**Q1 : 1. Elasticity and Scalability in Cloud Computing for Deep Learning Elasticity**

* + Elasticity in cloud computing refers to the ability of a system to automatically scale computing resources up or down based on demand.
  + In deep learning, this means dynamically adjusting GPU/TPU instances, memory, and storage based on training workloads.
  + Elasticity ensures cost efficiency by allocating resources only when needed.

1. **Scalability**
   * Scalability is the ability of a cloud system to handle increasing workloads by adding more resources, such as CPUs, GPUs, or nodes, without performance degradation.
   * In deep learning, scalability allows models to train faster on distributed computing resources.
   * There are two types:
     + **Vertical scalability**: Upgrading a single instance with more power (e.g., adding more RAM or GPUs).
     + **Horizontal scalability**: Adding more instances to distribute workload (e.g., parallel training on multiple GPUs).

**(b) Comparison of AWS Sage Maker, Google Vertex AI, and Azure ML Studio**

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| **Feature** | **AWS SageMaker** | |  | | --- | |  |  |  | | --- | | **Google Vertex AI** | | **Microsoft Azure ML Studio** |
| **Ease of Use** | Requires setup but has automation tools | Simplified end-to-end AI pipeline | User-friendly with drag-and-drop support |
| **Scalability** | Highly scalable with auto-scaling clusters | Seamless scaling with Google Cloud TPUs | Supports horizontal and vertical scaling |
| **Hardware Support** | NVIDIA GPUs, AWS Inferentia, Trainium | NVIDIA GPUs, TPUs | NVIDIA GPUs, FPGAs |
| **AutoML** | Yes (AutoPilot for training models) | Yes (AutoML for various AI tasks) | Yes (Azure AutoML) |
| **Pricing** | Pay-per-use with flexible instance pricing | Competitive pricing with free tier | Pay-as-you-go model |
| **Integration** | Integrates well with AWS services (S3, Lambda) | Works with Google Cloud ecosystem (BigQuery, GCS) | Strong integration with Microsoft products (Power BI, Azure Data Lake) |

* AWS SageMaker is best for highly customizable and large-scale deep learning workflows.
* Google Vertex AI is ideal for teams using TPUs and Google’s AI services.
* Azure ML Studio is user-friendly, making it suitable for enterprises using Microsoft tools.