**ASSIGNMENT 1**

**CCS21403 – Real Time System**

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| **Student** | **Photo** |
| **Name: Indra bin Isman**  **ID: 2022019070041** | **A person wearing glasses  Description automatically generated with medium confidence** |
| **Name: Muhammad Amsyar bin Abdul Malek**  **ID: 2022020070028** | **A person wearing glasses  Description automatically generated with medium confidence** |
| **Name: Siti Norsyahera Binti Abdul Hamid**  **ID: 2022019020027** | **A picture containing person, ceiling, indoor, child  Description automatically generated** |

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| **MARKS:** | **Report** |
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**DUE DATE:**

**7/3/2021**

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# **Question A: Introduction and concept of real time systems**

Real time systems are used in a variety of computer science fields. Protection and space networks, networked multimedia systems, integrated automotive electronics, and so on are some examples. The correctness of a real time system's action is determined not only by the logical results of computations, but also by the physical instant at which these results are produced.

A real time system's state varies as a function of physical time; for example, a chemical reaction tends to change its state long though its governing computer system has ceased. It can be decomposed into several subsystems based on this, including the managed object, the real-time computing system, and the human operator. The computer system must respond to stimuli from the controlled object or the operator within time intervals set by its surroundings. A deadline is the point at which a result is made.

The deadline is soft if the outcome is useful long after the deadline has passed; otherwise, it is solid. If missing a firm deadline could result in disaster, the deadline is difficult. Hard real-time services include command and control systems and air traffic control systems. Soft real-time applications include online transaction systems and airline reservation systems.

Real time system is becoming more and more popular in nowadays due to rise of digital technology. Air traffic control networks, networked multimedia systems, command control systems, and other real time systems are some of the examples. The correctness of the machine action in a real time system is determined not only by the logical outcomes of the computations, but also by the physical instant at which these results are produced.

The real time applications are categorized by a variety of perspectives, including factors external to the computer system and factors internal to the computer system. Hard and soft real time systems are given special attention. In hard real time systems, missing a deadline is disastrous, whereas in soft real time systems, it can result in a substantial loss. As a result, the most critical problem in these systems is the predictability of system behavior.

While the real time systems can be categorized in a variety of ways. The first two classifications, hard real time versus soft real-time, and fail-safe versus fail-operational, are based on the application's features, such as external conditions. The second three classifications, guaranteed-timeliness versus best-effort, resource-adequate versus resource-inadequate, and event-triggered versus time-triggered, are determined by the computer system's architecture and execution, such as internal variables.

Mixed systems combine two traditionally separate domains of computing such as real-time and non-real time.  Real time systems respond to external events within a bounded interval of time (timeliness) and are often classified as hard real-time or soft real-time. Hard real time systems require a guarantee that all processing is completed within a given time constraint every time.

A late response may result in catastrophic consequences.  Thus, timeliness is a primary measure of correctness in a real time system.  Common examples of hard real time systems include nuclear power plants, avionics control systems, embedded braking systems for automobiles or trains, and signal processing systems employed by the Department of Defense.

Soft real time systems have a less rigorous notion of temporal correctness and the consequences of a late response are not catastrophic.  Examples of soft real time systems include telephone switches, on-line transaction systems, and electronic games.

Non-real time systems also have a notion of temporal correctness, but the response time is very subjective and seldom specified.  Most non real time systems strive for good average-case performance and tolerate occasional slow response times. Examples of non-real time systems are desktop computers, workstations, information kiosks, and accounting systems.

# **Question B: Actual real time systems**

Soft real time system is an operating system in which a critical real-time task gets priority over other tasks and retains that priority over other tasks until it completes. The response predefined time of soft real time systems are not very stringent, therefore missing the deadline only affects the performance and not the entire system. Size of the data file in soft real time systems is large.

Soft real time systems are less restrictive in nature and the response predefined time of soft real time systems are not very stringent, therefore missing the deadline only affects the performance and not the entire system.  It misses deadlines occasionally. In soft real time system, a degraded operation in a rarely occurring peak load can be tolerated. Soft real time systems will slow down their response time if the load is extremely high.

