PROGRAMMING

CT103

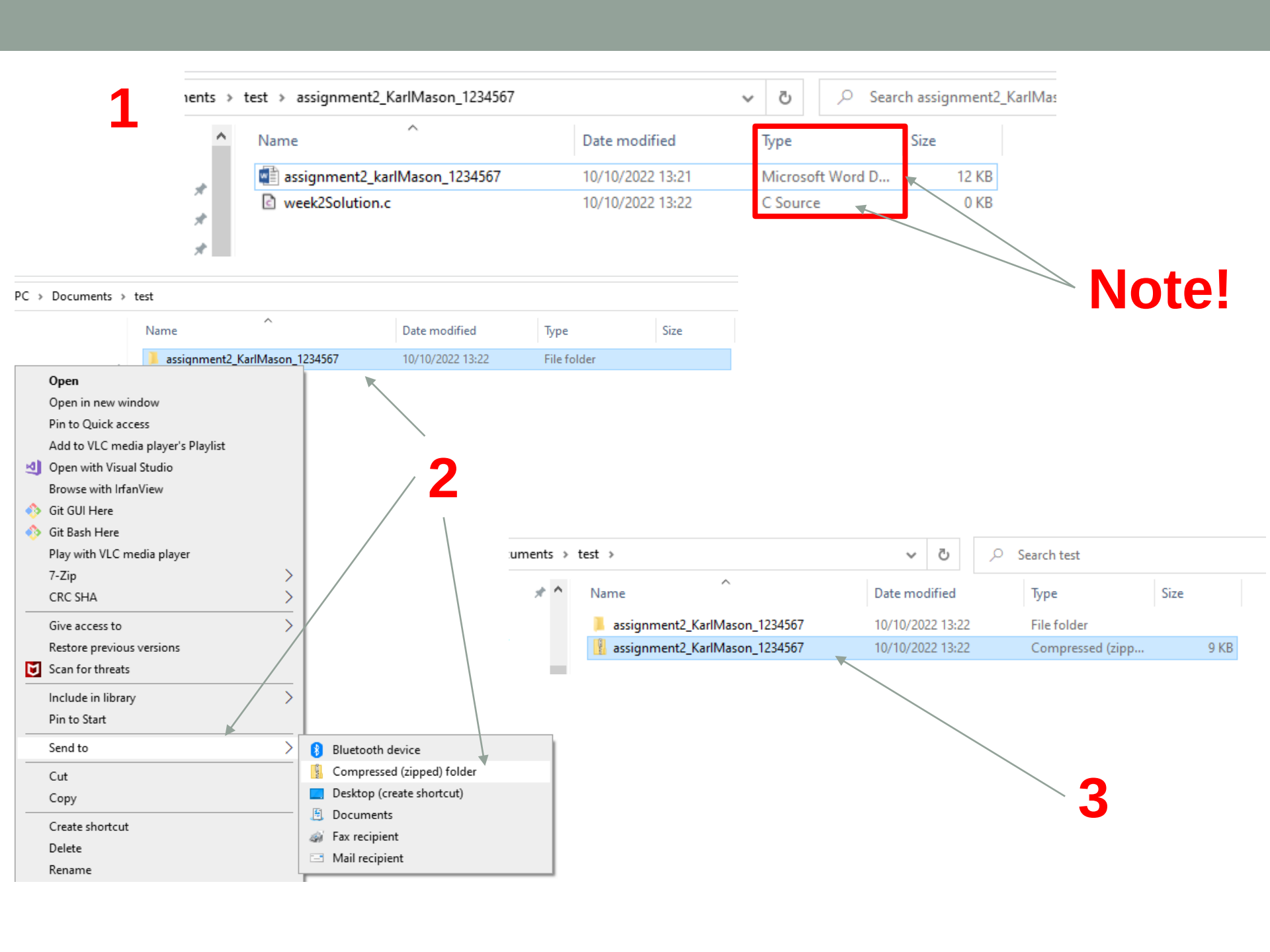
Week 3b

Note on Lab Assignments

- Please make sure to bring your laptop if you can.
- Submit your **.c file** and **.doc file** in a **zipped** up **folder**.
- If you receive an email from me or the lab instructors, requesting the correct files. Please **respond as soon as possible** to ensure the correct files are marked.
- Make sure your code in your .c file matches your code in your .doc file.

