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# AI and vision technology for improving efficiency and quality in meat production

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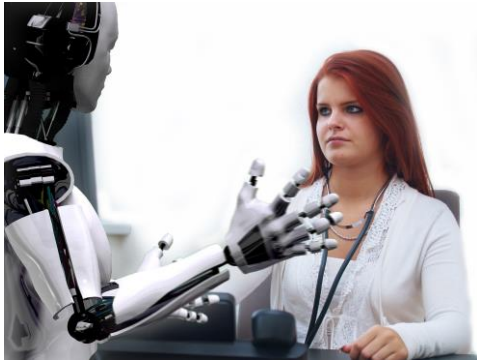


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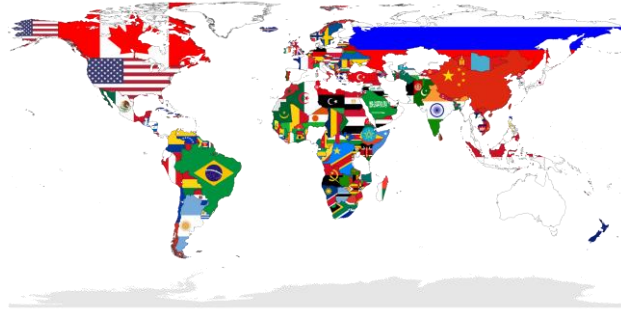
# AI applications and expert systems



Clinical decision support



Language recognition and translation



Chatbots



Customer Experience



Legal (agreements/assessments)



Preferences, face tagging





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# Expert knowledge in meat production



# Product recognition as an application of an AI expert system





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# Typical product types to be distinguished

1313 Bove u/ben



1327 nakkefilet



1450 Bov m/sværreste



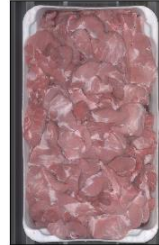
1539 backs u/svær



1608 kam



1621 hoftestykker



1642 kambenspl m/kød



1789 kam (vrag)



1829 spareribs



1871 brystflæsk, vrag



2038 kæbe/bovsn. u/s



2047 forskankekød



2061 kødskjold



2064 kamstrimmel



2102 fedtafp. m/sv.



2104 fedtafp. m/sv.



2180 brystfl. svær



2188 bugst. m(sv.)



