

KÜNSTLICHE INTELLIGENZ IN DER BAUWIRTSCHAFT

Simulation & Anwendung mit BIM

Dr. Gerhard Zucker

Center for Energy

Austrian Institute of Technology AIT



HOW AI WORKS



DATA

Which dataset do you want to use?



Ratio of training to test data: 50%



Noise: 0



Batch size: 10



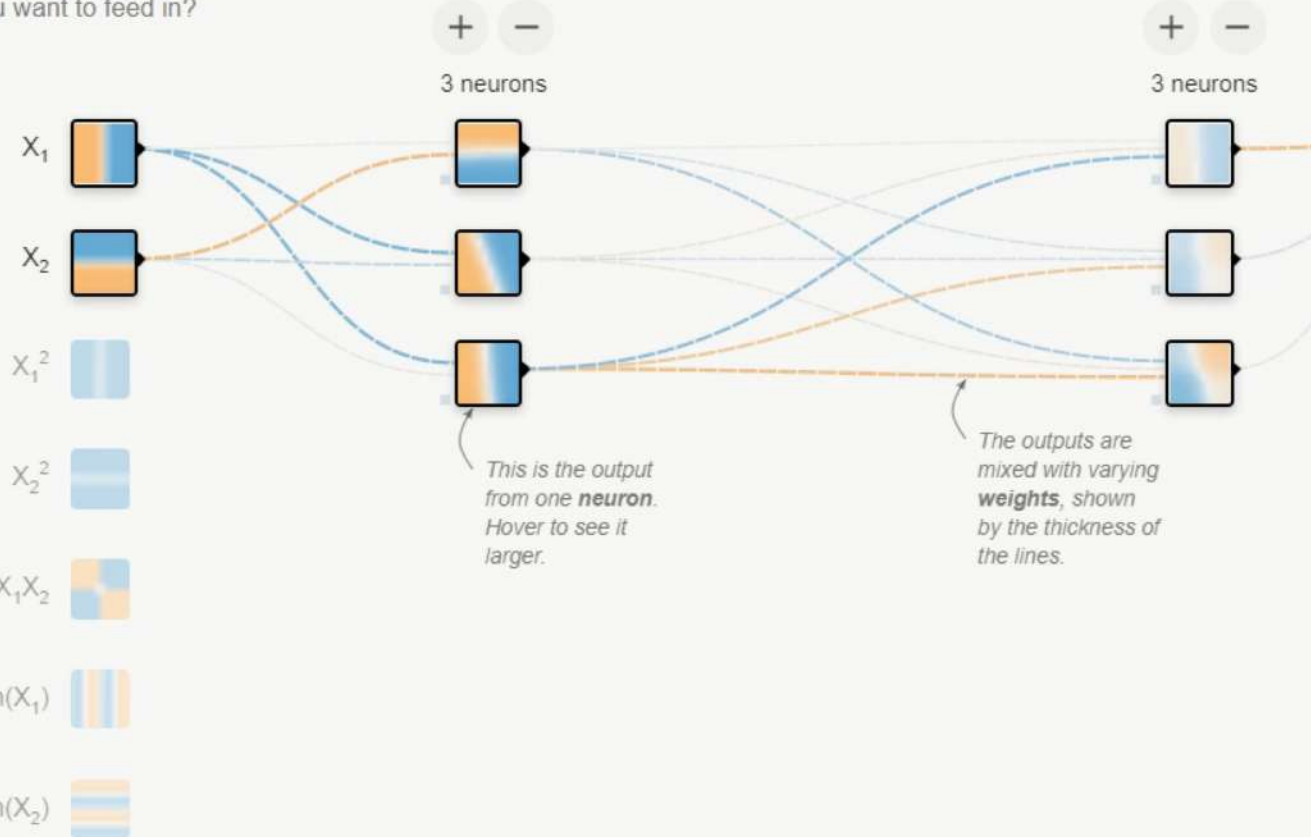
REGENERATE

FEATURES

Which properties do you want to feed in?

- X_1
- X_2
- X_1^2
- X_2^2
- $X_1 X_2$
- $\sin(X_1)$
- $\sin(X_2)$

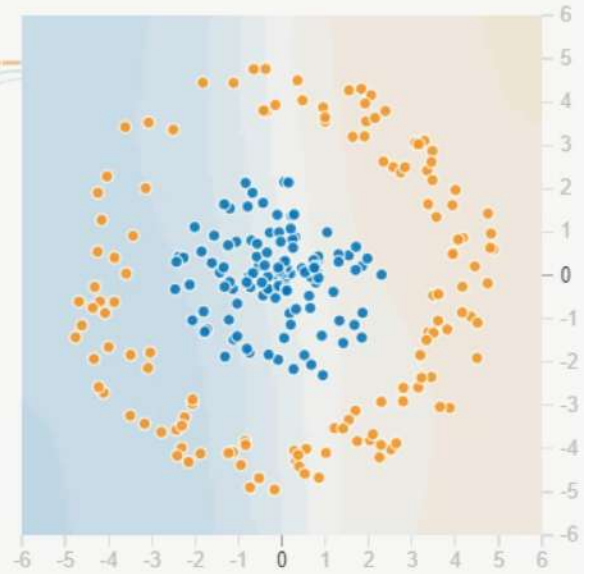
+ - 2 HIDDEN LAYERS



OUTPUT

Test loss 0.518

Training loss 0.497



Colors shows data, neuron and weight values.



