

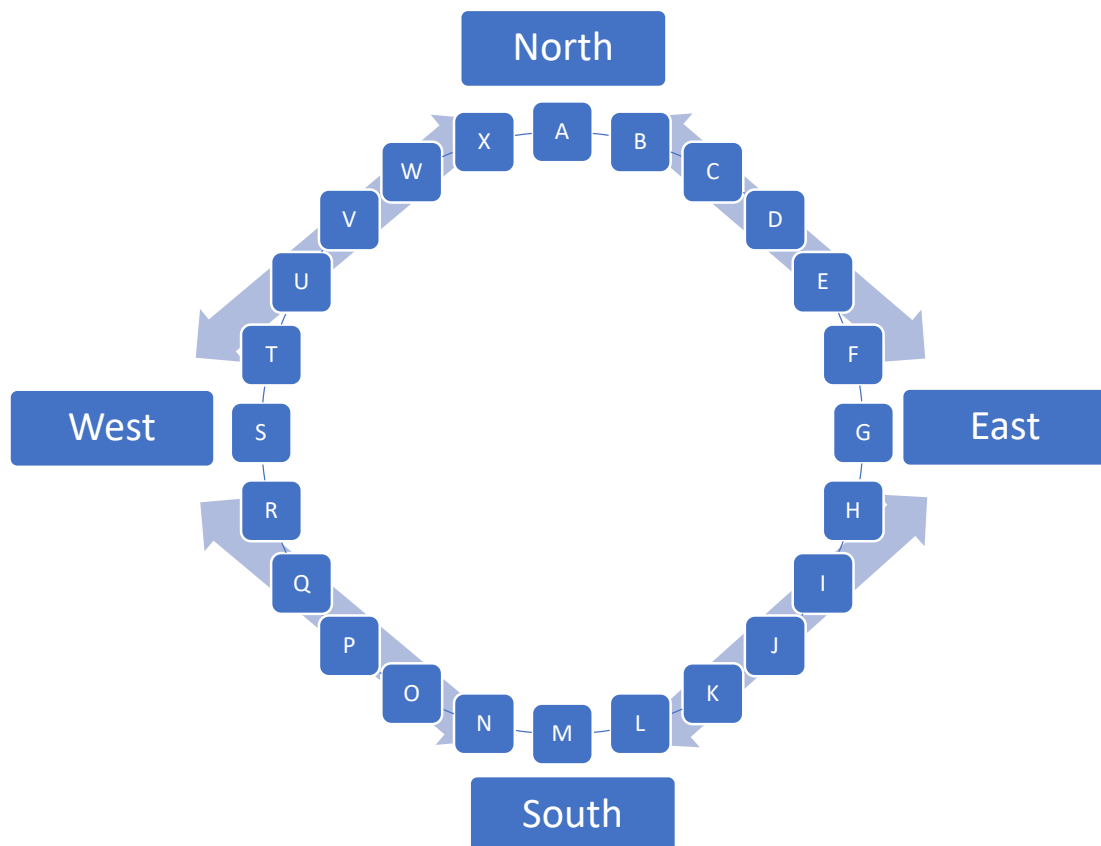
# ENGSCI 355 Conceptual Modelling Assignment, S2 2023

This assignment is worth 10% of the final grade.

Submit via Canvas by 11:59pm on Friday September 15 (last day of the 1<sup>st</sup> week after mid-semester break, i.e., week 7)

People enter a stadium through one of 4 gates (North, South, East and West), each gate has 20 turnstiles with people usually getting through a turnstile in 5s, at best 2s and (if bags need to be searched) they may take 12s.

Once through the turnstiles people enter the concourse at section A (from the North gate), G (East gate), M (South gate) and S (West gate). They look for the section they are seated in (A-X) which are distributed equally around the stadium as shown below.



People enter the concourse and then choose a direction to walk, passing through sections, until they find their section. The time  $T$  taken to walk through any section in the stadium is estimated by

$$T = \begin{cases} 10 \text{ s} & N < 100 \\ 9 + 1000^{400 \times 10^{-6}(N-100)} & N \geq 100 \end{cases}$$

where  $N$  is the number of people in the section when the person walking enters the section.

Currently the signage is not very good at the stadium, so people entering in any of the gates could be seated in any of the sections with equal probability. They will also start walking in either direction around the concourse with equal probability but will change direction in the next section if they are going in the wrong direction, e.g., if they are seated in section B, and they go from section G to section H they will change direction. This is true even if they are seated in section X and go from section A to section B, so they will walk all the way around the stadium in this case.

The stadium management want to know how long it will take for 50,000 people to be seated in the stadium given they arrive to each turnstile every 5s on average. They also want to know how long it will take if their signage works perfectly, i.e., all people seated in W, X, A, B, C arrive to the North gate and go the right direction (shortest distance) along the concourse. For the “boundary” sections, i.e., D, J, P & V, people will arrive at either of the surrounding gates, i.e., North or East for D, with 50% probability.

In 6 pages or less, complete all phases and steps of the Hierarchical Control Conceptual Modelling (HCCM) framework – shown below – to realise a conceptual model that enables the stadium management to understand how long it takes to seat 50,000 people currently, i.e., without effective signage. You must use the HCCM Standard for the Model Content.

