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Teamwork for the final optimization

- A group of two is recommended

- Special cases:
  - Work alone
  - A group of three

- Teamwork starts from the session 6

- Plagiarism checks

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Final presentation – time and place

- Room: 0406

- Date (tentative):

  1st round: Tue, 04.02.2020, 3pm-5pm
  2nd round: Tue, 11.02.2020, 2pm-4pm
  3rd round: Tue, 24.03.2020, 2pm-4pm

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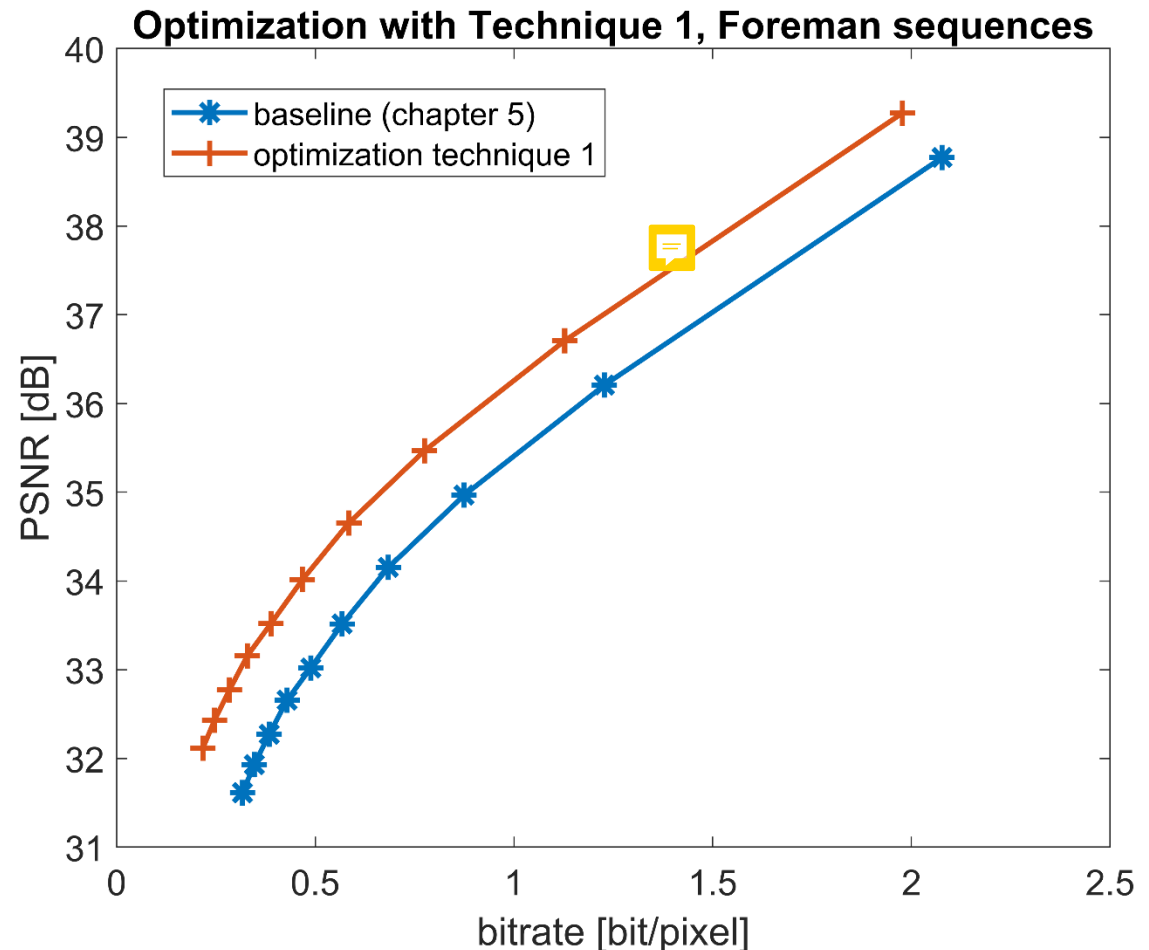Technische Universität München

Final presentation - prerequisites

- Please hand in or email to us the following items at the lastest the day before your presentation.
    - Scan of the signature page
    - Source codes of the optimized codec
    - Presentation slides
    - Outline of implemented techniques
    - Signed originality statement

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Final presentation - requirements

- 20 minutes talk + 10 minutes discussion
- Focus on the final optimization part
  - Pick up one or two topics you are really interested in and go deeper
- Show the RD curve for the „foreman" sequence
  - RD curves before and after the optimization
  - Calculate PSNR for the RGB images
  - When trying advanced algorithms, HD sequences may be helpful.

