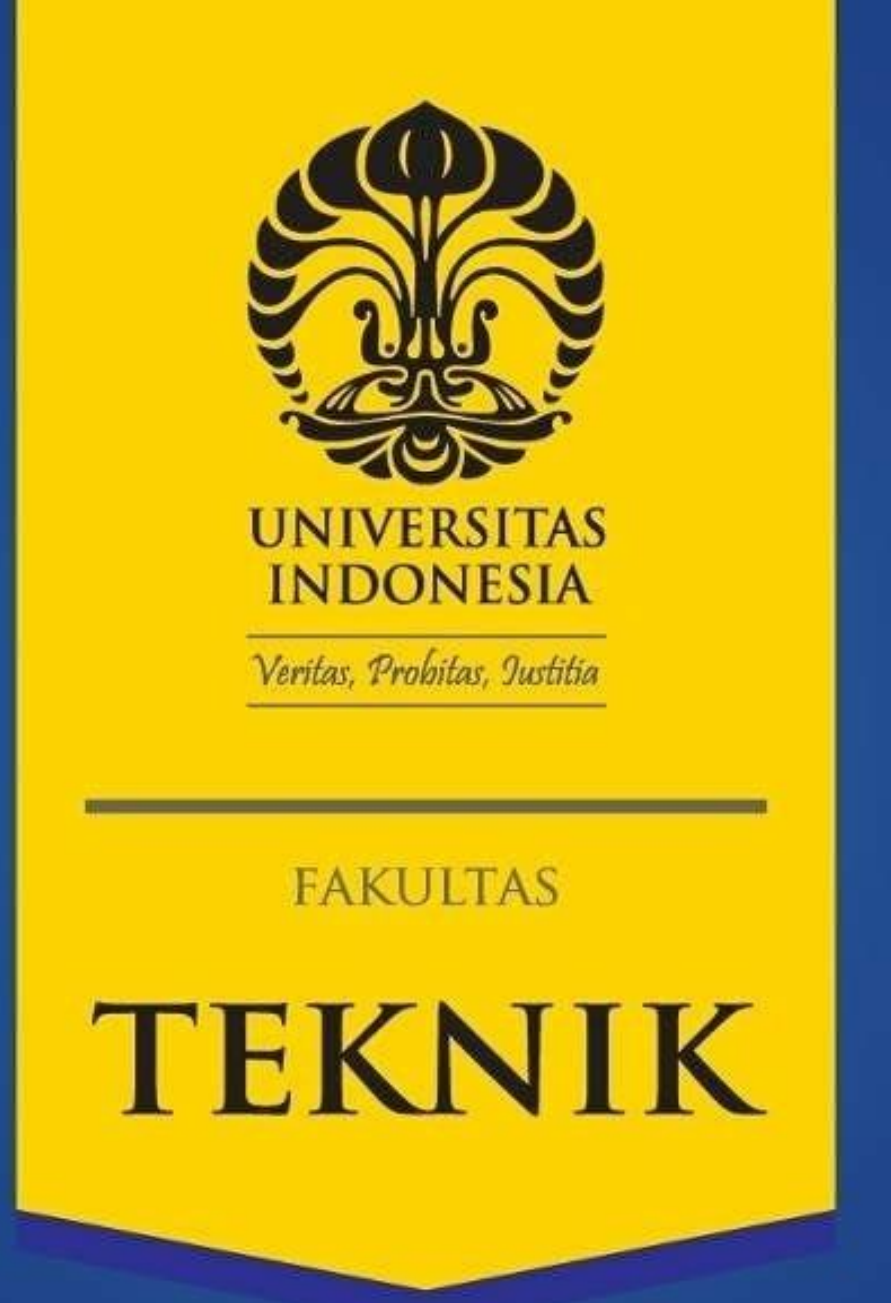


# Prediction of Tensile Strength, Hardness, and Melting Point of Nickel Superalloys Based on Composition Using Machine Learning



