# CATEGORIES and COMMUNITY (Draft 26 June 2002)

## Typos, remarks, and proposals

Uwe Wolter

**page 7** **line 3:** citation 7 instead of 8 (this error goes through the paper)

**page 8** **line 14:** references [65] and [66] are identical

**page 12** **line 16:** in reference [85] the year is missing

• I think [69] is a first step in changing education (of engineers) as you are advocating it in the last papragraph of section 1.1. (In Poland the have even changed ground school mathematics more in the direction of Category Theory. I think it was Semadeni who pushed this. But, you can asked Hartmut about this.)

**page 13** **footnote:** ... the author is ...

**page 14** **line 15:** In the second case, $A = \{a\}$ relates to $B$ if $a \in B$.

**page 15** **1.3.2:** • The first developments in Algebraic Data Types have been made by the group of Kaphengst and Reichel in East-Germany at ROBOTRON in the late 60s.

• As text-books you could also mention [1, 2].

**page 18** **1.4:** You have also given tutorials at ETAPS.

**page 24** **line 3:** Reference [68] is incomplete. What about the book of Bart Jacobs?

**2.1.9:** I would prefer to talk about "logical consequence" (or "logical entailment") to reserve the word "implication" for the corresponding logical connector as $\supset$ in 3.5.2 for example.

**2.1.11:** Use "sentence" as in 2.1.9 instead of "formula".

**page 25** **2.1.15:** Why not a more formal definition that the readers become used to the notation. The next paragraph is in constrast very formal. I would propose something like: The dual graph of $G = \langle G_0, G_1, src, trg \rangle$ is given by $G^{op} = \langle G_0, G_1, trg, src \rangle$, i.e., $src^{op} = trg$ and $trg^{op} = src$.

**2.2:** I expected here a nice motivation of composition (and associativity).

**page 27** **line 4:** You could mention that the notation $g \circ f$ corresponds to the application order, i.e., $f;g(a) = g(f(a))$ for all $a \in x$.

**2.2.3, line 4:** The subscripts 0 and 1 are too big.

**page 29** **line -5:** "...just the case of a composition $\langle h, i, j \rangle ; \langle h', i', j' \rangle = \langle h; h', i; i', j; j' \rangle$ ..."

**page 30** **2.2.11:** Later in the book you are using $\delta$ for diagrams (from 4.4.1 on). I would prefer one symbol for the whole book, but at least in this paragraph you should keep one notation. Maybe also one remark concerning the subscript notation $\delta_{u_1}$ for $\delta(u_1)$ could be clarifying.

**page 32** **line 8:** "social life"

**line -4:** More precise: The converse of the first property holds in **SET** but not in arbitrary categories.

**page 33** **2.3.7.1:** The proof is the same as in 2.3.5.1

**2.3.7.2:** It is enough to require split mono and epi.

**page 41** **3.3.2.4:** "partial functions compose exactly in the same way as total functions" — I wouldn't sign this! I propose to introduce a notation for partial functions (specially for the domain of definition) and to define the composition of partial functions. The crucial point is the construction of the domain of definition of $f;g$. Proving associativity and identity can be left as an exercise.

$\Rightarrow$ Later you may put the definition and the investigation of a functor **PAR**$\rightarrow$**SET**$_\perp$ as exercis(es).

**3.3.4:** • I'm sure that **POWER** is not a full subcategory of **SET**$_\perp$.

• Since the powerset construction is so basic for the book, I would introduce and present it in more details (in exercises?): Definition of images and pre-images of sets w.r.t. functions. Compatibility of the covariant and contravariant powerset construction with intersection and union. Functors $\mathbf{SET}\to\mathbf{SET}_\perp(\to\mathbf{SET})$ and $\mathbf{SET}\to\mathbf{PO}(\to\mathbf{CAT})$ where **PO** is the category of partial orders.