Note on Lab Assignments

- Make sure you do the assignments yourself. It is fine to ask each other questions or use C code I provide in lectures.
- Do not copy another students assignment. Plagiarism is taken seriously by the university.
- If instances of plagiarism are detected, all students involved will receive a grade of zero for the assignment and may be subject to further disciplinary proceedings.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Lecture Content

- Last lecture (Week 3a):
  - Boolean Logic.
  - Switch Statements.
  - Characters.
- Today's evening lecture (Week 3b):
  - Loops.
  - While loops.
  - Do while loops.
  - Example C program.

WHY DO WE NEED LOOPS?

Loops

- Up until now we have not actually looked at any C programs that use loops.
- Loops are useful if we want to do the same task more than once.
- If we did not have loops, we would have to rewrite the same code over and over.
  - This would be time consuming, unreadable and difficult to change.

Motivating Loops Example

- How would I write a program that would do the following 3 times **without using loops**.
  - Read in two numbers.
  - Add them together.
  - Print the result.

Motivating Loops Example

- You could do the following:

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);
}
```

Motivating Loops Example

- When you run the code, it works and gives the following output:

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);
}
```

```
Enter number 1:5
Enter number 2:3
The sum is 8
Enter number 1:4
Enter number 2:1
The sum is 5
Enter number 1:6
Enter number 2:8
The sum is 14
```

Motivating Loops Example

- There are plenty of problems with this:
- The code is longer than it needs to be.
- What if we want to change it so that we are subtracting numbers instead of adding numbers?
- This is doable for repeating this task 3 times, what if we want to do it 100 times? Or 10000 times?

- Loops are a way of solving these issues!

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);
}
```

WHILE LOOPS

While Loops

- The first type of loop we will cover is called the **while loop**.

- The while loop will repeat a block of code over and over while some condition is true.

While Loops Template

- While loops have the following structure:

```
while (condition) {
    // Do something
}
```

- We have some **condition**, e.g. number<10.
- While this condition is **True**, whatever is inside the curly brackets {} gets executed.
- This is useful for doing something more than once!

While Loops Example

- Lets look at the following simple while loop.

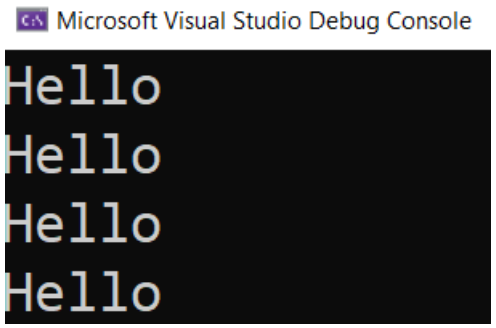
```
int j = 0;
while (j<4) {
    printf("Hello\n");
    j++;
}
```

- This code will print “Hello” to the screen 4 times.

While Loops Example

- See the output of this code:

