

Information Technology

Lecture 1: Introduction to the course

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Chair for Computational Engineering

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- aim and scope
- organisation of the course
- motivation
- requirements
- overview of software tools
- sample problems

Aim and scope

The course will enable students to comprehend the concepts and practice of Computer Science, the main focus is however put on developing programming skills. The main environment to exercise programming concepts Matlab. The minor goal is to give the student wider perspective on operating systems and software tools for data processing, visualization, geometric modelling. The student should also develop appreciation of the implications of computer use in solving engineering and scientific problems.



Course grading

- The computer labs grade is the same time the course grade.

Computer lab grading rules

- Students prepare to computer lab in their own study time.
- It is allowed to miss only one computer lab.
- The grade for computer labs is based on student's engagement, activity, progress and the results of a test written during the last lab.
- Students who failed to get passing grade for computer labs have one additional resit term for the test. The data for the resit term will be depending on the circumstances (generally one date for all students).

Lectures' topics 1-5

- **Lecture 1: Introduction to the course.** Aim and scope. Method of working. Motivation. Requirements. Overview of software tools. Sample problems.
- **Lecture 2: Introduction to programming.** Processor and program. High level programming languages. Compilation versus interpretation. Overview of popular languages. Introduction to programming in Matlab/Octave.
- **Lecture 3: Diving in Matlab/Octave programming** Pseudocode. Variables and assignment operator. Matrix variables. Conditional statement. Loops. Functions. Programming paradigms: structural object oriented, functional.
- **Lecture 4: Data structures and algorithms** Basic data structures: arrays, lists, sets, graphs. Overview of selected algorithms for sequences. Sorting and searching. Matrix algorithms.
- **Lecture 5: Data formats and data processing** Binary code. Data types. Characters, ASCII, code pages, UTF-8. Data formats. HDF5, JSON, XML, CSV. Data visualization. ParaView, Matplotlib, plotting in Matlab and Octave.



- **Lecture 6: Introduction to geometric modelling.** Geometric models and their representations. B-Rep i CSG. Meshes as data structures. Basic geometric transformations. Selected tools: GMSH, OpenScad, Blender.
- **Lecture 7: Overview of software engineering** Repositories. Git, GitHub. Documenting code. Markdown. Linux environment. Automating repetitive tasks. Software licences.
- **Lecture 8: Summary - the role of programming in engineering curriculum.**

- ① Introduction to Matlab/Octave. IDE. Running scripts.
- ② Assignment statement. Functions
- ③ Conditional statement. Functions (cont.)
- ④ Enumeration loops: `for`
- ⑤ Conditional loops: `while`
- ⑥ More complex programs. Exercises.
- ⑦ Final test.

Reading list

Primary readings

- Matlab(R) Primer, MathWorks, 2019 https://www.mathworks.com/help/releases/R2019b/pdf_doc/matlab/getstart.pdf
- David Houcque, Introduction to Matlab for Engineering Students, Northwestern University, 2005, <https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf>
- Tony Gaddis, Starting out with Python, Pearson, 2017 (4th edition)

Additional readings

- W. Gander, Learning MATLAB. A problem Solving Approach, Springer, 2015
- K.D Lee, Python Programming Fundamentals, Springer, 2011
- J. D. Foley et al, Computer Graphics: Principles and Practice, Addison Wesley; 3rd Edition, 2013
- D. M. Bourg, Physics for Game Developers, O'Reilly, 2001



Required background knowledge:

- Vector and matrix algebra. Planimetry. Elementary functions. Kinematics and dynamics of material points.

Lectures:

- The scope of lectures is only sketched and generally is open. If there are some topics you would like hear about or if you have some specific questions you would like me to discuss during the lecture then please let me know and I will address them in the lectures.

Computer labs:

- The main purpose of computer labs is to make possible to ask very specific questions about your programs and problems you encounter. During the labs you have an opportunity to show your **skills and engagement**. The main mode of working is **discussion**. Reaching the goals of the course require **INTENSE and SYSTEMATIC** work in your self-study time.

