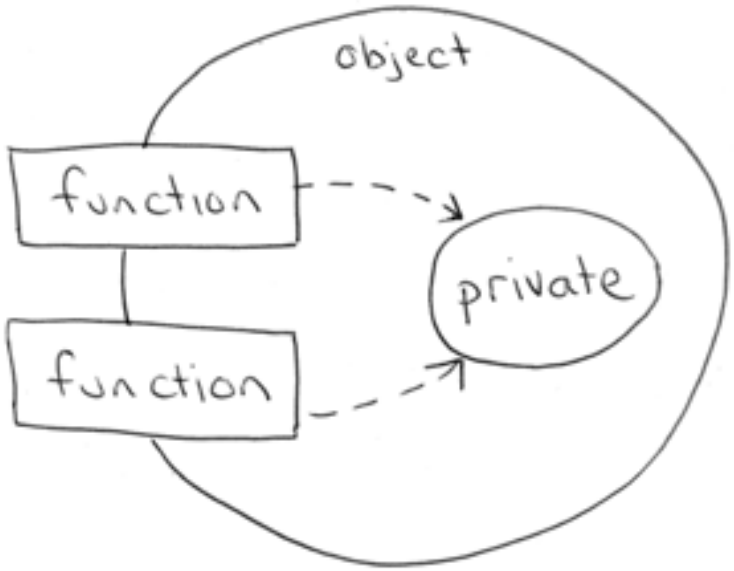
REPORTING

Unit 3 – Data exploitation. Query languages and visualization
S3 –2 – MDX

1

- **CUBES**
- **LANGUAGE**
- **M**ulti**D**imensional e**X**pression.
- Microsoft in 1997

- Do you remember studying Object-Oriented Programming?



Outline

1. Tuples, Sets & Cells
2. MDX Spells
3. MDX Query Syntax

1. Tuples, Sets & Cells

Tuples, Sets & Cells

- Measures | Dimensions>Members
- E.g.: 2 dimension cube
  - **1 measure**: discharged patients.
  - Time Dimension with 4 members: Jan to April.
  - Hospital Dimension with 4 members: H1,H2,H3,H4.

Discharged	H1	H2	H3	H4
January	20	44	81	44
February	15	32	78	32
March	23	65	88	65
April	19	67	67	67

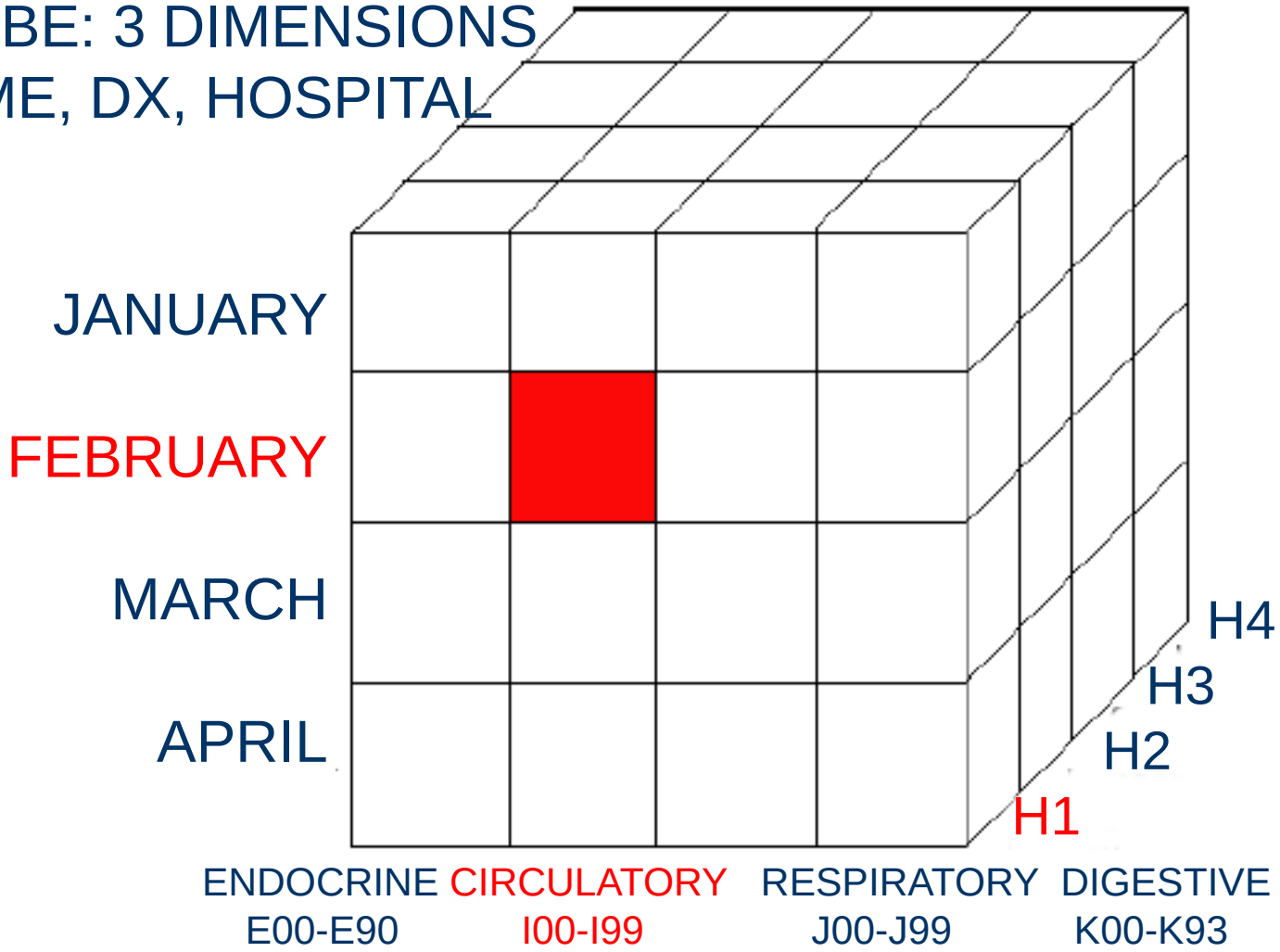
Tuples, Sets & Cells

- Measures | Dimensions>Members
- E.g.: 2 dimension cube
  - **2 measure**: no. discharged patients, total cost (M€).
  - Time Dimension with 4 members: Jan to April.
  - Hospital Dimension with 4 members: H1,H2,H3, H4.

Discharged	H1	H2	H3	H4
January	20 1.5M€	44 4.1M€	81 10.5M€	44 4.1M€
February	15 1.1M€	32 3.9M€	78 10.4M€	32 3.9M€
March	23 1.6M€	65 5.4M€	88 10.7M€	65 5.4M€
April	19 1.5M€	67 5.6M€	67 9.5M€	67 5.6M€

