



**Universidade Federal de Santa Catarina
Centro Tecnológico – CTC
Departamento de Engenharia Elétrica**



<http://gse.ufsc.br>

“EEL7020 – Sistemas Digitais”

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“EEL 7020 – Sistemas Digitais”

Apresentação da disciplina

Roteiro da aula – Parte I

1. Apresentação do site da disciplina

- Ementa, objetivos, metodologia, bibliografia
- Ferramentas, materias, recursos pedagógicos
- Cronograma previsto para as aulas

2. Organograma

3. Monitoria e equipe de apoio

4. Avaliação e discussão

Site da disciplina

<http://gse.ufsc.br/bezerra>

- Menu (barra superior) – *Teaching*
- Seguir link *EEL7020 Sistemas Digitais*

Organograma – UFSC / CTC / EEL / EEL-7020



Monitoria e equipe de apoio

- **Monitor da disciplina**
- **Estágio docência**

Avaliação da disciplina é criteriosa - O erro de um engenheiro pode resultar em perdas humanas e materiais.

Exemplos de erros de engenheiros que resultaram em catástrofes:

<http://www.youtube.com/watch?v=EMVBLg2MrLs>

June 4, 1996 -- Ariane 5 Flight 501. Working code for the Ariane 4 rocket is reused in the Ariane 5, but the Ariane 5's faster engines trigger a bug in an arithmetic routine inside the rocket's flight computer. The error is in the code that converts a 64-bit floating-point number to a 16-bit signed integer. The faster engines cause the 64-bit numbers to be larger in the Ariane 5 than in the Ariane 4, triggering an overflow condition that results in the flight computer crashing.

Avaliação criteriosa. O erro de um engenheiro pode resultar em perdas humanas e materiais.

July 28, 1962 -- Mariner I space probe. A bug in the flight software for the Mariner 1 causes the rocket to divert from its intended path on launch. Mission control destroys the rocket over the Atlantic Ocean. The investigation into the accident discovers that a formula written on paper in pencil was improperly transcribed into computer code, causing the computer to miscalculate the rocket's trajectory.

1985-1987 -- Therac-25 medical accelerator. A radiation therapy device malfunctions and delivers lethal radiation doses at several medical facilities. Based upon a previous design, the Therac-25 was an "improved" therapy system that could deliver two different kinds of radiation: either a low-power electron beam (beta particles) or X-rays. The Therac-25's X-rays were generated by smashing high-power electrons into a metal target positioned between the electron gun and the patient. A second "improvement" was the replacement of the older Therac-20's electromechanical safety interlocks with software control, a decision made because software was perceived to be more reliable. What engineers didn't know was that both the 20 and the 25 were built upon an operating system that had been kludged together by a programmer with no formal training. Because of a subtle bug called a "race condition," a quick-fingered typist could accidentally configure the Therac-25 so the electron beam would fire in high-power mode but with the metal X-ray target out of position. At least five patients die; others are seriously injured.

1993 -- Intel Pentium floating point divide. A silicon error causes Intel's highly promoted Pentium chip to make mistakes when dividing floating-point numbers that occur within a specific range. For example, dividing $4195835.0/3145727.0$ yields 1.33374 instead of 1.33382, an error of 0.006 percent. Although the bug affects few users, it becomes a public relations nightmare. With an estimated 3 million to 5 million defective chips in circulation, at first Intel only offers to replace Pentium chips for consumers who can prove that they need high accuracy; eventually the company relents and agrees to replace the chips for anyone who complains. The bug ultimately costs Intel \$475 million.

November 2000 -- National Cancer Institute, Panama City. In a series of accidents, therapy planning software created by Multidata Systems International, a U.S. firm, miscalculates the proper dosage of radiation for patients undergoing radiation therapy. Multidata's software allows a radiation therapist to draw on a computer screen the placement of metal shields called "blocks" designed to protect healthy tissue from the radiation. But the software will only allow technicians to use four shielding blocks, and the Panamanian doctors wish to use five. The doctors discover that they can trick the software by drawing all five blocks as a single large block with a hole in the middle. What the doctors don't realize is that the Multidata software gives different answers in this configuration depending on how the hole is drawn: draw it in one direction and the correct dose is calculated, draw in another direction and the software recommends twice the necessary exposure. At least eight patients die, while another 20 receive overdoses likely to cause significant health problems. The physicians, who were legally required to double-check the computer's calculations by hand, are indicted for murder.