Show test data

Discretize output



DATA

Which dataset do you want to use?



Ratio of training to test data: 50%



Noise: 0



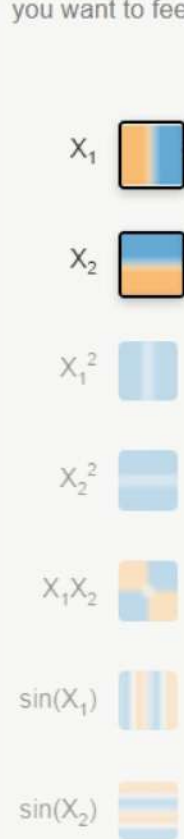
Batch size: 10



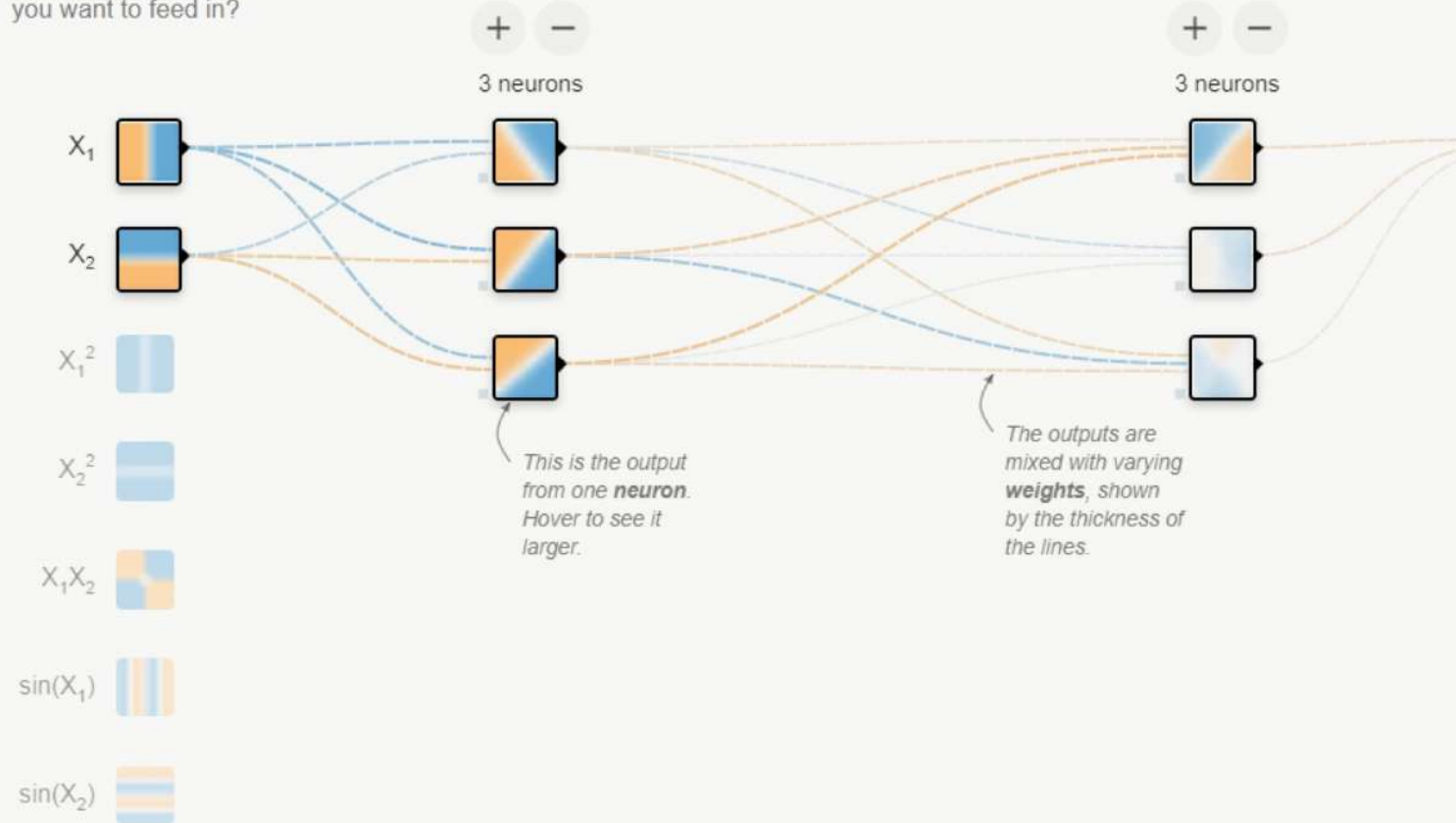
REGENERATE

FEATURES

Which properties do you want to feed in?



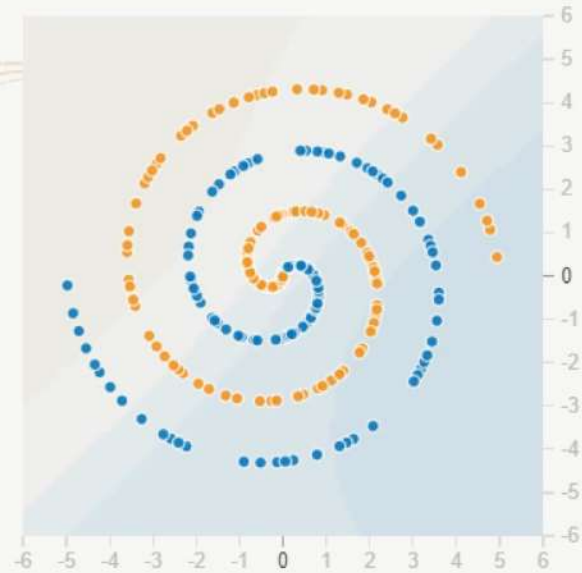
+ - 2 HIDDEN LAYERS



OUTPUT

Test loss 0.497

Training loss 0.494



Colors shows data, neuron and weight values.



