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Topic 26	• The objective is
Jackson's Description Principles	$\star$ to ensure that the developer becomes a professional specifier.
• The <b>prerequisite</b> for following this (part of the) lecture is that	• The <b>treatment</b> is systematic to formal.
you have followed the lectures on Description Principles and On	We build on ideas eloquently expressed in:
Defining and On Definitions.	Software Requirements & Specifications
• The aims are	a lexicon of practice, principles and prejudices Michael Jackson
$\star$ to introduce Jackson's concepts of designations, definitions and refutable assertions, and	ACM Press and Addison-Wesley Publishing Company
$\star$ to provide formal tools for the expression of manifestations of	ISBN 0-201-87712-0, 1995; xvi+228 Pages
these concepts.	
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Climate         Display         Page 688, Topic: 26, Feb. 3         Extert Present Path, Dis 2008 (pringle Densal	
• Since all we do is	• A description is about
* construct, analyse and compare descriptions	* manifest individuals, i.e., phenomena and concepts.
$\star$ we shall analyse $\star$ the concept and constituents of descriptions. <sup>8</sup>	★ Some of these represent, or are intended to represent, facts; ★ others represent mental constructions, i.e., concepts.
and concept and constitution of descriptions.	* A description includes <i>designations</i> , definitions and refutable
	descriptions.
	$\star$ A description can either be formal or informal.
	$\star\mathrm{A}$ description sets a scope and a span, and a description
	$\star$ expresses moods.
	• By an individual we mean a physically manifest phenomenon.
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<sup>4</sup> We shall here use the term description as also covering the terms prescription and specification.	
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Phenomena, Facts and Individuals	<ul> <li>A fact involves one or more <i>individuals</i>. Anything can be an individual. Each individual is identical to itself but distinct from all</li> </ul>
• Phenomena are what appears to exist.	other individuals.
Domain phenomena are built up from facts about individuals.	• If x is identical to y, then x and y are the same individual: $x = y$ .
• A fact is a simple truth about the world:	• If we say that $x$ is similar or equivalent to $y$ then $x$ and $y$ are
It is the smallest unit of observation.	distinct individuals that share some property, characteristic,
• Large and complex observations and truths can be broken down into assertions about several facts.	attribute or quality.
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• To create a <i>designation</i> we thus write down two items:	• That is: recognition rules are expressed only in terms that are / otherwise well understood, i.e., part of the folklore.
$\star$ a designation description $\star$ and a designation identification.	• If a recognition rule thus contains a term that is elsewhere <i>defined</i> ,
• The designation description is usually of the form:	$\star$ then it is not a recognition rule
* Designated term: dt.	$\star$ but becomes a definition.
* Recognition rule: dt's satisfy the following informally stated properties: — where all other words, i.e., terms, are assumed to be well-known!	
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Immedia/vell()Sh27/5h27         April 5, 2006, 60:18         Page 606, Tapic 26, Fail 11         Result Answer Fault (20:202 Fail 11)           Example 7.79 Rail Units, I: We give the first in a series of	Example 7.80 Rail Units, II: We give the second in a series of
<ul><li>examples relating to rail nets.</li><li>Designated term: rail_unit, or just U.</li></ul>	<ul><li>examples relating to rail nets.</li><li>Designated term: linear_rail_unit, or just U, for which a</li></ul>
<ul> <li>Recognition rule: A rail_unit, of just 0.</li> <li>Recognition rule: A rail_unit is a composition of an even number of parallel positioned rails (long, narrow, profiled iron bars)</li> </ul>	• Designated term: linear_fail_unit, of just 0, for which a predicate, to be assumed, holds: is_linear_rail_unit(u) for all u in the extension U, i.e., u:U.
<ul><li>separated such that one can always identify pairs of rails of the composition that are at a specified distance (the rail gauge), and otherwise held together by a set of ties.</li><li>When we write rail_unit we mean the extensional meaning (the</li></ul>	• Recognition rule: A linear_rail_unit is a pair of parallel positioned rails (long, narrow, profiled iron bars) separated at a specified distance (the rail gauge) and held together by a set of ties. (The predicate is_linear_rail_unit(u) "arises" from the
<b>type</b> ) of that term. ■	recognition rule.) Observe that the designation term and the recognition rule dealt with a concrete concept for which the immediate concretisation points to a set of a phenomena. What is being designated and to be recognised is any one member of this set.
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The fatter example is a specialisation of the former.     The former example expressed: composition of an even	Some Observations
number of parallel positioned 'rails'	• In general a designation description can be formalised;
• thus allowing for, say, two pairs as in a switch or in a simple crossover rail unit.	• but one cannot formalise the <i>identification</i> — as it relates a formal world to an inherently informal world.
• A designation identification is usually of the form:	• As illustrated in the two previous examples,
$\star$ "That 'thing' (u) there is a U.	• the latter of which was a specialisation of the former,
<ul> <li>* So is that 'thing' (u') over there!" —</li> <li>• thus physically pointing out a <i>designation set</i>, that is, instances of values that together become part of a type.</li> </ul>	• a designation may extensionally denote a class (of things) which can be subdivided into subclasses.
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ham(b)/ell/36/ Apri 5, 200, 09.13 Page 700, logic 20, Fel 13 Notaer Pressure Fact, the State System as	Example 7.81 Rail Units, III: We give the third in a series of
	examples relating to rail nets.
