



Structural Analysis & Design Software

www.dlubal.com



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Webinar

How to Integrate AI to RFEM using API



Questions During the Presentation



GoToWebinar Control Panel
Desktop



E-mail: info@dlubal.com



Show or hide control panel



The screenshot shows the GoToWebinar control panel with two main sections: Audio and Questions. The Audio section includes a Sound Check indicator, radio buttons for 'Computer audio' (selected) and 'Phone call', a 'MUTED' status with a microphone icon, and dropdown menus for 'Mikrofon (2- Sennheiser USB h...)' and 'Lautsprecher (2- Sennheiser U...'. The Questions section features a text input field with the placeholder '[Enter a question for staff]' and a 'Send' button. At the bottom, the 'Webinar ID: 373-901-987' and the 'GoToWebinar' logo are visible.



Adjust audio settings

Ask questions



Content

01 New Implementations in WebService & API

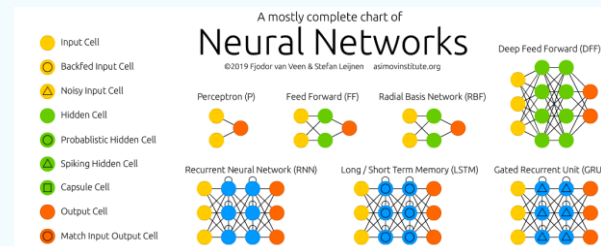
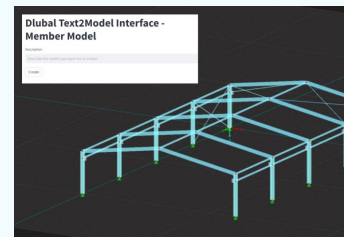
02 Background on AI, ML, DL

03 Using AI for Optimization

04 Help ChatBot

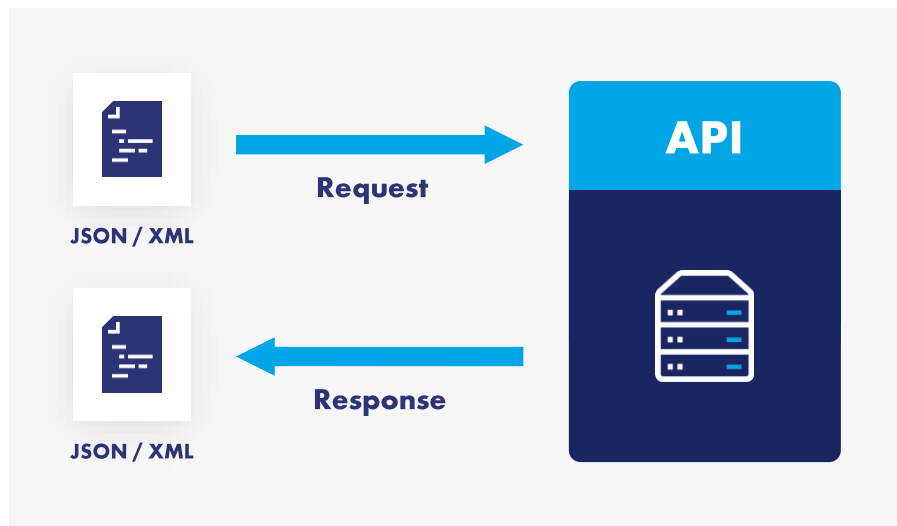
05 Text2Model

06 Our Future Plans



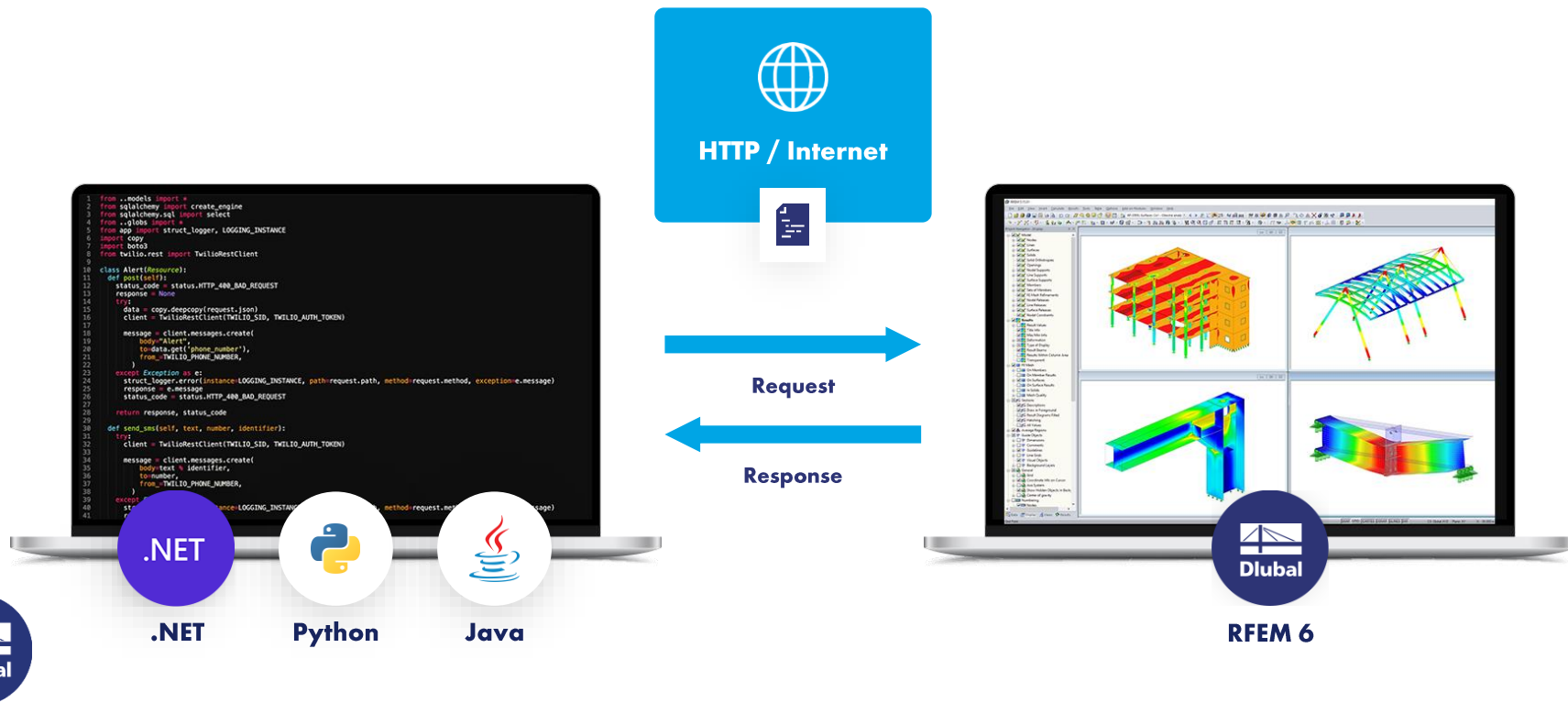


What is API?





What are Web Services?