Show test data Discretize output

<https://playground.tensorflow.org>



DATA

Which dataset do you want to use?



Ratio of training to test data: 50%



Noise: 0



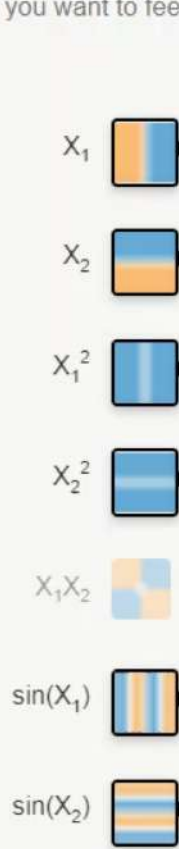
Batch size: 10



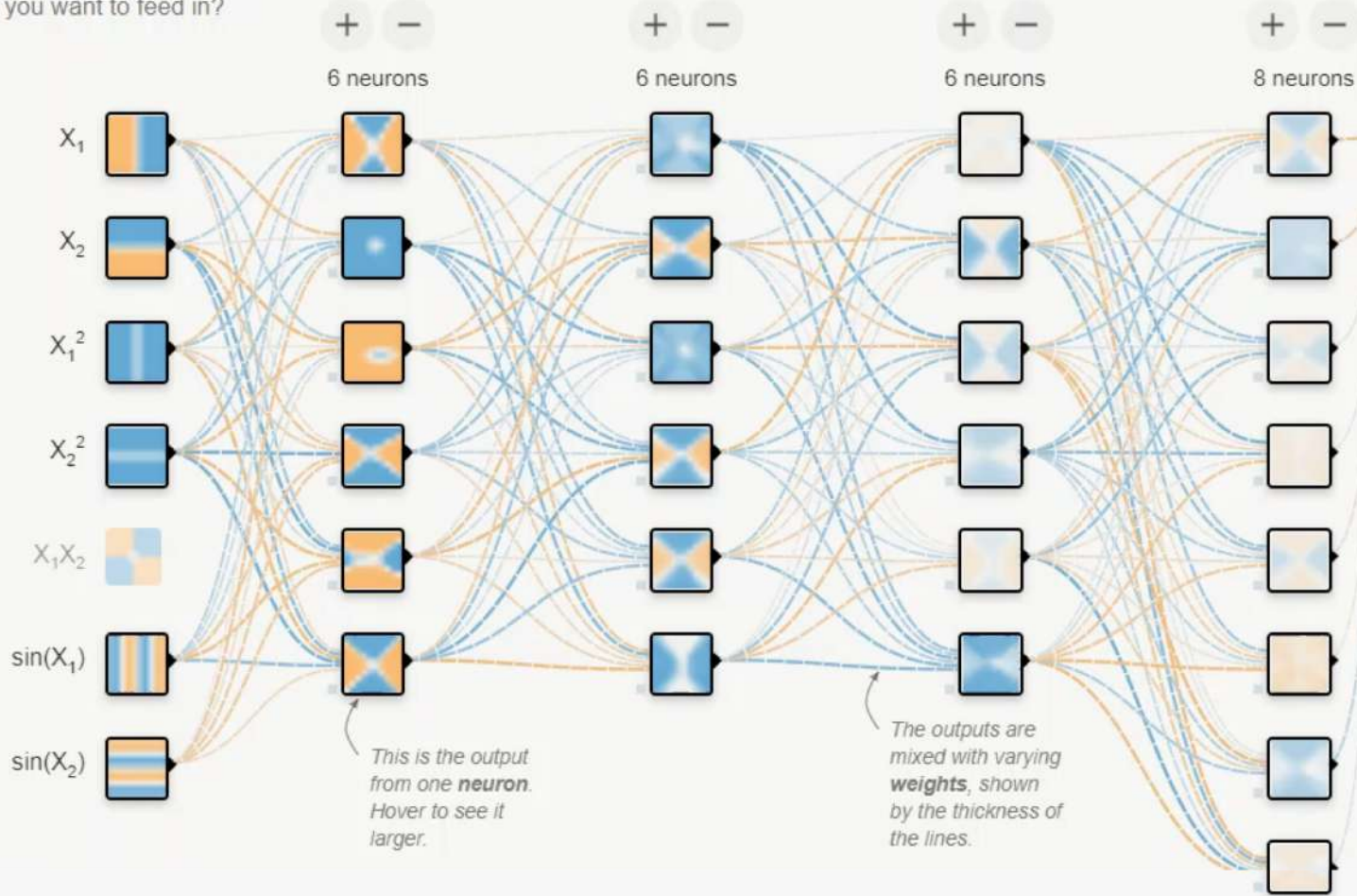
REGENERATE

FEATURES

Which properties do you want to feed in?



