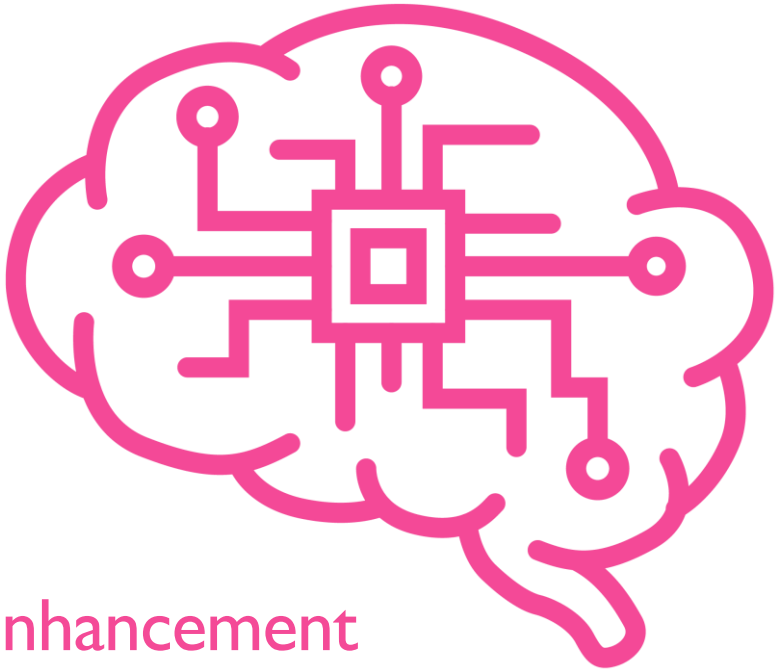


AI gets creative:

Use of machine learning in video enhancement

Marta Mrak, Lead Engineer, BBC R&D

2019 Intelligent Sensing Summer School, 2 Sept. 2019

BBC | Research & Development

Application scenario: content management platform

1. Content Creation, Archives

3. Production Team Smart Select

2. Auto AI Checks and Enhancements

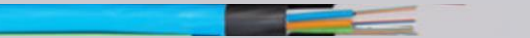
4. Distribution

Video coding

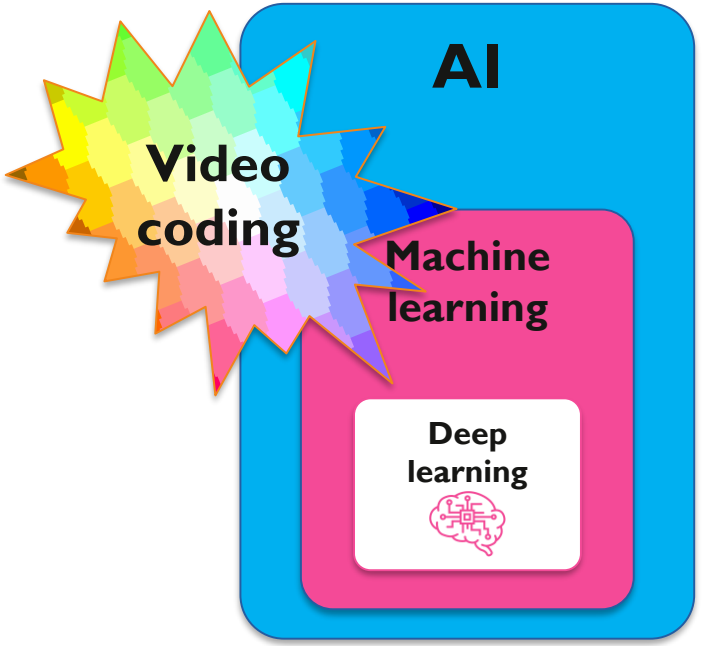
Video coding: an application of AI

H.264/AVC
> 15 years old
Video streaming enabler

H.265/HEVC
> 5 years old
UHD / HDR streaming enabler



VVC (/H.266?)
Under development
Killer app?

