2. This question involves two classes that are used to process log messages. A list of sample log messages is given below.

```
CLIENT3:security alert – repeated login failures
Webserver:disk offline
SERVER1:file not found
SERVER2:read error on disk DSK1
SERVER1:write error on disk DSK2
Webserver:error on /dev/disk
```

Log messages have the format *machineId*:*description*, where *machineId* identifies the computer and *description* describes the event being logged. Exactly one colon (":") appears in a log message. There are no blanks either immediately before or immediately after the colon.

The following `LogMessage` class is used to represent a log message.

```
public class LogMessage
{
   private String machineId;
   private String description;

   /** Precondition: message is a valid log message. */
   public LogMessage(String message)
   {  /* to be implemented in part (a) */  }

   /** Returns true if the description in this log message properly contains keyword;
    *          false otherwise.
    */
   public boolean containsWord(String keyword)
   {  /* to be implemented in part (b) */  }

   public String getMachineId()
   {  return machineId;  }

   public String getDescription()
   {  return description;  }

   // There may be instance variables, constructors, and methods that are not shown.
}
```

(a) Write the constructor for the `LogMessage` class. It must initialize the private data of the object so that `getMachineId` returns the *machineId* part of the message and `getDescription` returns the *description* part of the message.

Complete the `LogMessage` constructor below.

```
/** Precondition: message is a valid log message. */
public LogMessage(String message)
```

Part (b) begins on page 8.

(b) Write the `LogMessage` method `containsWord`, which returns `true` if the description in the log message *properly contains* a given keyword and returns `false` otherwise.

A description *properly contains* a keyword if all three of the following conditions are true.

- the keyword is a substring of the description;
- the keyword is either at the beginning of the description or it is immediately preceded by a space;
- the keyword is either at the end of the description or it is immediately followed by a space.

The following tables show several examples. The descriptions in the left table properly contain the keyword `"disk"`. The descriptions in the right table do not properly contain the keyword `"disk"`.

Descriptions that properly contain `"disk"`

`"disk"`
`"error on disk"`
`"error on /dev/disk disk"`
`"error on disk DSK1"`

Descriptions that do not properly contain `"disk"`

`"DISK"`
`"error on disk3"`
`"error on /dev/disk"`
`"diskette"`

WRITE YOUR SOLUTION ON THE NEXT PAGE.

Assume that the `LogMessage` constructor works as specified, regardless of what you wrote in part (a).

Complete method `containsWord` below.

```
/** Returns true if the description in this log message properly contains keyword;
 *          false otherwise.
 */
public boolean containsWord(String keyword)
```

Part (c) begins on page 10.

(c) The `SystemLog` class represents a list of `LogMessage` objects and provides a method that removes and returns a list of all log messages (if any) that properly contain a given keyword. The messages in the returned list appear in the same order in which they originally appeared in the system log. If no message properly contains the keyword, an empty list is returned. The declaration of the `SystemLog` class is shown below.

```
public class SystemLog
{
    /** Contains all the entries in this system log.
     *  Guaranteed not to be null and to contain only non-null entries.
     */
    private List<LogMessage> messageList;

    /** Removes from the system log all entries whose descriptions properly contain keyword,
     *  and returns a list (possibly empty) containing the removed entries.
     *  Postcondition:
     *    - Entries in the returned list properly contain keyword and
     *      are in the order in which they appeared in the system log.
     *    - The remaining entries in the system log do not properly contain keyword and
     *      are in their original order.
     *    - The returned list is empty if no messages properly contain keyword.
     */
    public List<LogMessage> removeMessages(String keyword)
    {  /* to be implemented in part (c) */  }

    // There may be instance variables, constructors, and methods that are not shown.
}
```

