

Discrete Math Applications in IT Fields

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Overview

The topics discussed today are **not**:

- on the final
- meant to be fully understood

Today you **should**:

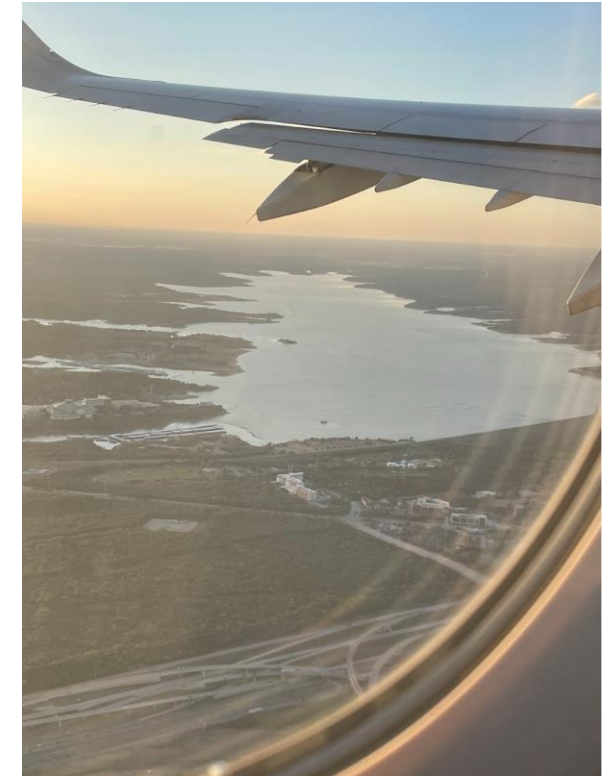
- note interesting topics for further research
- ask questions!

Goal: Briefly mention each module of course

- Fields and careers that extend these modules
- “Opinionated” points in red

Who Am I, To Make These Claims?

- Industry Internship/Part Time - Jr Automation Engineer
- Academia Internship - Security Researcher for a summer
- Applicant's Perspective
- A student too!

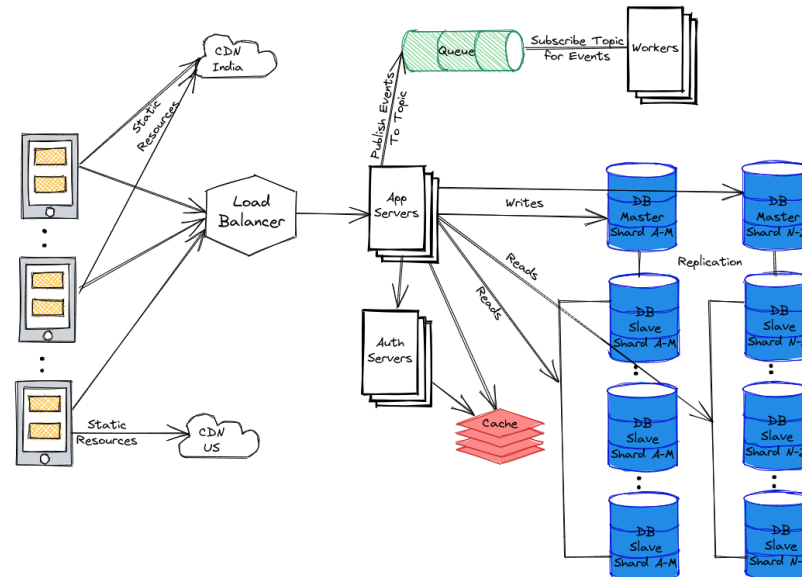


When will we use ****?

