CS3402 Tutorial 7:

1. Construct a B+ tree for the following set of key values:

   (2, 3, 5, 7, 11, 17, 19, 23, 29, 31)

   Assuming that the tree is initially empty, values are added in ascending order, and the degree of both internal nodes and leaf nodes is 4. Thus each internal node in the tree can fit four pointers and three key values, denoted as $<A_1,K_1,A_2, K_2, A_3, K_3,A_4>$. Within each node, the keys satisfy $K_1 < K_2 < K_3$. For all search field values X in the sub-tree pointed by A_i, we have:

   $K_{i-1} \leq X < K_i$ for $1 < i < 4$,

   $X < K_i$ for $i=1$,

   $K_{i-1} \leq X$ for $i = 4$.

2. For the B+ tree constructed for question 1, show the form of the tree after each of the following series of operations:
   (a) Insert 9
   (b) Insert 10
   (c) Delete 19
   (d) Delete 23
   (e) Delete 29

3. Consider a disk with block size B=512 bytes. A block pointer is P=6 bytes long, and a record pointer is PR =8 bytes long. A file has r=10,000 STUDENT records of fixed-length. Each record has the following fields: NAME (32 bytes), ID (10 bytes), DEPARTMENTCODE (8 bytes), ADDRESS (40 bytes), PHONE (8 bytes), BIRTHDATE (8 bytes), SEX (1 byte). Suppose the file is stored with an unspanned organization and file is ordered by the key field ID.

   (a) Calculate the record size R in bytes and the blocking factor bfr.

   (b) If we want to construct a single-level primary index on ID, calculate the number of index entries and the number of index blocks.