# COMP 30640 Operating Systems: Example

A system has the following resources: A, B, C and threads T1, T2, T3, T4.

The total number of each resource is: A 12,

| Resource | Total |
|---|---|
| A | 12 |
| B | 9 |
| C | 12 |

The threads have the following maximum requirements and current allocations:

| | Current Allocations | | | Maximum Allocations | | |
|---|---|---|---|---|---|---|
| **Thread ID** | A | B | C | A | B | C |
| **T1** | 2 | 1 | 3 | 4 | 9 | 4 |
| **T2** | 1 | 2 | 3 | 5 | 3 | 3 |
| **T3** | 5 | 4 | 3 | 6 | 4 | 3 |
| **T4** | 2 | 1 | 2 | 4 | 8 | 2 |

A. Is the system in a safe state (as defined by the Banker's algorithm)? If "yes", show a non-blocking sequence of thread executions. Otherwise, provide a proof that the system is unsafe. Show all steps, intermediate matrices, etc.

B. What is the maximum number of additional copies of resources (A, B, and C) that T1 can be granted in a single request without risking deadlock? Explain.

C. Suppose that T1 asks for 2 more copies of resource A. Can the system grant this if it wants to avoid deadlock (i.e. will the result be a SAFE state)? Explain.