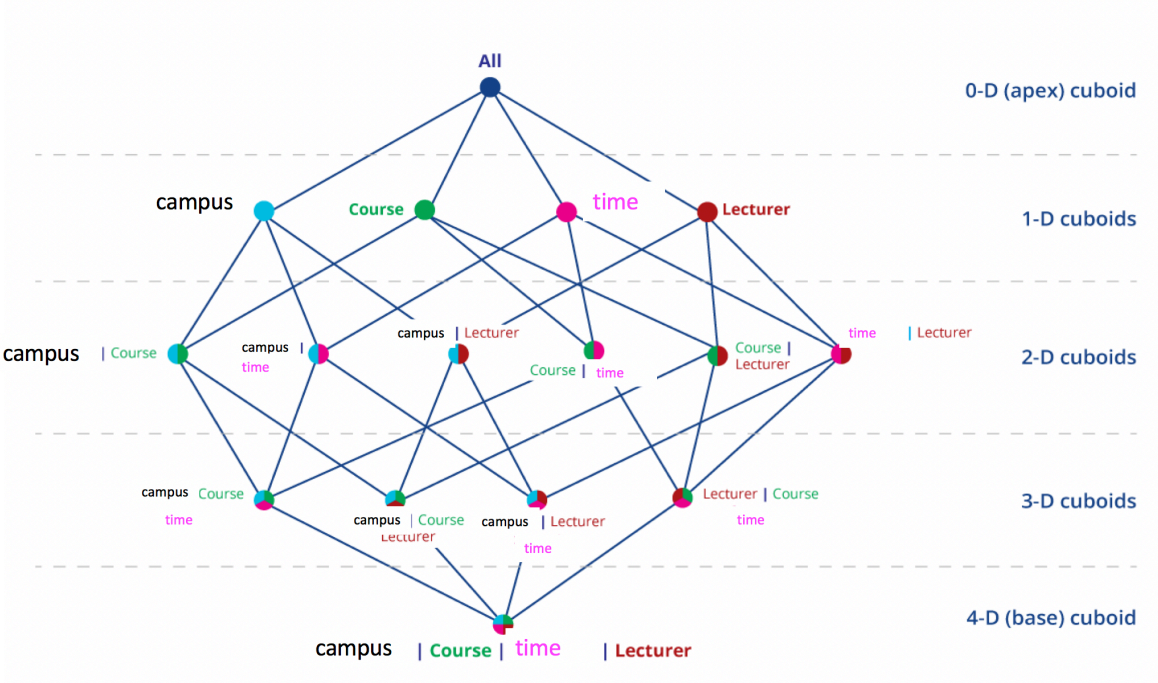
Assignment 2 Help

Step 8

Let's take an example of JCU with 4 dimensions (campus, course, time, lecturer) as shown below, and we are interested in number_of_students_enrolled:



An example of very simple actual data in the base cuboid would look like:

Student-ID	Course	Campus	Time Enrolled	Lecturer
1	MBA Global	Cairns	Semester 86	Jai
2	MDS	Townsville	Semester 82	Sisi
3	MBA Leadership	Singapore	Semester 86	Kurt
4	MDS	Townsville	Semester 82	Sisi
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
999	MBA Global	Townsville	Semester 84	Jai
…	…	…	…	…
…	…	…	…	…

In this case, we do have four dimensions, and the number of cuboids is simply $2^4 = 16$. This could be explained with a bit operation as below where each dimension is represented by a binary (0 is used for non-aggregated whilst 1 is used for aggregate).