Grading rule

		Engagement		
		small	medium	big
Effects	small	2.0	3	3.5
	medium	3.5	3.5	4
	big	4	4.5	5

- Generally I distinguish just two groups of students: the one who want to learn something and the others. Everything else are just less important details.
- The accuracy and objectivity of grading depends in fact on how much feedback on your engagement and achieved results you provide.
- **All the time it is possible to discuss the marks.**

Software tools : basic environment

Operating system:

- Windows

or

- Linux

Suggested solution:

- Windows + Linux via VirtualBox
(<https://www.virtualbox.org/>)

Absolute minimum: interpreter Octave/Matlab + editor



The screenshot shows the MathWorks Store website. The main heading is "MathWorks Store" with a search bar. Below the heading, there are links for "Purchase Products", "Quotes", and "FAQ". The main content area features the title "New License for MATLAB Student R2019b" and a note: "To purchase product for an existing license, select it in My Account first." To the right, there is a callout box for "Add-on Products" priced at "EUR 7,00", with a note: "Offer valid only for new license purchase. Explore Areas of Study". Below this, there is a table of product options.

Sort By Category | Sort By Name Add to Cart

MATLAB Product Family	Price	Add
MATLAB and Simulink Student Suite Includes MATLAB, Simulink, Control System Toolbox, Curve Fitting Toolbox, DSP System Toolbox, Image Processing Toolbox, Instrument Control Toolbox, Optimization Toolbox, Parallel Computing Toolbox, Signal Processing Toolbox, Statistics and Machine Learning Toolbox, Symbolic Math Toolbox	EUR 69,00	<input checked="" type="checkbox"/>

<https://www.mathworks.com/products/matlab.html>

GNU Octave, version 5.2.0
 Copyright (C) 2020 John W. Eaton and others.
 This is free software; see the source code for c
 This is ABSOLUTELY NO WARRANTY; not even for ME
 FITNESS FOR A PARTICULAR PURPOSE. For details,
 Octave was configured for "x86_64-w64-mingw32".
 Additional information about Octave is available
 Please contribute if you find this software usefu
 For more information, visit <https://www.octave.o>
 Read <https://www.octave.org/bugs.html> to learn h
 For information about changes from previous vers
 >> simplebeam
 >> Number of nodes: 6.03419
 >> |

```

1 % This is quick-and-dirty attempt at buildig simple
2 % application in Octave using GUI control.
3 % The application allows to crate and visualise simple 1D m
4
5 close all
6 clear app
7
8 graphics_toolkit qt
9
10 function app = generate_mesh(app)
11 % Take application structure input and generate
12 % simple 1D structured mesh in it.
13 % Retrun update application.
14 nn = app.mesh.nnodes;
15 app.mesh.x = linspace(0, app.mesh.L, nn);
16 end
17
18 function update_mesh(obj)
19 % GUI callbac called when number of meshes nodes changes.
20 % Update application by generating new mesh and its plot.
21 nn = get (obj, 'value');
22 fprintf('Number of nodes: %d\n', nn);
23 app = guidata(obj);
24 msg = sprintf('Number of nodes: %d', nn);
25 set(app.gui.nnodes_label, 'string', msg);
26 app.mesh.nnodes = nn;
27 app = generate_mesh(app);
28 app = plot_mesh(app);
  
```

Name	Class	Dimension	Value	Attribut
app	struct	1x1	...	

Command History

```

exit
# Octave 4.4.1, Fri Mar 15 02:59:01 2019 GMT <unknow
exit
# Octave 4.4.1, Sat Mar 30 22:16:02 2019 GMT <unknow
exit
# Octave 4.4.1, Sat Oct 19 20:54:34 2019 GMT <unknow
  
```

<https://www.gnu.org/software/octave/>



The screenshot shows the Ideone.com website interface. At the top, there are browser tabs for "Reset Your Ideone Password" and "Online Compiler and IDE >> C/C". The address bar shows "ideone.com". The navigation bar includes "new code", "samples", "recent codes", and "sign in".