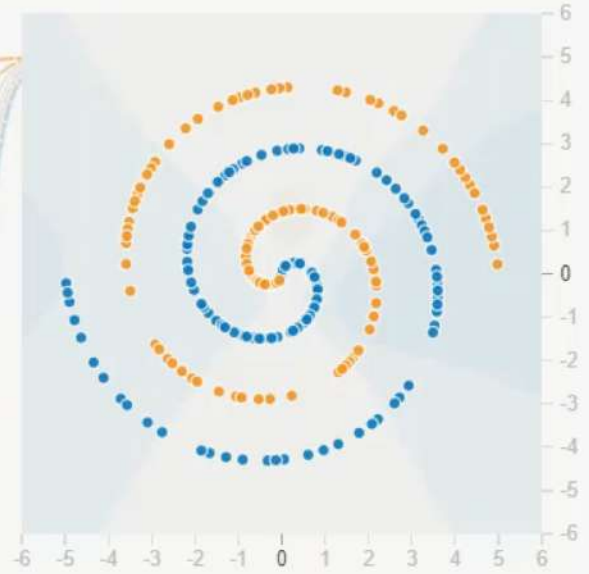
4 HIDDEN LAYERS



OUTPUT

Test loss 0.503

Training loss 0.497



Colors shows data, neuron and weight values.



Show test data

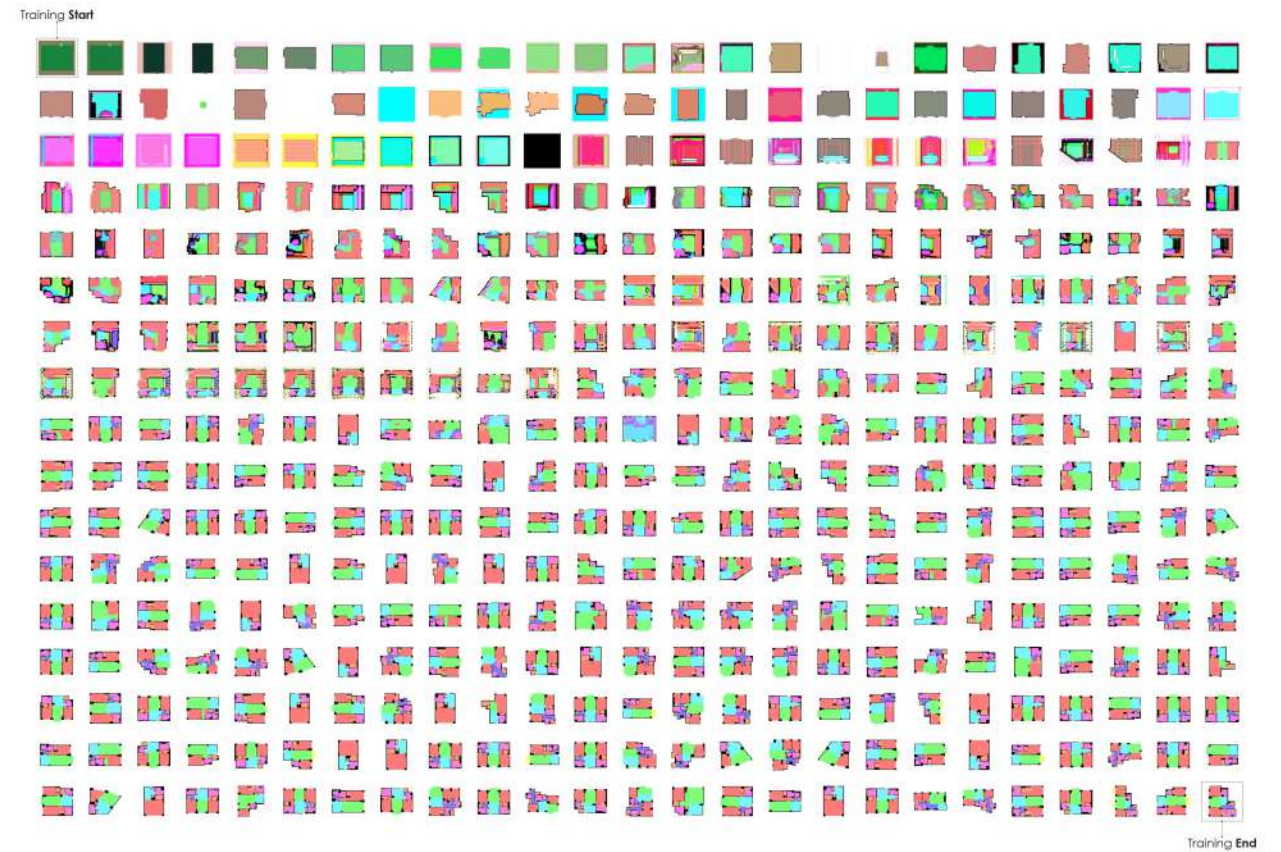
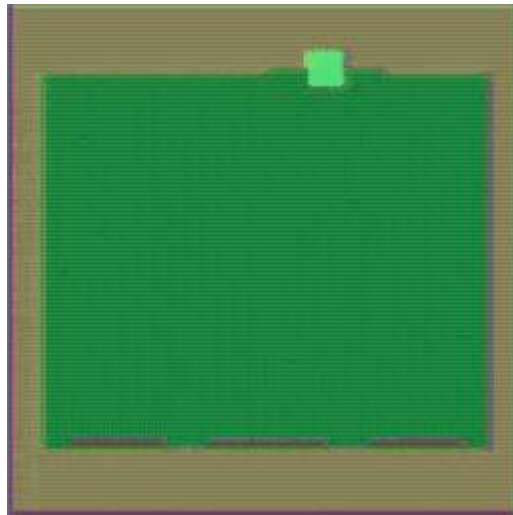
Discretize output