So the base cuboid could be as below where all dimensions have their raw values:

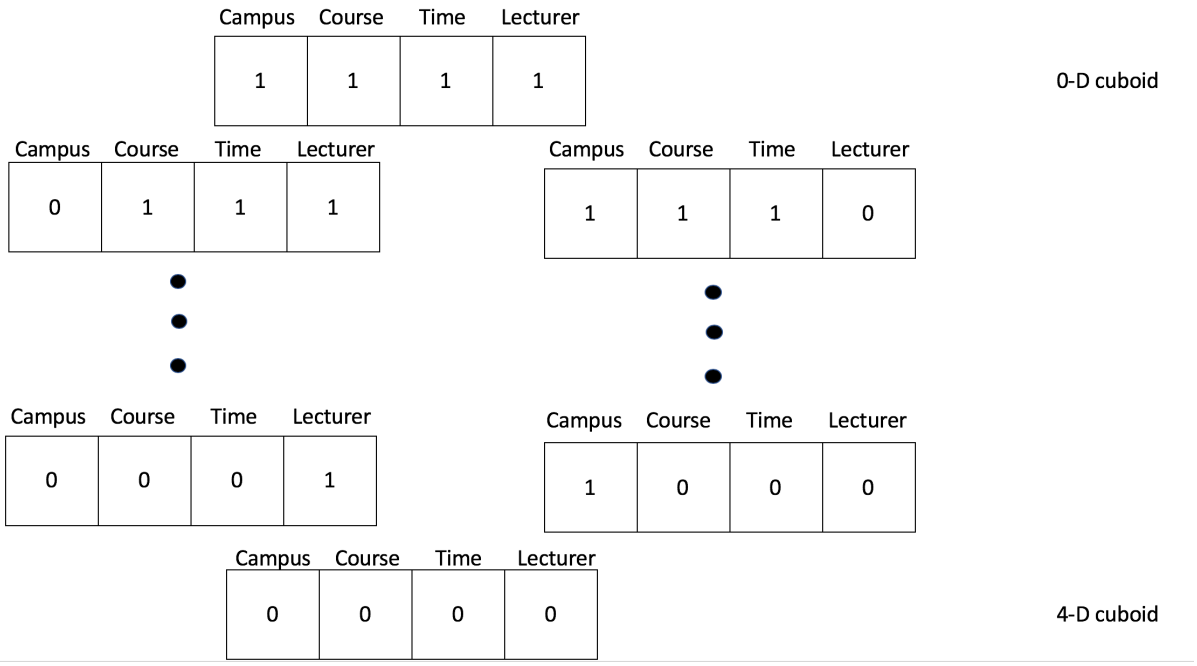
Campus	Course	Time	Lecturer
0	0	0	0

Similarly, the apex cuboid could be as below where all dimensions are aggregated (all values). That is, it calculates the number of students enrolled for all campuses, all courses, all time and for all lecturers:

Campus	Course	Time	Lecturer
1	1	1	1

Therefore, the number of different cases (cuboids) in this 4-bit representation is alternating each bit value with 0 or 1, so we have 4 dimensions, and each has two values (aggregate and non-aggregate) resulting in $2^4 = 16$.

The following diagram shows the corresponding lattice of cuboids:



In this particular example, let's assume a simple scenario where each dimension has 3 distinct values: Campus (Cairns, Townsville, Singapore), Course (MDS, MBA Global, MBA Leadership), Time (SP82, SP84, SP86), and Lecturer (Jai, Sisi, Kurt), and we are interested in number_of_students_enrolled for various cases.

In this simple scenario, what is the maximum number of cells possible in the base cuboid?

- ⇨ In this case, each dimension has 3 different values. Therefore, $3^4 = 81$.

What is the minimum number of cells possible in the base cuboid?

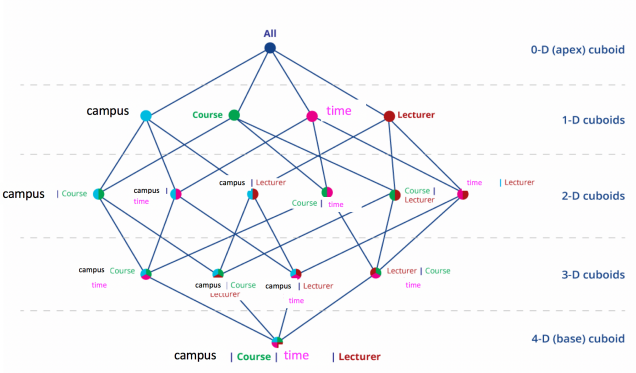
- ⇨ In this case, we know that each dimension in the base cuboid has 3 distinctive values, thus the minimum number of cells is the same as 3 where no two cells has the same value in the 4 dimensions.
- ⇨ For instance, one possible answer could be:
  - (Cairn, MDS, SP86, Jai)
  - (Townsville, MBA Global, SP84, Sisi)
  - (Singapore, MBA Leadership, Kurt)

