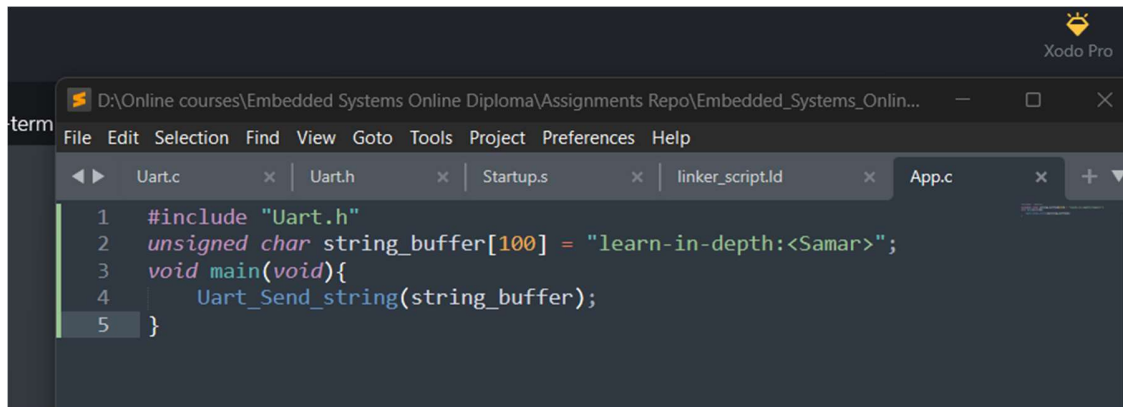


Lesson 2-Lab 1

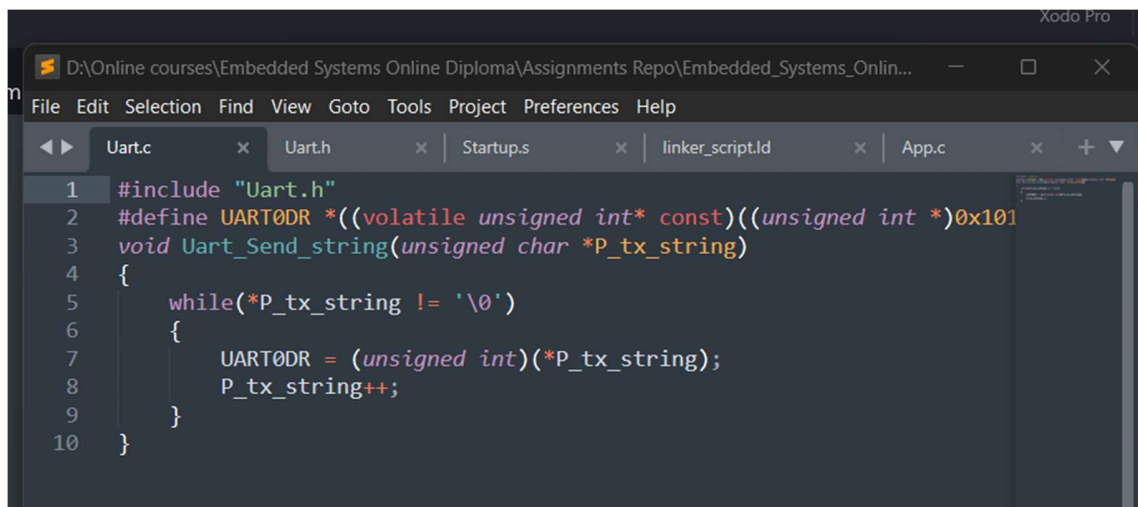
1-Codes

App.c

A screenshot of the Xodo Pro code editor. The window title is "D:\Online courses\Embedded Systems Online Diploma\Assignments Repo\Embedded_Systems_Onlin...". The menu bar includes File, Edit, Selection, Find, View, Goto, Tools, Project, Preferences, and Help. The tab bar shows Uart.c, Uart.h, Startup.s, linker_script.ld, and App.c. The App.c file is open, showing the following code:

