



# Software für Statik und Dynamik

[www.dlubal.com](http://www.dlubal.com)



**Dipl.-Ing. (FH) Andreas Hörold**  
Organisator

Marketing & Public Relations  
Dlupal Software GmbH



**Ing. Doğukan Karataş, M.Sc.**  
Co-Organisator

Product Engineering  
Dlupal Software GmbH

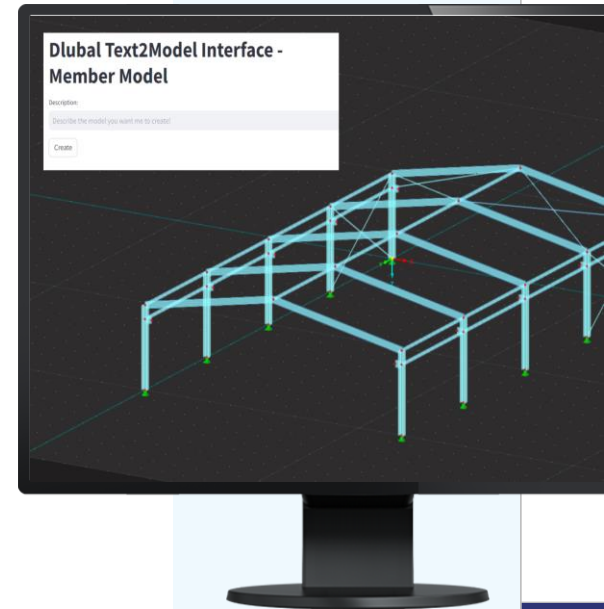


**Dr.-Ing. Michael Kraus**  
Co-Organisator

AI, ML, DL Specialist  
Dlupal Software GmbH

Webinar

# Integration von KI mittels API in RFEM



# Fragen während der Präsentation



GoToTraining-Bedienpanel  
Desktop



E-Mail: [info@dlubal.com](mailto:info@dlubal.com)



**Bedienpanel ein- oder ausblenden**

**Audioeinstellungen anpassen**

**Fragen stellen**

Audio

Sound Check ?

Computer-Audio  
 Telefonanruf

**STUMMGESCHALTET**

Mikrofon (Plantronics C310)

Lautsprecher (Plantronics C310)

**Sprecher:** Andreas Hörold

Fragen

[Frage an Mitarbeiter eingeben]

Senden

Webinar-ID: 109-458-163

GoToWebinar



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01 Was ist eine API? Was sind Webservices?

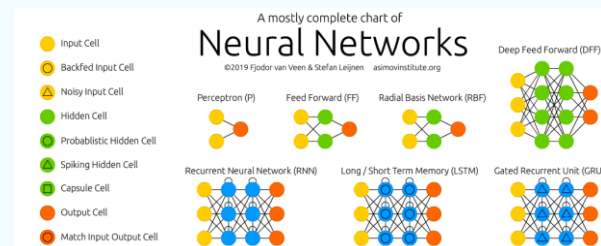
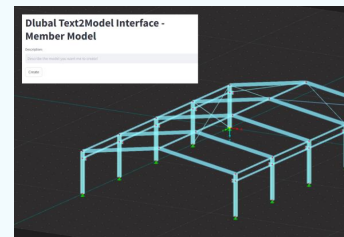
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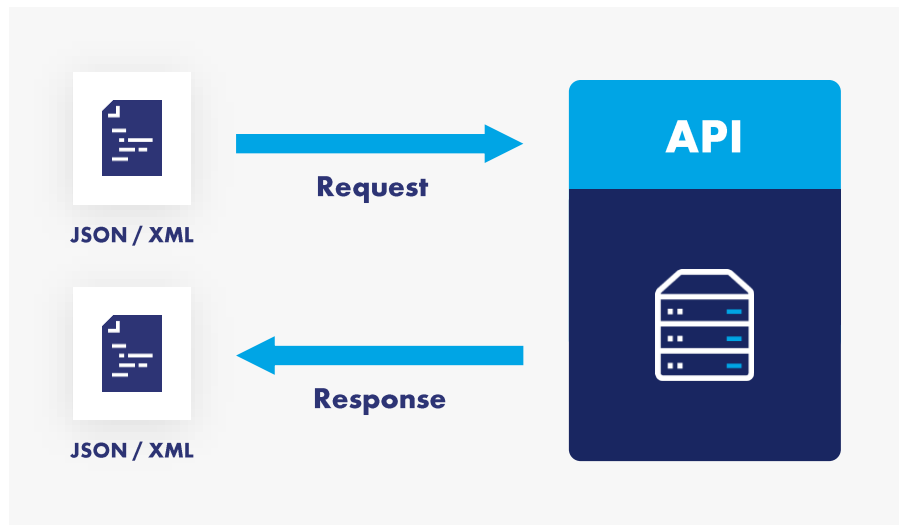
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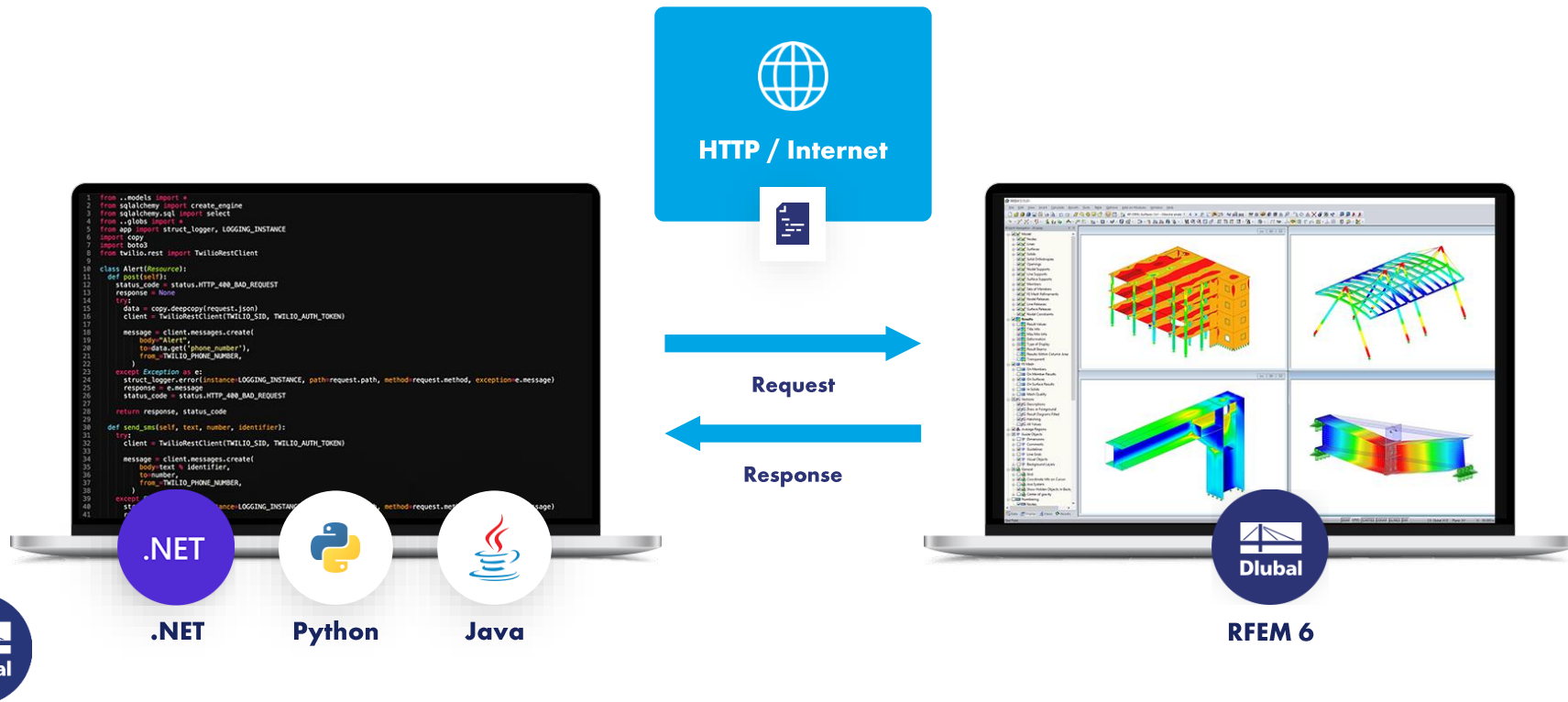


