

## Two questions of "class":



 Kind of quantity Classification

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## Harmonised concepts and relations in a concept system of *Quantity*

A standardised concept system for **Quantity** will:

• enable harmonised quantities, units and symbols and their relations,

which, thanks to their *translatability*, in turn can:

• promote better interoperability, improved information exchange, more reliable trading, and ensure safety of processes and products of all kinds.



http://www.perceptron.com/



(Image: Study.com)

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#### Harmonised concepts and relations in a concept system of *Quantity*



Figure 2. An RDF diagram representing the size of an apple as 10 cm.

RDF = Resource Description Framework





## Harmonised concepts and relations in a concept system of *Quantity*

ISO TC 215 Health informatics

ISO/IEC JTC 1 Information technology

ISO TC 37 Language and terminology



IEC 😨

ISO/TC 215, ISO/TC 12 and IEC/TC 25

Quantities and Units in e-Health

GLOBAL SURVEY OF STANDARDS FOR QUANTITIES AND UNITS USED/NEEDED IN e-HEALTH

Summary of Results, Recommendations and Next Steps OWL 2 - Web Ontology Language

Ontology of units of Measure (OM) 2.0

OWL ontology: mUnc (Metadata with UNCertainty)

QUDT





ISO/TC 215, ISO/TC 12

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Photo: Stocksy United

### **Quantities & units in e-health**

#### ISO TC 215 Health informatics

- "Semantic interoperability for electronic communication of quantity values and units of measurement based on a common understanding of:
- metrological concepts for the use of quantities and units
- information structures for data exchange
- controlled vocabularies"





ISO/TC 215, ISO/TC 12

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Photo: Stocksy United

### **Quantities & units in e-health**

### ISO TC 37 Language and terminology

For example:... (the) fast-growing **medical informatics** research ... needs to process a large amount of medical texts to analyze:

- the **dose** of medicine
- the eligibility criteria of clinical trial
- the **phenotype** characters of patients
- the **lab tests** in clinical records , etc.



### **Categorical properties**

#### **Satisfaction**

http://www.mynewsdesk.com/se/region\_skane/news/pati enter-vaerderar-vaarden-med-en-knapptryckning-



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#### Performance

https://www.alz.org/alzheimers-dementia/diagnosis/medical\_tests



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Cla	assificat	tion					
Probability							
	(	c – 1	С	c+1	c+2	c+3	Category value, y
				Scales of measurement [Stevens 1946]	Data tax [Monsteller an Chapter 5 Pe	onomies d Tukey 1977; endrill 2019]	
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# Two questions of "class":

Kind of quantity

Classification



III. **PER** numerum non tam multitudinem unitatum, quam abstractam quantitatis cujusvis ad aliam ejusdem generis quantitatem qua pro unitate (a) habetur, rationem intelligimus (b). Esique triplex; integer, fractus & surdus: Integer, quem unitas metitur: Fractus, quem unitatis pars submultiplex metitur: & Surdus, cui unitas est incommensurabilis (d).

'Article I. By Number we understand, not so much a Multitude of Unities, as the abstracted Ratio of any Quantity to another **Quantity of the same Kind**, which we take for Unity. And this is threefold: integer, fracted, and surd: An *Integer*, is what is measured by Unity; a *Fraction*, that which a submultiple Part of Unity measures; and a *Surd*, to which Unity is incommensurable.'



"Kind of Quantity" since the time of Newton has always been superordinate to "Quantity"

Universal arithmetick: or, A treatise of arithmetical composition and resolution by Newton, Isaac, Sir, 1642-1727; Cunn, Mr. (Samuel), ed; Raphson, Joseph, d. 1715 or 16, tr; Wilder, Theaker. https://archive.org/details/universalarithm00wildgoog/page/n15/mode/2up? https://archive.org/details/arithmetica01newtuoft/page/n31/mode/2up (Latin)

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*OM*. 'Quantities are classified according to similarity in their (implicit) metrological aspect, e.g. the length of my table and the length of my chair are both classified as length.' [owl:Class]

*UCUM*: The quotient  $\mathbf{u} / \mathbf{v}$  of any two commensurable units  $\mathbf{u} \sim \mathbf{v}$  is of the same dimension as the unity ( $\mathbf{u} / \mathbf{v} \sim \mathbf{1}$ ).