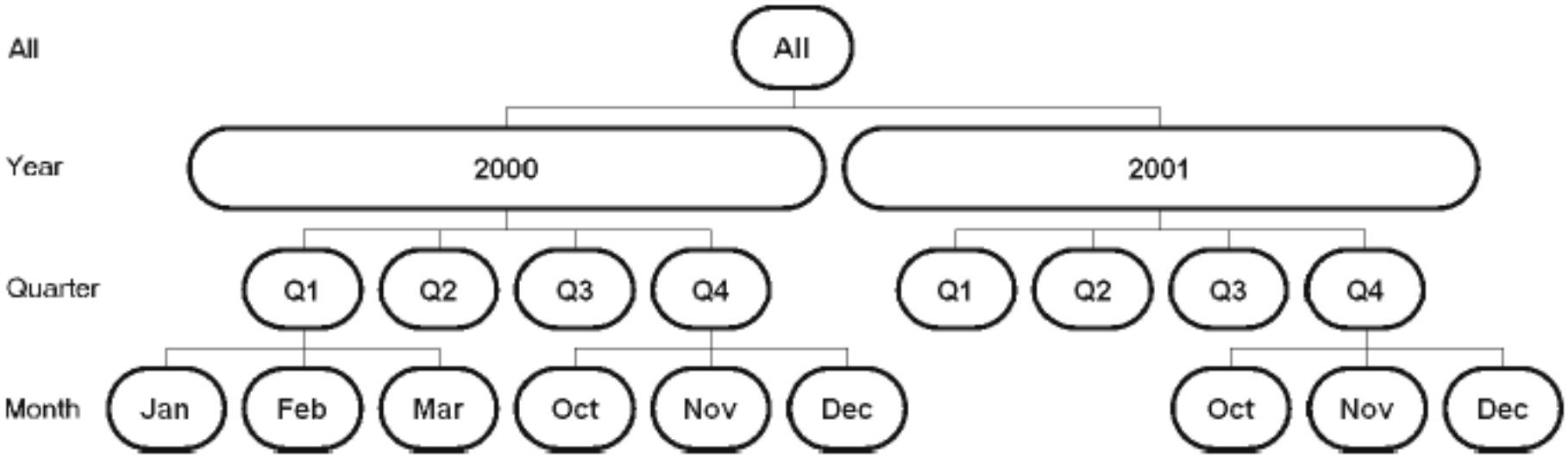
Tuples, Sets & Cells

CUBE: 3 DIMENSIONS
TIME, DX, HOSPITAL



Tuples, Sets & Cells

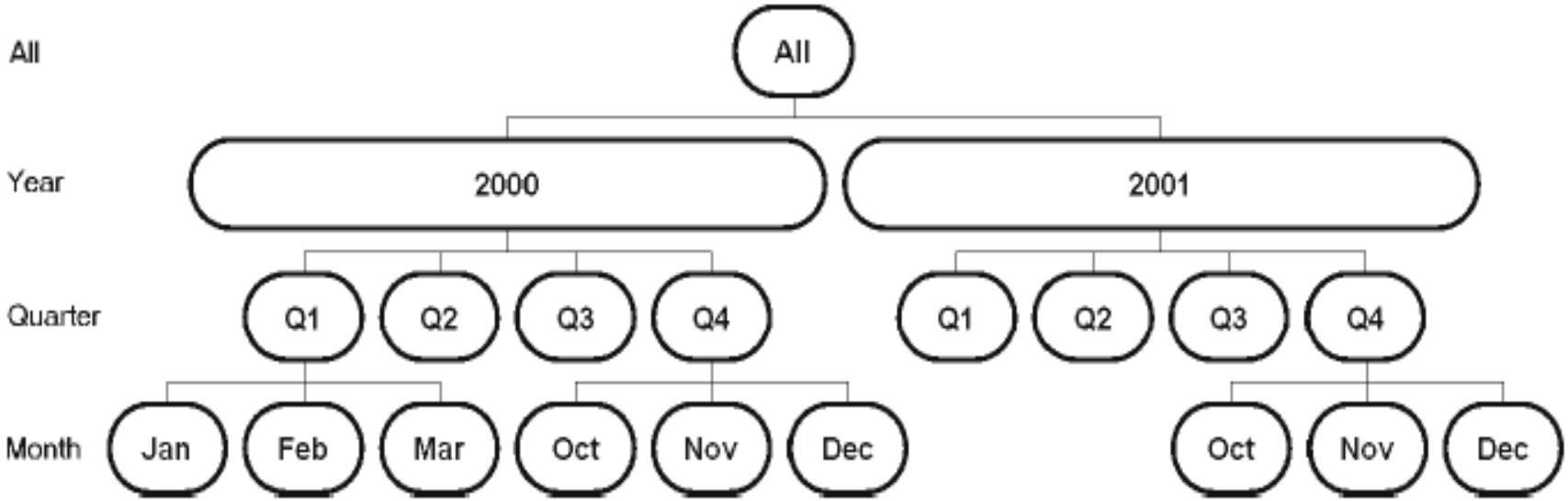
- Dimension has **hierarchies**
- Hierarchy has **levels**: All, Year, Quarter, Month



Tuples, Sets & Cells

- Naming Conventions

[Time].[All].[2000].[Q4].[Oct] = [Time].[Oct-2000]



Tuples, Sets & Cells

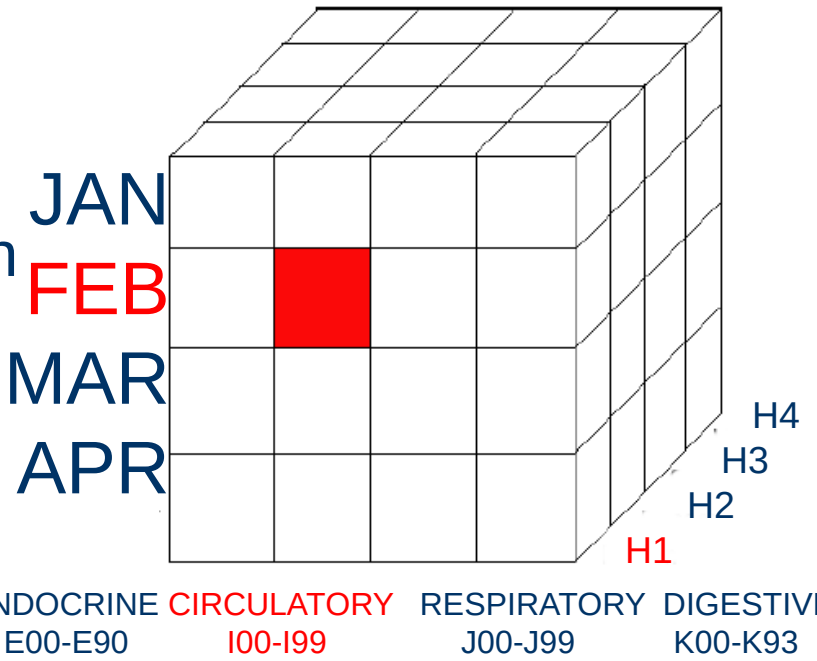
- Naming Conventions: **Tuple**

Tuple in pseudo-MDX: (x,y,z)=(y,z,x)
([Time].[Feb],[Dx].[Circ],[Hosp].[H1])

Def1: "***Tuple*** is the intersection choosing **one member of each dimension**"

Def2: "A tuple is the intersection of one (and only one) member taken from one or several of the dimensions in the cube."

(tuple=single cell in the cube ??)



Tuples, Sets & Cells

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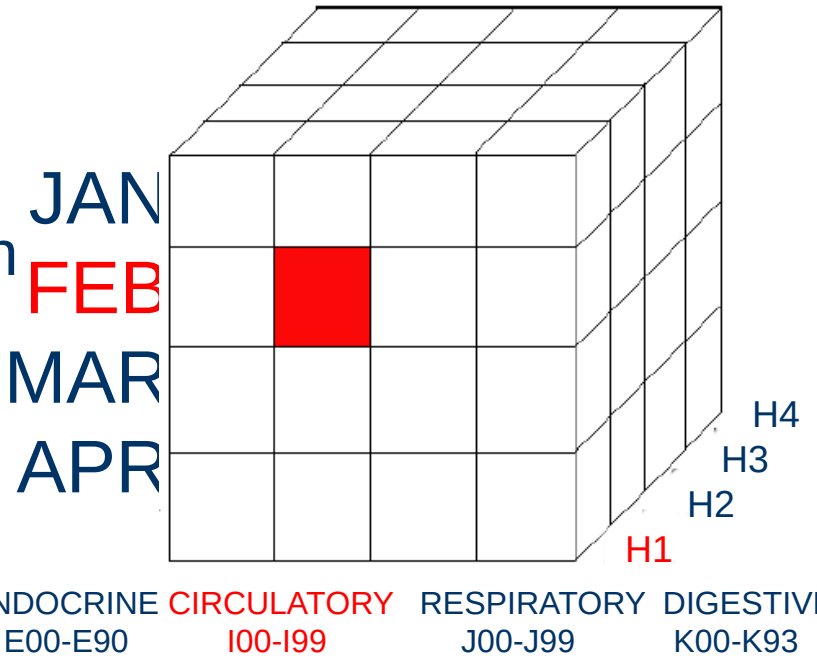
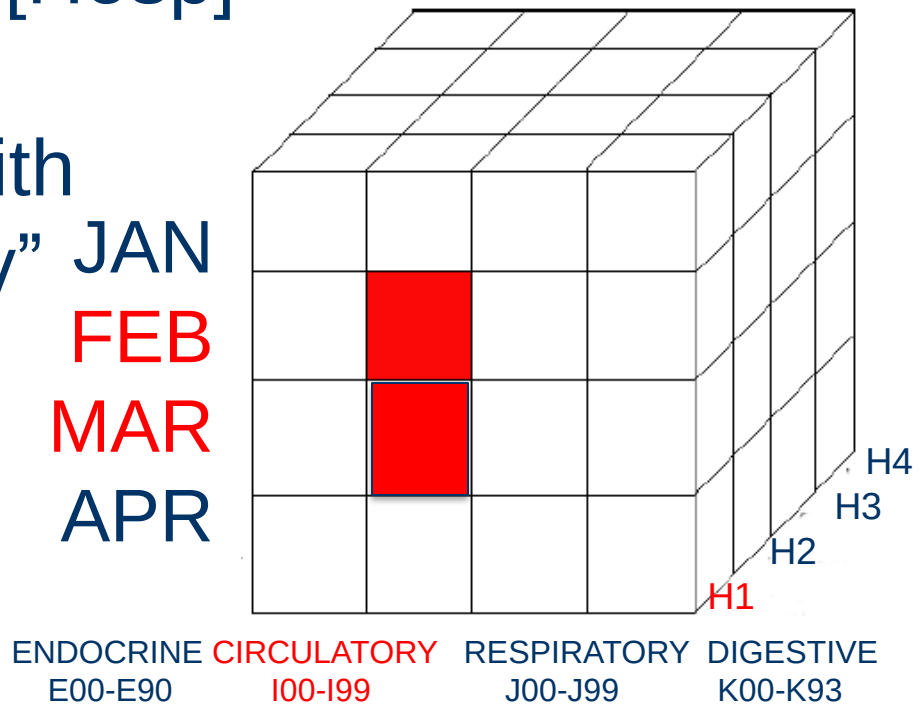


- Naming Conventions: **Set**

Set in pseudo-MDX: {(x1,y1,z1),..,(xn,yn,zn)}
{([Time].[Feb],[Dx].[Circ],[Hosp].[H1]),
([Time].[Mar],[Dx].[Circ],[Hosp].[H1])}

"***Set*** is a set of tuples with the same dimensionality"
(set of cells in the cube)

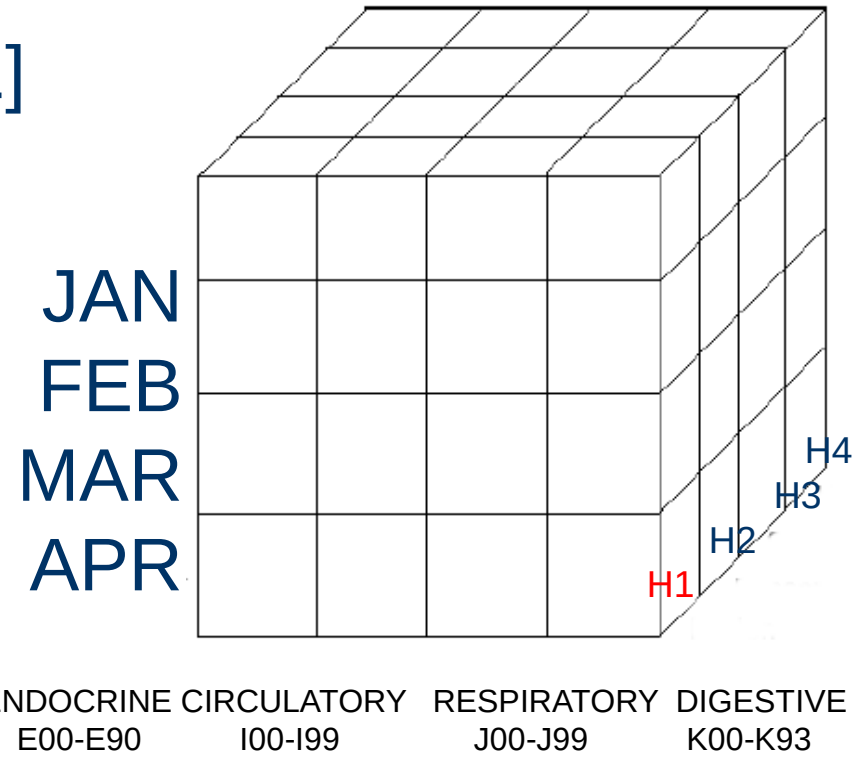
AVG(SET)→FLOAT



QUESTION 1: Tuples, Sets & Cells

- Question: Tuple or Set?