<https://playground.tensorflow.org>

FLOOR DESIGN UI



GENERATIVE DESIGN OF A FLOORPLAN

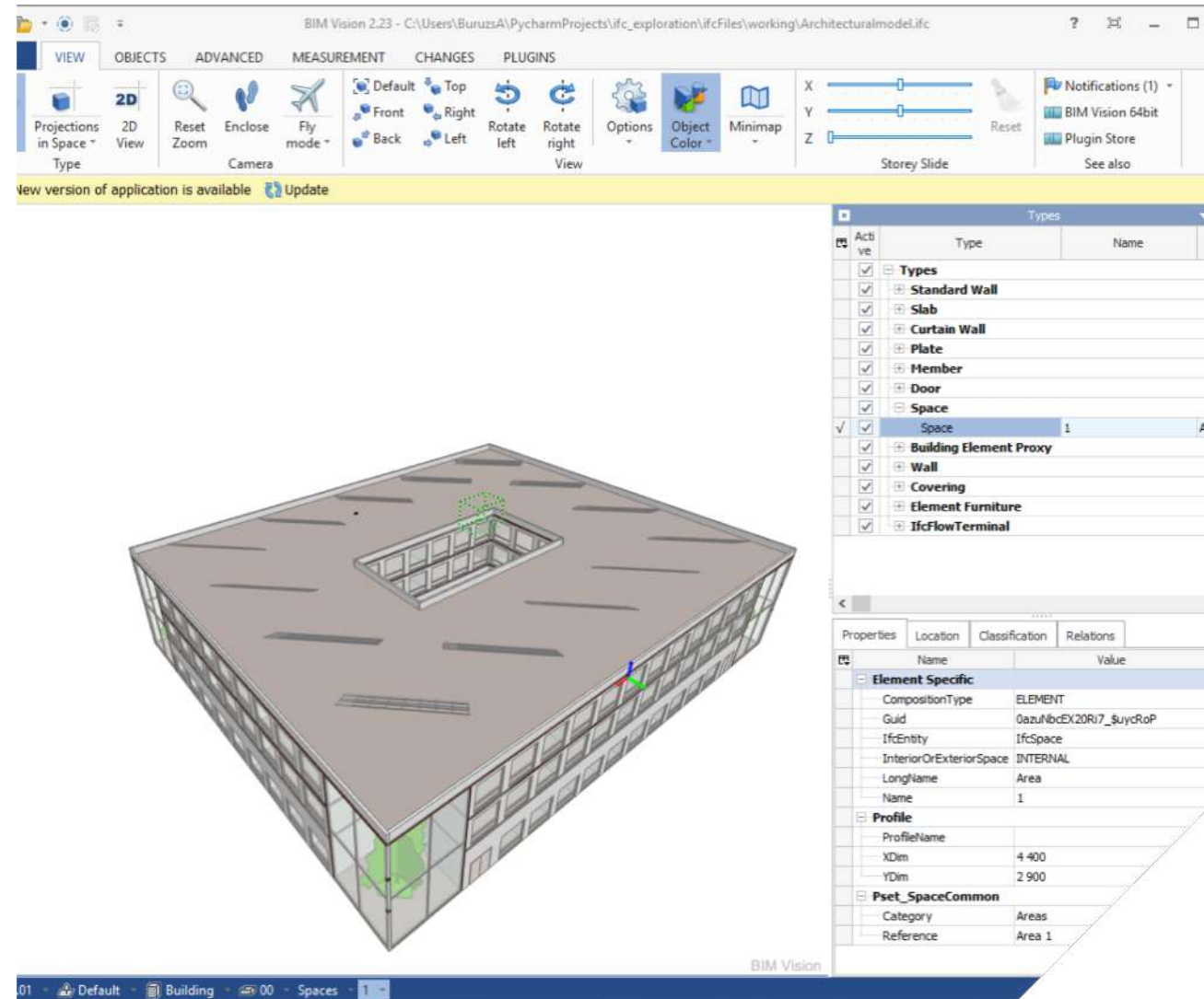


FIXING BIM MODELS



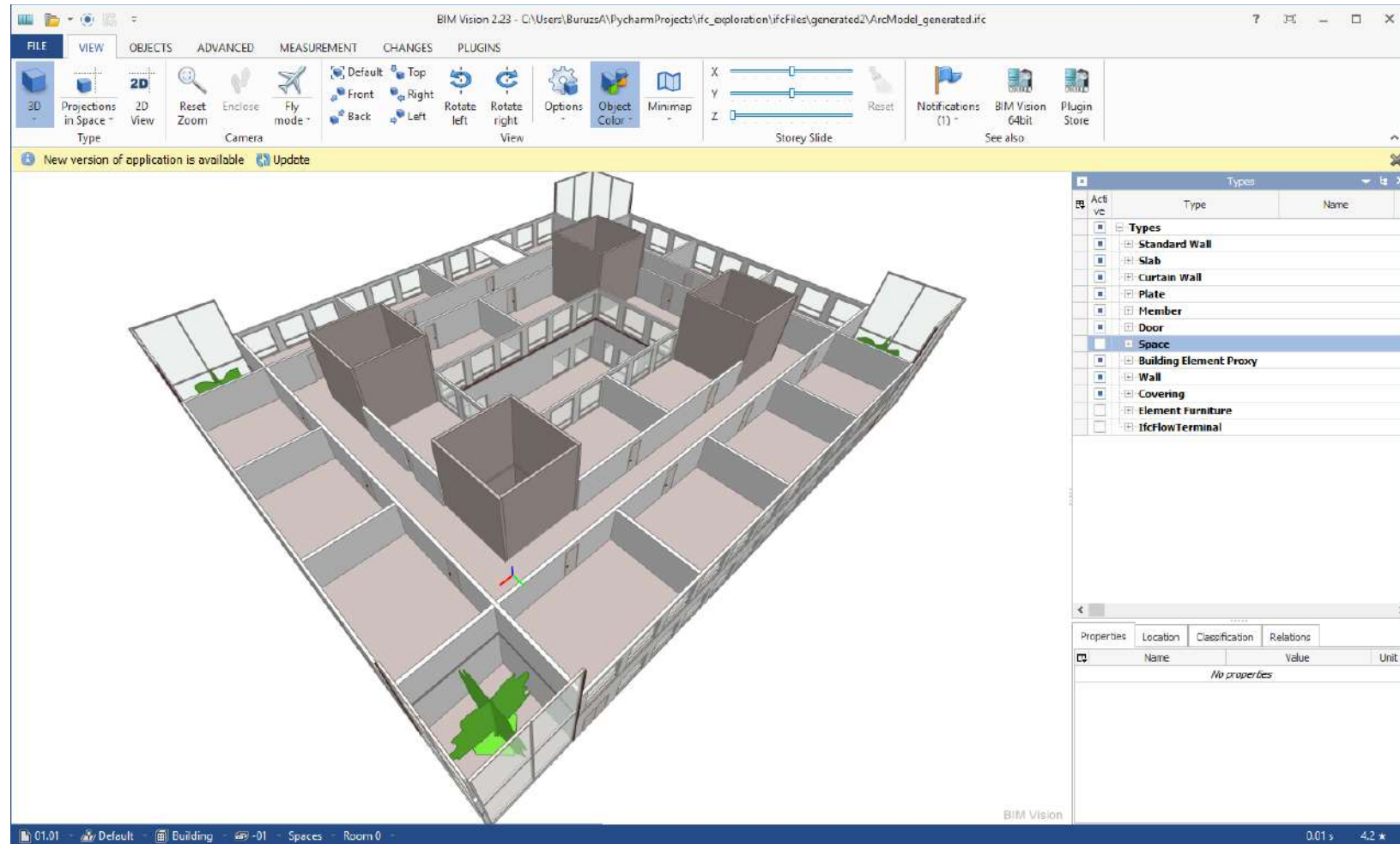
MISSING SPACES

- BIM Model missing ifcSpaces



MISSING IFCSPACES

- BIM Model missing ifcSpaces

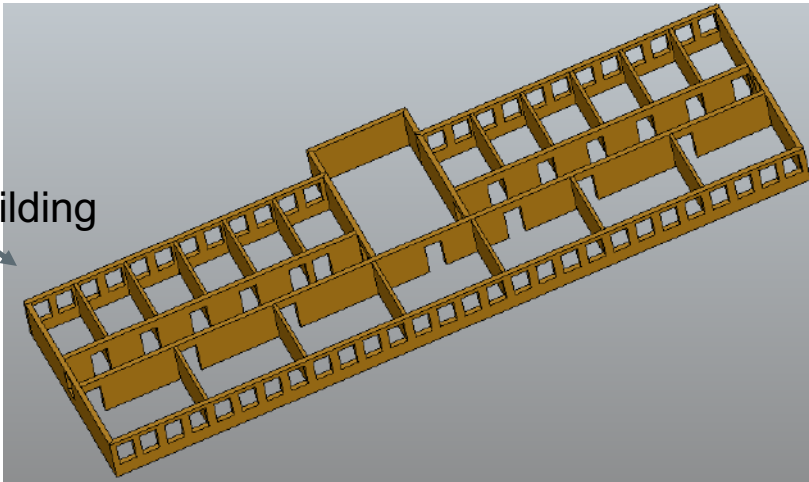


IFC SPACE COMPLETION

