**tnGPS: Discovering Unknown Tensor Network Structure Search Algorithms via Large Language Models (LLMs)**

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**Vision and Contributions**

A tensor network (TN) is a mathematical representation of a large, complex object that can be decomposed into simpler, interconnected parts.

**How Human Experts Conduct Innovative Research**

**Knowledge Categorization (KC):** Refine ideas into knowledge clusters.

**Idea Dropout (ID):** Filter out less interesting ideas to focus on the most promising ones.

**Knowledge Recomposition (KR):** Generate new ideas by merging existing ones.

**Incremental Innovation (II):** Make gradual improvements to existing ideas.

**Diversity Injection (DI):** Introduce new, orthogonal ideas through brainstorming or external feedback.

**Experiments (Evaluation):** Test and score ideas to validate their potential.

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**Fig. 1:** Overview of AlphaTensor.

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**Numerical Evidence**

**Natural Image Compression Task:** Use TN-SS to find compact TNs to represent natural images.

**Objective:**

- **Objective:** DE, 64, 256, 128, 64, 32

**Gaussian process Compression:** An out-of-domain Experiment

**Ablation Experiments:**

- **Algorithm:** DE
- **Objective:** DE
- **Results:** 1.08, 0.128, 0.327, 0.125

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**Concluding Remarks**

- **tnGPS:** a LLM-driven framework for discovering new TN-SS algorithms.
- **tnGPS** is designed by prompting LLMs to mimic human experts.
- **LLMs** provide new ideas of solving more broad tensor problems.