ROC Curve - 101
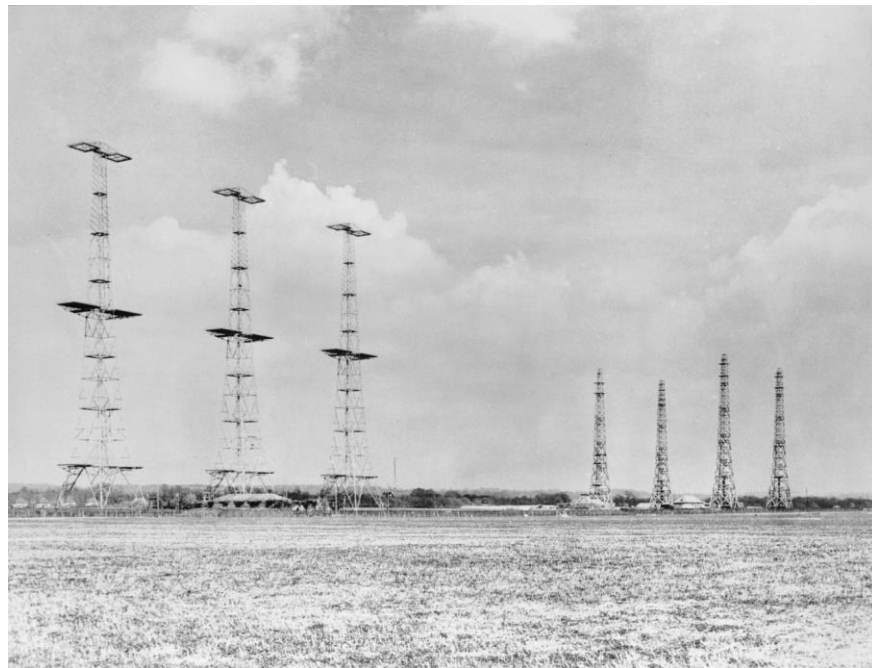
Bert Gollnick

Receiver Operating Characteristics (**ROC**) Curve

- First developed and used during WWII for detecting enemy objects in battlefields
- Later used in psychology, medicine, forecasting of natural hazards, …
- … and finally **model performance assessment**

Source: https://commons.wikimedia.org/wiki/File: Chain_Home_radar_installation_at_Poling,_Sussex,_1945._CH15173.jpg
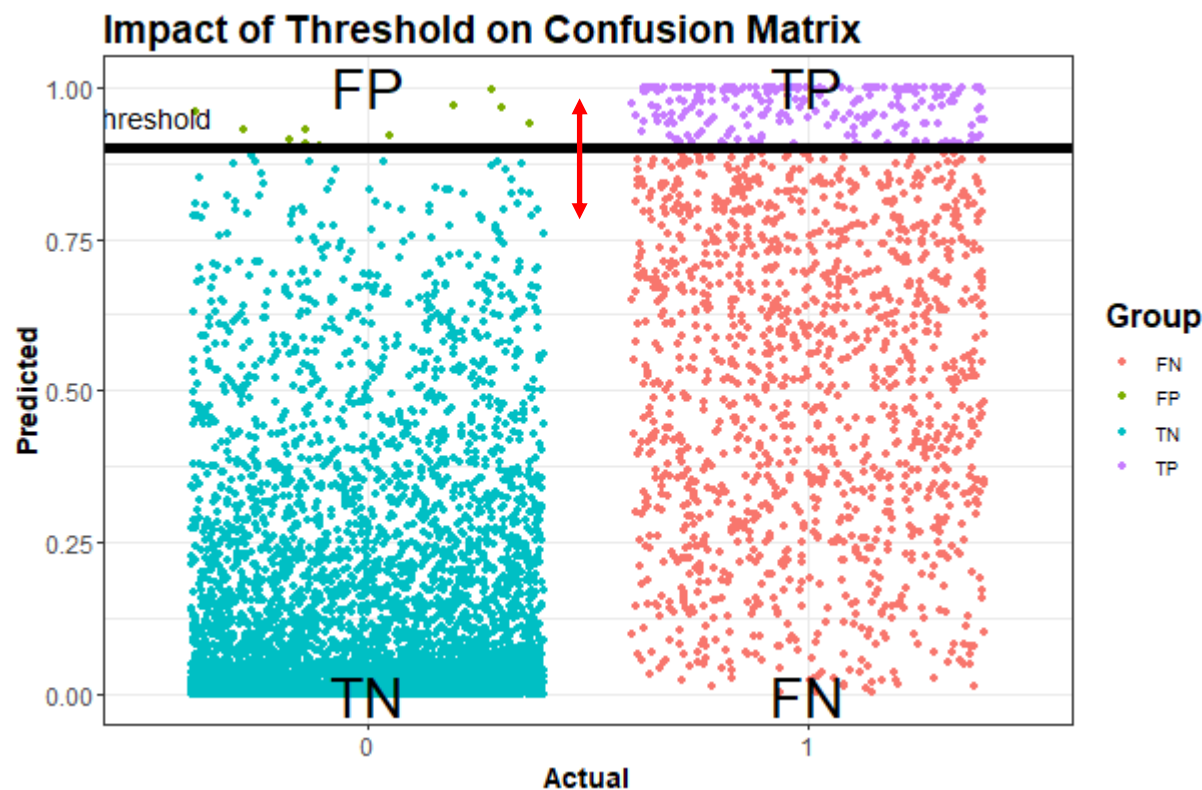
ROC Curve - 101