Linear Unit Switchable Unit Simple Crossover Switchable Crossover Figure 7.12: Roughly drawn rail units	<ul> <li>Designated term: rail_unit.</li> <li>Recognition rule: — as for the above, previous rail_unit</li> </ul>
	• <i>Recognition rule:</i> — as for the above, previous rall_unit example.
	• Designated term: linear_rail_unit.
	• Recognition rule: — as for the above, previous linear_rail_unit example, and additionally: Thus a linear_rail_unit has two "ends" and a single (two-way) link between these ends. Any other rail_unit may be connected to either of these ends (and if so, then the end is called a connector).
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deploy graphic means as in Fig. 7.12.	• Recognition rule: — as for rail_unit just above, and
• Even photographic means could be used.	additionally: A switchable_rail_unit has three connectors
<ul> <li>Even photographic means could be used.</li> <li>And then one usually could show several photos of variations of the same kind of designated individuals.</li> </ul>	which "define" (allow, permit) two two-way links through the switchable_rail_unit.
	• Designated term: simple_crossover_rail_unit.
	• Recognition rule: — as for rail_unit just above, and additionally: A simple_crossover_rail_unit has four connectors which "define" (allow, permit) two two-way links through the simple_crossover_rail_unit.
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болт Овигительна и Кальной и Кальной и Кальной и Кал	Som Observations state of the s
• Designated term: switchable_crossover_rail_unit.	• Further recognition rules deal with connectors and rail_units.
• Recognition rule: — as for rail_unit just above, and	• A connector is any "end" of a rail_unit to which other
additionally: A switchable_crossover_rail_unit has four	rail_units may be 'connected'.
<b>connectors</b> which, together with the switching ability of the unit, "define" (allow, permit) four two-way links through the	• Any one connector is shared by at most two rail_units.
switchable_crossover_rail_unit.	• A rail_unit is mutually exclusive either a linear_rail_unit or a switchable_rail_unit or a simpl_crossover_rail_unit or a switchable_crossover_rail_unit.
• Designated term: connector.	See axioms [2,3] in a formalisation given later.
• Recognition rule: A connector is that which allows two rail_units to be connected, "end to end".	
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• As we shall see in a later lecture,	$\bullet$ For the last (the mutual exclusion) we can claim it to be a fact,
• doubt may be raised as to whether some of the text parts of the above recognition rules express assertions.	<ul><li>hence it is part of a recognition rule.</li><li>For the "at most two", the case is a bit more complicated.</li></ul>
• (Designations state facts, not assertions.)	• And then,
• For example: "has two ends" (or three, or four).	$\star$ when we formalise the whole thing, as we shall see below,
• These parts are part of recognition rules,	$\star$ and when such a formalisation is compared to that of a refutable
• but what about:	assertion,
$\star$ "any one connector is shared by at most two rail units"?	$\star$ we shall see that, formally speaking, the difference is almost
• Or the part right after it:	invisible.
$\star$ " mutually exclusive "?	
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<ul> <li>♦ Thus we must be prepared for the eventuality</li> <li>♦ that the pragmatics of making a distinction between</li> </ul>	
designations, definitions and refutable assertions	• Which of the above alternative ways of designations are we going to formalise?
◊ can not be carried visibly over into formal models of the things	
being designated or defined, or for which assertions are expressed.	• Typically we formalise a <i>designation description</i> as shown in the next example.
orfs cooos.	• It allows for the general case of several alternatively expressible
	designations.
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Example 7.82 Units:	Let $W$ denote a concept of undirected "ways" through a unit (Fig. 7.13).
• We choose to introduce just one type (i.e., sort), U, for rail units,	type
• and we choose to let	U, C, W
<ul> <li>★ (recognition rule-oriented) observer functions</li> <li>★ and suitable axioms</li> </ul>	value
* and suitable axions help separate rail units into a partition of its more specialised rail	$obs\_Cs: U \rightarrow C-set$ $obs\_Ws: U \rightarrow W-set$
units.	is linear, is switch, is simpl cross, is switch cross: $U \rightarrow Bool$
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TWARE ENCINEERING. Domains, Requirements and Software Design Volume 3 Department of Unitativity Mathematics and Unitativity Mathematics and Athematics and	TVARE ENGINEERING. Demains, Requirements and Software Durige United States and Software Durige Software States and Software During Multiple States and Software States
Formaliadian Internal Values April 25, 2006, 00:18 Page 712, Topic: 26, Foil: 27 Robot Ponsor Pad, Dr. 2008 April 26, 2008 A	Formáliation Termáliation Honosci au Monosci
axiom [1] ∀ u:U, ∃ c,c',c",c":C ·	• U denotes the possibly infinite set of all <i>designations</i> satisfying the rail_unit recognition rule.
$\begin{array}{l} \mathbf{card} \{c,c',c'',c'''\} \Rightarrow \\ \text{is\_linear}(u) \Rightarrow obs\_Cs(u) \subseteq \{c,c',c'',c'''\} \Rightarrow \\ \text{is\_linear}(u) \Rightarrow obs\_Cs(u) \subseteq \{c,c'\} \land \mathbf{card} \ obs\_Ws(u) = 1 \lor \\ \text{is\_switch}(u) \Rightarrow obs\_Cs(u) = \{c,c',c''\} \land \mathbf{card} \ obs\_Ws(u) = 2 \lor \\ \end{array}$	• C stands for the possibly infinite set of all <i>designations</i> satisfying the connector <i>recognition rule</i> .
is_simpl_cross(u) $\Rightarrow$ obs_Cs(u)={c,c',c'',c''} $\land$ card obs.Ws(u)=2 $\lor$ is_switch_cross(u) $\Rightarrow$ obs_Cs(u)={c,c',c'',c''} $\land$ card obs_Ws(u)=4,	• W denotes the concept of way (or link).
