**Faculty of Computing and Informatics**

Data Representation & Operations

Simon H. Muchinenyika

|  |  |
| --- | --- |
| [smuchinenyika@nust.na](mailto:smuchinenyika@nust.na) | 2021 Semester I |

Introduction to Computing

(ITC511S)

**Faculty of Computing and Informatics**

Contents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1. Data Storage | | | | 3. Data Representation | |
| • | | | Binary and Data | • | Naming Variables |
| • | | | Data as Characters: ASCII, | • | single Vs double quotes |
| Unicode  2. Data Formats | | | | 4. Operations on Data | |
| • | Arithmetic Operations |
| • | | text | |
| • | Unary Operations |
| • | | numeric | | • | Logical Operations |
| • | boolean | | |



|  |  |
| --- | --- |
|  | **Data Storage 1/3** |

**Faculty of Computing and Informatics**

**1. Data Storage**

• computers stores data in electrical signals;

• such signals are stored in transistors as either ON of OFF;

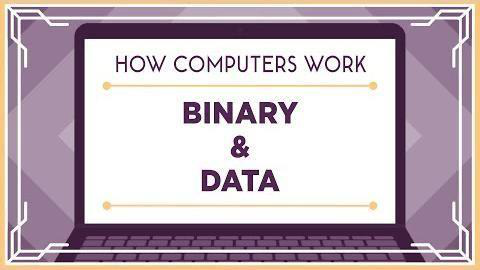
• ON and OFF can be represented as either 1 or 0 since those are the only possible states.



|  |  |
| --- | --- |
|  | **Data Storage 2/3** |

**Faculty of Computing and Informatics**

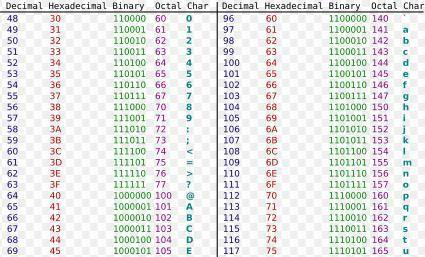
**2. Binary & Data Video (5 min)**



|  |  |
| --- | --- |
|  | **Data Storage 3/3** |

**Faculty of Computing and Informatics**

**3. Data as Characters**  
• ASCII – American Standard Code for Information Interchange;



• Unicode: <https://home.unicode.org/>;

• NB: Strings are a combination of characters.



|  |  |
| --- | --- |
|  | **Data Formats 1/3** |

**Faculty of Computing and Informatics**

**4. Data Formats**

• bits: 000111000101

• characters: ‘d’  
• strings: “papa”  
• files  
• graphics  
• audio

• video

Can you name other formats?



|  |  |
| --- | --- |
|  | **Data Formats 2/3** |

**Faculty of Computing and Informatics**

**5. Importance of Data Formats**

• effects on storage space:  
• of the data types in slide 4, which format do you think

takes much space?

• effects on possible basic operations:  
• once data is stored in a certain format, some operations

are not possible for that data



|  |  |
| --- | --- |
|  | **Data Formats 3/3** |

**Faculty of Computing and Informatics**

**6. ITC511S Data Formats**

• boolean: only two possible outcomes

• true of false;  
• 1 or 0;  
• yes or no

• numeric: any number whether integer or real;

• character: any keyboard character or space represented

between single quotes. Example: ’y’

• strings: any combination of characters represented between

double quotes. Example: “I enjoy ICG511S”



|  |  |
| --- | --- |
|  | **Data Representation 1/6** |

**Faculty of Computing and Informatics**

**7. Variable**

• any piece of data that can be taken as *input* or *output* on a computer;

• a variable should be given a meaningful name with no spaces in between it;

• in case where two or more words are joined for a variable

name, use camel casing or an underscore to join them.



|  |  |
| --- | --- |
|  | **Data Representation 2/6** |

**Faculty of Computing and Informatics**   
**8. Naming Variables**   
Example:   
A local construction company pays its workers 30N$ per hour and 35N$ per hour if it is overtime. Required is a program that takes in both the hours worked by an employee and the overtime hours and then calculates and displays the daily wage.

