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Unique,
light integrable
mathematical engine that
enables product
innovation and
enhances productivity
of software
development
and maintenance.

Vision Paper

Add capabilities of complex and precise mathematical functions to a database

2021

Trend

- **Businesses require** smarter, responsible, scalable AI.
- **Make decisions more** accurate, repeatable, transparent and traceable.
- **Small and Wide data allow** more robust analytics and AI.

Gartner Data & Analytics Summit , 2021

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Gartner says 70% of organizations will shift their focus from **big to small and wide** data by 2025.

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Gartner Top 10 Data and Analytics Trends for 2021

Wide data enables greater data management flexibility, speed, governance, and resilience.

A diversity of use cases is driving the interest in edge capabilities, ranging from **supporting real-time event analytics to enabling autonomous behavior of “things”**.

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Definition

Wide, or unstacked data is presented with each different data variable in a separate column.
Example

Device	Temperature (C°)	Humidity (%)	CO2 (ppm)	Light (lx)
Device1	-0.06	70.48	534.92	0.0004
Device2	24.74	34.93	3253.89	352.38
Device3	57.13	42.24	1253.27	98374.34

The concept of "wide data" is relative. In some domains 100 columns is considered "wide", while in others that's perfectly normal and you'd need to have thousands (or tens of thousands!) of columns for it to be considered even remotely "wide".

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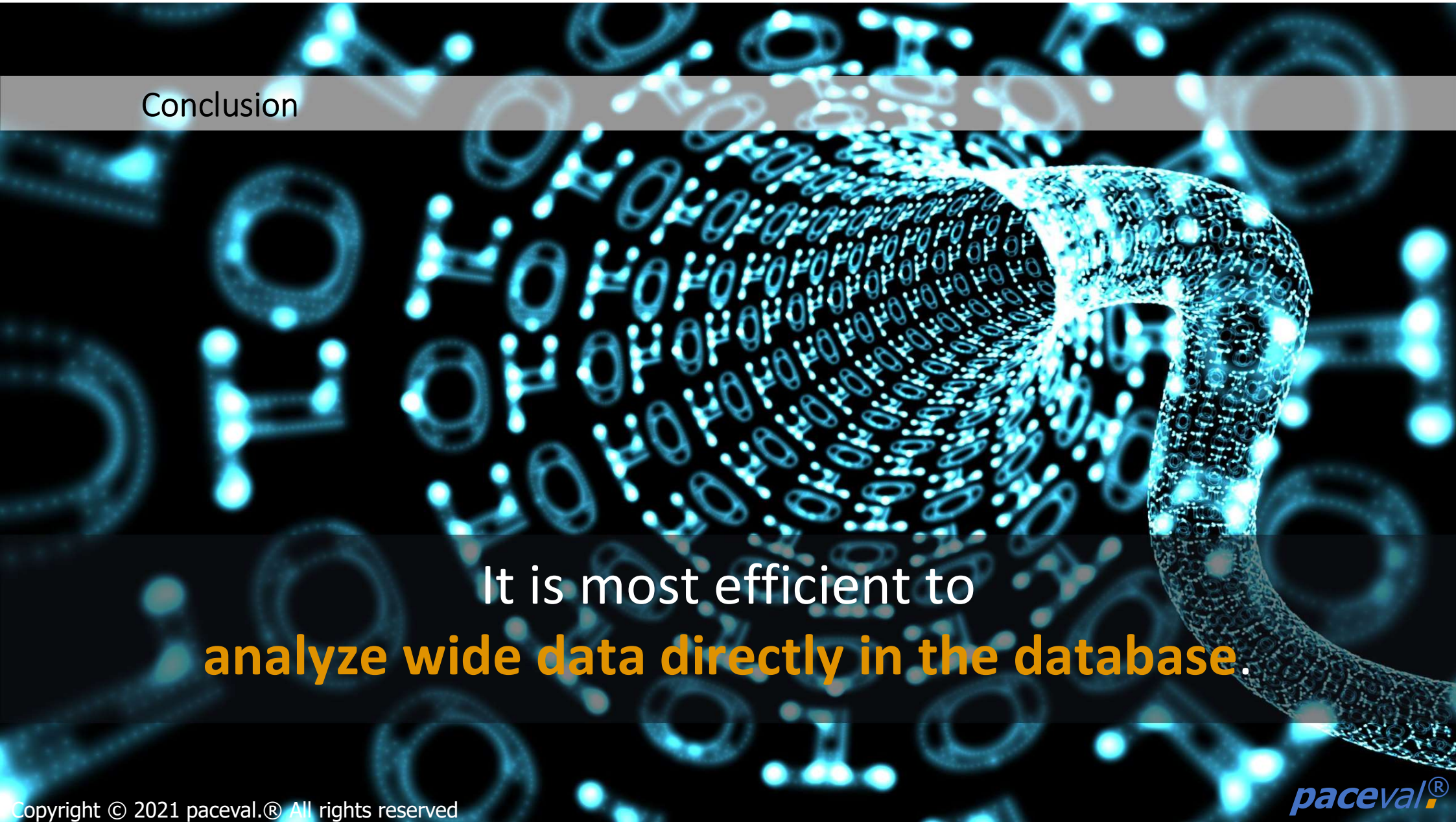
Conclusion



