

Course Overview

Data Structures
C++ for C Coders

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Data Structures & C++ for C Coders

- **Do the first things first**
 - Bible Study (B2B)
 - Repository for this course:
www.github.com/idebtor/nowic
- **DS20010 Syllabus.pdf**
 - Office hours, TA
 - Course Description and Objectives
 - Textbook, References and Resources
 - IDE and tools to install
 - Problem sets, quizzes, and Grading
- **01 GettingStarted.md**
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SHOW CANTILLATION MARKS ☐

Masoretic Text

SHOW VOWEL POINTS ☒

1:2 כִּי אִם בְּתוֹרַת יְהוָה חִפְּצוּ וּבְתוֹרָתוֹ יִהְיֶה יוֹמָם וּלְיָלָה:

Reverse Interlinear

English (NASB) [?]		Strong's	Root Form (Hebrew)	
But his delight	<input type="button" value="PHR"/>	H2656	חִפֵּץ <i>chephets</i>	<input type="button" value="audio"/>
is in the law	<input type="button" value="PHR"/>	H8451	תּוֹרָה <i>towrah</i>	<input type="button" value="audio"/>
of the LORD,	<input type="button" value="PHR"/>	H3068	יְהוָה <i>Yĕhovah</i>	<input type="button" value="audio"/>
And in His law	<input type="button" value="PHR"/>	H8451	תּוֹרָה <i>towrah</i>	<input type="button" value="audio"/>
<u>he meditates</u>	<input type="button" value="PHR"/>	H1897	הִגָּה <i>hagah</i>	<input type="button" value="audio"/>
day		H3119	יוֹמָם <i>yowmam</i>	<input type="button" value="audio"/>
and night.	<input type="button" value="PHR"/>	H3915	לַיִל <i>layil</i>	<input type="button" value="audio"/>

[시1:1-2] 복 있는 사람은 악인들의 꾀를 따르지 아니하며 죄인들의 길에 서지 아니하며 오만한 자들의 자리에 앉지 아니하고, 오직 여호와와의 율법을 즐거워하여 그의 율법을 주야로 **묵상하는도다**

(Psalm1:1-2) **Blessed is the one** who does not walk in step with the wicked or stand in the way that sinners take or sit in the company of mockers, but whose delight is in the law of the LORD, and who **meditates** on his law day and night.

I. הִנָּה fut. יִהְיֶה—(1) TO MURMUR, TO MUTTER, TO GROWL, (almost the same in meaning as הִמָּה); used of the growl of a lion over his prey (Gr. ὑποβρυχάομαι: *to roar* is שָׁאג, βρυχάομαι), Isa. 31:4; of low thunder (see הִנָּה Job 37:2); of the muttering of enchanters (see HIPHIL); of the sound of a harp when struck (see הִנָּיִן Ps. 9:17; 92:4); of the cooing of doves, Isa. 38:14; 59:11; of the groaning and sighing of men (οἰμώζειν), Isa. 16:7; Jer. 48:31.

(2) poetically, to speak.—(a) absolutely (*to utter sound*), Ps. 115:7.—(b) with an acc. of the thing, Job 27:4; Ps. 37:30; Isa. 59:3; Pro. 8:7; hence *to sing, to celebrate* (like *to say*, אָמַר). Psal. 35:28, לְשׁוֹנִי תְהַלֵּל צִדְקָךְ “my tongue shall celebrate thy righteousness;” Ps. 71:24.

(3) to meditate (prop. *to speak with oneself, murmuring and in a low voice, as is often done by those who are musing*, compare No. 1 and אָמַר בְּלִבּוֹ, אָמַר), followed by כִּי, *to meditate on any thing* (über etwas nachdenken). Josh. 1:8, וְהָנִיתָ בּוֹ יוֹמָם וָלַיְלָה “and thou shalt meditate thereon (on the law) day and night;” Ps. 1:2; 63:7; 77:13, וְהָנִיתִי בְּכָל-פַּעֲלֶךָ “and I will meditate on all thy works;” Ps. 143:5. (Syn. שִׁיחַ).



B2B : Back to the Bible



매주 화요일 늦은 7시, NTH311

**B2B(BackToTheBible)와 오석 공동체로 여러분을 초대합니다.
첫모임: 3/9월??일(화), 문의:010-0000-0000 학생, 김영섭 목.수.**

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Course overview

What does the data structure mean?

- **Data structures:**
 - **methods to store and organize data** in a computer so that it can be used efficiently.
 - A key to designing efficient **algorithms**.
- **Algorithms:**
 - methods for solving a problem
- **Data structures & algorithms** are **the fundamentals of programming**.
 - To become a good computer scientist or engineering it is essential to master the **data structures and algorithms** and learn to apply them to the real world problems.

which is complicated or complex.



Course overview

What is this course?

- Intermediate-level course.
- Programming **after** programming for problem solving with applications.

topic	data structures and algorithms
concepts	algorithms, time-complexity, array and structure
data types	linked list, array, stack, queue, trees, union-find, bag, priority queues
sorting	selection sort, quick sort, merge sort, heap sort
searching	binary search tree, hashing
graph	BFS, DFS

Why study data structures?

