

# Programming Proverbs

- 3. “Use the top-down approach.”
- Henry F. Ledgard, “Programming Proverbs: Principles of Good Programming with Numerous Examples to Improve Programming Style and Proficiency”, (Hayden Computer Programming Series), Hayden Book Company, 1st edition, ISBN-13: 978-0810455221, December 1975.

# Structs

- sometimes it is desirable to create your own data types which contain more than one other type
- for example, suppose we want to create a `coord` data type
- we would expect it to contain an `x` and `y` component
- in `C#` we can do this using a `struct`

## struct coord

- once the `coord` struct is defined we can use it
  - it should make our programs easier to maintain and clearer

## struct coord

```
using System;  
  
public struct coord  
{  
    public int x;  
    public int y;  
}
```



## Improving coord

- C# allows us to employ operator overloading and constructors with structs

# Improving coord

```
using System;

public struct coord
{
    public int x;
    public int y;

    public override string ToString ()
    {
        return String.Format ("{0}, {1}", x, y);
    }
}
```

## Improving coord

```
public class test
{
    public static void Main ()
    {
        coord monster;

        monster.x = 50;
        monster.y = 10;

        Console.WriteLine ("monster at {0}", monster);
    }
}
```



## Output of the improved program

- ```
monster at 50, 10
```
- the function/method `ToString` will be called by the `Console.WriteLine` to resolve how a data type is converted into a string
- technique referred to as polymorphism
  - we associate a method with its data type
  - if nothing else this mechanism provides a way of debugging these data types
- in subsequent years you will meet this issue again

## Pedagogical example: `fract`

- let us create a fraction data type `fract`
- `fract` will have a whole number, numerator and denominator
- $w + \frac{n}{d}$

## Pedagogical example: fract

```
using System;

public struct fract
{
    public int w; // the whole component
    public int n; // the numerator
    public int d; // the denominator
    private bool positive; // is this a positive number?
    private bool is_simplified; // have we simplified this yet?
```

## Pedagogical example: fract

- the constructor method

- ```
public fract (int whole, int num, int dem)
{
    w = whole;
    n = num;
    d = dem;
    positive = true;
    is_simplified = false;
}
```

## Pedagogical example: fract

```
public override string ToString ()
{
    if (w == 0 && n == 0)
        return "zero";

    if (positive)
    {
        if (w == 0)
            return String.Format ("{0}/{1}", n, d);
        else {
            if (n == 0)
                return String.Format ("{0}", w);
            return String.Format ("{0} and {1}/{2}", w, n, d);
        }
    }
}
```

## Pedagogical example: fract

```
else
{
  if (w == 0)
    return String.Format ("-{0}/{1}", n, d);
  else {
    if (n == 0)
      return String.Format ("-{0}", w);
    return String.Format ("-( {0} and {1} / {2} )", w, n, d);
  }
}
}
```

## Pedagogical example: fract

```
public class test
{
    public static void Main ()
    {
        fract a = new fract (1, 1, 2);

        Console.WriteLine ("a = {0}", a);
    }
}
```

output when the program is run

a = 1 and 1/2

## Pedagogical example: fract

- notice that we needed to use the keyword `new`



## Improved struct fract to include simplification

- let us revisit the code and introduce the ability for the output routine to simplify the fraction if necessary

## Improved struct fract to include simplification

```
using System;

public struct fract
{
    public int w;
    public int n;
    public int d;
    private bool positive;
    private bool is_simplified;

    public fract (int whole, int num, int dem)
    {
        w = whole;
        n = num;
        d = dem;
        positive = true;
        is_simplified = false;
    }
}
```

## Improved struct fract to include simplification

```
/*  
 * gcd - Euclid's Greatest Common Denominator algorithm.  
 *       pre-condition : x and y are both >0  
 *       post-condition: return the greatest denominator of,  
 *                       x, and, y.  
 */  
  
public int gcd (int x, int y)  
{  
    while (x != y)  
    {  
        if (x > y)  
            x -= y;  
        else  
            y -= x;  
    }  
    return x;  
}
```

## Dryrun of Euclid's algorithm

- the result of this algorithm is to return the largest whole number which can be divided into both, x, and, y



<b>Iteration number</b>	<b>x</b>	<b>y</b>
0	20	15
1	5	15
2	5	10
3	5	5

## Dryrun of Euclid's algorithm



<b>Iteration number</b>	<b>x</b>	<b>y</b>
0	9	12
1	9	3
2	6	3
3	3	3

## Dryrun of Euclid's algorithm



<b>Iteration number</b>	<b>x</b>	<b>y</b>
0	72	48
1	24	48
2	24	24

## Completing the code associated with the fract struct

```
/*
 * simplify - pre-condition : an initialised fract
 *                post-condition: whole, num, denom are
 *                converted into their
 *                simplist form.
 */

public void simplify ()
{
    int t;

    if (is_simplified) // if it has been simplified before return
        return;
    if (n == 0) // if the numerator is 0 set the demoninator to 0
        d = 0;
```

## Completing the code associated with the fract struct

```
if ((n != 0) && (d != 0)) // if we have a fraction component
{
    if (n > d) // if the fraction is vulgar
    {
        t = n / d; // t is the whole number in the vulgar fraction
        w += t; // add it to the whole number
        n = n % d; // find remainder which becomes new numerator
    }
}
```



## Completing the code associated with the fract struct

```
if ((n != 0) && (d != 0))
{
    t = gcd (n, d); // t is the largest number which goes
    if (t > 1) // into n, d
    {
        n = n / t; // reduce both numerator and demoninator
        d = d / t; // by t
    }
}
if (n == d) // is the fraction a whole number?
{
    n = 0;
    d = 0;
    w++;
}
is_simplified = true; // set flag saying it is simplified
}
```

## ToString method

```
public override string ToString ()  
{  
    if (w == 0 && n == 0)  
        return "zero";  
  
    simplify ();  
  
    /* as before. */  
}
```

## Test code

```
public class test
{
    public static void Main ()
    {
        fract a = new fract (0, 3, 2);

        Console.WriteLine ("a = {0}", a);
    }
}
```

output when running code:

a = 1 and 1/2

# Tutorial

- download the `<http://floppsie.comp.glam.ac.uk/download/csharp/pacman.cs>` code and `<http://floppsie.comp.glam.ac.uk/download/csharp/level1.txt>` file
  - `level1.txt` will need to be placed into your *projectname/bin/debug* directory
  
- build it and see the game start
  
- copy `level1.txt` to `level2.txt`
  - now edit `level1.txt` and make some changes

# Tutorial

- notice that the `move_ghost` is a function which calls four other functions depending upon the name of the ghost
  - currently only `move_ghost_1` is implemented
  - see if you can create `move_ghost_2`, `move_ghost_3` and `move_ghost_4` and call them appropriately inside `move_ghost`
  
- `move_ghost_2` should prioritise y movement
  
- `move_ghost_3` should only change direction if necessary
  
- `move_ghost_4` should change direction if at all possible
  - hint code 1 ghost at a time