```
int j = 0;
while (j<4) {
    printf("Hello\n");
    j++;
}
```



- Of course don’t forget # include and void main!

Loops Example

- Remember the problem from earlier:
- How would I write a program that would do the following 3 times **without using loops**.
  - Read in two numbers.
  - Add them together.
  - Print the result.

- How would I now do this **using a while loop**?

While Loops Example

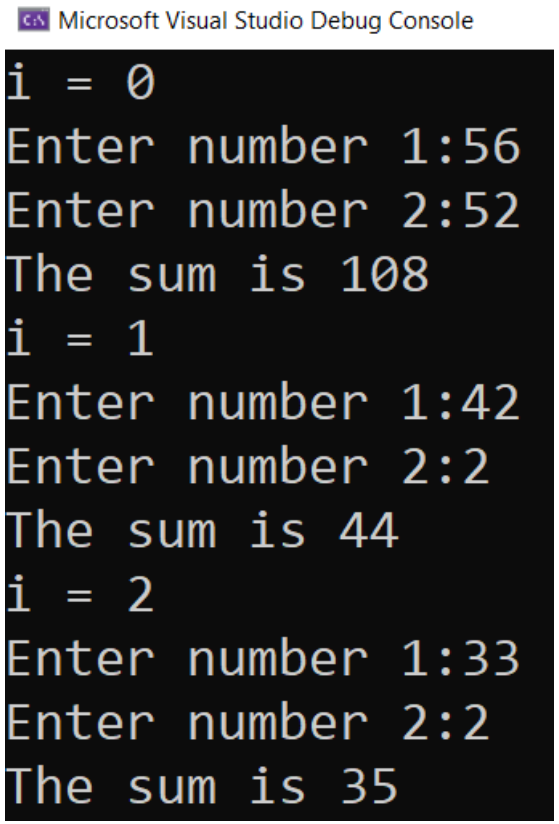
- You would do the following:

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;
    int i = 0;

    while (i<3){
        printf("i = %d\n",i);
        printf("Enter number 1:");
        scanf_s("%d", &num1);
        printf("Enter number 2:");
        scanf_s("%d", &num2);
        total = num1 + num2;
        printf("The sum is %d\n", total);
        i++;
    }
}
```

While Loops Example

- Running the program will give you the following output:

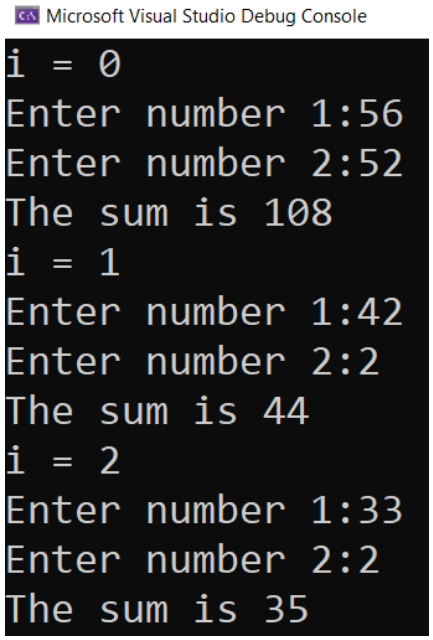
```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;
    int i = 0;

    while (i<3){
        printf("i = %d\n",i);
        printf("Enter number 1:");
        scanf_s("%d", &num1);
        printf("Enter number 2:");
        scanf_s("%d", &num2);
        total = num1 + num2;
        printf("The sum is %d\n", total);
        i++;
    }
}
```



While Loops Example

- This program gives the same output as the previous example (except I am printing an extra line that shows i).

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;
    int i = 0;

    while (i<3){
        printf("i = %d\n",i);
        printf("Enter number 1:");
        scanf_s("%d", &num1);
        printf("Enter number 2:");
        scanf_s("%d", &num2);
        total = num1 + num2;
        printf("The sum is %d\n", total);
        i++;
    }
}
```



Solution Comparison

- The solution on the left uses while loops. The solution on the right does not.

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;
    int i = 0;

    while (i<3){
        printf("i = %d\n",i);
        printf("Enter number 1:");
        scanf_s("%d", &num1);
        printf("Enter number 2:");
        scanf_s("%d", &num2);
        total = num1 + num2;
        printf("The sum is %d\n", total);
        i++;
    }
}
```

```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);

    printf("Enter number 1:");
    scanf_s("%d", &num1);
    printf("Enter number 2:");
    scanf_s("%d", &num2);
    total = num1 + num2;
    printf("The sum is %d\n", total);
}
```

Advantages of While Loops

- Using while loops gives us the following advantages:
  - The code is easier to read.
  - If I want to run the same block of code 10000 times, all I need to do is change the condition to (i<10000).
  - If I want to make a change to multiply numbers together instead of adding them, I only need to do it once!