From Confusion Matrix to ROC Curve

Impact of Threshold on Confusion Matrix
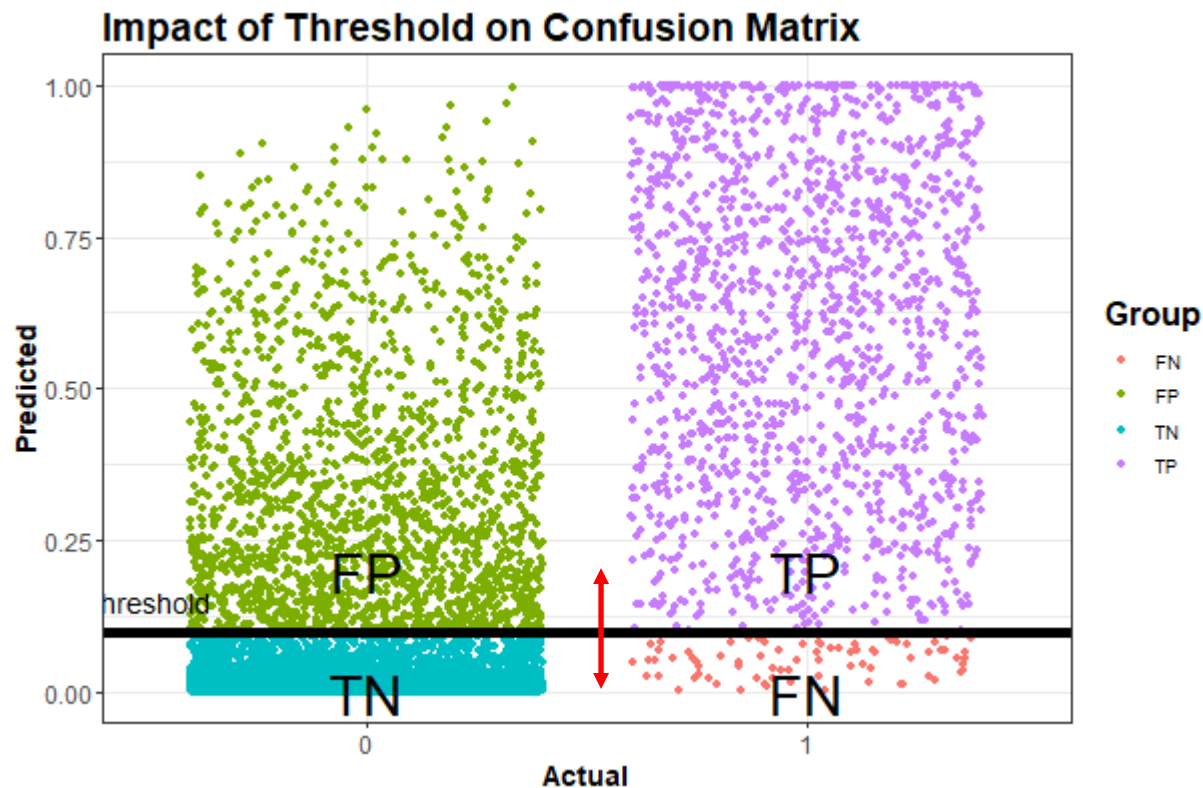
Actuals	PredNeg	PredPos
ActNeg	3117	1842
ActPos	84	1469

