ELEC-E8408 Embedded Systems Development

EXAM 8.4.2016

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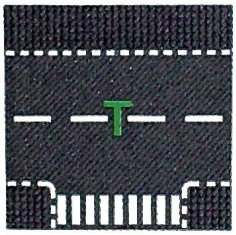
1. Are the following claims true (**T**) or false (**F**)? Every correct answer gives you +1 p, every incorrect –1 p, and an empty answer is worth 0 p. The minimum amount of total points is 0 p and maximum 6 p.

   a) The KLOC metric takes into account the complexity of the software involved.
   b) A real-time system with uncertainty can be viewed as having dimensions of behavior, space, and time.
   c) Temporal fault-tolerance includes methods involving redundant hardware and/or software solutions.
   d) In general, testing can only detect the presence of errors, not the absence of them.
   e) Regression testing is a type of system-level testing that seeks to flush out those failures appearing early in the life of an embedded system.
   f) Soft multi-core CPUs could be implemented in large FPGAs.

2. Draw a Moore-type finite state machine that describes a *safe* control logic for traffic lights in the **T**-shaped intersection shown below. (3 p)

   - The intersecting streets are meant for two-way vehicle traffic.
   - On the street that corresponds to the cross line of the letter **T**, there are separate traffic lights for straight-going and turning traffic flows.
   - The traffic lights for vehicles are controlled by timers.
   - On the street that corresponds to the vertical line of the letter **T**, there are additional traffic lights for pedestrians, which are activated by pushbuttons and make it possible to cross the street *safely* during a fixed time slot.



   Define unambiguously the purpose of all states and the events that control state transitions. (3 p)

3. Draw a block diagram of the Waterfall Model that is used for modeling the software life cycle. (3 p) Explain the principal ideas behind this model (1.5 p), and discuss its strengths and weaknesses (1.5 p).

4. Reliability is one of the important qualities of embedded software. In certain applications, the number of detected failures as a function of time can be modeled by a *bathtub-shaped* failure function, which depicts the development of failure rate over the entire software life cycle.

   a) Explain the feasibility of such a failure model in different phases of the life cycle. (3 p)
   b) How, in practice, could the edges of the "bathtub" be lowered for some embedded software product? (3 p)

5. An elevator monitoring system shows the clock time in hours and minutes (in service mode also seconds) on multiple displays. The time is based on a programmable 16-bit timer, which uses a 50-kHz clock signal for generating seconds. These seconds are then accumulated to minutes and further to hours by software. However, the users of the monitoring system complained that the clock time advanced or lagged up to 7 minutes in a month.

   A field engineer conducted a survey of the problem and noticed that the magnitude of advance or lag remains practically constant on each site, but is dependent on the individual monitoring computer. Based on these observations, a solution for the annoying problem was developed and taken in use in the final testing stage before the complete monitoring system leaves the elevator factory.

   What kind of approach would you take with this problem if no hardware modifications were allowed? Hint: the monitoring computer has free parameter space in a Flash memory that can be accessed by a service tool. (6 p)