Most of the soft real time systems have larger databases and require long-term integrity of the system. In case of an error in a soft real time system, the computation is rolled back to previously established checkpoint to initiate a recovery action. Completion of task or activity by soft real time system probabilistic. Users of soft real time systems do not always obtain the validation.

The response rate times of soft real time system is remarkably high, and the peak load can be tolerated too. Safety is not critical, and it is less restrictive. In case of a soft real time system, computation is rolled back to previously established a checkpoint. An example of a soft real time system is a video game console runs software for a game engine. There are many resources that must be shared between its tasks. At the same time tasks need to be completed according to the schedule for the game to play correctly. As long as the tasks are being completed relatively on time the game will be enjoyable, and if not, it may only lag a little.

A hard real time system also referred to as an immediate real time system is a hardware or software that must operate within the confines of a stringent predefined deadline. Usually, the application is considered to have failed if it does not complete its function within the specified timeline. The response predefined time of hard real time systems is in order of milliseconds and therefore, missing the deadline results in complete or massive system failure, and therefore this system should not miss the deadline.

A hard-real time system is very restrictive. The response predefined time of hard real time systems is in order of milliseconds and therefore, missing the deadline results in complete or massive system failure, and therefore this system should not miss the deadline. Peak load performance should be predictable and should not violate the predefined deadlines. A hard real time system must always remain synchronous with the state of the environment.

Most of the hard real time systems have small databases and occasionally require short-term integrity of the system. In case of an error in a hard real time system, the computation is rolled back, or recovery is of limited use. Completion of the task or activity by hard real time systems is predefined or deterministic. The users of hard real time systems obtain validation when required.

Hard real time is a system whose operation is incorrect whose result is not produced according to time constraint. In hard real time system, the size of the data file is small or medium. The example of a hard real time system is the controlling the airbag in every car, the controlling airbag system should detect the crash and inflate rapidly the bag. The whole process takes more or less one-twenty-fifth of a second. Thus, if the system for example reacts with 1 second of delay the consequences could be mortal and it will be no benefit having the bag inflated once the car has already crashed.

# **Question C: Failure of real time system**

Designing a real time system can be a difficult challenge. Most of the problem arises from the assumption that the real time system must deal with real-world entities. These relationships can become extremely complicated. A standard real time system can communicate with thousands of such entities at the same time. The broadband wireless access system, for example, regularly manages communications from tens of thousands of customers. Each request is always linked differently by the system. Often, the exact sequence of events in the request can vary a lot.

In one case of the real time system that failed to do its job for example in data engineering is when the system itself failed to capture the deadline of the process that occurred in one of the ETL (Extract, Transform and Loading) process. Since there is no error detected, the data warehouse system allows the processes to continue processing the duplicate data until the storage runs out of capacity.

This is not an issue if there is a person in-charge who keeps monitoring the query system from time to time, if a problem occurred, then the person-in-charge would simply stop the running processes. But it will be a major issue if it is implemented on the large-scale in production stage, where most part of the integrated system that being used by the stakeholders are heavily relies on the data warehouse system itself. If the data warehouse is down due to resource bottleneck caused by the problem, then it will greatly affect the capability of the stakeholders to do their jobs since most of the data that they used came from the data warehouse itself.

The reason the real time system failed to detect the problem for this case is due to a script problem that was implemented in the running jobs. The script instructed the data warehouse system to run the same process repeatedly which causing the storage to consume more spaces due to data duplication, that is why the system itself cannot calculate the deadline of the process.

The problem can be solved and prevented by developing a clean script for the running jobs, and by monitoring the CPU load usage from the log files from time to time during the peak hours. Usually if the CPU load usage has reached more than 70% usage and took more than 10 minutes of execution time, then it clearly indicates a problem related to the job that runs the process. Once the problem has been identified, then it is up to the person-in-charge to stop the process and consult the person who runs the job.

In another example of real case scenario is the use of airbag system in car safety feature. This is already discussed in the question B above related to hard real time system. The airbag system should detect the crash and inflate the bag rapidly. The whole process should take less one-twenty-fifth of a second. Thus, if the system for example reacts with 1 second of delay the consequences could be disastrous and it will be no benefit having the bag inflated once the car has already crashed. Some other real time system such as airplane sensors system uses the real time system to relays information as a plane experiences turbulence and transmits it to other airlines, helping aircrafts prepare for turbulence or avoid it.

