



## 0. Introduction

Required Textbook: "Data Structures..." by Standish (ISBN: 0-201-59118-9 © 1995)

CIS2520

Introduction

HOW TO ORGANIZE BOOKS: Examples

0.4



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(L,Wo,G,Web,C,B)



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**create** (an empty list)  
**insert** Web in 1<sup>st</sup> position  
 insert C in 2<sup>nd</sup> position  
 insert G in 1<sup>st</sup> position  
 insert L in 1<sup>st</sup>  
 insert Wes in 4<sup>th</sup>  
 insert Wo in 2<sup>nd</sup>  
**delete** the item in 5<sup>th</sup> position  
 insert B in 6<sup>th</sup> position

()  
 (Web)  
 (Web,C)  
 (G,Web,C)  
 (L,G,Web,C)  
 (L,G,Web,Wes,C)  
 (L,Wo,G,Web,Wes,C)  
 (L,Wo,G,Web,C)  
 (L,Wo,G,Web,C,B)

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## ORDERED LISTS: Example

0.7

**create** (an empty list)**insert** Web

insert C

insert G

insert L

insert Wes

insert Wo

**delete** the item in 5<sup>th</sup> position

insert B

()

(Web)

(C,Web)

(C,G,Web)

(C,G,L,Web)

(C,G,L,Web,Wes)

(C,G,L,Web,Wes,Wo)

(C,G,L,Web,Wo)

(B,C,G,L,Web,Wo)

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## STACKS: First Example (1/2)

0.8

**create** (an empty stack)**push** Web (onto the top)

push G

push C

push Wes

push B

push Wo

.....

()

(Web)

(G,Web)

(C,G,Web)

(Wes,C,G,Web)

(B,Wes,C,G,Web)

(Wo,B,Wes,C,G,Web)

.....

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.....

push Wo  
**pop** Wo (from the top)  
 pop B  
 pop Wes  
 push B  
 push Wo  
 push L

.....

(Wo,B,Wes,C,G,Web)  
 (B,Wes,C,G,Web)  
 (Wes,C,G,Web)  
 (C,G,Web)  
 (B,C,G,Web)  
 (Wo,B,C,G,Web)  
 (L,Wo,B,C,G,Web)

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**create** (an empty stack)  
**push** your crappy car (onto the top)  
 push my blue jaguar  
 push the grey car  
**pop** (from the top)  
 pop  
 push the grey car

()  
 (yellow)  
 (yellow,blue)  
 (yellow,blue,grey)  
 (yellow,blue)  
 (yellow)  
 (yellow,grey)

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**create** (an empty queue)

**insert** my blue jaguar (onto the rear)

insert the grey car

insert your crappy car

**remove** (from the front)

()

(blue)

(blue, grey)

(blue, grey, yellow)

(grey, yellow)

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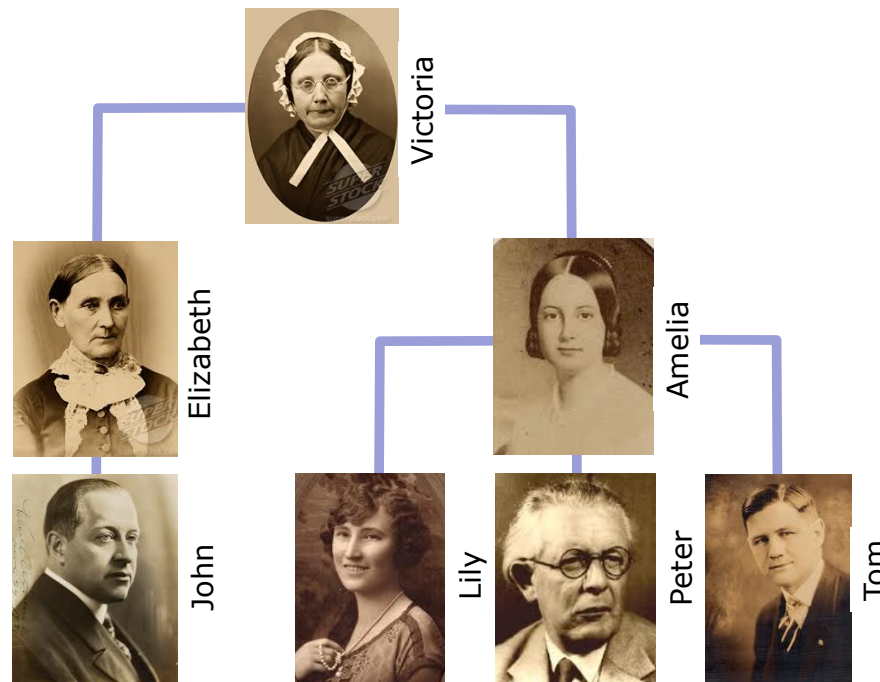