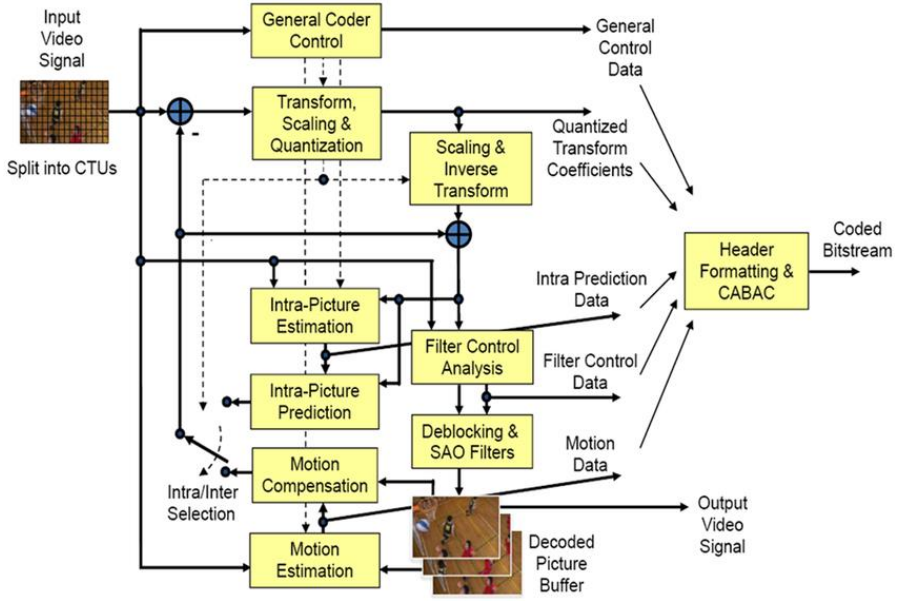


Video compression standards – building blocks

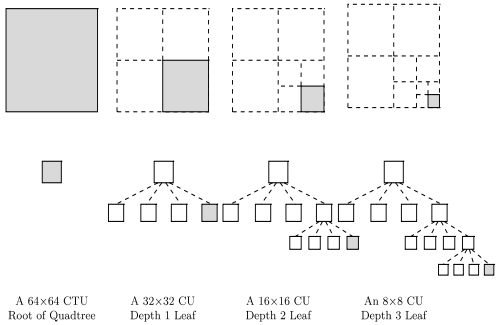
Video coding algorithms

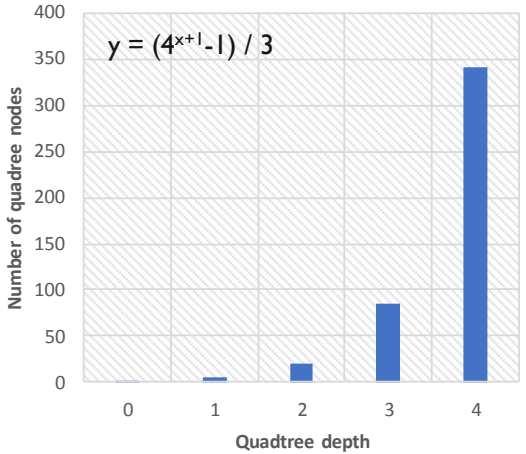
- Signal processing
- Perception science
- Statistics
- Machine learning

+ brute force



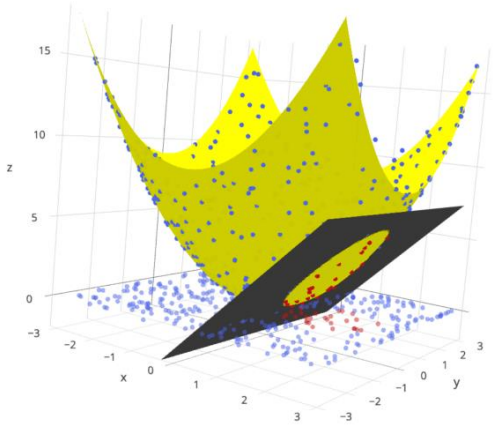
Applications of machine learning in video coding: reducing costs (or not)



