# Computer Vision

# Wie man der Google Cloud das Sehen beibringt

**25.11.2021 I Stellwerk18**

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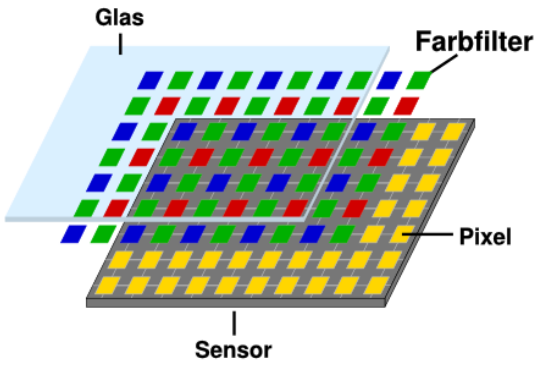
# Agenda

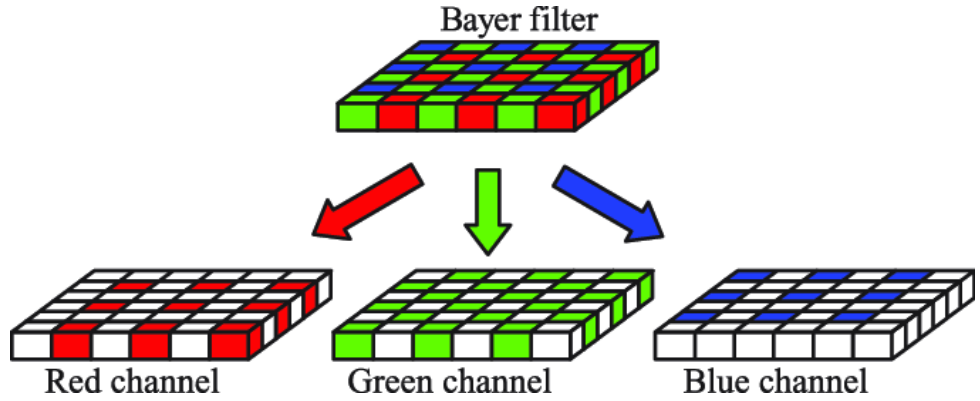
- 1. Digitale Bilder
- 2. Werkzeuge der digitalen Bildverarbeitung
- 3. Image Matching
- 4. Machine Learning
- 5. Google Cloud Platform

# 1. Digitale Bilder

- Licht trifft durch Farbfilter auf Sensor
- Sensor erzeugt Spannung durch Lichteinfall
- Spannung wird in Werten von 8, 10, … Bit gespeichert
- Unterschiedliche Möglichkeiten Werte zu kodieren (JPEG, PNG, …)




[1]

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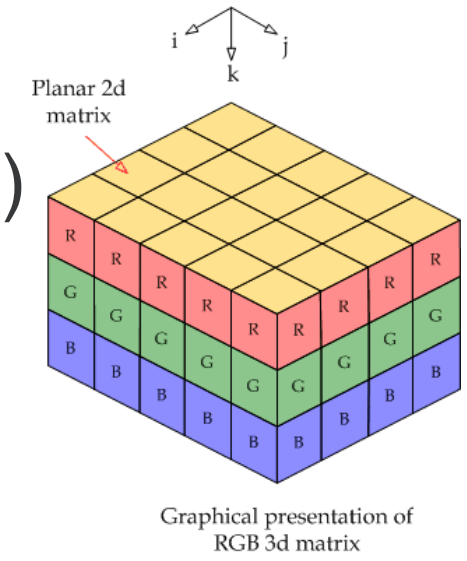



[3]

# 2. Werkzeuge der digitalen Bildverarbeitung




[4]

- Operationen auf Arrays
- Kreative Zwecke, z.B. mit Photoshop
- Preprocessing: Aufbereitung für weitere Verarbeitung

# 2. Werkzeuge der digitalen Bildverarbeitung

- Rotation
- Helligkeit
- Kontrast
- Schwellwert/Threshold
- K-Means
- Quantisierung
- Low Pass Filter
- High Pass Filter
- Canny Edge Detection
- Farben extrahieren
- …

$$g(x) = \alpha f(x) + \beta$$

| | | | | |
|---|---|---|---|---|
| 7 | 23 | 50 | 64 | 14 |
| 15 | 13 | 31 | 46 | 8 |
| 42 | 25 | 92 | 31 | 32 |
| 71 | 44 | 74 | 94 | 92 |
| 2 | 43 | 51 | 35 | 4 |

