

CSCI 136:
Data Structures
and
Advanced Programming
Lecture 22
Even more iterators / trees

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Williams

Topics

- Talent
- Reverse iterator
- Trees

Your to-dos

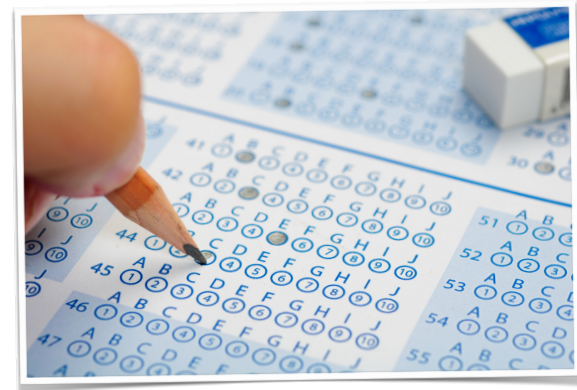
1. Read **before Mon**: Bailey, Ch 14-14.1, 14.3.
2. Lab 7 (partner lab), **due Tuesday 4/19 by 10pm**.

Thought experiment

Think of someone you know who is **talented**.

Were they **born** with **better abilities** than you?

Despite years (>100) of effort, scientists have **never** identified a universal, reliable measure of innate ability.



"The Role of Deliberate Practice in the Acquisition of Expert Performance", Ericsson et al., Psychological Review (1993)

No universal, reliable measure of innate ability.

The **relation of IQ to exceptional performance is rather weak** in many domains, including music (Shuter-Dyson, 1982) and chess (Doll & Mayr, 1987).

For scientists, engineers, and medical doctors that complete the required education and training, the **correlations between ability measures and occupational success are only around 0.2**, accounting for only 4% of the variance (Baird, 1985).

In a review of more than one hundred studies, Ghiselli (1966) found the **average correlation between success-on-the-job measuring and aptitude-test scores to be 0.19**.

In summary, the search for stable heritable characteristics that could predict or at least account for the superior performance of eminent individuals has been **surprisingly unsuccessful**.

Takeaway: "innate ability" is probably a **myth**.

"The Role of Deliberate Practice in the Acquisition of Expert Performance", Ericsson et al., Psychological Review (1993)

What factor does matter? **Practice**.

Binet (Varon, 1935) started out using tests of basic perceptual and cognitive capacities to measure IQ, but **found large practice effects**, which were later documented by Gibson (1969).

"The Role of Deliberate Practice in the Acquisition of Expert Performance", Ericsson et al., Psychological Review (1993)

But **mere repetition** is **not enough**.

Bryan and Harter (1897, 1899) identified **plateaus in skill acquisition**, when for long periods subjects seemed unable to attain further improvements.

[W]ith mere repetition, improvement of performance was often arrested at less than maximal levels, and **further improvement required effortful reorganization of the skill**.

Keller (1958) later showed that these plateaus ... were not an inevitable characteristic of skill acquisition, but **could be avoided by different and better training methods**.

"The Role of Deliberate Practice in the Acquisition of Expert Performance", Ericsson et al., Psychological Review (1993)

Study tip

Experts **practice deliberately**.

We view elite performance as the product of ... maximal efforts to improve performance in a domain through an **optimal distribution of deliberate practice**. This view provides us with unique insights into the potential for and limits to modifying the human body and mind. Many ... **characteristics, traditionally believed to be fixed, can adapt and change** in response to intense practice sustained for years.

Deliberate practice is purposeful and systematic practice requiring **focused attention** and is conducted with **the specific goal of improving performance**.

Deliberate practice is **exhausting**.

"The Role of Deliberate Practice in the Acquisition of Expert Performance", Ericsson et al., Psychological Review (1993)

Study tip

How does one **sustain** deliberate practice?

Our empirical studies [show] that experts carefully schedule deliberate practice and limit its duration to **avoid exhaustion and burnout**.

The **learning algorithm**:

1. **Start early**.
2. **Focus** solely on learning task.
(i.e., no Instagram)
3. **Stop** after some time period.
(~1 hr)
4. **Repeat** later.
(e.g., the next day)

"The Role of Deliberate Practice in the Acquisition of Expert Performance", Ericsson et al., Psychological Review (1993)

Quiz

A bit iterator

Suppose we want to do the following:

On each iteration, get the **next most significant bit**, starting initially with the **least significant bit**.

BIterator to the rescue.