- Not all technology jobs use **all** the topics discussed in this course
- **All** technology jobs have requirements that aren't actually used

- “Secret Handshake”

- Leetcode + DSA
- System Design

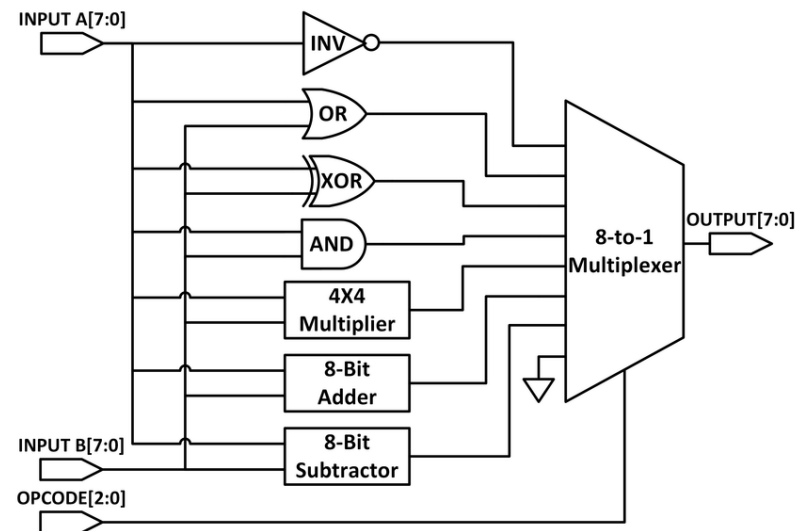


Logic + Proofs

Broadly: Ability to reason and demonstrate validity of *something*

Technical skill is *easy*, communication is hard

Fields: theoretical computer science, program correctness, hardware engineering, control theory, etc...



Set Theory

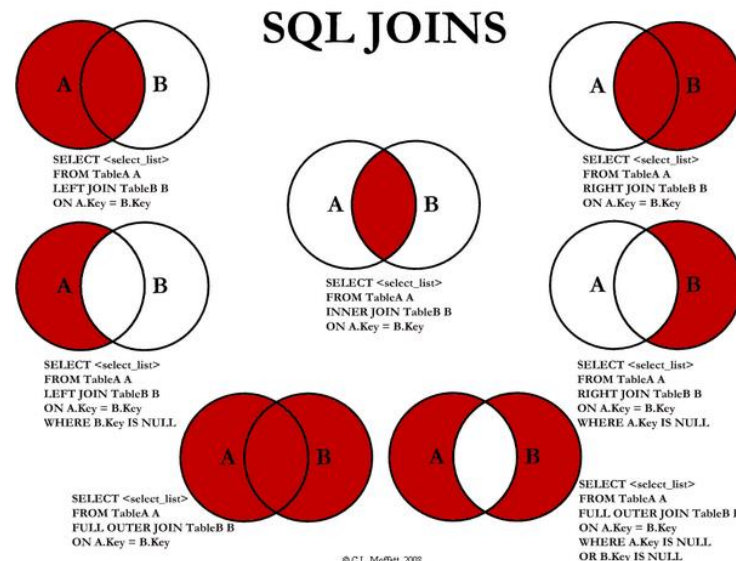
Broadly: The *syntax* of technical writing; How things are *contained*

It is common to be learning things in your own time, unpaid (☹)