The main content area features a code editor with the following C++ code:

```
</> enter your source code or insert template or sample shortcuts  
1 while(true)  
2   x = scanf('%d', [1]);  
3   if (x == 42)  
4     break;  
5   endif  
6   printf("%d\n", x);  
7 endwhile  
8
```

Below the code editor is an input field labeled "enter input (stdin)" containing the text:

```
1  
2  
88  
42  
10
```

On the right side, there are promotional banners:

- Sphere online judge**
Learn How to Code
- Discover > Sphere Engine API**
The brand new service which powers Ideone!
- Discover > IDE Widget**
Widget for compiling and running the source code in a web browser!

A "Feedback" button is visible on the right edge. At the bottom, a cookie consent banner reads: "We use cookies to improve our services. If you continue without changing your settings, we'll assume that you are happy to receive all cookies on Ideone website." with an "OK" button.

<https://ideone.com>

Python 3 via Anaconda

Anaconda Navigator

File Help



ANACONDA NAVIGATOR

Sign in to Anaconda Cloud

Home

Environments

Projects (beta)

Learning

Community

Documentation

Developer King

Feedback



Documentation (11)

Training (2)

Video (20)

Webinar (20)

Search



Python Tutorial

Read



Python Reference

Read



ANACONDA

Anaconda Package List

Read

pandas



<https://www.anaconda.com/>



The screenshot displays the PyCharm IDE interface. The main editor window shows a Python script named `demo_translate_and_scale.py` with the following code:

```
15
16 PKGDIR = os.path.dirname(femcalc.__file__)
17 DATADIR = os.path.join(PKGDIR, 'test', 'data')
18
19
20 class DemoEdgeBoundingBox(examples.Demo):
21     def demonstrate(self):
22         master_box = meshgrid.geometry.mrg.BoundingBox([0, 0, 10, 10])
23         for edge in meshgrid.geometry.mrg.BoundingBox.edges:
24             edge_box = master_box.getEdgeBox(edge, eps=1.0)
25             print(f"{edge} -> {edge_box.lbf} : {edge_box.hbf}")
26
27 if __name__ == '__main__':
28     demo = DemoEdgeBoundingBox()
29     demo.run()
```

The SciView window on the right displays a plot of two bounding boxes. The x-axis ranges from 0 to 15, and the y-axis ranges from 0.0 to 17.5. A green grid is visible in the bottom-left corner, and a yellow grid is visible in the top-right corner. A red rectangle is also present, enclosing the green grid.

The Run window at the bottom shows the output: "Process finished with exit code 0".

<https://www.jetbrains.com/pycharm/>



The screenshot displays the Spyder Python IDE interface. The editor window shows a Python script with the following code:

```
1# -*- coding: utf-8 -*-
2# Python packages
3import numpy as np
4
5
6""" FOR CLASS ROOM *****
7import sys
8#sys.path.insert(0, "C:\\Users\\magoulesf\\Desktop\\")
9#from pytransform import pyarmor_runtime
10#pyarmor_runtime()
11""" *****
12
13
14# MRG packages
15from femcalc import meshgrid
16import femcalc.meshgrid.graphics
17
18
19def simpleMesh():
20    """
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32    out_mesh = meshgrid._meshrg.Mesh()
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```

The IPython console shows the following output:

```
Python 3.6.7 (default, Jul 2 2019, 02:21:41) [MSC v.1900 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.

