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1a) Formal methods refer to various mathematical technique used for the formal specification and development of software. They consist of a formal specification language and employ a collection of tools to support the syntax checking of the specification, as well as the proof of properties of the specification.

Formal Methods

Abstraction Formal specification Modell checking Formal proofs

Formal specification Analytical Verification

ii) -Maintaining reliability in software intensive systems is very difficult

-Complexity of systems with embedded software has increased.

-Systems are becoming increasingly dependent on software components

b) A functional requirement defines a system or its component whereas a non-functional requirement defines the performance attribute of a software system

2a) -Planning and requirement analysis

This is programmed by the senior members of the team with inputs from the customer, the sales department, market surveys and domain experts in the industry. This information is then used to plan the basic project approach and to conduct product feasibility study in the economical, operational and technical areas.

-Defining requirements

Once the requirement analysis is done the next step is to clearly define and document the product requirements and get them approved from the customer or the market analysis

-Designing the product architecture

A design approach clearly defines all the architecture modules of the product along with its communication and data flow representation with the external and third party modules

-Building or developing the product

In this stage the actual development start and the product is built

-Testing the product

This step refers to the testing stage of the product where products defects are reported, tracked, fixed and retested until the product reaches the quality standard defined in the software requirement specification

-Deployment in the market and maintenance

Once products are tested and ready to deployed it is released formally in the appropriate market. Sometimes products deployment happens in the stages as per the business strategy of that organization. After the product is released to the market its maintenance is done for the existing customer base

b) Formal methods can assume various levels of rigor. At the extreme is the least rigorous level of rigour while most rigorous level of rigour lies at the other extreme

3a) Propositional logic converts a complete sentence into a symbol and makes it logical whereas in first order predicate logic relation of a particular sentence will be made that involves relations, constants, functions

ii) Disjunction (v)

This is the joining of two or more propositions by the word “or” or symbol “v” resulting in their logical sum. The members of the disjunction or the summands of the logical sum. The disjunction “A v B v C” has truth for its truth value when A is true or B is true or C is true but false when A, B, and C are false

Negation (-)

The negation is the simplest operation of proposition. This is the operation of proposition A which is when A is false. It is basically the opposite of the truth value.

Conjunction (Λ)

This is the joining of two or more propositions by the word “and” results in their so called conjunction or logical product. The propositions joined in this manner are called members of the conjunction or the features of the logical product. The conjunction “A Λ B”

b) ∀x∃y: Man(x) Λ smith(y) → Mortal(y,x)

or

∀x∃x (P(x) → Q(x))

4a) M(x) = “x is a monkey”

C(x) = “x is a curious monkey”

∃x: M(x)→C(x)

b) -History-based specification

Its behaviour is based on system histories its assertions are interpreted overtime

-State based specification

Its behaviour is based on system states. A series of sequential steps e.g. a financial transaction language such as VDM rely on this paradigm

-Functional specification

It specifies a system as a structure of mathematical functions. OBJ, ASL, PSL rely on this paradigm

5ai) A well-formed formula in propositional logic is a syntactically correct formula created according to the syntactic rules of the underlying calculus. A well-formed formula is built up from variables, constants, terms and logical connectives

ii) A Quantifier is an expression (e.g. all, some) that indicates the scope of a term to which it is attached

iii) A Predicate is a part of a sentence containing a verb or stating something about the subject (attribute)

iv) A Term denotes a mathematical object, in particular terms appears as components of a formula. A first order term is recursively constructed from constant symbols, variables and function symbols.

5bi) a > b = T, if a < b = F, otherwise

ii) For all mother. Mother like mother

6a) -Waterfall development

The waterfall model is a sequential development approach in which development is seen as flowing steadily downwards through several phases e.g. Business case rework and approval (4 weeks – by business manager & project manager with review and approval by executive team – benefits are exaggerated and estimates reduced – the object is fixed)

-Spiral development

This is a methodology which combines some key aspect of the waterfall model and rapid prototyping methodologies, in an effort to combine advantages of top-down and bottom-up concepts. It provided emphasis in a key area many felt had been neglected by other methodologies; deliberate iterative risk analysis, particularly suited to large-scale complex systems e.g. Evolution of Microsoft Windows operating systems

-Increment

This is an ROI- informed approach to software development in which software is developed and delivered in carefully prioritized chunks of customer valued functionality. These chunks are known as minimum marketable features example of a contemporary successful product is spotify

6b) A product requirement document is a document containing all the requirements to a certain product

7a) -Title and author information

-Purpose and scope

-Stakeholder identification

-Market assessment and target

-Product overview

-Requirements

-Assumptions

-Constraints

-Dependencies

-High level workflow plans

-Evaluation plan & performance metrics

b) -Making an outline

-Defining the purpose of the product

-Describe what you’re building

-Detail the requirements

-Get it approved