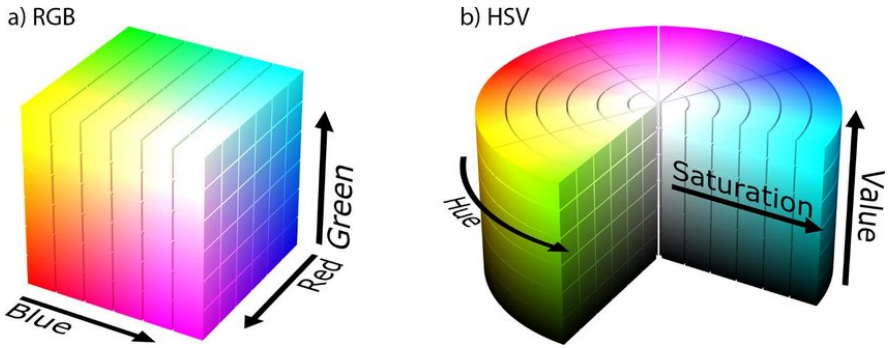
X

| | | |
|---|---|---|
| 0 | 2 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |

=

| | | | | |
|---|---|---|---|---|
| - | - | - | - | - |
| - | 46 | 100 | 128 | - |
| - | 26 | 62 | 92 | - |
| - | 50 | 184 | 62 | - |
| - | - | - | - | - |

[5]

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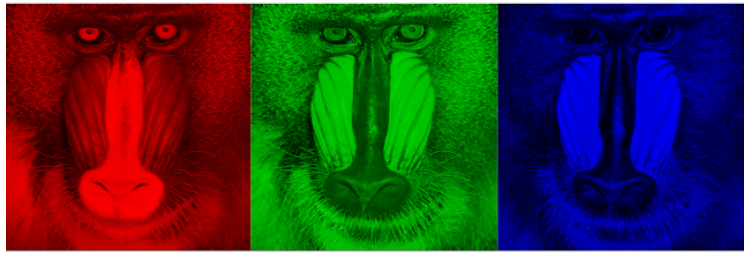

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# 3. Image Matching - Template Matching

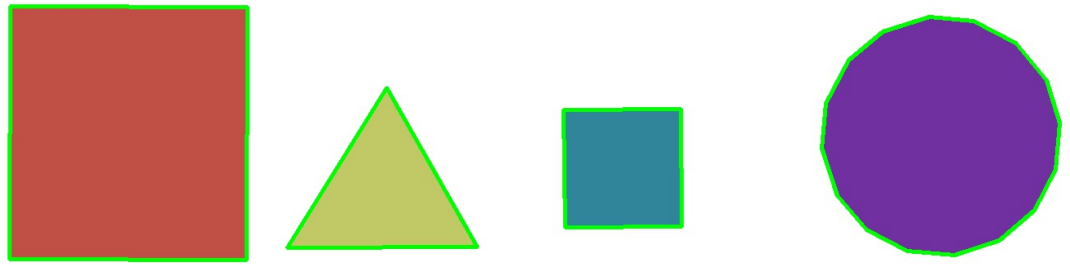


- Rahmen wandert über Bild
- Verrechnen von Rahmenausschnitt und Template im Frequenzspektrum
- Abhängig von Skalierung und Ausrichtung!


[8]

# 3. Image Matching - Contour Matching

- Globale Features
- Erkennen von Konturen
- Baumstruktur
- Matchen der Konturen
- Anfällig für Rauschen, Überlagerung



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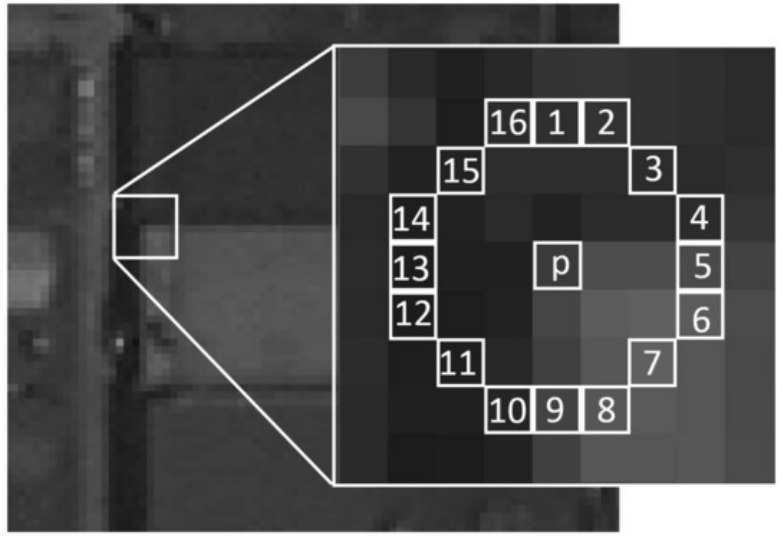
# 3. Image Matching - Feature Matching