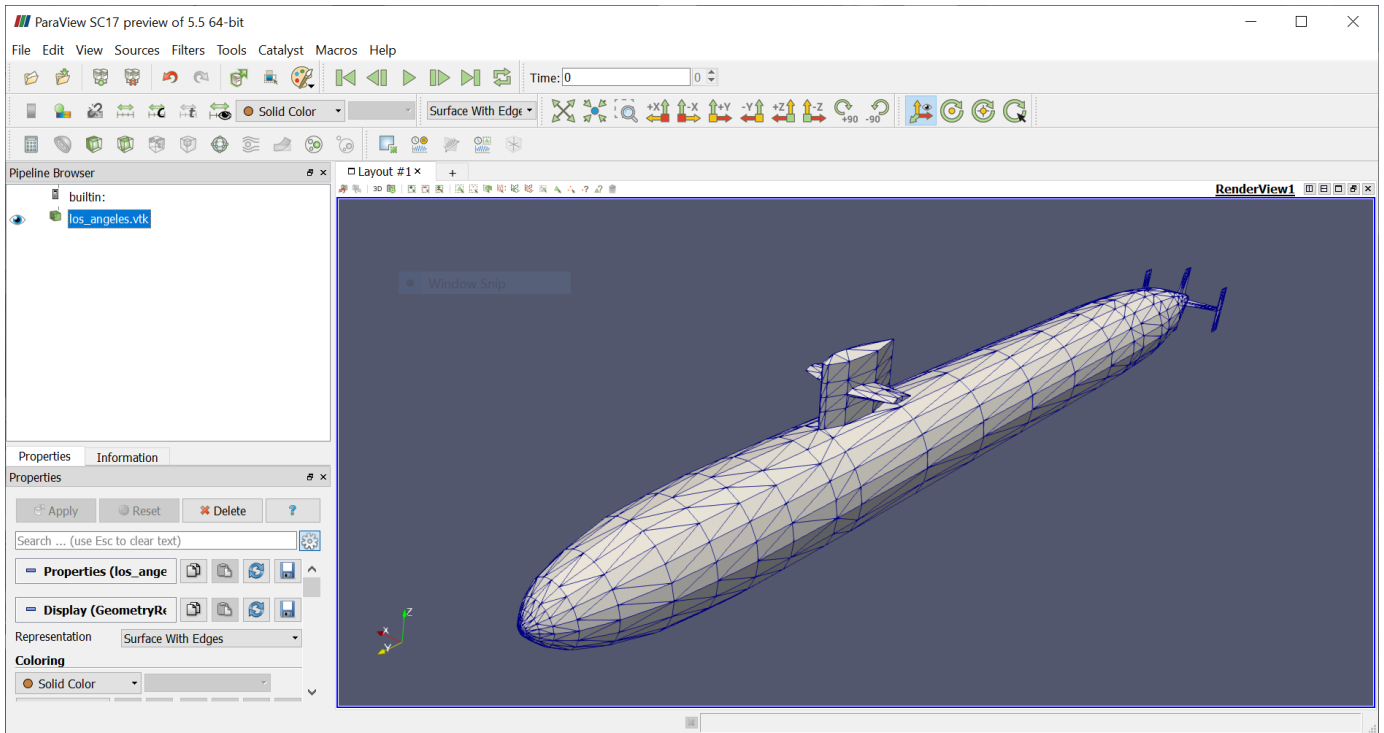
IPython 7.8.0 -- An enhanced Interactive Python.