$\text{is switch cross}(u) \Rightarrow \text{obs_Us}(u) = \{c, c, c, c, \} \land \text{Card} \text{ obs_Ws}(u) = 4,$	• The predicates
$[2] \forall c: C \cdot card\{ u \mid u: U \cdot c \in obs\_Cs(u) \} \le 2,$	* is_linear, is_switch, is_simpl_cross and is_switch_cross
$[3] let lus=\{ u:U:s\_linear(u) \}, sus=\{ u:U:s\_switch(u) \},$	further constrain the rail_unit recognition rule,
$cus=\{ u:U:s\_simpl\_cross(u) \}, scus=\{ u:U:s\_switch\_cross(u) \}$ in lus $\cap$ sus = lus $\cap$ scus = lus $\cap$ scus = {} $\land$	• as indicated by the <b>axiom</b> .
$sus \cap cus = sus \cap scus = cus \cap scus = \{\} end$	Observe how the formalisation fits with the narration.
	Observe now the formalisation into with the narration.
KS 12] Far. v6 488 504 🙄 Store Gjener, Fashing 11, Dr 388 Hilter, Danask Grank, Alforde Au, A., Speerlynel and A., Speerlynel and Str. Store Buck. Af	453 129, Far + 64 489 109 😩 Daw Tgawa, Fashing Li, DS 386 3466, Danash Fandar Malfana Javak, Sporellynol and, Sporellynol Java San Javak (Sporellynol Java)
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Formulation         Table of decide at plantand strong         \$	Observer Franktinn and Matelfaction         Status of underland in an Matelian Status of Underland Status of Under
	Observer Functions and Identification
Linear Unit Switchable Unit Simple Crossover Switchable Crossover	• The observer functions, eg. obs_Cs and obs_Ls, are the closest counterpart to the undefined terms of <i>recognition rules</i> that we
Figure 7.13: Undirected ways through units	have.
	• These <i>observer functions</i> cannot be defined.
	• They are postulated. They "arise" as the result of <i>identification</i> .
16 653 273, Far. + 6F 683 874 © Dire Tajawa, Fashing 11, 557-369 Hillin, Danask Fashir delfenseturk, Synowliped ann, familysen ble, 685, sewninn dar, de/"de	433.127, Far + 64 689 1071 Dense Egnere, Frankey 11, 155, 2016 bish, Densesk Franke dielemethende, hywerdigenstam, damethywers bis UK, wen inste du Af
TXMRE ENZ/MEERING. Donain, Regiments and Software Design Observer Functions and Heatification Observer Functions	With E SUCHEESING. Domains, Requirements and Software Design         Volume 1         Dimension of Graphic Streams and Software Design         DIM           Ourser or Francisco, and Meetification         Teaching and Meetification         <
Uberrorf Functions and Enterthration Technical Control of the State Stat	Observer Functions and Membhandam         Tachical Datasety of Densark         ###           w/dh/vdll/Jsh7/Lbh7         April 5, 2006, 50:18         Pager 717, Topic: 26, Foll: 32         Babled Ferenese Flad, BC-308 Kp-Lingdly Densark
• Given an actual universe of discourse — to which the above	Example 7.83 Rail Net: Lines and Stations:
	• A railway net consists of [one or more] lines and [two or more]
designations are said to apply — * one can now "define" these observer functions	• A ranway net consists of jone of morej mies and jowo of morej stations.
designations are said to apply —	stations.
