CS 5/7343 Fall 2021

Homework 1

Question 1:

A. 76-77. This is because every number in the child left of the key must be strictly less than the key, and every number in the child to the right of the key must be greater than or equal to the key. Since node K is splitting into two new nodes containing the numbers [74 75] and [77 78 80], the key must be strictly greater than 75 and less than or equal to 77. Therefore the key can only be 76 or 77.

B. Keys for:
   ○ A: [50 74]
   ○ B: [15 20]
   ○ C: [50]
   ○ D: [74]

C. Insertions:
   ○ 75
      ■ K -> KA [74 75] and KB [77 78 80]
      ■ D -> D [74 77]
   ○ 48
      ■ H -> H [40 44 47 48]
   ○ 49
      ■ H -> HA [40 44] and HB [47 48 49]
      ■ C -> C [47 50]
   ○ 2
      ■ E -> EA [0 2] and EB [8 10 11]
      ■ B -> BA [8] and BB [15 20]
      ■ A -> AA [15] and AB [50 74]
      ■ New root N [50]
   ○ 28
      ■ G -> GA [20 21] and GB [28 30 35]
      ■ BB -> BBA [15] and BBB [20 28]
      ■ AA -> AA [15 20]

Question 2:

A. 8 tuples/page (1600 bytes/page / 200 bytes/tuple)
B. 31250 pages (250,000 tuples / 8 tuples/page)
C. If:
    a. There is no index
        i. Worst case: 15.725 s (31250 pages * 0.5 ms/page + 2 tracks * 50 ms/track)
        ii. Best case: 50.5 ms (1 page * 0.5 ms/page + 1 track * 50 ms/track)
    b. There is a clustering index
        i. Worst case: 50.5 ms (1 page * 0.5 ms/page + 1 track * 50 ms/track)
        ii. Best case: 50.5 ms (1 page * 0.5 ms/page + 1 track * 50 ms/track)
D. If:
    a. There are 2 tuples, worst case: 101 ms (2 * 0.5 ms/page + 2 * 50 ms/track [could be on both tracks])
    b. There are 10,000 tuples, worst case: 5.1 s (10,000 * 0.5 ms/page + 2 * 50 ms/track [could be on both tracks])

Question 3:

```
[
    //Teachers
    {
        "name": "John",
        "age":  26
    },
    {
        "name": "Jane",
        "age":  28
    },
    {
        "name": "Brad",
        "age":  30
    },

    //Publishers
    {
        "name": "P1"
    },
```

```json
    {
        "name": "P2"
    },

    //Textbooks
    {
        "name": "T1",
        "authors": ["Johnson"],
        "publisher": "P1"
    },
    {
        "name": "T2",
        "authors": ["Jackson", "Hanson"],
        "publisher": "P1"
    },
    {
        "name": "T3",
        "authors": ["Manson"],
        "publisher": "P2"
    },

    //Classes
    {
        "name": "CS101",
        "teachers": [
            {
                "teacher": "John",
                "textbook": "T1"
            },
            {
                "teacher": "Jane",
                "textbook": "T2"
            }
        ]
    },
    {
        "name": "CS102",
        "teachers": [
            {
                "teacher": "John",
```

```json
            "textbook": "T2"
        },
        {
            "teacher": "Jane",
            "textbook": "T3"
        },
        {
            "teacher": "Brad",
            "textbook": "T1"
        }
    ]
}
]
```