

SNS COLLEGE OF TECHNOLOGY

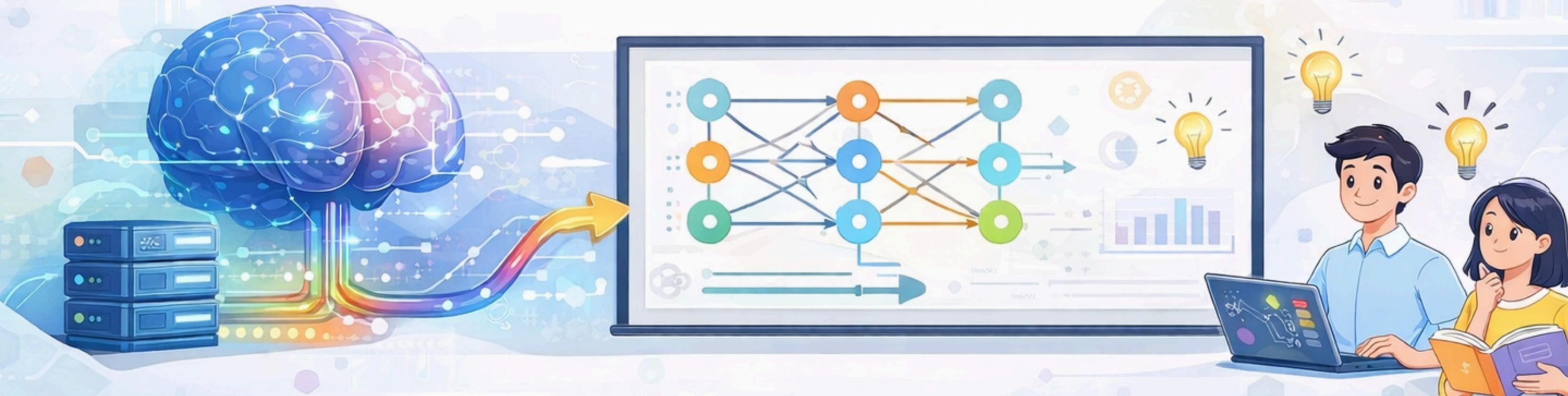
An Autonomous Institution

Coimbatore-35

Autoencoders and Variational Autoencoders (VAEs)

A Design Thinking Approach

23ECE604-GENAI AND AGENTIC AI SYSTEMS FOR ELECTRONICS ENGINEER



Empathize – Understanding the Problem



Interviews



Surveys



Empathy Maps

Define – Clearly Articulating the Problem

Problem Summary

Students struggle to improve in math because they lack personalized feedback and find practice problems unengaging.

- Who?** – Struggling Math Students
- What?** – Lack of personalized feedback
- Why?** – Unengaging Practice

How might we help them? !

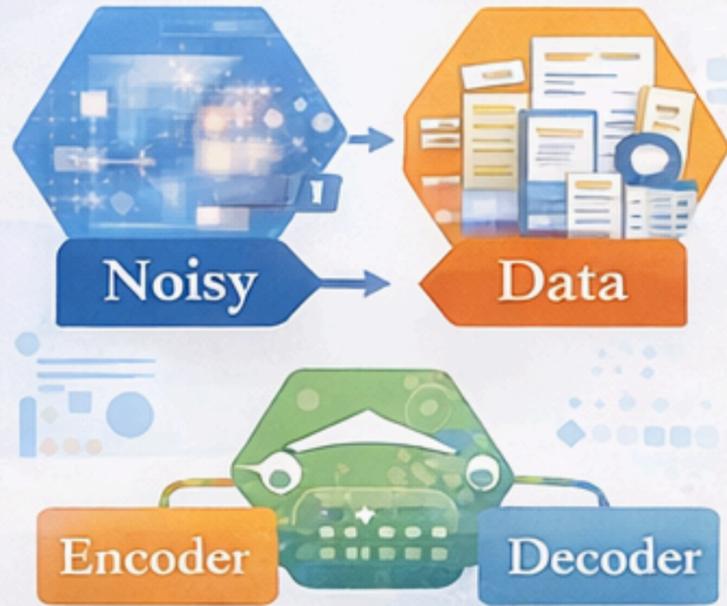


How might we help them?