<ul> <li>designations are said to apply —</li> <li>* one can now "define" these observer functions</li> <li>* by "walking out and into" the universe of discourse and</li> <li>* by providing the <i>identification</i>.</li> </ul>	<ul><li>stations.</li><li>A line is a linear sequence of one or more linear rail units.</li><li>A station is any composition (connection) of rail units. [A line</li></ul>
<ul> <li>designations are said to apply —</li> <li>* one can now "define" these observer functions</li> <li>* by "walking out and into" the universe of discourse and</li> </ul>	<ul> <li>stations.</li> <li>A line is a linear sequence of one or more linear rail units.</li> <li>A station is any composition (connection) of rail units. [A line connects exactly two distinct stations.]</li> <li>The above (excluding the bracketed parts) may be claimed to be a</li> </ul>
<ul> <li>designations are said to apply —</li> <li>* one can now "define" these observer functions</li> <li>* by "walking out and into" the universe of discourse and</li> <li>* by providing the <i>identification</i>.</li> <li>• To get a better grasp of possible relationships between recognition</li> </ul>	<ul> <li>stations.</li> <li>A line is a linear sequence of one or more linear rail units.</li> <li>A station is any composition (connection) of rail units. [A line connects exactly two distinct stations.]</li> </ul>
<ul> <li>designations are said to apply —</li> <li>* one can now "define" these observer functions</li> <li>* by "walking out and into" the universe of discourse and</li> <li>* by providing the identification.</li> <li>To get a better grasp of possible relationships between recognition</li> </ul>	<ul> <li>stations.</li> <li>A line is a linear sequence of one or more linear rail units.</li> <li>A station is any composition (connection) of rail units. [A line connects exactly two distinct stations.]</li> <li>The above (excluding the bracketed parts) may be claimed to be a</li> </ul>

TWARE ENGINEERING: Domain, Requirements and Software Design Volume 3 Department of Compare Sciona and Logensia, DIU 3 Observer Functions and Identification Television of Compare Science and Logensia, Compare Scienc	IVARE ENGINEERING: Domains, Requirements and Software Design         Volume 3         Department of Compare Software Quarks         DIT           Observer Functions and Metrification         Testing of Interactical Methods         Testin
Comment variables         Table University of Densek         ##           mildle/bill/3bb7/bb7         April 5, 2006, 00:18         Page 728, Topic: 26, Foli 13         Bitaler Present Flads, 00:280 FagLingh, Densek         ##	Unserve frankción azu saminaturán         Technic Ubierry of Dennik         ###           w/db/vell/28h7/28h7         April 5. 2006, 50:18         Page 719, Topic: 26, Fel: 34         Biolust Provins Fluid, DO-200 Rel Lingh, Dennik
• One can indeed "walk out, into" the railway system domain and, / with a sweeping hand, express:	type N, L, S, U, C, L
* That "thing" there is a linear rail unit. That one, next to it,	value obs_Ls: $N \rightarrow L$ -set, obs_Ss: $N \rightarrow S$ -set,
is likewise. * That particular sequence of those two linear units I just	$obs\_Us: (N L S) \rightarrow U-set$ axiom
pointed to forms (part of) a line.	$\forall$ n:N, l,l'.L, s,s:S · card obs.Ls(n) $\geq$ 1 $\land$ card obs.Ls(n) $\geq$ 2 $\land$
* This "thing" here is a rail unit of a station.	$ \{l,l\} \subseteq obs\_Ls(n) \land \{s,s\} \subseteq obs\_Ss(n) \Rightarrow \\ l\neq^{l'} \Rightarrow obs\_Us(l) \cap obs\_Us(l') = \{\} \land $
<ul> <li>★ It is a crossover.</li> <li>★ Here is the connector that separates a line from a station.</li> </ul>	$s \neq s' \Rightarrow obs \ Us(s) \cap obs \ Us(s') = \{\} \land$
* No rail unit is both a rail unit of a line and of a station, or	$obs_Us(l) \cap obs_Us(s) = \{\} \land exactly_two_distinct_stations(l,obs_Ss(n))$
of two otherwise distinct lines or stations.	-
122 for 14 681 101 () Cons Upon, Falani, (), DK 201 Hab, Danzak Enaile define de, A. Uponelgend ann, dandhjone bis, (15. une inn de, d./de	- 413 129, Far + 6F 618 101 Strate Bane Bane Finder 11, Dic 2018 Main, Consust English didentition, de formetigent sins, 614, englisher bis (151, uni in in it.), 6/
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Mathematical and Computing Entities	Mathematical Entities
• From a formal point of view, i.e., from the points of view of mathematics and computer and computing science, which are the kinds of designations?	• When viewed mathematically, are the designations scalars, like numbers (integers, reals (or complex), rationals, transcendental), or truth values, etc.?
• Which kinds of mathematical entities are they?	• Or are they composite, like sets, Cartesians, lists, maps or functions (or algebras, etc.)?
• Or, in the jargon of computing: Which types of computer and computing science entities are they?	• And if the latter, then which are their component elements?
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Computing Entities	Awareness
• When viewed computer and computing sciencewise, are the	$\bullet$ We do not intend to give a full answer to the question:
designations values (of, for example, the above-mentioned mathematical kind (where models are like algebras))?	• which kind (type) of formal entities can designations be modelled by?
• Or are they types of these, i.e., types as we know them in computer science: simple lattices, Scott domains or otherwise?	• We only advise that the practicing, professional software engineer be reasonably well-versed in these matters:
• Or are they events — whatever they are?	$\star$ modelling designations formally in terms of mathematical entities
If lists, then what do these lists model: behaviours (of processes, in terms of traces of actions and/or events, etc.), or other?	<ul> <li>perhaps couched in the computing jargon of, for example,</li> <li>types and values.</li> </ul>
In any case, when we model computing entities (values, types,	<ul> <li>♦ types and values,</li> <li>♦ events and (process) behaviours,</li> </ul>
events, (process) behaviours, semantic algebras), then we model them in terms of the above-mentioned mathematical entities.	$\diamond$ semantic algebras or other.
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ell1/2x37/2x37 April 5, 2006, 09:18 Page 724, Topic: 26, Fol: 30 Ridard Presence Fluid, 55:300 Kgi Lingle, Desauk	n/db/v8l/3bh7/3bh7 April 5, 2006, 00.18 Page 725, Topic: 26, Foil: 40 Robust Present Fund. IC:300 Rpi.jpdg. Dennak
Some Guidelines         /           In the following we shall try to stay clear of the deeper problems of         /	• Some designations are specific, "one of a kind" things ("that rail / unit there"), or they are specific events, or specific behaviours (etc.).
conceptual modelling as currently studied in computer and	• Or designations are types or models (i.e., algebras) over these.
computing science         But we must — since it cannot be avoided (if we are to cover any	<ul> <li>Some designations are those of components of contexts and states.</li> </ul>
ground at all) — postulate some possibilities of concept modelling (since that is what it, in essence, is all about).	• Contexts are entities whose properties — whose attributes, whose values — remain static over time.
