

Useful Resources:

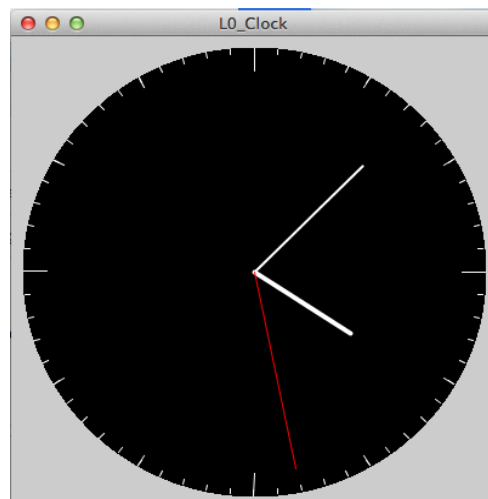
```
loops
helper functions
variables
conditional statements
map()
norm()
frameRate()
```

Instructions:

All parts of lab questions that have **R** at the beginning are mandatory, and their submission by each student is required. The parts of each question that begin with **O** are open-ended enhancements for further investigation into course material. These should be completed only after the mandatory parts of the lab are completed, and are not explicitly required for submission. If you choose to complete further optional add-ons, you are welcome to explore your own options, and not just the suggestions provided. Submit a zip document to the dropbox folder L0 on LEARN. The document should contain separate folders for the following file(s):

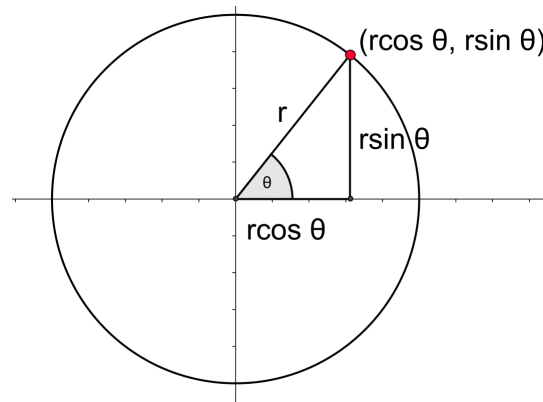
- **L0_Clock**

Lecturette: recap of loops, global variables, and helper functions, processing reference page <https://processing.org/reference/>

**1. Clock**

- a. **R** Create a program that draws a clock, using the functions `hour()`, `minute()` and `second()`. The clock should be able to be functional with any valid values of these 3 parameters.

To draw the ticks along the circumference of the clock, write a for loop which calls a helper function which consumes 3 parameters, where one is an angle (in radians), keeping track of the angle along the circle; and the other two are the lengths from the center of the clock to the inner and outer radius of the ticks. To create this helper function, you will have to use `sin()` and `cos()`. The diagram below and the information at <http://www.imaginary-institute.com/resources/TechNote02/TechNote02.html> may be helpful.



- b. **R** Update your code so that the hour and minute hands do not make a large jump on every change of hour or minute. Instead, make them update throughout the hour or minute, to make a smooth transition between numbers. **HINT:** you may want to update your `map()` function used to draw the clock hands by using the function `norm()`.
- c. **O Challenging** Rolex watches are famous for 'sweep movement', in which the second hand moves continuously instead of in discrete ticks. Update the second hand to also move smoothly instead of jumping every second, just like the minute and hour hands. To do this, you may have to keep track of whether or not the second is a new second, and how many times draw has been called since a new second. **Hint:** Use the function `millis()`.
- d. **O** Add a swinging pendulum to your clock to make it a grandfather clock.