How to define the content units of a course or a program

version 2.0

1 What is this guide?

In brief, this guide shows how to define shareable mindmaps of courses / programs contents through the use of ***content units (CUs)***, a concept explained below in details.

1 What does *Content Unit* mean?

In our acception **a *content unit* is an atomic unit of teaching-learning content that can be explained in half an hour or less, assuming that the learners know the surrounding context needed / useful for uptaking that content.** Simple examples are:

1) electric potential;
2) Rouché - Capelli theorem;
3) matrix - vectors multiplications.

The name of a content unit may contain some keywords. Content units may moreover be nested and grouped, so that one does not need worry too much about how detailed one should be in defining the "smallest / most detailed level" of content units. More information will come in Section 3.

2 So what shall I do?

Two things, in this order:

- first, make a list of the CUs that relate to your course as explained in Section 3;
- second, make a list of how these CUs relate to each other as explained in Section 4.

3 How do I summarize my course in terms of CUs?

Our advice is to follow this strategy:

1) copy the "*template - describing the contents of a course in terms of content units*" spreadsheet and rename it as wish (not its tabs, though!)
2) divide your course in separated parts, e.g., by lesson / lab session / etc or by topic / book section, and if you need for clarity do even a further division in sub-parts
3) go to your spreadsheet, go to the tab "***course outline***", and fill up the first four columns. Titles may be non-informative (e.g., "lesson 1", "lesson 2", etc) and you may also skip the 2nd, 3rd and 4th column (we however perceive that filling them up helps the steps below)
4) now for each row (i.e., part / subpart of the course):
    a) take the teaching material associated to that part,
    b) think at what it pre-requires and what it develops / cover,
    c) name these prerequisites and developed knowledge in terms of atomic contents (i.e., things that can be explained in half an hour or less, assuming that the learners know the surrounding context). There will be a trade-off in terms of time vs. detailedness of the maps we will get later on: to make a specific example, you may indeed
        i) let "*Fourier transforms*" be a big unique content unit
        ii) let "*definition of Fourier transforms*", "*properties of Fourier transforms*", "*common examples of Fourier transforms*", etc. be more specific content units
        iii) be even more detailed, and set "*linearity of Fourier transforms*", "*time shifts in Fourier transforms*" etc. be individual content units.

        The level of detail will likely depend on your course and importance of the various individual content units, as well as how detailed your teaching on this part is. In any case you decide the balance by yourself, we don't put constraints.
    d) insert these content units in the 5th and 6th column of the spreadsheet, divided by commas
    e) fill up also the 7th column - no need for very precise indications; however the information will help the software in making more appealing course contents flows maps.

4 How do I identify how the CUs connect to each other?

Now we need to insert information about how the contents within a course / program connect and flow. We consider five main types of relations among a generic content unit A and a generic content unit B:

- to learn about A it is **necessary** to know about B
- to learn about A it is **useful** to know about B
- A generalizes / contains B
- A is a synonym of B
- A is directly logically connected with B.

We empirically found that some teachers find it helpful to first compile the "*A generalizes / contains B*" relations before the other ones. Some others feel this is not necessary, and prefer to do the compilation of the relations simultaneously. We feel that doing "*A generalizes / contains B*" first and then the others takes more time, but leads to more accurate results. You do as you prefer; Section 4.1 below describes how to compile the "*A generalizes / contains B*" relations, while Section 4.2 describes the "everything simultaneously" approach. Our suggestion is: read both 4.1 and 4.2 before doing, and then decide depending on how you feel.

4.1 How do I define the "*A generalizes / contains B*" relations?

1) go to the tab "***content units hierarchies***" in your spreadsheet. Its header, that says "topic / discipline", "subtopic", "sub-subtopic", "...", suggests to use rows / columns placements to define the 'inclusion levels'. E.g.,

topic / discipline	**subtopic**	**sub-subtopic**	**...**
systems theory			
	signals		
		properties of signals	
			periodicity
			… (other content units)...
		sampling of signals	
			ideal impulse train sampling
			… (other content units)...
	systems		

   immediately defines a sort of hierarchy between the content units listed in the table
2) take the various content units that you listed in the tab "*list of which content units relate to this course*" and organize them as above.

4.2 How do I insert all the various relations?

1) sort the CUs you mentioned in the first two tabs of the spreadsheet as you prefer. E.g., some people like to sort them alphabetically, some others temporally and/or by some logical hierarchy. Do as you wish, the order of the rows is ininfluent;
2) go to the tab "***content units relations***" and copy these sorted content units in the first column of this tab;
3) for each remaining cell, insert the prompted information. If you need to insert a list of content units in one single cell then separate the individual units with a semicolon.

5 Bonus: describing some instructional material in terms of its content units directly *within* the material itself

If you write your instructional material in LaTeX, then you may code the relations written above directly in the .tex document itself, rather than using the spreadsheet file mentioned above. If you want to know more about this possibility, first look at the "how to index the cognitive difficulty of exercises with the using-explaining taxonomy" manual, then download the corresponding LaTeX template file and look at the instructions in *contentsmapping.tex* and the examples in *questions.tex*.

6 Some theoretical perspectives

The term "*Content Unit*" has been defined in the pedagogics literature as a "single student capability which is acquired under a single set of learning conditions, assuming that the prerequisite capabilities have been learned" (Gagne 1962, 1965, 1967 cited in Briggs, 1967, p.16). "Content unit" was also defined as the result of the breaking down of the course objectives into manageable sections (Briggs & Wager, 1981). The term "content unit" has also some synonyms: for example Ciampolini (1993) introduced the similar term of *vertical distillation* within short didactic, meaning with this a listing of the topics that make up the discipline in the order in which the teacher presents them. Similarly, Martini (2006) recently described *the criterion of essentialization* in the didactic programming of the disciplines, as the explicitation of the objects and structures of the discipline and, therefore, its constitutive elements and their mutual relations.

7 Further recommendations & best practices

- If you are mapping several courses, start with the most basic one. The units from the most basic course will probably be used in the next one, so it will be like climbing a ladder.
- table of contents of books are excellent pre-made information for compiling the first four columns of the tab "*list of which content units relate to this course*". To this regard,

    - the easiest is to copy all the headers, but delete all the headers without information, such as “where to find more on electric circuits”
    - headers of sections are usually very general, while the subsections are more specific
    - better to divide headers that indicate several content units into two or more headers. E.g. better to divide “Reactive and resistive circuits” into “reactive circuits” and “resistive circuits” and thus add two rows in the spreadsheet
- lesson titles are an equivalent pre-made information for compiling the four columns mentioned above. The same recommendations apply here too
- to map the prerequisites, ask yourself what you need to know to understand that part / sub-part of the course
- remove all the commas from the content units that you define, otherwise our text-parsers will go nuts :)
- if relevant, it is meaningful to consider all the mathematical prerequisites as independent content units. If you keep them quite generic (e.g., “Fourier transforms”) this will make you save time BUT also make it more difficult to draw precise connections with other courses
- for now do not worry too much about how you spell the names of the content units. But if you want to make our life easier consider spending some time in compiling the “*which CUs are a synonym of this CU?*” column.

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