- Lokale Features
- ORB
- KAZE
- …

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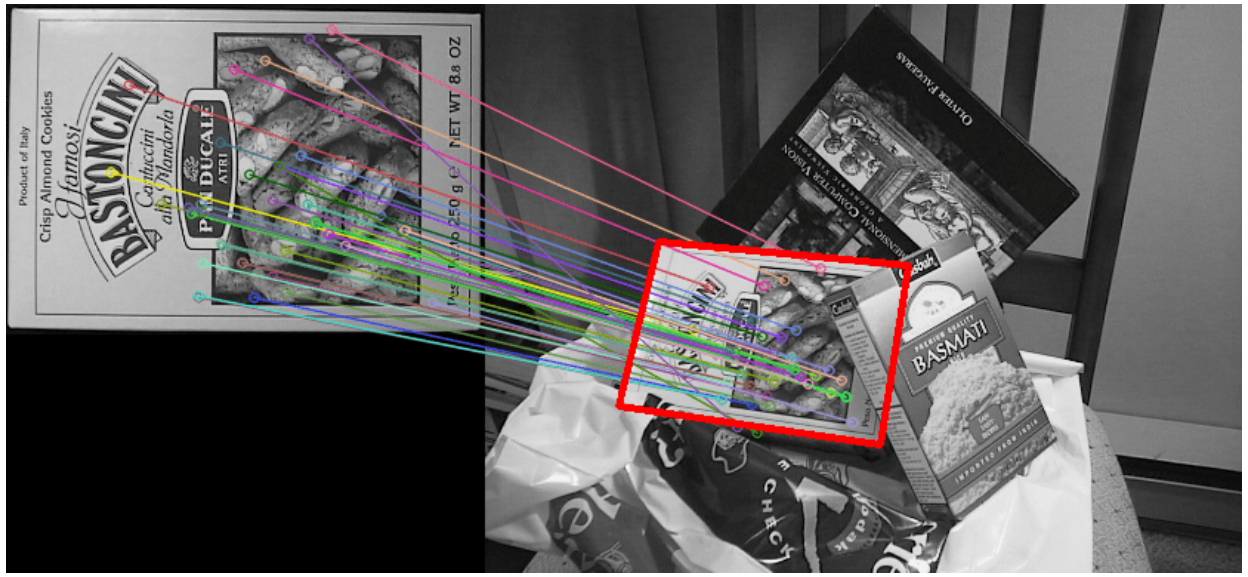


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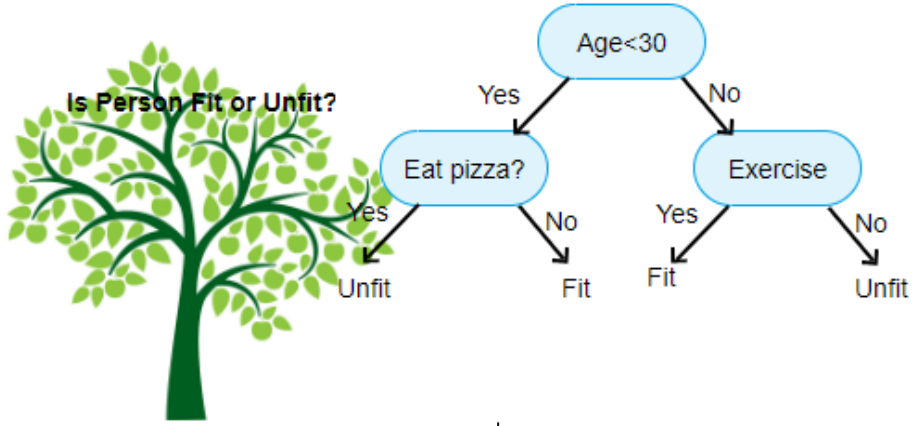
# 4. Machine Learning

- Supervised vs Unsupervised
- Decision Tree
- Regression
- K-Means!
- Deep Learning
  - DNN
  - CNN
  - …

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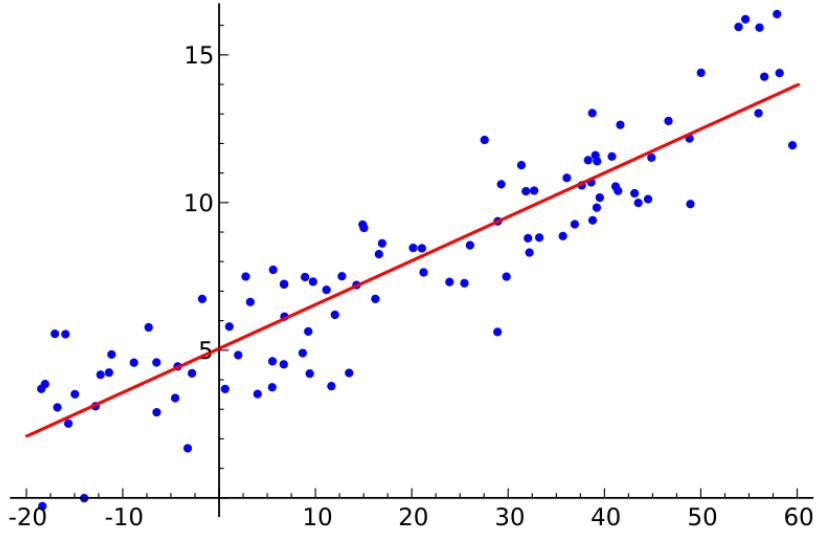