**page 44** **line 3:** "…Co-reflections are …"

**page 47** **line 8:** $\langle pre_r, pos_r\rangle$

• Sketch how the example `account` fits the schemes $\langle arg, res\rangle$ and $\langle pre_r, pos_r\rangle$. What is the difference between attributes and functions? Are there functions in `account`?

**page 48** **line 24:** $pre'_{F(r)}$ and $pos'_{F(r)}$

**class `flexible account`:** • <u>deferred</u> <u>class</u>

• Could you spend some words in what sense a class declaration provides a morphism?

**page 50** **line 7:** I feel there is something missing in this sentence.

**3.5.3, line 3:** • reference [102] instead of [Wolper 89]

• Why are you not using something like $\models$. This comma-notation for satisfaction and entailment is hardly to recognize.

**page 51** **example** In all all your examples of temporal specifications you have to replace **W** by **U**

**page 52** **3.5.5.1:** Use $\neg$ for negation

**3.5.5.3:** "morphism" also in boldface

**page 53** **line 21:** "…able to relate …"

**3.5.7.1, line 2:** "…for $\Sigma'$ …"

**line 3:** Write $f^{-1}$ in a better way (throughout the paper).

**3.5.7.2, line 2:** "…for $\Sigma'$ … $\underline{f}(\phi)$ …"

**page 54** **proof of 3.5.8.2:** It would be god to put a lemma after 3.5.4 stating reflexivity, monotonicity, and idempontnce of closure. Also in properation for the more abstract treatment of closure operators in section 3.6!

**page 56** **3.6:** • What is the methodological point to put section 3.6 (at this palce)?

• You have not defined $\mathbf{SPRES_{LTL}}$ in 3.5.

**3.6.1:** • $c$ has to be a map $c: 2^L \to 2^L$.

• What you call a "closure system" is usually called a "closure operator" in mathematics (see [3]). A "closure system" (over $L$) is a subset of $2^L$ closed under intersection.

• I feel it more convenient to formulate idempotence as an equality (in correspondence with with idempotence of binary operations as $x \cap x = x$).

**page 57** **3.6.3.2-4:** A small $c$ in the subscripts $\langle L, c\rangle$.

**page 61** **4.1:** You have already worked with "universal properties" in 3.3.8 and 3.3.11, where Proposition 4.1.2 relates to proposition 3.3.9.

**page 65** **line 7:** Why you don't use the "standard" co-tupling notation $[f_x, f_y]$ thus you are able to use $f_x + f_y$ for morphisms $x + y \to v + v$?

**page 66** **4.2.3.2:** The argumentation here for **PROOF** fits better for **LOGI** and it is better to keep the entailment notation (introduced in 2.2.4). For **PROOF** one would expect the construction of a proof tree $[f_x, f_y]$ out of proof trees for $f_x$ and $f_y$.

**page 68** **4.2.6:** Again, why not using the "standard" tuple notation $\langle f_x, f_y\rangle$ as you have done it later in ???? In 5.1.6 you are using $f_x \times f_y$ not for tupling but for parallel composition.

**line -6:** "…the set $a \oplus b$ …"

**page 70** **line -1:** "…clearly satisfies the commutativity requirements …"

**page 75** **4.3.8:** I think you must write $\langle\{produce, store, \perp_P\}, \perp_P\rangle$ and $\langle\{consume, retrieve, \perp_C\}, \perp_C\rangle$?

**page 79** **4.4.7:** Can you give a reference for this result?

**line 4: LOGI**

**4.4.8.2:** What about the functions in the specifications?

**page 80** **line -2:** It is not enough to say “The dual of 4.4.7 …”. The fact that a successive (co)limit constructions provides a (co)limit is always a result for its own (see exercise 4.3.6.3). Also results about equivalent successive way to construct a (co)limit or about interchanging limit and colimit constructions are relevant.

**page 85** mapping **spec:** • What about routines with arguments ? Is deposit(i) or deposit(10) an action symbol? Will we have in this way infinite many action symbols?

• What is **X**? Write big **X** also in the temporal formulas!