[DX].[Circulatory],[Hosp].[H1]

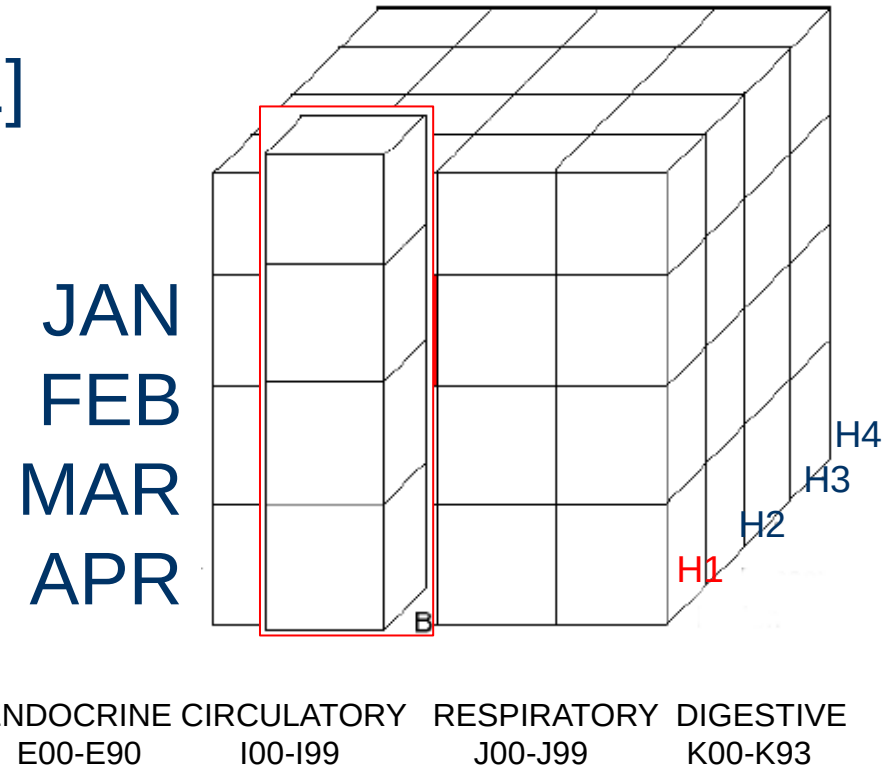


QUESTION 1:Tuples, Sets & Cells

- Question: Tuple or Set?

[DX].[Circulatory],[Hosp].[H1]

Is a TUPLE!
(but MANY CELLS!)



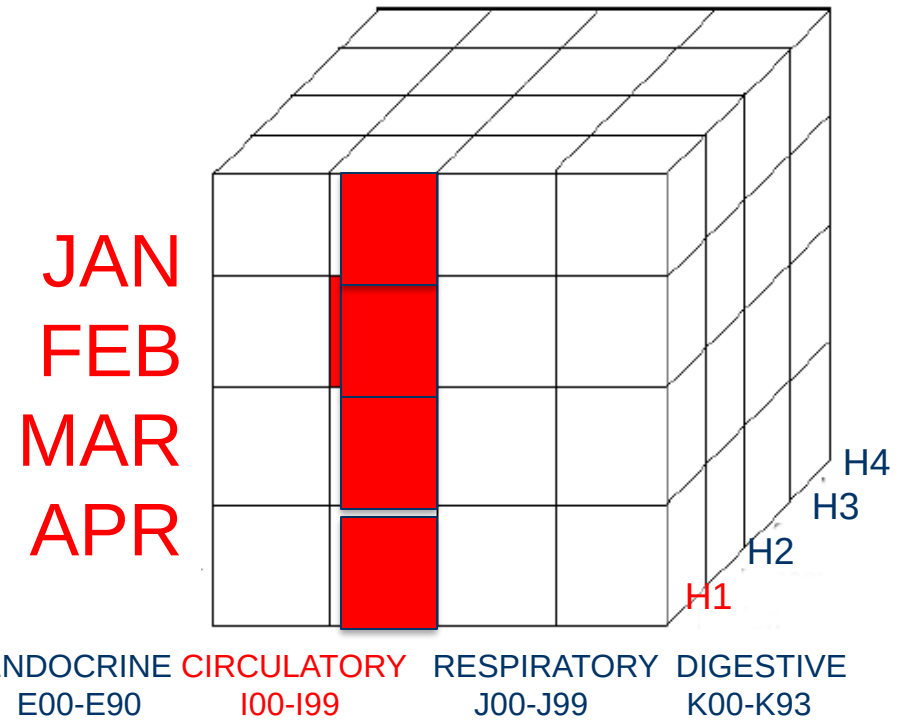
QUESTION 2: Tuples, Sets & Cells

- Question: Difference between?

a) ([Dx].[Circ],[Hosp].[H1])

b)

{([Dx].[Circ],[Hosp].[H1],[Time].[Jan]),
([Dx].[Circ],[Hosp].[H1],[Time].[Feb]),
([Dx].[Circ],[Hosp].[H1],[Time].[Mar]),
([Dx].[Circ],[Hosp].[H1],[Time].[Apr])
}



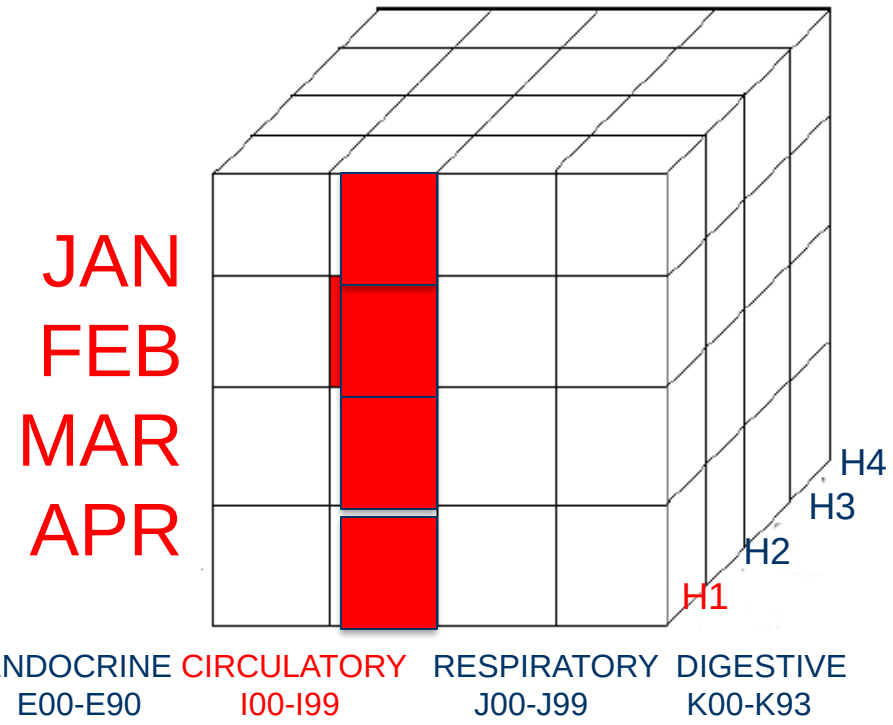
QUESTION 2: Tuples, Sets & Cells

- Question: Difference between?

a) ([Dx].[Circ],[Hosp].[H1]) **IS A TUPLE** (SEE DEFINITION 1)

b)

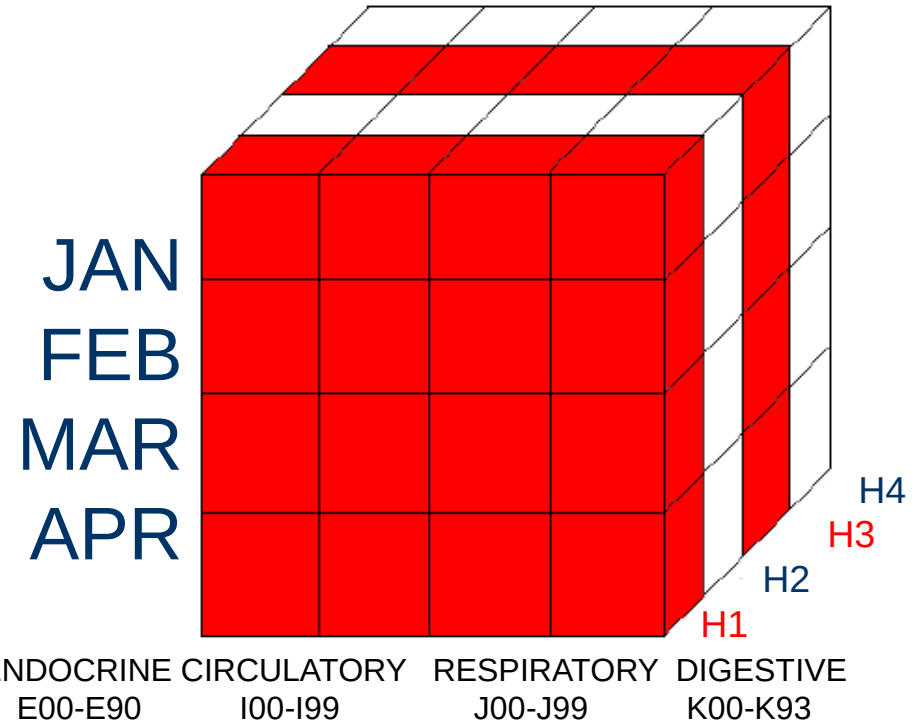
{([Dx].[Circ],[Hosp].[H1],[Time].[Jan]),
([Dx].[Circ],[Hosp].[H1],[Time].[Feb]),
([Dx].[Circ],[Hosp].[H1],[Time].[Mar]),
([Dx].[Circ],[Hosp].[H1],[Time].[Apr])
} **IS A SET**



QUESTION 3: Tuples, Sets & Cells

- Question: Tuple or Set?