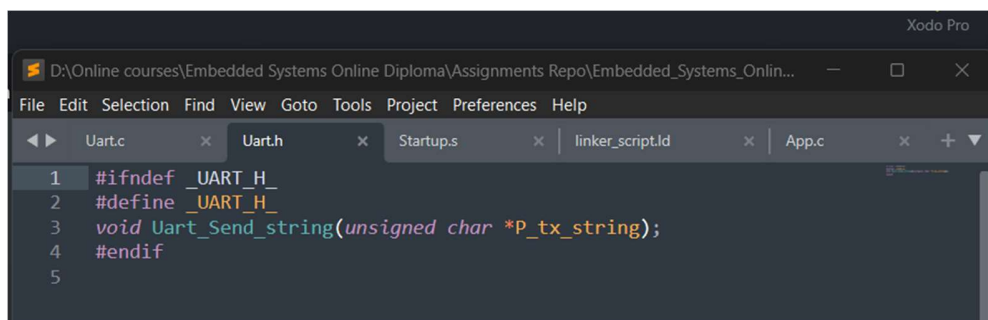
```
1 #include "Uart.h"
2 unsigned char string_buffer[100] = "learn-in-depth:<Samar>";
3 void main(void){
4     Uart_Send_string(string_buffer);
5 }
```

Uart.c

A screenshot of the Xodo Pro code editor. The window title is "D:\Online courses\Embedded Systems Online Diploma\Assignments Repo\Embedded_Systems_Onlin...". The menu bar includes File, Edit, Selection, Find, View, Goto, Tools, Project, Preferences, and Help. The tab bar shows Uart.c, Uart.h, Startup.s, linker_script.ld, and App.c. The Uart.c file is open, showing the following code:

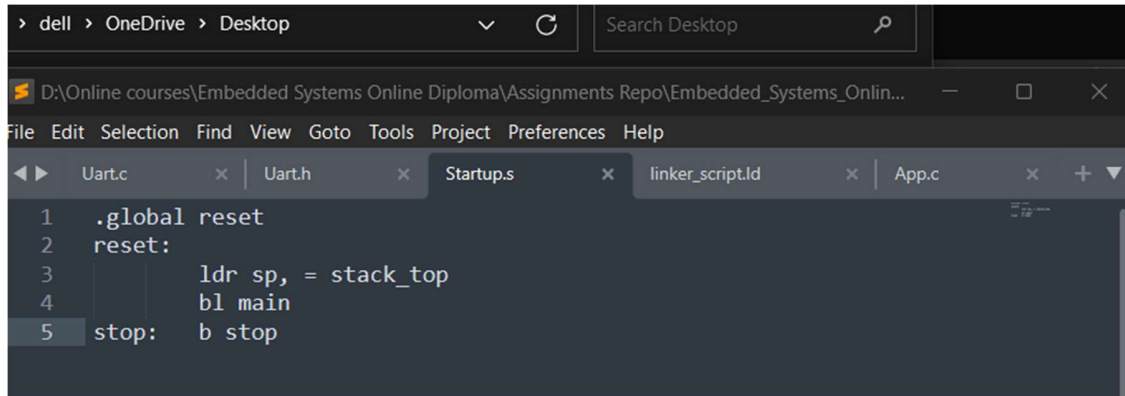
```
1 #include "Uart.h"
2 #define UART0DR *((volatile unsigned int* const)((unsigned int *)0x101
3 void Uart_Send_string(unsigned char *P_tx_string)
4 {
5     while(*P_tx_string != '\0')
6     {
7         UART0DR = (unsigned int)(*P_tx_string);
8         P_tx_string++;
9     }
10 }
```

Uart.h

A screenshot of the Xodo Pro code editor. The window title is "D:\Online courses\Embedded Systems Online Diploma\Assignments Repo\Embedded_Systems_Onlin...". The menu bar includes File, Edit, Selection, Find, View, Goto, Tools, Project, Preferences, and Help. The tab bar shows Uart.c, Uart.h, Startup.s, linker_script.ld, and App.c. The Uart.h file is open, showing the following code:

```
1 #ifndef _UART_H_
2 #define _UART_H_
3 void Uart_Send_string(unsigned char *P_tx_string);
4 #endif
5
```

