The Origin of the ProCoS Project – &c.

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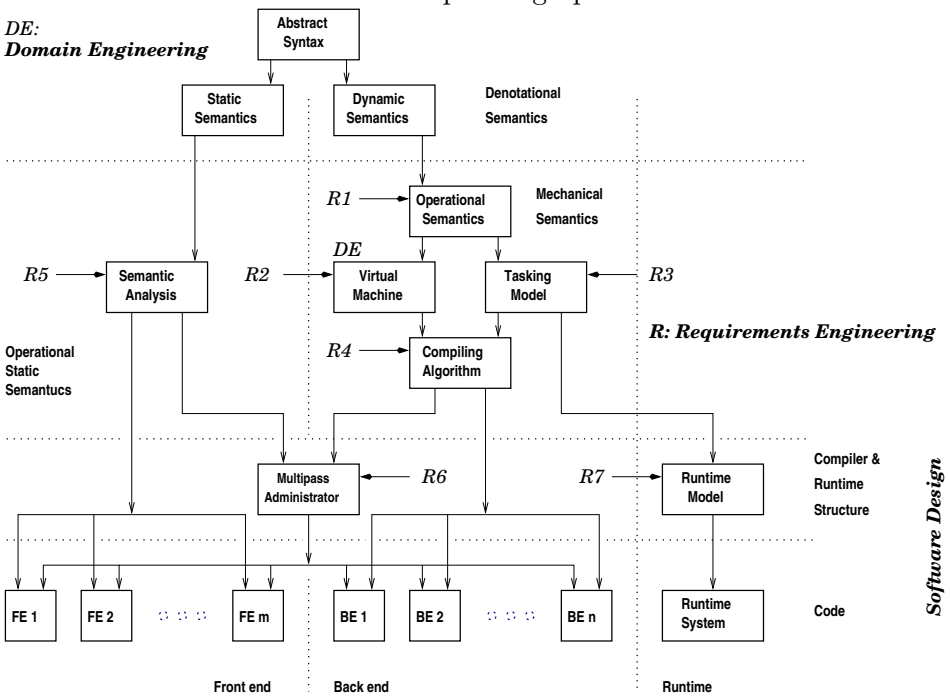
Dedicated to the Memory of Søren Prehn

1 An IFIP WG2.2 Meeting

It was at an IFIP[1] WG2.3[2] meeting, 13 November 1987, at *Château Du Point d'Oye* in the Vallon part of Belgium. I had *presented a topic for discussion*[3]. It was about the programming methodology use in the Dansk Datamatik Center development of `CHILL` and `Ada` compilers. My topic centered around a software development graph:



Each of the boxes, from a programming methodology point-of-view, represents a formal specification according to some theory: Strachey & Scott, McCarthy & Painter, Reynolds, and