# Was ist eine API?





# Was sind Webservices?





# Das Dlubal github repository

The screenshot shows the GitHub profile for Dlubal-Software. The profile includes a blue square logo with a white bridge structure and the word "Dlubal". The name "Dlubal Software" is displayed, along with the description "Structural Analysis and Design Software | RFEM | RSTAB". Below this, there are statistics for 61 followers, location in Prague, website URL, and social media handles. A "Verified" badge is also present. The main content area shows a README file with the title "Dlubal Software GmbH" and a large circular logo. Below the logo are social media links for GitHub, LinkedIn, Instagram, and the website. There are also badges for "RFEM v6.0", "RSTAB v9.0", and "RSECTION v1.0". The "Welcome" section contains a message about open source libraries. On the right side, there are sections for "View as: Public", "Top discussions this past month", "People" (a grid of user avatars), and "Top languages" (C++, Python, C#, C, HTML).

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





# Einfaches Beispiel zur Nutzung der Webservices

The image shows a dual-pane window. The left pane is a code editor with the following Python code:

```

columnar.py
1 from HFM.InitModel import Model, Calculate_all
2 from HFM.BasicObject.made import Made
3 from HFM.BasicObject.material import Material
4 from HFM.BasicObject.section import Section
5 from HFM.BasicObject.support import Member
6 from HFM.TypeOfMember.made import MemberType
7 from HFM.TypeOfMember.made import MemberSupport
8 from HFM.TypeOfMember.made import MemberSupportType, MemberSupportDirection, CheckObjectType
9 from HFM.LoadCaseAndConditions.staticAnalysisSettings import StaticAnalysisSettings
10 from HFM.LoadCaseAndConditions.loadCase import LoadCase
11 from HFM.LoadAndModel import Model
12 from HFM.Result.ResultTable import ResultTable
13 import json
14
15 sectionList = ["SE 00", "SE 100", "SE 100", "SE 100", "SE 100", "SE 100",
16              "SE 100", "SE 200", "SE 200", "SE 200", "SE 100", "SE 100",
17              "SE 100", "SE 400", "SE 400", "SE 500", "SE 500", "SE 600"]
18
19 Model("New, 'columnar")
20 resultDict = {}
21
22 for section in sectionList:
23     Node(1,0,0,0)
24     Node(2,5,0,0)
25     Material(1, "S235")
26     Section(1, section, 1)
27     Member(1, 1, 2, 0, 1, 1)
28
29     MemberSupport(1, 1, MemberSupportType.FIXED)
30
31     StaticAnalysisSettings()
32
33     loadCase(1, "LO00", [False])
34
35     ModelDir(1, 1, 2, MemberSupportDirection.LOAD_DIRECTION_GLOBAL_Z_OR_USER_DEFINED_X, 1000)
36
37     Calculate_all()
38
39     deformationResult = ResultTable.ResultTableFormat(CheckObjectType.OBJECT_TYPE_LOAD_CASE, 1, 2)
40
41     resultDict[section] = deformationResult[0] * displacement_absolute * 1000
42
43     Model.closeModel.service.delete_all()
44
45 import json
46 with open("results.json", "w") as fp:
47     json.dump(resultDict, fp)
  
```

The right pane is a 3D model viewer showing a perspective view of a rectangular columnar structure. A red arrow points to the top surface of the column. The viewer includes a navigation toolbar and a materials table at the bottom.

Material	Name des Materials	Menge	Materialmodell	Elementarmodell	Querschnitt	Spez. Gewicht	Dichte	Wärmeleitfähigkeit	Elastizität	Kennwerte
1	S 235	1000	ELAS	100001	0.785	0.000	7850	16.000	2.10000	
2										
3										
4										



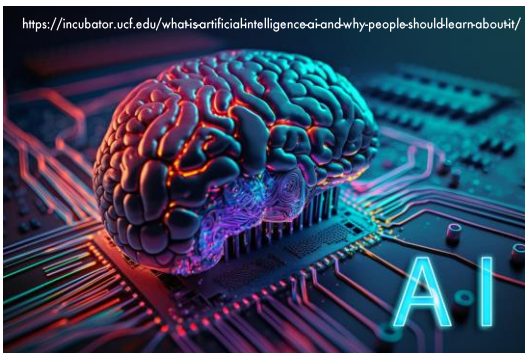


# Was ist Künstliche Intelligenz (KI)

“Populäre Darstellung”

