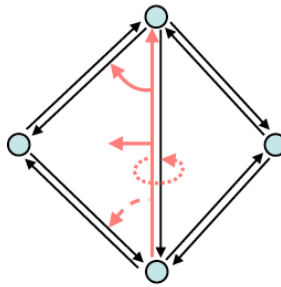


Basic Geometric Data Structures

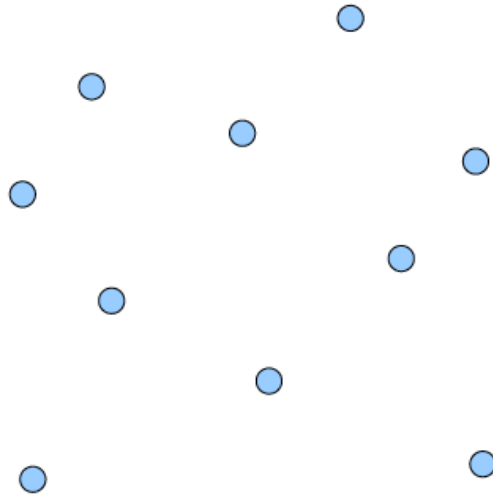
1. Prove the average valence of a vertex in a manifold triangle mesh is 6. *Hint: Use the Euler characteristic $V-E+F=2(1-g)$ to write E in terms of V*
2. Write a pseudo-code function that uses the half-edge data structure below to find all neighboring vertices of a vertex v .

```
class HalfEdge {  
    HalfEdge *opp;  
    Vertex *end;  
    Face *left;  
    HalfEdge *next;  
};  
  
HalfEdge e;
```



Spatial Partitions

3. Draw the 2D spatial partition that would be created by a kd-tree for the following point set. Assume you starting splitting the x-axis and split at the median point each time.



4. Suppose the overall bounding box for the tree is given by the corners $(3, 5)$ and $(8, 15)$ and the first split is at point $(7, 11)$. What is the bounding box of the right child of the root?
5. Compare the number of cells in a uniform grid containing n points and a kd-tree containing n points. Assume the uniform grid uses the allocation strategy discussed in lecture with a magic number $m=2$.