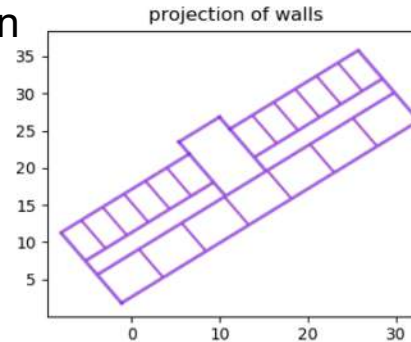
- IFC Space is often missing
- Needed: definition of the spaces based on the geometry of other elements (Walls)

IFC BIM Model

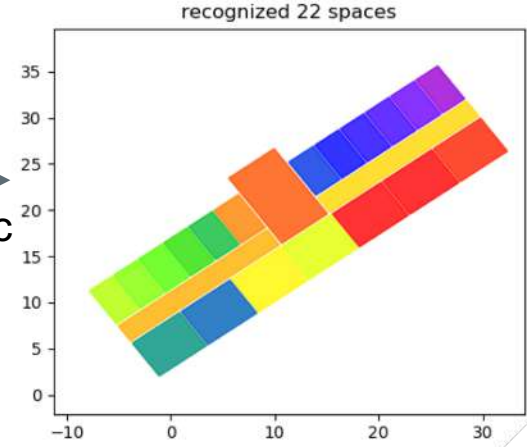
Select Building storey



2D projection



Geometric algorithm



Extracting Floor height

3D geometry of the spaces (Swept solid from polygons)