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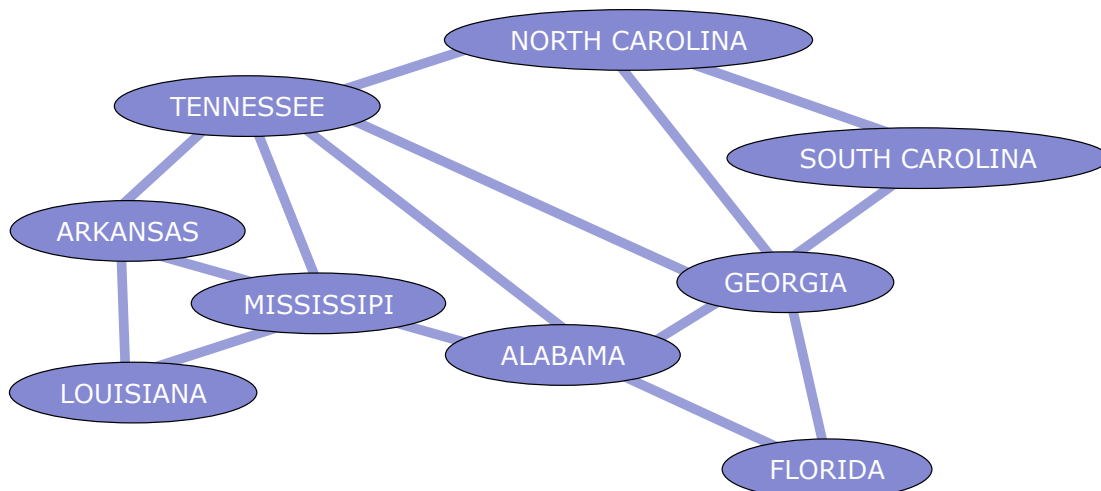


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FLORIDA  
GEORGIA  
LOUISIANA  
MISSISSIPPI  
NORTH CAROLINA  
SOUTH CAROLINA  
TENNESSEE



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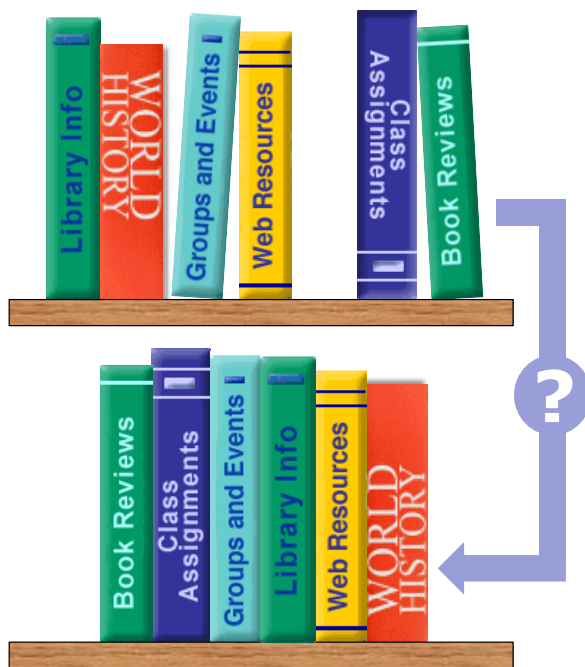


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## SORTING: An Iterative Algorithm

