File Structure vs. Data Structure
(large, persistent)

(file ops)
read
write
insert/delete
traverse

Absolute address (drive, head, track...)
Block address (0, 1, 2, etc.)
TTR - pair of binary numbers
1st in track:

<table>
<thead>
<tr>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Logical Files
1. Hash file - fast retrieval, fast update, no traversal
2. Indexed Sequential (compromise)
   ISAM - keyed file with a rigid index
   VSAM - B-tree index
3. Indexed random - full index, fairly fast retrieval,
   secondary keys (unique)

"acct #" \rightarrow H(k) \rightarrow \text{index} \rightarrow "name"

(could also be a hash file)
Example: Order 3 B-tree

```
(node)  □ [10, 50] □ [10, 40] | □ |

10  50
   o   o  □ 
   a   b  □ 

insert 60  □ |
meaningless: ">50" replaced by "50-60"

50
   □  □
10   60
   x   y
   □  □  □
a   b  x  y

insert 25

50
   □  □
10  25  60
   □  □
10  50
   □  □
10  35
   □  □
10  25

"insert at leaf level"

insert 35

50
   □  □
10  25  60
   □  □
10  35
   □  □
10  25

NOT VALID
B-tree!

Correct
```