Fields: Database design, Collection-based programming, Data creation

A lot of enterprise development is *data transmogrification*

- [6] L←(L↑:')↓L←,L n drop To:
- [7] L←LJUST VTOM',',L n mat with one entry per row
- [8] S←~1+/∧\Lz'(' n length of address
- [9] X←0ΓΓ/S
- [10] L←Sφ(-(ρL)+0,X)↑L n align the (names)
- [11] A←((1↑ρL),X)↑L n address
- [12] N←0 1↓DLTB(0,X)↓L n names)
- [13] N←,'α',N
- [14] N←(N='_')/ιρN]←' ' n change _ to blank
- [15] N←0 1↓RJUST VTOM N n names
- [16] S←+/∧\ '≠φN n length of last word in name



```
using namespace std::views;

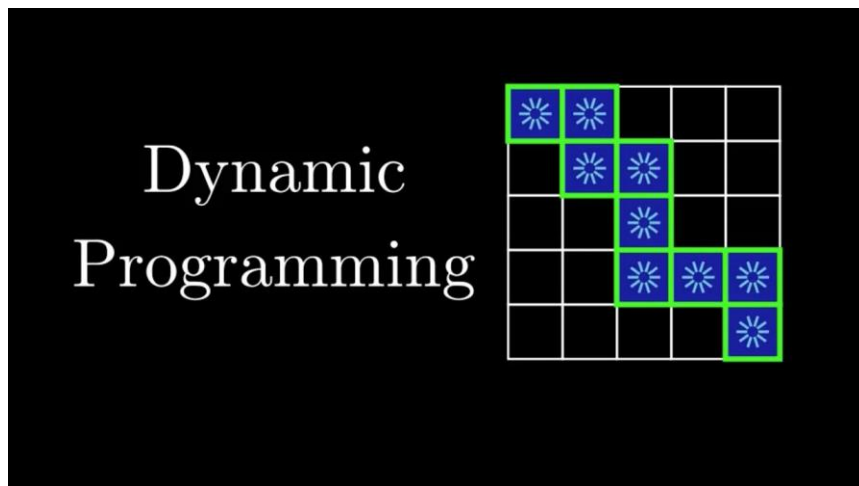
auto sushi_for_two(std::vector<int> sushi) {
    return 2 * std::ranges::max(sushi
        | chunk_by(_eq_)
        | transform(std::ranges::distance)
        | adjacent_transform<2>(_min_));
}
```

Recurrence Relations

Broadly: Modeling values as a result of prior computations

A 'fundamental' tool of programming

Uses: *Recursion*, Dynamic Programming, Optimizations, Cost Relation Systems

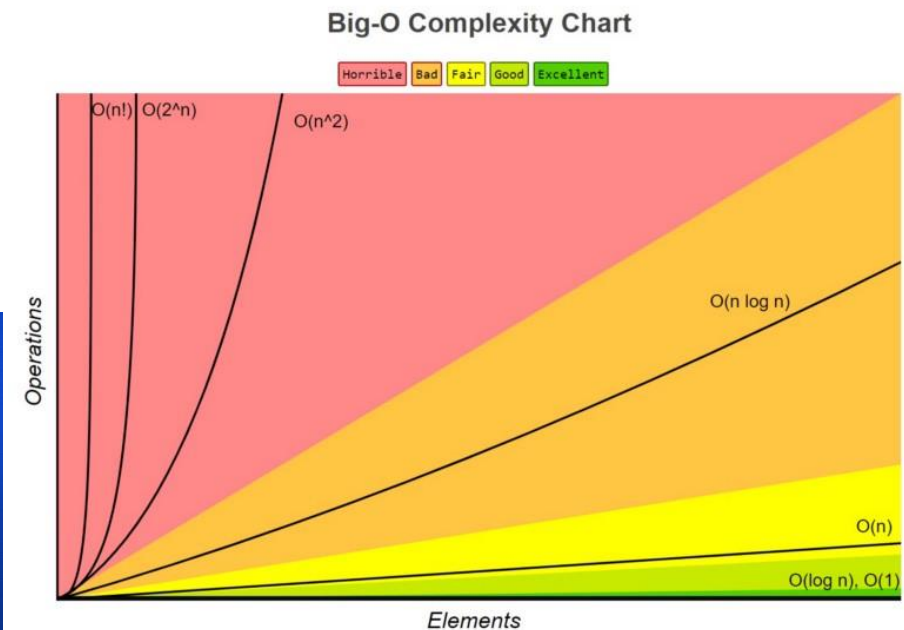
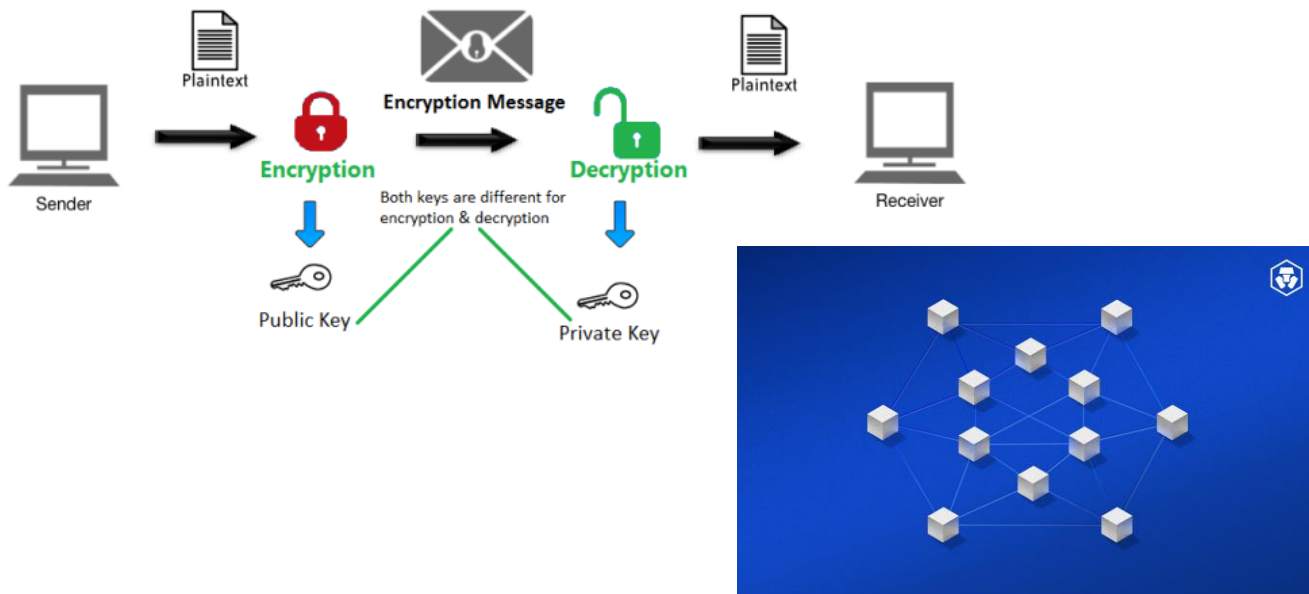