**page 86** **5.1.7.3+4:** Space after “hom-set restrictions”.

**page 90** **line 16:** Introduce here the name of the functor **int**:$\mathbf{PRES}_{LTL} \rightarrow$**fSET**.

**line -4:** “…that it exists.”

**page 92** **5.3.2.2:** $\mathbf{SPRES}_{LTL}$ is not defined in section 3.5!

**page 93** **5.3.3:** Please put “pre-order” into the Index. I would prefer to define the fibre as a subcategory as in 5.3.8.1 and than argue that in case of concrete categories the fibres become pre-orders.

**5.3.4.2:** You have not defined what a complete lattice is, but you can refer to the definition of complete and co-complete categories.

**page 95** **5.3.8:** I can think about an exercise to prove that pre-images of subcategories w.r.t. a functor are subcategories but not necessarely images.

**page 100** **5.3.15:** “… $f^{-1}$ is the composition $f_2^{-1}; f_1^{-1}$ …”

**page 108** **6.1.3.2:** Why not the “standard” notation $\mathbf{C} \downarrow \phi$?

**page 114** **6.2.1:** I think we can describe $\mathbf{spa}(\phi)$ by flattening th indexed category $\phi; power : C \rightarrow CAT$ where we take the powerset construction as a functor from SET into CAT.

**line -1:** $f^{\omega}(\Lambda_1) \subseteq \Lambda_2$

**page 115** **line 5:** Hence $P_1$ identifies part of the environment of $P_2$.

**page 116** **6.2.5:** What is a “concrete (co)limit”?

• Shift <u>Sum</u> to the next page.

**page 117** Shift <u>Pushout</u> to the next page.

**page 118** **6.2.6:** What is $\_{\emptyset}$?

**page 120** **6.3.1:** “An indexed category $\iota$ …”

**page 142** **line 10:** You could again mention [1, 2] Maybe also [7]?

**design** `P`: Delete the gap after **prv**

**page 144** **example** `buffer`: • Why keyword **component** and not **design** as on page 142?

• Keyword **is** in boldface.

• Where come the functions |_|, <, …from?

• `bound` must be a natural number?

• Why not [] before `put`?

• Please note that $b.i$ denotes not a component of $b$ but adding an element $i$ to the right of a list.

• It is not so intuitive that `rd` is `false` after the current message has been read by the environment.

**page 145** **8.1, line -6**: Are there related categorical reasons for the “absence of initialisation conditions”?

**page 146** **line 10+11:** Where is the receiver ?

**line 14:** Where we have seen that “channels and action names are typed and classified in different categories”?

**page 147** **8.2.1:** • Delete the double underline in 1!
• $\sigma_{ac}$ is a morphism in $SET_\perp$?
• Can you refer to the corresponding numbers of "The other constraints" in the last paragraph?

**page 148** **8.2.2, line 12+13:** The direction of the arcs is from output to input channels. **line 2:**

**page 149** Introduce here the name **c-sign** of this functor.
• Do you think that Part 1 provides enough that the reader can validate the sketch of constructions of colimits of design?

**page 150** **8.2.5:** What is a "diagram of designs?

**page 153** **line 1:** $\underline{\mathrm{D}}$

**page 154** **line 1:** What is "$Isomorph(\_)$"?
⇒ The discussion concerning morphisms in section 9.2 is missing in chapter 8.

**page 160** **line 13:** "already argued" ⇒ Exactly this discussion is missing in chapter 8.

**page 161** **line 11:** Reference [70] is in Portuguese. Can you give a reference in English or include the proof in the book (appendix)?

## References


[1] J. Loeckx and H.-D. Ehrich and M. Wolf. Specification ofAbstract Data Types. Wiley, 1996.

[2] H. Reichel. Initial Computability, Algebraic Specifications, and Partial Algebras. Oxford University Press, 1987.

[3] W. Wechler. Universal Algebra for Computer Scientists. Volume 25 of EATCS Monographs on Theoretical Computer Science. Springer-Verlag , 1992.