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Example RD-Curve results

- Individual plots for all optimizations + combinations

- Which sequence is adopted

- Label axes, large plots & font-size, distinctive colors, legend, clear curves, line-width

Optimization with Technique 1, Foreman sequences

Legend:
- baseline (chapter 5)
- optimization technique 1

X-axis: bitrate [bit/pixel]
Y-axis: PSNR [dB]

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Chap. 6 Codec Optimization

- Ideas source (how to come up with optimization ideas)

- Example topics from standard techniques (H.261, H.263, H.264, HEVC, VVC) and recent publications

- Forbidden topics

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Ideas Source

- ## IVC lecture notes and recordings
  - Many more techniques introduced in the lecture which we do not implement in the lab

- ## Scientific papers (IEEE Xplore, Google scholar, ArXiv)
  - Sullivan, G.J.; Ohm, J.R.; Han, W.; Wiegand, T.; , "Overview of the high efficiency video coding(HEVC) standard," IEEE Transactions on Circuits and Systems for Video Technology, vol.22, no.12, pp.1649-1668, Dec. 2012. [Link]
  - Chen, Yue, et al. "An overview of core coding tools in the AV1 video codec." 2018 Picture Coding Symposium (PCS). IEEE, 2018. [Link]

- ## Website
  - https://www.vcodex.com/hevc-an-introduction-to-high-efficiency-coding/
  - https://bitmovin.com/vvc-video-codec/
  - https://www.hhi.fraunhofer.de/en/departments/vca/research-groups/image-video-coding/research-topics.html

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Example Topics (1)

- ## Color space (RGB -> YCbCr -> other color spaces)
  - Li, Ming, et al. "*A Better Color Space Conversion Based on Learned Variances For Image Compression.*" CVPR workshops 2019. [Link]

  - Strutz, Tilo, and Alexander Leipnitz. "*Adaptive colour-space selection in high efficiency video coding.*" 2017 25th European Signal Processing Conference (EUSIPCO). IEEE, 2017. [Link]

  - Alexander Suhre, Kivanc Kose, Ahmet E. Cetin, and Metin N. Gurcan "*Content-adaptive color transform for image compression,*" Optical Engineering 50(5), 057003 (1 May 2011). [Link]

  - ……

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Example Topics (2)

- ## Bit-depth Adaptation

  - Zhang, A. , Afonso, M., & Bull, D. "*Enhanced Video Compression Based on Effective Bit Depth Adaptation*". ICIP 2019. [Link1] [Link2]

- ## Chroma subsampling and reconstruction

  - Zhu, Shuyuan, et al. "*Efficient Chroma Sub-Sampling and Luma Modification for Color Image Compression*." IEEE Transactions on Circuits and Systems for Video Technology (2019). [Link]

  - Korhonen, Jari. "Improving image fidelity by luma-assisted chroma subsampling." 2015 IEEE International Conference on Multimedia and Expo (ICME). IEEE, 2015. [Link]

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Example Topics (3)

- ## Quantization

  - ### Adaptive quantization table

    - Fu, Qiming, et al. "*A novel deblocking quantization table for luminance component in baseline JPEG*." J Comm 10.8 (2015): 629-637. [Link]

  - ### Vector quantization

    - Valin, Jean-Marc, and Timothy B. Terriberry. "*Perceptual vector quantization for video coding*." Visual Information Processing and Communication VI. Vol. 9410. International Society for Optics and Photonics, 2015. [Link1][Link2]

  - ......

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Example Topics (4)

- ## Techniques from standard video coding
  - Adaptive partitioning (HEVC, Quadtree) [Link]
  - Block-wise mode decision (H.264, HEVC)
  - Adaptive decision function J=D+λR [Link]
  - Multiple reference frames (bidirectional motion estimation)

- ## In-loop and Post-filtering
  - H.264, HEVC (in-loop filtering, deblocking, SAO) [Link1] [Link2]
  - Deep-learning based post filtering and in-loop filtering
    - Zhang, Kai, et al. "Beyond a gaussian denoiser: Residual learning of deep cnn for image denoising." IEEE Transactions on Image Processing 26.7 (2017): 3142-3155. [Link]
    - Yang, Ren, Mai Xu, and Zulin Wang. "Decoder-side HEVC quality enhancement with scalable convolutional neural network." 2017 IEEE International Conference on Multimedia and Expo (ICME). IEEE, 2017. [Link]

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Example Topics (5) 💬

- ## DWT
  - JPEG2000, Embedded Zerotree Wavelet [Link]

- ## Perceptual driven coding
  - Guetzli: Perceptually Guided JPEG Encoder by Google, 2017 [Link]

- ## Downsampling and super-resolution based
  - Jiang, Feng, et al. "An end-to-end compression framework based on convolutional neural networks." IEEE Transactions on Circuits and Systems for Video Technology 28.10 (2017): 3007-3018. [Link]

- ## Pure deep learning based
  - Rippel, Oren, and Lubomir Bourdev. "Real-time adaptive image compression." Proceedings of the 34th International Conference on Machine Learning-Volume 70. JMLR. org, 2017. [Link]
  - Minnen, David, Johannes Ballé, and George D. Toderici. "Joint autoregressive and hierarchical priors for learned image compression." Advances in Neural Information Processing Systems. 2018. [Link]

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Forbidden topics
(These are NOT considered as your workload)

- I-frame: DC/AC, DPCM

- Simple chroma subsampling with *resample*

- Arithmetic coding

- ME of fractional-pel accuracy

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Wish you a great success!