

Multi-sensor rail track detection in automatic train operations

Master's thesis in Data Science

Student: Attila Kovacs

1st Advisor: Lukas Rohatsch (FH Technikum)

2nd Advisor: Daniele Capriotti (M2C Expert Control GmbH)

Alignment: 02.02.2024

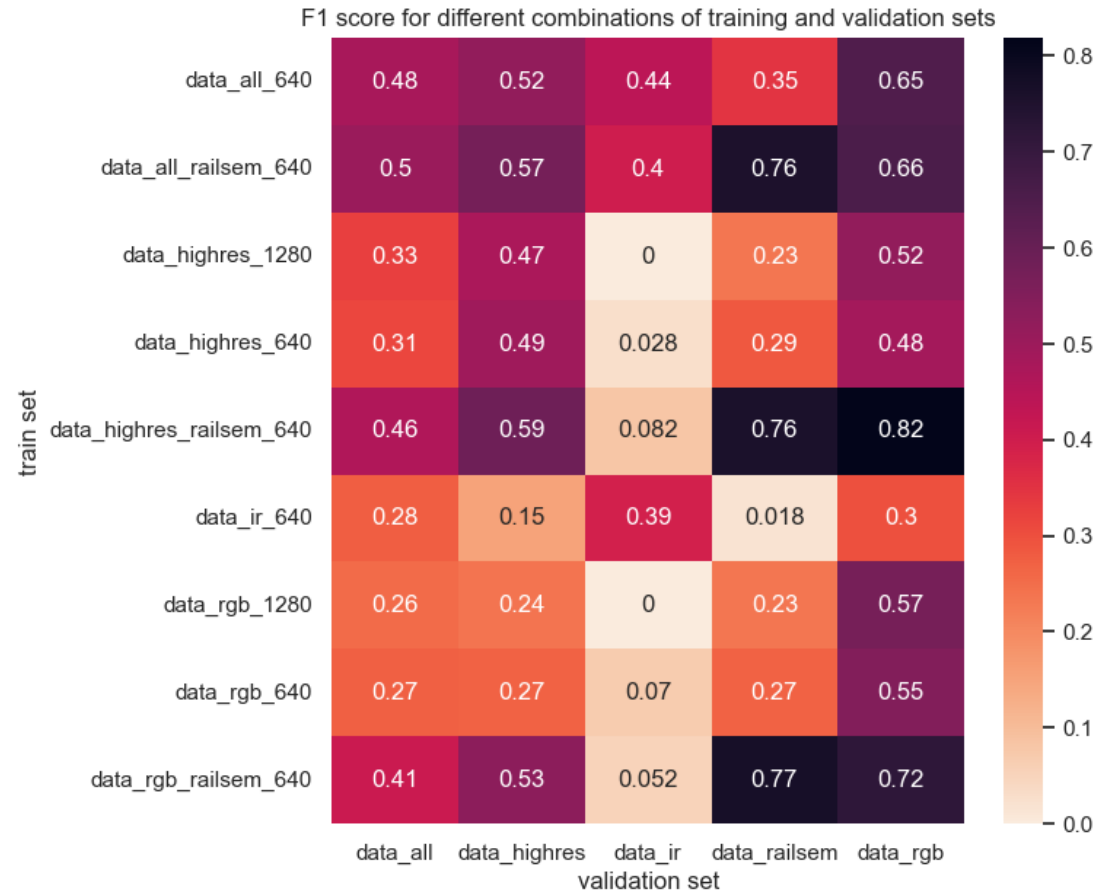


Outline

- Model comparison
- Parameter tuning
- Results on test set
- Next steps

Nine models have been trained and validated

Parameters set by YOLO

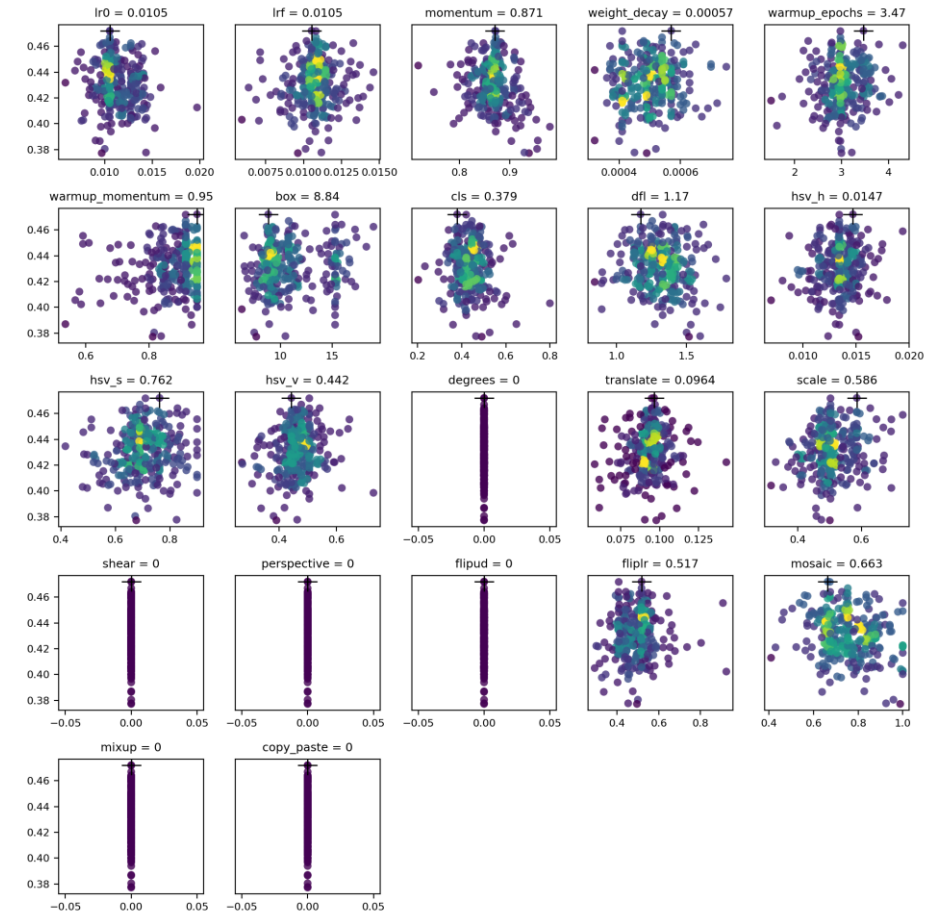
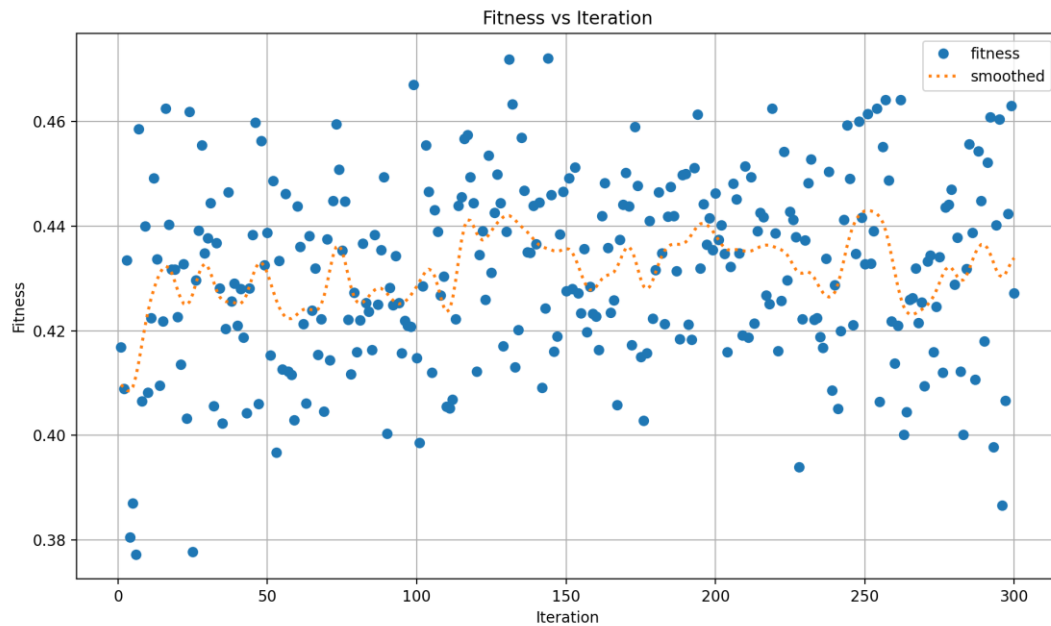