# **Question D: Conclusion**

In conclusion, designing a real time system can be a smart way whether we need to make sure that certain aspects of our software run in a certain amount of time, or whether we need to run our job reliably for a long period of time. If we are working on a mission-critical or safety-related project, the need for a real time system is obvious.

The real time system must react to external interactions in a predetermined period of time. Successful execution of the process relies on the proper and timely operation of the procedure. Design the hardware and software in the device to satisfy the real-time specifications. In order to satisfy these conditions, the off-clock detection mechanism and the software communication system concerned must operate under a short time budget. The system must satisfy these criteria for all calls made at any given time While the real-time technology provides rewards to the organization or individuals who used it, there is a time when the system has simply collapsed and caused a horrific tragedy for someone who relies heavily on it.

And where accurate scheduling and long-term durability are not absolute criteria for your project, installing a real time system will offer additional peace of mind that your software can continue to operate without interrupting the calculation or control procedure. If the device you are building will result in repair costs in the event that it is disrupted, the hardware and software costs needed to set up a real time system could well be worth investing in.

The real-time method would not actually make sense for any calculation or control project. Real-time operating systems usually run only one job at a time, and most real time systems do not have a user interface; in this case, a different system may be used to have user interfaces or user controls. Some projects also include hardware determinism where logic is applied to ASIC or FPGA. Yet, thousands of the real-time solutions are in the service today and will continue to be a feasible option for projects that require accurate scheduling and high reliability.

# **References**

1. Robert Oshana, in DSP Software Development Techniques for Embedded and Real-Time Systems, 2006
2. Israel Koren, C. Mani Krishna, in Fault-Tolerant Systems, 2007
3. A. Burns, in Encyclopedia of Physical Science and Technology (Third Edition), 2003
4. Colin Walls, in Embedded Software (Second Edition), 2012

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Criteria** | **0** | **Low**  **1-3** | **Fair**  **4-6** | **Average**  **7-9** | **Above average**  **10-12** | **Excellent**  **13-15** | **Marks** |
| **Introduction of the report which covers the following:**   * **Definition of RTS** * **Concept of RTS and differences** | * No introduction. | * Unclear definition or concept of the topic. | * Acceptable introduction, but with plenty of room for improvement. * Quite clear explanation on the definition and concept of the topic. | * Clear and acceptable definition of the topic. * Concept of the topic is properly explained and supported with example. | * Good and clear introduction with proper definition of the topic. * Good explanation on the topic concept and supported with example. | * Excellent introduction with good choice of definition and citation. * Clear and comprehensive explanation on the concept of the topic and supported with good example. |  |
| **Discussion on the actual application of real time system:** | * No or wrong content. | * Most points are not related to the topic. * Examples are given are vaguely described. | * Some of the points are acceptable. * Only a few examples are acceptable or clearly described. | * Most of the points are acceptable. * Most examples are clearly described. | * Most points are clearly explained. * All examples are well described. | * All the points are explained very clearly and engaging the reader. * All examples are well described and referenced. |  |
| **Analysis of a case study on real time system that covers:** | * No or wrong content. | * Most points are not related to the topic. * Given example is not suitable and vaguely described. | * Some of the points are acceptable. * Given example is acceptable but vaguely described. | * Most of the points are acceptable. * Given example is acceptable and clearly described. | * Most points are clearly explained. * Good example is given and well described. | * All the points are explained very clearly and engaging the reader. * Good example is given, well described and referenced. |  |
| **Conclusion** | * No conclusion. | * Very brief or not related conclusion on the topic. | * A fair conclusion which summarizes some of the main ideas/points. | * Acceptable conclusion which states all main ideas/points of the topic. | * A good conclusion which states all main ideas/points of the topic discussed. | * An excellent conclusion which inclusively states all main ideas/points of the topic discussed. |  |
| **References and citation** | No references and citation. | Poor citation/references and did not follow APA style. | APA style of writing is adopted inconsistently and with some major mistakes or missing citation/references. | APA style of writing is adopted but with some mistakes or missing citation/references. | APA style is well adopted, but with few minor mistakes. | APA style is well adopted for all citation and references. |  |
| **Total** | | | | | | | **/75** |