For the JCU scenario explained above with 4 dimensions, let's assume there are three base cells:

1) (Cairns, MDS, SP86, Jai)
2) (Townsville, MBA Global, SP86, Jai)
3) (Cairns, MBA Global, SP86, Jai)

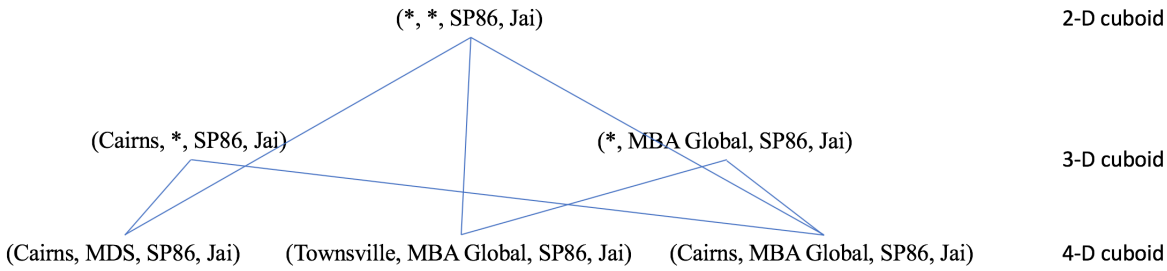
How many nonempty cuboids will a full data contain for this scenario?

- ⇨ $2^4 = 16$



How many nonempty aggregate (non-base) cells with a full cube contain?

- ⇨ Note that each cell generates $2^4 - 1$ nonempty cells;
  - This is because with the bit operation above, you do have 2^4 different combinations with 4 dimensions, but we have to remove (0,0,0,0) where all empty.
- ⇨ There are three cell combinations:



- ⇨ Since there are three cells and each cell generates $2^4 - 1$, in total $3 * (2^4 - 1)$ cells = $\mathbf{3 * 2^4 - 3}$;
- ⇨ The number of overlapping cells is: $2 * 2^2$ (one overlapping for each 3-D cuboid, thus 2 * overlapping bits) and $2 * 2^2$ (two overlapping for 2-D cuboid) = $4 * 2^2 = 2^4$
  - That is, (Cairns,*,SP86,Jai) is from both (Cairns, MDS, SP86, Jai) and (Cairns, MBA Global, SP86, Jai) so one of them is (SP86, Jai) repeating, and the same for (*, MBA Global, SP86, Jai). So we do have 2 cases * 2^2 (SP86, Jai) and (*, *, SP86, Jai) is a combination of all three (Cairns, *, SP86, Jai), (Townsville, MBA Global, SP86, Jai) and (Cairns, MBA Global, SP86, Jai), so two cells are duplicate with dimensions (SP86, Jai) resulting in 2 cells * 2^2.

- ⇨ Therefore, $3 * 2^4 - 3 - 2^4 = 2 * 2^4 - 3 = 29$

How many nonempty aggregate cells will an iceberg cube contain if the condition of the iceberg cube is "count ≥ 2"?

- ⇨ (Cairns, *, SP86, Jai) has count 2, (*, MBA Global, SP86, Jai) has count 2, and (*, * SP86, Jai) has count 3
- ⇨ Thus, $3 * 2^2 = 12$

How many closed cells are in the full cube?

- ⇨ There are 6 as follows:

1) (Cairns, MDS, SP86, Jai) : 1
2) (Townsville, MBA Global, SP86, Jai) : 1
3) (Cairns, MBA Global, SP86, Jai) : 1
4) (*, MBA Global, SP86, Jai): 2
5) (Cairns, *, SP86, Jai): 2
6) (*, *, SP86, Jai): 3