Grain Elevator System (GES*) Case Study

* Some tutorial questions refer to the GES as the subject system.

The Grain Elevator System is a program for tracking the grain stored in a grain elevator as it arrives in trucks from farms, and is shipped out in trains from the elevator. See http://en.wikipedia.org/wiki/Storage_silo and http://en.wikipedia.org/wiki/Grain_elevator for an explanation of silo and grain elevator operations.

A. Harvested grain is trucked from farms to a central storage elevator where it is placed in silos. The grain is eventually moved from the silos to railroad cars that take it to processing plants. The elevator relies on a software system to track the grain.

B. The elevator accepts shipments of wheat, barley, long grain rice, short grain rice, oats, and hops. Each type of grain has two grades, high and low. An empty silo may store any kind of grain, but a silo with grain in it can store only grain of the same type and grade.

C. There are 12 silos in the elevator: silos 1-6 silos hold 8,000 bushels each, and silos 7-12 hold 12,000 bushels each. Each truck carries between 150 and 180 bushels. A single railroad car holds 2,000 bushels.

D. Grain only arrives in trucks from growers selling the grain, and only leaves in rail cars taking it to processing plants buying the grain. Each truck has a plate number, a driver, and a grain seller. Each rail car has a serial number, a conductor, and a grain buyer.

E. Grain stored in the silo must be kept dry. Therefore, the humidity and temperature of each silo are closely monitored. Humidity and temperature sensors in each silo send data to the system periodically. If the temperature or humidity of a silo exceeds normal levels, the humidity and temperature sensors will send an alert to the system, as well as, to an external grain dryer. Until its temperature and humidity levels are brought back to normal, the silo cannot accept any more grain.

Diagram of airflow through a silo
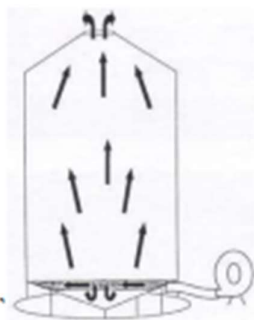
F. For accounting purposes, the system maintains a transaction log that records, for each shipment in or out of the elevator, all the information about the shipment, namely: the quantity, type, and grade of grain, the time and date, the elevator manager, the type of shipment (arrival or departure), the truck or rail car identifier, the driver or conductor, and the seller or buyer.

G. When a truck arrives at the elevator with a load of grain, the elevator manager informs the system of the type of grain, its grade, and its quantity. The system must find one or more silos to store to store the grain and tell the elevator manager which silos it has chosen, and how much grain goes in each one. The system may accept only part of a load if there is not room for the entire load, or none of it if there is no place to store it.

H. The elevator manager may accept or overrule the system's choice of silos for an arriving load of grain. The elevator manager must inform the system how much grain is actually deposited in each silo, and enter data about the truck, the driver, and the seller. The system should acknowledge receipt of this data.

I. As a train is loaded, the elevator manager must tell the system how much grain has been removed from each silo, the rail cars loaded, the conductor, and the buyer. The system should acknowledge receipt of this data.

J. Upon request from the elevator manager, the system must produce a complete report of the state of the elevator. This report should list, for each silo, the type of grain stored, the amount stored, and the remaining capacity of the silo. The report should also list the total remaining capacity of the elevator for each type of grain currently stored, and the total capacity of the elevator not currently committed to any type of grain.

K. Upon request from the elevator manager, the system must produce a chronological listing of the transaction log.