Write the `SystemLog` method `removeMessages`, which removes from the system log all entries whose descriptions properly contain `keyword` and returns a list of the removed entries in their original order. For example, assume that `theLog` is a `SystemLog` object initially containing six `LogMessage` objects representing the following list of log messages.

```
CLIENT3:security alert - repeated login failures
Webserver:disk offline
SERVER1:file not found
SERVER2:read error on disk DSK1
SERVER1:write error on disk DSK2
Webserver:error on /dev/disk
```

The call `theLog.removeMessages("disk")` would return a list containing the `LogMessage` objects representing the following log messages.

```
Webserver:disk offline
SERVER2:read error on disk DSK1
SERVER1:write error on disk DSK2
```

After the call, `theLog` would contain the following log messages.

```
CLIENT3:security alert - repeated login failures
SERVER1:file not found
Webserver:error on /dev/disk
```

Assume that the `LogMessage` class works as specified, regardless of what you wrote in parts (a) and (b). You must use `containsWord` appropriately to receive full credit.

Complete method `removeMessages` below.

```
/** Removes from the system log all entries whose descriptions properly contain keyword,
 *  and returns a list (possibly empty) containing the removed entries.
 *  Postcondition:
 *    – Entries in the returned list properly contain keyword and
 *      are in the order in which they appeared in the system log.
 *    – The remaining entries in the system log do not properly contain keyword and
 *      are in their original order.
 *    – The returned list is empty if no messages properly contain keyword.
 */
public List<LogMessage> removeMessages(String keyword)
```

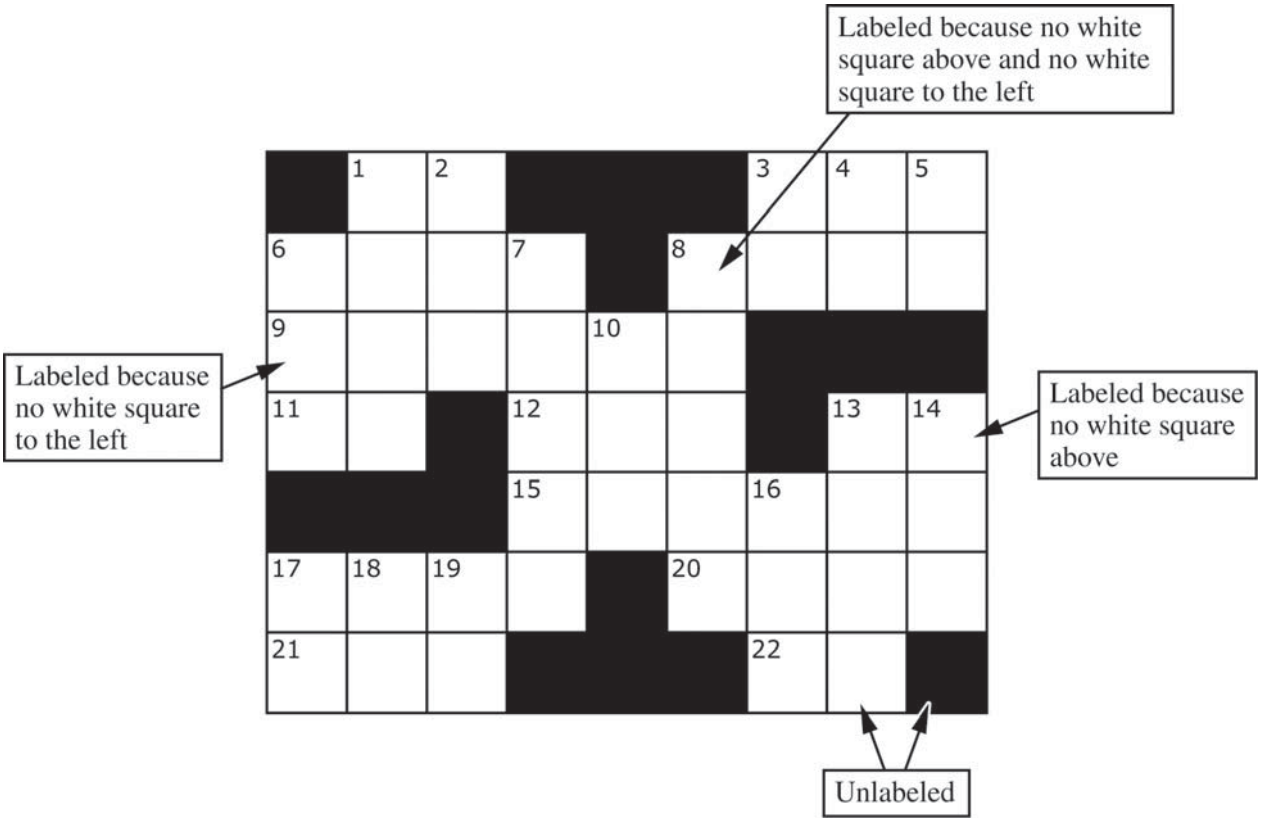
3. A crossword puzzle grid is a two-dimensional rectangular array of black and white squares. Some of the white squares are labeled with a positive number according to the *crossword labeling rule*.

