Christian Sidemo
Lund University, Spring 2021

Lab 1

Christian Sidemo Real-time Systems

Analysis:

1) **Change the sampling time of the system. What happens with the system dynamics?**
   With to high sampling (low h) the computer can no longer keep up with computations. This also increases precision in the system, causing more mathematical calculations. This in the end makes the system more "sensitive".
   A lower sampling (high h) causes the system to be slow. Computations are not done often enough resulting in overshooting, as the balls state is not updated often enough for it to be controlled. Causing more radical movement to compensate.
2) **Three shared resources:**
   Inner and outer controllers as their states needs to be carefully accessed and changed. To avoid race conditions. These are both shared by regul thread as well as the EDT thread.
   Reference generator which is both shared by refgen thread as well as the EDT thread.
3) **Why do we put synchronized keyword on every method in PI and PID classes?**
   This is to protect against race conditions. The example being that one thread changes the parameters while the other calculates the new ones. If the thread changing the parameters has not had time to save the data to main memory before the thread that calculates output caches it. The thread calculating output will calculate output based on old data. It might also over save and replace the data that was supposed to be changed.
4) **Why would it be poor design to add an integrator the inner loop?**
   Integrator adds instability and delay to the inner loop. This is not desired as the inner loop should be much faster than the outer loop. Also be very steady. However, an integrator must be used in the outer loop to account for stationary errors.
5) **What does duration less than 0 mean?**
   It means that the computations done by the controller is not fast enough for the system to keep up with sampling time. This causes the system to fall behind desired sampling time.
6) **Why do we use feed forward?**
   To reduce disturbances to the system as well as improve response to command signals.