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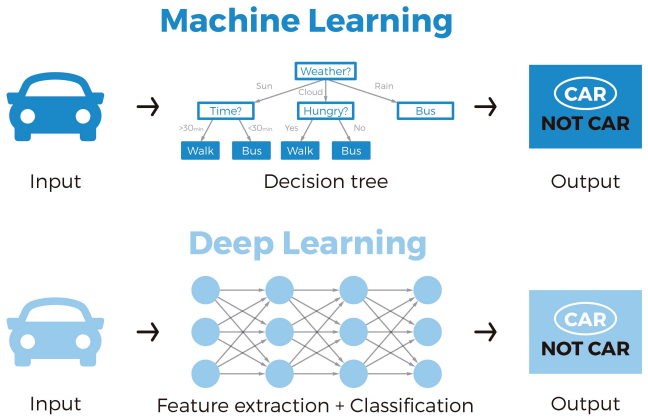


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# 4. Machine Learning - DNN

- Bias
- Activation Function
- Backpropagation

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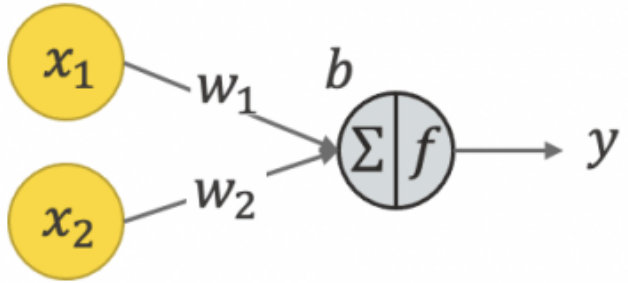
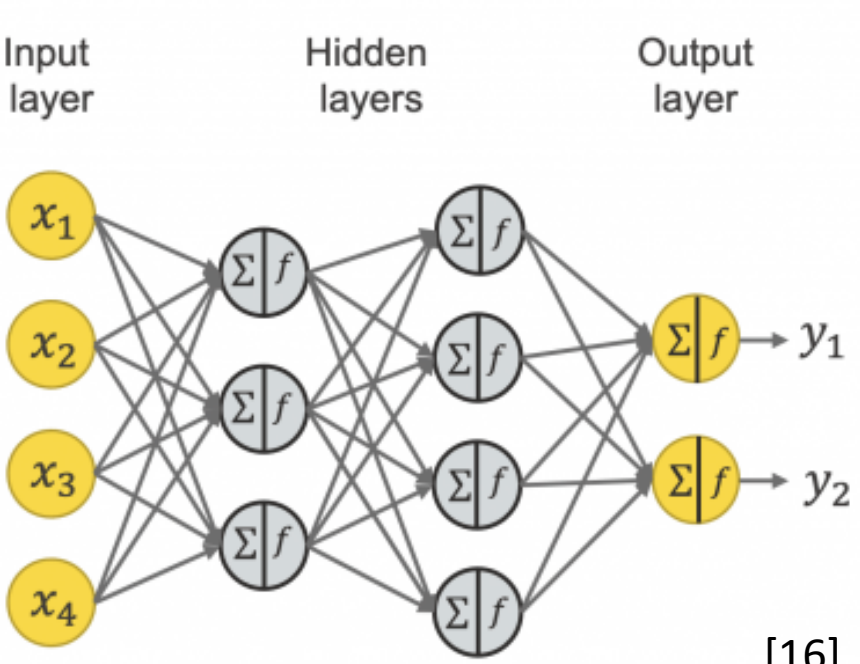