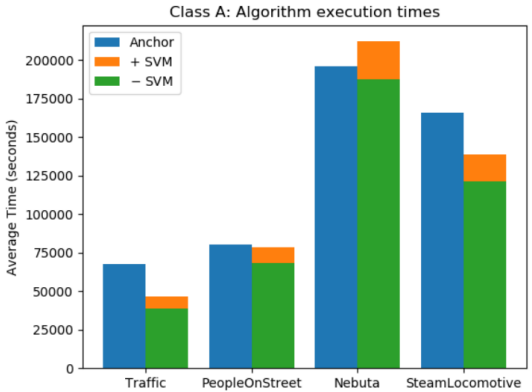


- Brute force
  - Check various split options, and pick the one that compresses given block the best
- Required
  - Reduce complexity of video encoder by reducing the number of split options that are checked
- Hypothesis
  - Reduction can be done using knowledge from the context

Applications of machine learning in video coding: Support Vector Machines



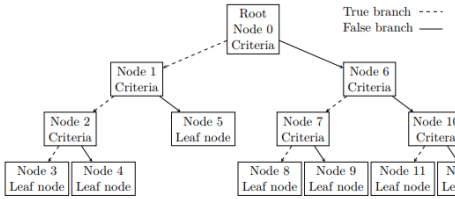
- Knowledge from the context filtered using SVM
- Reduced number of split options that are checked
- Reduced core encoder time
- But…SVMs are costly
- Reduced overall cost

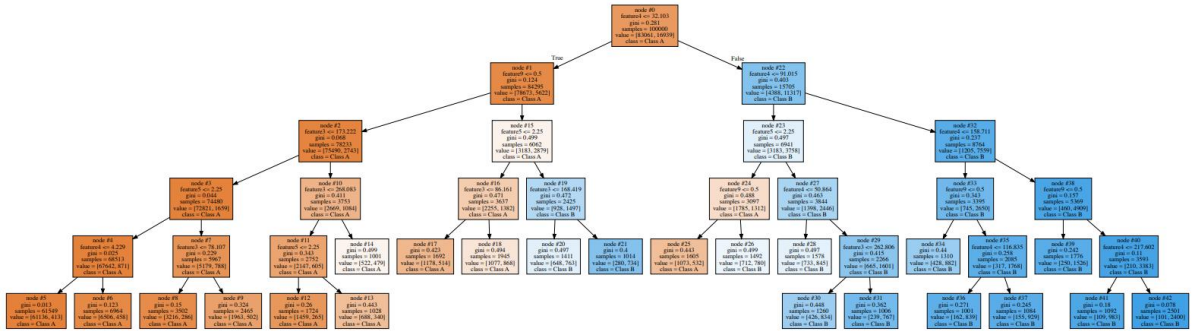


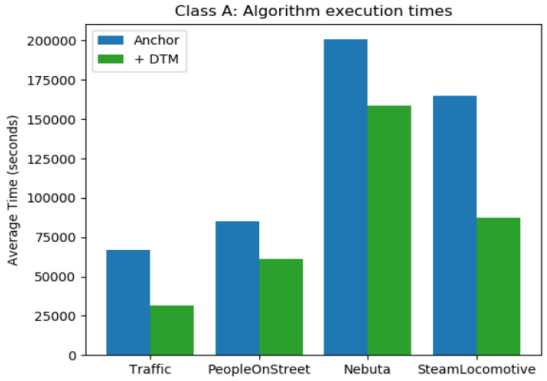
Turing codec

Applications of machine learning in video coding: Decision Trees

- Decision trees – "glass box" approach
  - Determine optimised split decision structure



