A Machine Learning-Enabled Study of Superconductivity

Application of the XGBoost Algorithm

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Outline

Introduction

XGBoost

- eXtreme Gradient Boosting

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  - Combination of homogenous weak learners

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  - Combination of homogenous weak learners
  - End result is a weighted sum of weak learners

$$\theta_f = \sum_j w_j \theta_j$$

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Ginzburg-Landau Theory

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- The characteristic length scale ξ is called the Ginzburg-Landau coherence length

$$\xi = \sqrt{\frac{\hbar^2}{2m^*|\alpha|}}$$

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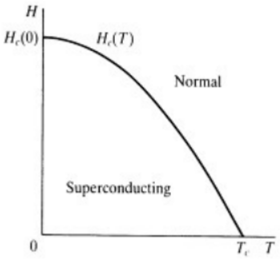

Figure: $H - T$ **phase diagram for a Type 1 superconductor [Tinkham]**

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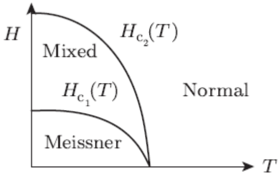

Figure: $H - T$ **phase diagram for a Type 2 superconductor [Girvin and Yang 2019]**

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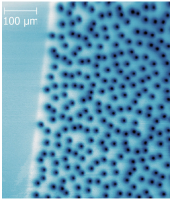

Figure: **Abrikosov vortices in YBCO - created by Wells et al. 2015 using scanning SQUID microscopy**

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Figure: **UCI Machine Learning Repository**

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- XGBoost library
  - XGBClassifier class

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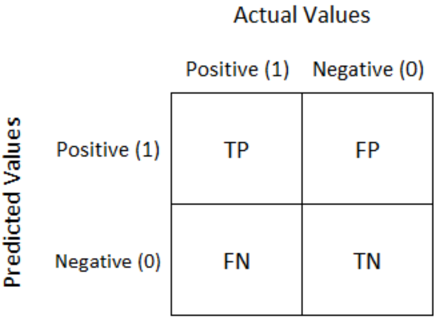

Figure: **Example Confusion Matrix**

Conclusion

References

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iResearch INSTITUTE

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