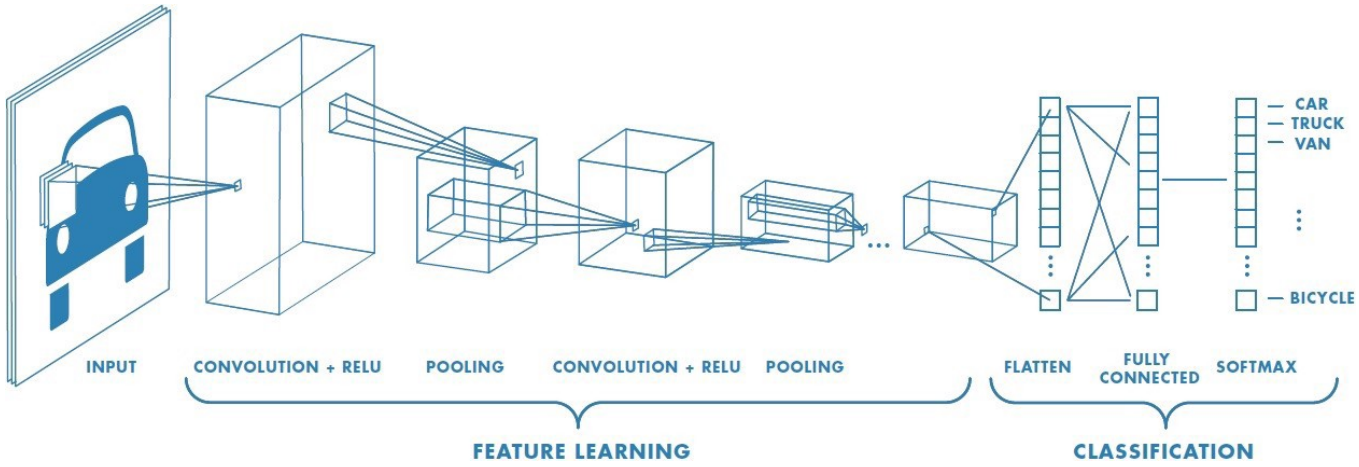

o = f(w1 * x1 + w2 * x2 + b)




[16]

# 4. Machine Learning - CNN

- Convolution
  - Filter
- ReLu
  - Aktivierungsfunktion
- Pooling
  - Downsampling
- Flatten
  - Vector erstellen
- Fully Connected
  - DNN
- Softmax
  - Anpassung an erlaubten Wertebereich

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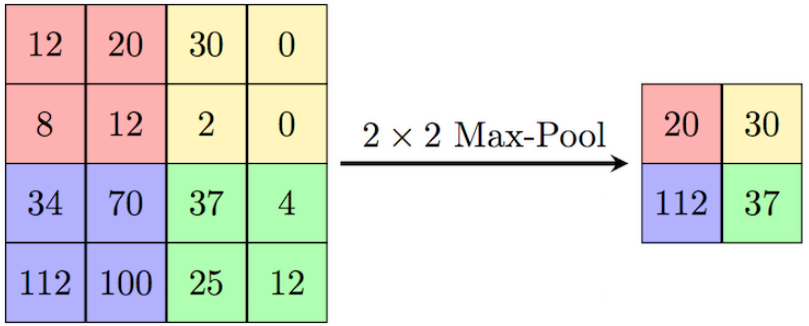


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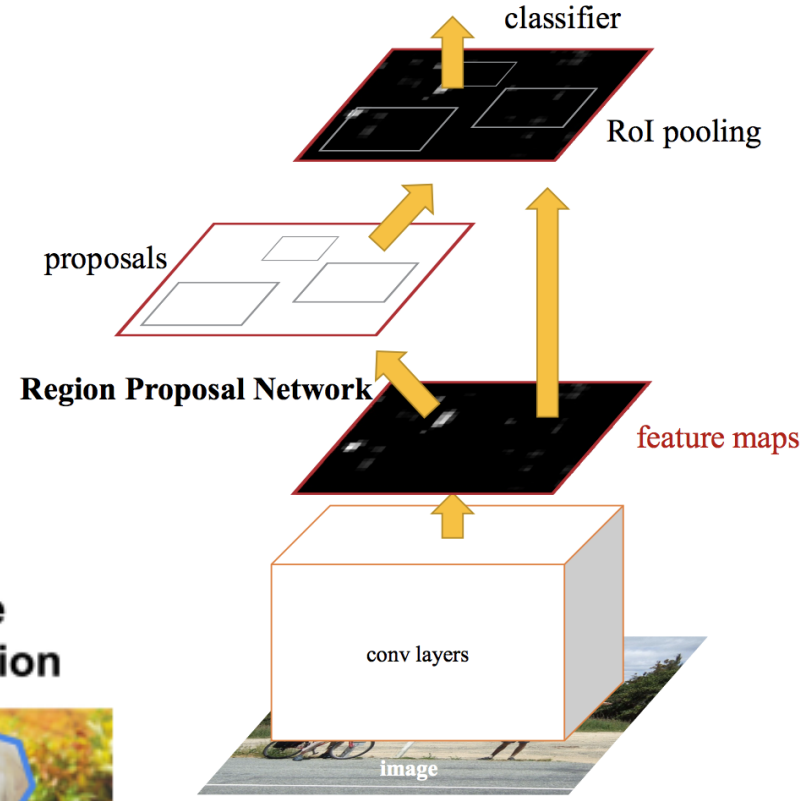
# 4. Machine Learning - CNN: Beispiele