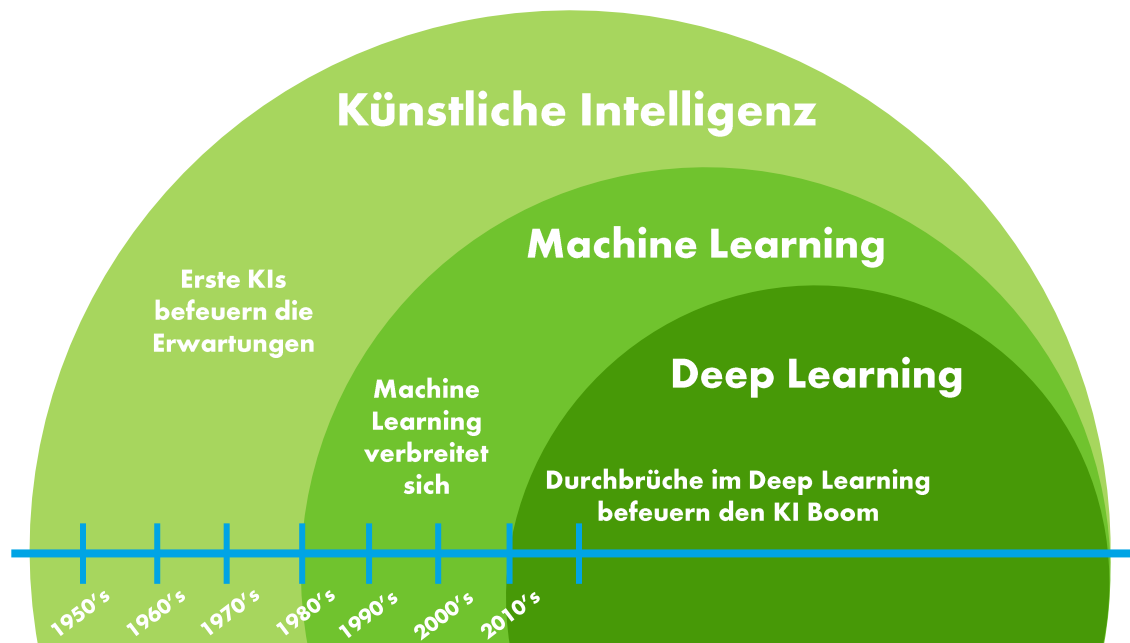
vs.

Realität



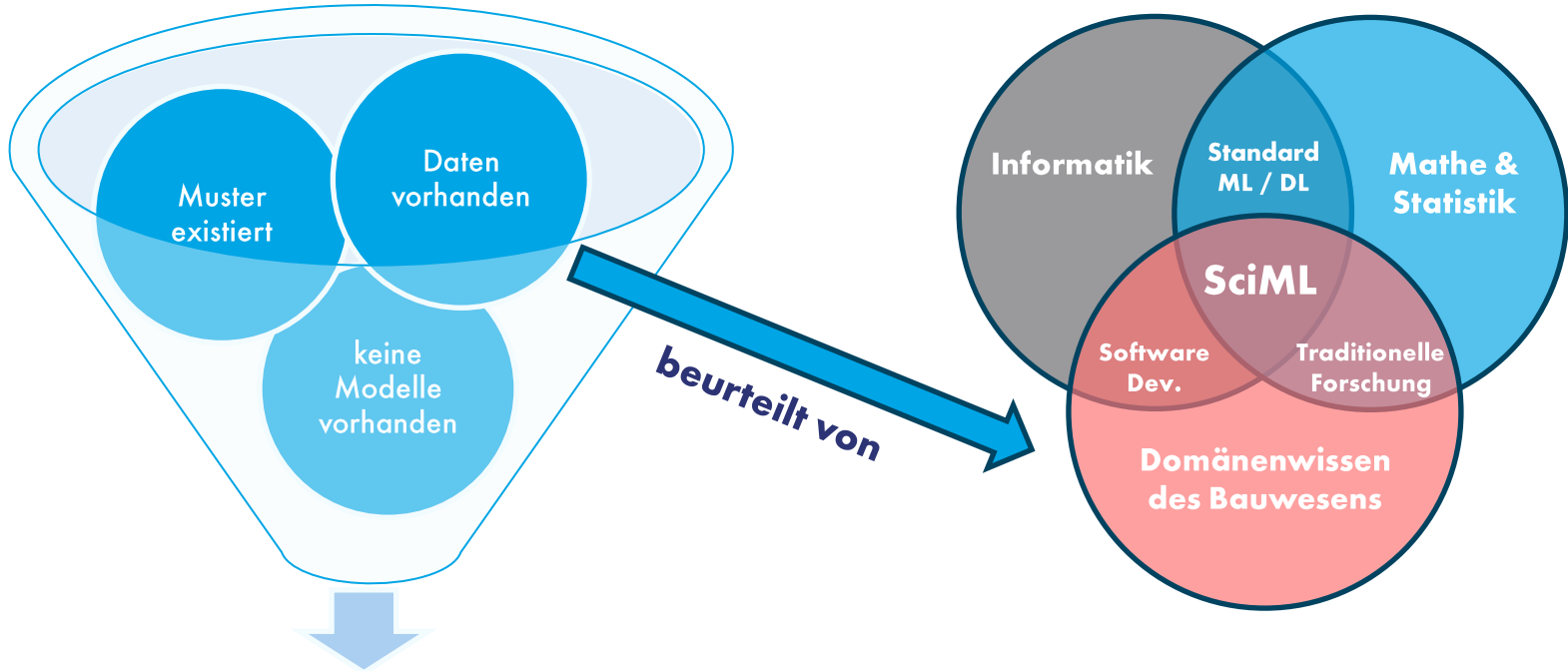


# Was ist Künstliche Intelligenz (KI)



Adaptiert nach: [https://miro.medium.com/max/639/1\\*U0H9Af2FT-DK0nnHhaoJQ.png](https://miro.medium.com/max/639/1*U0H9Af2FT-DK0nnHhaoJQ.png)

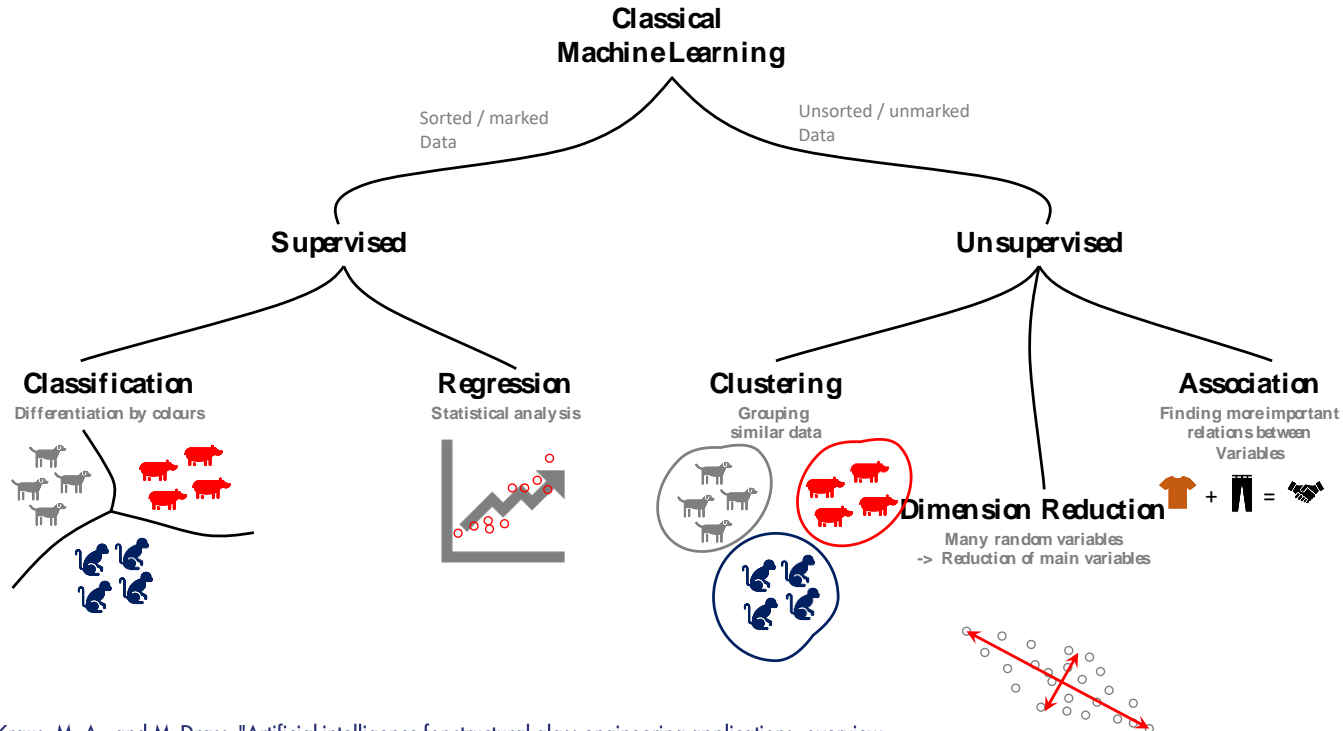
# Zutaten der Künstlichen Intelligenz (KI)



