Charting the Future of Persistent Memory: Insights from Optane PMEM

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Background: Non-volatile memory (NVM), or persistent memory, is a promising and emerging storage technology that has not only disrupted the typical long-established memory hierarchy but also invalidated the proclaimed programming paradigm used in traditional database management systems and file systems. [NVM1, NVM2, NVM3, NVM4, IDS1, IDS2, DB1 , DB2 , DB3 , DB4 , DB5]

- It bridges the gap between primary and secondary storage
- Shares the characteristics of both categories.
- Nonvolatile, offers latency close to DRAM, and entails higher capacity than DRAM.
- Byte-addressable

Goal: The primary goal of this exercise is to conduct a comprehensive survey

- Survey of the applications and performance implications of byte-addressable persistent memory (PMEM), with a focus on emerging technologies such as Intel Optane DC Persistent Memory Module.
- Work should aim to systematically review the current state of research, classify application scenarios, and evaluate the design trade-offs associated with different operational modes (e.g., Memory Mode, AppDirect Mode, and mixed configurations).
- Work should synthesize experimental results, benchmark studies, and design techniques from various domains; including in-memory databases, file systems, and high-performance computing
- Provide an in-depth analysis of the impact of DC PMEM on these applications/domains, while also identifying gaps and future research directions.

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Steps that should be considered:

- Literature Review:
  - Define the scope and formulate specific research questions.
  - Collect relevant literature from digital libraries, conferences, and technical reports (e.g., IEEE Xplore, ACM Digital Library, Google Scholar) using defined search keywords (such as “Intel Optane PMem”, “persistent memory”, “byte-addressable NVM”, “NVDIMM”, “persistent memory applications”, etc.).
  - Specify a time range if needed to capture the most recent developments.
- Data Extraction and Classification:
  - Extract key information (e.g., application domain, operational mode, performance metrics) from selected studies.
  - Develop a taxonomy categorizing the applications and methodologies that leverage PMEM.
- Comparative Analysis:
  - Synthesize trends and common findings across the literature.
  - Use tables, graphs, and taxonomies to compare performance outcomes and design trade-offs.
- Gap Analysis and Future Directions:
  - Identify open research challenges and areas where further investigation is needed.
- Paper Write-up:
  - Document the methodology, analysis, findings, and recommendations in a structured thesis format.

References

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