[Hosp].[H1], [Hosp].[H3]

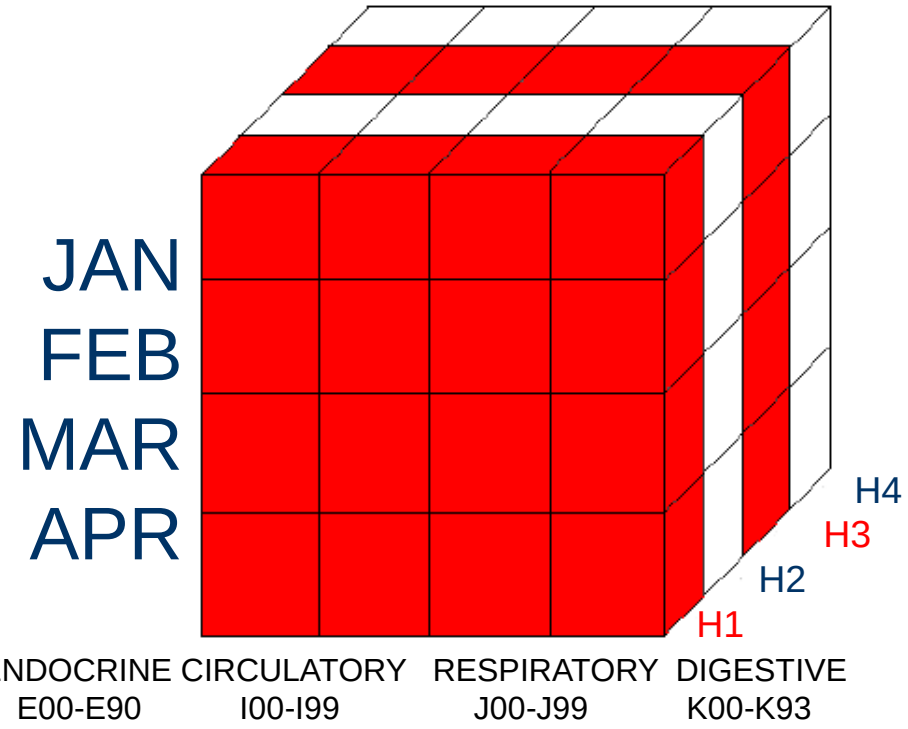


QUESTION 3: Tuples, Sets & Cells

- Question: Tuple or Set?

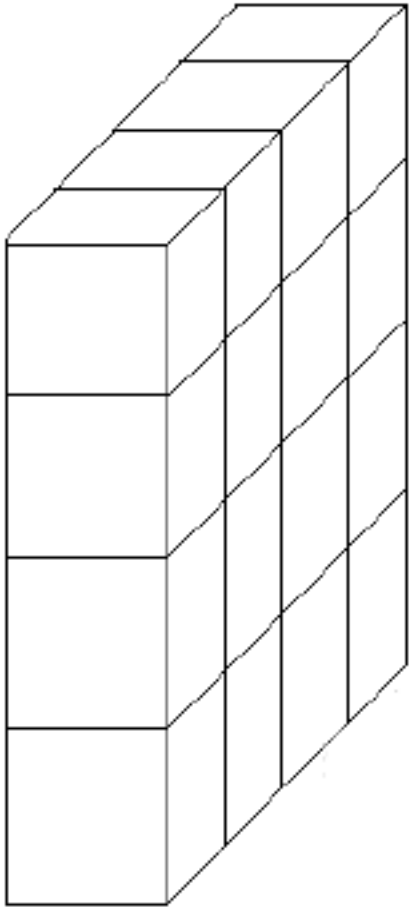
[Hosp].[H1], [Hosp].[H3]

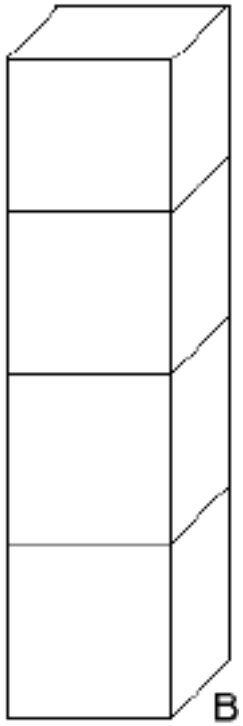
is a Set
(see Def2!)



RECAP: Tuples, Sets & Cells

[DX].[Circulatory] [DX].[Circulatory],[Hosp].[H1]



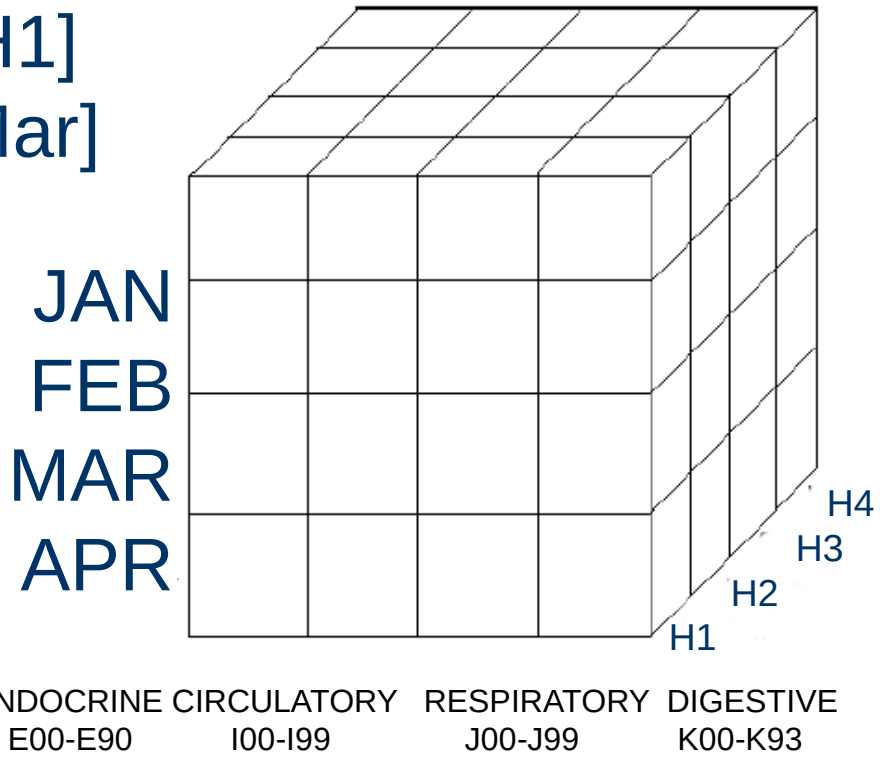


ALL THESE ARE TUPLES SINCE THEY HAVE THE "CAPACITY TO POINT TO A SINGLE CELL"
(actually they don't)

QUESTION 4: Tuples, Sets & Cells

- Question: Do these tuples point to a single cell?

[DX].[Circulatory],[Hosp].[H1], [Time].[Mar]
[DX].[Circulatory],[Hosp].[H1]
[DX].[Circulatory],[Time].[Mar]
[Hosp].[H1]



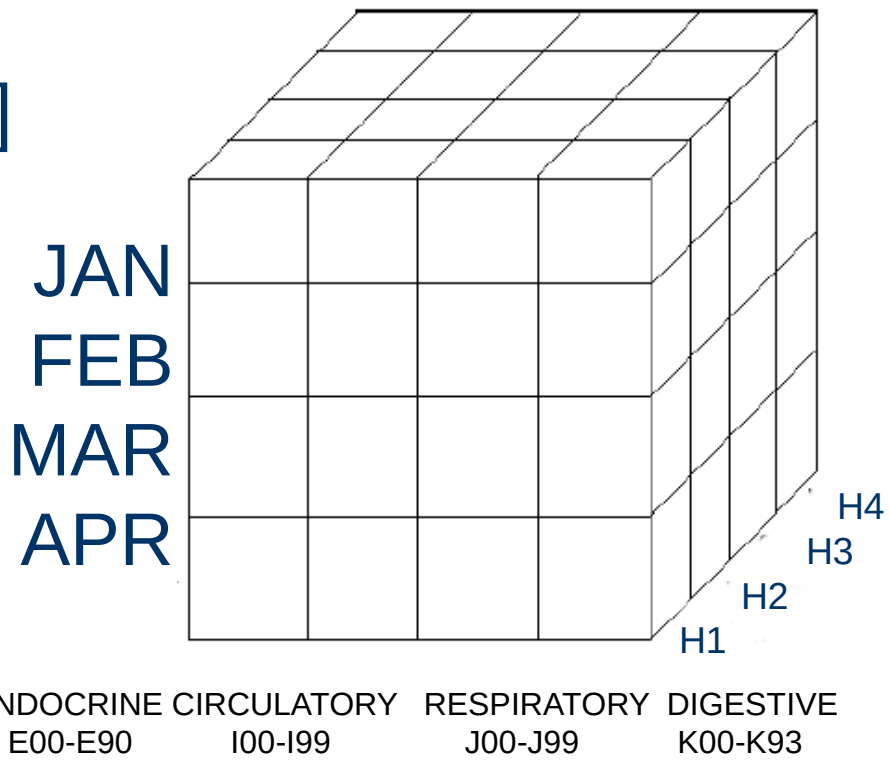
QUESTION 4: Tuples, Sets & Cells

- Question: Do these tuples point to a single cell?