The Dlubal github repository

The screenshot shows the GitHub profile for Dlubal-Software. The profile includes a bio: "Structural Analysis and Design Software | RFEM | RSTAB", 61 followers, and a location in Prague. It lists social media links for GitHub, LinkedIn, Instagram, and a website. The repository page displays the README, which features the Dlubal logo and a "Welcome" message. The README text states: "We are glad that you visited our Dlubal's company GitHub. We are publishing our open source libraries developed in Python & C# for Webservice. We are also publishing open source libraries which we have used for development of our commercial applications and we did some modifications." The repository also shows social media links, version tags for RFEM v6.0, RSTAB v9.0, and RSECTION v1.0, and a list of top languages: C++, Python, C#, C, and HTML.


Overview Repositories 24 Discussions Projects 3 Packages Teams 3 People 39

Dlubal Software
Structural Analysis and Design Software | RFEM | RSTAB
61 followers Prague <http://dlubal.com> @dlubal_en api@dlubal.com **Verified**

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README.md

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RFEM v6.0 RSTAB v9.0 RSECTION v1.0

Welcome

We are glad that you visited our Dlubal's company GitHub. We are publishing our open source libraries developed in Python & C# for Webservice. We are also publishing open source libraries which we have used for development of our commercial applications and we did some modifications.

View as: Public
You are viewing the README and pinned repositories as a public user.

Top discussions this past month

Discussions are for sharing announcements, creating conversation in your community, answering questions, and more.

[Start a new discussion](#)

People

View all

Top languages

C++ Python C# C HTML

<https://github.com/Dlubal-Software>





A simple example using WebServices

The image shows a dual-pane window. The left pane is a code editor with a Python script for a simulation. The right pane is a 3D model viewer showing a mechanical part with a red arrow indicating a force or displacement.

```

1 from NEMO_UtilsModel import Model, Calculate_all
2 from NEMO_BasicObject.material import Material
3 from NEMO_BasicObject.section import Section
4 from NEMO_BasicObject.mesh import Member
5 from NEMO_TypeOfMesh.NodesSupport import NodesSupport
6 from NEMO_vmem import ModelSupportType, ModelSupportType, CaseObject
7 from NEMO_LoadCaseAndConditions.StaticAnalysisSettings import StaticAnalysisSettings
8 from NEMO_LoadCaseAndConditions.LoadCase import LoadCase
9 from NEMO_LoadAndMesh import MeshList
10 from NEMO_Result.ResultTable import ResultTable
11 import json
12
13 sectionList = ["FE 00", "FE 100", "FE 120", "FE 140", "FE 160", "FE 180",
14              "FE 200", "FE 220", "FE 240", "FE 260", "FE 280", "FE 300",
15              "FE 320", "FE 340", "FE 360", "FE 380", "FE 400", "FE 420", "FE 440", "FE 460", "FE 480"]
16
17 Node(["Free", "Stochastic"])
18
19 resultDict = {}
20
21 for section in sectionList:
22     Node(1,0,0,0)
23     Node(1,0,0,0)
24     Node(1,5,0,0)
25
26 Material(1, "S10")
27
28 Section(1, section, 1)
29
30 Member(1, 1, 2, 0, 1, 1)
31
32 ModelSupport(1, 1, ModelSupportType.FEMO)
33
34 StaticAnalysisSettings()
35
36 loadCase(1, "LOAD", [False])
37
38 MeshList(1, 1, 2, ModelLoadDirection.LOAD_DIRECTION_BOTTOM_OF_USER_DEFINED, 1000)
39
40 Calculate_all()
41
42 deformationResult = ResultTable.ResultTableFormatList(CaseObject.CASE_OBJECT_TYPE_LOAD_CASE, 1, 2)
43
44 resultDict[section] = deformationResult[0] * displacement_absolute * 1000
45
46 ModelClassModel.service.delete_all()
47
48 import json
49 with open("results.json", "w") as fp:
50     json.dump(resultDict, fp)
    
```

The 3D model viewer shows a mechanical part with a red arrow indicating a force or displacement. The interface includes a 'Navigator - Datas' panel on the left and a 'Material' table at the bottom right.

Material	Name des Materials	Menge	Materialtyp	Elementarzählung	Schubmodul	Querdehnung	Spez. Gewicht	Dichte	Wärmeleitfähigkeit	Extensiv	Komponente
1	S10	1000	Stahl	100000	0.7981	0.000	7.850	193000	1000000		
2											
3											
4											

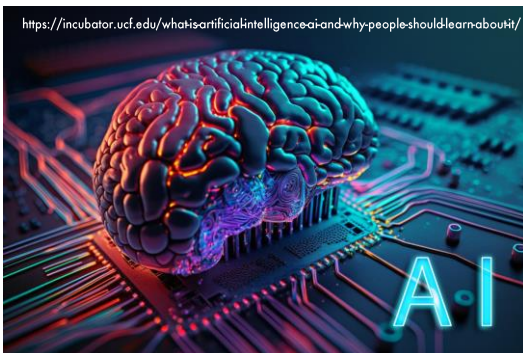


What is Artificial Intelligence (AI)

Expectation

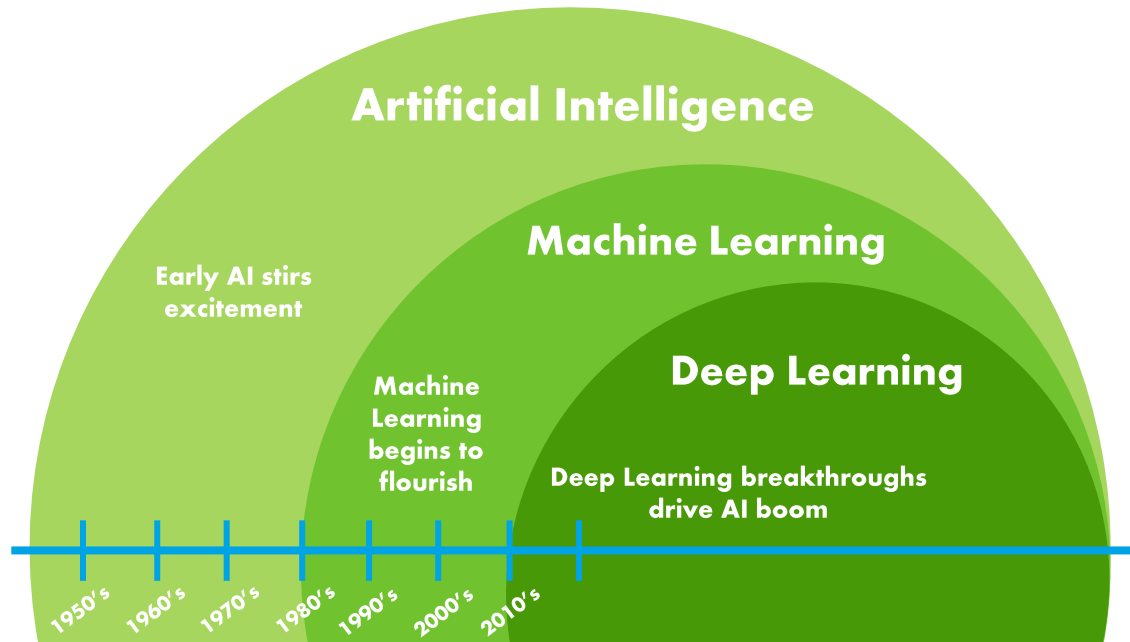
vs.