In [1]: |
```

The status bar at the bottom indicates: Permissions: RW, End-of-lines: CRLF, Encoding: UTF-8, Line: 8, Column: 1, Memory: 59 %.

<https://www.spyder-ide.org/>

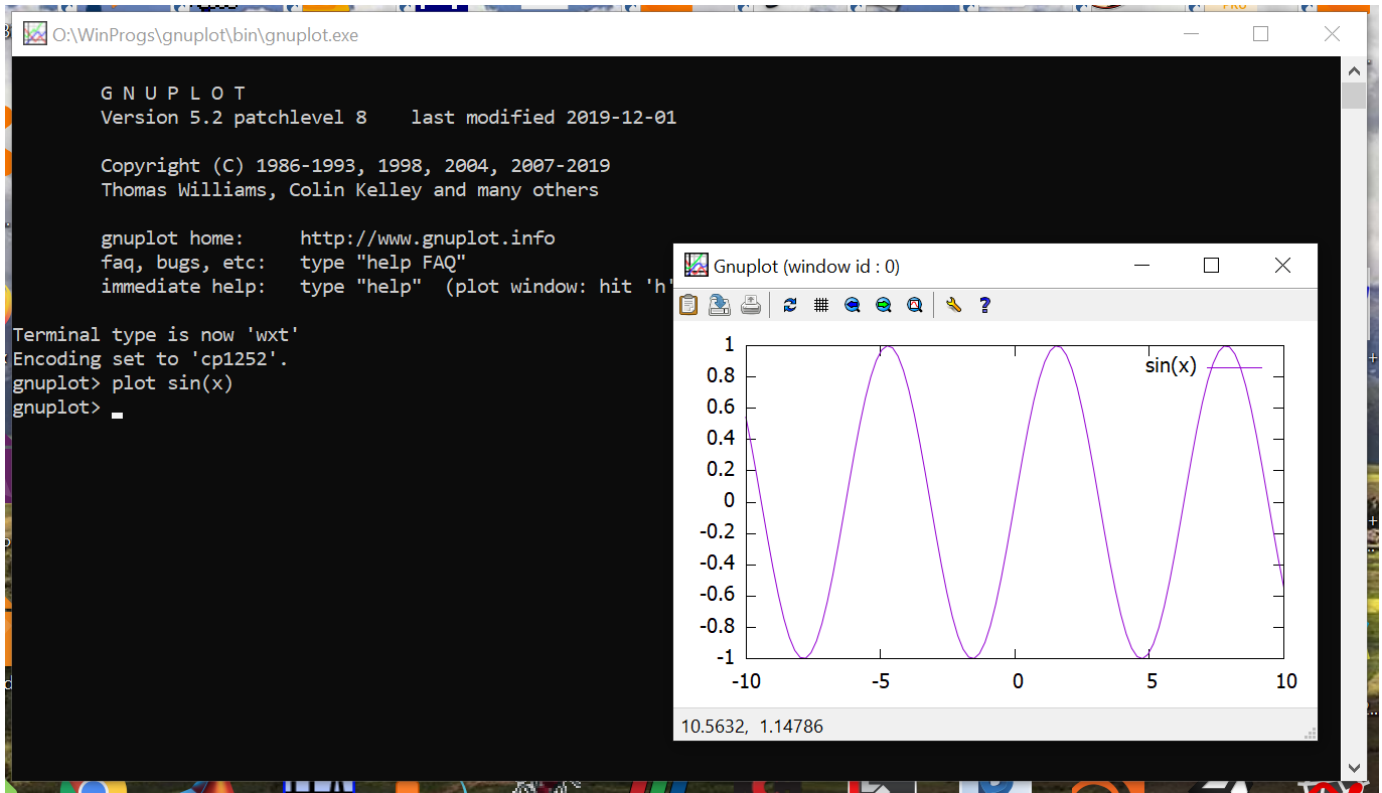




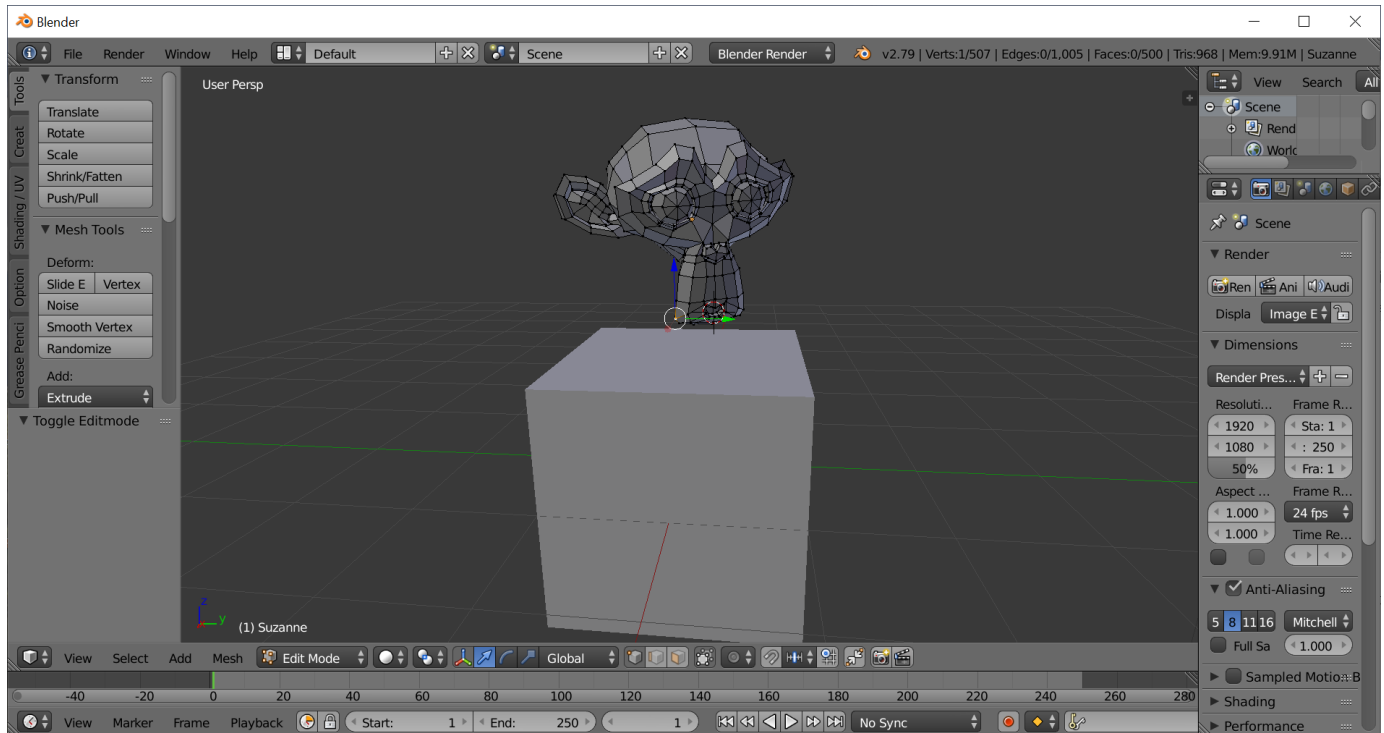
<https://www.paraview.org/>

ParaView can be controlled and extended via Python scripts.

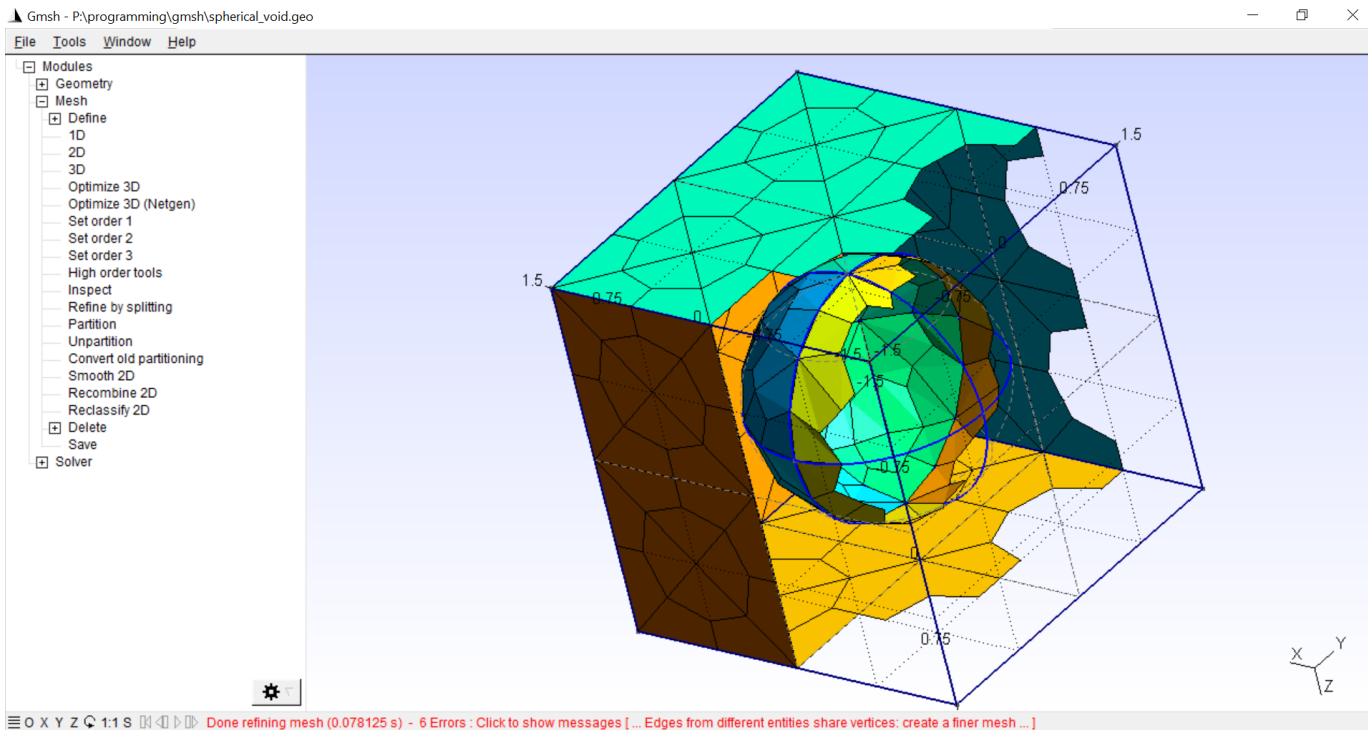
Gnuplot



<https://www.gnuplot.info>



<http://www.blender.org>



<https://gmsh.info>

Git is a specific revision control system. Such systems are nowadays the basic tool underlying any but trivial software project. Git (<https://git-scm.com/>) is a *distribute* revision control system and one of the most popular in its category.