Combinatorics

Broadly: Very advanced counting; enumerate data, computation, etc.

Napkin math: determine if a certain approach is worth dev hours

Fields: Computability theory, Cybersecurity, Cryptography



Probability

Fields: Statistics & Data Science, Machine Learning, Probabilistic Algorithms



Relations + Functions

Broadly: Interactions between data, how *operations* are performed

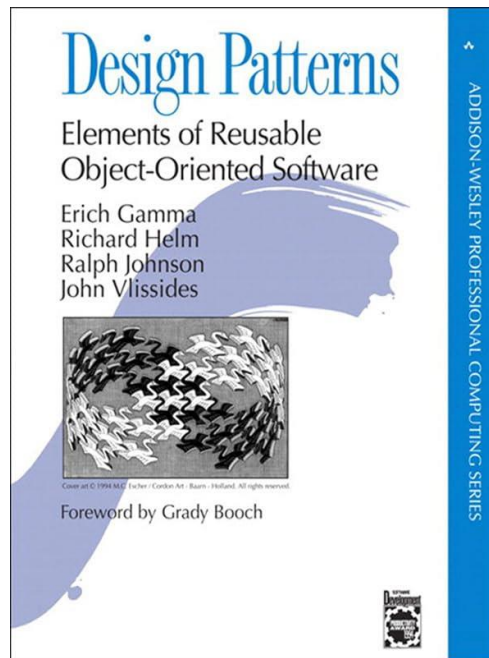
Comprehending data flow and state of a program is extremely useful