- Faster R-CNN
- Mask R-CNN
- YOLO
- SSD
- …

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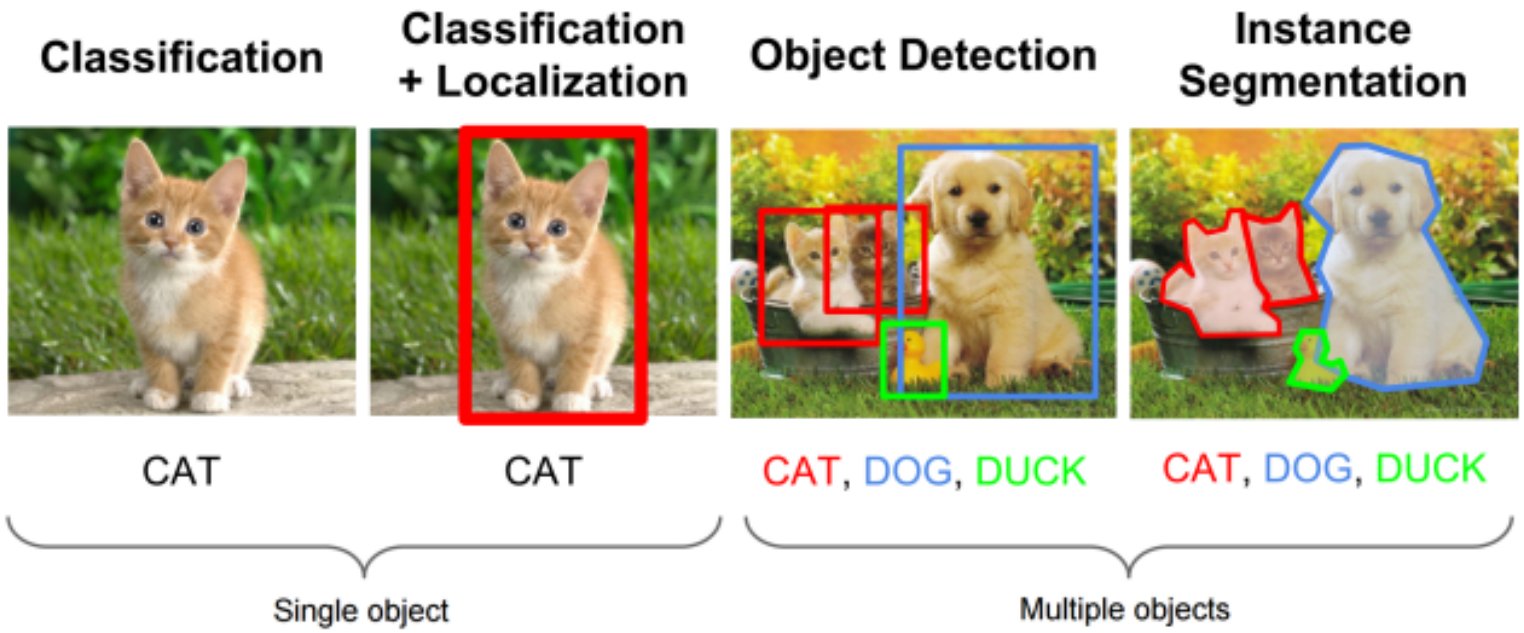


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# 5. Google Cloud Platform - Wieso? Läuft doch!



- Developer
  - Fokus: Konzentriere dich auf die wesentlichen Parts
  - Angebot: Nutze die Möglichkeiten
  - Einstieg: Dashboard, Tutorials, Democode
  - Monitoring: Vielfältige Metriken
- User/Kunde
  - Serverless: Niedrigere Kosten
  - Time-to-market
  - Ausfallrisiko

Google Cloud [21]