Reality





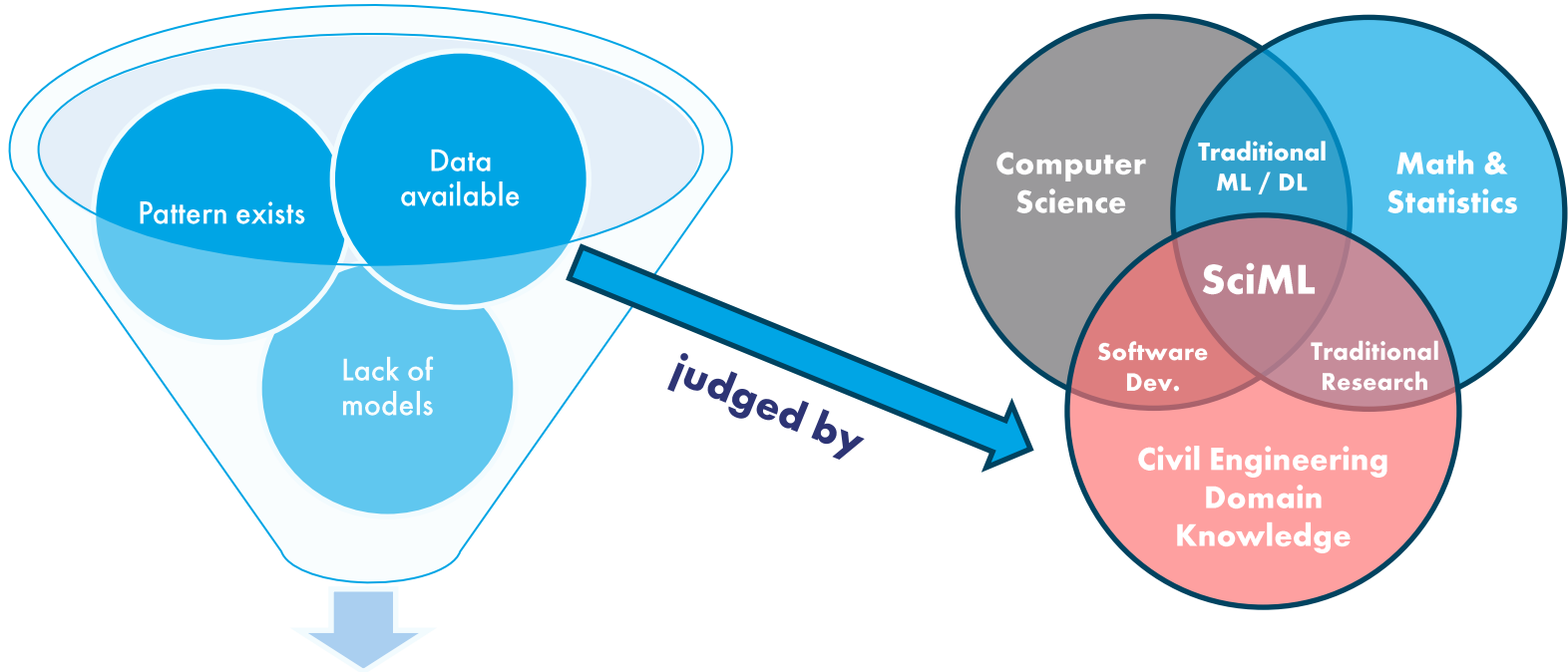
What is Artificial Intelligence (AI)



after: https://miro.medium.com/max/639/1*U0-H9Af2FT-DK0nnHhaoJQ.png



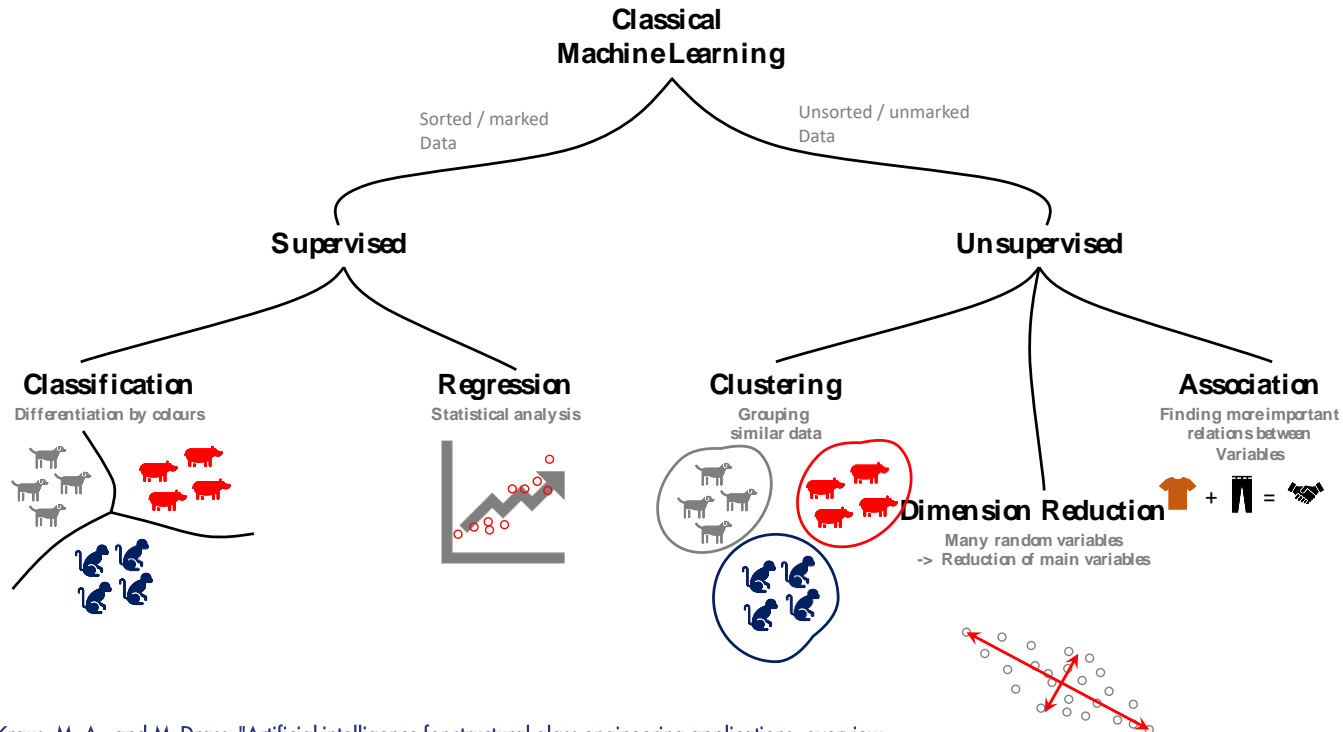
Ingredients of Artificial Intelligence (AI)



Necessary components for an AI implementation

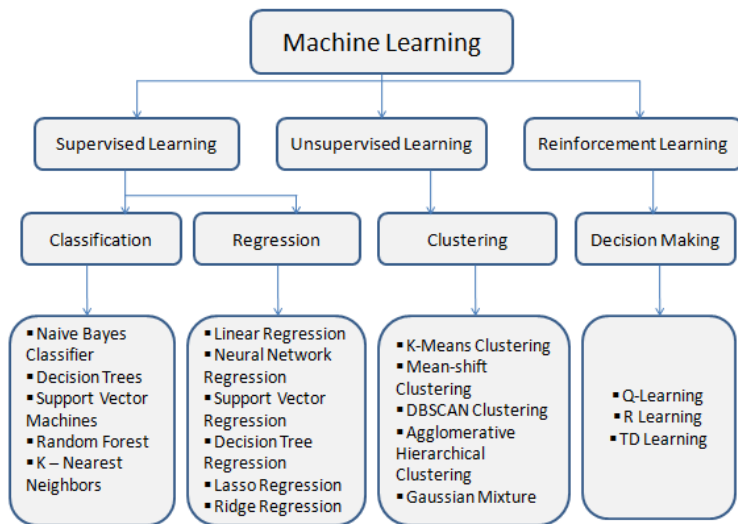


Types of Machine Learning (ML)