Uses: Software Architecture (Design Patterns), Functional Programming, Closures

0 := $\lambda f. \lambda x. x$

1 := $\lambda f. \lambda x. f x$

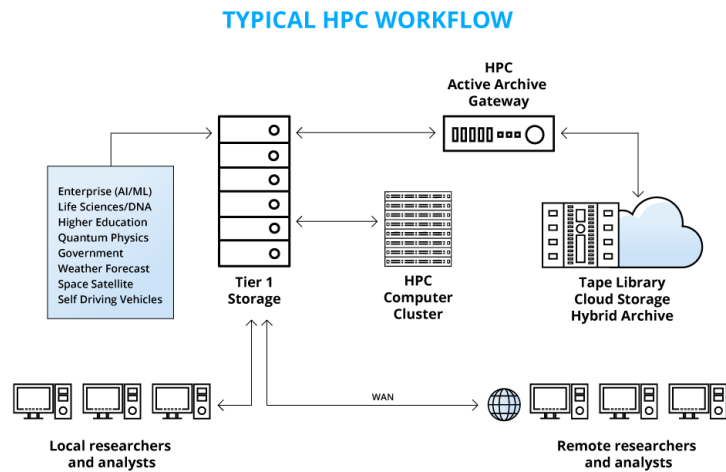
2 := $\lambda f. \lambda x. f (f x)$



elixir

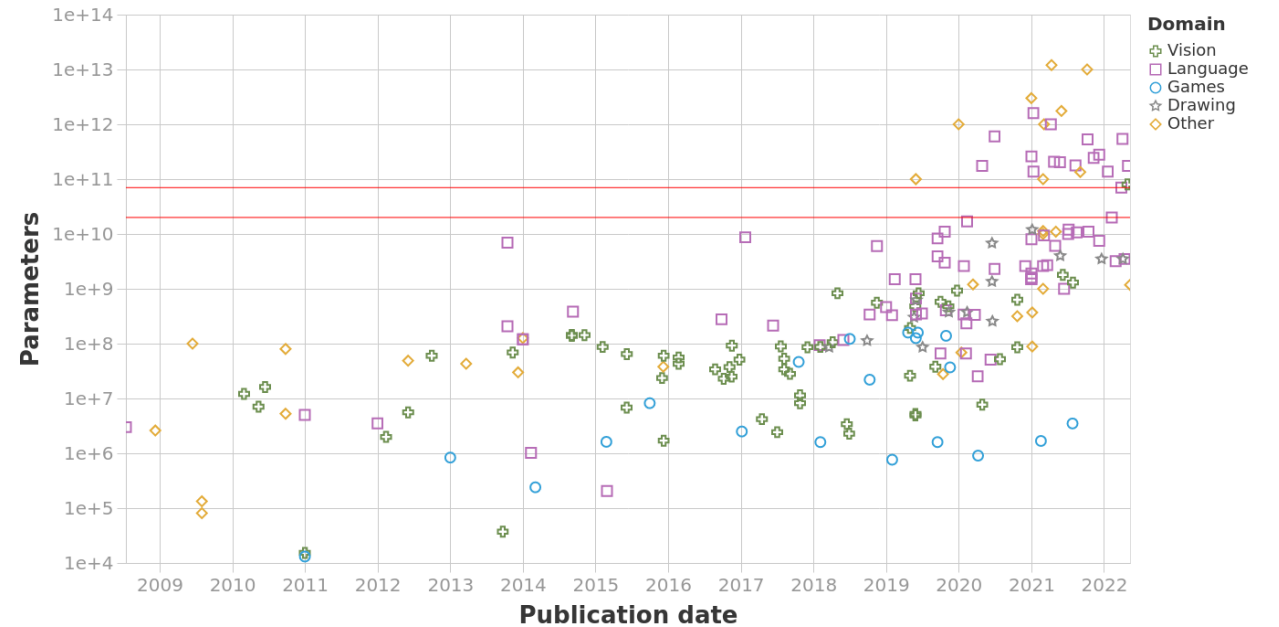
Linear Algebra

Uses: Machine Learning, Scientific Computing