|  |  |  |  |
| --- | --- | --- | --- |
| |  | | --- | | **Underscore** | | **Camel Casing** | **Not Acceptable** |
| |  | | --- | | hours\_worked | | hoursWorked | hours worked |
| overtime\_hours | overtimeHours | overtime hours |
| daily\_wage | dailyWage | daily wage |



|  |  |
| --- | --- |
|  | **Data Representation 3/6** |

**Faculty of Computing and Informatics**

**9. Assignment Operation**

• variables can be assigned values, and may be reassigned

other values again and again; that is the reason why they are

called variables because the value varies;

• values are changed by an assignment operator (=);

• Example:

*1. dailyWage = 308.87*   
*2. hoursWorked = 6*   
*3. dailyWage = 356.09*

• What is the value of dailyWage?



|  |  |
| --- | --- |
|  | **Data Representation 4/6** |

**Faculty of Computing and Informatics**

**10. Still on Assigning Variables**

*1. employeeLastName = “Tulipohambe”*  
*2. employeeInitial = ‘P’*  
*3. isMarried = true*   
*4. dailyWage = 356.09*   
*5. salary = 3000.88*   
*6. salary = dailyWage \* 9*

• discuss what happens on each line above;



|  |  |
| --- | --- |
|  | **Data Representation 5/6** |

**Faculty of Computing and Informatics**

**11. Records**

• a data structure that combines several fields usually of different types into one reference variable;

• Example:   
*student = {studenNumber, name, age, accountBalance} x = student(2029210, “Peter Hango”, 19, 12563)*   
*y = student(2009123, “Eunike Ntwala”, 21, 0)*

• Note that *student* is the record name, *x* and *y* are both variables that make references to a record *student*.



|  |  |
| --- | --- |
|  | **Data Representation 6/6** |

**Faculty of Computing and Informatics**

**12. Common Mistakes**

|  |  |  |  |
| --- | --- | --- | --- |
| |  | | --- | | **Correct** | | **Incorrect** | **Why Incorrect** |
| |  | | --- | | surname = “Tuli” | | surmane = Tuli | double quotes required |
| surname = ‘Tuli’ | for strings |
| firstName = “Kaupu” | “Kaupu” = firstName | value is always in the |

|  |  |  |
| --- | --- | --- |
|  |  | right |
| age = 20 | age = “20” | no quote for numeric |

|  |  |  |
| --- | --- | --- |
|  |  | values |
| |  | | --- | | firstName = surname | | firstname = age | data types mismatch |
| isMarried = true | isMarried = “true” | no quotes for boolean |

|  |
| --- |
| variables |



|  |  |
| --- | --- |
|  | **Operations on Data 1/8** |

**Faculty of Computing and Informatics**

**13. Operations on Data**

|  |  |
| --- | --- |
| • • • • | arithmetic operations;  unary operations;  logical operations;  dot operation |



|  |  |
| --- | --- |
|  | **Operations on Data 2/8** |

**Faculty of Computing and Informatics**

**14. Arithmetic Operations**

|  |  |
| --- | --- |
| • • • • | add;  subtract;  multiply;  divide. |

**NB:** In order to see how these operations are actually carried out on a

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| computer, | download | and | study | the | pdf |

[http://www.nhu.edu.tw/~chun/CS-ch04-Operations%20on%20Data.pdf](http://www.nhu.edu.tw/~chun/CS-ch04-Operations%2520on%2520Data.pdf)



|  |  |
| --- | --- |
|  | **Operations on Data 3/8** |

**Faculty of Computing and Informatics**

**15. Unary Operations**

|  |  |  |
| --- | --- | --- |
| • • • | have only one operand;  evaluated before any other operations containing them;  Examples: | |
| • | -5 |