2243 finnebrusk



Flommer



2871 afpillede ben



# The DynaCQ Platform



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Plastic detection

*Cuts, Trim & Coarse ground products*







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## DynaCQ - R

Product Recognition  
Automatic routing of products in crates  
or on the belt

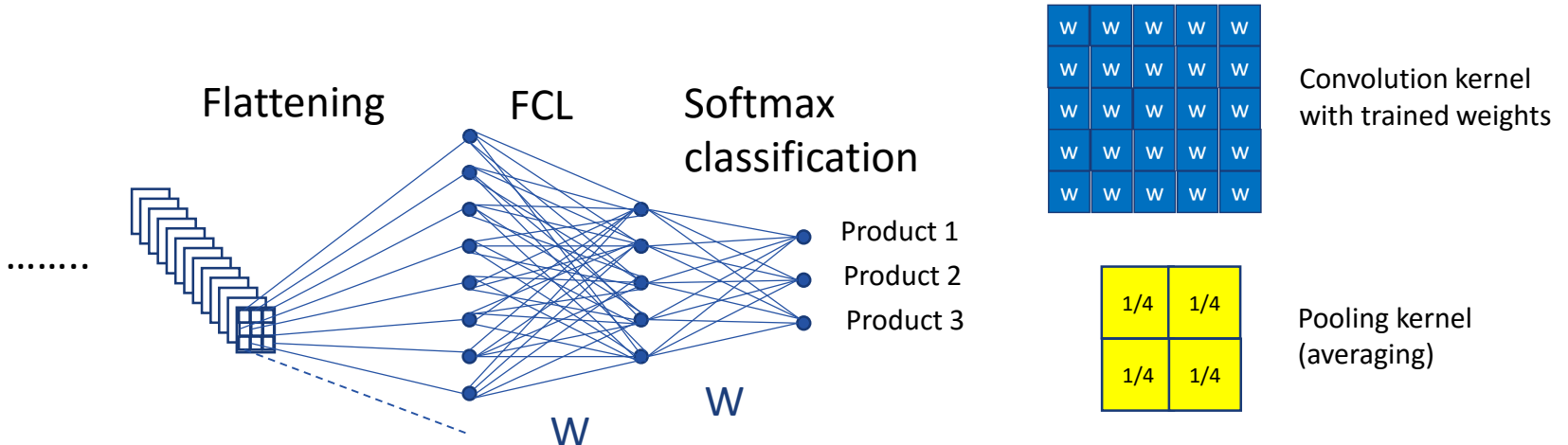
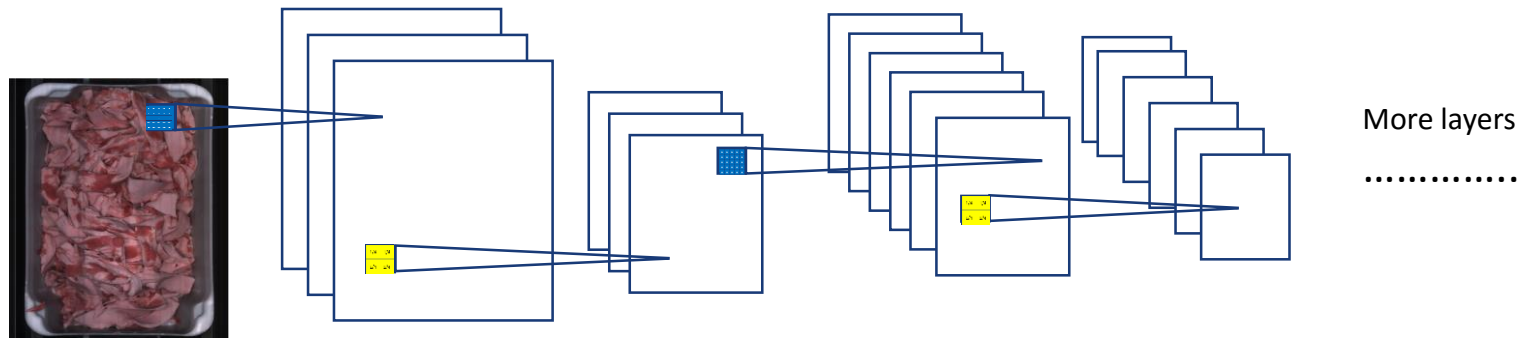
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# Convolutional Neural Network (CNN) principle (simplified)

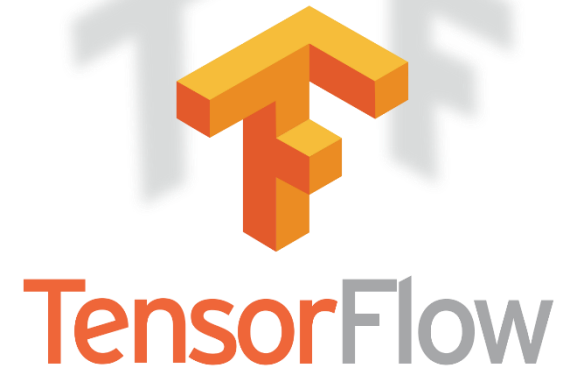
Image feature recognition (learning/inference) and pooling (information condensing)





# Convolutional Neural Network approach

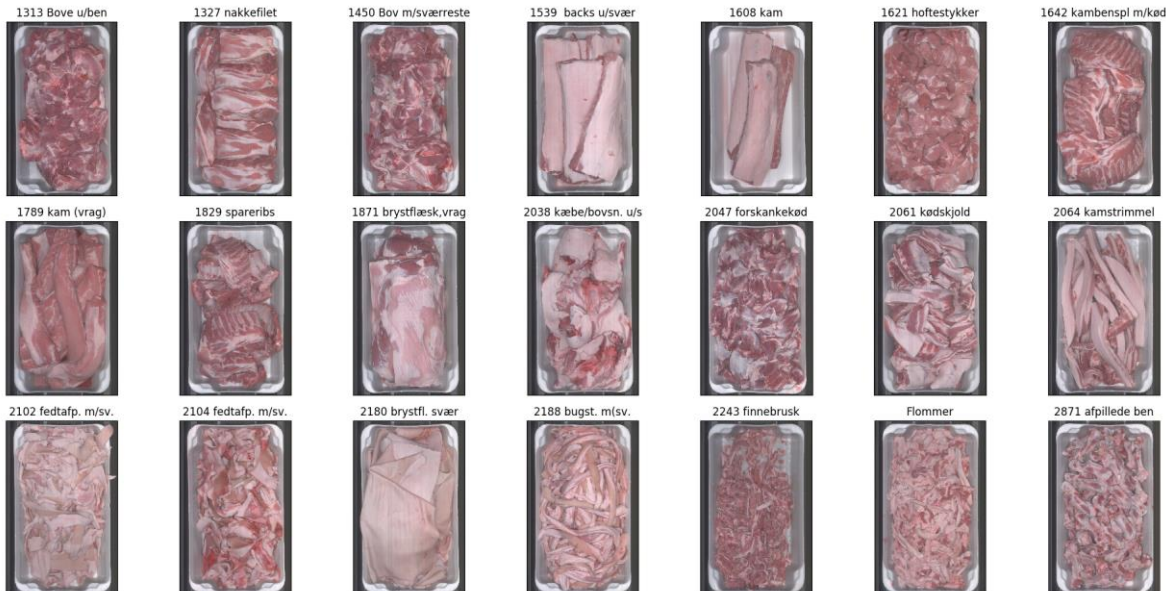
- Test of several ImageNet pre-trained CNNs
- ResNet-50 showed best performance
- Training of
  1. The classification layers
  2. The last three convolutional layers (high level feature recognition)





# Method

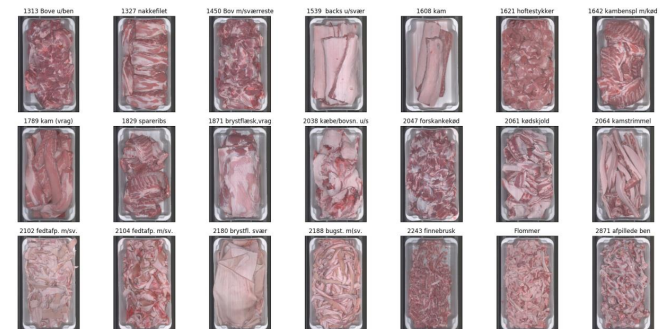
- Classification into 30 categories
- 500-1.000 images pr. category training set
- Training set images verified for correct label





# Results offline test

- Test on 300 images of each category
- Reference product labels from operator input **but verified**
- Precision:
  - 97%
  - 99% w. 7% manual handling (removing the 7% with lowest Softmax value)





# Results online test

- Test on 30.000 images
- Label from operator, **not verified**
- Precision online:
  - 94%
  - 98% w. 11% manual handling



Softmax value	Precision [%]	Manual inspection [%]
0.0	93.9	0.0
0.5	94.2	0.5
0.7	95.6	3.5
0.8	96.6	5.5
0.9	97.5	8.3
<b>0.95</b>	<b>98.0</b>	<b>10.9</b>

A close-up photograph of a robotic arm in a meat processing plant. The arm is white and metallic, with various colored cables (red, green, blue, yellow) attached to it. It is positioned over a large piece of raw meat, which is being processed. The background is slightly blurred, showing a person in a blue uniform and a white apron, likely a worker in the plant. The overall scene is brightly lit, typical of a food processing facility.

## Conclusion

- AI (deep learning in combination with vision) is a powerful tool in meat production.
- Visual product recognition can be automated with an investment payback of 1-2 years!
- Many other applications e.g. robot control, quality control, maintenance etc.





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**Thank you for your  
attention!**

**Questions?**



# Results

- Classification into 30 categories
- 30 x 700 images training set
- Offline test on 30 x 300 images
- Online test 30.000 images
  
- Precision offline:
  - 97%
  - 99% w. 7% manual handling
- Precision online:
  - 94%
  - 98% w. 11% manual handling



## Online test results

Softmax value	Precision [%]	Manual inspection [%]
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