Parameters of milestone Machine Learning systems over time

n = 203

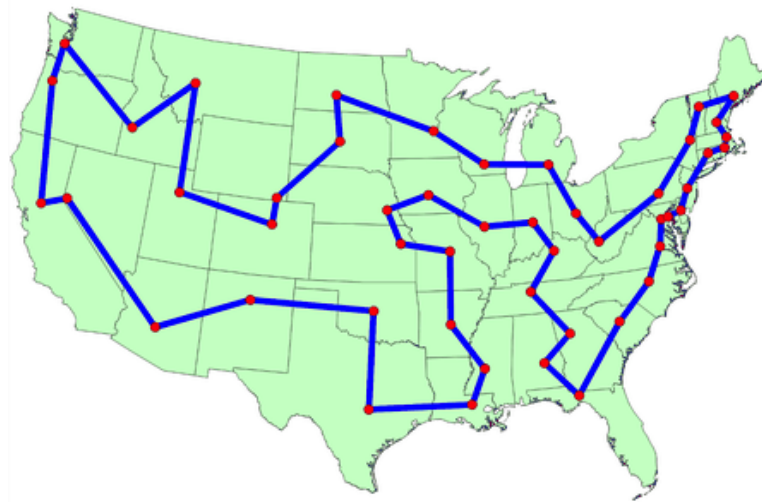


Graph Theory

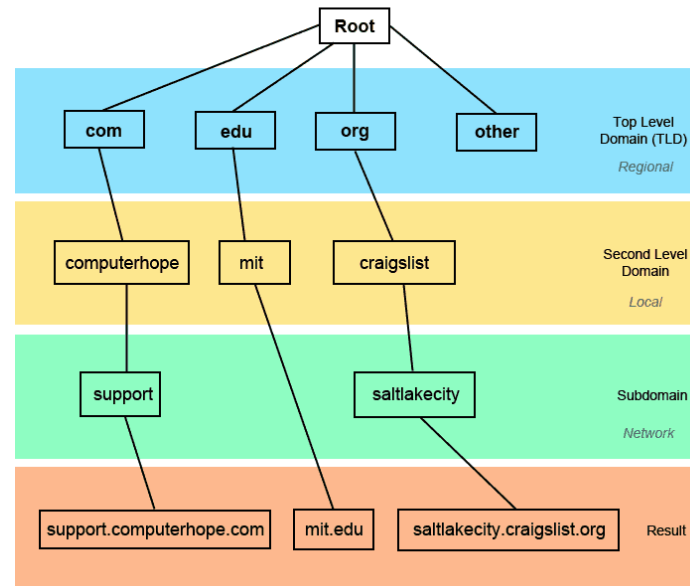
Broadly: Modeling *relationships* between objects

All 'hard' computer science problems end up being graph theory

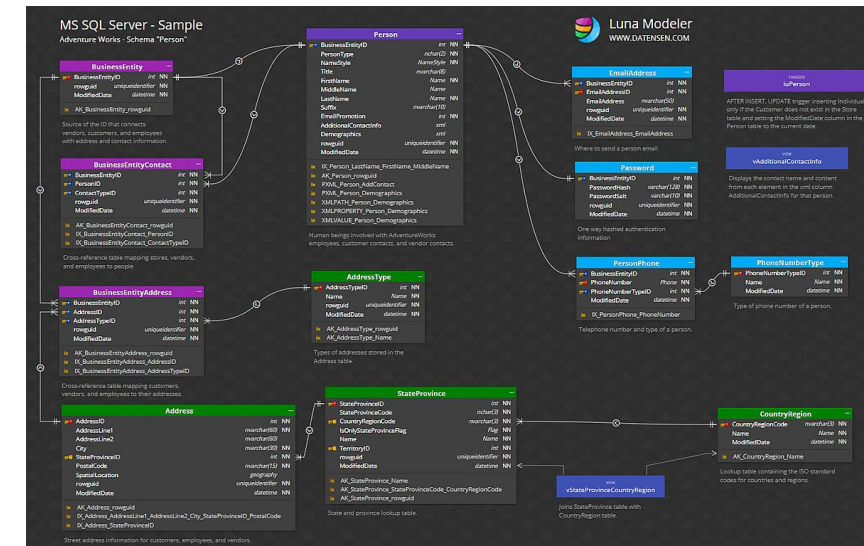
Uses: (Computer) Networking, Path Routing, Data Relations, etc...



