“Safer Language Subsets"

by

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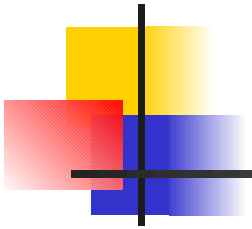
Overview



- Some history
- Taxonomy
- Enforceability
- Special issues with C
- Future direction

Some history

Safer subsets (also mixed up with programming standards), have been around for a long time

- Fortran subsets have been around for 20 years
- Ada subsets, (Spark …) have also been around for a long time.
- C subsets do not appear to have been so well-entrenched,

Taxonomy

Define the following taxonomy

- *Category A*: Purely stylistic stuff like indentation standards, variable naming conventions and so on.
- *Category B*:
  - B.1: Rejection of features based on *folklore*, for example the *goto* statement
  - B.2: Rejection of features based on known failures through measurement, for example type conversions which lose bits.

Definition of a safer subset

A safer subset is constructed from:-

- Category B.2 rules as mandatory
- Category B.1 rules as recommendations only

Programming standards make poor safer subsets

N = (B/A) for a number of commercial standards

Safety-related	Number of pages	B/A
Yes	15	5%
No	75	0%
No	66	8%
Yes	37	2%
No	33	35%
Yes	17	6%
No	18	8%

Enforceability

Rules in a safer subset ideally must be worded to have the following properties:-

- Orthogonality (lack of interaction with other rules)
- Decidability (knowing what the rule means precisely)
- Atomicity (A rule can either be enforced or not.)

Enforceability is hopeless in practice

N = (B/A) for a number of commercial standards

Language	Safety-related	Transgression rate
C	Yes	1 every 14 lines
C	No	1 every 12 lines
C	No	1 every 121 lines
Fortran	No	1 every 66 lines
Fortran	No	1 every 771 lines

Special issues with C

- Measurement support and what can be achieved
- Standardisation problems
- Influential nature of language
- Existence of MISRA C

Measurement support

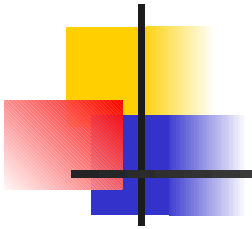
The good news

- There is an abundance of measurement-supported information to assist in the construction of C safer subsets.

The bad news

- People don’t in general use it
- The language needs subsetting more than most.

Two examples of what can be achieved in C



CDIS – component of LHR air-traffic control system

- 400 KLOC source format lines
- Asymptotic defect density 0.71 per KLOC, (after 4 years in field).

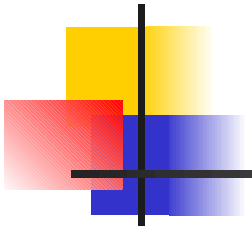
Safer C toolset

- 125 KLOC source format lines
- Asymptotic defect density 0.26 per KLOC, (after 3 years in field).

Standardisation problems

- Like most standardised languages, each successive ISO revision generally creates more problems for safer subsetting than its predecessor. C99 is *no* exception.
- Language committees are too interested in features and not interested enough in reliable features.

Influential nature of language



- C has spawned many languages such as C++, Java, Javascript, PHP, Perl, Tcl, Objective C.

