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CSIS 1800: Introduction to Computer Science and Information Systems

Chapter number: 18 Limitation of Computing

Assignment number: 14

1. Given the following three real values what is the best order in which we should add these numbers in order to get the most accurate result? Prove details of your calculations.

x = 2351 \* 105 y = 11339 \* 10-2 z = 123679\* 10-8

|  |
| --- |
| (y+z)+x |

1. Given the following three real values, what is the best order in which to add these values in order to get the most accurate answer? Prove details of your calculations.

x = 999 \* 103 y = 71603 \* 10-9 z = 151 \* 106

|  |
| --- |
| (x+z)+y |

1. Define representational error, cancellation error, underflow, and overflow. Discuss how these terms are interrelated.

* **Representational (round-off) error**:
  + An arithmetic error caused by the fact that the precision of the result of an arithmetic operation is greater than the precision of our machine.
* **Cancellation error**:
  + A loss of accuracy during addition or subtraction of numbers of widely differing sizes, due to limits of precision.
* **Underflow**:
  + The condition that occurs when the results of a calculation are too small to represent in a given machine.
* **Overflow**:
  + The condition that occurs when the results of a calculation are too large to represent in a given machine.
* **Interrelation**:
* These terms are interrelated in that they represent the range of errors encountered due to the limitation of computers representing real numbers and extremely large integers, both positive and negative.

1. Given the following numbers, what would be the check digit for each?
2. 1774

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | + |  | 7 |  | + |  | 7 |  | + |  | 4 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**9** |  |  |  |  |  |  |

1. 1558

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | + |  | 5 |  | + |  | 5 |  | + |  | 8 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**9** |  |  |  |  |  |  |

1. 1773

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | + |  | 7 |  | + |  | 7 |  | + |  | 3 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**8** |  |  |  |  |  |  |

1. 8810

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 |  | + |  | 8 |  | + |  | 1 |  | + |  | 0 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**7** |  |  |  |  |  |  |

1. 4729

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 |  | + |  | 7 |  | + |  | 2 |  | + |  | 9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 2**2** |  |  |  |  |  |  |

1. Given the following numbers, what would be the additional digits if the unit's digit of the sum of the even digits is used along with the check digit?
2. 3915

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 |  | + |  | 9 |  | + |  | 1 |  | + |  | 5 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**8** |  |  | 9 + 5 = 1**4** | | | |

1. 1122

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | + |  | 1 |  | + |  | 2 |  | + |  | 2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **6** |  |  | 1 + 2 = **3** | | | |

1. 2728

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 |  | + |  | 7 |  | + |  | 2 |  | + |  | 8 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**9** |  |  | 7 + 8 = 1**5** | | | |

1. 1532

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | + |  | 5 |  | + |  | 3 |  | + |  | 2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**1** |  |  | 5 + 2 = **7** | | | |

1. 4431

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 |  | + |  | 4 |  | + |  | 3 |  | + |  | 1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**2** |  |  | 4 + 1 = **5** | | | |

1. Given the following numbers, what would be the additional digits if the unit's digit of the sum of the odd digits is used along with the check digit?
2. 5214

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 5 |  | + |  | 2 |  | + |  | 1 |  | + |  | 4 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**2** |  |  | 5 + 1 = **6** | | | |

1. 3651

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 |  | + |  | 6 |  | + |  | 5 |  | + |  | 1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**5** |  |  | 3 + 5 = **8** | | | |

1. 8617

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 |  | + |  | 6 |  | + |  | 1 |  | + |  | 7 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 2**2** |  |  | 8 + 1 = **9** | | | |

1. 5219

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 5 |  | + |  | 2 |  | + |  | 1 |  | + |  | 9 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 1**7** |  |  | 5 + 1 = **6** | | | |

1. 6386

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 |  | + |  | 3 |  | + |  | 8 |  | + |  | 6 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 2**3** |  |  | 6 + 8 = 1**4** | | | |

1. Give the Big-O complexity measure of the following polynomials.
2. 133 x5 + 25x2 + x +5
3. 5x4 + 3x2 + 13x
4. 26x3 + 2x- 12
5. 3x2 + 29
6. Give the common name for the following complexity measures and an example of an algorithm that falls into this category.
7. O(N)

|  |
| --- |
| Linear time |

1. O(NlogN)

|  |
| --- |
| N log2 N time |

1. O(N2)

|  |
| --- |
| Quadratic time, Selection sort and bubble sort |

1. How does a Turing machine simulate a human with a paper and pencil?

The Turing Machine’s control unit simulates a human’s decision-making process by representing a finite series of instructions that the control unit can execute.

Each instruction causes:

* A symbol to be read from a cell on the tape.
* A symbol to be written into the cell.
* The tape to be moved one cell left, to be moved one cell right, or to remain positioned as it was.
* Such actions certainly model a person with a pencil, if the person is allowed to replace a symbol with itself.

1. Name and describe at least 5 timings where a software error could be introduced during the software cycle.

**Software life cycle:**

* **Requirements:**
  + First phase of the software life cycle. Used to analyze the requirements of the customer.
  + It gives the abstract idea as to what the end result should be.
* **Specifications:**
  + Second phase of the software life cycle. Reflects the functionality needed to meet the requirements.
* **Design:**
  + Third phase of the software life cycle. Defines the required features and operations through the process diagrams, software architecture, algorithmic details, and interface representations.
* **Implementation:**
  + Fourth phase of the software life cycle. Programmers develop code for the above requirements and designs.
* **Maintenance:**
  + Last phase of the software life cycle. Necessary modification are made, end support is provided to ensure functionally and satisfaction. Updates are released.
* **Software errors:**
* Each phase presents timings where errors could be introduced.
* The design phase introduces the majority of the errors with the implementation phase following close as another one to introduce a great deal of errors.
* Early detection of errors result in lower cost compared to undetected ones.

Reference:

1. Computer Science Illuminated, Nell Dale and John Lewis, Fourth Edition, Chapter 17.
2. Dr. Szabo’s Tutorial Ch18\_Limitations of computing.ppt
3. http://www.purplemath.com/modules/exponent.htm