The Role of Formal Languages in Engineering Education

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Properties of Engineering Systems

- modular, hierarchically structured
- viewpoints
  - structural
  - functional
- operate in real time
- correctness
- specification

Properties of Formal Languages

- simple and unambiguous specification
- computer storable, readable and interpretable
- basis for correctness verification
- basis for implementation

Importance of Formal Languages in Engineering Education

formal language

system model

way of reasoning

Teaching communication protocols with SDL

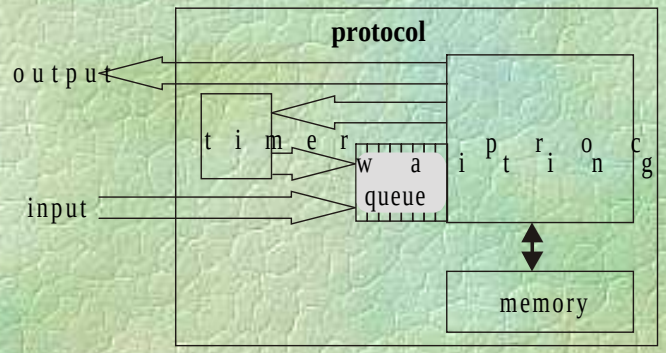
	communication system	**SDL description**
structure	protocol entities & channels, protocol stack	blocks & channels, block nesting
functionality	protocol entities' behaviour, message transfer	processes, signals

Specification of functionality: message transfer

	communication system	**SDL description**

message transfer	• mesages
	• parameters
	• message
	  • transmission
	  • reception
		• signals
		• values
		• events
		  • signal output
		  • signal input

Specification of functionality: entity behaviour

	communication system	**SDL description**
entity behaviour		process • states, variables • transition rules • timers • input/output • input queue

The goal of teaching SDL:

- present one of formal languages
- stimulate students to reason more rigorously and/or formally
- stimulate students to implicitly become aware of the basic model of a protocol entity
- impose students to consider functionality in terms of the EFSM model
- teach students the essentials of real-time systems operation

Communication protocols course @ University of Ljubljana

	whole course	SDL part
lectures	30 hours	4 hours
lab	30 hours	4 hours
home	2 projects	1 project
exam	4 questions	1 question

Communication protocols course: lectures

- elements and structure of communication systems
- model of a protocol entity
- need for formal languages
- basic syntax and semantics of SDL
- similarities between system and SDL models
- basic communication algorithms with examples in SDL

Communication protocols course: lab work

- GEODE: editor, syntax checker, simulator
- presentation of editor and simulator
- a simple communication system
- step-by-step simulation
- logical errors
- system overload

Communication protocols course: home work

- specification of the Alternating Bit Protocol
- task:
  - students are given textual specification
  - students must write SDL specification
- students:
  - come to know the protocol
  - get used to formal thinking
  - appreciate the advantages of formal languages
  - must think in terms of the model imposed by SDL

Communication protocols course: home work

- homework is checked by the teacher
- possible continuation in the lab
  - entering specification into computer
  - simulating specification
  - correcting errors
- paperwork is most important!
- semantics are more important than syntax
- teacher can tolerate minor syntax errors

Exam

- homework is necessary condition
- always one “SDL” question

Conclusions

- importance of teaching a formal language
- most important: reasoning that is compatible with an appropriate system model
- this paradigm can be applied to any branch of engineering education

Thank you for your attention