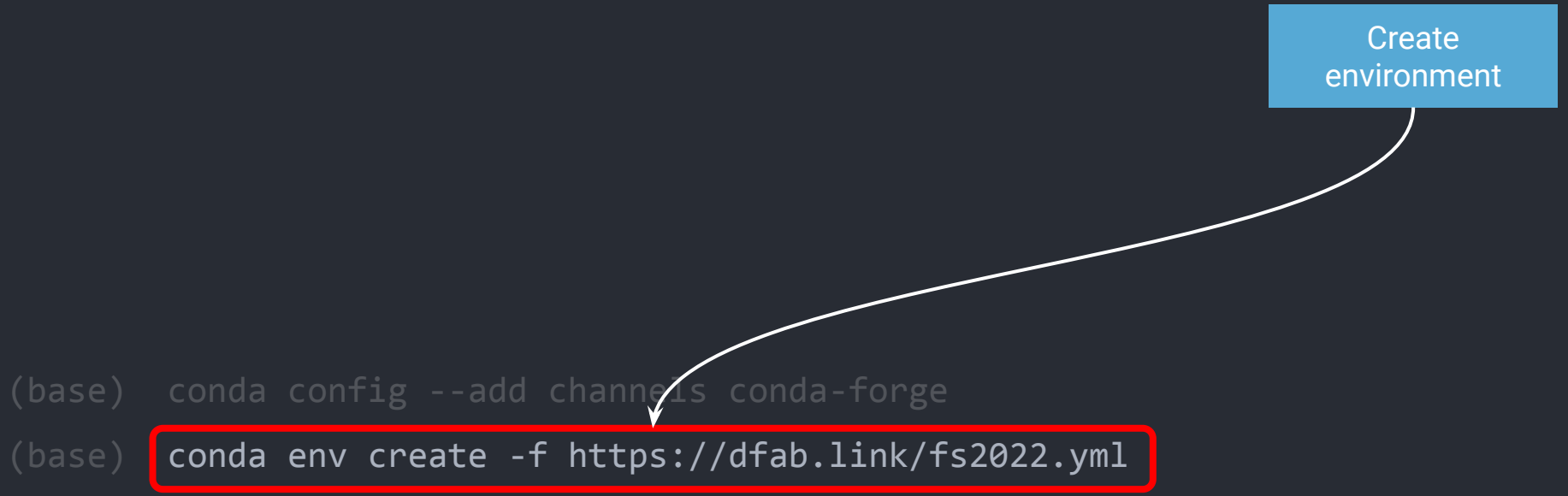
⌘ + SPACE

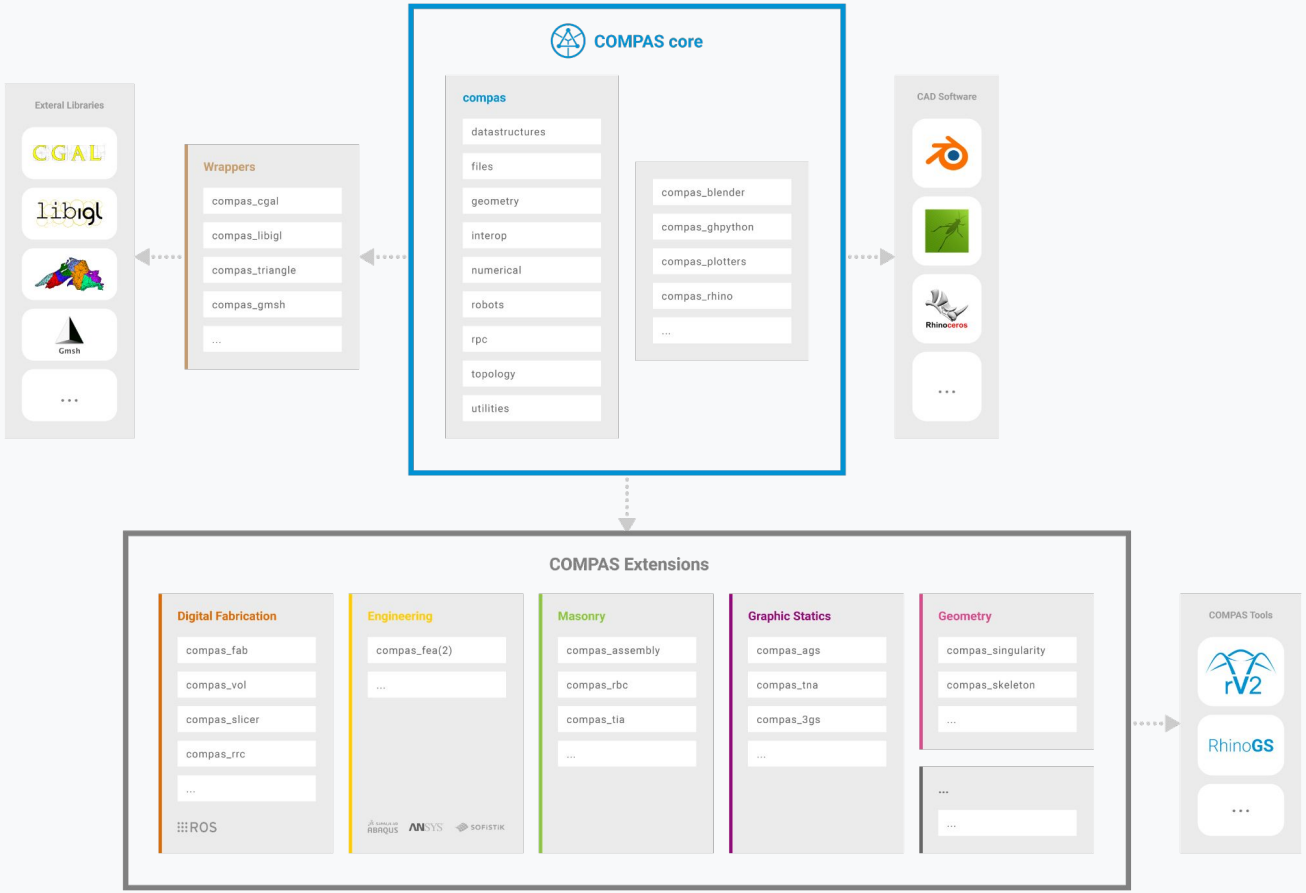


Terminal

Anaconda Prompt

```
(base)  conda config --add channels conda-forge
(base)  conda env create -f https://dfab.link/fs2022.yml
```


Create environment
(base) conda config --add channels conda-forge
(base) conda env create -f https://dfab.link/fs2022.yml