[DX].[Circulatory],[Hosp].[H1], [Time].[Mar]
[DX].[Circulatory],[Hosp].[H1]
[DX].[Circulatory],[Time].[Mar]
[Hosp].[H1]

YES

If we consider that all dimensions have a '*DEFAULT MEMBER*'
In MDX if you don't specify a member of a dimension the default member is implied



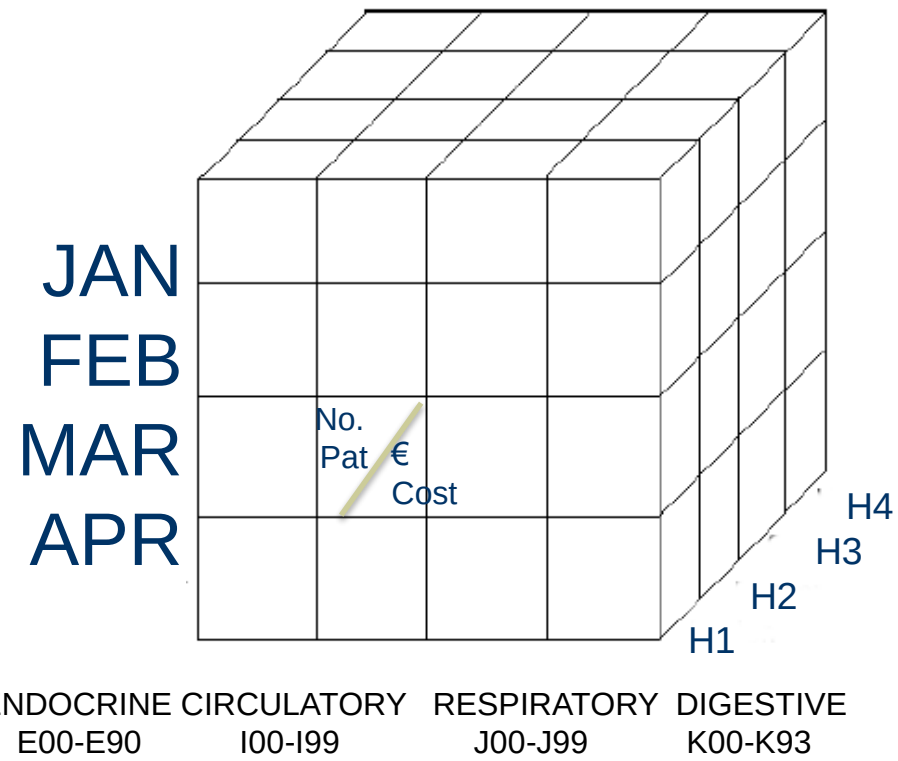
WHAT IF…

- Measures like dimensions

Suppose a cube **with 2 measures**:
No.Patients and €Cost.

[Hos].[H1],[TIME].[Mar],
[Dx].[Car],**[Measures].[NoPat]**

Measure behaves like member of a dimension

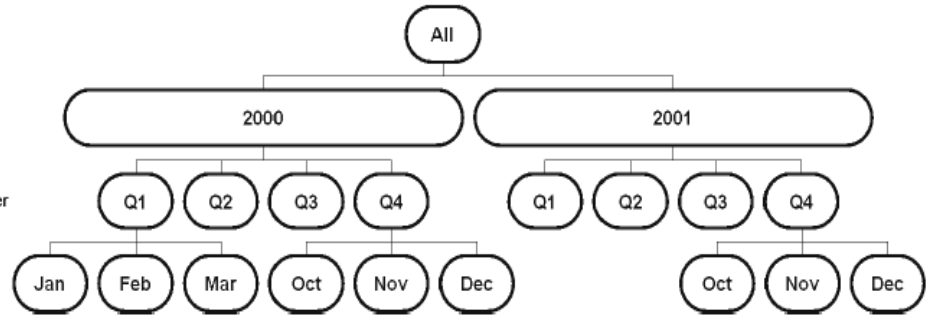


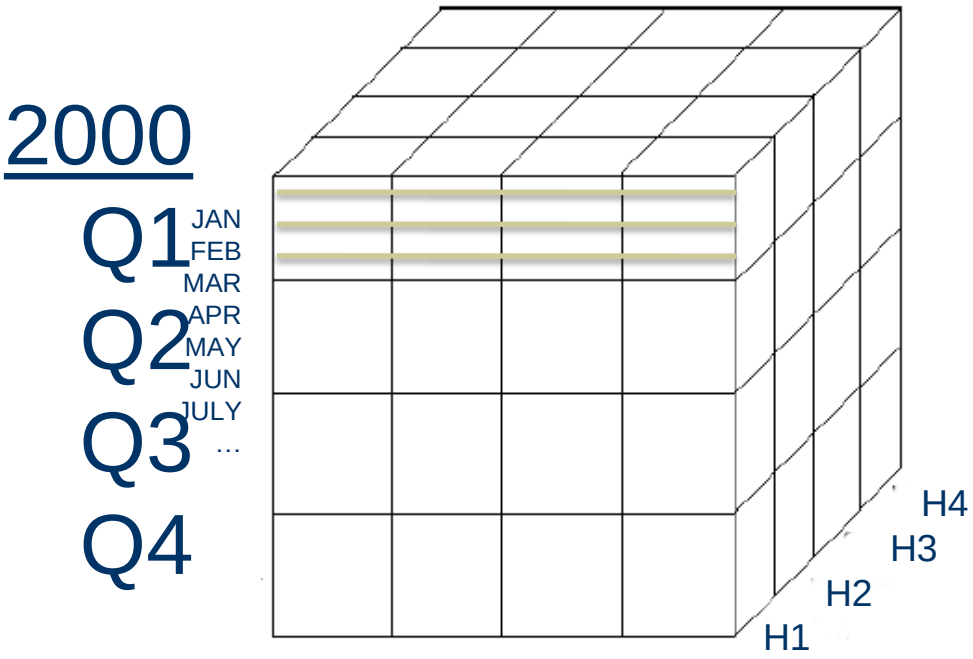
QUESTION 5: Tuples, Sets & Cells

- Measures & Hierarchies

[Hos].[H1],**[TIME].[Q1]**,[Dx].[Cir]

SET?
TUPLE?
CELL?



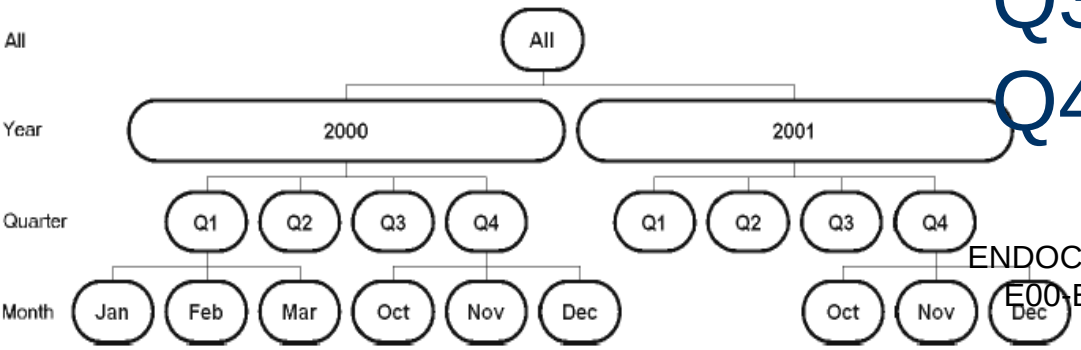


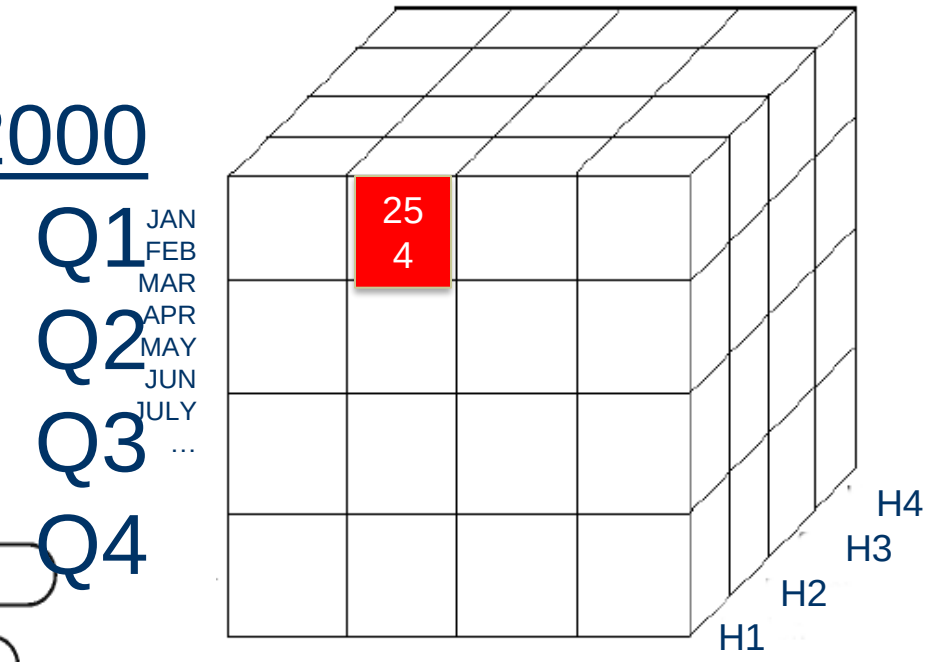
QUESTION 5: Tuples, Sets & Cells

- Measures & Hierarchies

[Hos].[H1],**[TIME].[Q1]**,[Dx].[Cir]

TUPLE!
CELL! (AGGREGATION)



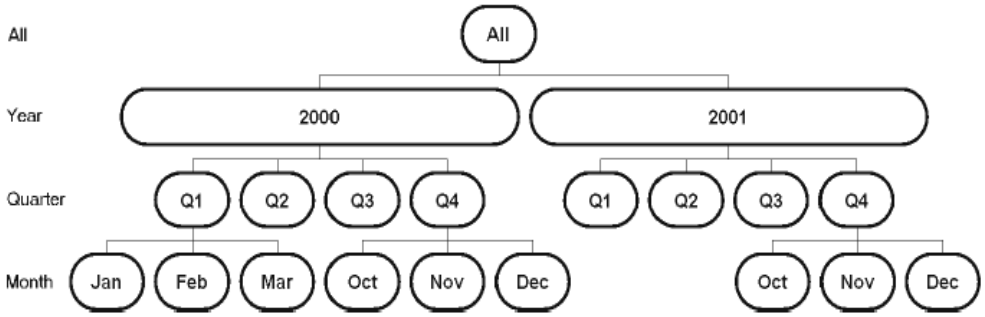


2. MDX Spells

MDX spells

MDX ≠ SQL ?