0.17

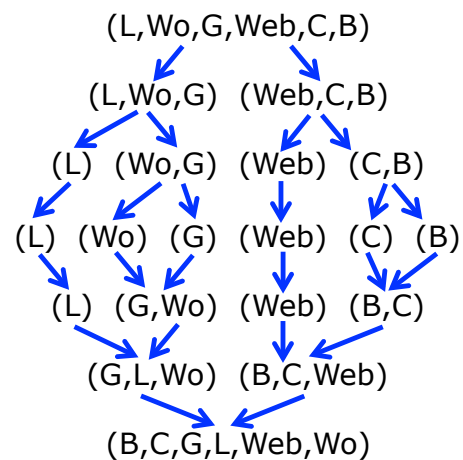
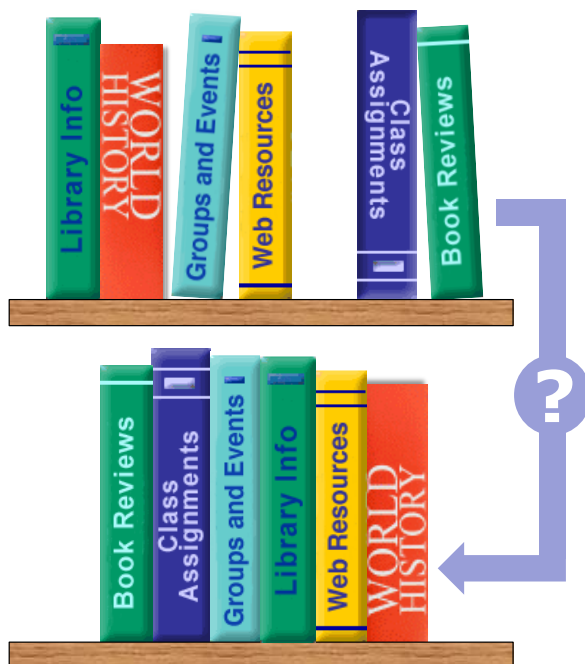


(L, Wo, G, Web, C, B)  
 (L, **Wo**, G, Web, C, B)  
 (L, G, **Wo**, Web, C, B)  
 (L, G, Web, **Wo**, C, B)  
 (L, G, Web, C, **Wo**, B)  
 (L, G, Web, C, B, **Wo**)  
 (G, L, **Web**, C, B, Wo)  
 (G, L, **Web**, C, B, Wo)  
 (G, L, C, **Web**, B, Wo)  
 .....  
 (B, C, G, L, Web, Wo)

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## SORTING: A Recursive Algorithm

0.18



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?

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graph TD
    Root["(L, Wo, G, Web, C, B)"] --> L_Wo_G["(L, Wo, G)"]
    Root --> Web_C_B["(Web, C, B)"]
    L_Wo_G --> L["(L)"]
    L_Wo_G --> Wo_G["(Wo, G)"]
    Web_C_B --> Web["(Web)"]
    Web_C_B --> C_B["(C, B)"]
    L --> L2["(L)"]
    L --> Wo["(Wo)"]
    Wo_G --> Wo2["(Wo)"]
    Wo_G --> G["(G)"]
    Web --> Web2["(Web)"]
    Web --> C["(C)"]
    C_B --> C2["(C)"]
    C_B --> B["(B)"]
    L2 --> L3["(L)"]
    L2 --> G_Wo["(G, Wo)"]
    Wo2 --> G_Wo2["(G, Wo)"]
    Wo2 --> Web3["(Web)"]
    G --> G_Wo3["(G, Wo)"]
    G --> Web4["(Web)"]
    Web2 --> Web5["(Web)"]
    Web2 --> B_C["(B, C)"]
    C2 --> B_C2["(B, C)"]
    C2 --> B_C3["(B, C)"]
    B --> B_C4["(B, C)"]
    B --> B_C5["(B, C)"]
    G_Wo3 --> G_L_Wo["(G, L, Wo)"]
    G_Wo3 --> B_C6["(B, C, Web)"]
    Web5 --> B_C7["(B, C, Web)"]
    Web5 --> B_C8["(B, C, Web)"]
    B_C4 --> B_C9["(B, C, Web)"]
    B_C4 --> B_C10["(B, C, Web)"]
    B_C5 --> B_C9["(B, C, Web)"]
    B_C5 --> B_C10["(B, C, Web)"]
    B_C6 --> Final["(B, C, G, L, Web, Wo)"]
    B_C7 --> Final["(B, C, G, L, Web, Wo)"]
    B_C8 --> Final["(B, C, G, L, Web, Wo)"]
    B_C9 --> Final["(B, C, G, L, Web, Wo)"]
    B_C10 --> Final["(B, C, G, L, Web, Wo)"]