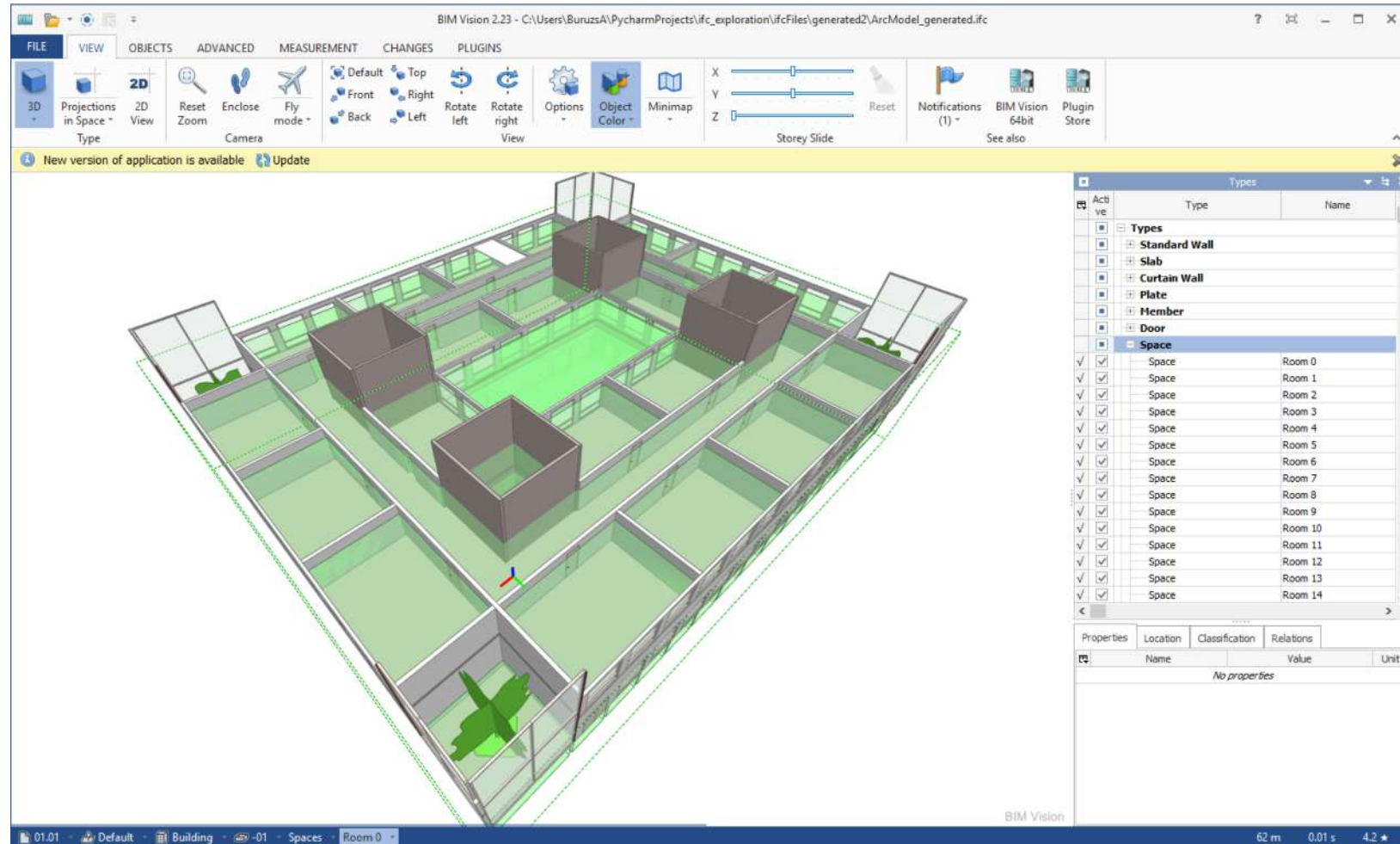
Inject IfcSpaces with Aggregate Relations Back to the IFC object