	ALL (TIME)
COST	45,300,000 €



- **SELECT**
  {[TIME].[*ALL*]} **ON *COLUMNS*** *(COL dimension)*
  {[Measure].[Cost]} **ON *ROWS*** *(ROW dimension)*
  FROM [MyCube]
  (shows costs of [HOSP].[H1], default member of HOSP)
  (also for [Dx].[Circulatory])

MDX spells

	COL 1	COL 2	COL 3
ROW A			
ROW B			
ROW C			

SELECT

{column headers} ON COLUMNS → SET

{row headers} ON ROWS → SET

FROM [cube] →name

MDX spells

```
SELECT
    {[Measure].[Patient]} ON COLUMNS
    {[Hospital].[Hosp1],
     [Hospital]. [Hosp2],
     [Hospital]. [Hosp3],
     [Hospital]. [Hosp4]}    ON ROWS
    FROM [MyCube]
```

(shows a default member of TIME)

	PATIENT
HOSP 1	23
HOSP 2	65
HOSP 3	88
HOSP 4	65

MDX spells

```
SELECT
    {[Measure].[Patient]} ON COLUMNS
    {[Hospital].[All Hosp]}    ON ROWS
    FROM [MyCube]
SELECT
    {[Measure].[Patient]} ON COLUMNS
    {[Hospital].Children}    ON ROWS
    FROM [MyCube]
```

•

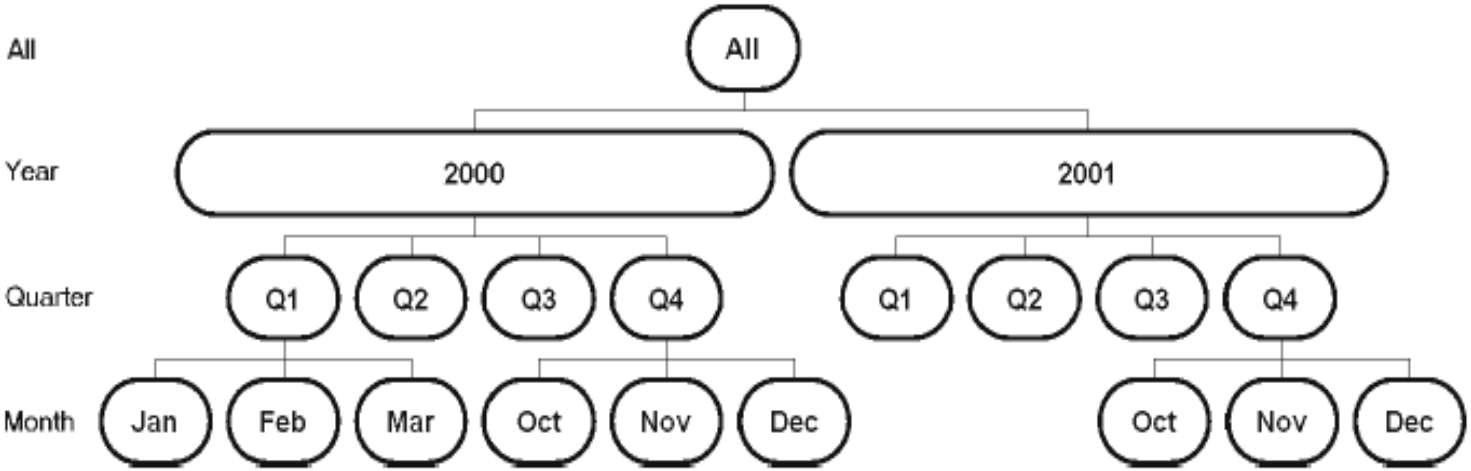
	PATIENT
HOSP 1	23
HOSP 2	65
HOSP 3	88
HOSP 4	65

MDX spells

- QUESTION:

Cost in H1,H2
during 2000 (by Q), for circulatory diseases.

Y2000	HOSP1	HOSP2
Q1	2M€	0.3M€
Q2	3.2M€	0.7M€
Q3	1.5M€	0.6M€
Q4	0.4M€	0.5M€



<u>Hint:</u>
cost/circulatory are default members

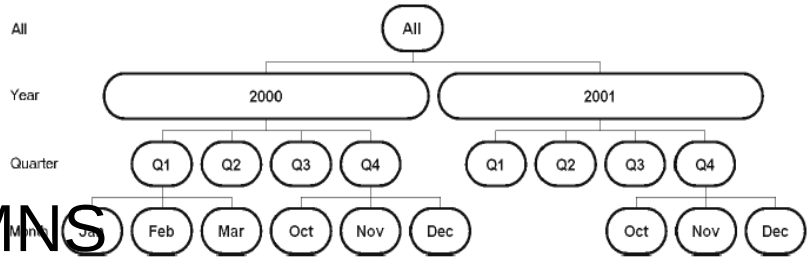
MDX spells

QUESTION:

Cost in H1,H2 in 2000 (by Q), for circulatory diseases.

```
SELECT
    {[Hospital].[Hosp1],
     [Hospital].[Hosp2]} ON COLUMNS
    {[Time].[All].[2000].Children}    ON ROW
    FROM [MyCube]
```

Y2000	HOSP1	HOSP2
Q1	2M€	0.3M€
Q2	3.2M€	0.7M€
Q3	1.5M€	0.6M€
Q4	0.4M€	0.5M€



MDX spells

- QUESTION:

Patients no. in H1,H2 during 2000 (by Q), for circulatory diseases.

Y2000	HOSP1	HOSP2
Q1	121 pat	78 pat
Q2	165 pat	61 pat
Q3	115 pat	41 pat
Q4	120 pat	76 pat

Hint:

Number of patients is NOT a default member

MDX spells

QUESTION:

Patients in H1,H2

during 2000 (by Q), for

circulatory diseases.

```
SELECT
      {[Hospital].[Hosp1],
       [Hospital].[Hosp2]} ON COLUMNS
      {[Time].[All].[2000].Children}    ON ROWS
FROM [MyCube]
WHERE ([Measures].[NoPat])
```

Hint:

Number of patients is NOT a default member

Y2000	HOSP1	HOSP2
Q1	121 pat	78 pat
Q2	165 pat	61 pat
Q3	115 pat	41 pat
Q4	120 pat	76 pat

MDX spells

WHERE clause

- Not restricted to measures.
- Not restricted to 1 dimension.
- It is a *SLICER/DICER*.

MDX spells

WHERE clause

Not restricted to measures.

```
SELECT
    {[Hospital].[Hosp1],
     [Hospital].[Hosp2]} ON COLUMNS
    {[Time].[All].[2000].Children}    ON ROWS
    FROM [MyCube]
    WHERE ([Dx].[Respiratory])
```

Y2000	HOSP1	HOSP2
Q1	1M€	0.4M€
Q2	1.2M€	0.1M€
Q3	0.5M€	0.5M€
Q4	0.4M€	0.3M€

MDX spells

WHERE clause

Not restricted to 1 dimension.

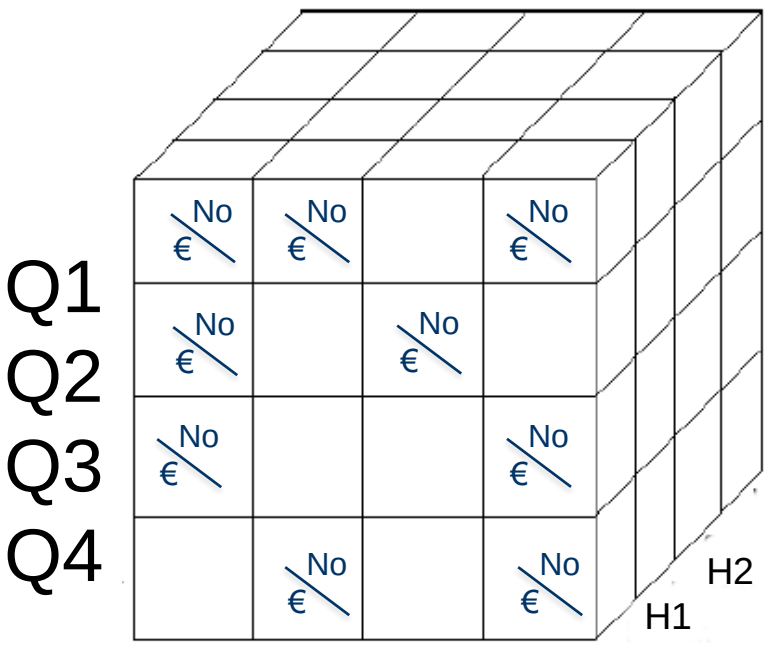
```
SELECT
    {[Hospital].[Hosp1],
     [Hospital].[Hosp2]} ON COLUMNS
    {[Time].[All].[2000].Children}    ON ROWS
    FROM [MyCube]
    WHERE ([Dx].[Respiratory],[Measures].[NoPat])
```

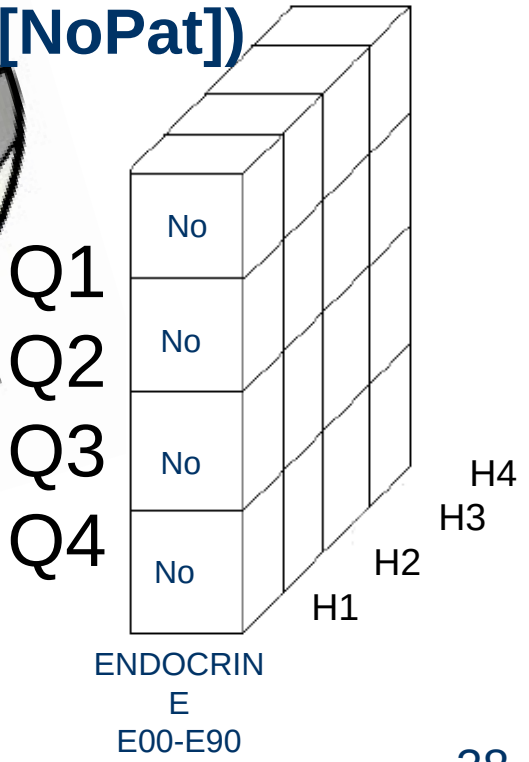
Y2000	HOSP1	HOSP2
Q1	61 pat	28 pat
Q2	75 pat	41 pat
Q3	105 pat	11 pat
Q4	112 pat	56 pat

MDX spells

- WHERE clause
  - It is a *SLICER/DICER*.

