

Machine Learning and Configurable Systems: A Gentle Introduction (tutorial at SPLC'19)

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<https://github.com/VaryVary/>



Case: x264

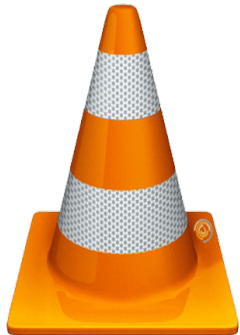
- Widely considered in the literature
- Performance prediction
- Regression problem vs Classification problem
 - Metrics
 - Precision/recall != MAE
 - Algorithm level (classification vs regression tree)

```
x264 --no-progress
      --no-asm
      --rc-lookahead 60
      --ref 9
      -o trailer_480p24.x264
trailer_2k_480p24.y4m
```



?? seconds





<code>--psy-rd <float:float></code>	Strength of psychovisual optimization ["1.0:0.0"] #1: RD (requires subme>=6) #2: Trellis (requires trellis, experimental)
<code>--no-8x8dct</code>	Disable adaptive spatial transform size
<code>-t, --trellis <integer></code>	Trellis RD quantization. [1] - 0: disabled - 1: enabled only on the final encode of a MB - 2: enabled on all mode decisions
<code>--nr <integer></code>	Noise reduction [0]
<code>--cqmfile <string></code>	Read custom quant matrices from a JM-compatible file
Input/Output:	
<code>-o, --output <string></code>	Specify output file
<code>--muxer <string></code>	Specify output container format ["auto"] - auto, raw, mkv, flv
<code>--demuxer <string></code>	Specify input container format ["auto"] - auto, raw, y4m, avs
<code>--input-fmt <string></code>	Specify input file format (requires lavf support)
<code>--input-csp <string></code>	Specify input colorspace format for raw input
<code>--output-csp <string></code>	Specify output colorspace ["i420"] - i420, i422, i444, rgb
<code>--input-depth <integer></code>	Specify input bit depth for raw input
<code>--input-range <string></code>	Specify input color range ["auto"] - auto, tv, pc
<code>--input-res <intxint></code>	Specify input resolution (width x height)
<code>--index <string></code>	Filename for input index file
<code>--sar width:height</code>	Specify Sample Aspect Ratio
<code>--fps <float rational></code>	Specify framerate
<code>--seek <integer></code>	First frame to encode
<code>--frames <integer></code>	Maximum number of frames to encode
<code>--level <string></code>	Specify level (as defined by Annex A)
<code>--bluray-compat</code>	Enable compatibility hacks for Blu-ray support
<code>--avcintra-class <integer></code>	Use compatibility hacks for AVC-Intra class - 50, 100, 200
<code>--stitchable</code>	Don't optimize headers based on video content Ensures ability to recombine a segmented encode

Performance Prediction



```
x264 --no-progress  
--no-asm  
--rc-lookahead 60  
--ref 9  
-o trailer_480p24.x264  
trailer_2k_480p24.y4m
```



40 seconds

Performance Prediction



```
x264 --no-mbtree  
--rc-lookahead 40  
--ref 9  
-o trailer_480p24.x264  
trailer_2k_480p24.y4m
```



10 seconds

Performance Prediction



x264 ...

```
-o trailer_480p24.x264  
trailer_2k_480p24.y4m
```



??? seconds

Performance Prediction



```
x264 --no-mbtree
--rc-lookahead 40
--ref 9
-o trailer_480p24.x264
trailer_2k_480p24.y4m
```



??? seconds

no_8x8dct	no_asm	no_cabac	no_deblock	no_fast_pskip	no_mbtree	no_mixed_refs	no_weightb	rc_lookahead	ref	size	elapsedtime
True	False	False	True	True	False	True	True	20	9	1718492	3.444
True	False	True	False	True	False	False	True	40	9	1962957	4.744
True	False	False	True	False	True	True	False	40	1	3657562	2.427
True	False	True	False	True	True	True	False	40	9	3436410	3.447
False	False	False	True	False	False	True	False	60	5	2066645	2.957

Regression problem (linear regression, regression tree, random forest, gradient boosting, SVM, etc.)

Guo et al. ASE 2013, Apel et al. ASE'15, Czarnecki et al. SPLC'15,
Siegmond et al. FSE'15, Kastner et al. ASE'17, Menzies et al.
FSE'17, Batory et al. FSE'17

Exercise on x264

- See instructions/notebook
- MAPE/MSE/MAE metric
- Interpretability
- Effect of
 - Training set size
 - Hyperparameters
 - Algorithms (eg gradient boosting tree)