Their impact is broad and far-reaching

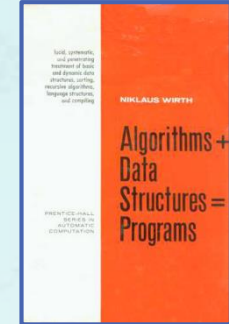
- **Internet** Web search, packet routing, distributed file sharing, ...
- **Social networks** News feeds, advertisements, ...
- **Computers** Circuit layout, file system, compilers, ...
- **Computer graphics** Movies, video games, virtual reality, ...
- **Multimedia** MP3, JPG, DivX, HDTV, face recognition, ...
- **Security** Cell phones, e-commerce, voting machines, ...
- **Biology** Human genome project, protein folding, ...
- **Physics** N-body simulation, particle collision simulation, ...



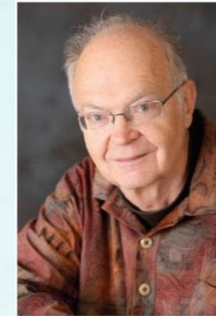
Why study data structures?

To become a proficient programmer.

" Algorithms + **Data Structures** = Programs. " — *Niklaus Wirth*



" An **algorithm** must be seen to be believed. " — *Donald Knuth*



Donald E. Knuth, winner of the Katayanagi Prize for Research Excellence.

" I will, in fact, claim that the difference between a bad programmer and a good one is whether he considers his code or his data structures more important. Bad programmers worry about the code. Good programmers worry about **data structures** and their **relationships**. "

— *Linus Torvalds* (creator of Linux)



Why study data structures?

Algorithms – Old roots, new opportunities.

- Study of **algorithms** dates at least to Euclid.
- Formalized by Church and Turing in 1930s.
- Some important **algorithms** were discovered by undergraduates in a course like this.
- Then, why **data structures**?
It always comes with algorithms like its shadow.

Ex. Fast Fourier Transform(FFT) Algorithm

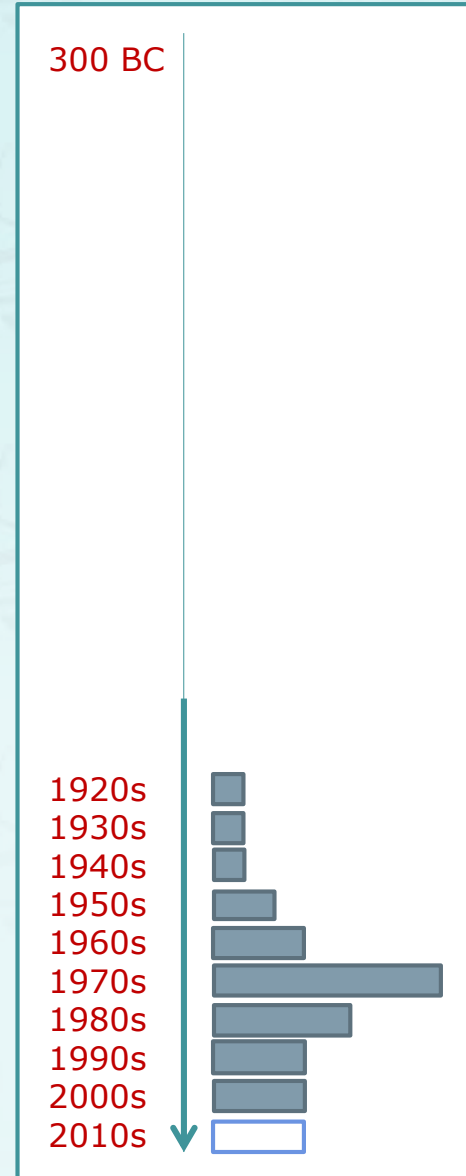
Joseph Fourier(1768-1830) used for heat-transfer computation.

1805 – invented by Carl Friedrich Gauss.

1965 – popularized by James Cooley(IBM) and John Tukey(Princeton).

1986 – JPEG(Joint Photographic Experts Group) was formed.

1992 – issued the first standard of JPEG using DCT
Discrete cosine transform – another form of FFT.



Why study data structures?

They may unlock the secrets of life and of the universe.

Computational models are replacing math models in scientific inquiry.

Ex. Fourier Transform → Fast FT algorithm → Image Processing → **JPEG/MPEG**

1805

1965

1992

Fourier Series & The Fourier Transform

Joseph Fourier 1768 - 1830



What is the Fourier Transform?

Fourier Cosine Series for even functions and Sine Series for odd functions

The continuous limit: the Fourier transform (and its inverse)

The spectrum

Some examples and theorems

$$f(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega) \exp(i\omega t) d\omega \quad F(\omega) = \int_{-\infty}^{\infty} f(t) \exp(-i\omega t) dt$$

Prof. Rick Trebino, Georgia Tech

~ old century science
(formula based)

```
RECURSIVE-FFT(a)
1  n ← length[a]           ▷ n is a power of 2.
2  if n = 1
3    then return a
4  ωn ← e2πi/n
5  ω ← 1
6  a[0] ← (a0, a2, ..., an-2)
7  a[1] ← (a1, a3, ..., an-1)
8  y[0] ← RECURSIVE-FFT(a[0])
9  y[1] ← RECURSIVE-FFT(a[1])
10 for k ← 0 to n/2 - 1
11   do yk ← yk[0] + ω yk[1]
12     yk+(n/2) ← yk[0] - ω yk[1]
13     ω ← ω ωn
14 return y                 ▷ y is assumed to be column vector.
```

21st century science
(algorithm based)

Why study data structures?

- Their impact is broad and far-reaching.
- Old roots, new opportunities.
- To solve problems that could not otherwise be addressed.
- For intellectual stimulation.
- To become a proficient programmer.
- They may unlock the secrets of life and of the universe.
- For fun and profit..



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