Introduction

Lecture 1

1107186 – Estruturas de Dados
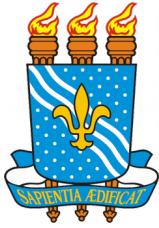
Prof. Christian Azambuja Pagot
CI / UFPB

What are Data Structures?
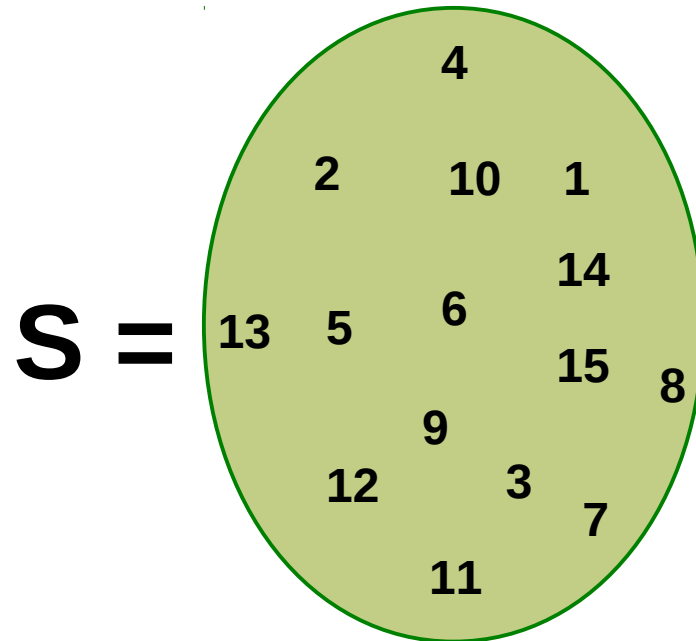
- *"(...) a data structure is a particular way of organizing data in a computer so that it can be used efficiently."*

Wikipedia (2015)

One Example

- Suppose the following set **S** of integer numbers:

S =

How a computer could answer the following question:
Does S contains the integer number 14?

Universidade Federal da Paraíba
Centro de Informática

Array-based Solution

- First, read the **S** elements into an **array**:

C code excerpt:
```
int s[15];
s[0] = 5;
s[1] = 3;
…
s[14] = 11;
```

Index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Value	5	3	1	15	6	4	7	10	2	8	13	9	12	14	11

- Second, look for the value '14' **looping over** the array.

14 steps to find the value!

> Can it be done **faster** through the use of an alternate **data structure**?

Universidade Federal da Paraíba
Centro de Informática

Ordered Array-based Solution

- **First**, load the elements of **S** into an **ordered array**:

Index →	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Value →	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**

Universidade Federal da Paraíba
Centro de Informática

Ordered Array-based Solution

- **Second**, look for the element 14 through **binary search**:

1o. Passo: Localize o elemento central do vetor.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

2o. Passo: Localize o elemento central do vetor.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

3o. Passo: Localize o elemento central do vetor.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

3 steps to find the value!

Can it be even **faster**?

Universidade Federal da Paraíba
Centro de Informática

Hash-like-based Solution

- First, set the **S** elements in an array:

C code excerpt:

```
bool s[20];
s[0] = true;
s[1] = true;
…
s[19] = false;
```

Index
(=Value-1)

Existence
Flag

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F

- Second, look for the value '14' computing the hash value (value-1 = 13) and checking the flag at this position.

1 step to find the value!!!!!!!

Universidade Federal da Paraíba
Centro de Informática

Course Outline

- C programming language.

- Data types.

- Memory allocation.

- Linked lists.

- Stacks, queues and deques.

- Dictionaries ans hash tables.

- Asymptotic analysis.

- Recursion.

- Trees.

- Graphs.

Background

- **Algorithms:**
  - Simple variables.
  - Structured variables.
  - Functions.
  - Parameter passing (by value, by reference).
- **C programming skills:**
  - General syntax.
  - Compiling.
  - Debugging.

To **pass** this course...

- **Attend** classes regularly and participate.

- **Understand** the concepts.

- **Do** the assignments.

- **Do** the exams.

Universidade Federal da Paraíba
Centro de Informática

To **fail** this course...

- **Do not attend** classes regularly and/or **do not** participate.

- **Avoid understanding** the concepts.

- **Don't do**, or **cheat**, the assignments.

- **Don't do**, or **cheat**, the exams.

Grading Policy

- Students will be individually evaluated according to the following formula:

$$NF1 = \left(\frac{(P1 + P2)}{2} \times 40\% \right) + \left(\frac{(T1 + T2 + \cdots + Tn)}{n} \times 60\% \right)$$

- **NF1** = Final grade.
- **P1** = Exam 1.
- **P2** = Exam 2.
- **T1**, **T2**, …, **Tn** = Assignments.

Universidade Federal da Paraíba
Centro de Informática

Bibliography

- Weiss, M. A. **Data Structures and Problem Solving Using Java**. Addison Wesley, 1998.

- Tenembaum, A. M.; Langsam, Y.; Augenstein, M. J. **Estruturas de Dados usando C**. McGraw-Hill.

- Szwarcfiter, J. L. e Markenzon, L. **Estruturas de Dados e seus Algoritmos**. LTC – Livros Técnicos e Científicos Ed., 1994.

- Tremblay, J. e Sorenson, P. G. **An Introduction to Data Structures with Applications**. McGraw-Hill, 1987.

Universidade Federal da Paraíba
Centro de Informática

Useful Tools

- **A (Text editor + C compiler) or IDE:**
  - DevC++.
  - Code::Blocks.
  - Vi + gcc.
  - Eclipse + C compiler.
  - Microsoft Visual C++.
  - Etc.

Universidade Federal da Paraíba
Centro de Informática

Classroom Policy

- Participate every lecture.

- Focus on the lessons.

- Disconnect from the whole world for a while.
    - Mute/turn off cell phones.
    - Don't use social networks, messengers, and anything else strictly related to the class.

- Willing to ask and answer questions.

Universidade Federal da Paraíba
Centro de Informática

Our Website

- All relevant stuff will be available in our web page at SIGAA!

The **student** is **responsible** for **keeping** his data **up to date** in the **SIGAA** system!

Next class...

- **Review of the C programming language.**