Best bookseller predictor

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project title: BEST BOOKSELLER PREDICTOR

ABSTRACT:

🔍 What Is the Research About?

The **main goal** of this research is to **predict the critical point** of **real fluids** (specifically isotopes of rubidium, sodium, and cerium: 87^{87}87Rb, 23^{23}23Na, and 133^{133}133Ce).

The **critical point** of a fluid is the temperature, pressure, and density at which the **liquid and gas phases become indistinguishable**. This property is important in industrial applications like supercritical fluid extraction, energy systems, and chemical processing.

□ Methodology

The researchers used **theoretical models** to predict critical points. The process involved the following:

1. Imperfect Boson Gas Model

They start by modeling the fluids as **imperfect boson gases**.

- A **boson gas** refers to a collection of particles (bosons) that obey Bose-Einstein statistics.
- An **imperfect gas** accounts for **interactions between particles**, unlike an ideal gas where no interactions exist.
- Real fluids are **not ideal**, so this model is more realistic.

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2. Virial Expansion

They apply a **Perturbed Virial Expansion (PVE)** to describe the thermodynamic properties of the system.

- The **virial expansion** is a series that expresses the pressure of a gas in terms of powers of the density:

  $$\frac{P}{kT} = \rho + B_2(T)\rho^2 + B_3(T)\rho^3 + \cdots$$

  Where:

  - P: Pressure
  - T: Temperature
  - ρ: Density
  - $B_n(T)$: Virial coefficients (depend on temperature and interactions)
- **PVE** introduces corrections by using **reference fluids**.

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3. Virial Coefficients Calculated Analytically

They calculate the virial coefficients **up to fourth order** (B_4) **analytically**, which means using mathematical derivation instead of just fitting to data.

- Higher-order virial coefficients allow for a more accurate representation of real gas behavior, especially near the critical point.

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4. Reference Fluids Used

To improve the virial expansion predictions, two types of reference fluids were used:

1. **Percus–Yevick (PY)** – A model useful for hard-sphere fluids.
2. **Carnahan–Starling (CS)** – A more accurate model for hard-sphere interactions than PY.

These references serve as **starting points**, and the PVE corrects their behavior to better represent the real fluid.

Prediction of Critical Points

Using the model and virial coefficients, the authors calculate:

- **Critical Temperature (TcT_cTc)**
- **Critical Pressure (PcP_cPc)**
- **Critical Density (ρc\rho_cρc)**

They compute these for:

- 87^{87}87Rb (Rubidium-87)
- 23^{23}23Na (Sodium-23)
- 133^{133}133Ce (Cerium-133)

They do this using:

- Second, third, and fourth-order virial expansions
- Both PY and CS as reference fluids

Results and Accuracy

The results are compared with **experimental or available data**. Key findings:

- The **accuracy depends on**:
  - The **reference fluid** used
  - The **order of the virial expansion**
- Best accuracy is achieved using:
  - **Fourth-order** virial coefficients
  - **Carnahan–Starling (CS)** reference fluid

Reported Errors:

- **Best critical temperature**:
  - 87^{87}87Rb and 23^{23}23Na → 1% error
- **Best critical pressure**:
  - 133^{133}133Ce → 1% error
- **Best critical density**:
  - 23^{23}23Na → 1.4% error

These are **very small errors**, indicating the model is highly accurate for these cases.

□ Summary of the Study's Importance

This research is valuable because:

- It provides a **mathematical model** to predict critical points with **high accuracy**.
- It demonstrates that **PVE with CS reference fluid** and **higher-order coefficients** gives the best results.
- It shows that **bosonic models** can be useful for describing real fluids in some conditions.

🚀 Potential Applications

- **Industrial design** of processes involving supercritical fluids
- **Material science** and **quantum gas studies**
- Understanding **fluid behavior under extreme conditions**