ISO/IEC JTC 1/SC 32: 'Quantities may be grouped together into <u>categories of quantities which are mutually comparable</u>. Lengths, diameters, distances, heights, wavelengths and so on would constitute such a category. Mutually comparable quantities have the same dimensionality. **ISO 80000-1 calls these "quantities of the same kind"**.'



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12. BAND, HEFT 9

Rudolf Fleischmann zum 75. Geburtstag

Unit-invariant Quantity comparison, Dimension

DER MATHEMATISCHE UND NATURWISSENSCHAFTLICHE UNTERRICHT

Sind of Quantity" is a major concept in ISQ - see Newton, Maxwell, "Kind of Quantity" is a major concept in a second is essential to include "Kind of Quantity" additivity dimensionality etcand is essential to include the second secon \*Issignentilly sehr wichtiger Punkt -, denn di Juantität. Sie sind Größenwerte. von Größ

Lit point – .... Kinds of peatedly emphasized, <u>no</u> quantity.

things (Gedanken-dinge) of a different kind than quantities, they are an **concept**), namely **Classes** of quantities.



The Physical Basis of DIMENSIONAL ANALYSIS Copyright © 2001 by Ain A. Sonin

#### Ain A. Sonin

 $Q_A, Q_B \in K_{class}$ 



Department of Mechanical Engineering MIT Cambridge, MA 02139

#### Similarity

- some **equivalence** between two things or phenomena that are actually different
- a transformation of variables that leads to a **reduction in the number of independent variables** that specify the problem
- main utility derives from its ability to contract, or **make more succinct**, the functional form of (physical) relationships
- based on ideas that originate at such a substratal point in science that **most scientists and engineers have lost touch with them**.



2021-09-



#### qudt:QuantityKind

a owl:Class ;

qudt:informativeReference

"http://www.electropedia.org/iev/iev.nsf/display?openform&ievref=112-01-04"^^xsd:anyURI;

rdfs:comment "A <b>Quantity Kind</b> is a v observable property that can be measured and quantified numerically. ...

*QUDT*: '...the **QuantityKind vocabulary is a set of a the kinds** of things we might measure... '

QUDT



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### Maxwell: $\mathbf{Q} = {\mathbf{Q}} \cdot [\mathbf{Q}]$



#### "(Ab)surdity" and Commensurability

Two concepts or things are commensurable if they are measurable or comparable by a common standard - wiki

*Universal arithmetick: or, A treatise of arithmetical composition and resolution* by Newton, Isaac, Sir, 1642-1727; Cunn, Mr. (Samuel), ed; Raphson, Joseph, d. 1715 or 16, tr; Wilder, Theaker. <u>https://archive.org/details/universalarithm00wildgoog/page/n15/mode/2up</u>? <u>https://archive.org/details/arithmetica01newtuoft/page/n31/mode/2up</u> (Latin)

## **Metrology of ordinal responses**

Scales of measurement [Stevens 1946]	Data taxonomies [Monsteller and Tukey 1977; Chapter 5 Pendrill 2019]
Ratio	Balances (unbounded, positive or negative values)
	Amounts (non-negative real numbers)
Interval	Counts (non-negative integers)
	Counted fractions (bounded by zero and one. Includes percentages, e.g.)
Ordinal	Counted fractions (bounded by zero and one. Includes percentages, e.g.) Ranks (starting from 1, which may represent wither the largest or smallest)
Ordinal	Counted fractions (bounded by zero and one. Includes percentages, e.g.) Ranks (starting from 1, which may represent wither the largest or smallest) Grades (ordered labels such as Freshman, Sophomore, Junior, Senior)

#### Assuring measurement quality in person-centred healthcare

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**Figure 4.** Distortion of MMSE scale where average scores calculated with CTT successively underestimate cognitive ability ( $\theta$ ) according to Rasch analysis towards scale end (MMSE score = 30) (based on Hughes *et al* (2003)).

#### Instances of ordinal properties <u>cannot</u> be measured! => There are <u>no</u> ordinal quantities





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Accuracy (decision-making) =

response categorisation – input (true) categorisation

eq. (2.8)

 $log\left(\frac{P_{success,i,j}}{1-P_{success,i,j}}\right) = \theta_i - \delta_j$ 



Georg Rasch (1901-1980)

2021-09-13



Quality Assured

Measurement

Preview





# Classification Metrological references



Physical ability





## Two questions of "class":

Kind of quantity – *important concept!*

Classification – *metrology of categorical properties*

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European Network for Business and ndustrial Statistics

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