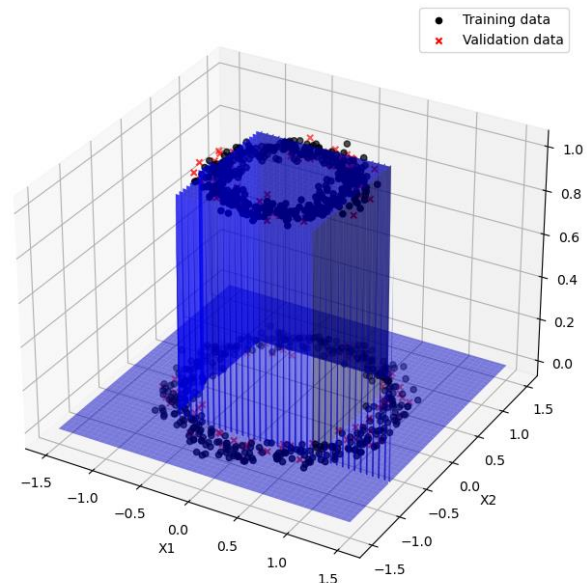




Machine Learning (ML)



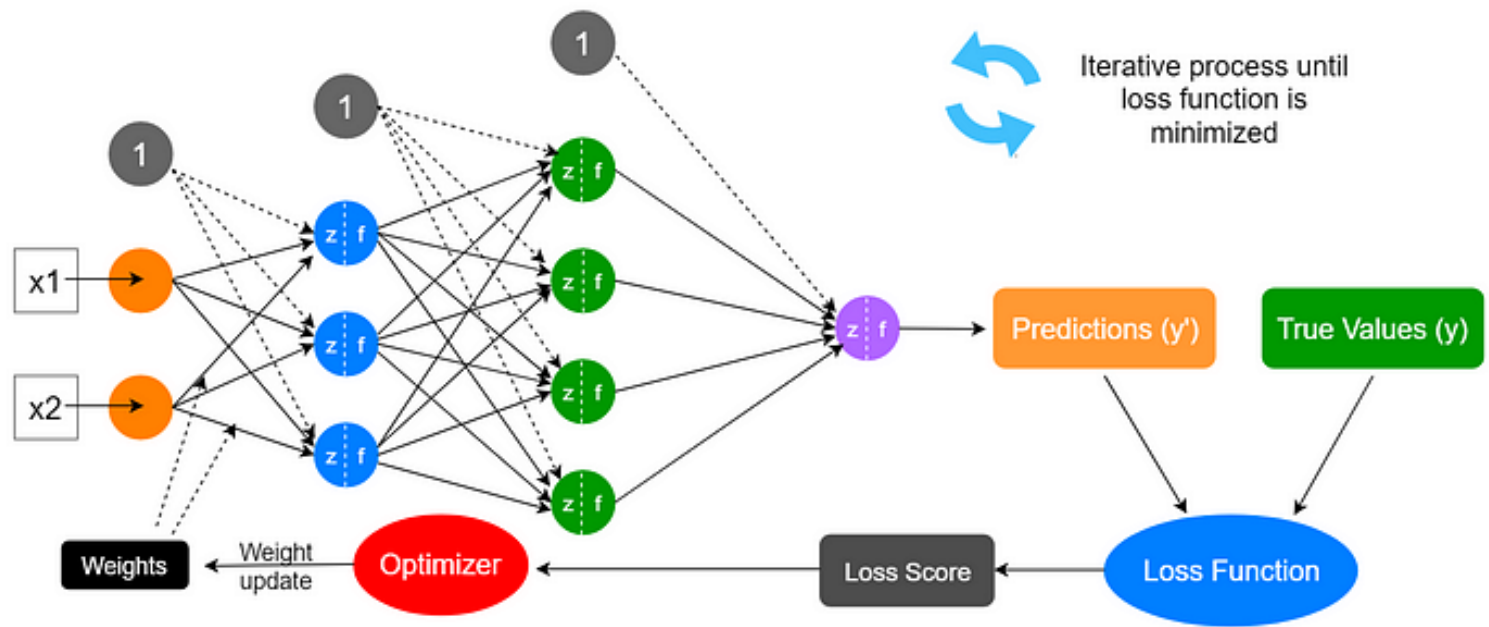
3D Decision Tree Classifier Decision Boundaries



<https://www.analyticsvidhya.com/blog/2021/03/everything-you-need-to-know-about-machine-learning/>



Deep Learning (DL) and Neural Networks

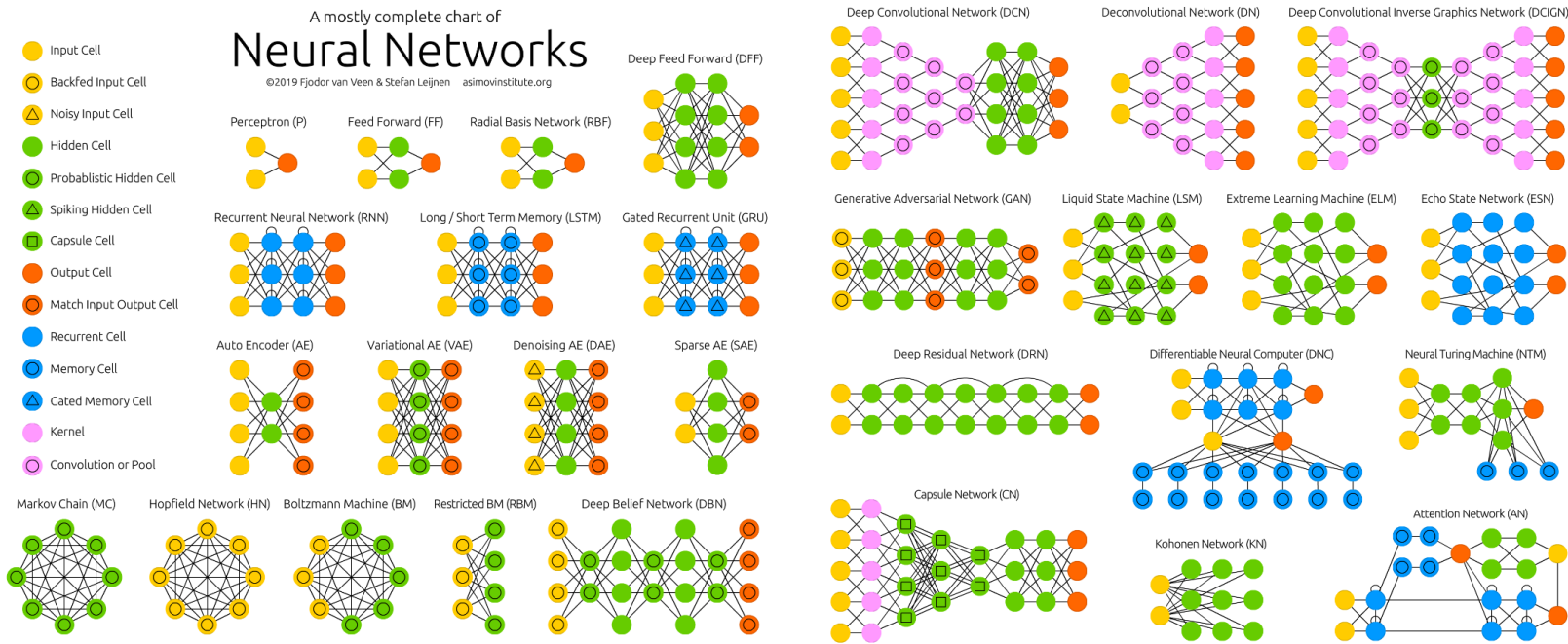


<https://medium.com/data-science-365/overview-of-a-neural-networks-learning-process-61690a502fa>