Parameter tuning

- Best models trained on:
 - data_highres + railsem with 640x640 pixels for RGB, Highres Images
 - data_ir with 640x640 pixels for IR images
- These models have been finetuned
 - 300 iterations
 - 30 epochs each
 - Optimizer: Adam vs SGD
 - 16 parameters, respectively
 - Parameters are adjusted by evolutionary algorithm
- Computational resources are a limiting factor → only 10% of training data was used
- Tuning took ~ 520h with 12 CPU + GPU

Parameter tuning

Evolution of parameters for data_highres_railsem_sgd

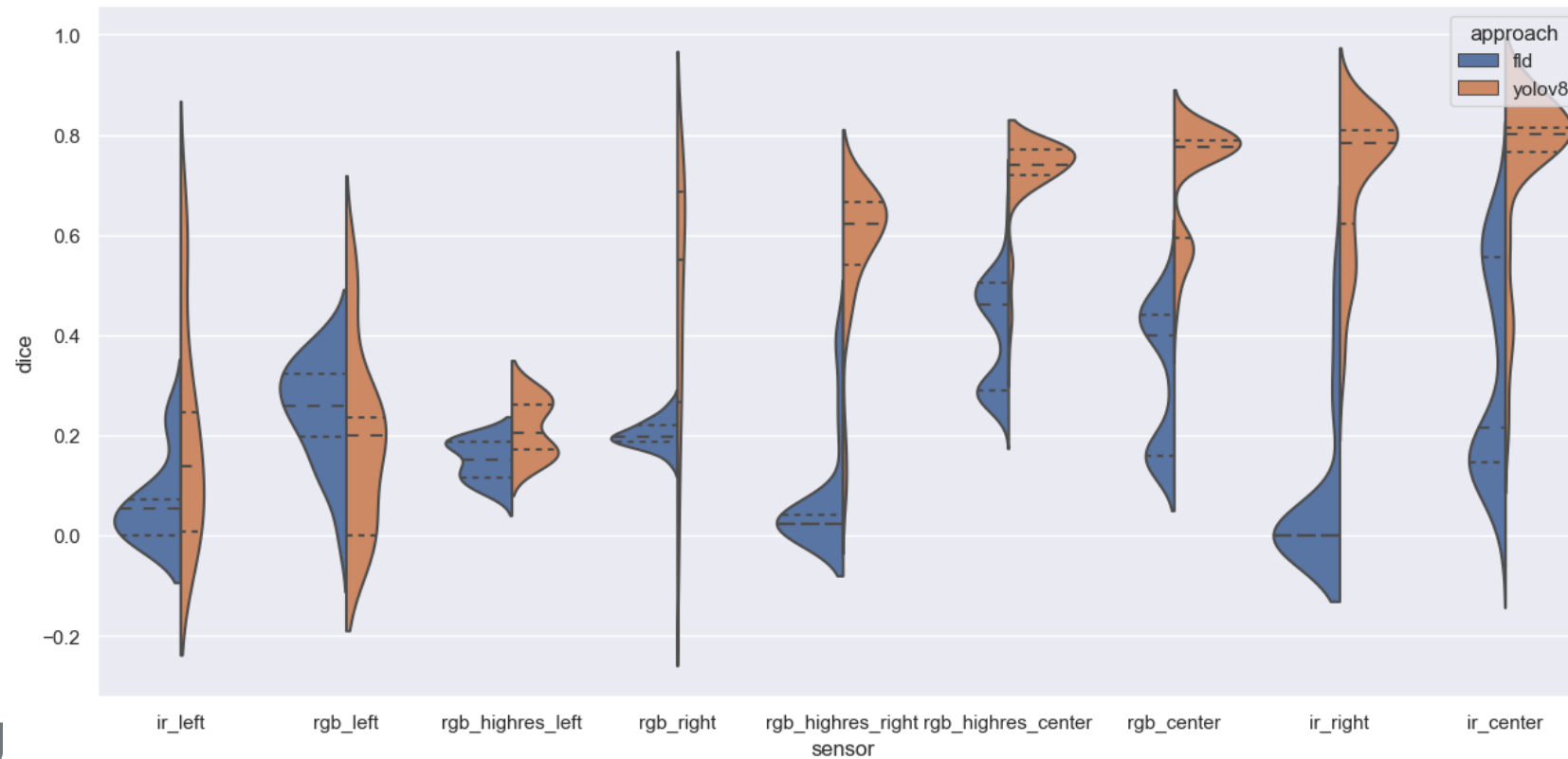


