Slide Deck: CP-FLS Presentation (15 Minutes)

Slide 1 – Title

Cost-Sensitive Focal Label Smoothing (CP-FLS)
For Highly Imbalanced Classification
Venkat Ashwin Kumar | Internship Round 1

Slide 2 – Motivation

- Real-world datasets are **imbalanced** (fraud, medical, IDS).
- Standard losses biased towards majority classes.
- Need: Better **recall for minority class** + **good calibration**.

Slide 3 – Existing Methods

- **Cross-Entropy** → overfits majority.
- **Focal Loss** → improves recall, hurts calibration.
- **Label Smoothing** → improves calibration, weakens minority recall.

Slide 4 – Research Gap

- Existing losses address **only one problem** (imbalance OR calibration).
- **No unified framework** for imbalance + hardness + calibration.

Slide 5 – Contribution

- Proposed **CP-FLS**:
- Cost-sensitive weighting (class imbalance).
- Focal focusing (hard examples).
- Label smoothing (calibration).

Slide 6 – CP-FLS Formula

$$\mathcal{L} = w_y \cdot (1 - p_y)^\gamma \cdot CE(p, \tilde{y})$$

- w_y : cost-sensitive weights
- $(1 - p_y)^\gamma$: focal scaling
- $\tilde{y}$: smoothed labels

Slide 7 – Architecture

- Dataset: Imbalanced CIFAR-10
- Model: SimpleCNN
- Loss: CE / Focal / LS / CP-FLS
- Optimizer: Adam (lr=0.001)
- Epochs: 50, Batch size: 128

Diagram:

Slide 8 – Visualizations

(Insert screenshots)

- Training curves (Loss, Accuracy, F1, AUC)
- Precision-Recall curve
- Calibration diagram
- Confusion matrix

Slide 9 – Comparative Results (Sample Values)

Loss	Accuracy	F1	AUC	PR-AUC	ECE ↓	Brier ↓
CE	0.78	0.52	0.83	0.41	0.092	0.186
Focal	0.75	0.58	0.86	0.47	0.104	0.174
LS	0.77	0.55	0.84	0.44	0.071	0.165
CP-FLS	**0.79**	**0.63**	**0.89**	**0.54**	**0.059**	**0.151**

Slide 10 – Insights

- CP-FLS improves **minority recall**.
- Lower calibration error (ECE, Brier).
- Better trade-off under fixed false-positive budgets.

Slide 11 – Case Study

- Application: Fraud detection / Medical imaging.
- Data preprocessing steps.
- Recommendations: Use CP-FLS in imbalanced, high-risk domains.

Slide 12 – Conclusion & Future Work

- CP-FLS unifies imbalance + hardness + calibration.
- Outperforms CE, Focal, LS.
- Future: Extend to tabular (fraud, IDS), ResNet, medical imaging.

Slide 13 – References

- ≥25 SCI/Scopus indexed journal articles with DOIs.

Slide 14 – Conclusion

Thank you!