Mandatory Exercise: LCA and RMQ

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1 The First Covering Ancestor Problem Let T be a rooted tree with n nodes. Each leaf in T is assigned a label from a set of characters Σ. Given a node $v \in T$, the subtree rooted at v, denoted $T(v)$, is the tree consisting of v and all descendants of v. A node $v \in T$ *covers a character* c if $T(v)$ contains a leaf with label c. We are interested in efficient data structures for T that support the following query. Let ℓ be a leaf in T and c a character in Σ.

- FCA(ℓ, c): return the deepest ancestor a of ℓ such that a covers c.

Give a linear-space data structure for T that supports fast FCA queries. You may assume that the root of T covers all characters in Σ. Ignore the preprocessing time.