Exteral Libraries
CGAL
libigl
Gmsh
...
Wrappers
compas_cgal
compas_libigl
compas_triangle
compas_gmsh
...
COMPAS core
compas
datastructures
files
geometry
interop
numerical
robots
rpc
topology
utilities
compas_blender
compas_ghpython
compas_plotters
compas_rhino
...
CAD Software
Rhinoceros
...
COMPAS Extensions
Digital Fabrication
compas_fab
compas_vol
compas_slicer
compas_rrc
...
ROS
Engineering
compas_fea(2)
...
ABAQUS
ANSYS
SOFISTIK
Masonry
compas_assembly
compas_rbc
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Graphic Statics
compas_ags
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Geometry
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compas_skeleton
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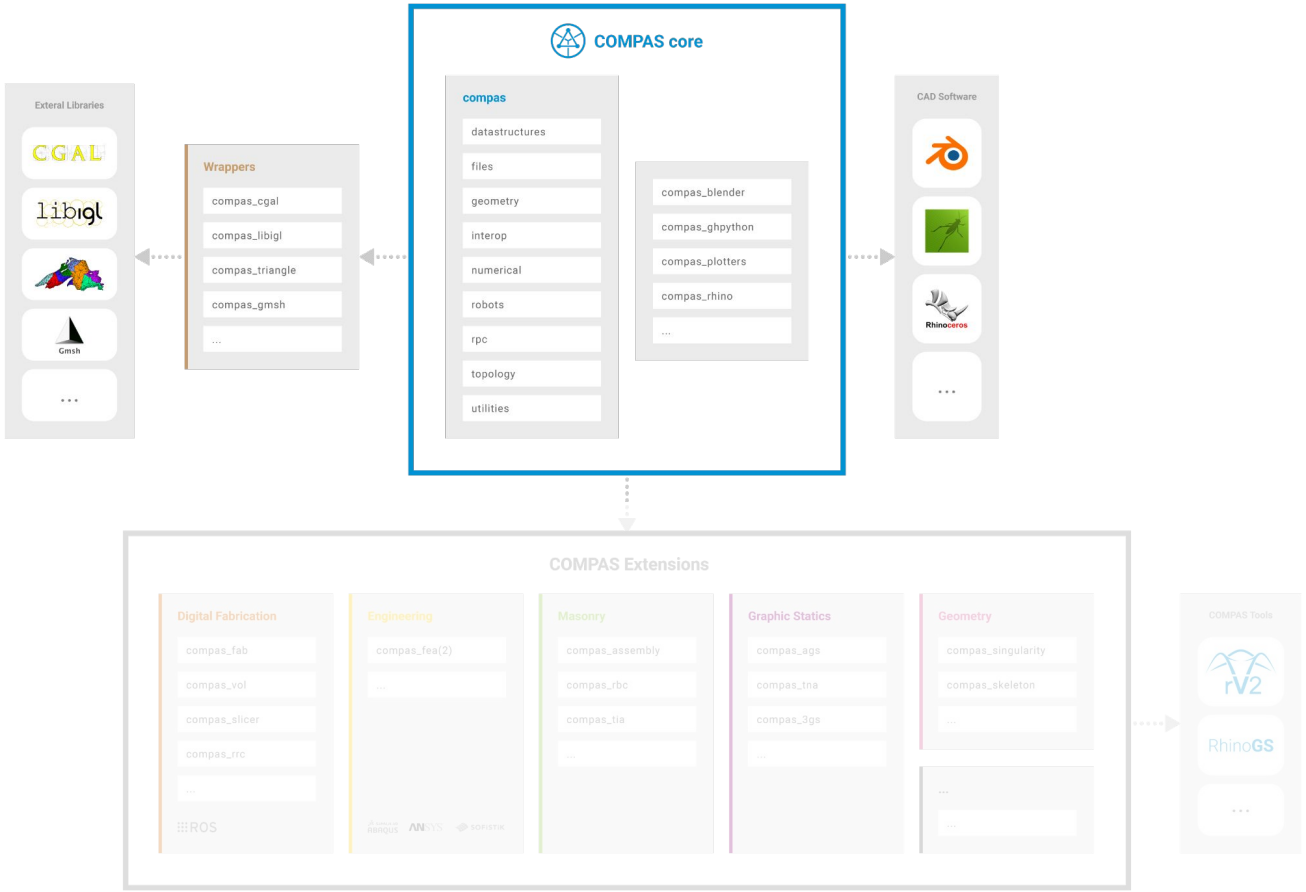
COMPAS Tools
rV2
RhinoGS
...


COMPAS core
Exteral Libraries
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Gmsh
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Wrappers
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Rhinoceros
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COMPAS Extensions
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compas_vol
compas_slicer
compas_rrc
...
ROS
Engineering
compas_fea(2)
...
RHINO|RAHUS
ANSYS
SOFISTIK
Masonry
compas_assembly
compas_rbc
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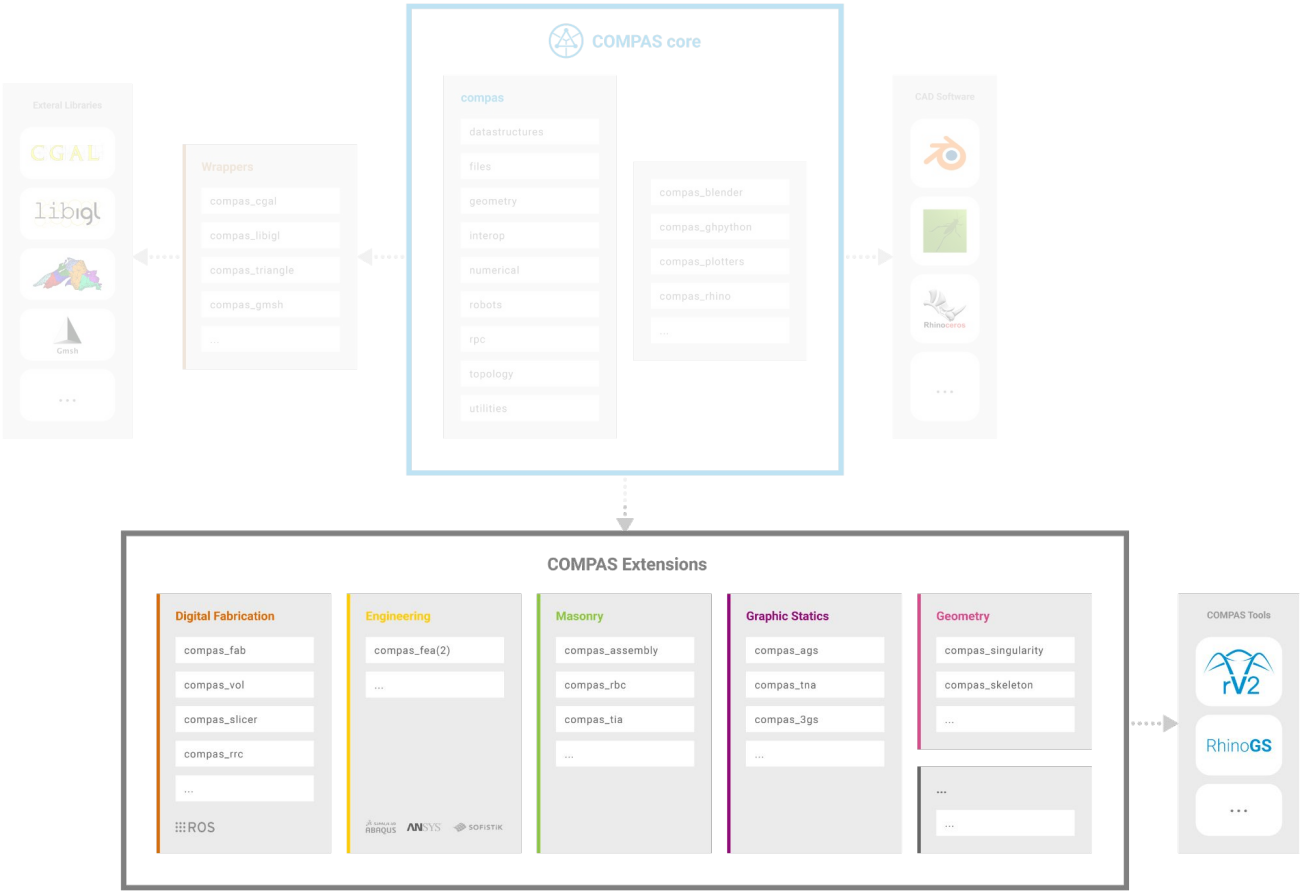
COMPAS Tools
rV2
RhinoGS
...


Exteral Libraries
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compas_3gs
...
Geometry
compas_singularity
compas_skeleton
...
...
...
COMPAS Tools
rV2
RhinoGS
...

COMPAS core

- compas.data
- compas.datastructures
- compas.files
- compas.geometry
- compas.numerical
- compas.plugins
- compas.robots
- compas.rpc
- compas.scene
- compas.topology
- compas.utilities
- compas_plotters
- compas_rhino
- compas_ghpython
- compas_blender

COMPAS core extensions

- compas_cgal
- compas_cloud
- compas_dashboard
- compas_gmsh
- compas_libigl
- compas_occ
- compas_triangle
- compas_view2

Data modelling & Assessment

- `compas_ifc`
- `compas_lca`

Digital Fabrication

- `compas_fab`
- `compas_slicer`
- `compas_rrc`
- `compas_vol`
- `compas_timber`

Engineering

- `compas_fea(2)`

Data modelling & Assessment

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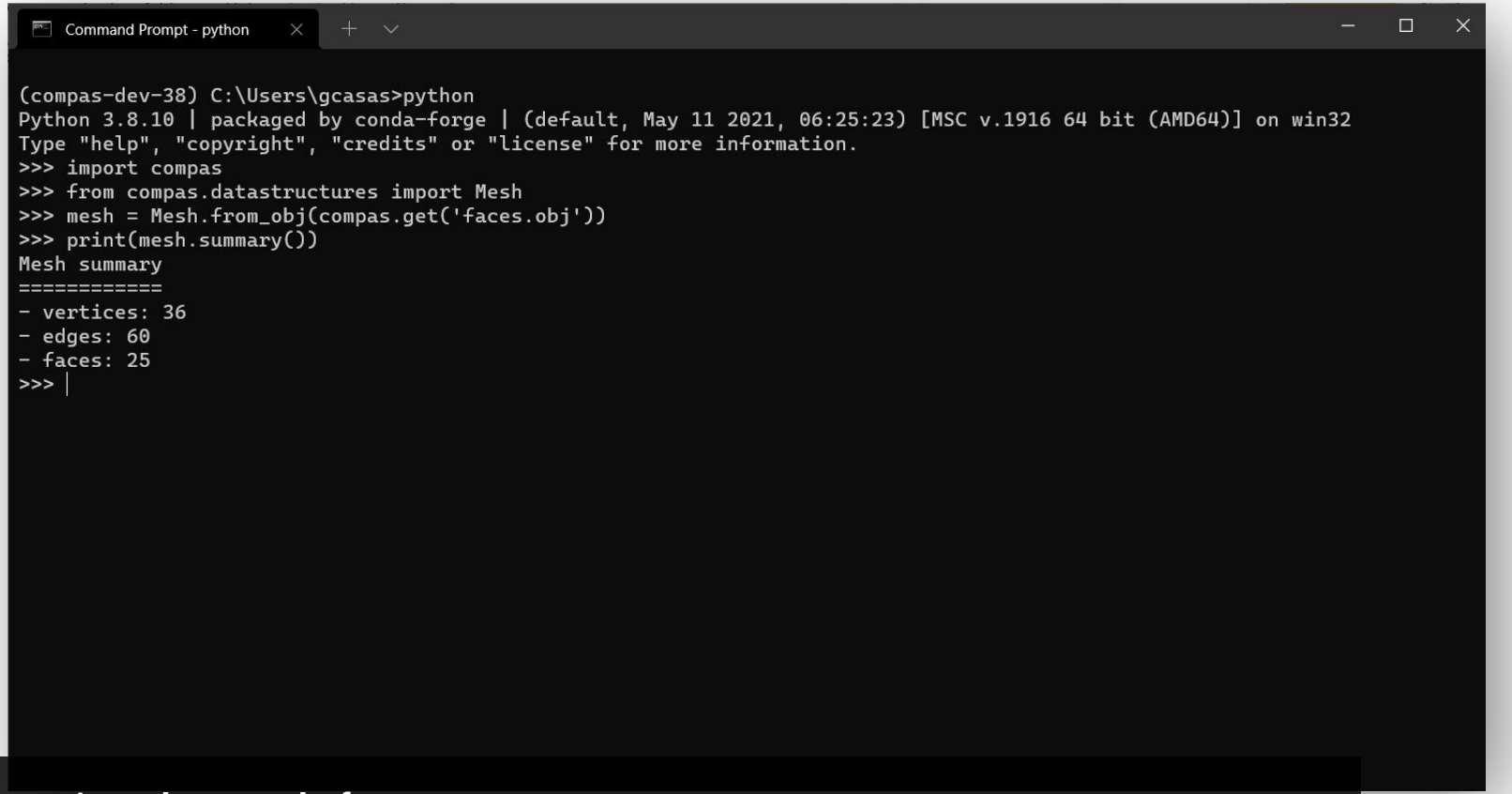
- compas_lca

Digital Fabrication

- **compas_fab**
- **compas_slicer**
- **compas_rrc**
- compas_vol
- compas_timber

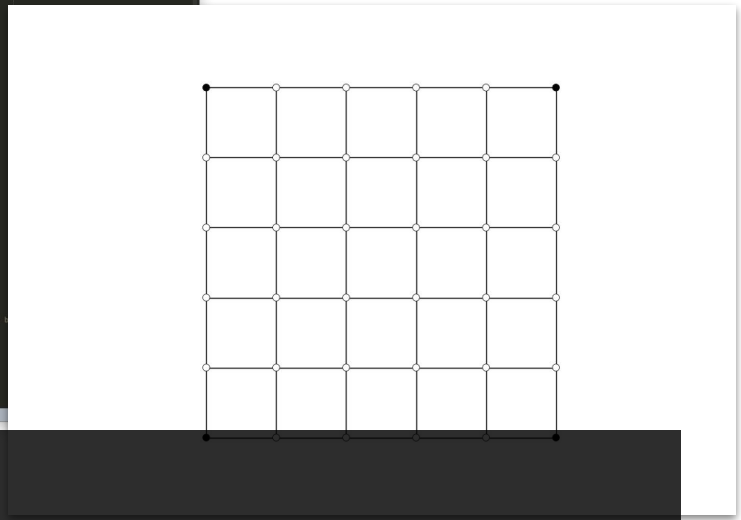
Engineering

- compas_fea(2)



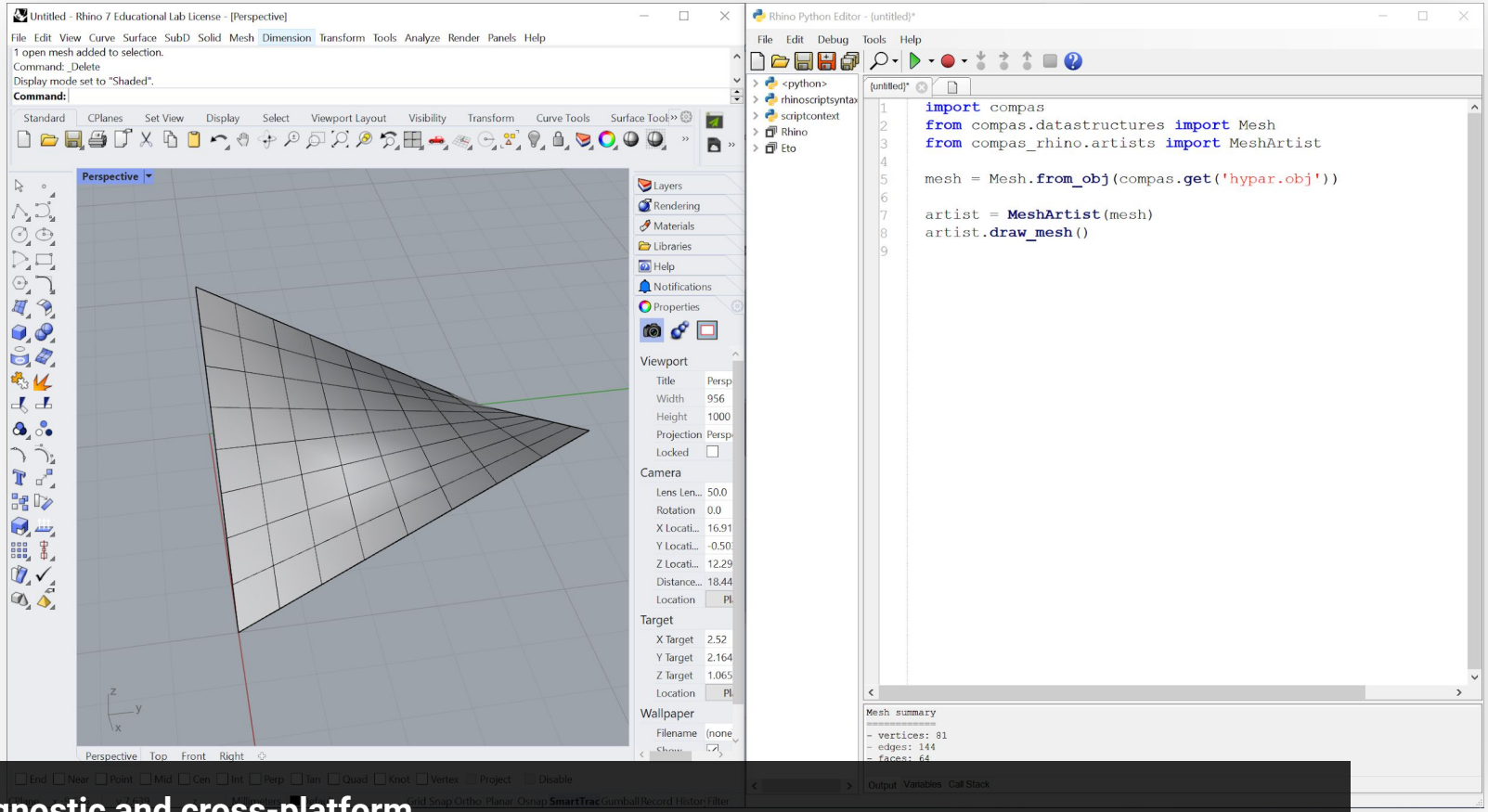
CAD-agnostic and cross-platform

Usage from the CPython interpreter



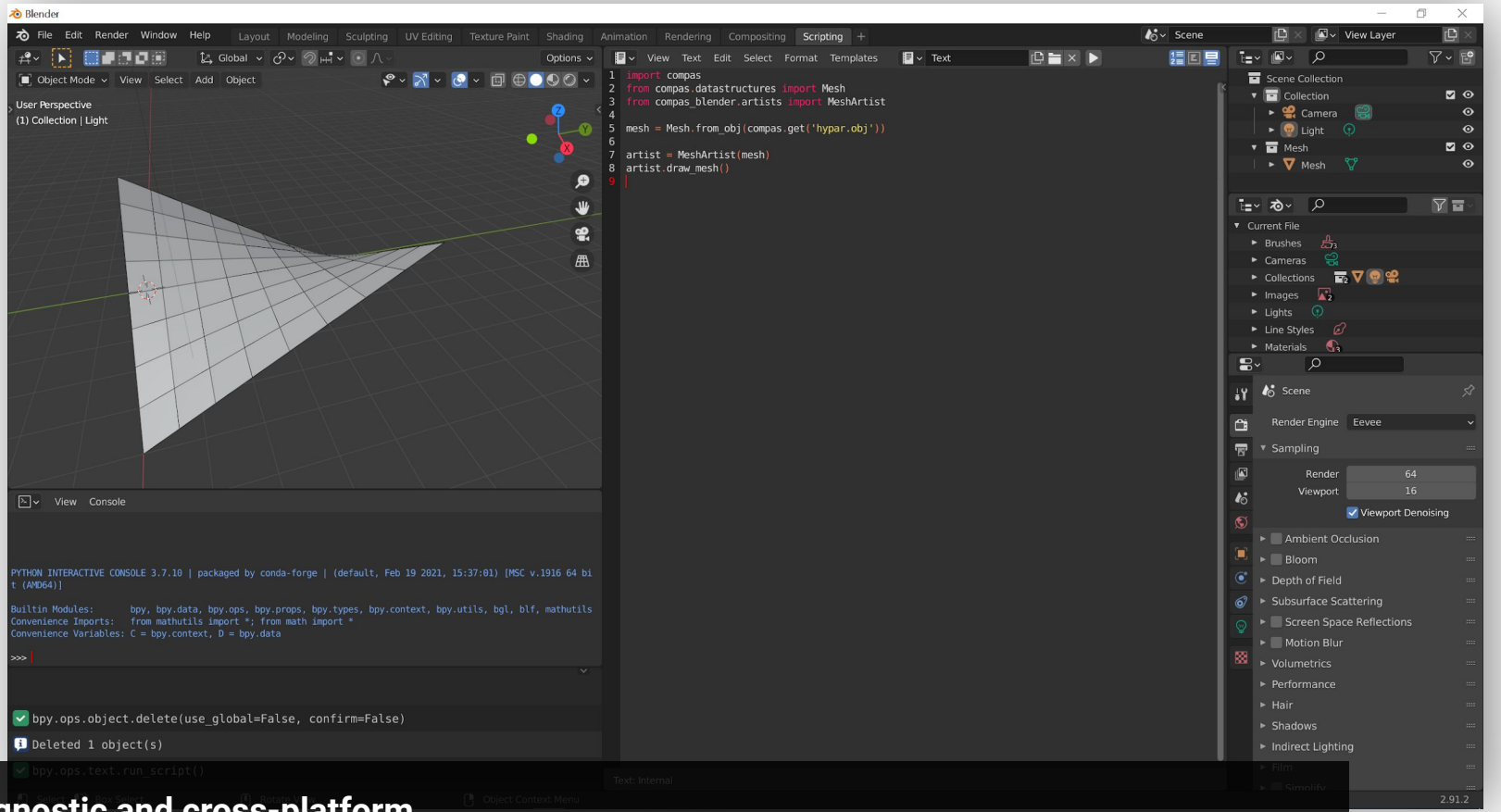
CAD-agnostic and cross-platform

Usage with standalone viewer



CAD-agnostic and cross-platform

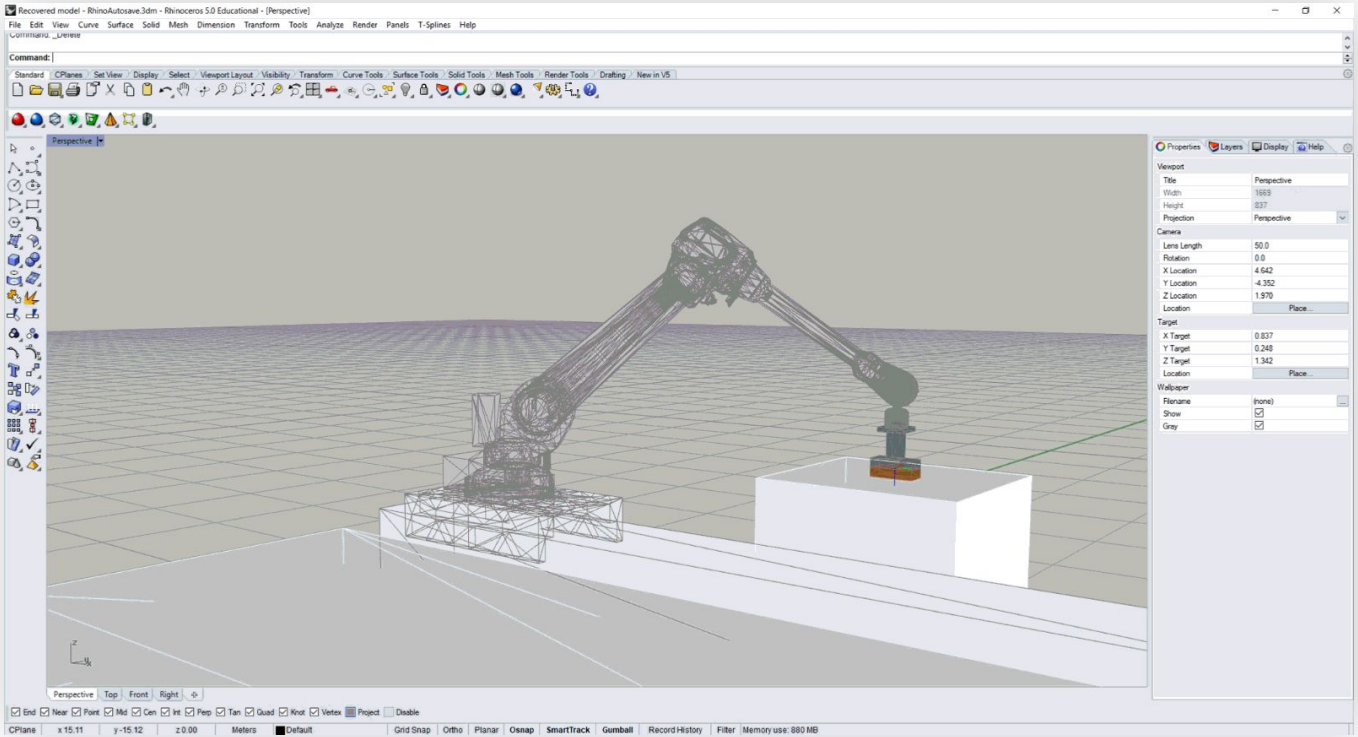
Usage from Rhino on IronPython



CAD-agnostic and cross-platform

Usage from Blender on CPython

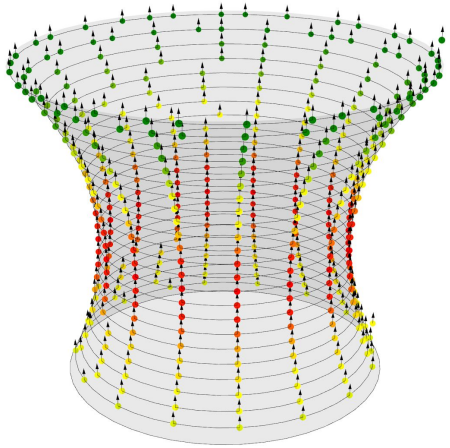
```python
# Any supported CAD
import compas
from compas.artists import Artist
from compas.datastructures import Mesh

mesh = Mesh.from_obj(compas.get('hypar.obj'))

artist = Artist(mesh)
artist.draw_mesh()
```

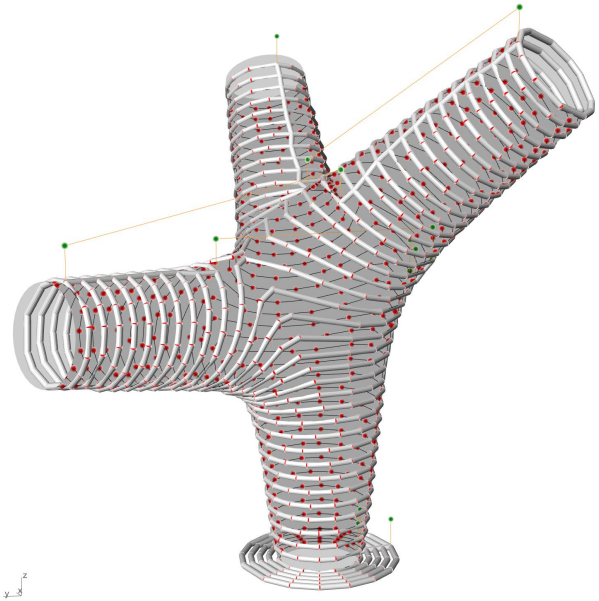


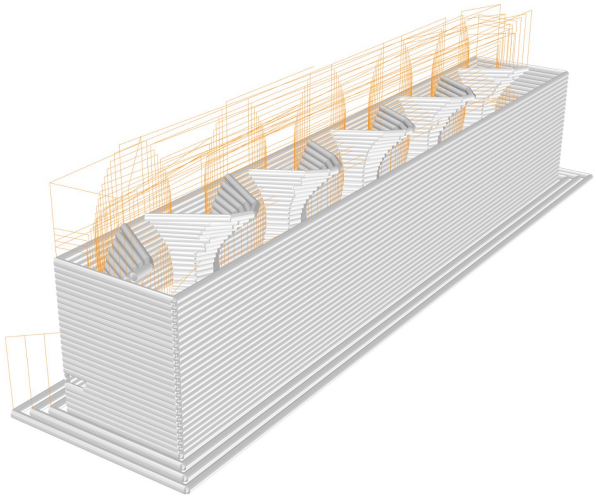
COMPAS FAB

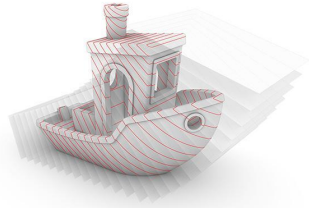
Robotic fabrication package

ETH zürich



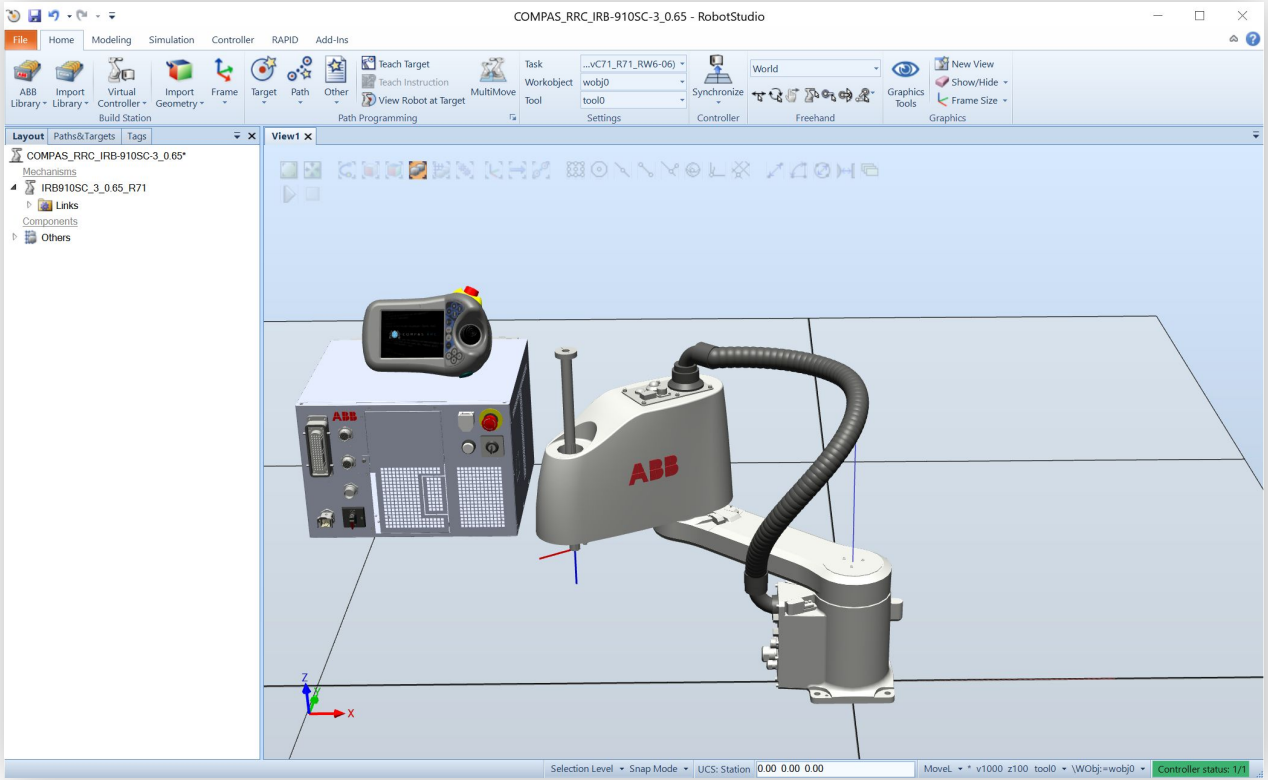






COMPAS SLICER

Slicing package for FDM 3D Printing



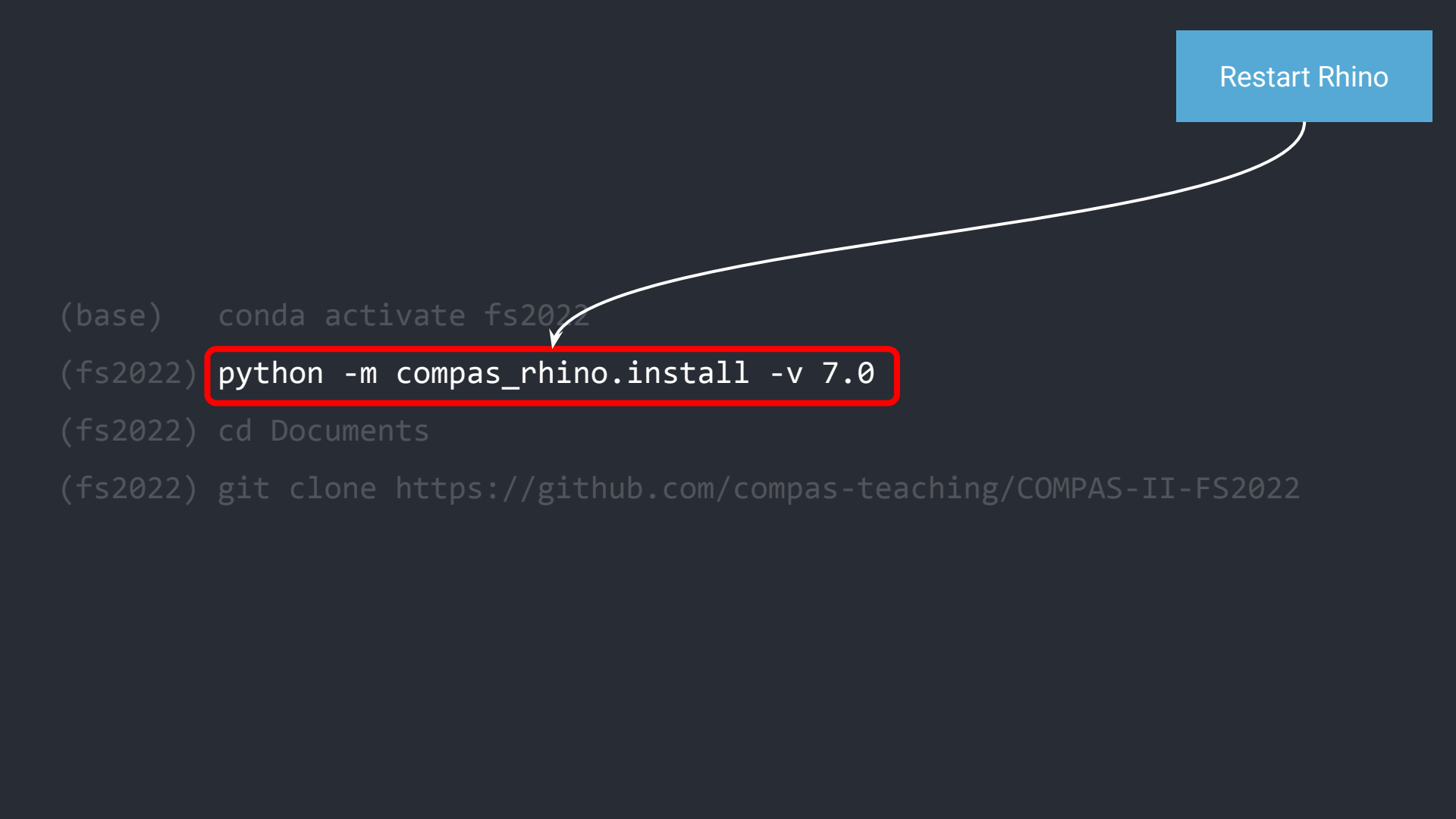
COMPAS RRC

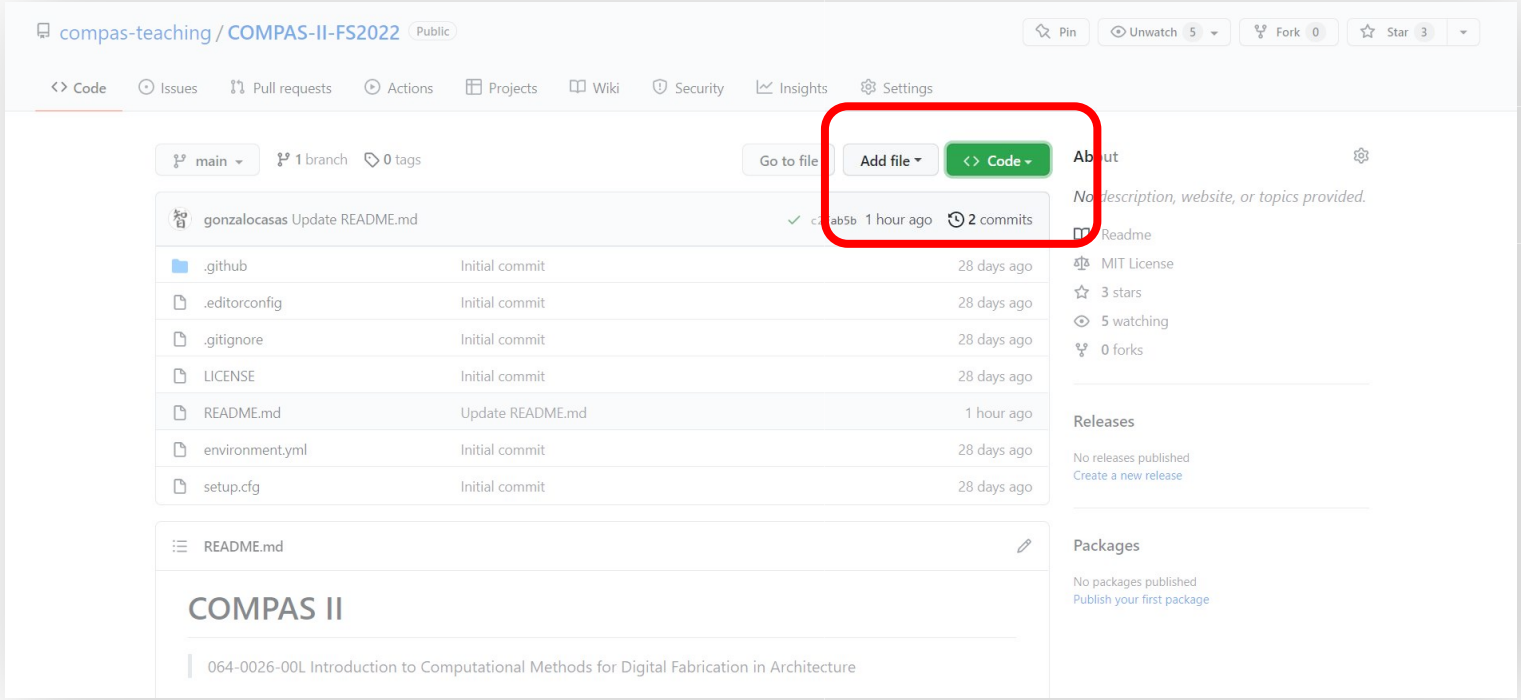
Robot control for ABB robots

Installation

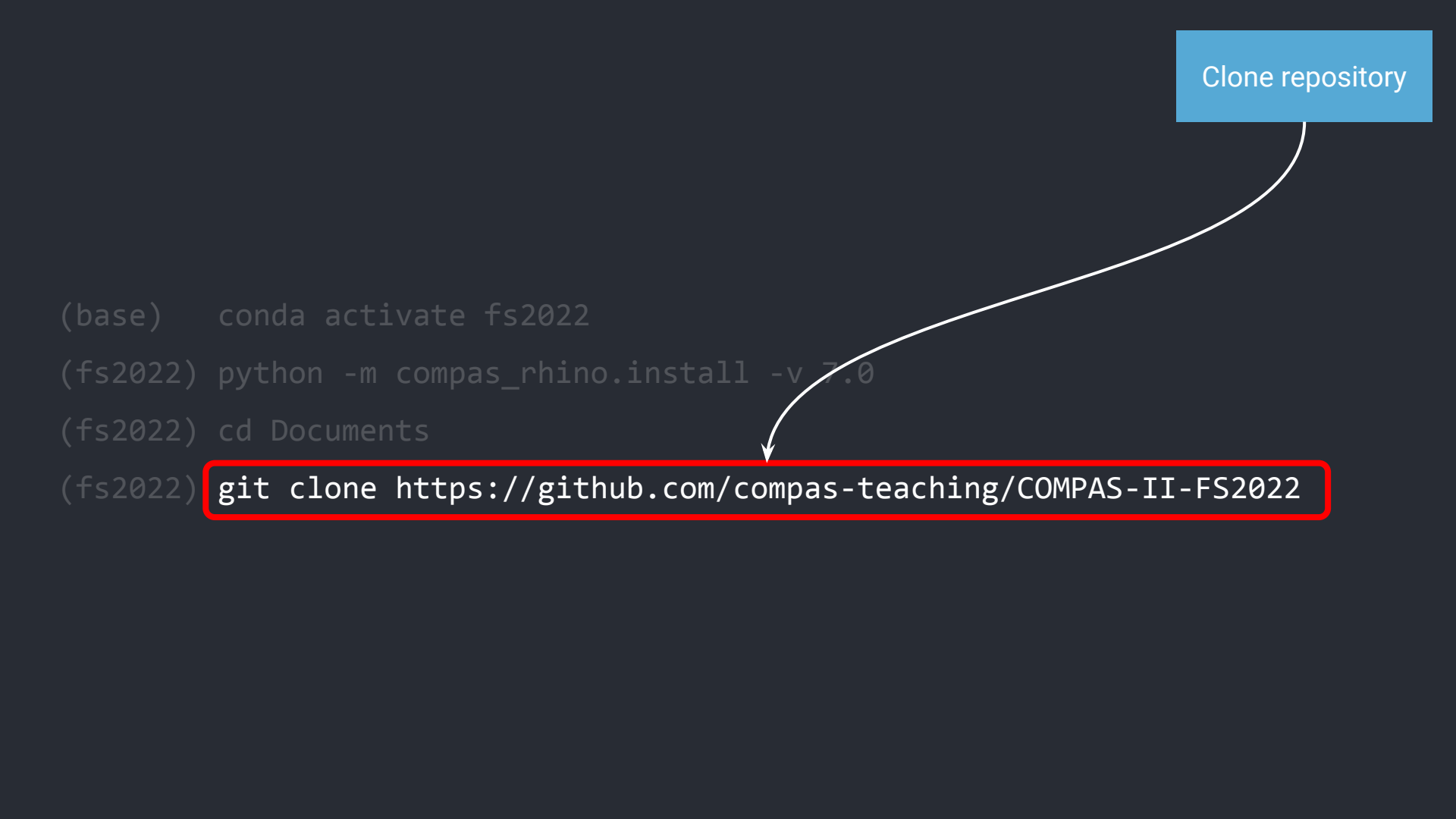
*https://***dfab.link/fs2022**


Activate
(base) conda activate fs2022
(fs2022) python -m compas_rhino.install -v 7.0