Deep Learning (DL) and Neural Networks



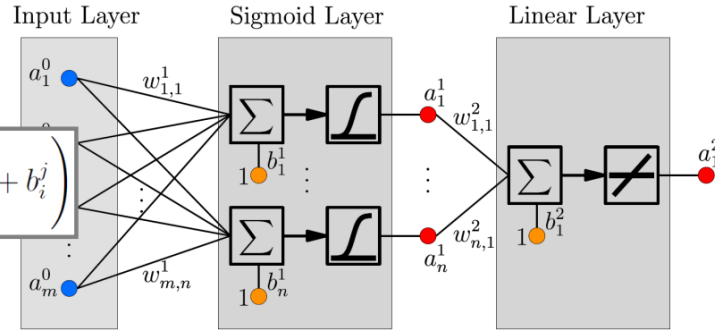
<https://www.asimovinstitute.org/neural-network-zoo/>



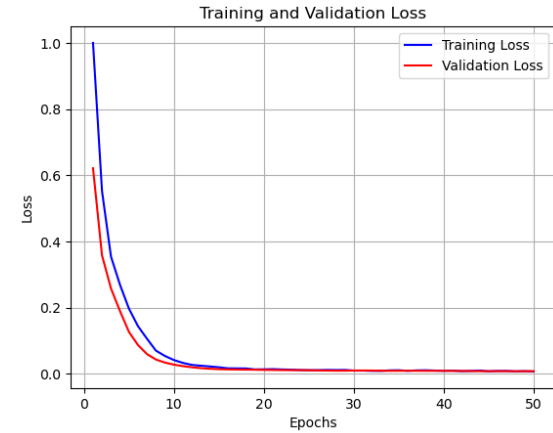
Deep Learning (DL) and Neural Networks

Feedforward Networks

$$a_i^j = f_i^j(x) = f \left(\sum_{k=1}^m w_{k,i}^j a_k^{j-1} + b_i^j \right)$$



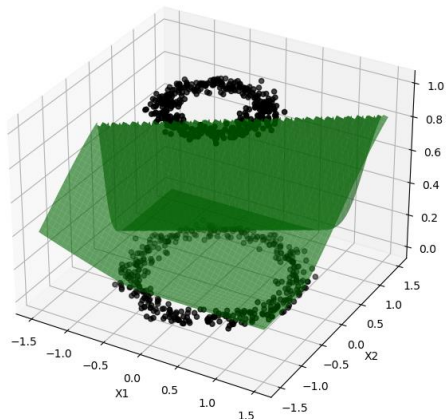
- Output and hidden layer consist of linear or nonlinear neurons
- Feedforward network with only linear neurons is a linear regression!
- Training by minimizing the sum of squared errors in a training data set
- Early stopping to avoid overfitting



