**Is an array that is sorted in Ascending order a min-oriented heap? Why?**

A min-heap has a binary tree structure and an array has a random access structure so in that sense, No they are two very different structures.

But if you interpret the array as having an implied binary tree structure then it can be interpreted as a valid min-heap.

A min-heap has three properties:

1. Each node has at most two children
2. Every parent is ranked less than its children
3. The binary tree is complete

An array is often interpreted as a binary tree where the children of a given index 𝑖i are located at indices 2𝑖+12i+1and 2𝑖+22i+2*.* If the array has a size less than 2𝑖+12i+1or 2𝑖+22i+2 then those children of 𝑖i are considered *null*.

When an array is interpreted in this way, with this implementation of a binary heap, it can be proven that each parent will have a value less than or equal to its two children. Therefore it is a valid min heap.

Here is a proof of why it is a valid min-heap (specifically an array of integers):

Statement: An array of integers sorted in increasing order is a valid min-heap.

we must prove 3 things: each node has at most two children, the (interpreted) tree is complete, and every nodes value is less than the value of each of its children.

1. Each node has at most two children
   1. let the binary tree be interpreted such that the children of index 𝑖i are at indices 2𝑖+12i+1 for all 2𝑖+1<𝑛2i+1<n and 2𝑖+22i+2 for all 2𝑖+2<𝑛2i+2<n
   2. (a) defines exactly two possible children for every node, thus (1) is true
2. The tree defined by (1.a) is complete
   1. let *x* be defined as a power of 2 such that 𝑛2≤𝑥<𝑛n2≤x<n
   2. let y be defined as a power of 2 such that 𝑛≤𝑦<2𝑛n≤y<2n
   3. nodes at indices [0,𝑥−1][0,x−1] are all internal nodes because the node at index 𝑥−1,x−1 has at least 1 child \*\*
   4. nodes at indices [𝑥,𝑛−1][x,n−1] are all leaf nodes because the node at index 𝑥x has no children \*\*
   5. the node at index 𝑥−1x−1 is the rightmost node in level $h$, where level ℎh contains nodes at indices [2ℎ−1,2ℎ+1−2][2h−1,2h+1−2] \*\*
   6. statements (a-e) prove statement (2)
3. Every nodes value is less than the value of each of its children
   1. for a node at index 𝑖i, its children (if they exist) are at indices 2𝑖+12i+1 and 2𝑖+22i+2
   2. the value at any index 𝑖i is less than the value at the index 𝑖+1i+1(inferred by definition of an array sorted by increasing value)
   3. by (a) and (b), statement (3) is true
4. By the proof of statement (1–3), the original statement is true

EDIT:

1. updated definition of min-heap to include completeness.
2. updated proof to compensate for completeness of binary tree.