Module III: Processes
Learning Goals (1/2)

• recognize and explain the five essential properties of an algorithm: input specified, output specified, definiteness, effectiveness, and finiteness

• explain how variables are used to ease data management and to describe actions on data, and be able to use variables for these purposes in familiar contexts

• recognize and explain the concept of sequences of instructions, variables, loops, functions, conditional statements, and arrays in short programs specified in a programming language such as JavaScript, or in other clearly expressed processes (which may or may not be computer related)
Putting it all together

Data Organization

Interfaces

Processes
Intersect Alphabetized Lists

List 1
- Elephants
- Have
- Humongous
- Noses
- Today

List 2
- Amy’s
- Elephants
- Have
- No
- Noses

List 3
- Elephants
- Fix
- Flying
- Noses
- In
- The
- Zoo

Intersect List
Intersect Alphabetized Lists

List 1
Elephants Have Humongous Noses Today

List 2
Amy’s Elephants Have No Noses

List 3
Elephants Fix Flying Noses In The Zoo

Intersect List
Intersect Alphabetized Lists

List 1

- Elephants
- Have Humongous Noses
- Today

List 2

- Amy’s Elephants
- Have No Noses

List 3

- Elephants Fix Flying Noses In The Zoo

Intersect List

- Elephants

MATCH!!
Intersect Alphabetized Lists

List 1
- Elephants Have Humongous Noses Today

List 2
- Amy's Elephants Have No Noses

List 3
- Elephants Fix Flying Noses In The Zoo

Intersect List
- Elephants
Intersect Alphabetized Lists

List 1
- Elephants
- Have
- Humongous
- Noses
- Today

List 2
- Amy’s
- Elephants
- Have
- No
- Noses

List 3
- Elephants
- Fix
- Flying
- Noses
- In
- The
- Zoo

Intersect List
- Elephants

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Intersect Alphabetized Lists

List 1
- Elephants
- Have
- Humongous
- Noses
- Today

List 2
- Amy’s
- Elephants
- Have
- No
- Noses

List 3
- Elephants
- Fix
- Flying
- Noses
- In
- The
- Zoo

Intersect List
- Elephants
Intersect Alphabetized Lists

List 1
- Elephants
- Have
- Humongous
- Noses
- Today

List 2
- Amy’s
- Elephants
- Have
- No
- Noses

List 3
- Elephants
- Fix
- Flying
- Noses
- In
- The
- Zoo

Intersect List
- Elephants
Intersect Alphabetized Lists

List 1
- Elephants
- Have
- Humongous
- Noses
- Today

List 2
- Amy's
- Elephants
- Have
- No
- Noses

List 3
- Elephants
- Fix
- Flying
- Noses
- In
- The
- Zoo

Intersect List
- Elephants
Intersect Alphabetized Lists

List 1
- Elephants
- Have
- Humongous
- Noses
- Today

List 2
- Amy’s
- Elephants
- Have
- No
- Noses

List 3
- Elephants
- Fix
- Flying
- Noses
- In
- The
- Zoo

Intersect List
- Elephants
Intersect Alphabetized Lists

List 1
Elephants
Have
Humongous
Noses
Today

List 2
Amy’s
Elephants
Have
No
Noses

List 3
Elephants
Fix
Flying
Noses
In
The
Zoo

Intersect List
Elephants
Intersect Alphabetized Lists

List 1
Elephants Have Humongous Noses Today

List 2
Amy’s Elephants Have No Noses

List 3
Elephants Fix Flying Noses In The Zoo

Intersect List
Elephants Noses

MATCH!!
Intersect Alphabetized Lists

List 1
Elephants Have Humongous Noses Today

List 2
Amy’s Elephants Have No Noses

List 3
Elephants Fix Flying Noses In The Zoo

Intersect List
Elephants Noses
Intersect Alphabetized Lists

List 1
Elephants Have Humongous Noses Today

List 2
Amy’s Elephants Have No Noses

List 3
Elephants Fix Flying Noses In The Zoo

Intersect List
Elephants Noses

We have hit the end of the list so we are done
No Alphabetized Lists

Assumption: Input lists are not in lexicographic order

Procedure No Alphabetized Lists:
1. Put a marker/arrow at the start of each list
2. If markers point to the same item, save it
3. Move marker of one list down by one
4. If the marker is at the end of the list, move the marker to the top and advance the marker on the next list by one
5. Repeat 2-4 until all markers are at the end of the list
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1: Socks
       Box
       Knox

List 2: Socks
       On
       Knox

List 3: Knox
       In
       Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

List 1: Socks, Box, Knox
List 2: Socks, On, Knox
List 3: Knox, In, Box

Intersect List
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

- List 1: Socks, Box, Knox
- List 2: Socks, On, Knox
- List 3: Knox, In, Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List

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No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

List 1: Socks, Box, Knox
List 2: Socks, On, Knox
List 3: Knox, In, Box

Intersect List
No Alphabetized Lists

List 1

Socks
Box
Knox

List 2

Socks
On
Knox

List 3

Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List

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No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
No Alphabetized Lists
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

Intersect List
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
- Knox

MATCH!!
No Alphabetized Lists

List 1
- Socks
- Box
- Knox

List 2
- Socks
- On
- Knox

List 3
- Knox
- In
- Box

Intersect List
- Knox
No Alphabetized Lists

List 1
Socks
Box
Knox

List 2
Socks
On
Knox

List 3
Knox
In
Box

We are at the end of all the lists so we are done!

Intersect List
Knox
IAL vs NAL

• Intersect Alphabetized List (IAL):
  • Requires input lists to be in alphabetical order
  • Requires much fewer steps than NAL

• No Alphabetized List (NAL):
  • Does not require the lists to be in alphabetical order
  • Requires many more steps than IAL

Lesson learned: Organizing data in certain ways can make computations much more efficient!
IAL vs NAL

- Steps in IAL: $5 + 5 + 7 = 17$
- Steps in NAL: $5 \times 5 \times 7 = 175$

List 1
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- Today

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- Noses

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### IAL vs NAL

#### A bigger example:
- Steps in IAL: $5+7+7+8+6+6 = 39$
- Steps in NAL: $5*7*7*8*6*6 = 70560$