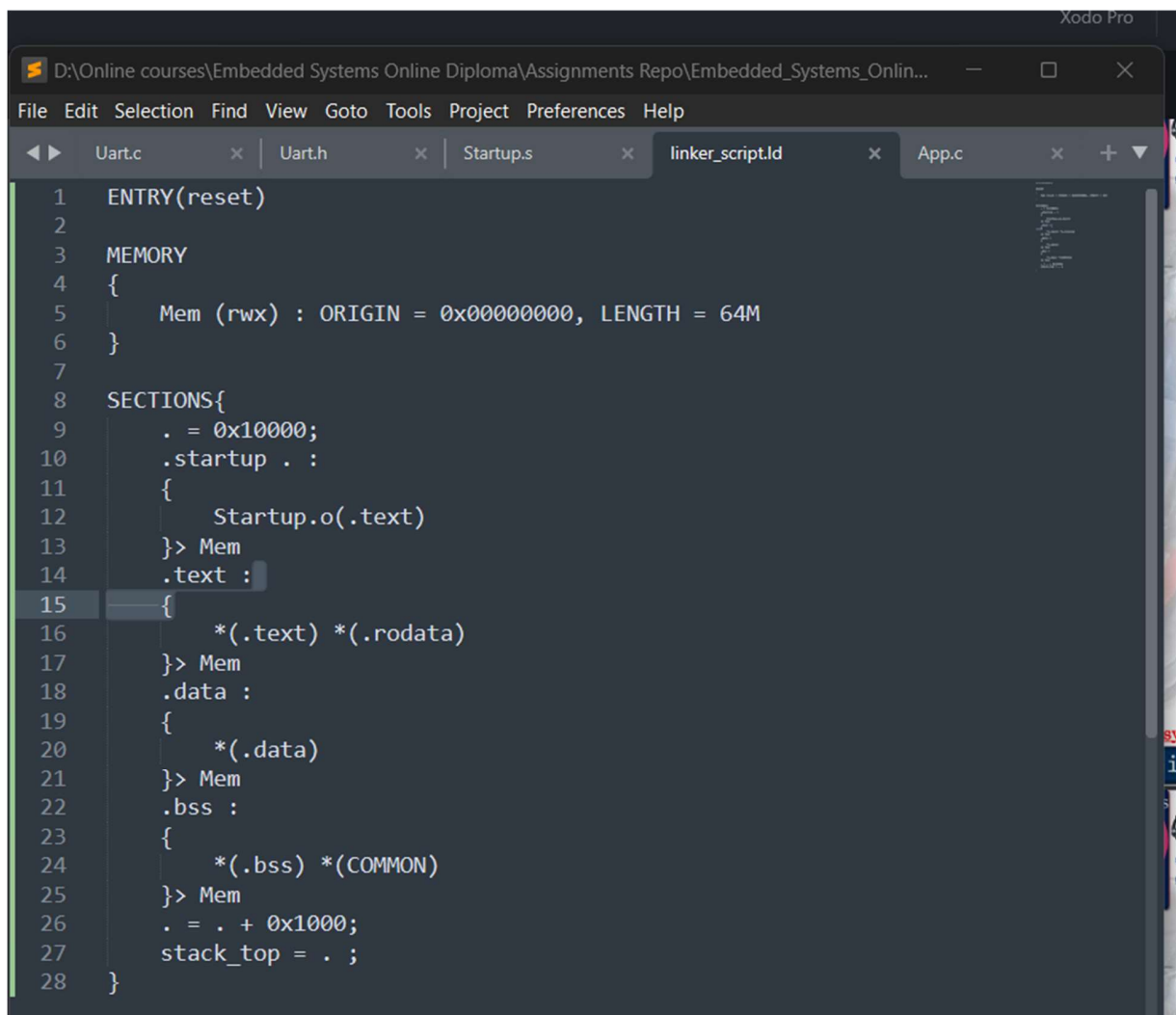
Startup.s



The screenshot shows a code editor window with the file path `D:\Online courses\Embedded Systems Online Diploma\Assignments Repo\Embedded_Systems_Onlin...`. The editor has a menu bar with `File`, `Edit`, `Selection`, `Find`, `View`, `Goto`, `Tools`, `Project`, `Preferences`, and `Help`. The tab bar shows `Uart.c`, `Uart.h`, `Startup.s`, `linker_script.ld`, and `App.c`. The `Startup.s` file is open, showing the following assembly code:

```
1 .global reset
2 reset:
3     ldr sp, = stack_top
4     bl main
5 stop: b stop
```