• We do so in order to identify some designation (etc.) principles and	<ul> <li>States are such whose values change with time — they are dynamic.</li> </ul>
techniques.	state and state and state and state and state and state and
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April 15.407 April 5.308.69.13 Page 726. Tape: 24. Full: 4 We have housen that the 30 Mar party de toward     Examples of contexts are: road and rail nets (when viewed topologically and over time periods that are not too large),	
similarly for airline <i>timetables</i> .	• These values we consider inert:
• Examples of states are: road, rail and air traffic, hence trucks,	
trains and aircraft, and the hubs (where they meet and passengers	• They do not change by themselves.
embark and disembark, or where freight receipt, transfer and	• Some external action has to change them.
<ul> <li>A bill of lading is somewhere "in between": The route along which a freight item should be conveyed is, we assume, static, but</li> </ul>	• Designations thus could, alternatively, be the, or a, specific action (active phenomenon, <i>function</i> , operation, task, procedure) of inscribing a freight item for conveyance with a logistics firm, loading it onto the truck, unloading it, etc.
the <i>bill of lading</i> is (probably) marked ("updated") to show the (believed) current (or last recorded) position of the <i>freight item</i> for	• In this case we refer to the designations as function values.
which it is the <i>bill of lading</i> .	<ul> <li>Or designations could be the events of <i>truck departure</i> from, resp. arrival at a hub.</li> </ul>
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ARE ENGINEERING: Domains, Requirements and Software Dasign Volume 3 Department for the Software of Konson Software Softw	IVAREE ENGINEERING. Domains, Requirements and Software Dasign         Volume 3         Department of compare for compare
April (3b37)(ht7 April 5, 3006, 00.18 Page 728, Fage 24, Fage	Principles 7.31 Conceptual Frameworks: When setting out on a first description, identify which conceptual modelling framework you intend to work within.
<ul> <li>In this case we refer to the designations as behaviours (a certain kind of function values).</li> </ul>	<b>Techniques 24</b> Framework Model: Among the conceptual modelling frameworks that can be believably offered are:
	• B, VDM, Z
	• B, VDF, Z • RAISE
• The above explication presents just one kind of conceptual	
modelling approach.	• CafeOBJ, CASL
• It is "slanted" towards CSP and RAISE.	We list three groups. The first are solely model-oriented, the last is solely property-oriented (in the algebraic semantics style). <b>RAISE</b> basically offers both styles.
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Targe transp       April 1.200, 00.11       Pap 706, Tapic 36 fold       The advance data participation of the present section to suggest neither principles nor techniques for exactly how to formally model	$\frac{1}{2} \frac{1}{2} \frac{1}$
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The prime is a price for any intervention of the present section to suggest neither principles nor techniques for exactly how to formally model designations.       Image: State Stat	$\frac{1}{2^{(1)}(2^{(1)}$
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• First, designations represent one form of definition.	• The example above contained only designatable quantities, or so we claimed.
• In any description all terms that are special to the <i>universe</i> of	
discourse being described must be defined	• But that may not always be possible, or convenient.
$\star$ either through designations	• Sometimes it is easier to define a term by giving it a definition,
$\star$ or by explicit definitions.	but (notably) using already defined (including designated) terms.
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+6 65 123, Fac +6 683 801 © Dien Egner, Federa II, DC 308 Hilto, Denak E-naite define da. d., kjann-Byail con, denByann In; UK, som inn da. d./ 'di	425 125, far + 6 688 101 © Done Egner, Fraherj II, DK 286 Hilts, Donest Ernik definentisch, Sponelgene las, dan Bigmer biz UR, was inn das A/de
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Example 7.85 Rail Lines:	value
• A railway line is a linear, acyclic, sequence of linear rail units,	obs_Cs: $U \rightarrow C$ -set
that is, a sequence where adjacent elements of the sequence are	wf_L1: U-set $\rightarrow$ Bool
rail units that share exactly one connector.	$wf_{L1}(us) \equiv \exists ul: U^* \cdot len ul = card us \land elems ul = us \land wf_{L2}(ul)$
type	wf_L2: $U^* \rightarrow \mathbf{Bool}$ wf_L2(ul) $\equiv$
U, C	$ \forall \mathbf{u}: \mathbf{U} \cdot \mathbf{u} \in \mathbf{elems} \ \mathbf{u} \Rightarrow \mathbf{is\_linear}(\mathbf{u}) \land $
L1' = U-set	$\forall i: \mathbf{Nat} \cdot \{i, i+1\} \subseteq \mathbf{inds} \text{ ul } \Rightarrow$
$L1 = \{   us:L1' \cdot wf_L1(us)   \}$ $L2 = U^*$	$\mathbf{card}(\mathrm{obs\_Cs}(\mathrm{ul}[\mathrm{i}]) \cap \mathrm{obs\_Cs}(\mathrm{ul}[\mathrm{i+1}])) = 1 \land$
L2 = 0 $L2 = \{   us: L2' \cdot wf_L2(us)   \}$	$len ul > 1 \Rightarrow obs\_Cs(hd ul) \cap obs\_Cs(ul[len ul]) = \{\}$
- 16 65 222 far: +6 681 851 😨 Date Rijeers, Frankeij II, DK-386 Nata, Danask 🕹 Frankei die Bernerdgenal aus, derethijeers dat, USL: waai inn die de/ de	405 120, far +6 468 804 © Don Egner, Frahenj II, Dr 206 Han, Dannak E-nain: definendinak Ejnerefiguation, denefiguen kij UR, sens inn des de/de
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• Here the terms linear rail unit and connector are already designated /	<b>Techniques 25</b> Definitions must be expressed in terms of designated and/or defined terms, and ultimately definitions must be
terms;	based on designations.
• and the concept of a line is defined in terms of those designations.	<b>Principles 7.34</b> Although it may seem utterly obvious we urge the
• Recall an earlier axiom which stated that for any connector there are at most two units sharing that connector.	developer to develop alternative definitions.
0	
• That axiom is assumed above.	• Here we developed alternatives L1 and L2.
•	• Although one may claim that lines could be designations, since, in
	a sense, they are tangible, we have here defined the concept of line.
	• We follow the advice of Michael Jackson when we raise it to a
	principle:
r 66 65 220, far 1-6 681 8214 (), Dan Bjenn, Federaj 11, De 360 Heter, Danast E-ruik, delfens du du, kjennefgunt son, denthjone kaj (161, van inn du du) du	-165 120, Far. + 6-601 1201 👔 Dan Egines, Frankrij 11, Dr. 366 1464 a. Damask Ersake, dafornador, de, izvendiperation, disettigione ku, UK, wan instatu di /
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Principle 7.35 The Narrow Bridge: Seek as few designations as	Example 7.86 Path:
possible: Enough to define all the other possibly designatable as well as all the desirable abstract, nontangible concepts.	• A rail unit defines a concept of path.
	• A path (through a rail unit) represents the ability for a train to
Definition of Abstract, Intangible Concepts	move along that path, through the rail unit. <sup>9</sup>
• We shall next define some abstract, intangible concepts.	• (Notice that we neither, at present, designate nor define what we
General Contraction of the second second	mean by train or move.)
	• We define (i.e., we model) a <i>path</i> as a pair of <i>connectors</i> .
	• (Based on the definition of <b>path</b> we then proceed to define further integrible i.e. not physically manifest concepts)
	intangible, i.e., not physically manifest, concepts.)
- 46 455 126 Far - 16 458 129 💿 Dana Barrer Franka (1, 100-3168 Math, Donast E-anak deBarredon de Uparelynal ann, danaBarrer 16 455. voor inn de de "de	102 220, Fax + 6 483 881 () Directions Facher (11, DS 389 14b, Darrack Facher (11, DS 389 14b, Darrack

3.2 Definition of Abstract, Intangible Concepts Table Concepts	TWARE ENGINEERING: Domains, Requirements and Software Design         Volume 3         Department Computer Scince and Engineeing         DTU           Definition of Abstract, Intangible Concepts         Testical University Owned         Testical University Owned         Testical University Owned
home/db/vall/2xb7/3xb7 April 5, 2006, 00-18 Page 742, Topic: 26, Foil: 57 Robot Power Park, DV-300 KysLydy, Denark	n (db)/vell/3ds7/3ds7 April 5, 2006, 09:18 Page 743, Topic: 26, Feil: 58 Robust Present Fuel, DC-2009 Pagi Lipely, Dennak
• With any rail unit we can associate a state: a possibly empty	type
set of paths.	$U, C, P = C \times C$
• And, finally, we can associate with any rail unit its state space:	$\Sigma = P\text{-set}, \Omega = \Sigma\text{-set}$ axiom
the set of all the states that a rail unit may "be in" over its lifetime as a rail unit.	∀ (c,c'):P · c≠c'
metime as a ran unit.	value
	obs_ $\Sigma$ : U $\rightarrow \Sigma$ , obs_ $\Omega$ : U $\rightarrow \Omega$
	We shall soon look at possible relations between designations and
	definitions of the railway system.
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omi/db/vdll/2dx7/3dx7 April 5, 2006, 00:18 Page 744, Topic: 26, Fol: 59 Richard Province Pade, DX-300 Kgs Lagds, Demax	w/db/vell/3dx7/3dx7 April 5, 2006; 00:18 Page 745; Topic: 26; Foil: 60 Riclard Previous Plad; DK-300 HpcLinetyL
How Much, How Little to Define?	• It is only, we believe, in "roaming around" and experimenting with /
• The question is now: how much to <i>define</i> ?	definitions, and, later, with refutable assertions, that we may discover the most interesting, most relevant, most fitting
•	domain concepts.
• For the universes of discourse of requirements and software design there is a utility concept: We know what we aim at, so we	• It is in this exploration, and based on <i>definitions</i> that we can
define at least that; but why more than that?	expect to build theories of specific domains.