💡 IDEATE — Stage 3

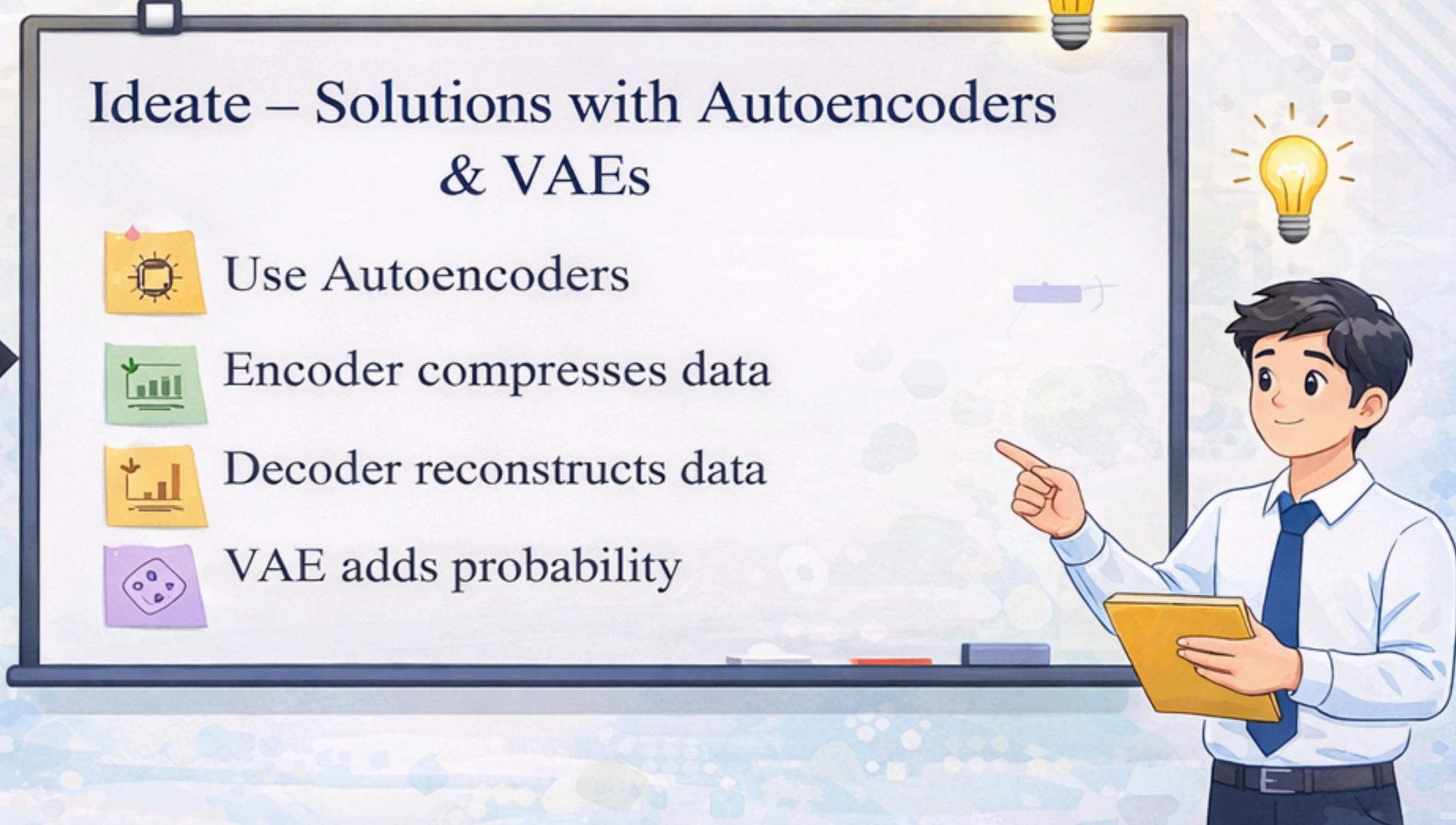
Ideate – Solutions with Autoencoders & VAEs

Empathize findings

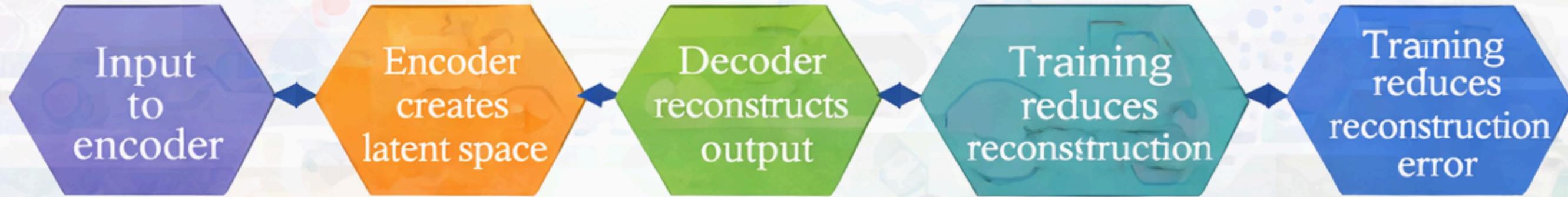


Ideate – Solutions with Autoencoders
& VAEs

- 📁 Use Autoencoders
- 📈 Encoder compresses data
- 📈 Decoder reconstructs data
- 📊 VAE adds probability



Prototype – Training with Autoencoders & VAEs



Prototype – Training with Autoencoders & VAEs



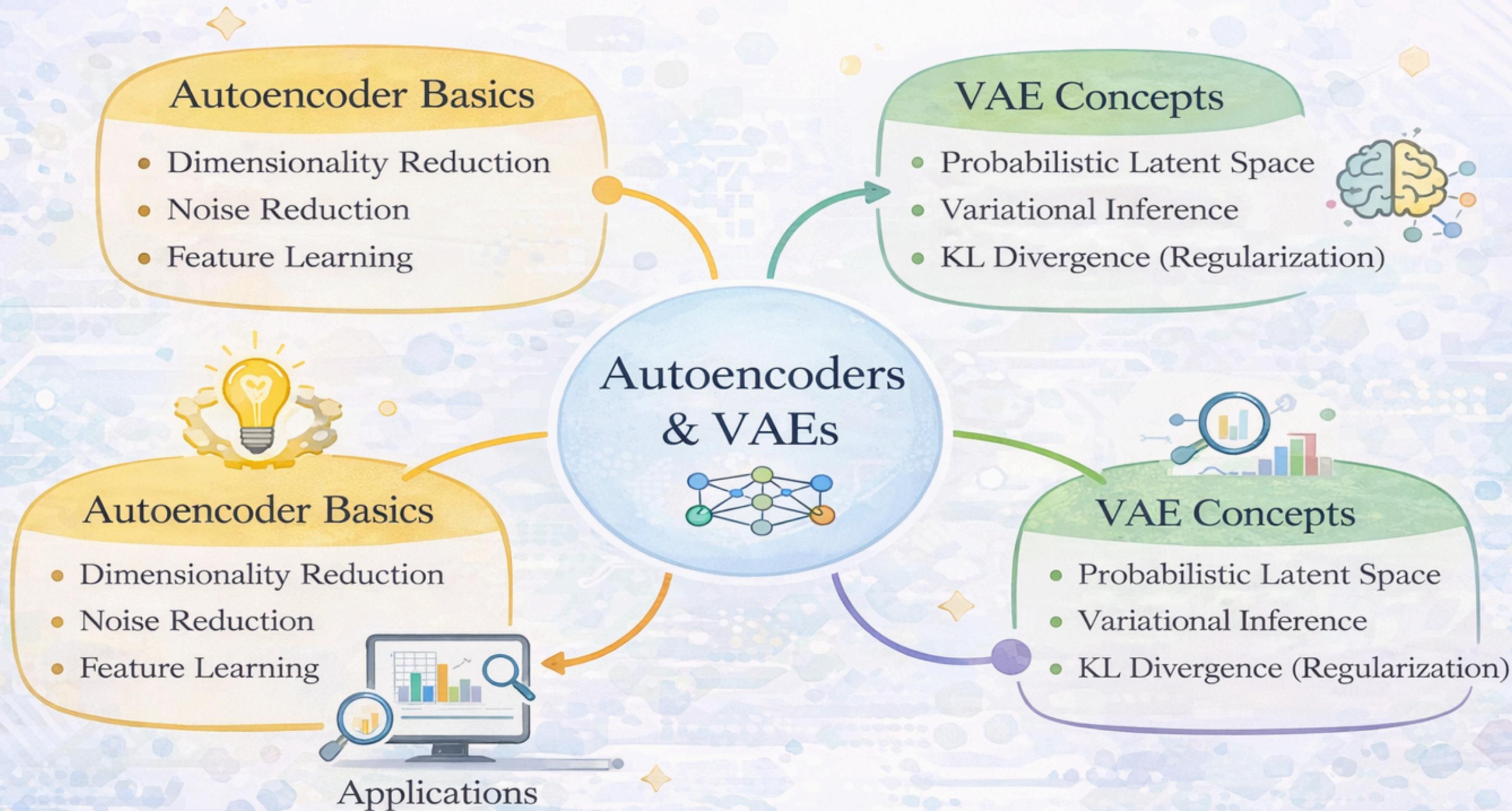
-  Use latent encoders
-  Encoder reconstructs data
-  Decoder reconstructs data
-  VAE adds probability



Test – Evaluation with Autoencoders & VAEs



MIND MAP



CURIOSITY / DISCUSSION



Why VAEs generate smoother outputs?

How latent space helps learning?



Where are VAEs used?