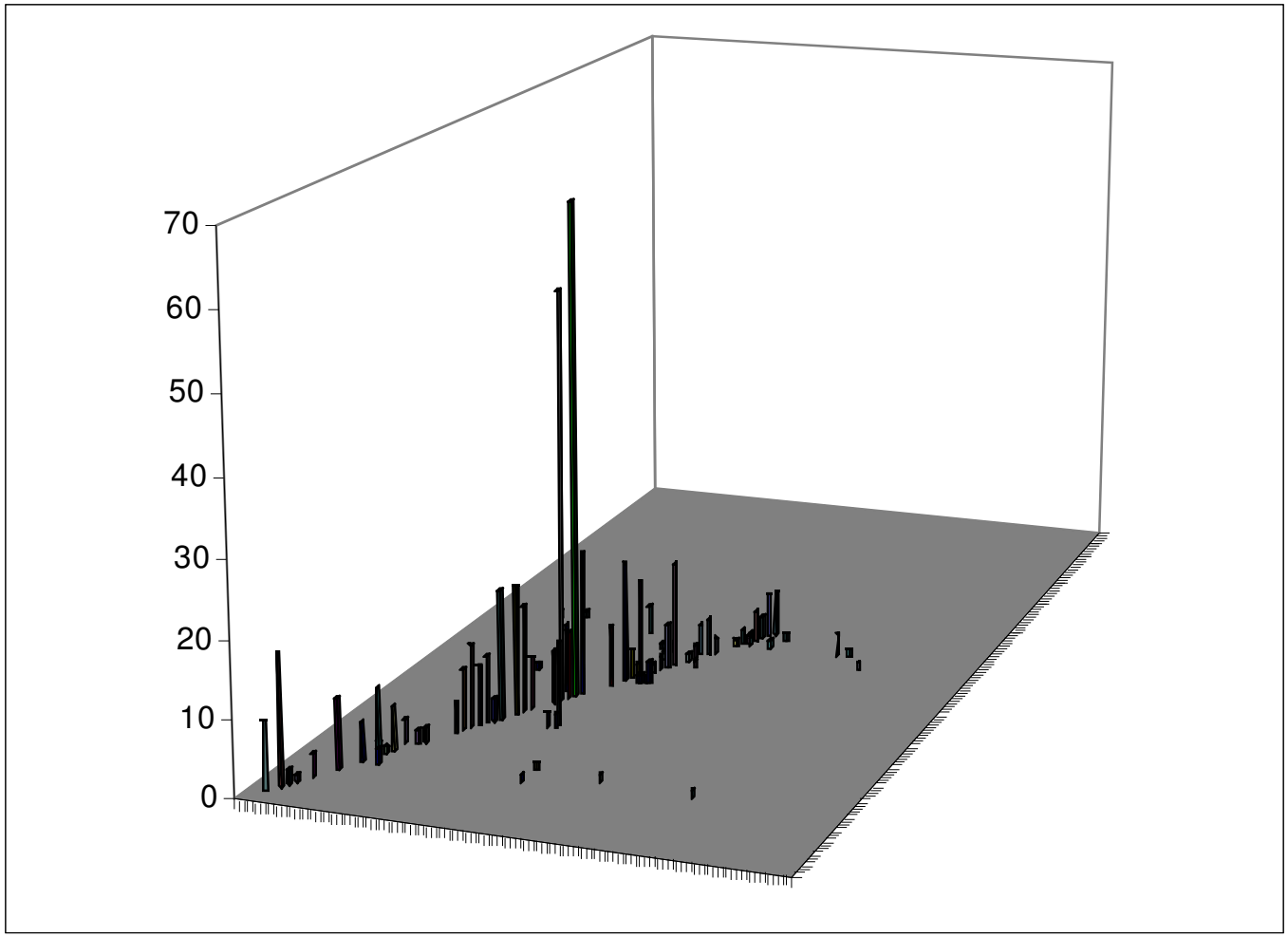
The good and bad news …

- This means that most of these languages have inherited a large subset of C's known defects, but at least the same principles can be used in rendering them safer.

Existence of MISRA C

- In April 1998, the auto industry decided that a safer subset of C was necessary. MISRA C was the result.
  - 127 rules, B/A close to 100%
  - Some problems with decidability, atomicity and cross-talk but better than previous attempts. However these currently mean that enforceability can not be satisfactorily defined. Test cases remain test cases and cannot define validation.

Rule crosstalk so far ...



Initiatives for improvement

MISRA

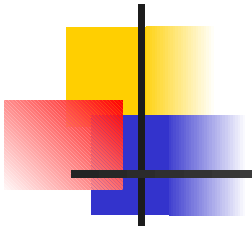
- Steering committee now attempting to address decidability, atomicity, orthogonality and test case implementation questions.

UKC

- Large project starting to attack safer subsetting and enforceability in the C-like languages from a number of directions, both theoretical and empirical. It will work closely with the MISRA steering committee but has a broader scope.

In both cases, test case deliverables will be available under the GPL.

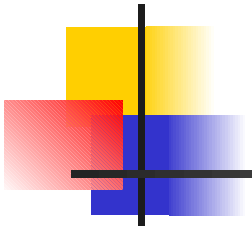
What do you do about C++ ?



There are two possible approaches:-

- Through folkloric approaches such as EC++, i.e. accepted but non measurement supported practice.
- Through measurement based on careful extensions from C. The problem here is that OO in general and C++ in particular is a measurement-free zone.

UKC safer subset site (under extensive development)



Download sites:-

- The as yet incomplete exemplary test case suite for MISRA C is available at the UKC national Safer Language Subsets project site:-

  http://www.cs.ukc.ac.uk/national/SLS