• +3

|  |  |  |
| --- | --- | --- |
| • | • | 8+-6 |
| • | -incomeTax |
| logical operations. | |



|  |  |
| --- | --- |
|  | **Operations on Data 4/8** |

**Faculty of Computing and Informatics**

**16. Logical Operations**

|  |  |
| --- | --- |
| • • | based on two states: 1 or 0, TRUE or FALSE  AND: both operands have to be TRUE for it to return TRUE, |

otherwise FALSE;

|  |  |
| --- | --- |
| • | OR: either one of the operands or both of them have to be TRUE for |

it to return TRUE, otherwise FALSE;

|  |  |
| --- | --- |
| • • | NOT: it returns the opposite of the operand;  EQUAL (==) comparison operator that is commonly confused with |

an assignment (=) operator.



|  |  |
| --- | --- |
|  | **Operations on Data 5/8** |

**Faculty of Computing and Informatics**

**17. dot Operation**

• consider the example below from the slide 11:

• Example:   
*student = {studenNumber, name, age, accountBalance} x = student(2029210, “Peter Hango”, 19, 12563)*   
*y = student(2009123, “Eunike Ntwala”, 21, 0)*

|  |  |
| --- | --- |
| • | What is the value represented by ?? in below operations? |

1. x.age = ??

2. y.accountBalance = ??

• Note that the order and number of arguments in a record matters and depends on the declaration



|  |  |
| --- | --- |
|  | **Operations on Data 6/8** |

**Faculty of Computing and Informatics**

**18. Fundamental Operations Summary**

|  |  |  |  |
| --- | --- | --- | --- |
| |  | | --- | | **Operation** | | **Description** | **Result** |
| |  | | --- | | x==y | | comparison | boolean |
| |  | | --- | | x!=y | | not equal to | boolean |
| |  | | --- | | x AND y | | logical AND | boolean |
| |  | | --- | | NOT x | | same as !x; logical NOT | boolean |
| |  | | --- | | x>y | | greater than | boolean |
| |  | | --- | | x<=y | | less or equal to | boolean |
| |  | | --- | | x/y | | divide by | numeric |
| |  | | --- | | x-y | | subtract | numeric |
| |  | | --- | | x mod y | | modulo | numeric |
| |  | | --- | | x=y | | assignment operator | universal |
| |  | | --- | | x.surname | | selects a field | string in this context |



|  |  |
| --- | --- |
|  | **Operations on Data 7/8** |

**Faculty of Computing and Informatics**

**19. Exercise**

Identify the logical operations expressed in the following sentences:

|  |  |
| --- | --- |
| 1.  2.  3. | May I have icecream and peanuts?  We are writing the test either Wednesday or Friday. Anyone can come except men. |



|  |  |
| --- | --- |
|  | **Operations on Data 8/8** |

**Faculty of Computing and Informatics**

**20. Solution to Exercise**

Identify the logical operations expressed in the following sentences: 1. The candidate should be 18 years old and   
male.

age ==18 and gender ==“male”  
*Explanation: only candidates who meet both conditions (being 18 years old and male) are eligible.*

We are writing the test either Wednesday or Friday. 2.

*DayOfweeks==“Wednesday" OR daysOfWeeks == “Friday" Explanation: Either one of the two days. It cannot be both.*

|  |  |
| --- | --- |
| 3. | Anyone can come except men. |

*gender != “male” or gender <> “male”*

*Explanation: As long as you are a male, you are not coming.*



|  |  |
| --- | --- |
|  | **ITC511S Introduction to Computing** |

**Faculty of Computing and Informatics**

**21. Further Study**

[• Operations on Data: http://www.nhu.edu.tw/~chun/CS-ch04-Operations%20on%20Data.pdf](http://www.nhu.edu.tw/~chun/CS-ch04-Operations%2520on%2520Data.pdf)

•Unary Operations:   
<https://en.wikibooks.org/wiki/Programming_Fundamentals/Unary_Operations>



|  |  |
| --- | --- |
| 13 Storch Street  Private Bag 13388  Windhoek  NAMIBIA | T: +264 61 207 2054  F: +264 61 207 9054  E: [smuchinenyika@nust.na](mailto:smuchinenyika@nust.na) W: [www.nust.na](http://www.nust.na/) |

**Faculty of Computing and Informatics**

Thank You.