WHERE ([Dx].[ENDOCRIN], [Measures].[NoPat])





3. MDX syntax

() [] {} .

MDX syntax

- Brackets []
  - Dimensions: [Time]
  - Members: [2000]
- Dots .
  - Separators: [Time].[2000].[Q3]
- Braces ()
  - Tuples: ([DX].[Circulatory],[Hosp].[H1])

MDX syntax

- Curly Braces {}
  - Sets: {[Hosp].[H1], [Hosp].[H3]}
    {[Dx].Children}
    { ([Dx].[Circ],[Hosp].[H1],[Time].[Jan]),
      ([Dx].[Circ],[Hosp].[H1],[Time].[Feb]),
      ([Dx].[Circ],[Hosp].[H1],[Time].[Mar]),
      ([Dx].[Circ],[Hosp].[H1],[Time].[Apr]) }

MDX syntax

SELECT
{ SET } **ON COLUMNS**
{ SET } **ON ROWS**
FROM [cube]
WHERE (TUPLE)

MDX syntax

- QUESTION: Correct? Why?

```
SELECT
([Measures].[NoPatients]) ON COLUMNS,
{[Time].[2000].Children} ON ROWS
FROM [MyCube]
```

MDX syntax

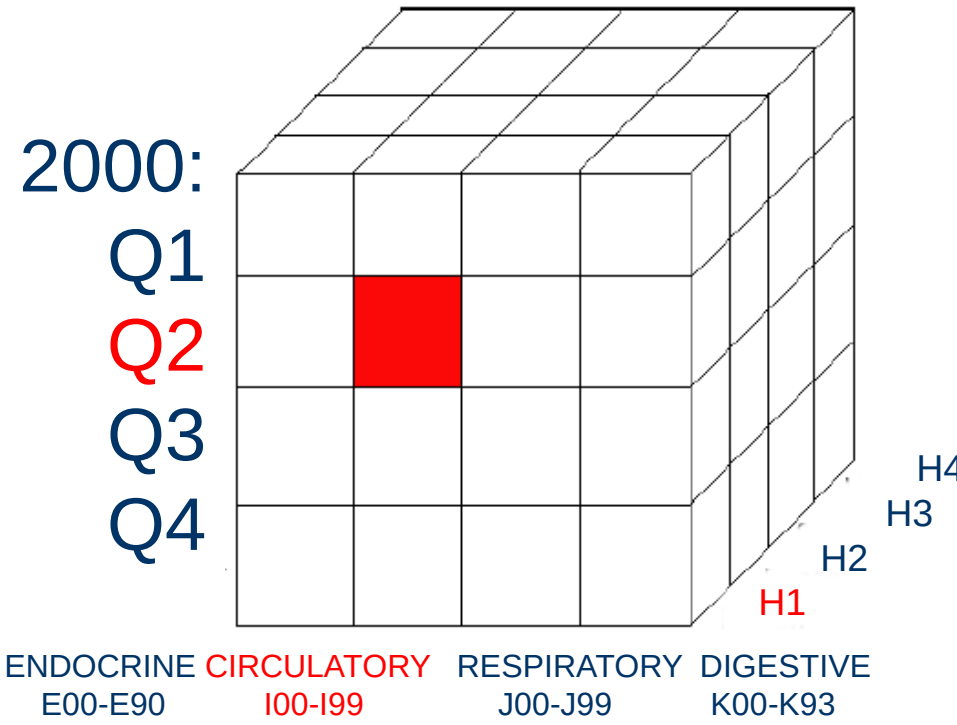
- QUESTION: Correct? Why?

```
SELECT
{[Dx].Children} ON COLUMNS,
{[Time]. [2000].[Q1].[May].Children} ON ROWS
FROM [MyCube]
WHERE {[Measure].[cost],[Hosp].[H2]}
```

MDX syntax

- Name of a CELL.
  - In a cube, each cell has a name.

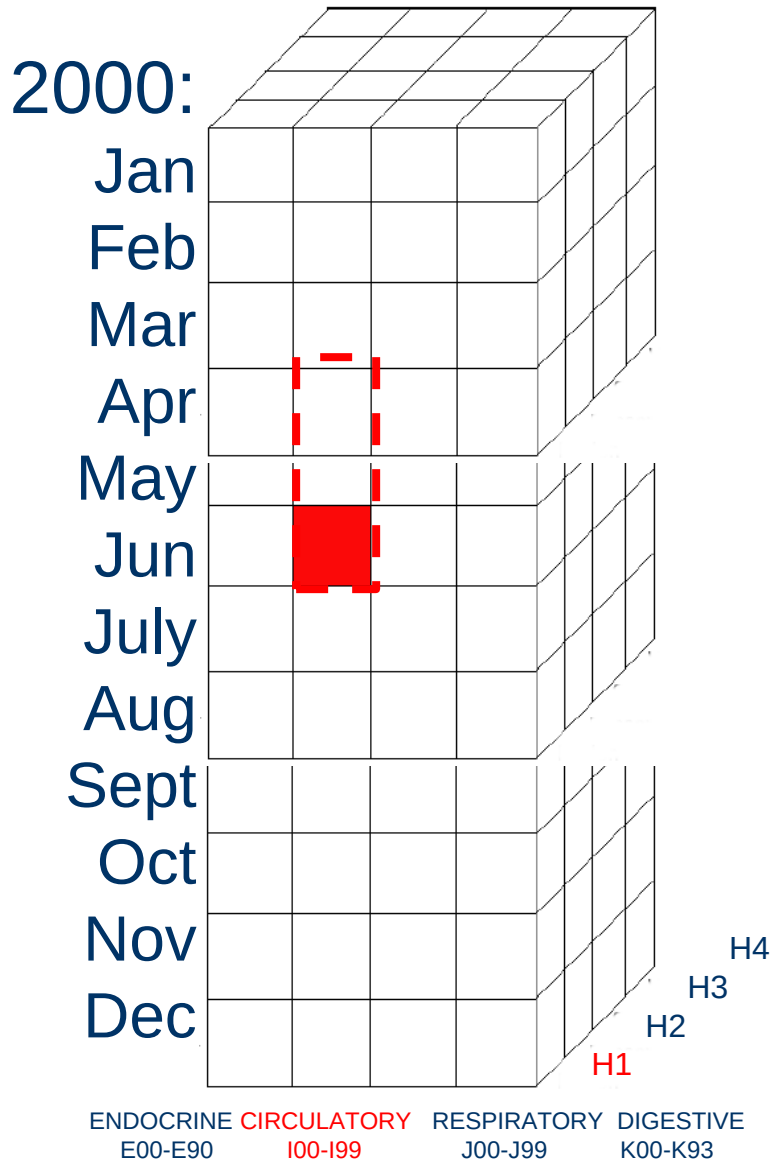
The name of this cell is:
([Time].[2000].[Q2],
[Dx].[Circulatory],
[Hospital].[H1])



MDX syntax

- Name of a CELL.

The name of this cell is:
([Time].[2000].[Q2].[Jun],
[Dx].[Circulatory],
[Hospital].[H1])

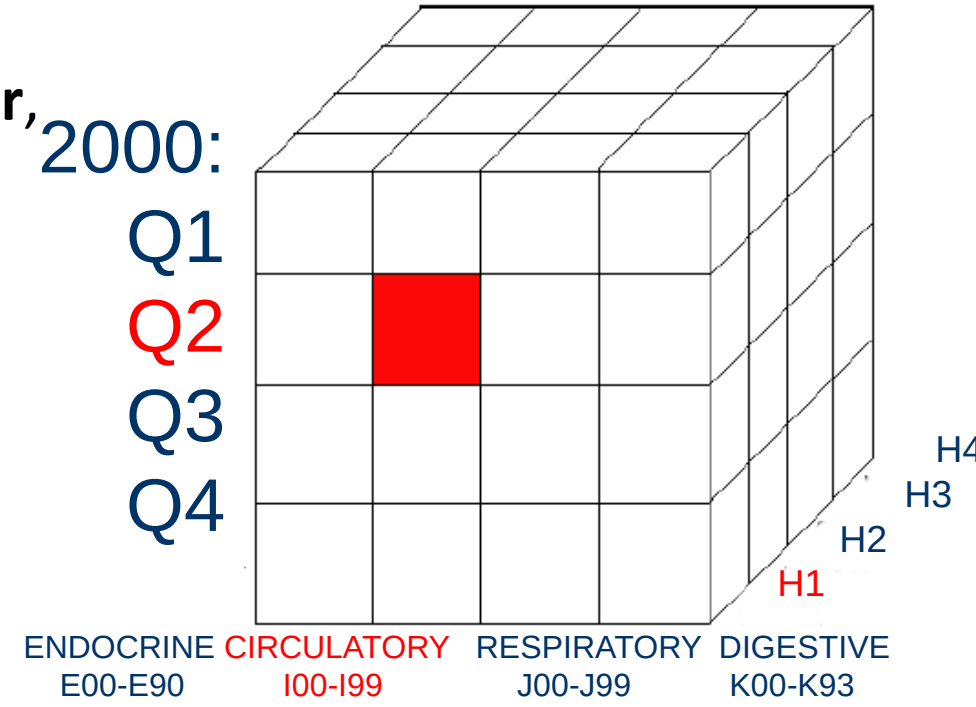


MDX syntax

- Relative Cell Referencing:
  - CurrentMember, PrevMember, NextMember.