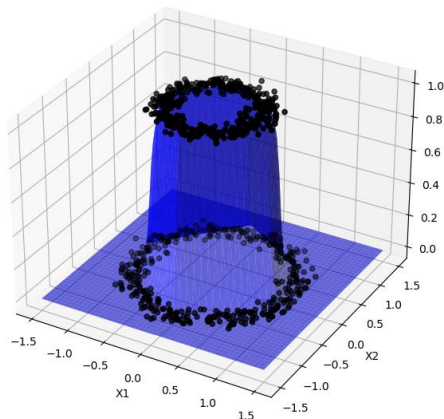


Deep Learning (DL) and Neural Networks

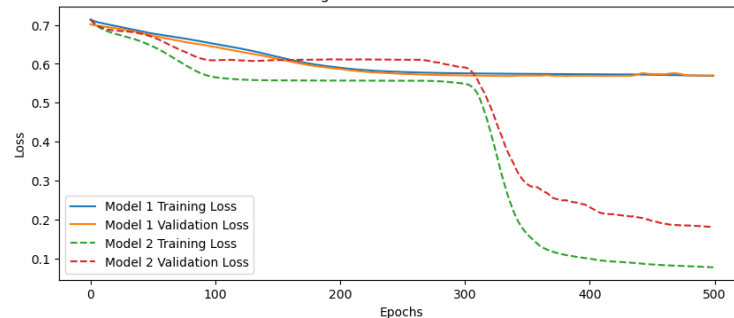
1 hidden layer, 4 neurons



2 hidden layers, 4 neurons



Training and Validation Loss Curves

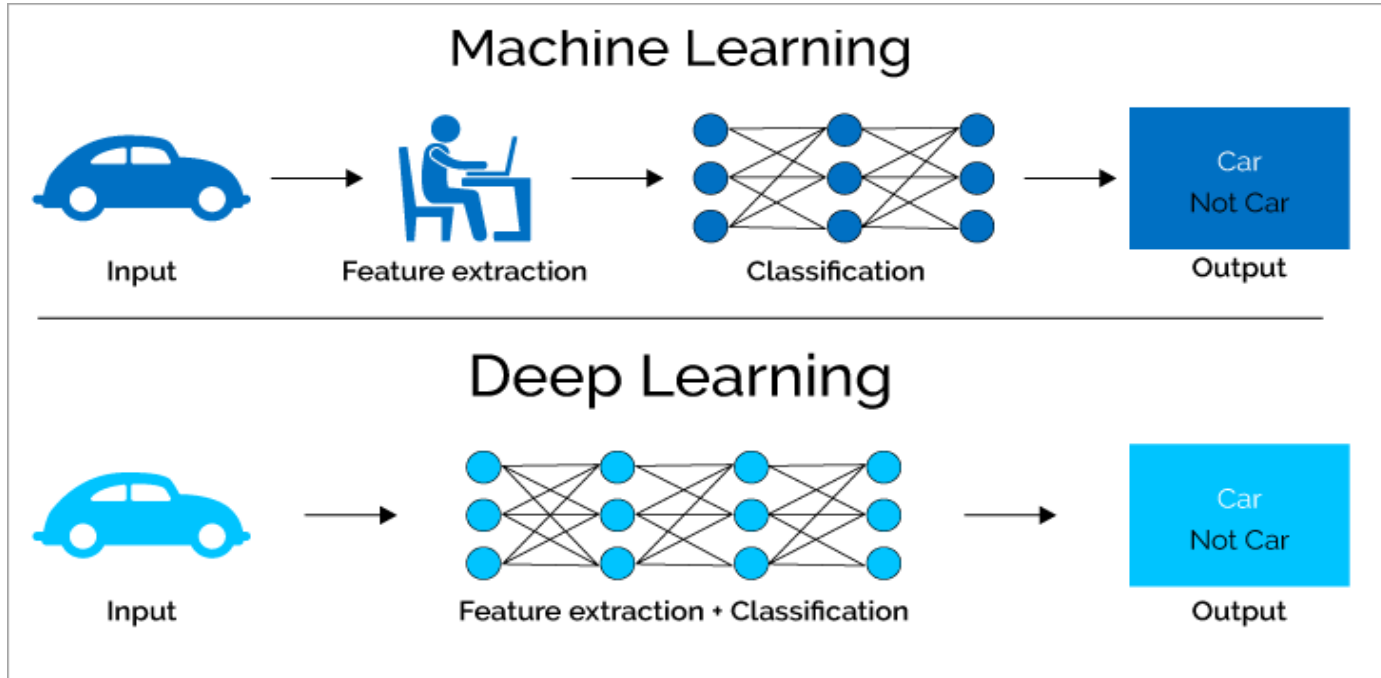


- Neural Networks are function approximators
- Interactions can be represented better with more hidden layers
- Deep network architecture typically improve regression quality





Difference of Machine and Deep Learning

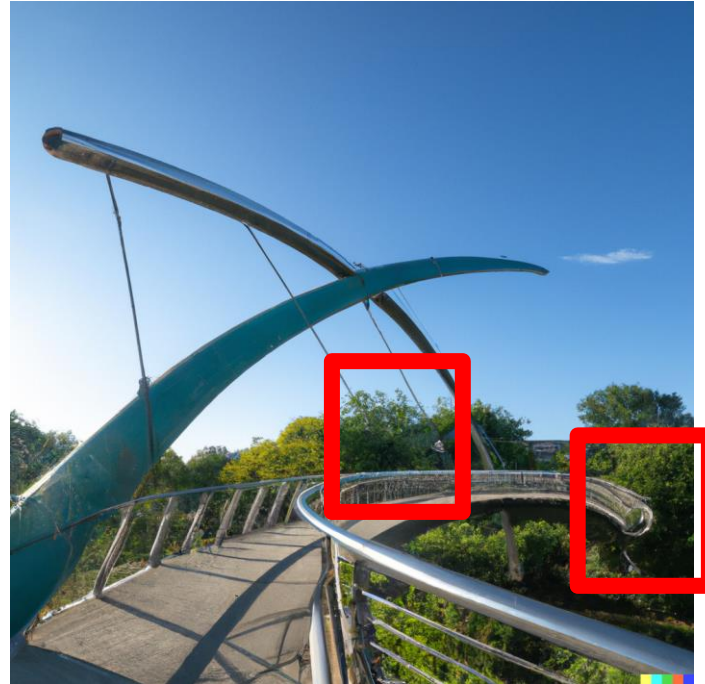


<https://cdn.softwaretestinghelp.com/wp-content/qa/uploads/2019/04/DeepLearning.png>



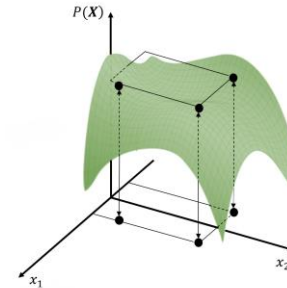
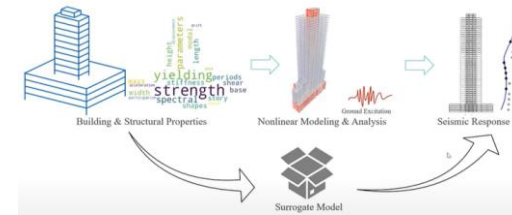
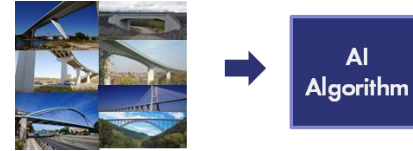
Why should Civil Engineers dive into AI/ML/DL?

What DALLE2 imagines a “*sustainable concrete bridge over a river*”



When should Civil Engineers use ML/DL?

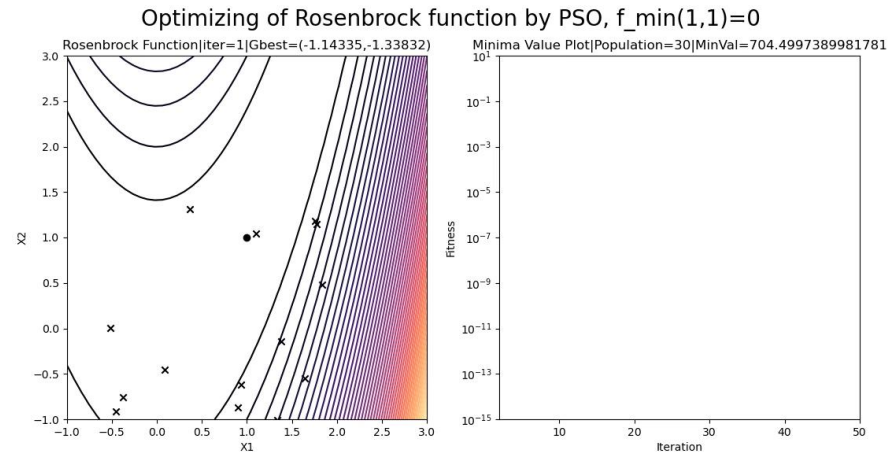
- if you are going to use an empirical model anyway
- when your “physics-based” model is “incomplete”
- if you want to mine existing databases for structure
- if it saves time (i.e. surrogate modelling & optimization)





Optimization Tool – Background PSO

- an AI technique used to find approximate solutions to extremely difficult or impossible numeric maximization and minimization problems.
- proposed in 1995 by Kennedy and Eberhart [22]
- based on the simulating of social behavior
- algorithm uses a swarm of particles to guide its search
- each particle has a position and velocity
- each particle is influenced by locally and globally best-found solutions.





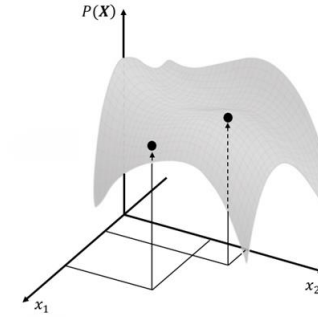
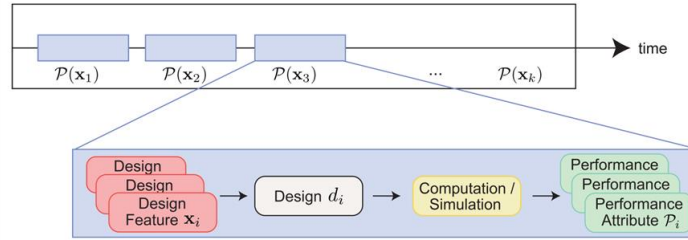
Optimization Tool

The screenshot displays the Dlubal RSTAB software interface. The main window shows a 2D truss structure with a total length of 30,000 units and a height of 1,500 units. The structure consists of a bottom chord, a top chord, and vertical members, with diagonal bracing in the interior bays. The bottom chord is divided into five equal segments of 6,000 units each. A coordinate system (X, Y, Z) is shown at the bottom left of the structure. The software interface includes a menu bar (File, Edit, View, Insert, Assign, Calculate, Results, Tools, Options, Window, CAD-BM, Help), a toolbar, and a Navigator - Data panel on the left. The Navigator panel shows a tree view of the model's data, including Basic Objects (Materials, Sections, Nodes, Members, Member Sets), Special Objects, Types for Nodes/Members, Imperfections, Load Cases & Combinations, Loads, Results, and Guide Objects. An Optimization tool window is open at the bottom, featuring a 'Go To' menu, 'Edit', 'Selection', 'View', and 'Settings' options. The tool has a tab labeled 'Optimization' and a large blue button labeled 'OPTIM Optimize'. A text input field is visible to the right of the button. The status bar at the bottom indicates 'Optimized Values'.