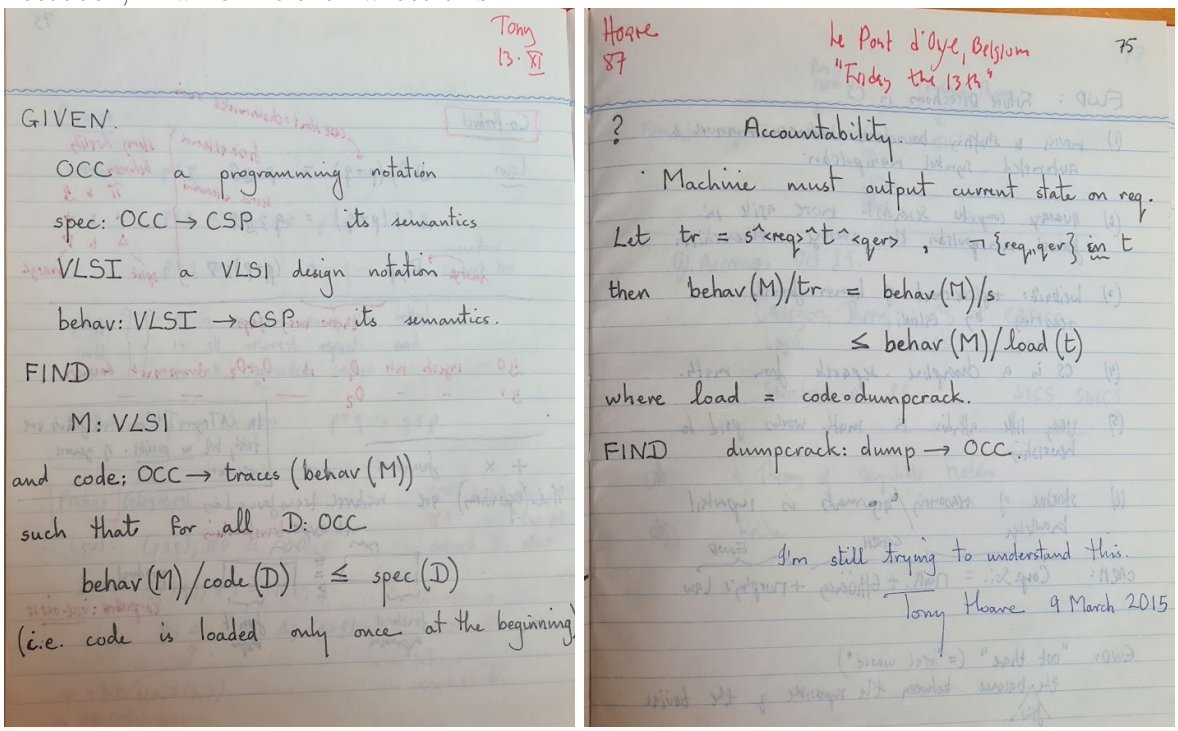
[1] IFIP: International Federation for Information Processing

[2] Working Group 2.3: Programming Methodology

[3] At IFIP WG2.3 meetings one did nor present papers: one suggested a topic for discussion, say 5-10 minutes, and, under the skillful guidance of the chairman, the members then decided as to whether or not that topic was worth listening to!

many others. And each of the arrows represents one or another form of reification. From a theoretical computer science point of view boxes "stood" for some kind of algebra and arrows for algebraic injections.

After the talk there was a coffee break, but Tony Hoare held me back, asked for my notebook, in which he then wrote this:



GIVEN

OCC a programming notation
spec: OCC → CSP its semantics
VLSI a VLSI design notation
behav: VLSI → CSP its semantics.

FIND

M: VLSI
and code: OCC → Traces (behav(M))
such that ∀ D:OCC
behav(M)/code(D) ≤ spec(D)
(i.e. code is loaded only one at the beginning).

Accountability
Machine must output curret state on req.

Let $tr = s \frown \langle req \rangle \frown t \frown \langle qer \rangle, \{req, qer\} \subseteq t$
then behav(M)/tr = behav(M)/s ⊆ behav(M)/load(t)
where load = code ∘ dumpcrack.

FIND dumpcrack: dump → OCC.

In his subtle style, Tony then wondered: *"could this, perhaps, be a basis for an ESPRIT project ?*

Yes, was my answer. I then worked out both a group of colleagues and the basis for a proposal. Jonathan Bowen provided the wonderful logo. And so it went !

At the March 2015 ProCoS gathering in London, In my talk, 9 March 2015, 27 and a half years later, I displayed the above image – and, again, afterwards, Tony Hoare, asked for the notebook and wrote the right hand side page bottom two blue lines !

I'm still trying to understand this.
Tony Hoare 9 March 2015

Dear reader, whoever You are: *May You could try Your wit on this?*

2 The Tian AnMen "Incident"

Independent of all this I had had Zhou ChaoChen visit my DTU institute some winters, for 3 months since 1982. He was also invited, with his family, for half a year. They were to come on July 1, 1989. Some most tragic events took place on June 3-4, a month earlier, on Tian AnMen Square and elsewhere in China. We were about to obtain ESPRIT funding for the ProCoS proposal. So I sat down, spent perhaps a whole day, June 5th, formulating a 2/3 page fax which I then sent to two of my "connections" in Beijing: one to Prof. Wang ShengWei, director of the PLA's[4] Research Center and one to Prof. Xu KongShi, Director of the Chinese Academy of Science's Institute for Computing Technology, a forerunner for todays Institute of Software. Prof. Wang ShengWei was a close confidante of the then Minister for *Science, Technology and Industry* of the *PLA:* Ding HengGao – with whom and his wife, Madame Nie Li, daughter of the the military leader of the *Long March,* Marshal Nie RhongZhen, I have had dinner with, in Beijing as well as, with him and some of his staff, in my home in Denmark! In the fax I expressed our happiness in soon receiving the Zhou family in Denmark; that the ProCos project had been approved; and that a main focus of its research was that of programming methodologies for real-time, safety critical systems. I got two reply faxes within 24 hours: *Oh, yes, the whole family would come.* And they came. Instead of 6 months, it became 4 years!

