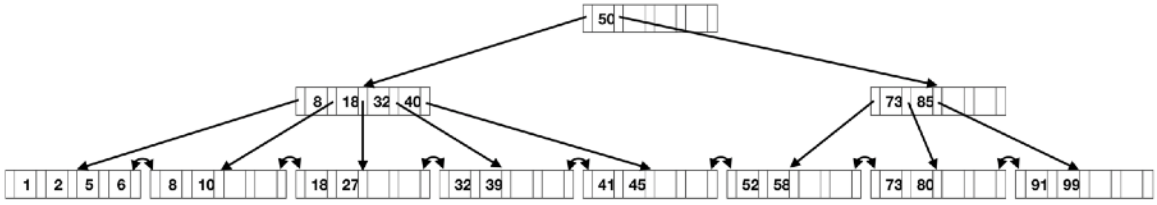
# Assignment 3

**Please make sure that you always use notations consistent with lecture notes. Different notations will not be accepted. The deadline for assignment 3 is:**

**Mon 29 Apr, 10:00 am**

## Question 1 (8 marks)

Consider the B+ tree shown in the following as an original tree.




Answer the following questions:

1) (2 marks) There are currently 18 records in this tree. How many additional records could be added to this tree without changing its height (give the maximum possible number)?

2) (3 marks) Show the B+ tree after inserting a data entry with key 3 into the original tree.

3) (3 marks) Show the B+ tree after deleting the data entry with key 91 from the original tree.

## Question 2 (4 marks)

Consider a relation R(a,b,c,d,e,f,g,h) containing 10,000,000 records, where each data page of the relation holds 10 records. R is organised as a sorted file with the search key R.a. Assume that R.a is a candidate key of R, with values lying in the range 0 to 9,999,999. For the relational algebra $\pi_{\{a,b\}}(\sigma_{(a>2{,}000{,}000\ and\ a<8{,}000{,}000)}(R))$, state which of the following approaches (or combination thereof) is the most likely to be the cheapest:

1. Access the sorted file for R directly.
2. Use a clustered B+ tree index on attribute R.a.
3. Use a clustered B+ tree index on attribute R.b.
4. Use a linear hashed index on attribute R.a.
5. Use a clustered B+ tree index on attributes (R.a, R.b).
6. Use a linear hashed index on attribute s (R.a, R.b).

We assume that the database considers index-only plans. Index-only plans allow an index to contain all columns required to answer the query. It means that by using index-only plans, you will not have to access the data records in the file that contain the queried relations.

# Question 3 (8 marks)

Consider the schedule below. Here, R(*) and W(*) stand for 'Read' and 'Write', respectively. $T_1$, $T_2$, $T_3$ and $T_4$ represent four transactions and $t_i$ represents a time slot.

| Time | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ | $t_7$ | $t_8$ | $t_9$ | $t_{10}$ | $t_{11}$ | $t_{12}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | | R(B) | | | | R(A) | W(B) | | W(A) | | | |
| $T_2$ | | | R(A) | W(A) | | | | | | | | |
| $T_3$ | | | | | | | | R(B) | | W(B) | | |
| $T_4$ | R(A) | | | | W(A) | | | | | | R(B) | W(B) |

Each transaction begins at the time slot of its first Read, and commits right after its last Write (same time slot).

Regarding the following questions, give and justify your answers.

1) Assume a checkpoint is made between $t_4$ and $t_5$, what should be done to the four transactions when the crash happens between $t_7$ and $t_8$. (2 marks)

2) Is the transaction schedule conflict serialisable? Give the precedence graph to justify your answer. (2 marks)

3) Construct a schedule (which is different from above) of these four transactions which causes deadlock when using two-phase locking protocol. If no such schedule exists, explain why. (2 marks)

4) Construct a schedule (which is different from above) of these four transactions which **does not** cause deadlock when using two-phase locking protocol. If no such schedule exists, explain why. (2 marks)

# Assignment Submission

We accept electronic submissions only. Please submit your assignments as follows:

- The file name should be ass3.pdf.
- Ensure that you are in the directory containing the file to be submitted. (note: we only accept files with .pdf extension)
- Type "give cs9311 ass3 ass3.pdf" to submit.
- You can also use the web give system to submit.
- Please keep a screen capture (including **timestamp** and the **size** of the submitted file) for your submissions as proof in case that the system is not working properly. If you are not sure how, please have a look at the FAQ.

Note:

1. If the size of your pdf file is larger than 2MB, the system will not accept the submission. If you face this problem, try converting to compress pdf.
2. If you have any problems in submissions, please email to comp9311unsw@gmail.com.
3. We do not accept e-mail submissions, and the submission system will be immediately closed after the deadline.

# Late Submission Penalty

Zero mark