(fs2022) cd Documents
(fs2022) git clone https://github.com/compas-teaching/COMPAS-II-FS2022

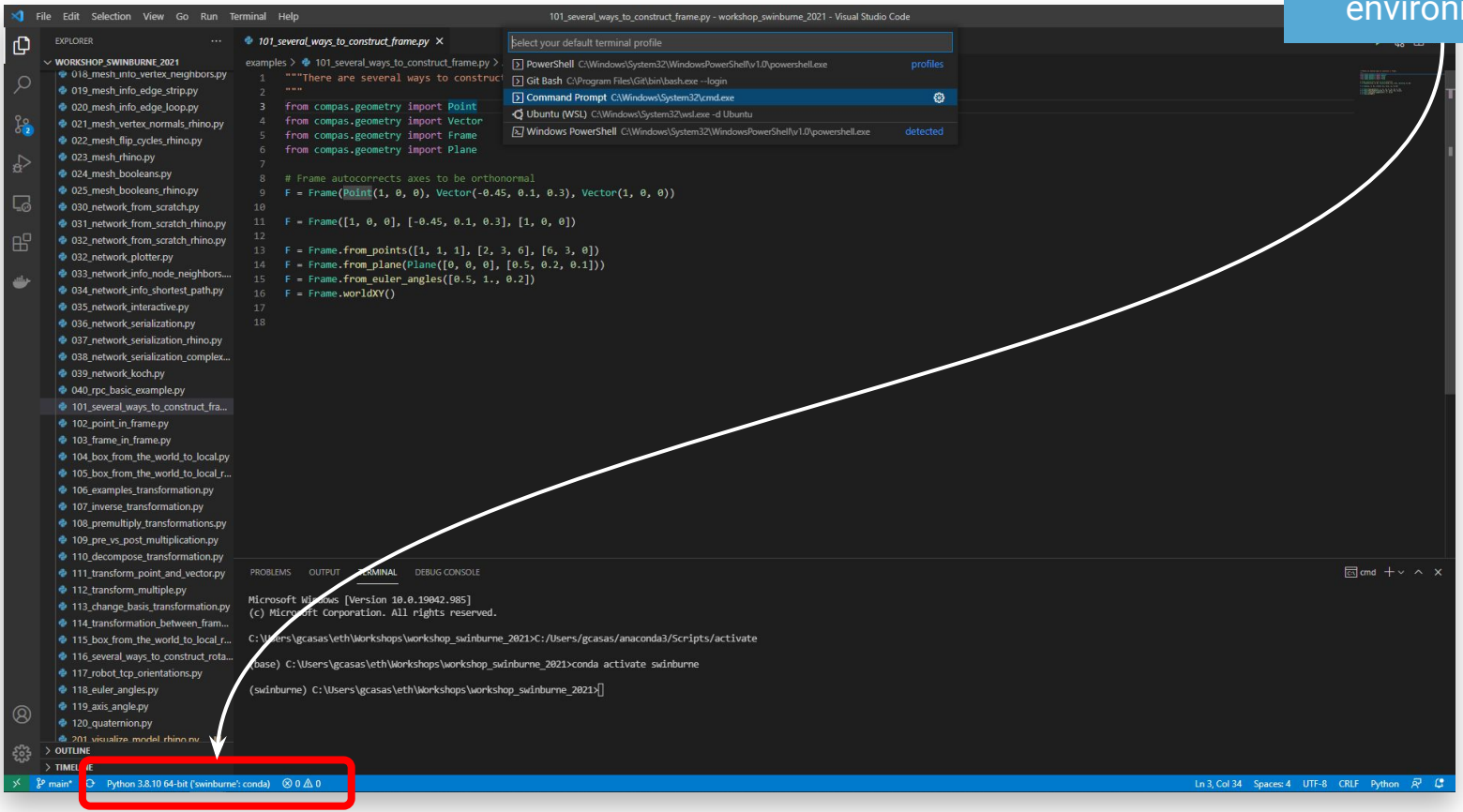

Restart Rhino
(base) conda activate fs2022
(fs2022) python -m compas_rhino.install -v 7.0
(fs2022) cd Documents
(fs2022) git clone https://github.com/compas-teaching/COMPAS-II-FS2022


compas-teaching / COMPAS-II-FS2022
Public
Pin
Unwatch 5
Fork 0
Star 3
Code
Issues
Pull requests
Actions
Projects
Wiki
Security
Insights
Settings
main
1 branch
0 tags
Go to file
Add file
Code
gonzalocasas Update README.md
1 hour ago
2 commits
.github Initial commit 28 days ago
.editorconfig Initial commit 28 days ago
.gitignore Initial commit 28 days ago
LICENSE Initial commit 28 days ago
README.md Update README.md 1 hour ago
environment.yml Initial commit 28 days ago
setup.cfg Initial commit 28 days ago
README.md
COMPAS II
064-0026-00L Introduction to Computational Methods for Digital Fabrication in Architecture
About
No description, website, or topics provided.
Readme
MIT License
3 stars
5 watching
0 forks
Releases
No releases published
Create a new release
Packages
No packages published
Publish your first package