Optimization Tool – Future Development

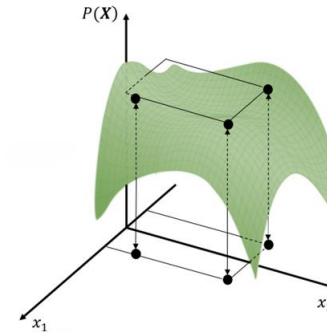
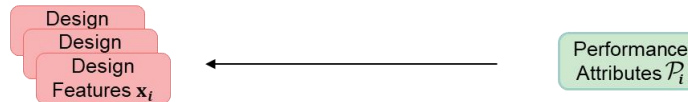
State-of-the-art



Forward Design



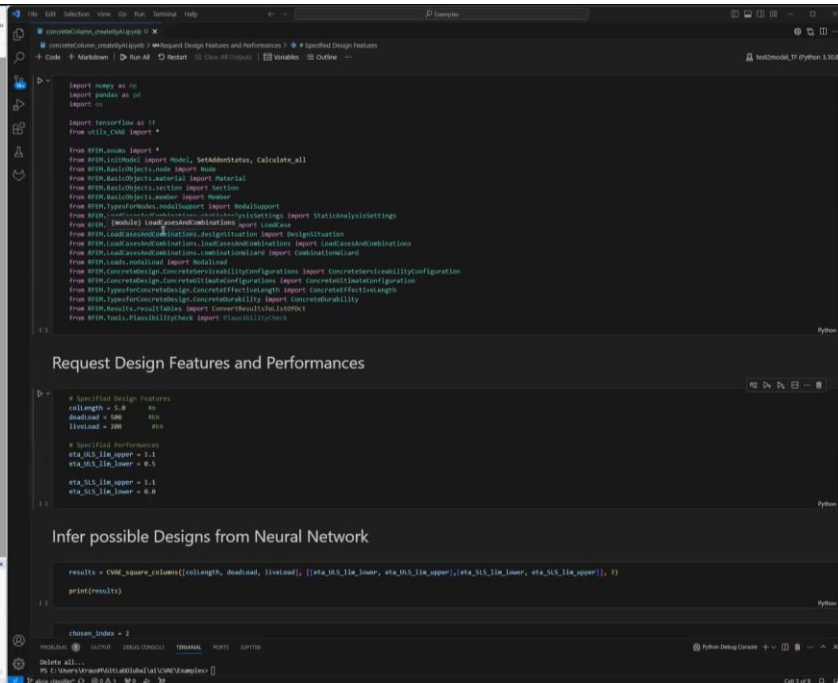
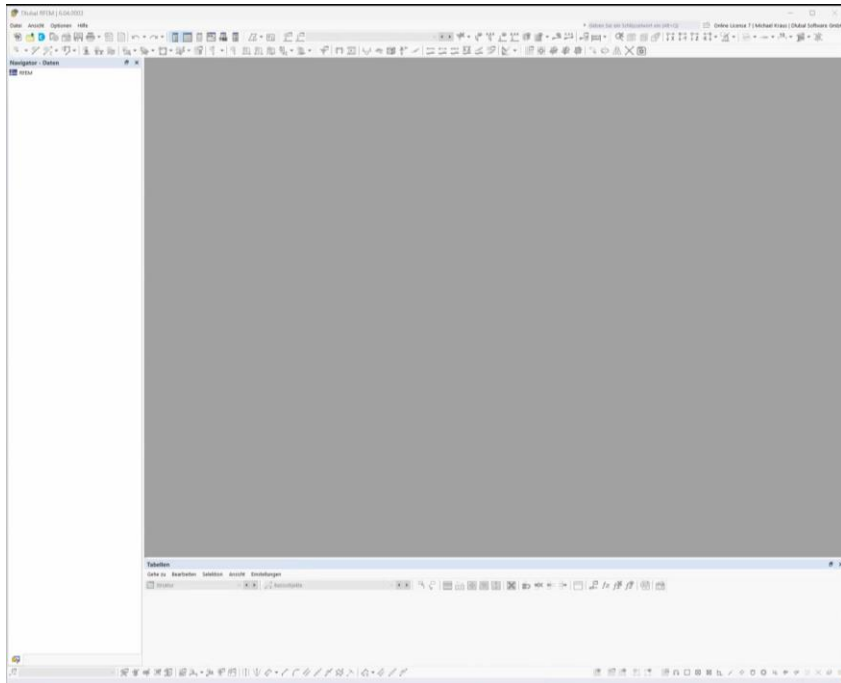
Design
Meta-Models



Inverse Design



Optimization Tool – Future Development





Help ChatBot



The screenshot displays the Dlubal RFEM 6.03.0008 software interface. The main window shows a 3D structural model of a roof truss system. On the right, a chatbot window titled "RFEM 6 Help ChatBot" is open, showing a conversation with the user. The chatbot has responded with suggestions for excluding specific load combinations (COs) in the design add-on.

Chatbot Conversation:

User: Hello there! How may I assist you today?

ChatBot: Hello there! How may I assist you today?

User: How do I exclude specific load combinations (COs) in the design add-on?

ChatBot: As an AI language model, I can suggest the following methods:

- In the Load Combinations tab, select the load combinations (COs) to be excluded and then uncheck the "To Solve" option.
- Alternatively, the COs or RCs (result combinations) can be excluded in the table of the design add-on.
- Also another possible way is...

Buttons: Stop generating...

Input field: Ask me anything...

Material Properties Table:

Material No.	Material Name	Material Type	Material Model	Modulus of Elast. E [N/mm ²]	Shear Modulus G [N/mm ²]	Poisson's Ratio ν [-]	Specific Weight γ [N/m ³]	Mass Density ρ [kg/m ³]	Coeff. of Th. Exp. α [1/°C]	Options	Comment
1	STEEL	Steel	SuStress / Linear - Elastic	210000.0	80782.0	0.300	78.50	7850.00	1.200012		
2											
3											
4											
5											
6											
7											
8											
9											
10											



Help ChatBot

- generative AI based chat bot
- grounded in FAQ, knowledge base and manuals
- will be used on the website and within the programs



Dlubal GPT
Dlubal's RFEM 6 expert
By Dlubal Software GmbH

How do I use the RFEM6 interface?

Where can I find more info about RFEM5?

Can you explain a feature in RSTAB9?

Help with a specific problem in RFEM6?

