This test has 2 pages. Please write your name, the course number and "Test 2" on the exam booklet.

Books, notes, calculators, computers and phones are *not* permitted. Work on the questions in the order that you want, but try to write your answers in order in the booklet.

If a question asks for C++ code, don't worry about remembering every little detail of C++ syntax. Minor details will not affect your grade.

You can keep your copy of the exam. Or leave it in the booklet and you'll get it back.

1. (8%) Answer each of the following questions briefly but precisely.

   (a) What is a function object?

   (b) What is the main advantage of vectors over linked lists?

2. (12%) Create a function `read_fraction(a, b)` that reads a fraction from `cin` and sets the integer arguments `a` and `b` to be the numerator and denominator of the fraction, respectively. The fraction is read in the format `a/b`, where `a` and `b` are integers. If a fraction cannot be read, or if the denominator is 0, the function throws an exception of type `FractionInputError` and leaves `a` and `b` unchanged. Assume that the exception class has already been declared. The exception class includes a single constructor that takes as argument a `string` that describes the error.

3. (16%) Create a function called `read(in, v)` that reads integers from input file stream `in` and stores them in the vector of integers `v`. The file is assumed to contain only integers separated by white space. Integers are read until the end of the file is reached. The original contents of `v` is erased.

4. (16%) Implement the generic algorithm `fill(start, stop, e)`. Recall that this algorithm sets to `e` all the elements in the range `[start,stop)`. The arguments `start` and `stop` are bidirectional iterators.

5. (16%) Implement the generic algorithm

   ```
   find_if(start, stop, condition)
   ```

   Recall that this algorithm returns an iterator to the first element in the range `[start,stop)` that satisfies the unary predicate `condition`. If no element satisfies the predicate, `find_if` returns `stop`. The arguments `start` and `stop` are bidirectional iterators.

6. (16%) Create a generic function `append(n, e, ls)` that adds `n` copies of element `e` to the end of list `ls`.

7. (16%) Suppose that the file `people.txt` contains the names, ages and states of residence of a group of people. Each name, age and state of residence is given on a line by itself. The state of residence is given as a two-letter abbreviation. For example,

   ```
   Alice Brown
   19
   NY
   ```

   Write two separate pieces of code that perform the following tasks:

   (a) Read the file and store all the data in a map. The names of the people should be used as keys. Include a declaration of the map and any other data types you may need.

   (b) Assuming that Part (a) has been done, print to standard output the names of all the children in the map. (Consider that a child is someone who is younger than 18).