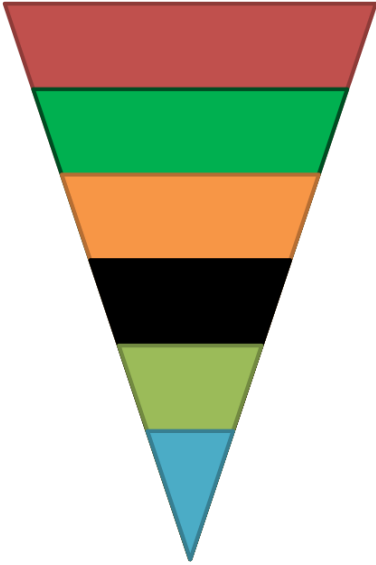


1. (3 points) Label each of the levels of the DRAM subsystem organization pyramid.



2. (3 points) Given the following information, fill in the table

- **Row buffer hit:** only need to move data from row buffer to pins (~20 ns access time)
- **Empty row buffer access:** must first read read the row, the move data from row buffer to pins (~40 ns access time)
- **Row buffer conflict:** must first precharge the bitlines, then read the other row, the move data from row buffer to pins (~60 ns access time)

Requested	Time of Arrival	Time of Service	
		Open	Closed
X	0		
Y	10		
$X + 1$	100		
$X + 2$	200		
$Y + 1$	250		
$X + 3$	300		