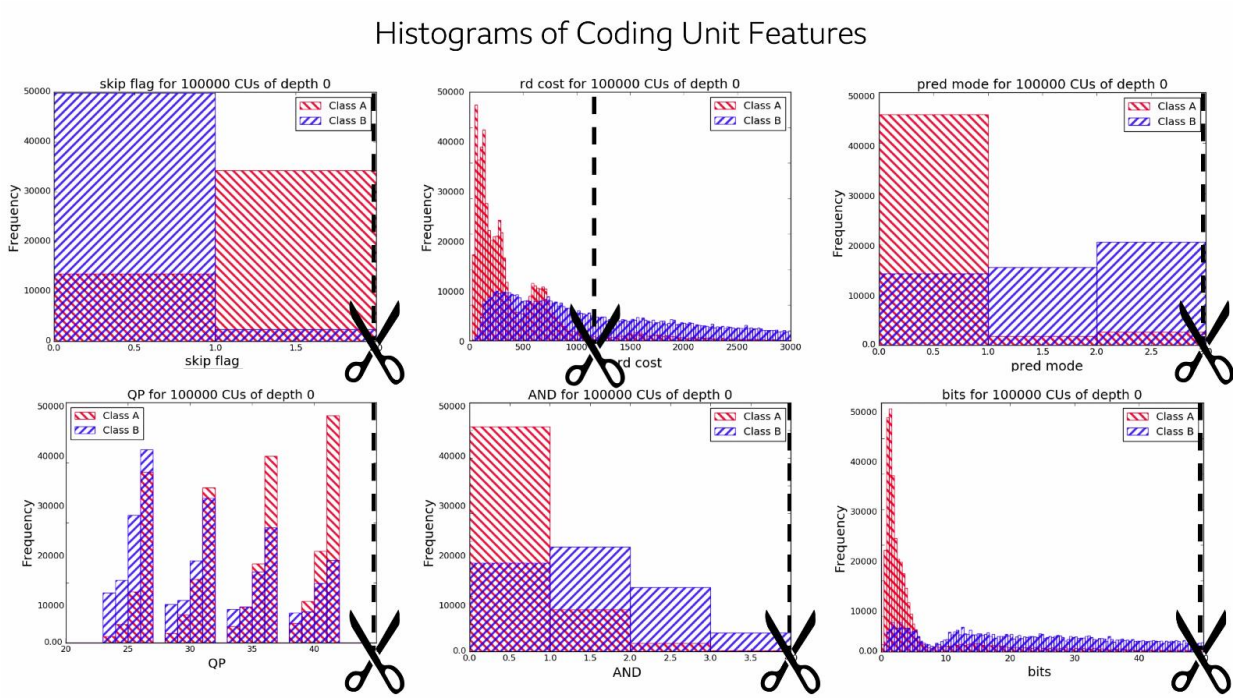




- Applied in HEVC and AV1 encoders
  - On average approx. 40% processing time saving, for less than 1% BD-rate loss

- Natasha Westland et al., "Decision Trees for Complexity Reduction in Video Compression," to appear in Proc. IEEE ICIP 2019
- Jieon Kim et al., "Fast Inter-prediction Based on Decision Trees for AV1 Encoding," in Proc. IEEE ICASSP 2019

Growing of Decision Trees



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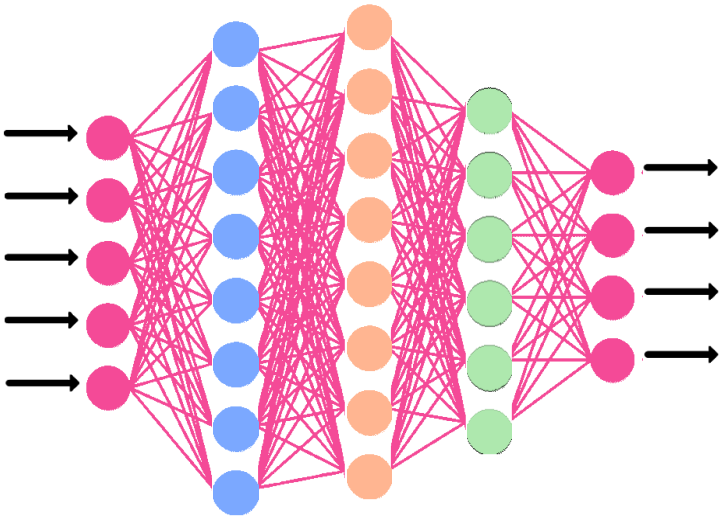
Deep learning

Deep learning

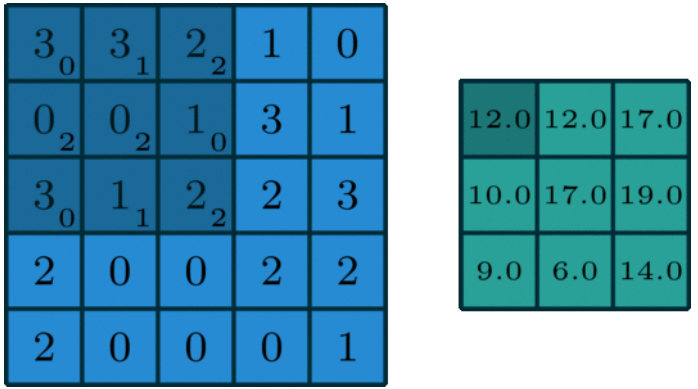


- Artificial neural networks
  - Algorithms inspired by the human brain
  - Learn from large amounts of data
  - Groups of neurons – layers (deep)
  - Learning by adapting the neurons and connections between neurons based on training data
- Why now
  - Increase in data
  - Computing power

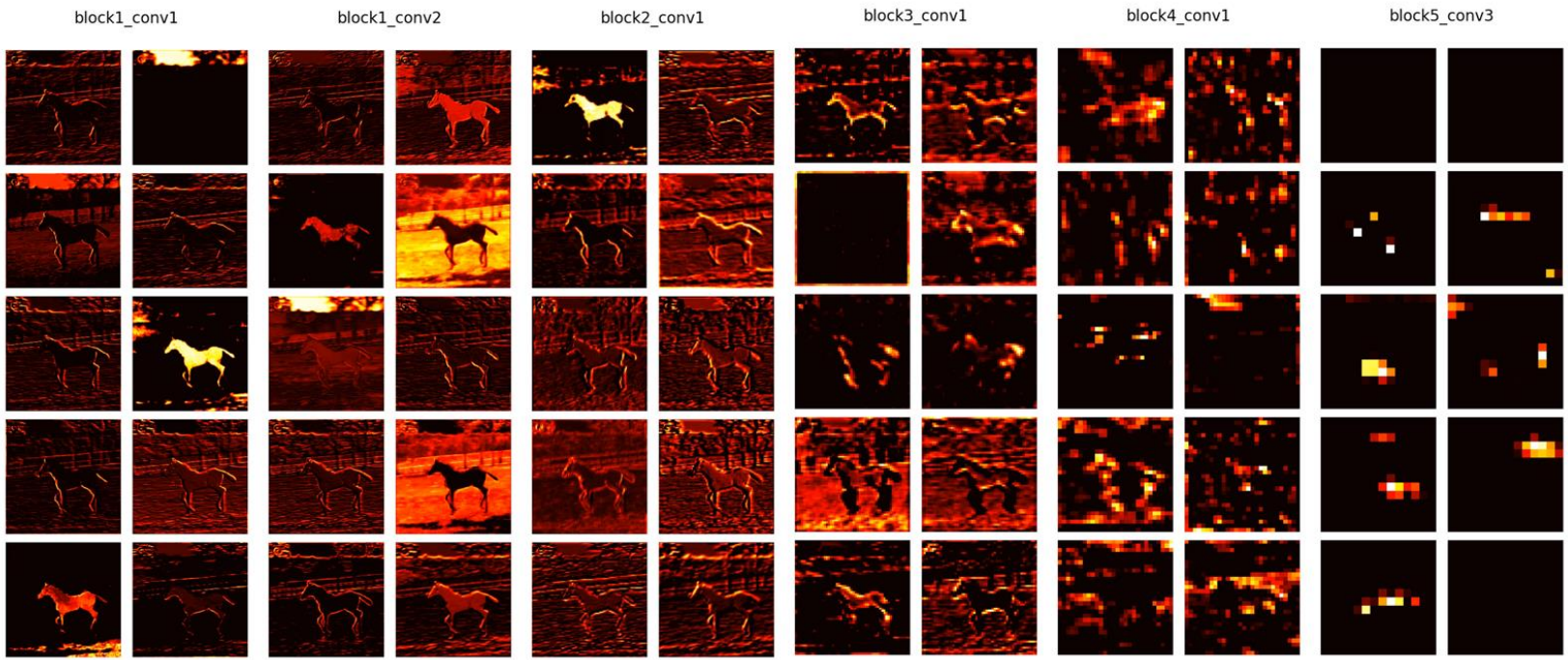
Visual data

- 50% of our neural tissue is related to vision
- Algorithms developed for visual data are very complex
  - But can help us with other data challenges

- Useful tool: 2D convolutions



An example of AI's perception of media using convolutions



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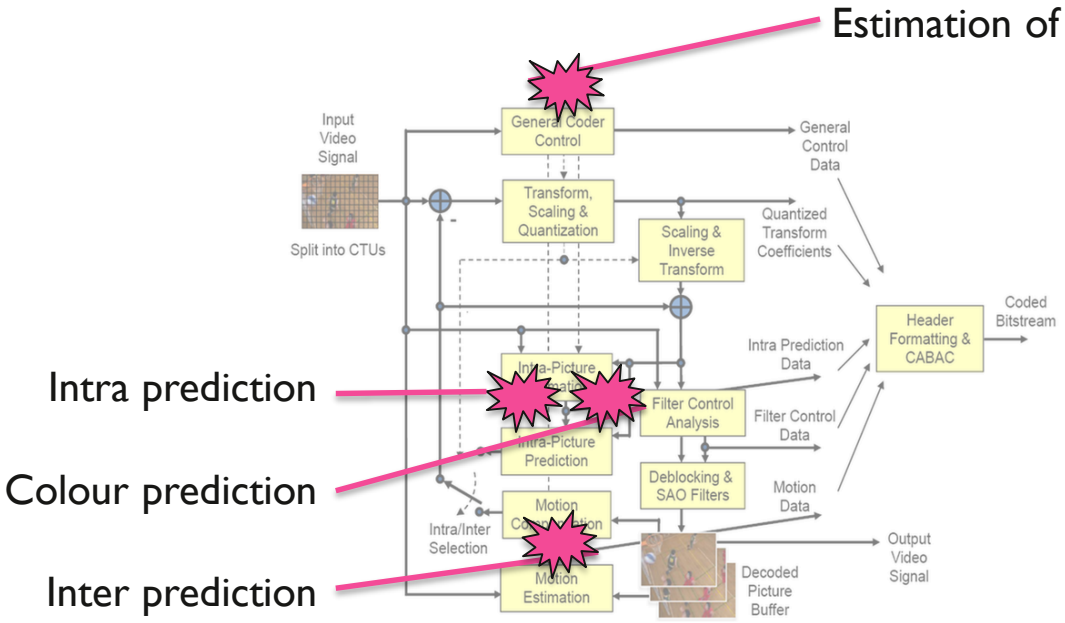
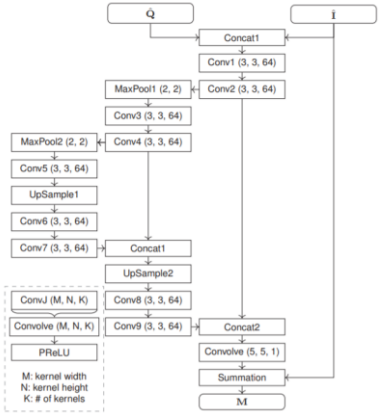
Examples of deep learning application in traditional video compression





- Maria Santamaria et al., "Estimation of Rate Control Parameters for Video Coding Using CNN," in Proc. IEEE VCIP 2018

Video coding and ML: conclusions

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- For AI to be effective, algorithms have to be carefully designed

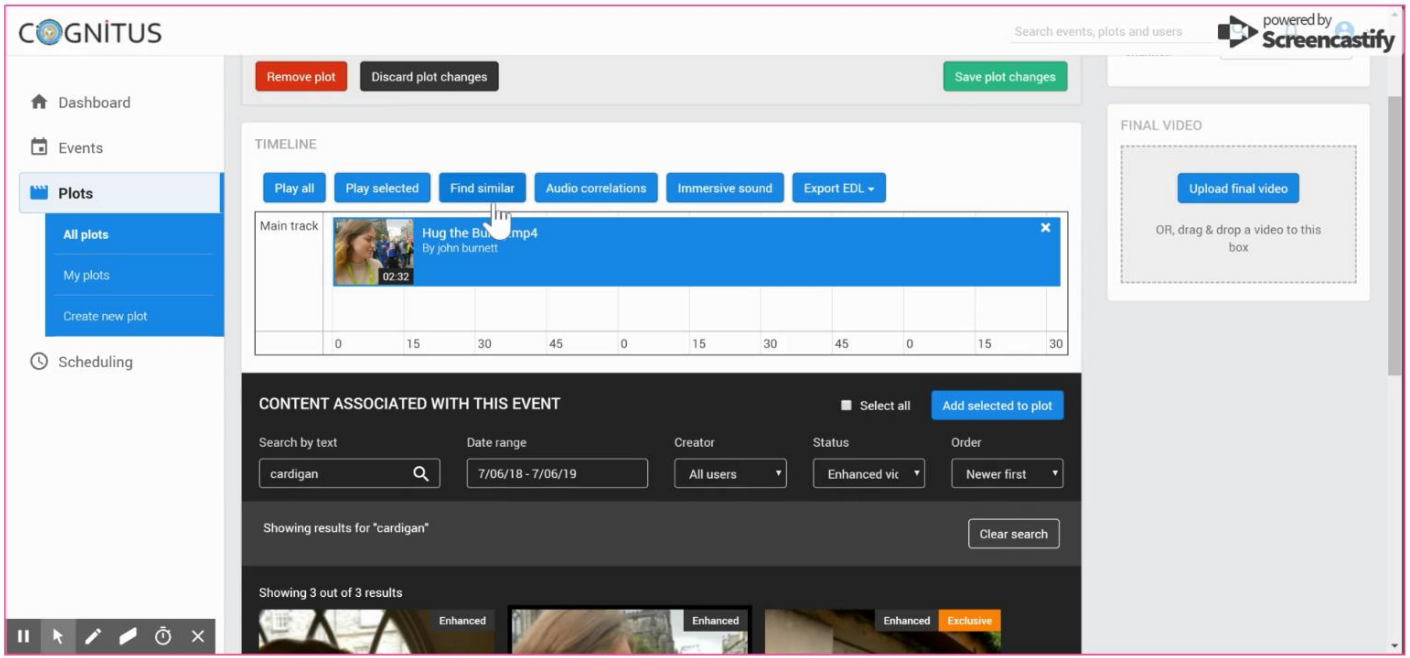
- Benefits:
  - Improved efficiency
  - Improved accuracy
  - Better decisions
  - Better predictions
  - Cost reduction
  - Quality improvement

AI gets creative

Video enhancement: super-resolution

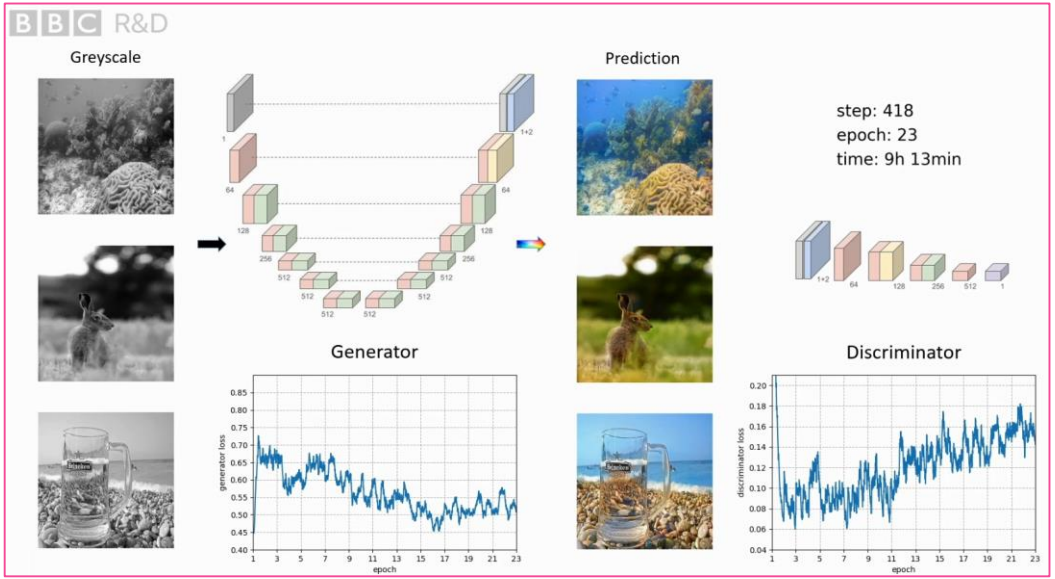
[Video not available in this version of the slides; see https://www.bbc.co.uk/rd/projects/cognitus]

Semantic enrichment



[Video not available in this version of the slides; see https://www.bbc.co.uk/rd/projects/cognitus]

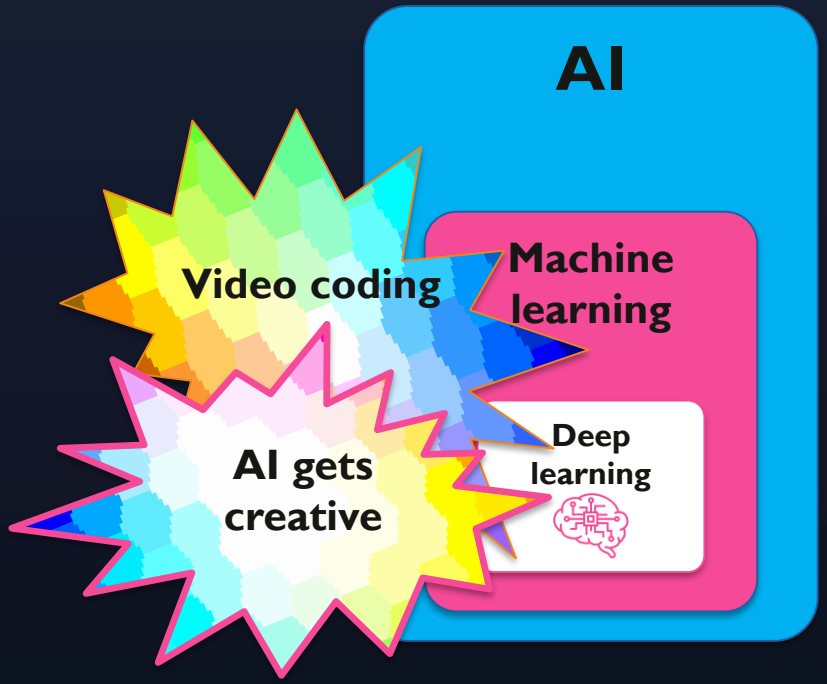
Video enhancement: colourisation



[Video not available in this version of the slides; see https://www.bbc.co.uk/rd/blog/2019-09-artificial-intelligence-colourisation-video]

jolt
MARIE CURIE ACTIONS
Horizon 2020 Programme

• Marc Gorriz Blanch et al., "End-to-End Conditional GAN-based Architectures for Image Colourisation," to appear in Proc. IEEE MMSP 2019


AI
Machine learning
Deep learning
Video coding
AI gets creative

Thank you for your attention!