Parameter tuning

Default setting provides good results

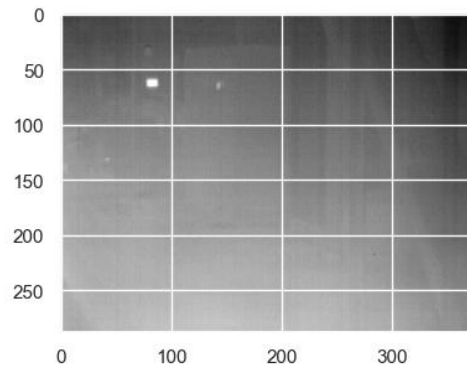
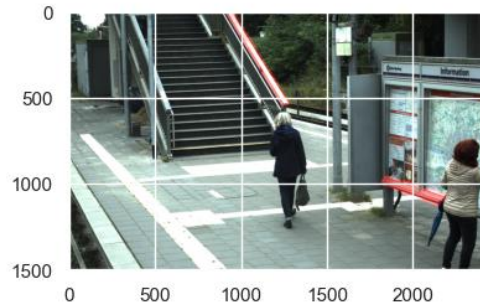
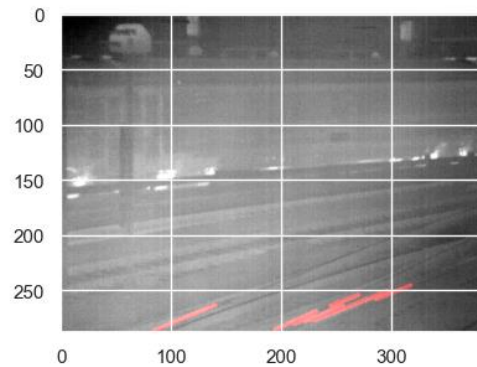
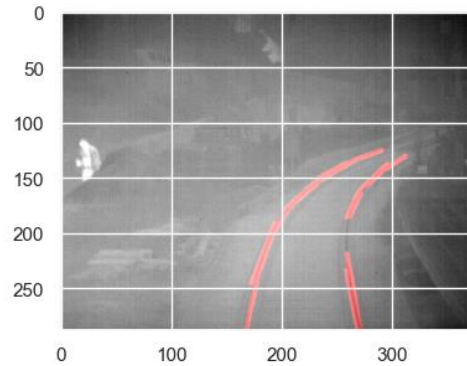
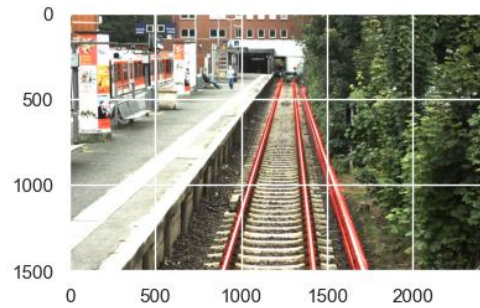
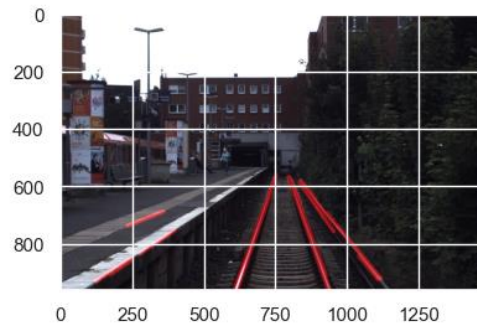
validation_set	Dice - auto	Dice - sgd	Dice - adam	sgd_vs_auto [%]	adam_vs_auto [%]
data_ir	0.440	0.425	0.375	-3.323	-14.703
data_highres	0.587	0.5960	0.558	1.479	-4.912
data_railsem	0.758	0.765	0.766	0.878	1.056
data_rgb	0.818	0.774	0.752	-5.439	-8.140