APPLICATIONS



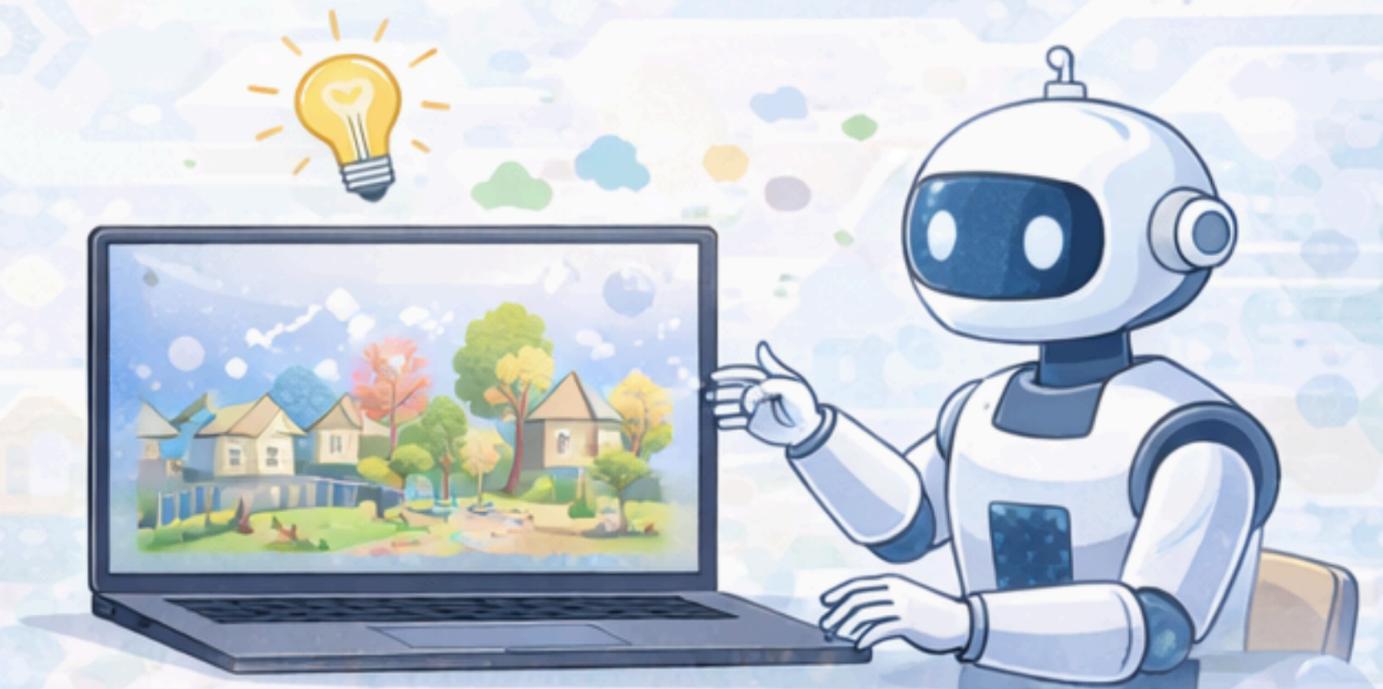
Image Enhancement



Anomaly Detection



Data Compression



Generation

ADVANTAGES & LIMITATIONS

Advantages

- ✓ Efficient Data Representation
- ✓ Noise Reduction
- ✓ Feature Extraction
- ✓ Data Generation

Limitations

- ✗ Training Challenges
- ✗ Overfitting Risk
- ✗ Limited Interpretability
- ✗ Computational Cost



CONCLUSION

- ✓ Autoencoders efficiently learn data representations
- ✓ VAEs add a probabilistic layer, enabling new applications
- ✓ Many real-world uses from denoising to creative generation
- ✓ Ongoing research seeks to improve, like multimodal & ethical AI

Keep exploring and applying these techniques to discover new possibilities!



REFERENCES

- Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press
- Kingma, D. P, & Welling. M. (2014). Auto-encoding variational Bayes. In *Advances in Neural Information Processing Systems (Vol. 27)*.
- Doersch, C. (2021). Tutorial on variational autoencoders. arXiv preprint arXiv:1606.05908.
- Pu, Y., Gan, Z., Henao, R., Yuan, X., Li C., Stevens, A. ; & Carin, L. (2016). Variational autoencoder for deep learning of images, labels, and captions. In *Advances in Neural Information Processing Systems (Vol. 29)*.
- Higgins, I., Matthey, L., Pal, A., Burgess, C., Glorot, X., Botvinick, M., Mohamed, S., & Lerchner, A. (2017). *beta-VAE: Learning basic visual concepts with a constrained*

