Case Study 3: Memory Optimized Instances

1. Overview of Recommended Instances

Memory-optimized instances are designed to deliver **high memory-to-vCPU ratios**, ideal for workloads that process **large datasets in memory**.
The recommended instance types—**R5, R6g, X2idn, and X2iedn**—are tailored for **memory-intensive applications** like genomics analysis and in-memory caching.

- **R5 Series**: Built on Intel Xeon Scalable processors, providing a good balance between performance and cost for general-purpose memory-heavy tasks.
- **R6g Series**: Based on AWS Graviton2 processors (ARM architecture), these provide cost-effective performance with cloud-native optimizations.
- **X2idn & X2iedn**: High-end Intel-based instances offering **very large memory per vCPU**, suitable for advanced workloads like genome analytics, SAP HANA, and high-performance databases.

2. Characteristics

Instance Series	Key Characteristics
R5	Intel Xeon-based, 8 GB memory per vCPU, stable for general workloads.
R6g	Graviton2 ARM-based, lower cost, 8 GB memory per vCPU, efficient for modern cloud-native workloads.
X2idn	Intel Xeon Scalable processors, 16 GB memory per vCPU, higher throughput and network bandwidth.
X2iedn	Up to 32 GB memory per vCPU, optimized for large datasets, SAP-certified.

3. Why They Are Suitable

- **Scenario A (Genomic Analysis)**:
  Genomics requires **large memory footprint and low latency** to load and process DNA sequences.
  X2idn/X2iedn offer high memory per core, perfect for such data-intensive applications.
- **Scenario B (In-memory Caching)**:
  Caching services need **fast memory access** and scalability.
  R6g provides **best performance-per-cost** for in-memory databases like Redis or Memcached.

4. Consideration Detailing the Instance Series

Series	Processor	Memory/CPU	Highlights
R5	Intel Xeon	~8 GB	Balanced for legacy & existing Intel workloads
R6g	Graviton2 ARM	~8 GB	Cost-efficient, ideal for containerized/cloud-native apps
X2idn	Intel Xeon	~16 GB	High memory-to-vCPU ratio, supports SAP HANA
X2iedn	Intel Xeon	~32 GB	Enterprise-ready, for ultra high-memory applications

5. Comparison and Selection

Use Case	R5	R6g	X2idn	X2iedn
Intel Compatibility	Best	No	Best	Best
ARM Support (Graviton)	No	Best	No	No
Memory per vCPU	~8 GB	~8 GB	~16 GB	~32 GB
Performance/Cost	Ok	Best	Better	Better
Suitable for Genomics	Ok	Ok	Best	Best
Suitable for Caching	Better	Best	No	No
Cloud-native/Modern Stack	No	Best	Ok	Ok

6. Key Considerations Supporting the Business Case

- **Cost Efficiency**:
  R6g provides **lowest cost per GB of RAM**, making it ideal for memory-heavy but budget-conscious applications.
- **High Memory Needs**:
  Genomics workloads like DNA analysis benefit from **X2iedn's massive memory capacity**—reduces disk I/O and speeds up computation.
- **Architecture Planning**:
  ARM-based R6g helps in **cloud-native modernization**. X2idn/X2iedn remain compatible with legacy and enterprise apps.
- **Scalability**:
  All instances support **horizontal scaling**, but Graviton-based instances offer **better performance per dollar** for scale-out architecture.

7. Conclusion

For **genomic workloads**, **X2idn or X2iedn** offer the best memory capabilities and latency benefits.
For **in-memory caching**, **R6g** stands out with cost-effective performance and ARM-based future-readiness.
R5 remains a balanced option for applications requiring **Intel compatibility** without the need for ultra-high memory.
The choice depends on **budget**, **performance goals**, and **architectural direction** (Intel vs ARM).