Results on test set



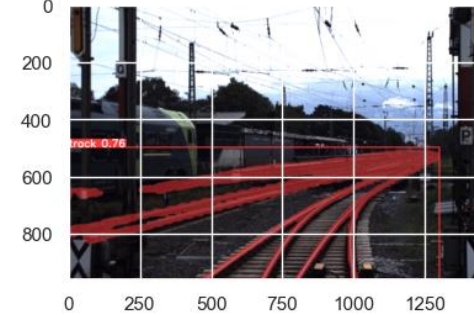
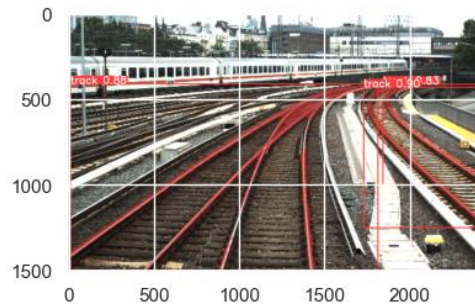
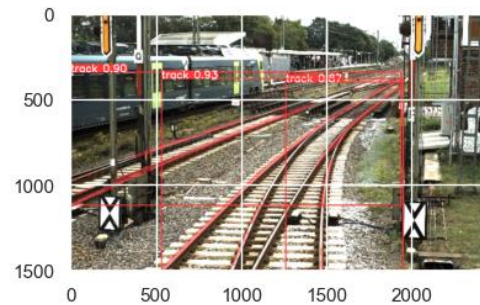
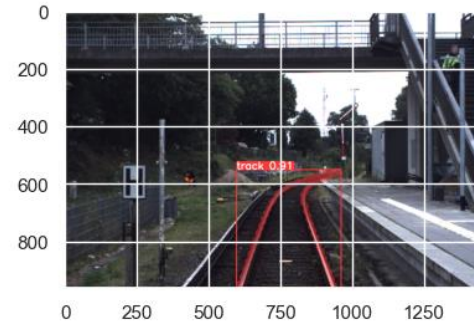
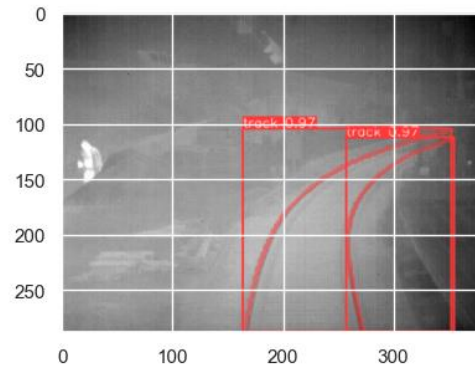
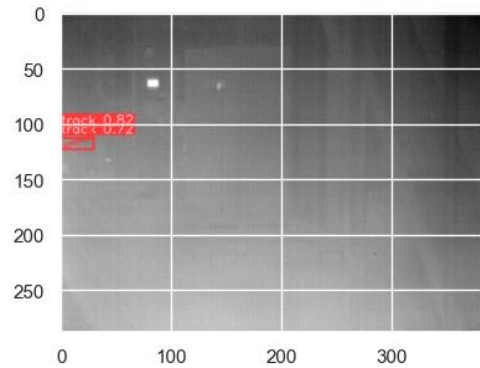
FLD