It is most efficient to

analyze wide data directly in the database.

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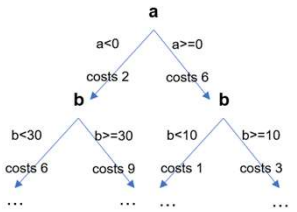
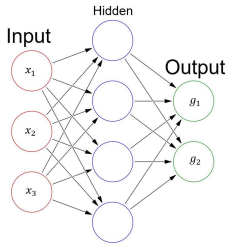
Artificial Intelligence and Mathematics

- **Decision tree learning or induction of decision trees** is one of the predictive modelling approaches used in statistics, data mining and machine learning.



- **Artificial neural network is an interconnected group of nodes**, inspired by a simplification of neurons in a brain. **Neural networks learn (or are trained) by processing examples.**



Further techniques are approximations, statistical models (Hidden Markov) or other decisions based on mathematical rules.

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Finding

All these techniques can be mapped to a **single mathematical function**

$$y = f(x_1, x_2, \dots, x_n)$$

or a **set of mathematical functions**

$$y_1 = f_1(x_1, x_2, \dots, x_n)$$
$$y_2 = f_2(x_1, x_2, \dots, x_n)$$

$$y_m = f_m(x_1, x_2, \dots, x_n)$$

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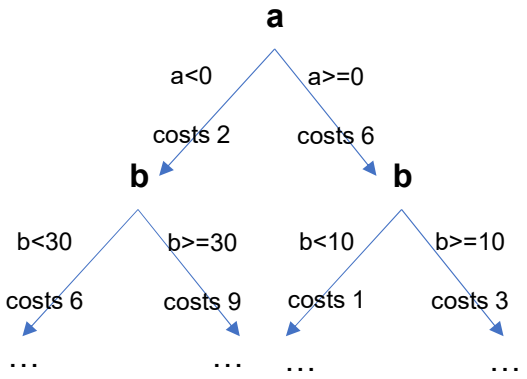
Example Decision trees



=

$$f(a,b) = \textbf{((a<0) AND (b<30))} * (2+6) + \textbf{((a<0) AND (b>=30))} * (2+9) + \textbf{((a>=0) AND (b<10))} * (6+1) + \textbf{((a>=0) AND (b>=10))} * (6+3) + \ldots$$

Decision tree with
variables and costs

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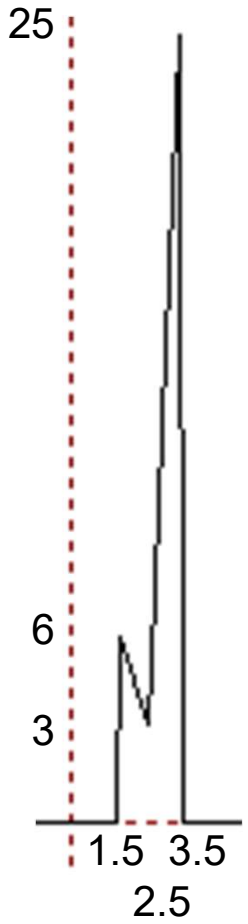
Example Approximations