3 The Viborg Meeting

One of the ProCoS project meetings took place at the Golf Hotel in Viborg, Denmark. My colleagues, Prof. Erling Vagn Sørensen, gave a talk on how electric switching circuits exhibited "spikes" and how that affected their logic. A fine, clear talk – which obviously inspired Zhou ChaoChen, Tony Hoare and Anders Peter Ravn. After EVS's talk there was a break before lunch. During that break the Duration Calculus was conceived. In a neighbouring conference room the three spent an hour in front of a white board! Soon there after Zhou ChaoChen, C.A.R. Hoare, A.P. Ravn: *A Calculus of Durations.* Information Processing Letters **40**, 5 (1992) appeared.

4 UNU/IIST

I was headhunted, in May 1991, to become the first and founding UN Director of the upcoming UN University's International Institute for Software Technology, located in Macau. I served for 5 years: 1 July 1982 – 30 June 1997. I was able to have Søren Prehn with UNU/IIST as from 1 August 1992 and Zhou ChaoChen as from 1 September 1992. In the years 1993–1997 UNU/IIST hosted more than 60 young scholars, from China, Vietnam, The Philippines, India, Mongolia, both Koreas (!), Nepal, Argentina, Cameroon, Nigeria, etc. UNU/IIST's charter was to enable developing countries to themselves be developers of sophisticated software. I chose to do so by propagating state-of-the-art software development methods and their underlying science. We identified the UNU Fellows, as they were, through giving 2 week

[4] PLA: Peoples Liberation Army

courses at universities in these countries and selected those participants who asked probing questions. My staff, besides *Zhou ChaoChen* and *Søren Prehn*, were such computing scientists as *Chris W. George, Dang Van Hung, Richard Moore, Tomasz Janowski* and *Kees Middelburg.* I, later *Chris W. George*, would lead two-three of these, as a Programming Methodology Group, and Zhou ChaoChen two-three as a more *Theoretical Computer Science Group.* Usually the UNU Fellows would arrive by September, these years, and be exposed to a month of lectures by all of us. Dring that month they were then assigned to one of the groups and a study topic was tentatively identified. Zhou ChaoChen's group primarily work around `Duration Calculus` topics. My and Chris W. George's group with *domain specific* topics: *Run-time Scheduling of Trains* (China), *Ministry of Finance Software* (Vietnam), *Multi-script Editing* (Mongolia), *Radio Telephony* (The Philippines), etc. Over these and the following years, where first Zhou ChaoChen, and, finally, Mike Reed, succeeded me as UN Directors, several guest lecturers spent, typically 6 months at UNU/IIST. UNI/IIST eventually hosted both an IFIP WG2.3 meeting and a ProCoS meeting! Today we can say that UNU/IIST, with its programme of Formal Methods domain-specific software development and Duration Calculus studies, have been the origin of main studies and course directions at several Chinese, some Indian, etc., universities. Notably East China Normal University, ECNU with *He JiFeng* who also spent some years at UNU/IIST.

5 Looking Back & Acknowledments

There is no longer an identifiable core of colleagues at my former institute who work as we did in the 1990s and early 1990s. My "stint" at UNU/IIST appears to have brought an end to that! I, anyway, thank my former colleagues, *Hans Henrik Løvengreen, Hans Rischel* and M*ichael Reichhardt Hansen*, for loyal and kind collaboration. I am also grateful to *Hans Langmaack, Tony Hoare, Chris W. George, Richard Moore, Dang Van Hung, Kees Middelburg* and *Tomasz Janowski* for inspiring collaboration.