   The crossword labeling rule identifies squares to be labeled with a positive number as follows.

   A square is labeled with a positive number if and only if
   - the square is white and
   - the square does not have a white square immediately above it, or it does not have a white square immediately to its left, or both.

   The squares identified by these criteria are labeled with consecutive numbers in row-major order, starting at 1.

   The following diagram shows a crossword puzzle grid and the labeling of the squares according to the crossword labeling rule.



AP® COMPUTER SCIENCE A
2016 SCORING GUIDELINES

Question 2: Log Messages

Part (a) `LogMessage` constructor **2 points**

Intent: *Initialize instance variables using passed parameter*

+1 Locates colon

+1 Initializes instance variables with correct parts of the parameter

Part (b) `containsWord` **2 points**

Intent: *Determine whether description properly contains a keyword*

+1 Identifies at least one properly-contained occurrence of `keyword` in `description`

+1 Returns `true` if and only if `description` properly contains `keyword`
Returns `false` otherwise (*no bounds errors*)

Part (c) `removeMessages` **5 points**

Intent: *Remove log messages containing keyword from system log list and return these messages in a new list*

+1 Accesses all items in `messageList` (*no bounds errors; point lost if no removal attempted*)

+1 Identifies keyword-containing entry using `containsWord`

+1 Adds all and only identified entries to new list (*point lost if original order not maintained*)

+1 Removes all identified entries from `messageList` (*point lost if* `messageList` *reordered)*

+1 Constructs and returns `new ArrayList<LogMessage>`

AP® COMPUTER SCIENCE A
2016 CANONICAL SOLUTIONS

Question 2: Log Messages

Part (a):

```
public LogMessage(String message)
{
      int colon = message.indexOf(":");
      machineId = message.substring(0, colon);
      description = message.substring(colon + 1);
}
```

Part (b):

```
public boolean containsWord(String keyword)
{
   if (description.equals(keyword))
   {   return true;   }
   if (description.indexOf(keyword + " ") == 0)
   {   return true;   }
   if (description.indexOf(" " + keyword + " ") != -1)
   {   return true;   }
   if (description.length() > keyword.length())
   {
       if ((description.substring(description.length() -
                                  keyword.length() - 1).equals(
                                  " " + keyword)))
       {
          return true;
       }
   }
   return false;
}
```

Part (c):

```
public List<LogMessage> removeMessages(String keyword)
{
      List<LogMessage> removals = new ArrayList<LogMessage>();

      for (int i = 0; i < messageList.size(); i++)
      {
            if (messageList.get(i).containsWord(keyword))
            {
                  removals.add(messageList.remove(i));
                  i--;
            }
      }
      return removals;
}
```

These canonical solutions serve an expository role, depicting general approaches to solution. Each reflects only one instance from the infinite set of valid solutions. The solutions are presented in a coding style chosen to enhance readability and facilitate understanding.