**Assignment # 3**

**CLO - 3**

You are a system administrator at a cloud computing platform that allocates virtual machines (VMs) and memory to various customer services running in containers. To prevent over-allocation and potential deadlock, you implement the Banker's Algorithm for resource allocation.

The platform has the following services running:

* **WebApp Service (S1):** Needs occasional bursts of extra CPU and RAM during peak hours.
* **DataAnalytics Job (S2):** Consumes heavy CPU but can release memory once batch processing completes.
* **AI Model Trainer (S3):** Starts with minimal resources but needs to grow resource usage steadily as training proceeds.
* **Backup Sync Service (S4):** Takes lots of memory but can be delayed if system load is high.

The system has a fixed pool of 10 CPUs, 5 Network Units, and 7 Memory Units (RAM).

**Questions:**

**a) Define the Max, Allocation, and Need matrices for the above 4 services based on the case (you can make realistic assumptions).**

**b) Suppose the following current allocations exist. Use the Banker's Algorithm to determine whether the system is in a safe state or not.**

**c) If the AI Model Trainer (S3) requests additional resources (2 CPUs, 1 Network Unit, 1 Memory), should the system grant it immediately? Justify using Banker's check.**

**d) Discuss how using the Banker's Algorithm prevents deadlock in cloud-based environments like this one**.