

Data Structures

SY BTech(CSE)

Unit – 1

Introduction

PPT-2

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Unit 1 [6 hrs]

Introduction:

Data,

Data types,

Data structure,

Abstract Data Type (ADT),

Representation of Information,

Characteristics of algorithm,

Program,

Analyzing programs.

Data Types:

A data type is a collection of **objects and
a set of **operations**
that act on those objects.**

Ex: int

Objects: -32768 to +32767

Operations: +, -, *, /, %

Abstract Data Type (ADT):

Definition:

ADT is a data type that is organized in such a way that

the specification of the objects and

the specification of the operations

on the objects is separated from

the representation of the objects and

the implementation of the operations.

- The **specification** consists of
 1. The name of every function,
 2. The type of its arguments and
 3. The type of its result.
- ADT is **implementation-independent**.

Classification of functions:

- 1. Creator/constructor**
- 2. Transformers**
- 3. Observers/reporters**

1.Creator/constructor:

Create a new instance of the designated type.

2. Transformers:

Create an instance of the designated type, by using one or more other instances.

3.Observers/reporters:

Provide information about an instance, but they do not change the instance.

Ex: ADT NaturalNumber:

objects: zero to INT_MAX.

Operations: Test zero,
test equality,
successor,
add, subtract

ADT NaturalNumber:

Objects: An ordered sub-range of the integers starting at zero and ending at the maximum integer (INT_MAX) on the computer.

functions:

for all $x, y \in \text{Natural number}$,

TRUE, FALSE $\in \text{Boolean}$

and $+$, $-$, $<$ and $==$ are the usual integer operations

Boolean IsZero(x)::=

if(x)

return FALSE

else

return TRUE

Boolean Equal(x, y)::=

if(x==y)

return TRUE

else

return FALSE

NaturalNumber **Successor(x)::=**

if(x==INT_MAX)

return x

else

return x+1

Ex: INT_MAX = 50

x = 50

Successor(50) = 51 (>INT_MAX)

Return 50

x = 20

Successor(20) = 21 (<INT_MAX)

Return 21

NaturalNumber **Add(x,y)::=**

if((x+y)<= INT_MAX)

return x+y

else

return INT_MAX

Ex: INT_MAX = 50

x = 30 y = 40

Add(30,40) = 70 (>INT_MAX)

Return 50

x = 20 y = 10

Add(20,10) = 30 (<INT_MAX)

Return 30

NaturalNumber Subtract(x,y) ::=

if(x<y)

return 0

else

return x-y

End NaturalNumber

Ex: x = 30 y = 40

Subtract(30,40) = 30-40=-10

As x<y

Return 0

x = 20 y = 10

Subtract(20,10) = 10

As (x>y)

Return 10

- **ADT definition begins with the name of the ADT.**

- **Two main sections: objects**
functions

- **Objects:**

Objects are defined in terms of the integers.

- **Functions:**

Data type: NaturalNumber,

TRUE/FALSE : Boolean

Operations: plus, minus, equal and less than

::= assigns result to the left of the function name

Read as “is defined as”.

1.Zero(): No arguments and returns the natural number zero.

2.Successor(): Returns the next natural number in sequence.

If x is `INT_MAX`, then returns `INT_MAX` or Error message.

3. Add, Subtract: May generate error message.

Ex: Add the following operations to the NaturalNumber ADT: Predecessor, IsGreater, Multiply, Divide.

```
NaturalNumber Predecessor(x)::= if(x==0)
                                return 0
                                else
                                return x-1
```

```
NaturalNumber IsGreater(x,y)::=if(x>y)
                                     return x
                                   else
                                     return y
```

```
NaturalNumber Divide(x,y)::=if(x<y )
                                return 0
                                else
                                return x/y
```

Ex: Create an ADT Boolean. The operations are And, Or, Not, Xor.

ADT Boolean:

objects: An ordered sub-range of the integers starting at zero and ending at the maximum integer (INT_MAX) on the computer.

Function:

for all $x, y \in \text{Natural number}$,

TRUE, FALSE \in Boolean

Operations: $>$, $==$, $!=$