# 5. Google Cloud Platform



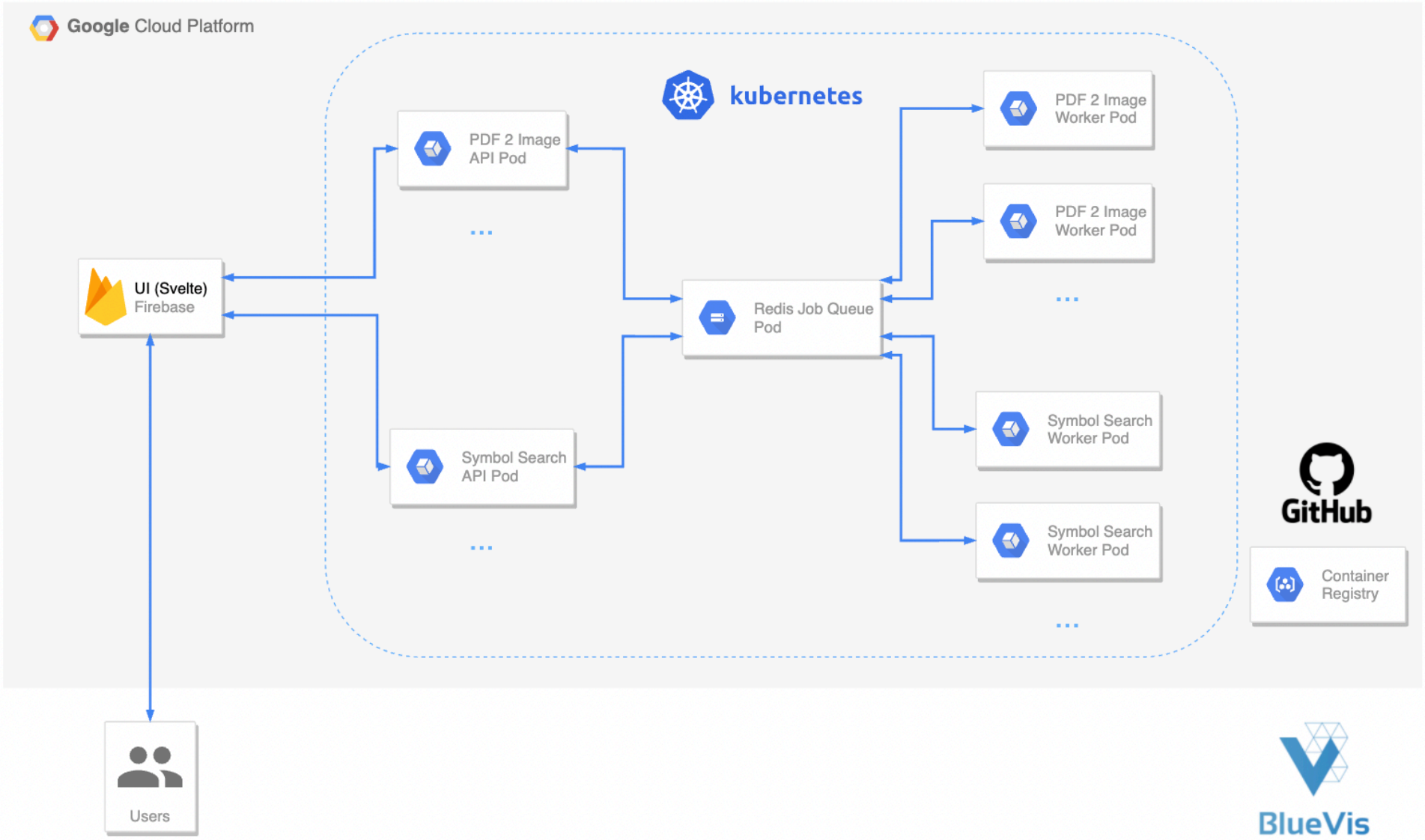
- Produkte der innFactory
  - Laura AI
  - Cotema/Corsign
  - BlueVis

BlueVis

- BlueVis
  - Symbolerkennung in Bauplänen
  - z.B. Leistungsverzeichnisse erstellen
  - Template Matching & CNNs
  - Dataflow, AI Platform, Cloud Run, BigQuery/ Firestore, Firebase