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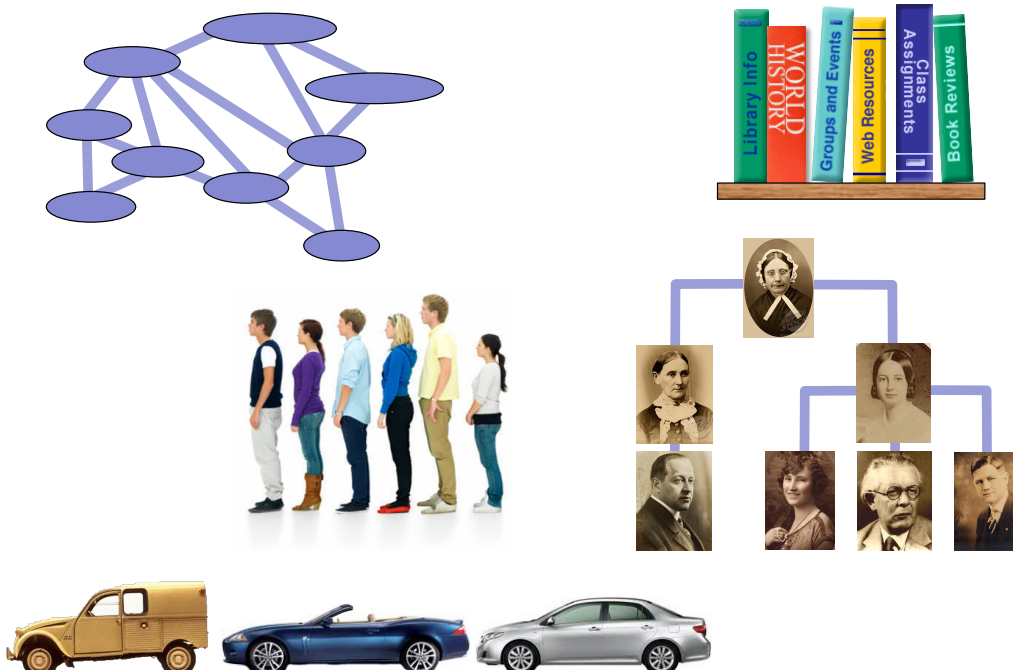
**Abstraction**

What are the relevant characteristics of these real-world objects?

**Implementation**

How to store each object's characteristics in the computer's memory?

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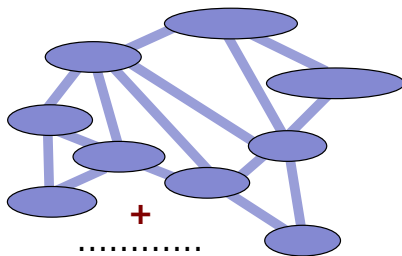
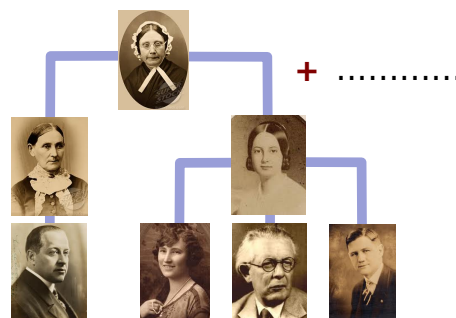
**Abstraction**

How to organize the data?

**Implementation**

How to store the organized data in the computer's memory?

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create,  
insert,  
delete...create,  
insert,  
remove...

+ create, push, pop...

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**Abstraction**

What are the operations that naturally fit with the data structure?

**Implementation**

How to implement these operations?

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1. Lists
2. Recursion
3. Analysis of Algorithms
4. Stacks and Queues
5. Trees
6. Graphs
7. Hash Tables
8. Sorting

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