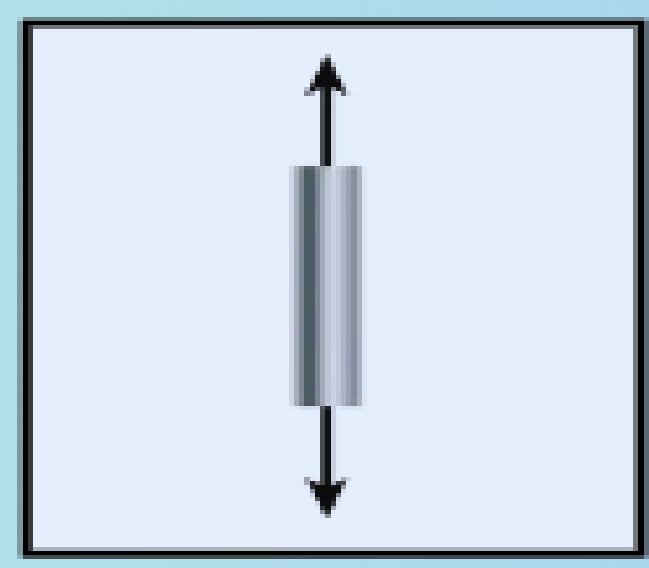
Jaka Fajar Fatriansyah<sup>1</sup>, Rio Sudwitama Persadanta Kaban<sup>2</sup>

## Introduction



- Superalloys are a class of materials renowned for retaining mechanical properties at **elevated temperatures**.
- Extreme operating temperature conditions impact the **tensile strength, hardness, and melting point properties**
- Three machine learning models which are KNN, ANN, and SVR are used in this study to **predict properties based on composition (C2P) and composition based on properties (P2C)**