ROC Curve - 101

From Confusion Matrix to ROC Curve

Impact of Threshold on Confusion Matrix

Actuals	PredNeg	PredPos
ActNeg	4948	11
ActPos	1305	248

ROC Curve - 101

From Confusion Matrix to ROC Curve

		Predicted Class	
		Yes	No
Actual Class	Yes	True Pos (Hit)	False Neg (Type I Error)
	No	False Pos (Type II Error)	True Neg (Correct Rejection)

$$TPR = \frac{TP}{TP + FN}$$

→ Y Axis on ROC Curve

ROC Curve - 101

From Confusion Matrix to ROC Curve

	Predicted Class	
	Yes	No
Actual Class Yes	True Pos (Hit)	False Neg (Type I Error)
No	False Pos (Type II Error)	True Neg (Correct Rejection)

$$FPR = \frac{FP}{FP + TN}$$
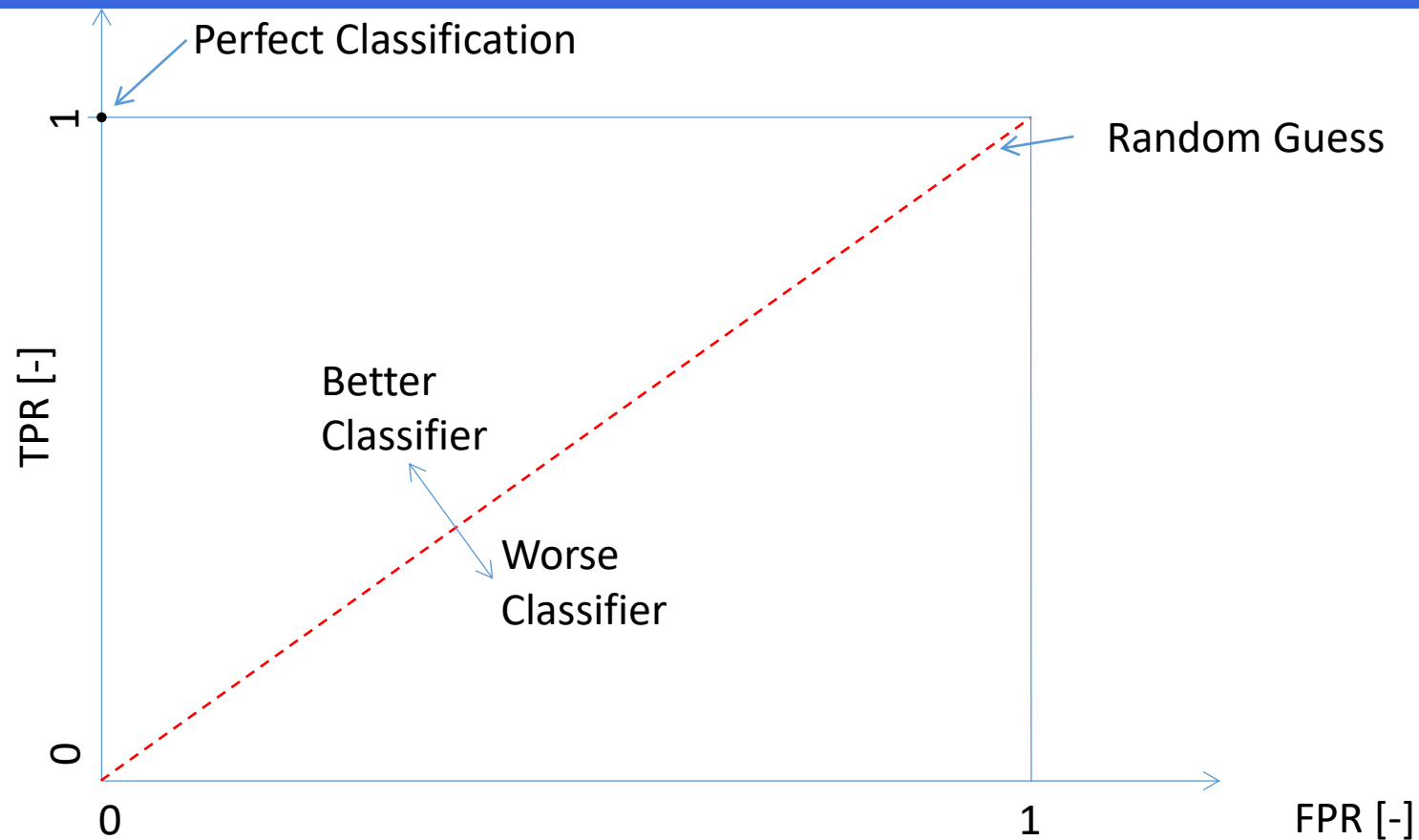
→ X Axis on ROC Curve