**Assignment 1: Report (15%) – 75 marks**

**Indra bin Isman 2022019070041**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Criteria** | **0** | **Low**  **1-3** | **Fair**  **4-6** | **Average**  **7-9** | **Above average**  **10-12** | **Excellent**  **13-15** | **Marks** |
| **Introduction of the report which covers the following:**   * **Definition of RTS** * **Concept of RTS and differences** | * No introduction. | * Unclear definition or concept of the topic. | * Acceptable introduction, but with plenty of room for improvement. * Quite clear explanation on the definition and concept of the topic. | * Clear and acceptable definition of the topic. * Concept of the topic is properly explained and supported with example. | * Good and clear introduction with proper definition of the topic. * Good explanation on the topic concept and supported with example. | * Excellent introduction with good choice of definition and citation. * Clear and comprehensive explanation on the concept of the topic and supported with good example. |  |
| **Discussion on the actual application of real time system:** | * No or wrong content. | * Most points are not related to the topic. * Examples are given are vaguely described. | * Some of the points are acceptable. * Only a few examples are acceptable or clearly described. | * Most of the points are acceptable. * Most examples are clearly described. | * Most points are clearly explained. * All examples are well described. | * All the points are explained very clearly and engaging the reader. * All examples are well described and referenced. |  |
| **Analysis of a case study on real time system that covers:** | * No or wrong content. | * Most points are not related to the topic. * Given example is not suitable and vaguely described. | * Some of the points are acceptable. * Given example is acceptable but vaguely described. | * Most of the points are acceptable. * Given example is acceptable and clearly described. | * Most points are clearly explained. * Good example is given and well described. | * All the points are explained very clearly and engaging the reader. * Good example is given, well described and referenced. |  |
| **Conclusion** | * No conclusion. | * Very brief or not related conclusion on the topic. | * A fair conclusion which summarizes some of the main ideas/points. | * Acceptable conclusion which states all main ideas/points of the topic. | * A good conclusion which states all main ideas/points of the topic discussed. | * An excellent conclusion which inclusively states all main ideas/points of the topic discussed. |  |
| **References and citation** | No references and citation. | Poor citation/references and did not follow APA style. | APA style of writing is adopted inconsistently and with some major mistakes or missing citation/references. | APA style of writing is adopted but with some mistakes or missing citation/references. | APA style is well adopted, but with few minor mistakes. | APA style is well adopted for all citation and references. |  |
| **Total** | | | | | | | **/75** |

**Assignment 1: Report (15%) – 75 marks**

**Muhammad Amsyar bin Abdul Malek 2022020070028**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Criteria** | **0** | **Low**  **1-3** | **Fair**  **4-6** | **Average**  **7-9** | **Above average**  **10-12** | **Excellent**  **13-15** | **Marks** |
| **Introduction of the report which covers the following:**   * **Definition of RTS** * **Concept of RTS and differences** | * No introduction. | * Unclear definition or concept of the topic. | * Acceptable introduction, but with plenty of room for improvement. * Quite clear explanation on the definition and concept of the topic. | * Clear and acceptable definition of the topic. * Concept of the topic is properly explained and supported with example. | * Good and clear introduction with proper definition of the topic. * Good explanation on the topic concept and supported with example. | * Excellent introduction with good choice of definition and citation. * Clear and comprehensive explanation on the concept of the topic and supported with good example. |  |
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| **Conclusion** | * No conclusion. | * Very brief or not related conclusion on the topic. | * A fair conclusion which summarizes some of the main ideas/points. | * Acceptable conclusion which states all main ideas/points of the topic. | * A good conclusion which states all main ideas/points of the topic discussed. | * An excellent conclusion which inclusively states all main ideas/points of the topic discussed. |  |
| **References and citation** | No references and citation. | Poor citation/references and did not follow APA style. | APA style of writing is adopted inconsistently and with some major mistakes or missing citation/references. | APA style of writing is adopted but with some mistakes or missing citation/references. | APA style is well adopted, but with few minor mistakes. | APA style is well adopted for all citation and references. |  |
| **Total** | | | | | | | **/75** |