• For the universes of discourse of application domains we do not,	Principle 7.36 Exploring Theory Bases: In constructing domain
as a matter of principle, know what we are aiming at, so here we go	models, i.e., descriptions of domains, designate according to the
for more: as long as some interesting ideas are being <i>defined</i> , then	"narrow bridge" principle, and then define as many abstract
why not?	concepts as long as their definition (and those of attendant refutable
	assertions help) "reveals" further concepts. $\hfill\blacksquare$
+66 455 223, Fax: +66 483 80% © Diene Rijmen Findung 11, DK-340 Mitte, Dennak E-maile differenda-da, kjonerdipual.com, derethijmen kit, URL: www.inen.da.dk/db	4125 2026, Fac + 64 4938 8014 © Disse Egnese, Findung 31, Dis 2006 Hiktor, Diseasch
OFTWARE ENCINEERING. Domains, Requirements and Software Design Volume 3 33 How Much, How Little to Define? The Software Software Design Volume 4 The Software Softwar	TWARE ENCINCERSING. Domains, Requirements and Software Design         Volume 3         Dupressed functional Methods in Software Design         DUT           Hew Much, How Little to Define?         Three/Little/Software Methods in Software Design         Three/Little/Software Design <t< th=""></t<>
Jar Yosh mana, Yosh Salan a Dalamin Tasaka Disana ya Kata Kata Kata Kata Kata Kata Kata	n/db/vall/32h73ch7 April 5, 2006; 00:18 Page 747, Topic: 26, Fail: 62 Richard Province Pade, DF-Sail Vall-1946, DF-Sail Vall-19
A last example may illustrate the previous point.	• (iv) Given any two rail units, an 'origin' and a possible
A CONTRACTOR AND A CONT	• (iv) Given any two ran units, an origin and a possible
Example 7.87 Routes:	'destination', of a railway network define a more general notion
Example 7.87 Routes:	'destination', of a <i>railway network</i> define a more general notion of <i>reachability</i> , one that is satisfied if there are <i>open routes</i> from
<ul> <li>Example 7.87 Routes:</li> <li>(i) A route is a sequence of connected rail units.</li> </ul>	'destination', of a railway network define a more general notion of reachability, one that is satisfied if there are open routes from the 'origin' to the 'destination'.
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<ul> <li>Example 7.87 Routes:</li> <li>(i) A route is a sequence of connected rail units.</li> <li>(ii) A route is an open route if the states of all rail units of the route are such that there are paths in those states that also connect (in one direction or another).</li> </ul>	<ul> <li>'destination', of a railway network define a more general notion of reachability, one that is satisfied if there are open routes from the 'origin' to the 'destination'.</li> <li>And so forth.</li> <li>The present example illustrates the definition of a number of (viz.: four) concepts without a priori making sure that these concepts will</li> </ul>
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Introduct Assertion:       Example 7.88 rail Met Assertion:         Characterisation 7.138 by a refutable assertions we nean a chim that above how to be coust.       In that a line connects cardely two difficut stations is one and a stations.         Disignation and Definition Assertion:       In the above connects cardely two stations in a railway of the and stations.         They captes do not designate consider things.       In they often of the above counce of a station of the context on a station.         We shall refer to such context station is context that assertions.       In the context the advect context on a station of the context on a static on a state on the context on a static on the context on a state on the cont	TWARE ENGINEERING: Domains, Requirements and Software Design URL and Article Software Course of	TWARE ENCINEE FBIG: Domains, Requirements and Software Dasign         Volume 3         Department of Comparis Software         Difference           Designation and Definition Assertions         Testicate of Monitorial Midding         Tes
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<ul> <li>caland using the strength of the stre</li></ul>		• That a line connects exactly two distinct stations is one such
<ul> <li>In Example 7.83, where we described indexy nets of lies, and stations, we put in some hardbacket stations puts.</li> <li>I'bue partial dot ensight environments as refutable assertions.</li> <li>We asserted stations of designs and index is a station provide the station of designs in the construction.</li> <li>We have half there to such constructions and the station of designs in the construction.</li> <li>The partial dot dot terms, or both kinds of terms.</li> <li>Previous and there of definition and a station may then step to the dot dots and the construction.</li> <li>The partial dot dots and the station of designs in the construction.</li> <li>The partial dot dots and the station of designs in the construction.</li> <li>The partial dots are may the step to the dots and the station process and the construction.</li> <li>The partial dots are may the step to the dots and the station process in the construction.</li> <li>The partial dots are the average of the station of domain the construction of the station process and the station proces</li></ul>	· · · · · · · · · · · · · · · · · · ·	<ul><li>It implies that there must be at least two stations in a railway</li></ul>
		net — another refutable assertion — and at least one line — yet another refutable assertion.
<ul> <li>Lose place of the source number of the signations (may be observed in table), describe or other relations of designations (may be observed in table), describe or other relations of designations (may be observed in table), describe or other relations of designations (may be observed in table), describe or other relations of designations (may be observed in table), describe or other relations of designations (may be observed in the source of definitions).</li> <li>The source of definitions of the max beauxes of the designation of the source of the described or other relations of the source of the described or other relations of the source of the described or other or other o</li></ul>	· · · ·	$\bullet$ We asserted elsewhere that every connector is shared by at most
<ul> <li>(and, there, of definitions).</li> <li>(and, there, of definitions).</li> <li>(and, there, of definitions are definited as a refit able assertions.</li> <li>(and, there, or definitions are definitions and the regressed in terms of the definitions are definitions and sums the sequences of the terms.</li> <li>(b) definitions may scene great and may thus need to be characterized ("tiel down") through some form of constraining assertions.</li> <li>(b) definitions may scene great and may thus need to be characterized ("tiel down") through some form of constraining assertions.</li> <li>(c) definitions are definitions and may thus need to be characterized ("tiel down") through some form of constraining assertions.</li> <li>(c) definitions are definitions and may thus need to be characterized ("tiel down") through some form of constraining assertions.</li> <li>(c) definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions.</li> <li>(c) definitions are definitions are definitions are definitions are definitions.</li> <li>(c) definitions are defi</li></ul>		two connectors and define one link; that switchable rail units
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	• We shall refer to such constraints as <i>refutable assertions</i> .	• These sentence parts can an be considered relutable assertions.