notwendige Voraussetzungen für  
den (sinnvollen) Einsatz von KI

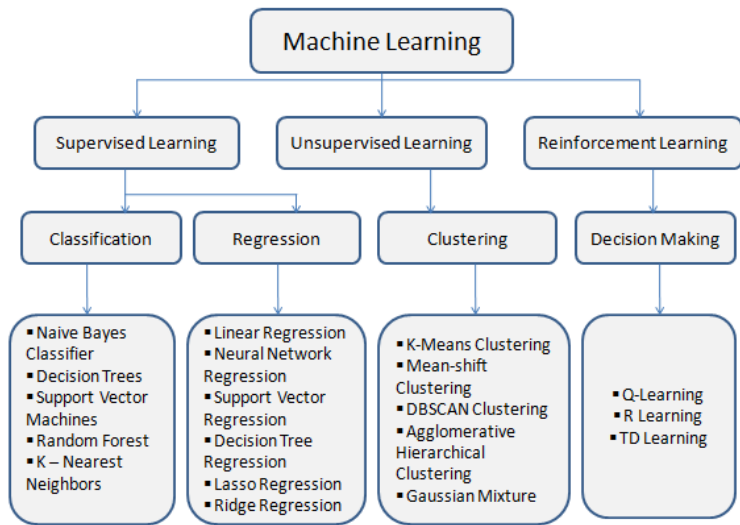


# Algorithmen des Machine Learning (ML)

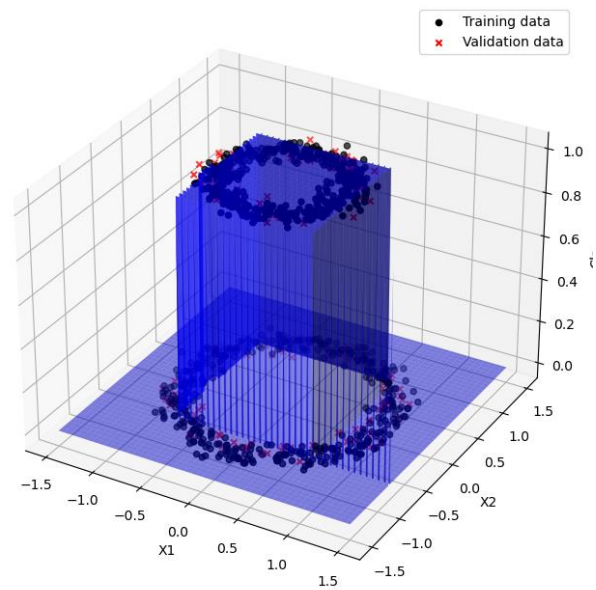




# Algorithmen des Machine Learning (ML)



3D Decision Tree Classifier Decision Boundaries

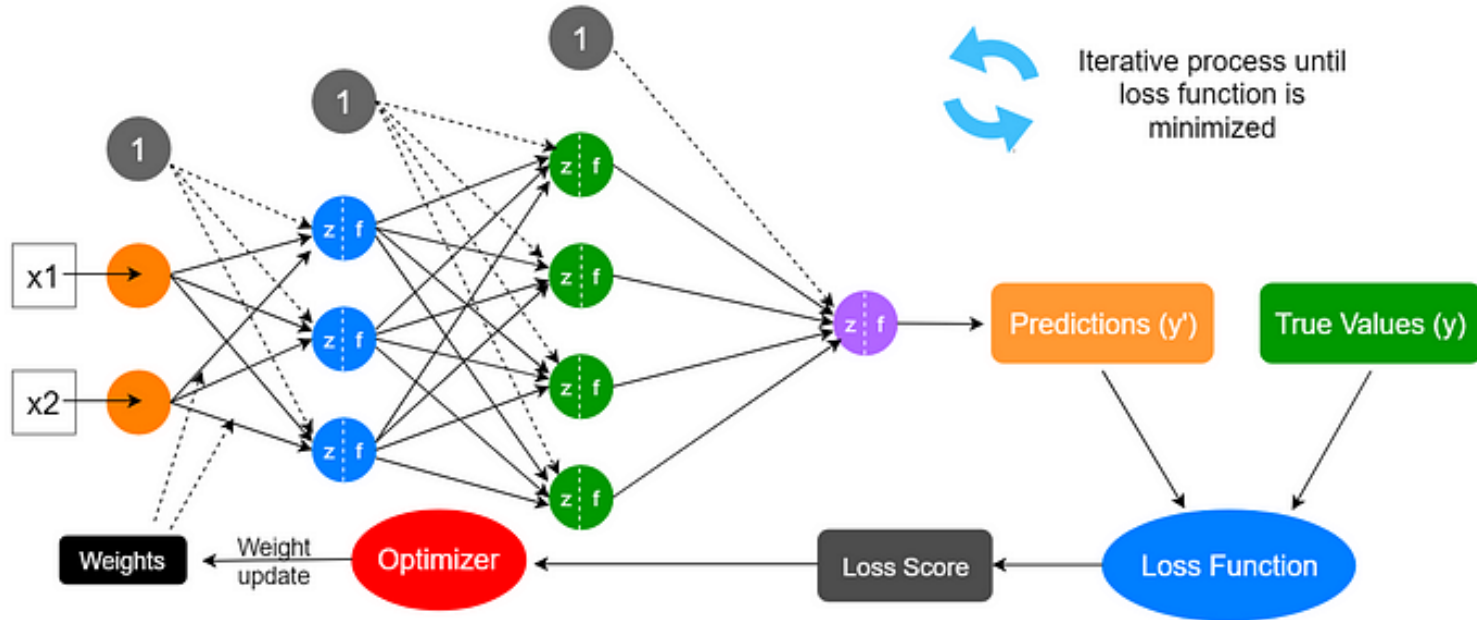


<https://www.analyticsvidhya.com/blog/2021/03/everything-you-need-to-know-about-machine-learning/>