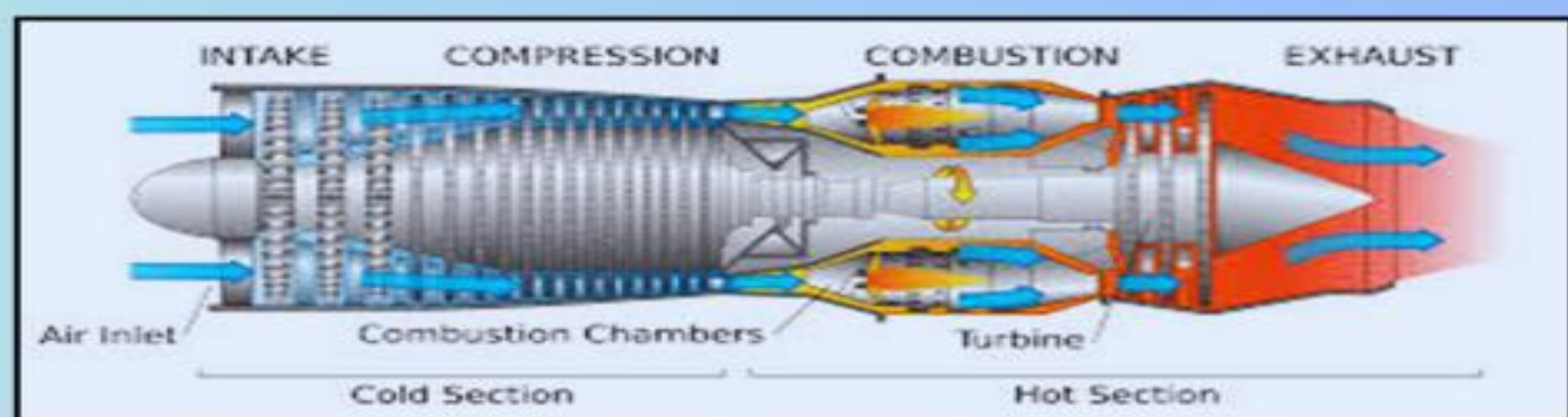
## Targeted Properties



High Tensile Strength

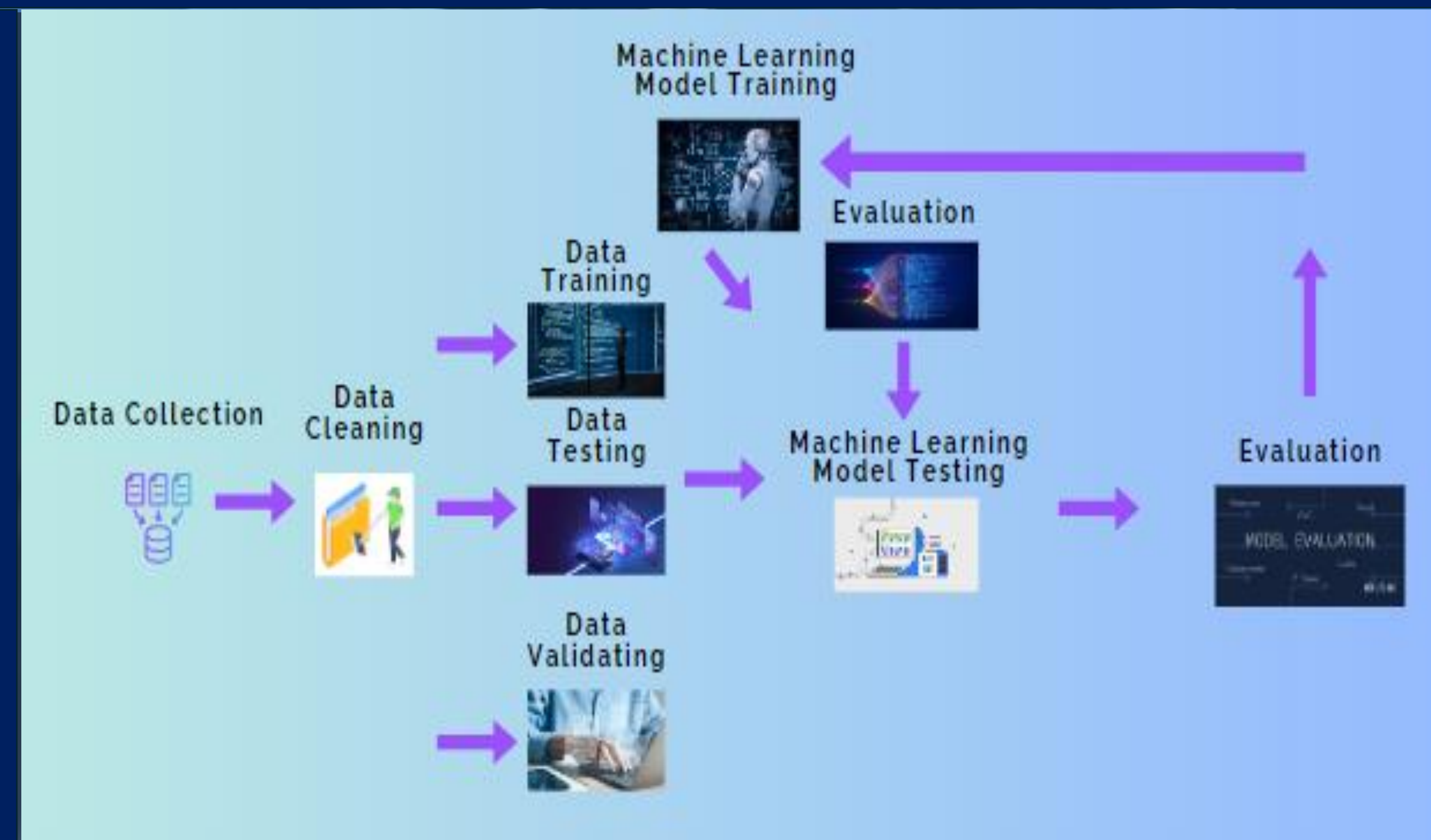


High Hardness

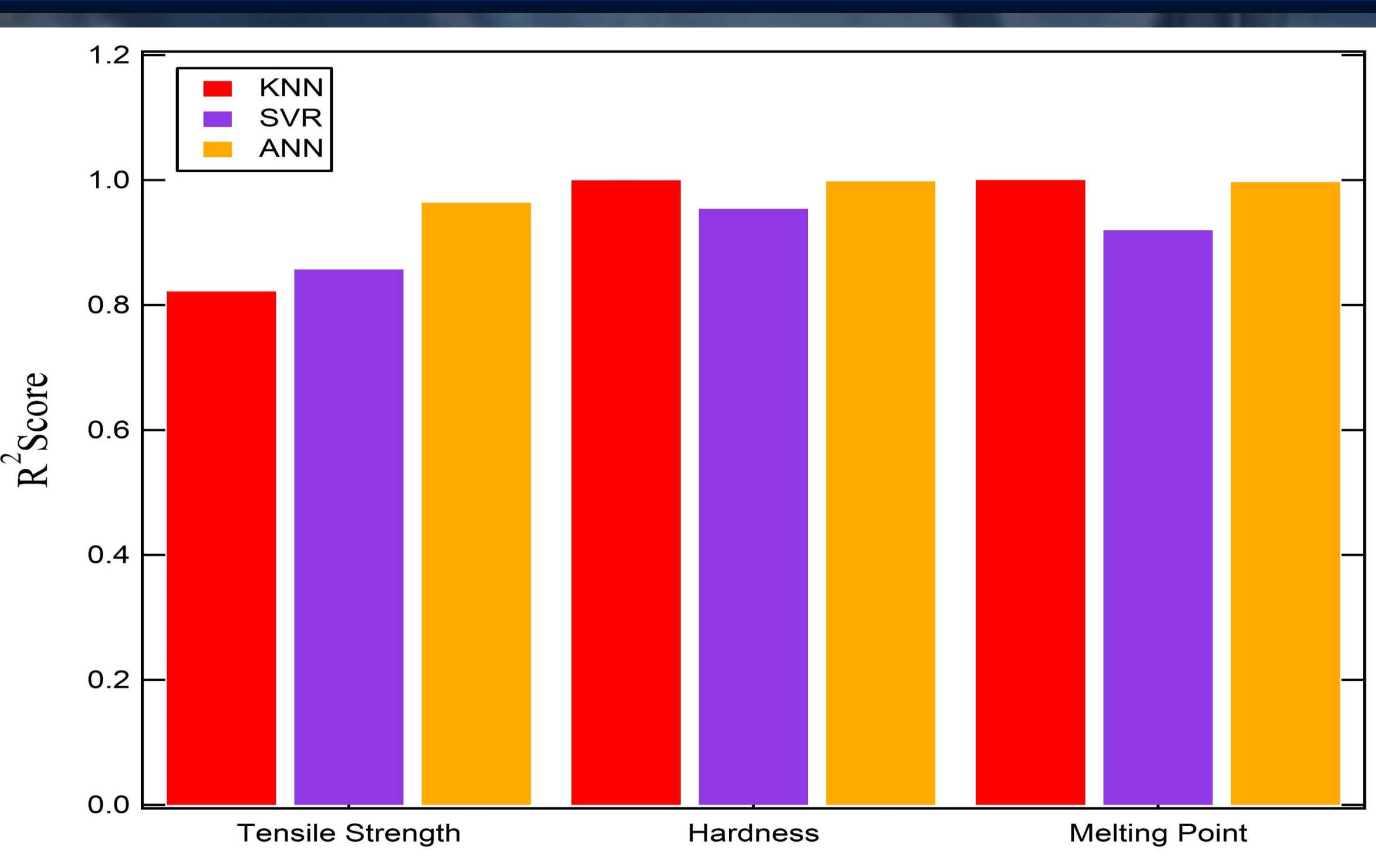


High Melting Point

## Research Methodology



## Performance C2P Predictions



## Most Influenced Element for Each Properties

**Tensile Strength**

Molybdenum (Mo) significantly increases tensile strength.

The increased tensile strength is attributed to molybdenum's (Mo) ability to induce solid solution strengthening within the gamma prime ( $\gamma'$ ) phase.