The minimal set of Git's commands: `clone`, `add`, `commit`, `status`, `diff`, `pull`, `push`

The best approach to learn Git is to start with its intrinsic command line interface and only after mastering the basic to use one of many Git's graphical user interfaces.

Markdown + Pandoc

math.md - Markdown Monster (unregistered)

File Edit Tools Weblog View Window Help

math.md x configuration_and_compilation.md x TaskToDo_max.md x TaskToDo.md x

C:\Users\putan\D

```
---
useMath: true
title: Ala ma Math
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Test file for Markdown/Pandoc features

Here is the problem $e = mc^2$

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- ola

Here is the other math

[Other math](#)

Code sample

Ready 51 words 27 lines 315 chars Ln 6, Col 22 100% UTF-8 markdown MarkDig vscodedark Dharkan

<https://markdownmonster.west-wind.com/> <https://pandoc.org>



L^AT_EX (be careful with pronunciation) is a document preparation system that uses special markup language to define document structure and the appearance of rendered final form. The document source is saved as a plain text file what makes it very suitable for storing in all kinds of revision control systems, easy to edit and share.

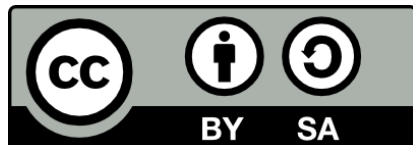
Sample problems

- Tabulating scalar function of a scalar variable
- Plotting a function of one variable
- Dot product and cross product of vectors
- Rotating points in plane



Thank you for your attention





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