2. Consider a guessing game in which a player tries to guess a hidden word. The hidden word contains only capital letters and has a length known to the player. A guess contains only capital letters and has the same length as the hidden word.

   After a guess is made, the player is given a hint that is based on a comparison between the hidden word and the guess. Each position in the hint contains a character that corresponds to the letter in the same position in the guess. The following rules determine the characters that appear in the hint.

If the letter in the guess is …	**the corresponding character in the hint is**
also in the same position in the hidden word,	the matching letter
also in the hidden word, but in a different position,	`"+"`
not in the hidden word,	`"*"`

The `HiddenWord` class will be used to represent the hidden word in the game. The hidden word is passed to the constructor. The class contains a method, `getHint`, that takes a guess and produces a hint.

For example, suppose the variable `puzzle` is declared as follows.

```
HiddenWord puzzle = new HiddenWord("HARPS");
```

The following table shows several guesses and the hints that would be produced.

Call to `getHint`	**String returned**
`puzzle.getHint("AAAAA")`	`"+A+++"`
`puzzle.getHint("HELLO")`	`"H****"`
`puzzle.getHint("HEART")`	`"H*++*"`
`puzzle.getHint("HARMS")`	`"HAR*S"`
`puzzle.getHint("HARPS")`	`"HARPS"`

Write the complete `HiddenWord` class, including any necessary instance variables, its constructor, and the method, `getHint`, described above. You may assume that the length of the guess is the same as the length of the hidden word.

3. A two-dimensional array of integers in which most elements are zero is called a *sparse array*. Because most elements have a value of zero, memory can be saved by storing only the non-zero values along with their row and column indexes. The following complete `SparseArrayEntry` class is used to represent non-zero elements in a sparse array. A `SparseArrayEntry` object cannot be modified after it has been constructed.

```
public class SparseArrayEntry
{
  /** The row index and column index for this entry in the sparse array */
  private int row;
  private int col;

  /** The value of this entry in the sparse array */
  private int value;

  /** Constructs a SparseArrayEntry object that represents a sparse array element
   *  with row index r and column index c, containing value v.
   */
  public SparseArrayEntry(int r, int c, int v)
  {
    row = r;
    col = c;
    value = v;
  }

  /** Returns the row index of this sparse array element. */
  public int getRow()
  {  return row;  }

  /** Returns the column index of this sparse array element. */
  public int getCol()
  {  return col;  }

  /** Returns the value of this sparse array element. */
  public int getValue()
  {  return value;  }
}
```

The `SparseArray` class represents a sparse array. It contains a list of `SparseArrayEntry` objects, each of which represents one of the non-zero elements in the array. The entries representing the non-zero elements are stored in the list in no particular order. Each non-zero element is represented by exactly one entry in the list.

```
public class SparseArray
{
  /** The number of rows and columns in the sparse array. */
  private int numRows;
  private int numCols;

  /** The list of entries representing the non-zero elements of the sparse array. Entries are stored in the
   *  list in no particular order. Each non-zero element is represented by exactly one entry in the list.
   */
  private List<SparseArrayEntry> entries;

  /** Constructs an empty SparseArray. */
  public SparseArray()
  {  entries = new ArrayList<SparseArrayEntry>();  }

  /** Returns the number of rows in the sparse array. */
  public int getNumRows()
  {  return numRows;  }

  /** Returns the number of columns in the sparse array. */
  public int getNumCols()
  {  return numCols;  }

  /** Returns the value of the element at row index row and column index col in the sparse array.
   *  Precondition: 0 ≤ row < getNumRows()
   *                0 ≤ col < getNumCols()
   */
  public int getValueAt(int row, int col)
  {  /* to be implemented in part (a) */  }

  /** Removes the column col from the sparse array.
   *  Precondition: 0 ≤ col < getNumCols()
   */
  public void removeColumn(int col)
  {  /* to be implemented in part (b) */  }

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

The following table shows an example of a two-dimensional sparse array. Empty cells in the table indicate zero values.

	0	1	2	3	4
0					
1		5			4
2	1				
3		-9			
4					
5					

The sample array can be represented by a `SparseArray` object, `sparse`, with the following instance variable values. The items in `entries` are in no particular order; one possible ordering is shown below.

```
numRows: 6

numCols: 5

entries: [ row: 1  col: 4  value: 4 ]
         [ row: 2  col: 0  value: 1 ]
         [ row: 3  col: 1  value: -9 ]
         [ row: 1  col: 1  value: 5 ]
```

(a) Write the `SparseArray` method `getValueAt`. The method returns the value of the sparse array element at a given row and column in the sparse array. If the list `entries` contains an entry with the specified row and column, the value associated with the entry is returned. If there is no entry in `entries` corresponding to the specified row and column, 0 is returned.

In the example above, the call `sparse.getValueAt(3, 1)` would return -9, and `sparse.getValueAt(3, 3)` would return 0.

WRITE YOUR SOLUTION ON THE NEXT PAGE.

Part (a) continues on page 12.

AP® COMPUTER SCIENCE A
2015 SCORING GUIDELINES

Question 2: Guessing Game

Class:	`HiddenWord`	**9 points**

Intent: *Define implementation of class to represent hidden word in guessing game*

+1 Uses correct class, constructor, and method headers

+1 Declares appropriate `private` instance variable

+1 Initializes instance variable within constructor using parameter

+6 Implement `getHint`

- **+1** Accesses all letters in both guess and hidden word in loop (*no bounds errors in either*)
- **+4** Process letters within loop
  - **+1** Extracts and compares corresponding single letters from guess and hidden word
  - **+1** Tests whether guess letter occurs in same position in both guess and hidden word
  - **+1** Tests whether guess letter occurs in hidden word but not in same position as in guess
  - **+1** Adds correct character exactly once to the hint string based on the test result
- **+1** Declares, initializes, and returns constructed hint string

Question-Specific Penalties

-1 (t) Uses `get` to access letters from strings

-2 (u) Consistently uses incorrect name instead of instance variable name for hidden word

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2015 CANONICAL SOLUTIONS

Question 2: Guessing Game

```
public class HiddenWord
{
    private String word;

    public HiddenWord(String hWord)
    {
        word = hWord;
    }

    public String getHint(String guess){
        String hint = "";
        for (int i = 0; i < guess.length(); i++){
          if (guess.substring(i,i+1).equals(word.substring(i,i+1))){
                hint += guess.substring(i,i+1);
          } else if (word.indexOf(guess.substring(i,i+1))!= -1){
                hint += "+";
          } else {
                hint += "*";
          }
        }
        return hint;
    }

}
```