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Techniques 26 Refutable assertions must be expressed in terms of other disgusted or defined terms, or both kinds of terms.       •         • Designations, in a sense, are facts.       •         • Definitions are definitions may seem general and may thus need to be characterized ('tied down') through some form of constraining assertions.       •         • Definitions may seem general and may thus need to be characterized ('tied down') through some form of constraining assertions.       •         • This is a refutable asserticat:       •       •         • This is a refutable asserticat:       •       •         • One might think of cases where there could be connectors of a path in some unit's state that were not connectors of that unit, or could more refutable.       •         • We basically will not know till someone one day shows us an interpretation!       •       •         • We there were inderection one connectors of that unit, or could more refutable?       •       •         • We there there were indeed connector in the main state that were not connectors of that unit.       •       •         • We there there will be refuted remains to be seen, but they are potentially refutable.       •       •         • We there they will be refuted remains to be seen, but they are potentially refutable assertion.       •       •         • We there they will be refuted remains to be seen, but they are potentially refutable.       •       •         • We there they will be r	nigration and Definition Assartions to the second s	Designation and Definition Assertions Tachical University of Desark
<ul> <li>We continue the rail unit path, state and state space example gi andre.</li> <li>Observations, in a sense, ara facts.</li> <li>And facts counts be refuted.</li> <li>Definitions and definitions, and as such must be accepted.</li> <li>But definitions may seem general and may thus need to be demanstraised ("tied down") through some form of constraining assertions.</li> <li>The paths of a rail unit, i.e., the paths of any of its states, must mention only connectors of that unit.</li> <li>The back of the paths of a rail unit, i.e., the paths of any of its states, must mention only connectors of that unit.</li> <li>The back of the paths of a rail unit, i.e., the paths of any of its states, must mention only connectors of that unit.</li> <li>The back of the paths of a rail unit, i.e., the paths of any of its states, must mention only connectors of a path are always distinct.</li> <li>The back assertion: <ul> <li>One might think of cases where there could be connectors of a path in some unit's state that we not connectors of that unit, or could one?</li> <li>We basically will not know till someone one day shows us an understanding of a railway net that "favours" such an interpretation!</li> <li>We basically will not know till someone one day shows us an understanding of a railway net that "favours" such an interpretation!</li> <li>We basically will not know till someone one day shows us an understanding of a railway net that "favours" such an interpretation!</li> <li>We basically will not know till someone one day shows us an understanding of a railway net that "favours" such an interpretation!</li> <li>We basically will not know till someone one day shows us an understanding of a railway net that "favours" such an interpretation!</li> <li>We basically will not know till someone to a day since that we as shore by three (or money) nall units, then we have inderfute the assertion.</li> <li>We basically will not know till someone to a station from, or mow will an enormal three were inderefute the assertion.</li></ul></li></ul>		Example 7 89 Unit States
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<ul> <li>We basically will not know till someone one day shows us an understanding of a railway net that "favours" such an interpretation!</li> <li>Whether they will be refuted remains to be seen, but they are potentially refutable.</li> <li>Take the example of any connector being "constrained" to be shared by at most two rail units.</li> <li>If one could show, in the future, that there were indeed connector that were shared by three (or more) rail units, then we have inderefuted the assertion.</li> <li>But is it likely?</li> <li>Mether they will be refuted remains to be seen, but they are potentially refutable.</li> <li>Take the example of any connector being "constrained" to be shared by at most two rail units.</li> <li>If one could show, in the future, that there were indeed connector that were shared by three (or more) rail units, then we have inderefuted the assertion.</li> <li>But is it likely?</li> <li>Mether they will be refuted remains to be seen, but they are potentially refutable.</li> <li>The mether they are most two rail units.</li> <li>If one could show, in the future, that there were indeed connector that were shared by three (or more) rail units, then we have inderefuted the assertion.</li> <li>But is it likely?</li> <li>Mether they assertion should amount to allowing railway nets with completely isolated stations.</li> <li>Is that likely?</li> <li>If this assertion is refuted then there will be at least one station from, or into which one cannot "trave!"!</li> <li>Is that likely?</li> <li>Mangling" Assertions</li> <li>It is much too easy to write down texts that "weave a web" of the second station of the net.</li> </ul>	in some unit's state that were not connectors of that unit, or could	
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Applicity       Applic 50:000.00 18       Page 70: Tape: 26:001.00       Page 70: Tape: 26:001.00         Example 7.90 Stations and Lines: A station is connected to at least one line.       Image: Connected to at least one potentially open route from, and at least one successful to the station of the net.         • Refuting this assertion would amount to allowing railway nets with completely isolated stations.       • If this assertion is refuted then there will be at least one station from, or into which one cannot "travel"!         • Is that likely?       • Is that likely?		Instance of Informatics and Mathematical Mobiling
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