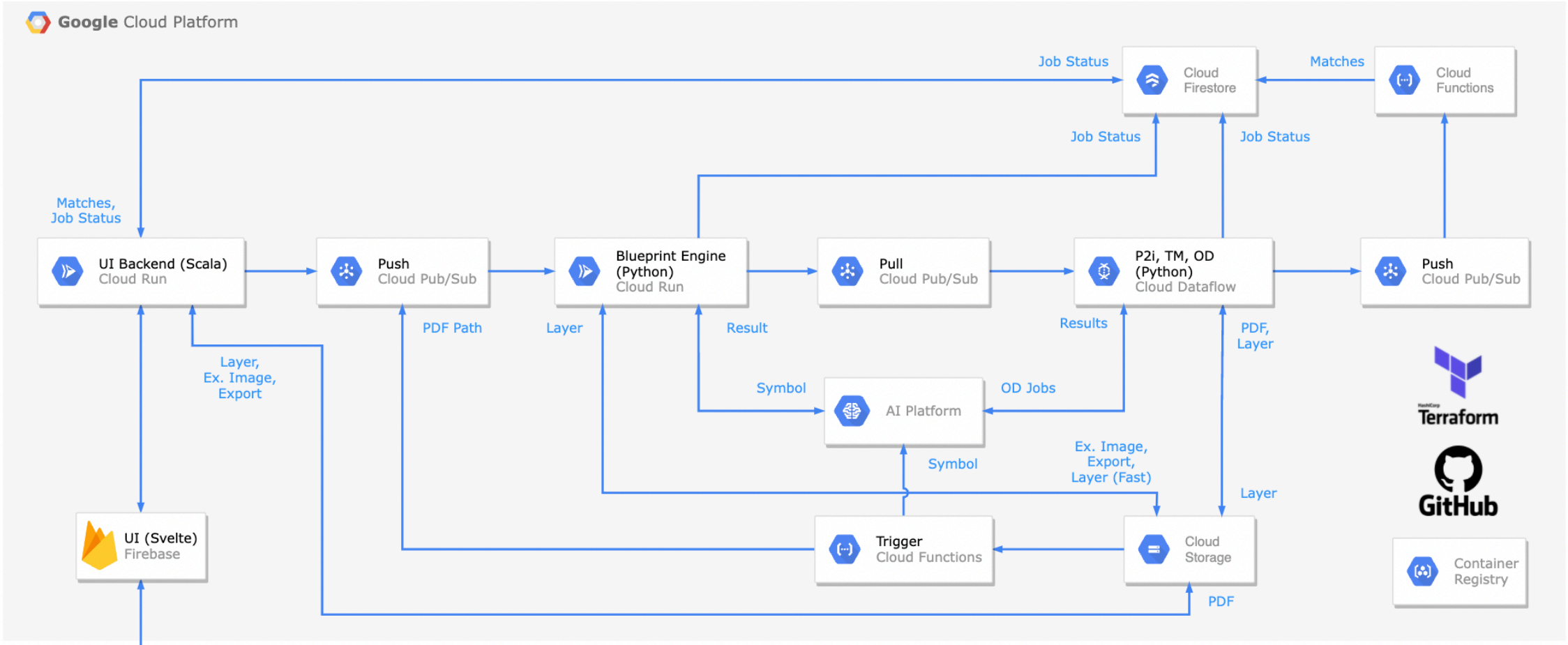
# 5. Google Cloud Platform





# 5. Google Cloud Platform





# Noch Fragen? :-)

# Vielen Dank!

# Quellen




- [1] https://www.elmar-baumann.de/fotografie/techtutorial/sensoren-02.html
- [2] https://www.researchgate.net/figure/Bayer-RGB-filter-pattern-17_fig18_282867924
- [3] http://eng-shady-mohsen.blogspot.com/2011/04/graphical-presentation-of-rgb-3d-matrix.html
- [4] https://dasbildprojekt.de/bildbearbeitung/
- [5] https://www.codingame.com/playgrounds/2524/basic-image-manipulation/filtering
- [6] https://www.researchgate.net/figure/a-the-RGB-color-space-black-arrows-show-the-three-main-color-dimensions-whose-values_fig2_323952018
- [7] https://www.r-bloggers.com/2016/01/color-quantization-in-r/
- [8] https://docs.opencv.org/4.x/d4/dc6/tutorial_py_template_matching.html
- [9] https://github.com/zutshianand/shape_matching-using-contours
- [10] https://en.wikipedia.org/wiki/Features_from_accelerated_segment_test#/media/File:FAST_Corner_Detector.jpg
- [11] https://www.researchgate.net/figure/Feature-matching-and-object-detection-using-ORB-a-BRISK-b-SIFT-c-or-SURF-d_fig1_328991586
- [12] https://www.aitimejournal.com/@akshay.chavan/a-comprehensive-guide-to-decision-tree-learning
- [13] https://de.wikipedia.org/wiki/Lineare_Einfachregression
- [14] https://blog.bismart.com/en/difference-between-machine-learning-deep-learning
- [15] https://www.knime.com/blog/a-friendly-introduction-to-deep-neural-networks
- [16] https://www.knime.com/blog/a-friendly-introduction-to-deep-neural-networks
- [17] https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53
- [18] https://computersciencewiki.org/index.php/Max-pooling_/_Pooling
- [19] https://towardsdatascience.com/r-cnn-fast-r-cnn-faster-r-cnn-yolo-object-detection-algorithms-36d53571365e
- [20] https://medium.com/swlh/object-detection-and-instance-segmentation-a-detailed-overview-94ca109274f2
- [21] https://www.datamation.com/artificial-intelligence/google-cloud-c3-ai-partnering-enterprise-ai-solutions/
- coins.png https://www.istockphoto.com/de/foto/us-m%C3%BCnzen-gm92890281-7300979
- rosenheim.jpeg https://www.br.de/nachrichten/bayern/inzidenzregelung-rosenheimer-ob-fordert-ausnahmeregelung,SRnQOo4


- Alle restlichen Bilder sind aus eigenen Quellen

# Links



- Neuronale Netze selbst programmieren: https://www.thalia.de/shop/home/artikeldetails/A1043460437
- Object Detection API von Tensorflow: https://tensorflow-object-detection-api-tutorial.readthedocs.io/en/latest/training.html
- PyTorch torchvision modul: https://pytorch.org/tutorials/intermediate/torchvision_tutorial.html
- OpenCV: https://docs.opencv.org/4.5.4/