Molybdenum (Mo)

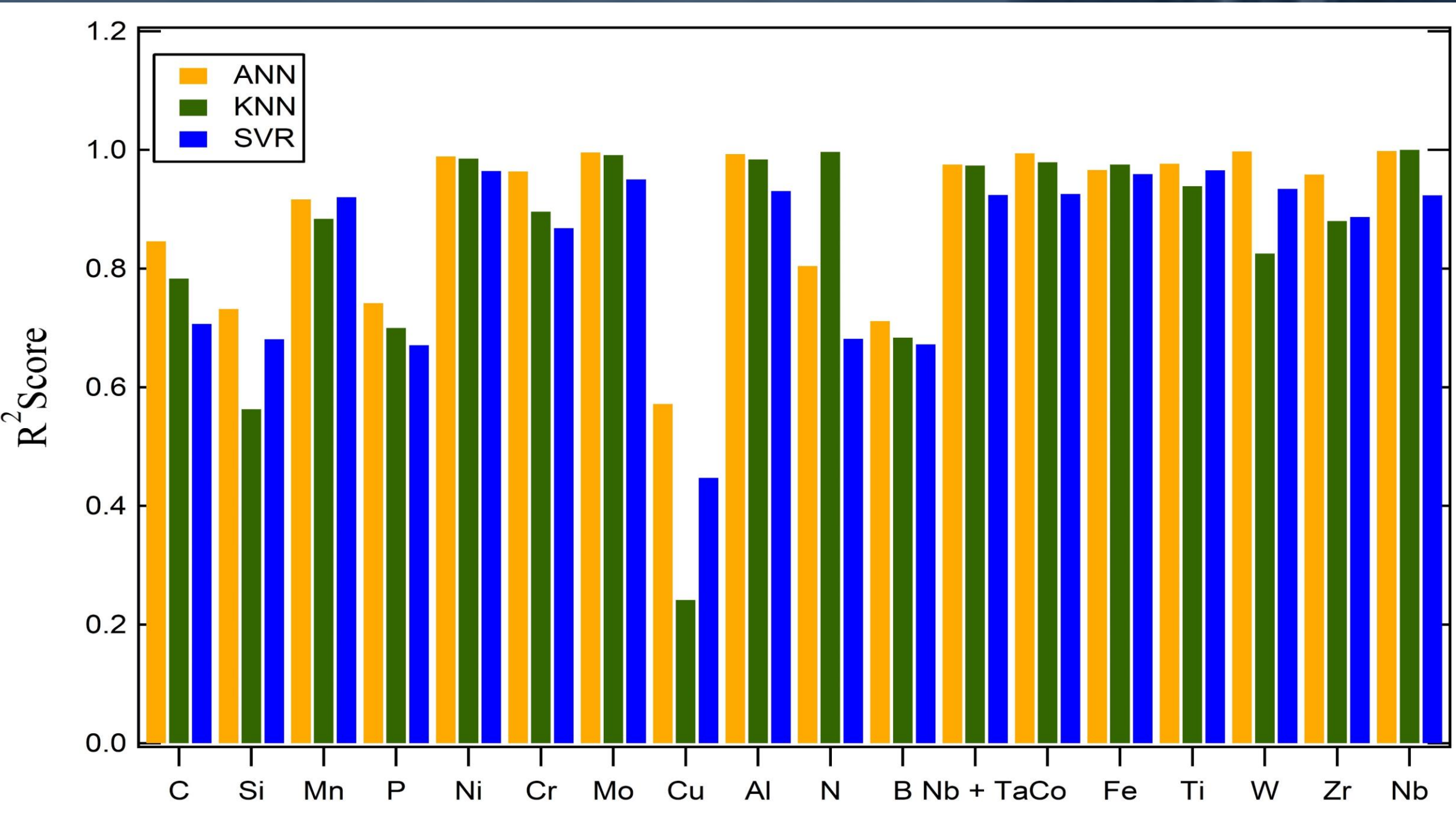
**Hardness**

The addition of Cobalt (Co) reduces the solubility of aluminum (Al) and titanium (Ti) in the gamma phase.

Thereby, Cobalt (Co) promoting precipitation and increasing the material's hardness.

Cobalt (Co)

## Performance P2C Predictions



**Niobium (Nb)**

**Melting Point**

Niobium (Nb) contributes to the formation of a carbide compound known as niobium carbide (NbC).

Consequently, niobium carbide can be employed to elevate the melting point of other materials.

This carbide exhibits an exceptionally high melting temperature, reaching up to 3490 degrees Celsius.