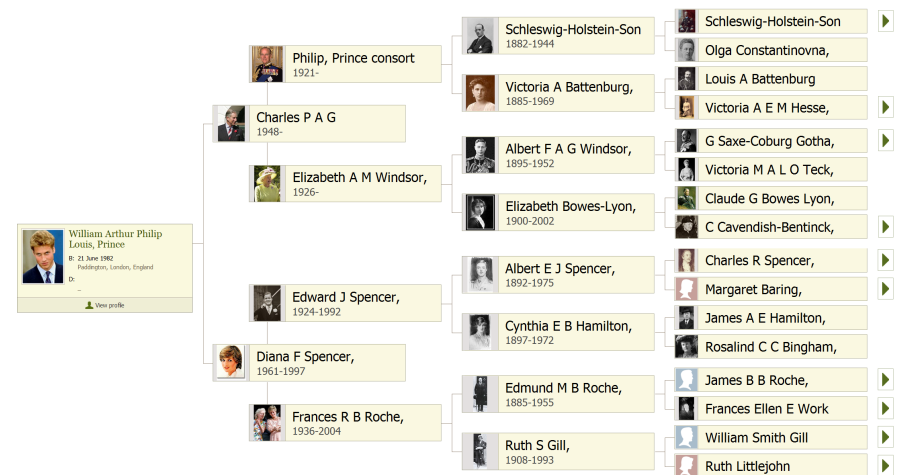
Trees

Motivation

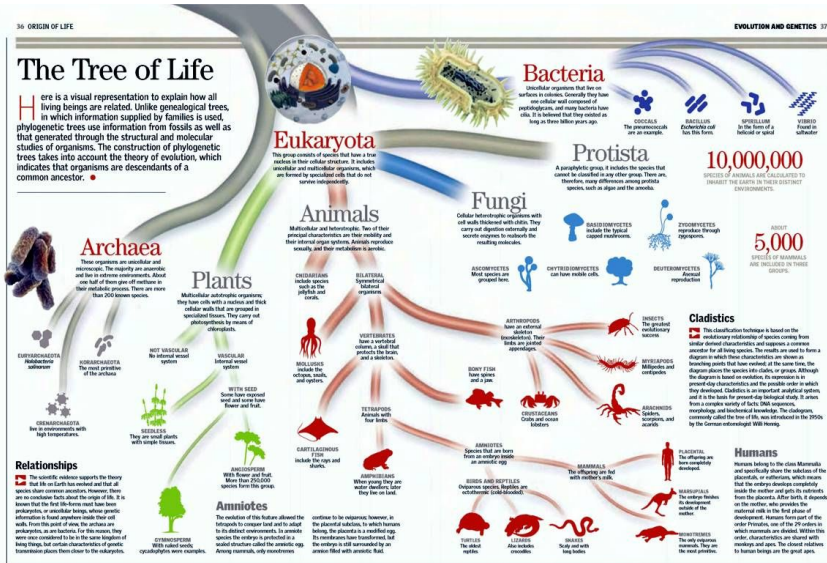
Information is often **hierarchical**.

Trees facilitate **encoding** such information on a computer.

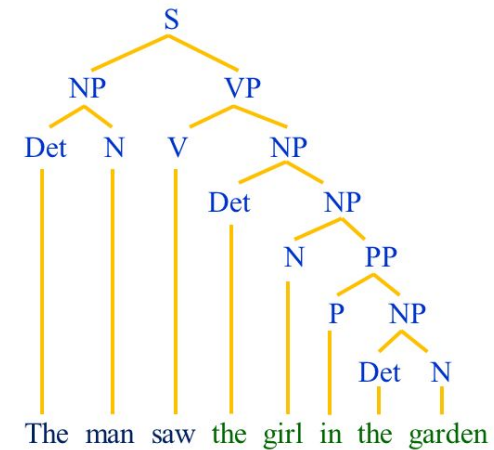
Uses



Uses

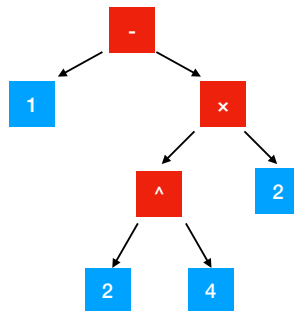


Uses



Uses

$$1 - 2^4 \times 2$$



List ADT

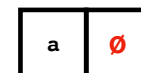
A **list** is a recursive data structure that stores information sequentially. A list is either:

- **empty** (i.e., \emptyset) or
- a **node** containing a **value** and a reference to a **list**.

The empty list:

\emptyset

List of length 1:



List of length 3:



Tree ADT

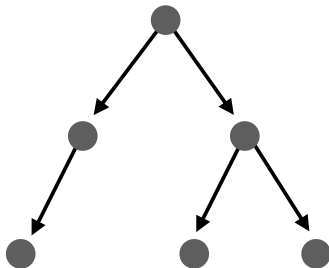
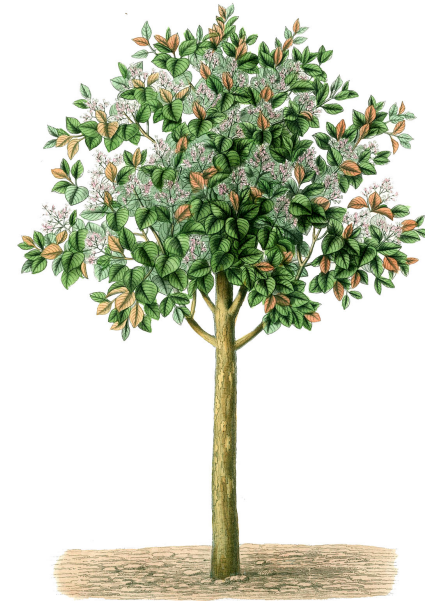
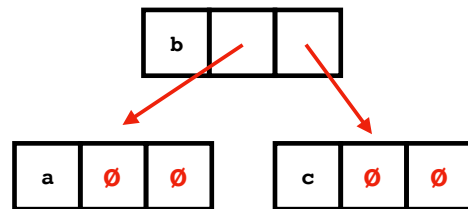
A **tree** is a recursive data structure that stores information hierarchically. A tree is either:

- **empty** (i.e., \emptyset), or
- a **node** containing a **value** and references to one or more **trees**.

The empty tree:

\emptyset

A non-empty **binary** tree:



Recap & Next Class

Today:

Talent

Reverse Iterator

Tree ADT

Next class:

Terminology

Implementation