Linker_script.ld



The screenshot shows a code editor window with the file path `D:\Online courses\Embedded Systems Online Diploma\Assignments Repo\Embedded_Systems_Onlin...`. The editor has a menu bar with `File`, `Edit`, `Selection`, `Find`, `View`, `Goto`, `Tools`, `Project`, `Preferences`, and `Help`. The tab bar shows `Uart.c`, `Uart.h`, `Startup.s`, `linker_script.ld`, and `App.c`. The `linker_script.ld` file is open, showing the following linker script:

```
1 ENTRY(reset)
2
3 MEMORY
4 {
5     Mem (rwx) : ORIGIN = 0x00000000, LENGTH = 64M
6 }
7
8 SECTIONS{
9     . = 0x10000;
10    .startup . :
11    {
12        Startup.o(.text)
13    }> Mem
14    .text :
15    {
16        *(.text) *(.rodata)
17    }> Mem
18    .data :
19    {
20        *(.data)
21    }> Mem
22    .bss :
23    {
24        *(.bss) *(COMMON)
25    }> Mem
26    . = . + 0x1000;
27    stack_top = . ;
28 }
```

2-Object files

App.o

```
MINGW32:/d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Syste...
_Diploma/Unit3/Lesson2/Lab1 (main)
$ arm-none-eabi-objdump.exe -h App.o

App.o:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA           LMA           File off  Algn
  0 .text          00000018  00000000  00000000  00000034  2**2
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000064  00000000  00000000  0000004c  2**2
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  000000b0  2**0
    ALLOC
  3 .debug_info     0000006c  00000000  00000000  000000b0  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  4 .debug_abbrev   0000005a  00000000  00000000  0000011c  2**0
    CONTENTS, READONLY, DEBUGGING
  5 .debug_loc      0000002c  00000000  00000000  00000176  2**0
    CONTENTS, READONLY, DEBUGGING
  6 .debug_aranges  00000020  00000000  00000000  000001a2  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  7 .debug_line     00000035  00000000  00000000  000001c2  2**0
    CONTENTS, RELOC, READONLY, DEBUGGING
  8 .debug_str      000000b2  00000000  00000000  000001f7  2**0
    CONTENTS, READONLY, DEBUGGING
  9 .comment        00000012  00000000  00000000  000002a9  2**0
    CONTENTS, READONLY
10 .ARM.attributes 00000032  00000000  00000000  000002bb  2**0
    CONTENTS, READONLY
11 .debug_frame    0000002c  00000000  00000000  000002f0  2**2
    CONTENTS, RELOC, READONLY, DEBUGGING

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Emb
edded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$
```

Startup.o

```
MINGW32:/d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Syste...

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Emb
edded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$ arm-none-eabi-objdump.exe -h Startup.o

Startup.o:  file format elf32-littlearm

Sections:
Idx Name          Size      VMA           LMA           File off  Algn
  0 .text          00000010  00000000  00000000  00000034  2**2
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000000  00000000  00000000  00000044  2**0
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  00000044  2**0
    ALLOC
  3 .ARM.attributes 00000022  00000000  00000000  00000044  2**0
    CONTENTS, READONLY

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Emb
edded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$
```


3-Use linker_script to get the executable and the map file

Learn-in-depth.elf sections

```
dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$ arm-none-eabi-ld.exe -T linker_script.ld Startup.o App.o Uart.o -o learn-in-depth.elf -Map=Map_file.map

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$ arm-none-eabi-objdump.exe -h learn-in-depth.elf

learn-in-depth.elf:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
 0  .startup       00000010  00010000  00010000  00008000  2**2
    CONTENTS, ALLOC, LOAD, READONLY, CODE
 1  .text          00000068  00010010  00010010  00008010  2**2
    CONTENTS, ALLOC, LOAD, READONLY, CODE
 2  .data          00000064  00010078  00010078  00008078  2**2
    CONTENTS, ALLOC, LOAD, DATA
 3  .ARM.attributes 0000002e  00000000  00000000  000080dc  2**0
    CONTENTS, READONLY
 4  .comment       00000011  00000000  00000000  0000810a  2**0
    CONTENTS, READONLY

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Emb
```

Symbol table for learn-in-depth.elf

```
MINGW32:/d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Syste...
dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$ arm-none-eabi-nm.exe learn-in-depth.elf
00010010 T main
00010000 T reset
000110dc D stack_top
00010008 t stop
00010078 D string_buffer
00010028 T Uart_Send_string

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
```

4-get binary file

5-burn binary file on board using qemu

```
MINGW32:/d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Syste...
dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$ ../qemu
bash: ../qemu: No such file or directory

dell@DESKTOP-SKJEPK2 MINGW32 /d/Online courses/Embedded Systems Online Diploma/Assignments Repo/Embedded_Systems_Online_Diploma/Unit3/Lesson2/Lab1 (main)
$ qemu-system-arm -M versatilepb -m 128M -nographic -kernel App.bin
learn-in-depth:<Samar>
```