**Assignment 1: Report (15%) – 75 marks**

**Siti Norsyahera Binti Abdul Hamid 2022019020027**

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| --- | --- | --- | --- | --- |
| **Performance Area** | **4-5: Exceeds Standards** | **2-3: Meets Standards** | **1: Fails to Meet Standards** | **Score** |
| **Organization** | Presenter follows logical sequence and provides explanations/elaboration. | Presenter follows logical sequence but fails to elaborate. | Presenter does not follow logical sequence (jumps around in presentation). | 5 4 3 2 1 |
| **Eye Contact** | Presenter seldom returns to notes, maintaining eye contact with audience throughout the presentation. | Presenter maintains eye contact with audience most of the time, but frequently returns to notes. | Presenter reads most or all of report, making little to no eye contact with audience. | 5 4 3 2 1 |
| **Delivery** | Presenter speaks clearly and loud enough for all in audience to hear, makes no grammatical errors, and pronounces all terms correctly and precisely. | Presenter’s voice is relatively clear, but too low to be heard by those in the back of the room. Presenter makes several major grammatical errors and mispronounces some terms. | Presenter mumbles, mispronounces terms, and makes serious and persistent grammatical errors throughout presentation. Presenter speaks too quietly to be heard by many in audience. | 5 4 3 2 1 |
| **Responsiveness:**  Q&A | Addresses all questions in a manner that demonstrates a thorough command of the topic(s) of the presentation. | Presenter demonstrates an ability to address most questions in a thoughtful and effective manner. | Presenter cannot address basic questions about the topic or addresses them in a superficial manner. | 5 4 3 2 1 |
| **Time** | Speaker uses the allotted time effectively. Finishes on time. | Speaker finishes on time but has to rush through last points to finish on time. | Speaker does not finish on time or finishes well before allotted time. | 5 4 3 2 1 |
|  | **TOTAL** | | | **/25** |

**Assignment 1: Presentation (5%) – 25 marks**

**Indra bin Isman 2022019070041**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Performance Area** | **4-5: Exceeds Standards** | **2-3: Meets Standards** | **1: Fails to Meet Standards** | **Score** |
| **Organization** | Presenter follows logical sequence and provides explanations/elaboration. | Presenter follows logical sequence but fails to elaborate. | Presenter does not follow logical sequence (jumps around in presentation). | 5 4 3 2 1 |
| **Eye Contact** | Presenter seldom returns to notes, maintaining eye contact with audience throughout the presentation. | Presenter maintains eye contact with audience most of the time, but frequently returns to notes. | Presenter reads most or all of report, making little to no eye contact with audience. | 5 4 3 2 1 |
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| **Responsiveness:**  Q&A | Addresses all questions in a manner that demonstrates a thorough command of the topic(s) of the presentation. | Presenter demonstrates an ability to address most questions in a thoughtful and effective manner. | Presenter cannot address basic questions about the topic or addresses them in a superficial manner. | 5 4 3 2 1 |
| **Time** | Speaker uses the allotted time effectively. Finishes on time. | Speaker finishes on time but has to rush through last points to finish on time. | Speaker does not finish on time or finishes well before allotted time. | 5 4 3 2 1 |
|  | **TOTAL** | | | **/25** |

**Assignment 1: Presentation (5%) – 25 marks**

**Muhammad Amsyar bin Abdul Malek 2022020070028**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Performance Area** | **4-5: Exceeds Standards** | **2-3: Meets Standards** | **1: Fails to Meet Standards** | **Score** |
| **Organization** | Presenter follows logical sequence and provides explanations/elaboration. | Presenter follows logical sequence but fails to elaborate. | Presenter does not follow logical sequence (jumps around in presentation). | 5 4 3 2 1 |
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|  | **TOTAL** | | | **/25** |

**Assignment 1: Presentation (5%) – 25 marks**

**Siti Norsyahera Binti Abdul Hamid 2022019020027**