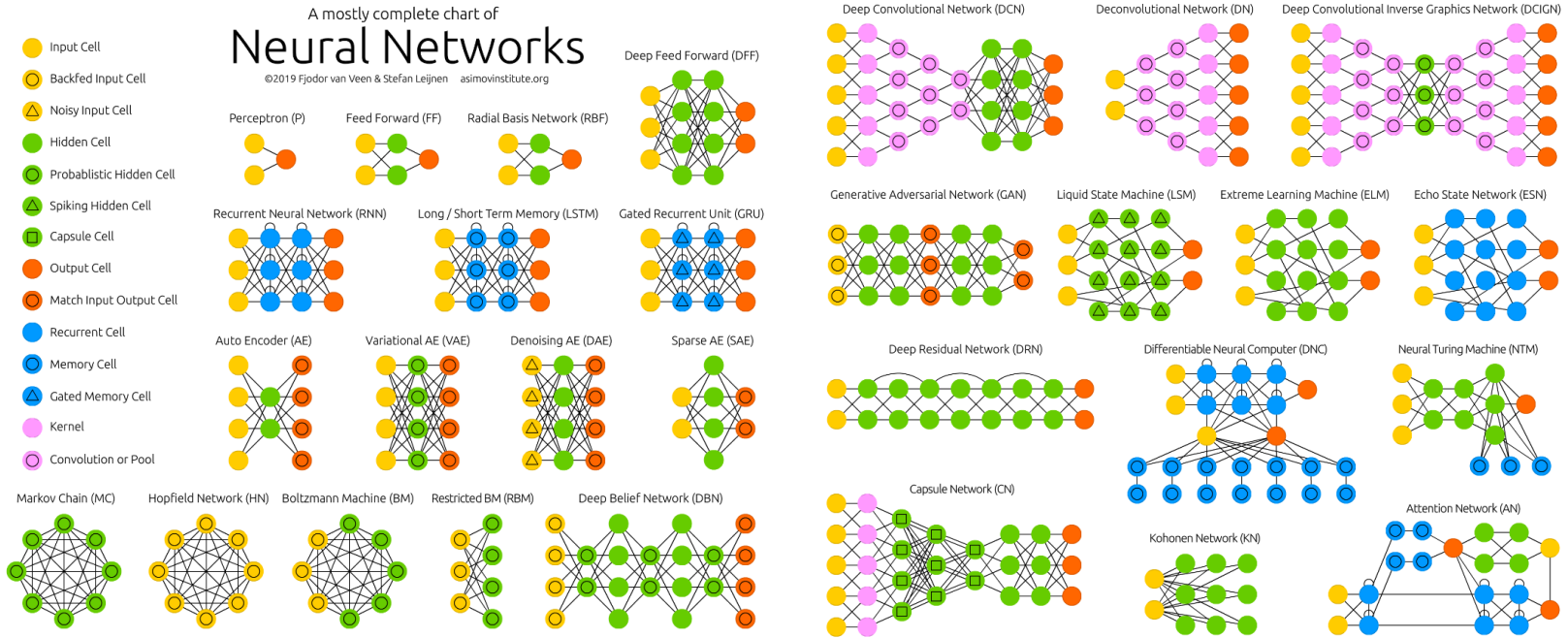
# Deep Learning (DL) und Neuronale Netze



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



# Deep Learning (DL) und Neuronale Netze



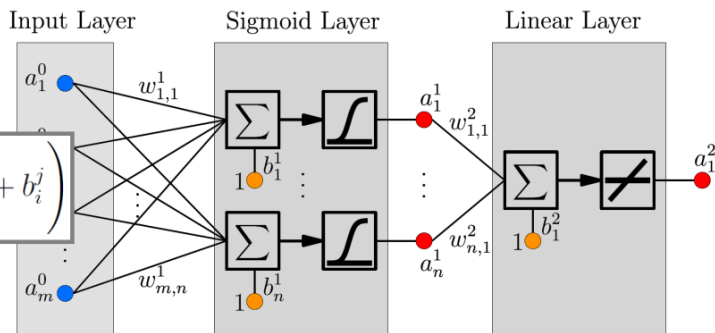
<https://www.asimovinstitute.org/neural-network-zoo/>



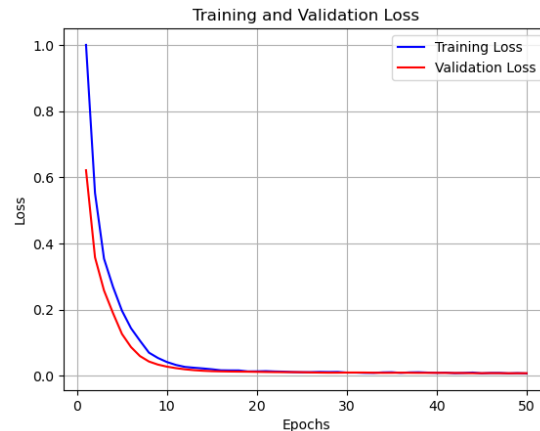
# Deep Learning (DL) und Neuronale Netze

## 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" und "hidden Layer bestehen aus linearen oder nichtlinearen Neuronen
- Feedforward-Netze mit ausschließlich linearen Neuronen sind lineare Regression!
- Training durch Minimierung eines Losses (z. B. Summe der Quadratefehler) auf einem Trainingsdatensatz
- "early stopping" um eine Überanpassung zu vermeiden

