Work through the following sections. Seek assistance whenever needed. From http://schmidt.nuigalway.ie/cs102/python files with Python programs can be downloaded. Present your results to one of the demonstrators, so that a record of your achievements can be kept.

22. True or False?

1. A `while` statement implements a definite loop.
2. The counted loop pattern uses a definite loop.
3. A sentinel loop asks the user whether to continue on each iteration.
4. A sentinel loop should not actually process the sentinel value.
5. The Boolean operator `or` returns `True` when both of its operands are true.
6. `a and (b or c) == (a and b) or (a and c)`
7. `not(a or b) == (not a) or not(b)`
8. `True or False`

23. Multiple Choice.

1. A loop pattern that asks the user whether to continue on each iteration is called an
   (a) interactive loop
   (b) end-of-file loop
   (c) sentinel loop
   (d) infinite loop
2. A loop pattern that continues until a special value is input is called an
   (a) interactive loop
   (b) end-of-file loop
   (c) sentinel loop
   (d) infinite loop
3. Which of the following is not a valid rule of Boolean algebra?
   (a) `(True or x) == True`
   (b) `(False and x) == x`
   (c) `not (a and b) == not a and not b`
   (d) `(True or False) == True`
4. A loop that never terminates is called
   (a) busy (b) indefinite (c) tight (d) infinite
5. Which line would not be found in a truth table for `and`?
   (a) T T T (b) T F T (c) F T F (d) F F F
6. Which line would not be found in a truth table for `or`?
   (a) T T T (b) T F T (c) F T F (d) F F F

7. The term for an operator that may not evaluate one of its subexpressions is
   (a) short-circuit (b) faulty (c) exclusive (d) indefinite

24. Programming Exercises.

1. Write a program that uses a `while` loop to determine how long it takes for an investment to double at a given interest rate. The input will be an annualized interest rate, and the output is the number of years it takes for an investment to double. (Note: the amount of the initial investment does not matter; you can use any amount you like, or let the program work without a principal altogether. As Financial Maths student you probably know a formula to compute the number of years directly: implement this formula as well in your program and print the resulting value for comparison.)
2. A positive integer $n > 2$ is a prime number if no number between 2 and $\sqrt{n}$ (inclusive) evenly divides n. Write a program that accepts a value of n as input and determines if the value is prime. If n is not prime your program should quit as soon as it finds a value that evenly divides n.
3. The Collatz sequence is generated by starting with a natural number $n > 0$ and repeatedly applying the following function f until reaching 1:

$$f(n) = \begin{cases} n/2, & \text{if } n \text{ is even,} \\ 3n+1, & \text{if } n \text{ is odd.} \end{cases}$$

   For example, the Collatz sequence starting with $n = 5$ is $5, 16, 8, 4, 2, 1$. It is an open question in Mathematics whether this sequence will always go to 1 for every possible starting value.

   Write a program that gets a starting value from the user and then prints the Collatz sequence for that number and its length. What is the longest sequence you can find?
4. The greatest common divisor (GCD) of two natural numbers m and n can be computed using Euclid's algorithm. Staring with the values m and n, repeatedly apply the formula

   ```
   n, m = m, n % m
   ```

   until m is 0. At that point, n is the GCD of the original values m and n. Write a program that finds the GCD of two numbers using this algorithm.
5. Heating and cooling degree-days are measures used by utility companies to estimate energy requirements. If the average temperature for a day is below 60°F, then the number of degrees below 60 is added to the heating degree-days. if the temperature is above 80°F, the amount over 80 is added to the cooling degree-days. Write a program that accepts a sequence of average daily temperatures and computes the running total of heating and cooling degree-days. The program should print these two totals after all the data have been processed.
6. Modify the previous program to get its input from a file.