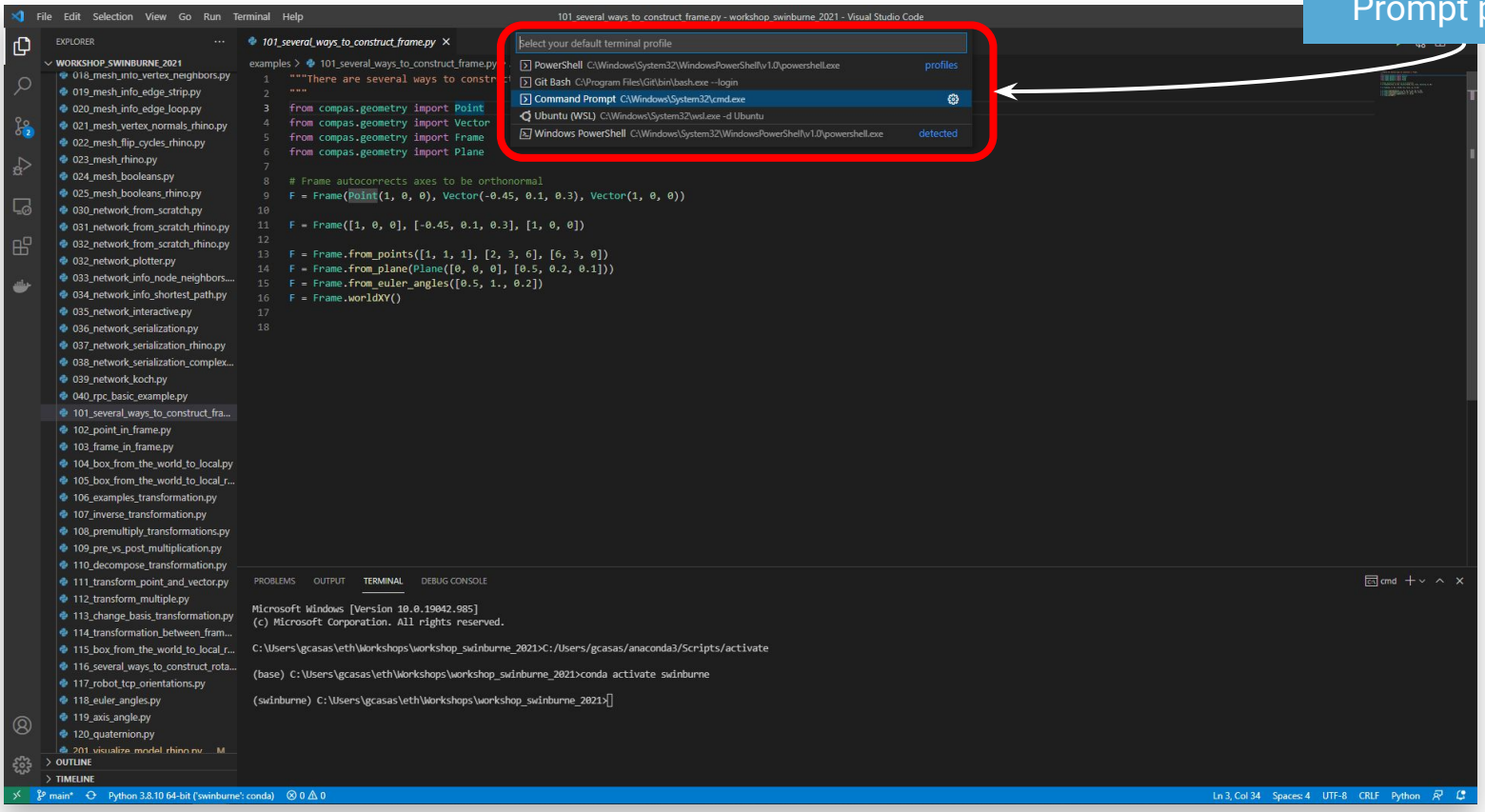

Choose any target folder
(base) conda activate fs2022
(fs2022) python -m compas_rhino.install -v 7.0
(fs2022) cd Documents
(fs2022) git clone https://github.com/compas-teaching/COMPAS-II-FS2022


Clone repository
(base) conda activate fs2022
(fs2022) python -m compas_rhino.install -v 7.0
(fs2022) cd Documents
(fs2022) git clone https://github.com/compas-teaching/COMPAS-II-FS2022

Select environment



Select Command Prompt profile



intro

course overview

dfab toolbox

datastructures

Primitives & Shapes

compas.geometry

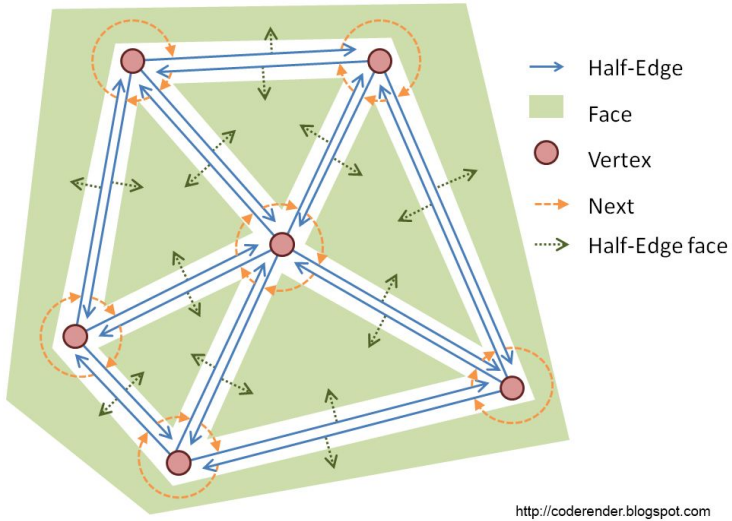
- point, vector, line, plane, circle, polyline, polygon, frame
- transformation, translation, rotation, scale, reflection, projection, shear
- box, sphere, polyhedron, torus, cone, capsule

Object	Python	COMPAS
point	`point = [0, 0, 0]`	`point = Point(0, 0, 0)`
vector	`vector = [0, 0, 1]`	`vector = Vector(0, 0, 1)`
line	`line = [0, 0, 0], [1, 0, 0]`	`line = Line(point, point)`
plane	`plane = [0, 0, 0], [0, 0, 1]`	`plane = Plane(point, vector)`
circle	`circle = ([0, 0, 0], [0, 0, 1]), 1.0`	`circle = Circle(plane, radius)`
polyline	`polyline = [0, 0, 0], [1, 0, 0], [1, 1, 0], [0, 0, 0]`	`polyline = Polyline(points)`
polygon	`polygon = [0, 0, 0], [1, 0, 0], [1, 1, 0]`	`polygon = Polygon(points)`
frame	`frame = [0, 0, 0], [1, 0, 0], [0, 1, 0]`	`frame = Frame(point, xaxis, xyp`

Mesh

compas.datastructures

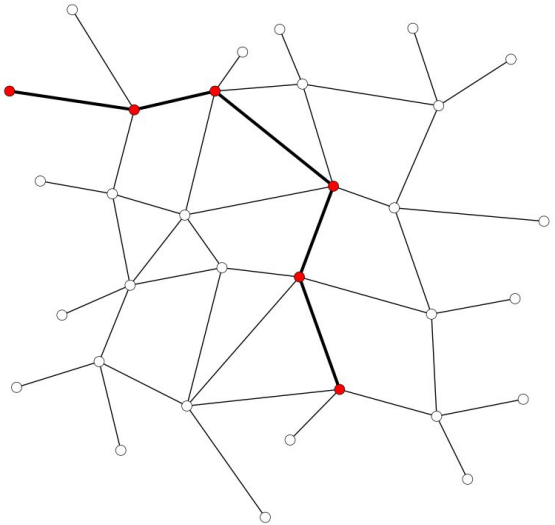
- **CAD-agnostic**
- half-edge data structure
- support for n-sided polygonal faces
- open or closed, polygonal surfaces
- custom attributes at mesh, vertex, edge and face



Network

compas.datastructures

- directed edge graph data structure
- graph: topological
- network: geometric implementation of graph
- custom attributes at network, node and edge
- networkx support



Remote Procedure Calls

compas.rpc

Next week

- Make sure examples run on your machine
- Ask for help if needed
  - Slack
  - Forum
- Next week:
  - Robotic fundamentals

Thanks!