=

$f(x) =$ **((x>=1.5) AND (x<=2.5))**
(((3-6)/(2.5-1.5))(x-1.5)+6)
+ **((x>2.5) AND (x<=3.5))**
(((25-3)/(3.5-2.5))(x-2.5)+3)

Approximation for the
measurement values (1.5; 6),
(2.5; 3) and (3.5; 25)

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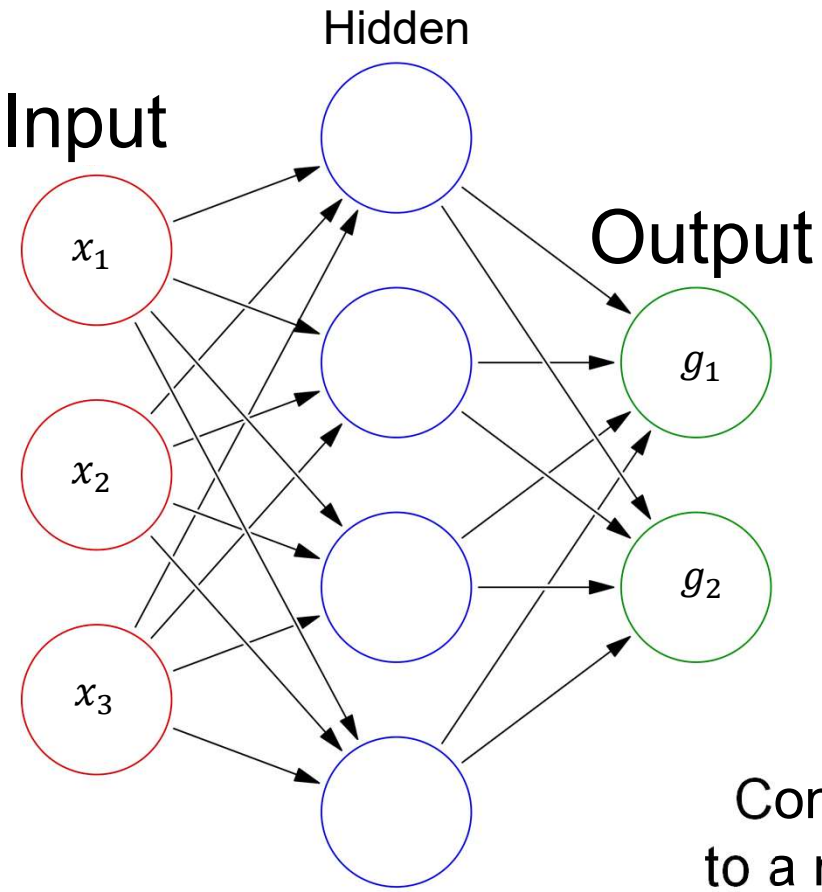
Example Neural networks



=

$$g_1(x_1, x_2, x_3) =$$
$$(((1.1544664390561268 * (1/(1+$$
$$\exp((0.04934491206103983 * x_1))$$
$$+(0.12975707678433665 * x_2))$$
$$+(0.06215928752528358 * x_3))$$
$$\ldots$$

Conversion of an output
to a mathematical function

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Conclusion

Artificial intelligence models with their representing mathematical functions can easily be used **in SQL expressions and further optimized there**.

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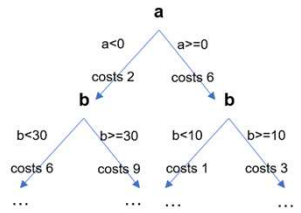
Examples Decision trees



Expression for querying a specific cost amount on two data variables

SELECT * FROM table1 WHERE (((a<0) AND (b<30)) * (8) + ((a<0) AND (b>=30)) * (11) + ((a>=0) AND (b<10)) * (7) + …) >12;

Annotation: Average length of query >10.000 characters

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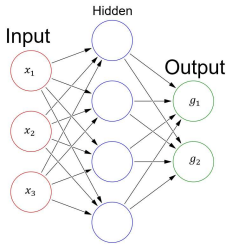
Examples Neural networks



Expression for querying a specific pattern on several hundreds of data variables

```
SELECT * FROM table2 WHERE
(((((1.1544664390561268*(1/(1+exp((0.04934491206103983*x1))+
(0.12975707678433665*x2))+…) >1;
```

Annotation: Average length of query >500.000 characters

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