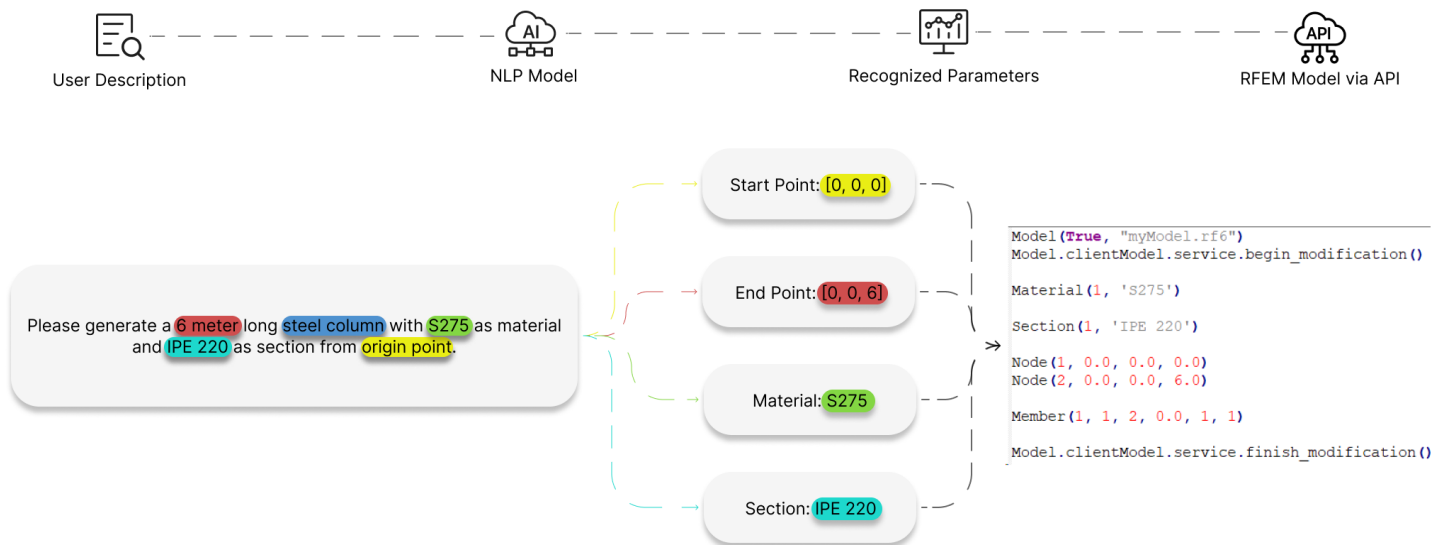
 Message Dlubal GPT...

I



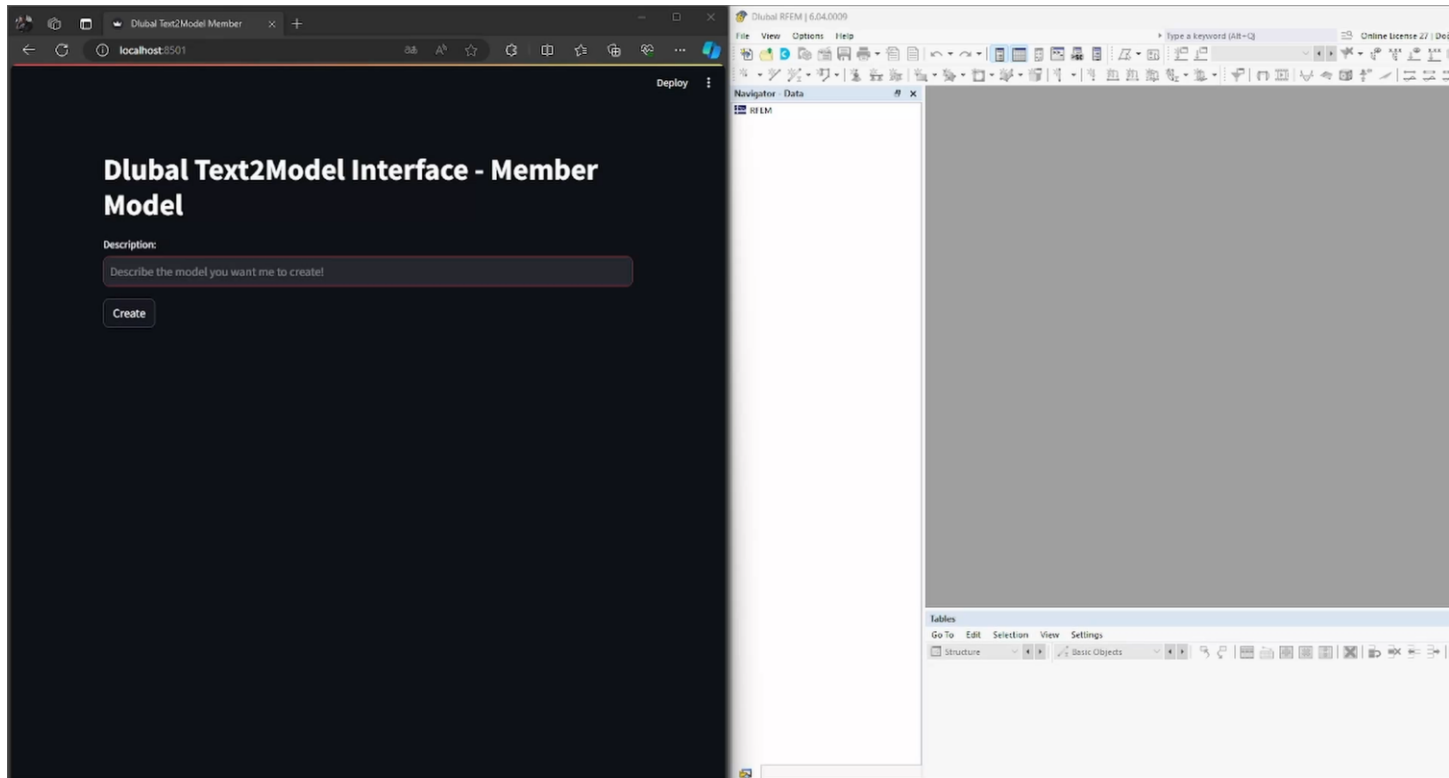


Entity Recognition for Text2Model Interface





Entity Recognition for Text2Model Interface





Roadmap



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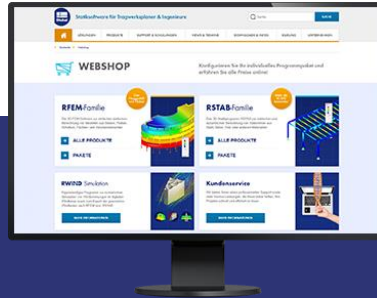
Youtube Channel - Webinars, Videos

Videos and webinars about the structural engineering software.



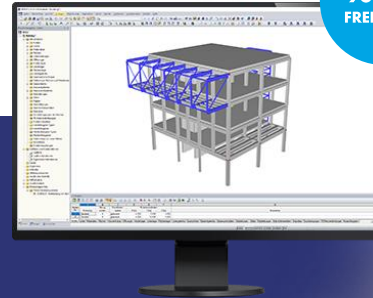
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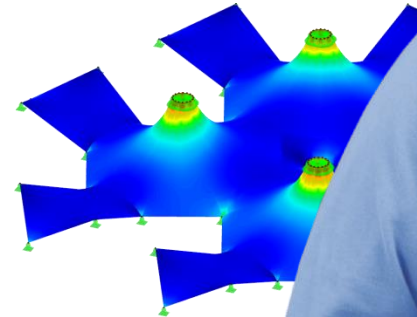
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