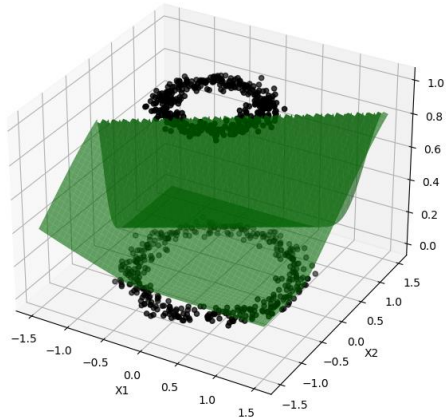




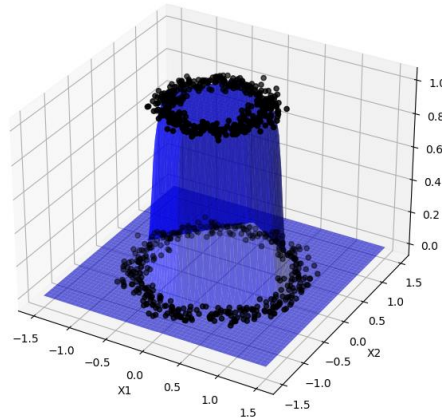


# Deep Learning (DL) und Neuronale Netze

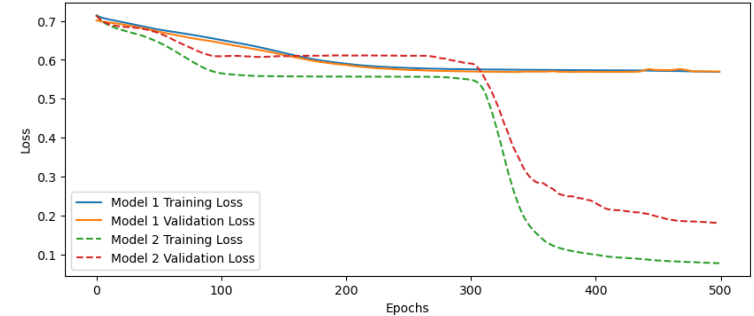
1 hidden layer, 4 neurons



2 hidden layers, 4 neurons



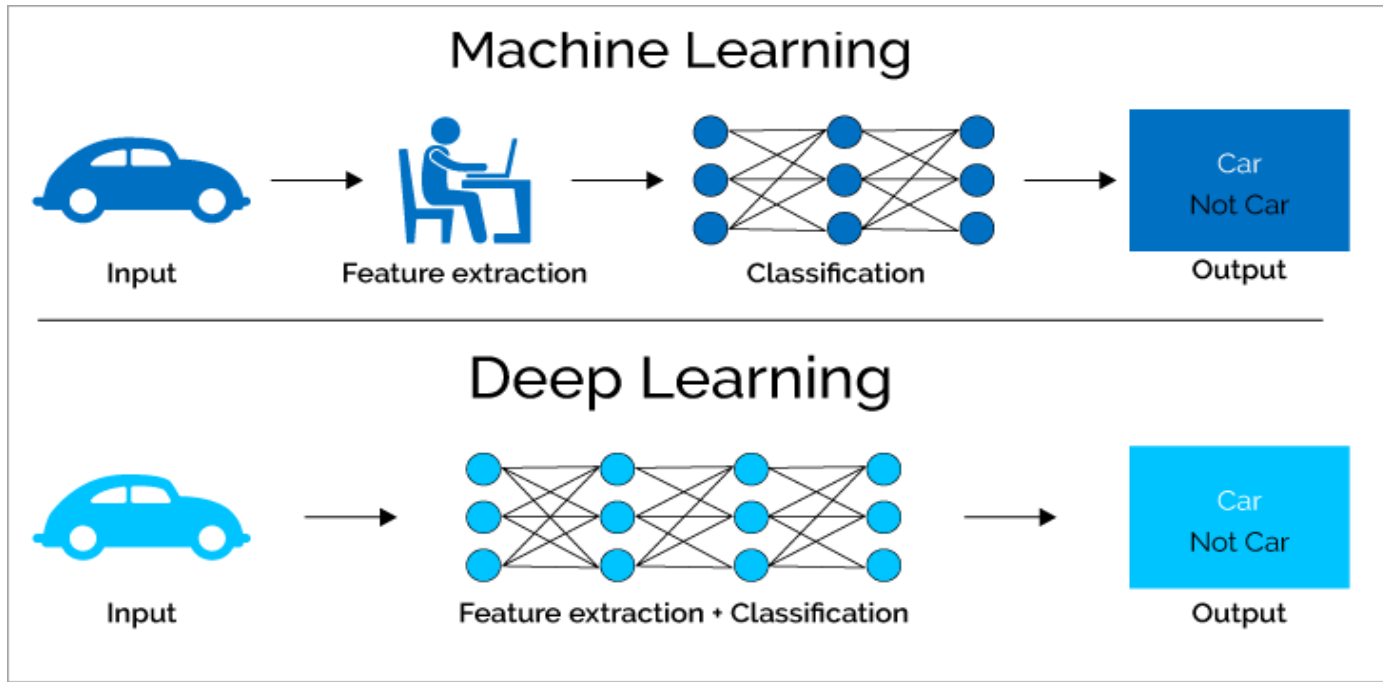
Training and Validation Loss Curves



- Neuronale Netze sind Funktionsapproximatoren
- Interaktionen können besser durch mehrere Layer abgebildet werden
- tiefe Neuronale Netze haben im Allgemeinen eine bessere Anpassungsqualität



# Unterschied von Machine und Deep Learning

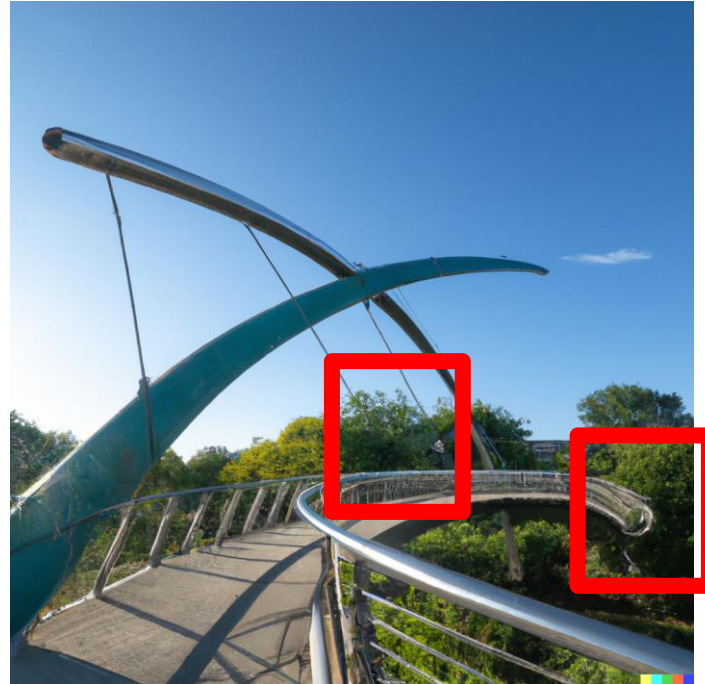


<https://cdn.softwaretestinghelp.com/wp-content/qa/uploads/2019/04/DeepLearning.png>



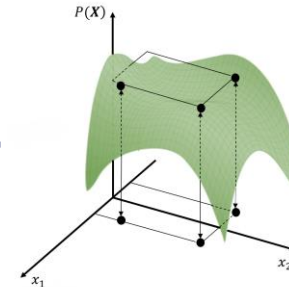
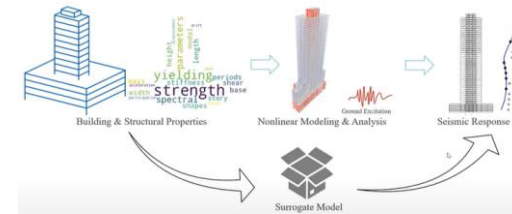
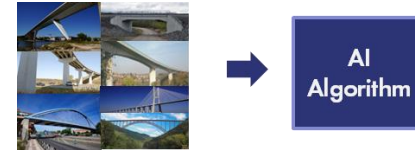
# Warum sollte sich das Bauwesen mit KI befassen?