ROC Curve - 101

From Confusion Matrix to ROC Curve

Example

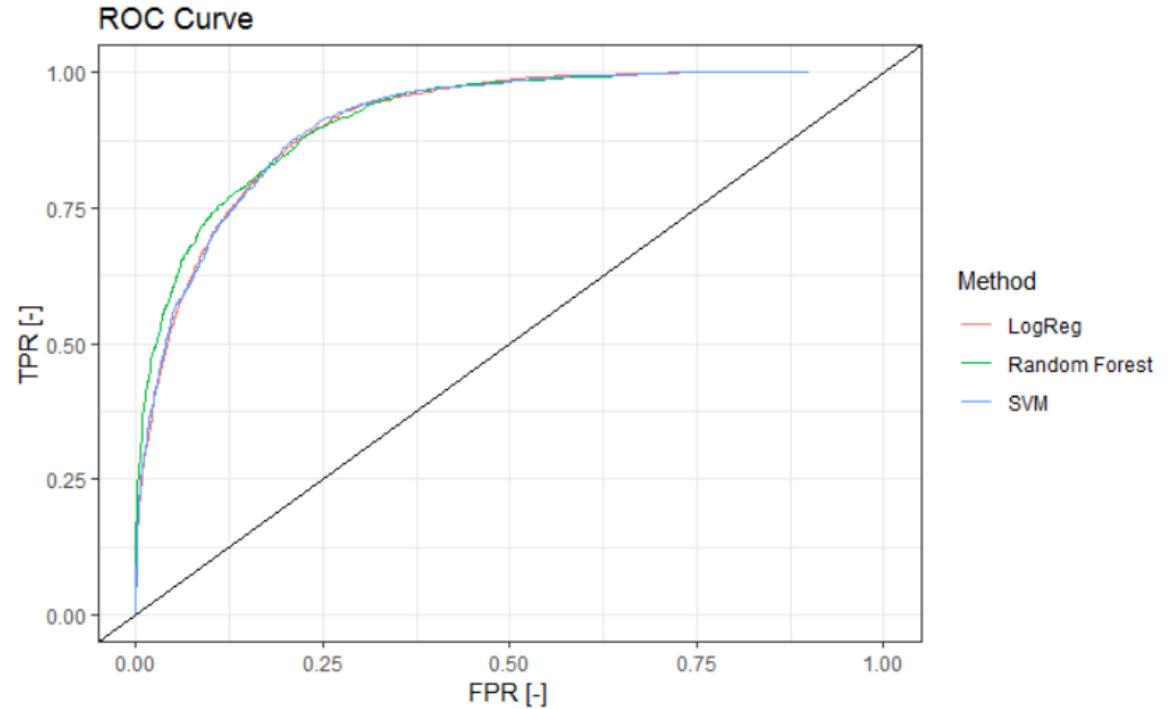| Threshold	TN	FP	FN	TP	FPR	TPR
0.01	1318	3641	3	1550	0.73	1
0.02	1776	3183	10	1543	0.64	0.99
…						
0.98	4958	1	1431	122	0	0.08
0.99	4958	1	1448	105	0	0.07