Improved IFC file

```

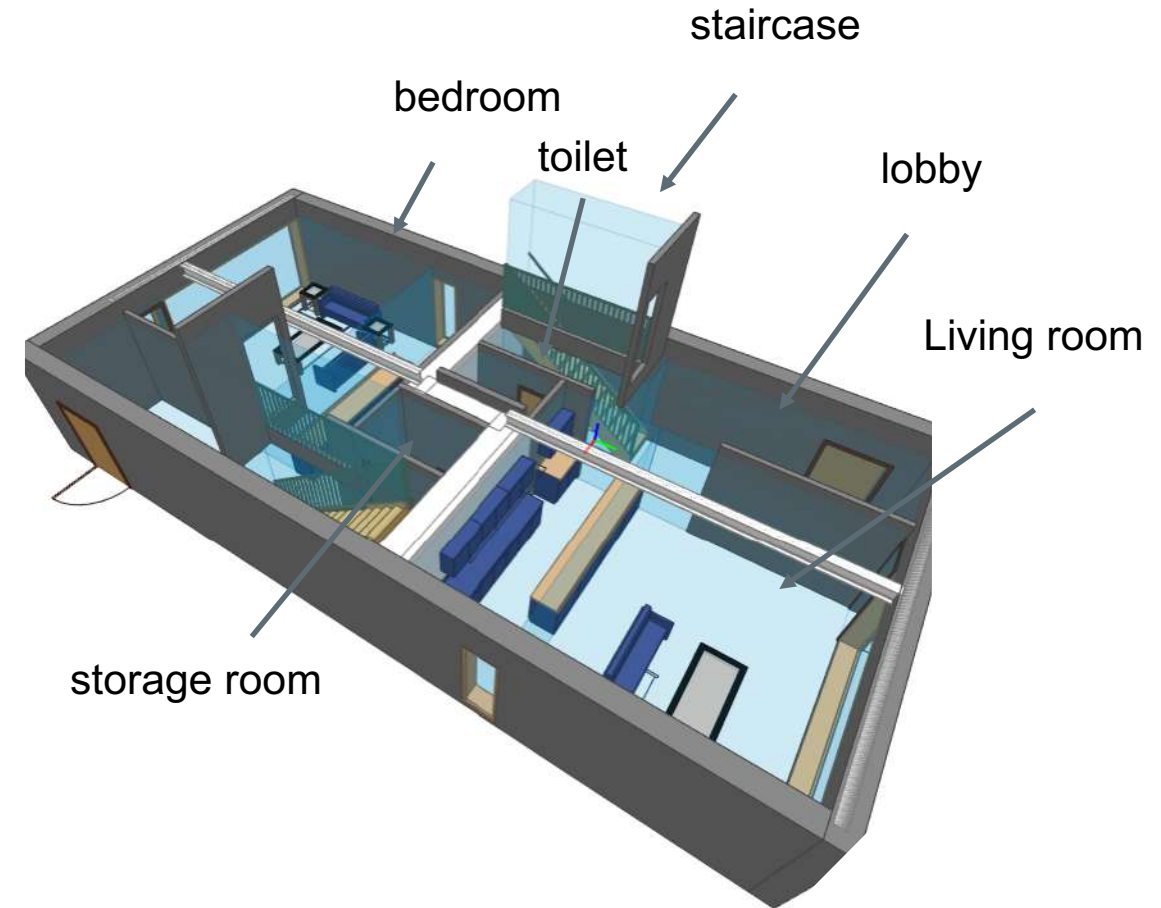
112713 #219777=IFCLOCALPLACEMENT(#152,#219777);
112714 #219778=IFCLOCALPLACEMENT(#152,#219778);
112715 #219779=IFCLOCALPLACEMENT(#152,#219779);
112716 #219780=IFCLOCALPLACEMENT(#152,#219780);
112717 #219781=IFCLOCALPLACEMENT(#152,#219781);
112718 #219782=IFCLOCALPLACEMENT(#152,#219782);
112719 #219783=IFCLOCALPLACEMENT(#152,#219783);
112720 #219784=IFCLOCALPLACEMENT(#152,#219784);
112721 #219785=IFCLOCALPLACEMENT(#152,#219785);
112722 #219786=IFCLOCALPLACEMENT(#152,#219786);
112723 #219787=IFCLOCALPLACEMENT(#152,#219787);
112724 #219788=IFCLOCALPLACEMENT(#152,#219788);
112725 #219789=IFCLOCALPLACEMENT(#152,#219789);
112726 #219790=IFCLOCALPLACEMENT(#152,#219790);
112727 #219791=IFCLOCALPLACEMENT(#152,#219791);
112728 #219792=IFCLOCALPLACEMENT(#152,#219792);
112729 #219793=IFCLOCALPLACEMENT(#152,#219793);
112730 #219794=IFCLOCALPLACEMENT(#152,#219794);
112731 #219795=IFCLOCALPLACEMENT(#152,#219795);
112732 #219796=IFCLOCALPLACEMENT(#152,#219796);
112733 #219797=IFCLOCALPLACEMENT(#152,#219797);
112734 #219798=IFCLOCALPLACEMENT(#152,#219798);
112735 #219799=IFCLOCALPLACEMENT(#152,#219799);
112736 #219800=IFCLOCALPLACEMENT(#152,#219800);
112737 #219801=IFCLOCALPLACEMENT(#152,#219801);
112738 #219802=IFCLOCALPLACEMENT(#152,#219802);
112739 #219803=IFCLOCALPLACEMENT(#152,#219803);
112740 #219804=IFCLOCALPLACEMENT(#152,#219804);
112741 #219805=IFCLOCALPLACEMENT(#152,#219805);
112742 #219806=IFCLOCALPLACEMENT(#152,#219806);
    
```


THE RECOGNIZED ROOMS ARE WRITTEN TO THE IFC FILE



IFC SPACE TAGGING

- Classification of Rooms/Spaces:
- Geometric features from the BIM Model.
- Needed: Labelled Training dataset with Ground Truth
- Machine Learning training for multiclass classification task





InFraReD

Intelligent Framework for Resilient Design

AI CHECKLIST

Data

- Is your task data-driven?
- Do you have enough data?
- Do you have good data?
- Problems have to be mapped (manually) to a feature vector

Application

- Focus on tasks that are repeated often
- Focus on small parts, not the whole process
- Low cost of mistakes – recommender instead of decider

Operation

- AI is not „fit and forget“, it needs adjustments during operation
- Interaction between model output and your experts
 - Build feedback loops, make it easy to use

THANK YOU!



Dr. Gerhard Zucker

AIT Austrian Institute of Technology GmbH
Giefinggasse 6 | 1210 Vienna | Austria
M +43(0) 664 235 19 21

gerhard.zucker@ait.ac.at | <http://www.ait.ac.at>