The name of this cell is:

([Time].[2000].**[Q3].PrevMember**,
[Dx].[Circulatory],
[Hospital].[H1])



MDX syntax

- Calculated Members: +-*/ %

"Attention improvement on circulatory patients of the 1st quarter of years 1999 and 2000".

Calculus:

([Hosp].[H1],[Dx].[Circ],[Time].[2000].[Q1],[Measure].[NoPatient])

-

([Hosp].[H1],[Dx].[Circ],[Time].[1999].[Q1],[Measure].[NoPatient])

MDX syntax

- Calculated Members: +-*/ %

“Growth cost throughout year 2000 in H1 for Circulatory patients”.

MDX syntax

- Calculated Members: +-*/ %

"**Growth** cost **throughout** year 2000 in H1 for Circulatory patients".

  - Growth cost: cost(t)- cost(t-1) (increment/derivate)
  - Obviate: H1 for Circulatory patients

MDX Syntax

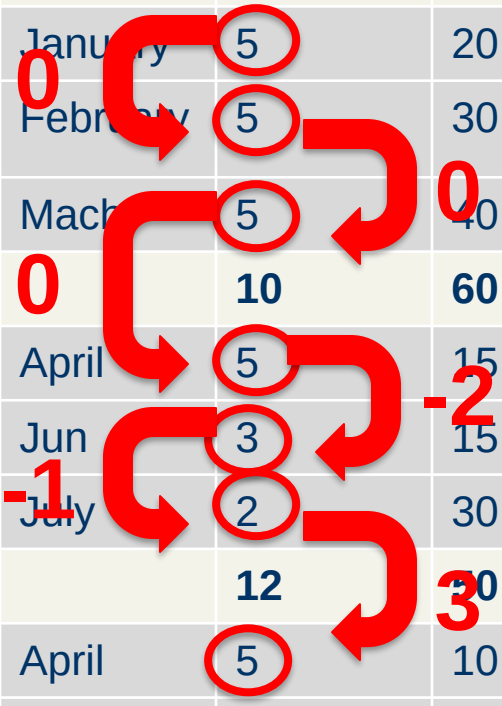
"Growth cost throughout year 2000".

Year	Quarter	Month	Cost M€	No Patient
2000			57	280
	Q1		**15**	**90**
		January	5	20
		February	5	30
		Mach	5	40
	Q2		**10**	**60**
		April	5	15
		Jun	3	15
		July	2	30
	Q3		**12**	**50**
		April	5	10
		Jun	5	10
		July	2	30
	Q4		**20**	**80**
		April	5	15
		Jun	5	15
		July	10	50

MDX Syntax

"Growth cost throughout year 2000".

Year	Quarter	Month	Cost M€	No Patient
2000			57	280
	Q1		**15**	**90**
		January	5	20
		February	5	30
		March	5	40
	Q2		**10**	**60**
		April	5	15
		Jun	3	15
		July	2	30
	Q3		**12**	**70**
		April	5	10
		Jun	5	10
		July	2	30
	Q4		**20**	**80**
		April	5	15
		Jun	5	15
		July	10	50



MDX Syntax

Year	Quarter	Month	Cost M€	No Patient
2000			57	280
	Q1		**15**	**90**
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		Jun	3	15
		July	2	30
	Q4		**20**	**80**
		April	5	15
		Jun	5	15
		July	10	50

"Growth cost throughout year 2000".

[Time].[**CurrentMember**],[Measures].[Cost]

-

[Time].[**PrevMember**],[Measures].[Cost]

MDX syntax

- Calculated Members: +-*/ %

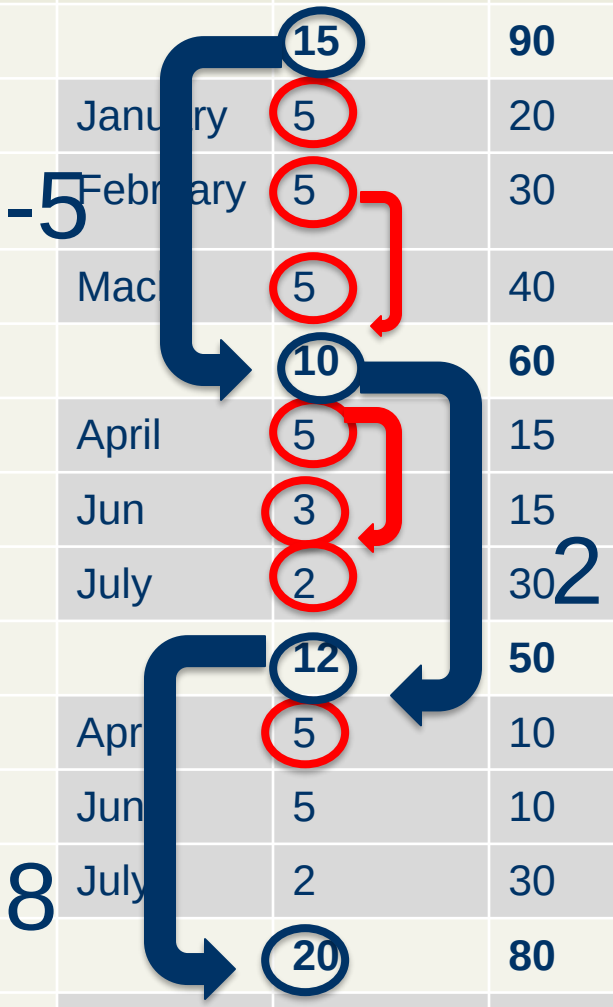
"**Growth** cost **throughout** year 2000 in H1 for Circulatory patients".

- ([Time].[**CurrentMember**],[Measures].[Cost]
  - [Time].[**PrevMember**],[Measures].[Cost])

YES… WHAT IF WE FOCUS ON **THE QUARTER GROWTH** ?????

MDX Syntax

Year	Quarter	Month	Cost M€	No Patient
2000			57	280
	Q1		**15**	**90**
		January	5	20
		February	5	30
		March	5	40
	Q2		**10**	**60**
		April	5	15
		Jun	3	15
		July	2	30
	Q3		**12**	**50**
		April	5	10
		Jun	5	10
		July	2	30
	Q4		**20**	**80**
		April	5	15
		Jun	5	15
		July	10	50



MDX syntax

- Calculated Members: +-*/ % AVG SUM …

"**Growth** cost **throughout** year 2000 in H1 for Circulatory patients".

- ([Time].[**CurrentMember**],[Measures].[Cost] - [Time].[**PrevMember**],[Measures].[Cost])

YES… WHAT IF WE FOCUS ON **THE SEMESTER GROWTH** !!!

… SAME EXPRESSION. THAT'S THE COOL THING. DEPENDS ON THE TIME DIMENSION, WHICH DEFINES THE *CURRENT MEMBER* PROPERTY

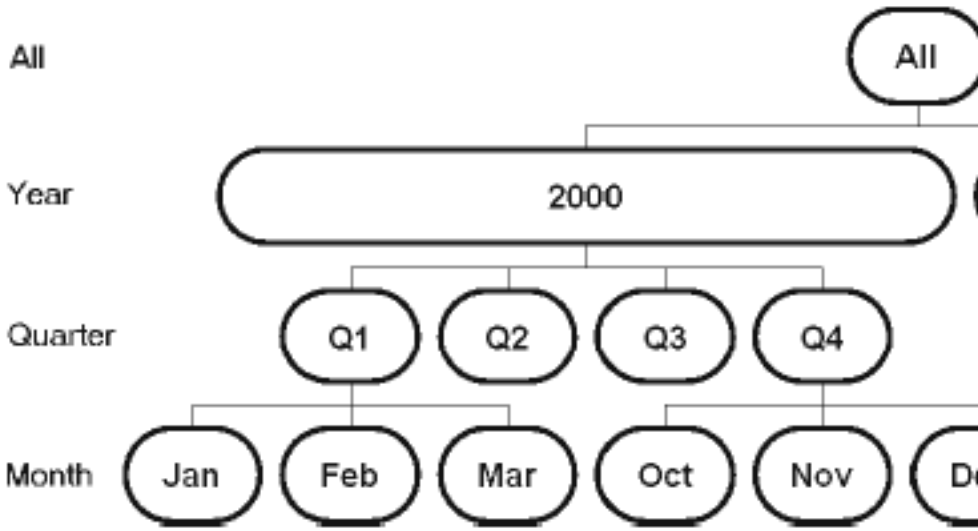
MDX syntax

- OTHER FUNCTIONS:
  - Sum (X)→Number : Sums all members of X
  - X.Lag(N) : N positions back from X.
  - X.Lead(M) : M position forward from X.
  - YTD(X)→Set : YearToDate: Members of the Year until member X.
    e.g. YTD(March) → {Jan, Feb, March}

  ClosingPeriod, OpeningPeriod, ParallelPeriod,

MDX syntax

- Hiearchy navitagion:
  - *Member*.Children
  - *Member*.Parent
  - *Member*.FirstChild / LastChild
  - Descendants(X,n)
  - Ancestors(X,n)
  - Siblings / Cousins
  - ~~Aunt~~ / ~~Uncle~~



MDX

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