ROC Curve - 101

ROC Curve - 101

- Different methods can be compared
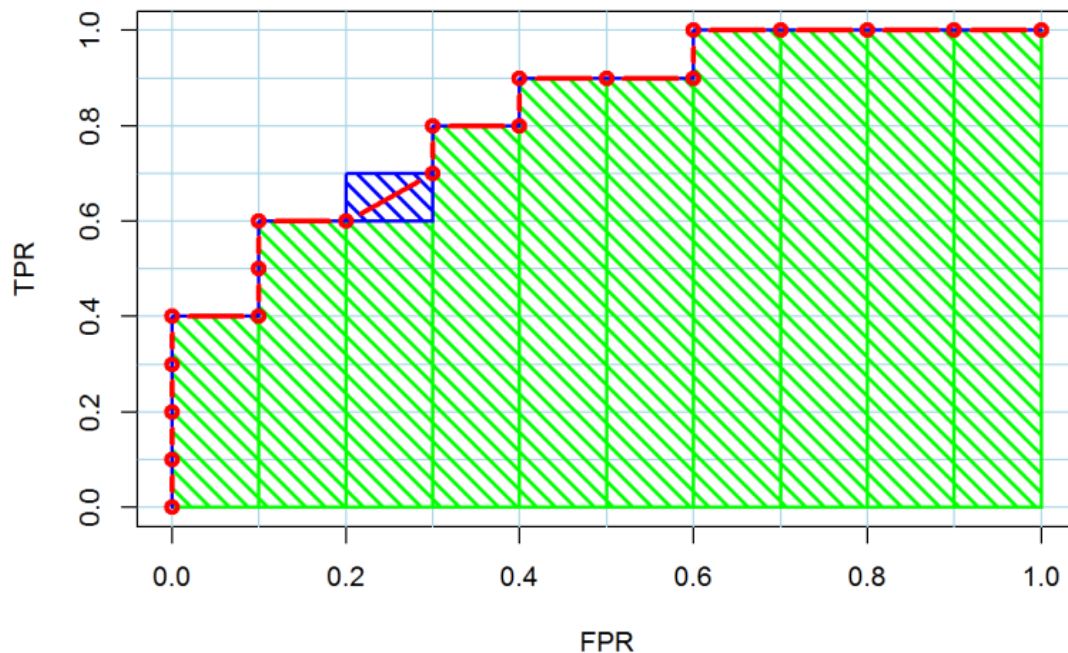

Source: own graph

ROC Curve - 101

Model Evaluation: Area Under Curve

Area under curve
- Maps ROC to one measure
- Purpose: compare different models

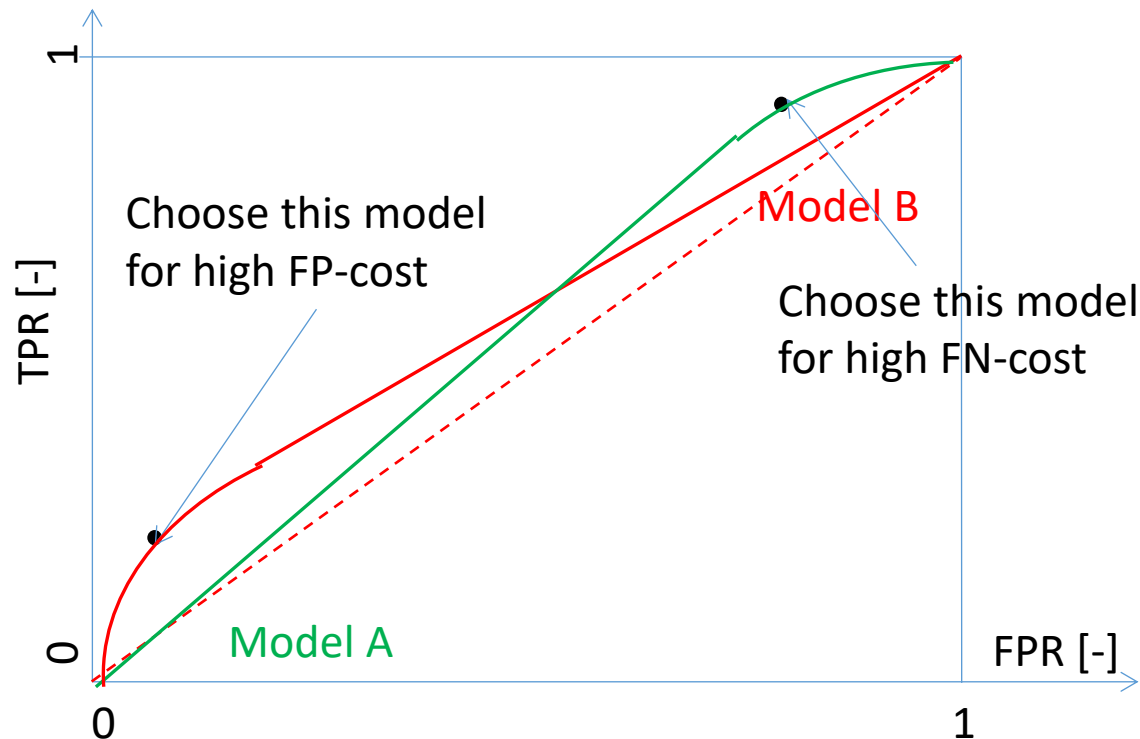Calculates as:
- Sum of green squares
- Half of blue squares

Source: http://blog.revolutionanalytics.com/2016/11/calculating-auc.html

ROC Curve - 101

Model Evaluation: Loss Curve

- Model A: AUC = 0.6
- Model B: AUC = 0.58
- Which model should you choose? → That depends ☺
- FN and FP might not value identical
- Example: WWII detection of enemy submarine attacks
→ False Negatives (actual attack, predicted no) more critical than False Positive.
- For this you can add different costs, e.g. FN-Cost = 10, FP-Cost = 1

Choose this model for high FP-cost

Model B

Choose this model for high FN-cost

Model A

TPR [-]

FPR [-]

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- The images show the same model, colored with different cost-penalties.