Das versteht DallE2 unter einer “*nachhaltigen Betonbrücke über einen Fluss*”



# Wofür sollte KI im Bauwesen eingesetzt werden?

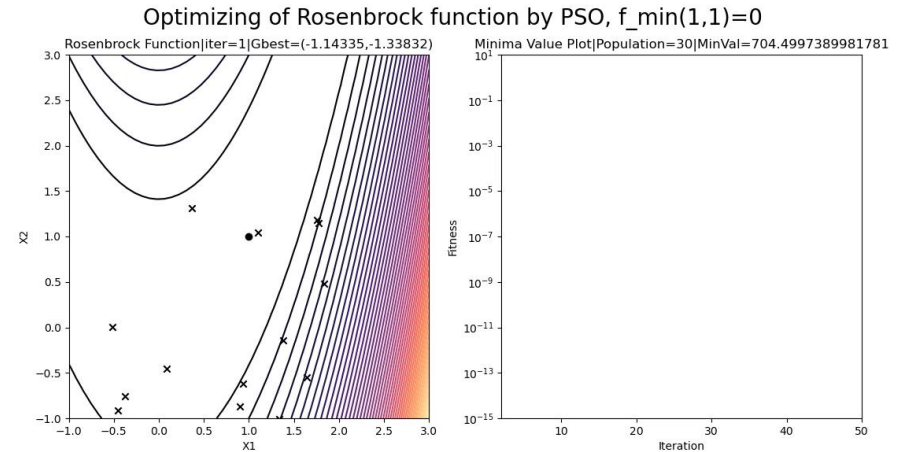
- wenn sowieso empirische Modell eingesetzt werden
- wenn das “physik-basierte” Model “unvollständig” ist
- zum Mining von Datenbanken
- zur Zeitersparnis (z. B. Meta- und Surrogat-Modelle & Optimierung)





# Optimierung – Hintergrund zur PSO

- eine KI-Technik zum Auffinden von Näherungslösungen für extrem schwierige numerische Maximierungs- und Minimierungsprobleme
- wurde 1995 von Kennedy und Eberhart vorgeschlagen
- basiert auf der Simulation von sozialem Verhalten
- der Algorithmus verwendet einen Schwarm von Partikeln, um seine Suche zu steuern
- jedes Teilchen hat eine Position und eine Geschwindigkeit - jedes Teilchen wird durch lokal und global beste Lösungen beeinflusst.





# Optimierungs-Tool in RFEM

The screenshot displays the RFEM software interface. The main window shows a 2D truss structure with a total length of 30,000 and a height of 1,500. The structure consists of a bottom chord, a top chord, and vertical members, with diagonal bracing in the interior bays. A coordinate system is shown at the bottom left with the X-axis pointing right and the Z-axis pointing down. The left sidebar contains a 'Navigator - Data' tree with the following structure:

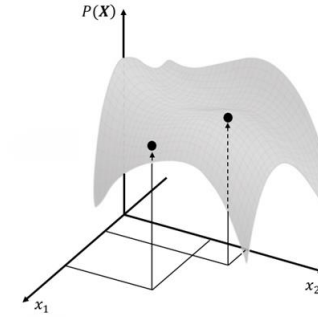
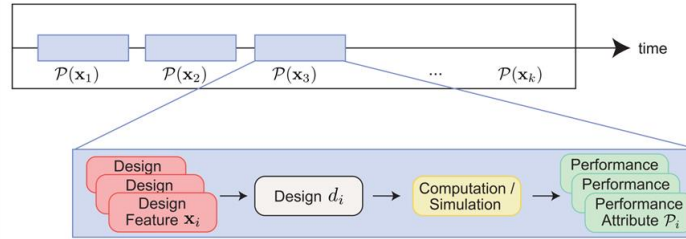
- RFEM
- Basic Objects
  - Materials
  - Sections
  - Nodes
  - Members
  - Member Sets
- Special Objects
- Types for Nodes
- Types for Members
- Types for Special Objects
- Imperfections
- Load Cases & Combinations
  - Load Cases
  - Actions
  - Design Situations
  - Action Combinations
  - Load Combinations
  - Static Analysis Settings
  - Combination Wizards
  - Relationship Between Load Cases
- Load Wizards
- Loads
  - LC1 - Eigengewicht
  - LC2 - Nutzlast
- Results
- Guide Objects
- Stress-Strain Analysis
- Printout Reports

The bottom of the interface features an 'Optimization' toolbar with a menu bar (Go To, Edit, Selection, View, Settings) and a main area containing the text 'OPTIM Optimize' and an empty input field.



# Optimierungstool – künftige Weiterentwicklung

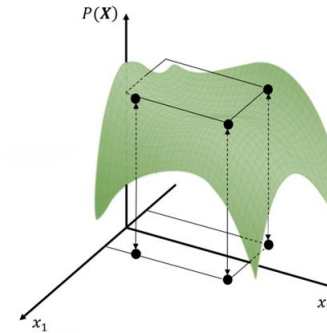
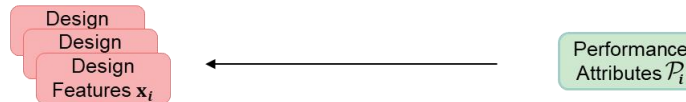
State-of-the-art



Forward Design



Design  
Meta-Models



Inverse Design







# ChatBot-Hilfe



The screenshot shows the Duibal RFEM 6.03.0008 software interface. The main window displays a 3D structural model of a building frame. On the right, a chatbot window titled "RFEM 6 Help ChatBot" is open, showing a conversation:

Hi

Hello there! How may I assist you today?

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

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...

Stop generating...

Ask me anything...

