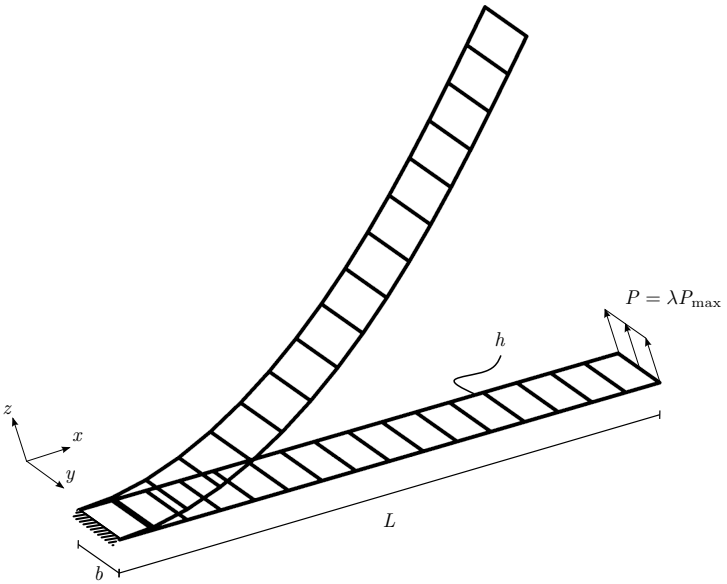
Problem 1: Cantilever subjected to End Shear Force

The following problem is adopted from Sze et al. (2004). The boundary conditions, geometry, and material details are provided.



$$
\begin{aligned}
L &= 10 \\
b &= 1 \\
h &= 0.1 \\
E &= 1.2 \cdot 10^6 \\
\nu &= 0.0 \\
P_0 &= \frac{EI}{L^2} = 1 \\
P_{\max} &= 4P_0 = 4
\end{aligned}
$$

The problem is solved using Ikarus. Finite elements, according to Kirchhoff-Love shell theory, are used for discretization.

a) Fill in the missing blocks of code in the provided file, `Cantilever.ipynb`.

b) Compare the results with the provided reference solution for various numbers of elements chosen along the x-direction.

References:

[1] Sze, K.Y., Liu, X.H., Lo, S.H., 2004. *Popular benchmark problems for geometric nonlinear analysis of shells.* Finite Elements in Analysis and Design 40, 1551–1569.

Instructions for use:

a) Open Microsoft Edge.

b) Sign in to your GitHub account.

c) Join the assignment `Exercise11` in the GitHub Classroom via this link.

d) Authorize GitHub Classroom access, if necessary.

e) Find your name in the list of identifiers and link your GitHub account with it. If you do not find your name, choose the option, "`Skip to the next step`→".

f) Click "`Accept this assignment`".

g) Click "`Open in GitHub Codespaces`".

h) Click "`Building codespace...`" to view the status of container creation.

i) If you cannot see the execution of the `pip install ...` statements, click at the search bar and click `Befehle anzeigen und ausführen` (or alternatively, use `Ctrl + Shift + P`). Then, search and execute "`Codespaces: View Creation Log`".

j) Open the file "`Exercises/Cantilever.ipynb`".

k) Execute the first code cell with import statements and check if `ikarus` is imported successfully.

l) If necessary, VS Code will ask you to set an environment for Python.
Choose "`Python-Umgebungen...`". Then choose the `dune-env`.