Domain Naming Hierarchy



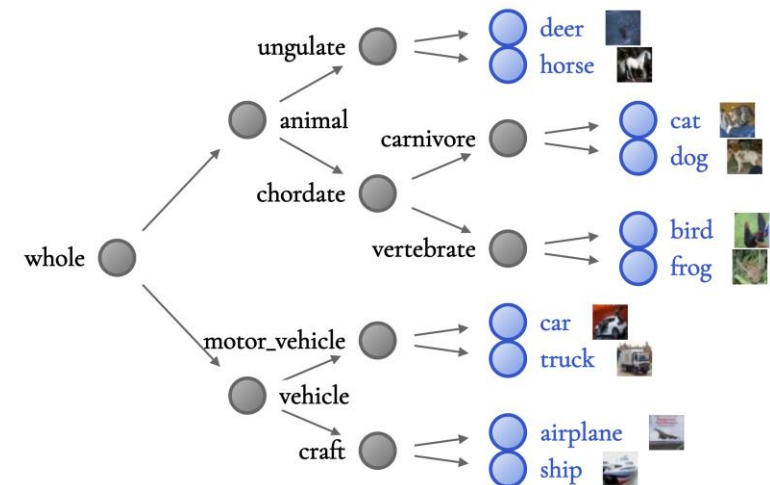
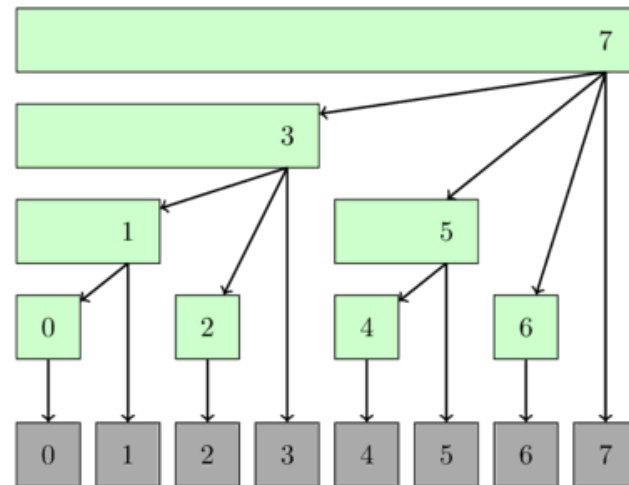
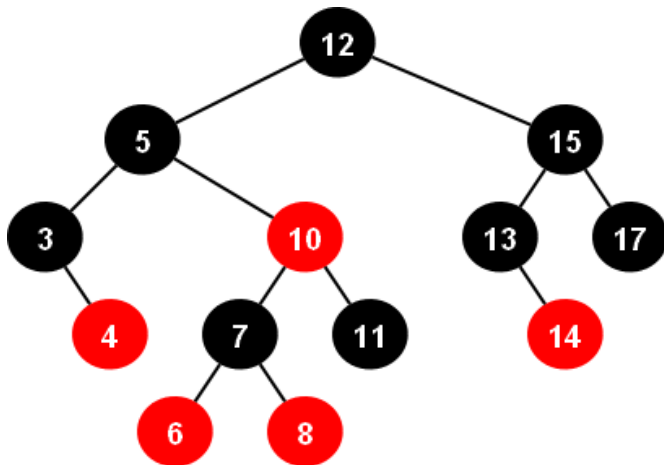
ComputerHope.com



Trees

Uses: Extremely useful way of imbuing 'structure' to a collection of data

A lot of software is using trees + related data structures behind the scenes; Searching data is overwhelmingly more common than creating data



What Now?

- Full courses on these modules (215, 211, 223)
- **Industry | Academia**

PhD or Industry job – onboarding is always an involved part at the beginning, so knowing the fundamentals extremely well allows for quicker onboarding

Find a niche: Computer Science is broad, IT is broad, Tech is broad...

Knowing fundamentals, being able to learn new topics is much more important than skill in <specific technology> tool