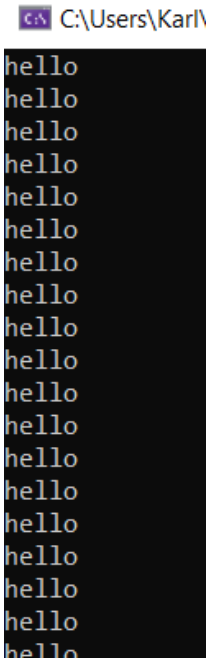
```c
#include <stdio.h>
void main() {
    int num1;
    int num2;
    int total;
    int i = 0;

    while (i<3){
        printf("i = %d\n",i);
        printf("Enter number 1:");
        scanf_s("%d", &num1);
        printf("Enter number 2:");
        scanf_s("%d", &num2);
        total = num1 + num2;
        printf("The sum is %d\n", total);
        i++;
    }
}
```

Avoid infinite loops!

- An infinite loop is a loop that can never end.
- Therefore be careful with your while **condition**.
- You must change a variable inside the while loops body that is used in the condition – otherwise you could end up in an infinite loop.
- Below are both examples of infinite loops:

```
int i = 0;
while (i < 3) {
    printf("hello\n");
}
```

```
while (2 < 3) {
    printf("hello\n");
}
```



DO WHILE LOOPS

Do While Loops

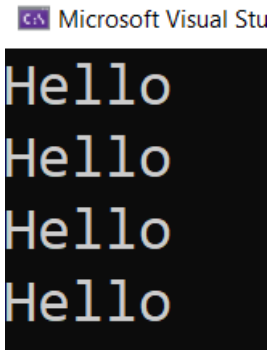
- Do While Loops are a variant of while loops.
- They work in much the same way as while loops.
- Do While Loops have the following structure.

```
do {
    // do something
} while (condition);
```

Do While Loops Example

- Print “Hello” 4 times using a do while loop.

```
int j = 0;
do {
    printf("Hello\n");
    j++;
} while (j<4);
```



Why Use Do While Loops?

- You can use a do while loop if you want to ensure that you execute a block of code **at least once**.

```
int j = 0;
do {
    printf("Hello\n");
    j++;
} while (j<4);
```

"Hello" will be printed at a minimum of once, irrespective of what value j has.

Do While Comparison with While

- Both of the following programs with print “Hello” 4 times.
- The program on the **left** uses a **do while** loop.
- The program on the **right** uses a **while** loop.

```
int j = 0;
do {
    printf("Hello\n");
    j++;
} while (j<4);
```

```
int j = 0;
while (j<4) {
    printf("Hello\n");
    j++;
}
```

EXAMPLE PROBLEM

Example Problem

- Write a program that reads in the users weight in kg and height in meters.
- Calculate their BMI as: BMI = weight / height^2.
- Your program should then give the user an option to go again or to end the program.
- The user should be able to do as many BMI calculations as possible.

Example Problem

- Go to C program solution.

BMI C Program

- The following will code will work:

```c
#include <stdio.h>
void main() {
    float height;
    float weight;
    float bmi;
    int again = 1;
    do
    {
        printf("Enter your weight in kilos: ");
        scanf_s("%f", &weight);

        printf("Enter your height in metres: ");
        scanf_s("%f", &height);

        bmi = (weight) / (height * height);

        printf("Your BMI is: %f.  \n Enter 1 to do again or 0 to exit.\n", bmi);
        scanf_s("%d", &again);
    } while (again == 1);
}
```

BMI C Program Output

- The code will produce the following output: