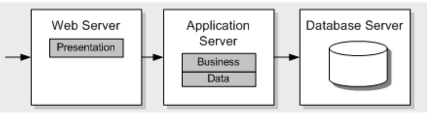
Basic System Design

Presentation Layer	User interface, caching, validation, single page or multi page
Business Layer	Logic/workflows, reuse common logic
Data Layer	Entity objects that pass data, database type. SQL vs NoSQL

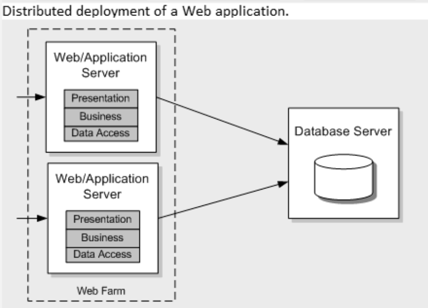
Also consider security of application.

System Design - Deployment Considerations

Non-distributed deployment of a Web application.



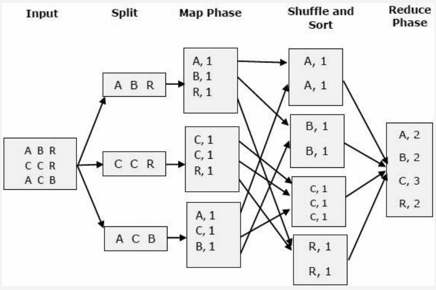
Distributed deployment of a Web application.



Load balancing a Web application.

Consider the following guidelines for deployment:
• Consider using non-distributed deployment to maximize performance.
• Consider using distributed deployment to achieve better scalability and to allow each layer
to be secured separately.

Map Reduce



The MapReduce algorithm contains two important tasks, namely Map and Reduce.
The Map task takes a set of data and converts it into another set of data, where individual elements are broken down into tuples (key-value pairs).
The Reduce task takes the output from the Map as an input and combines those data tuples (key-value pairs) into a smaller set of tuples.

SQL vs NoSQL

SQL	Language used for relational databases
	Scaled vertically by increasing power (more common), scaled horizontally by partitioning
	Tables and columns, rows, Have constrained logical relationships
	Must exhibit ACID properties
	MS-SQL, Oracle, Access, Ingress
NoSQL	Language used for non relational dbs
	Scales better horizontally using master-slave architecture
	Multiple formats: Column, Key-Value, Document, Graph

SQL vs NoSQL (cont)

	Adheres to CAP
	MongoDB, DynamoDB, CouchDB
Use SQL when:	data is small
	Conceptually modeled as tabular
	consistency is critical
Use NoSQL when:	Graph or hierarchial data
	Data sets which are both large and mutate significantly
	Businesses growing extremely fast but lacking data schemata

ACID - Atomicity, Consistency, Isolation, Durability
CAP - Consistency, Availability, Partition tolerance

Algorithms

Algorithm	BEST	AVERAGE	WORST
Insertion Sort	n	¼ n^2	½ n^2
Merge Sort	½ n lg n	n lg n	n lg n
Quick Sort	n lg n	2 n ln n	½ n^2

Quick Sort works better for small arrays
Merge Sort works better for linked lists and is consistent for any size of data

C# String Methods

CompareTo()	Compare two strings	`str2.CompareTo(str1)`
IndexOf()	Returns the index position of first occurrence of character	`str1.IndexOf(":")`
Remove()	deletes all the characters from beginning to specified index position.	`str1.Remove(i);`
Replace()	replaces the specified character with another	`str1.Replace('old', 'new');`
Substring()	his method returns substring.	`str1.Substring(1, 7);`

```
Substring(Int32)
Substring(Int32, Int32) //start, length
```

C# List Methods

`BinarySearch()`	Uses a binary search algorithm to locate a specific element in the sorted List<T> or a portion of it.
`ConvertAll(Converter)`	Converts the elements in the current List<T> to another type, and returns a list containing the converted elements.
`IndexOf()`	Returns the zero-based index of the first occurrence of a value in the List<T> or in a portion of it.

C# List Methods (cont)

`Sort()`	Sorts the elements or a portion of the elements in the List<T>
`Reverse()`	Reverses the order of the elements in the List<T> or a portion of it.

Sort is QuickSort

Search Basics

Breadth First Search	An algorithm that searches a tree (or graph) by searching levels of the tree first, starting at the root.
	Moves left to right on level, tracking children. Then moves to next level
Depth First Search	An algorithm that searches a tree (or graph) by searching depth of the tree first, starting at the root.
	It traverses left down a tree until it cannot go further
	traverses back up trying the right child of nodes on that branch, and if possible left from the right children

Search Basics (cont)

	When finished examining a branch it moves to the node right of the root then tries to go left on all it's children until it reaches the bottom.
When to use BFS:	Optimal for searching a tree that is wider than it is deep
	Uses a queue to store information about the tree while it traverses a tree so uses more memory than DFS
When to use DFS	Optimal for searching a tree that is deeper than it is wide.
	Uses a stack to push nodes onto.