Good examples and bad examples

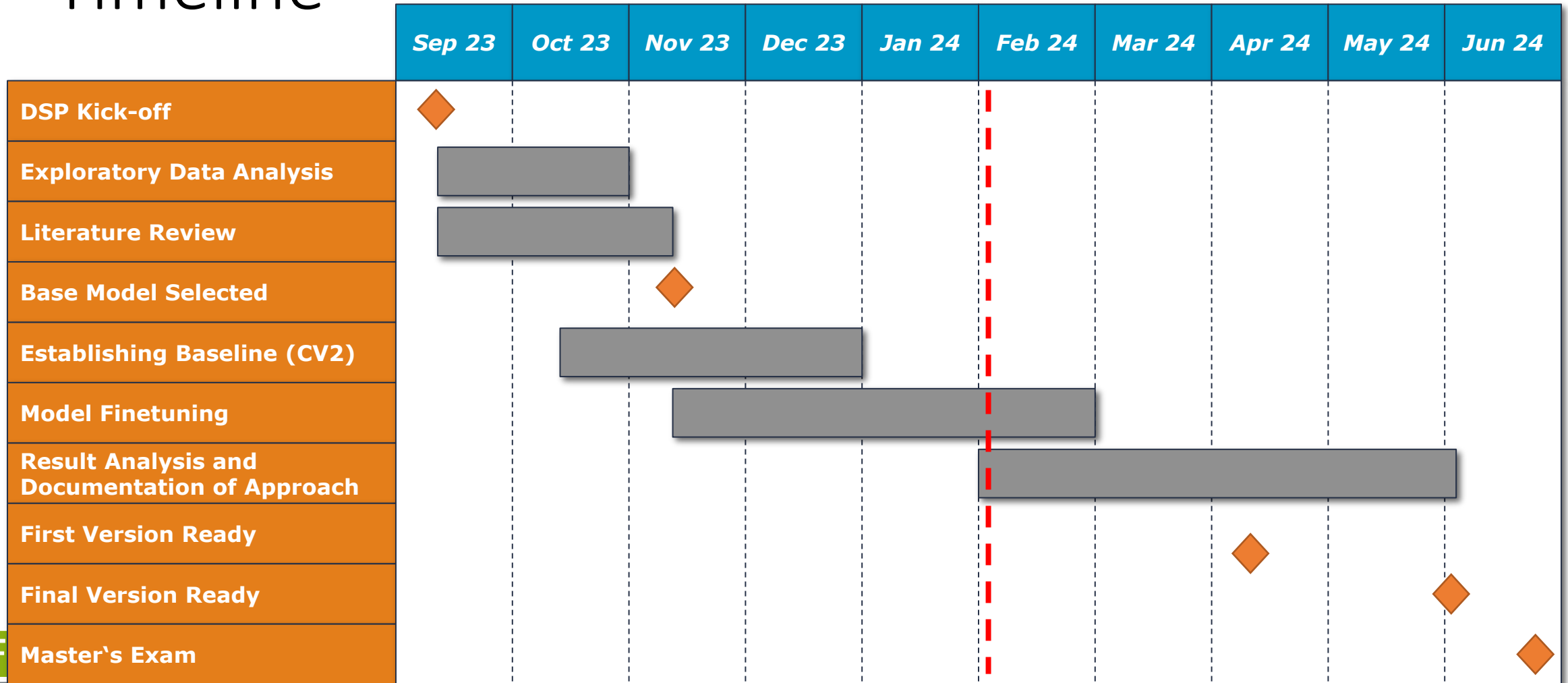


YOLO

Good examples and bad examples



Timeline



Thank you!

YOLOv8 vs FDL

Performance on **validation** data