Below the chatbot, a table of material properties is visible:

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



# ChatBot-Hilfe

- ChatBot basierend auf generativer KI
- trainiert mit den Daten der FAQ, Knowledge Base und der Handbücher
- wird auf der Homepage aber auch in den Programmen zum Einsatz kommen



## 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?

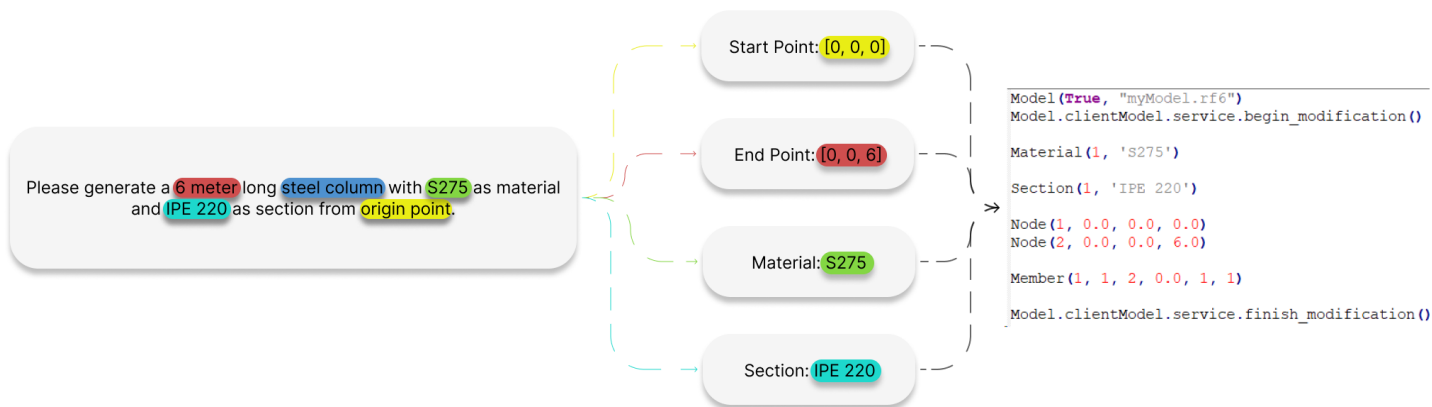
 Message Dlubal GPT...

I





# Entity Recognition für das Text2Model Interface



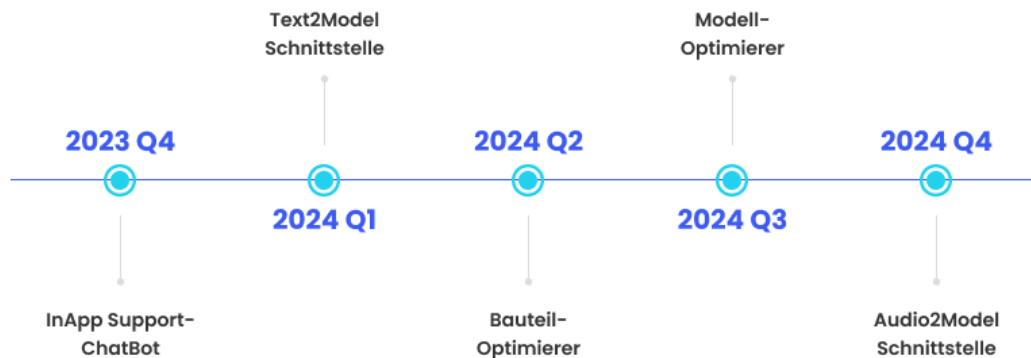


# Entity Recognition für das Text2Model Interface

The image shows two side-by-side screenshots. The left screenshot displays a web browser window with the URL 'localhost:8501'. The page title is 'Dlubal Text2Model Interface - Member Model'. It features a 'Description:' label, a text input field containing the placeholder text 'Describe the model you want me to create!', and a 'Create' button. The right screenshot shows the Dlubal RFEM software interface, version 6.04.2009. The 'Navigator' pane on the left shows a tree view with 'RFEM' selected. The main workspace is currently empty. The bottom toolbar includes options for 'Go To', 'Edit', 'Selection', 'View', and 'Settings', with 'Structure' and 'Basic Objects' visible in the dropdown menu.



# Zeitstrahl unserer künftigen Entwicklungen



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Erhalten Sie wertvolle Einblicke von einem unserer Experten



**Dipl.-Ing. (FH) Dipl.-  
Wirtschaftsing. (FH)  
Christian Stautner**

Head of Sales



**Bastian Ackermann, M.Sc.**

Sales



**Daniel Dlubal, M.Sc.**

COO of Dlubal Software GmbH



➔ **Sprechen wir miteinander**

# Kostenlose Online-Dienste

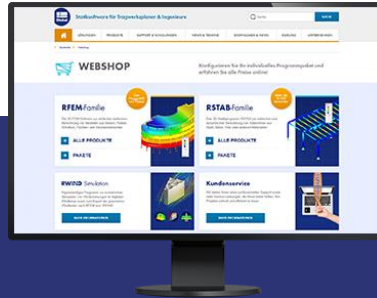
## Youtube-Kanal - Webinare, Videos

Sehen Sie sich die Videos und Webinare zur Statiksoftware von Dlubal an.



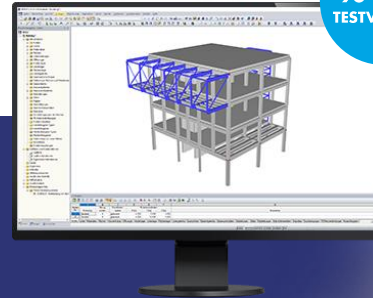
## Webshop mit Preisen

Erstellen Sie Ihr individuelles Softwarepaket und sehen Sie alle Preise online!



## Testversionen

Sie lernen am besten, wie Sie mit unseren Programmen umgehen, indem Sie sie einfach selbst testen. Laden Sie sich die 90-Tage-Testversion unserer Statikprogramme herunter.



90-TAGE-  
TESTVERSION



## Kostenloser Support per E-Mail und Live-Chat



# Hier finden Sie weitere Informationen zu Dlubal Software



Besuchen Sie unsere  
Webseite

[www.dlubal.com](http://www.dlubal.com)

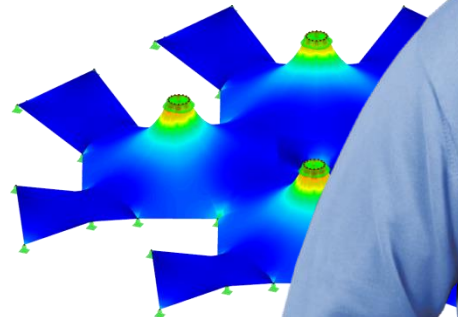
- Videos und aufgezeichnete Webinare
- Newsletter
- Veranstaltungen und Messen/Seminare
- Knowledge Base-Artikel



Sehen Sie den  
Einsatz von  
Dlubal Software  
in einem  
Webinar



Kostenlose  
Testversion  
herunterladen



**Dlubal Software GmbH**  
Am Zellweg 2, 93464 Tiefenbach  
Germany

Telefon: +49 9673 9203-0  
E-Mail: [info@dlubal.com](mailto:info@dlubal.com)





[www.dlubal.com](http://www.dlubal.com)