TTK4155
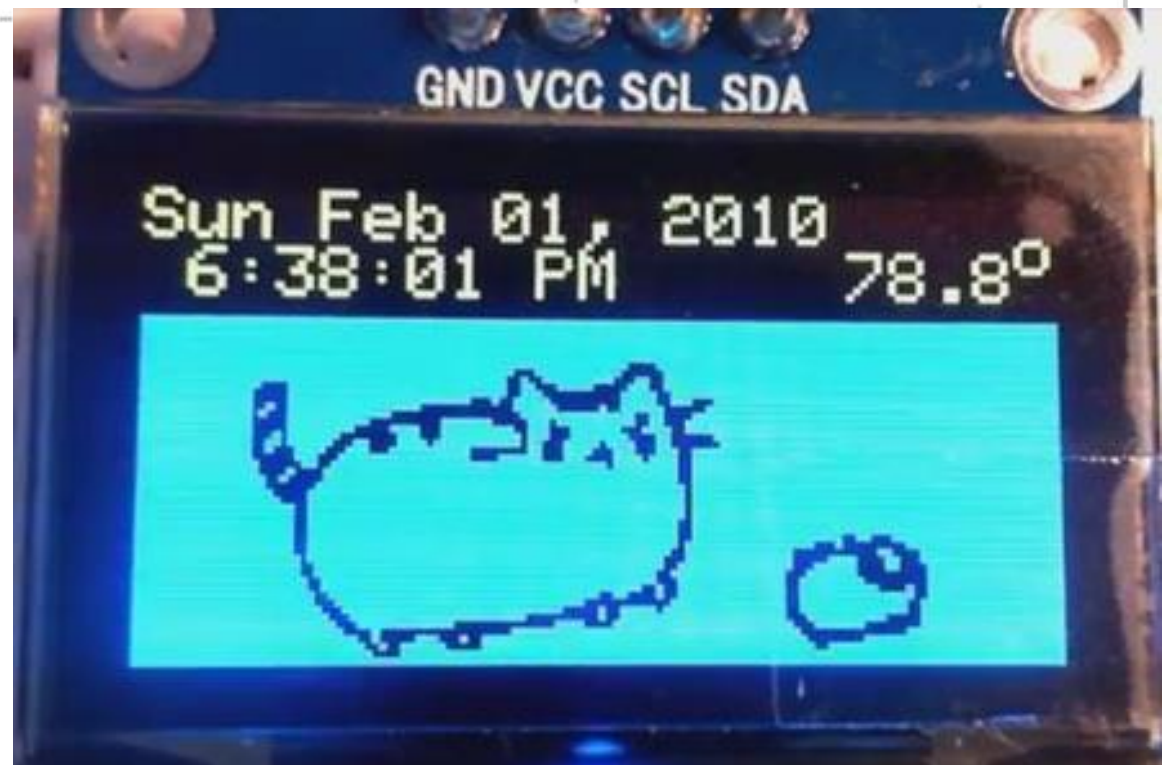
Industrial and Embedded Computer Systems Design

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Lab lecture 4

- OLED and user

  interface.

- Game Menu

GND VCC SCL SDA

Sun Feb 01, 2010
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- In this exercise, you will

  - Connect the OLED display to the memory bus
  - Extend the address decoding logic in the GAL

- The display will be used later for a game menu, and displaying the score while playing

- Can also be used for 'extras' e.g. dual buffer, animation, figures etc.

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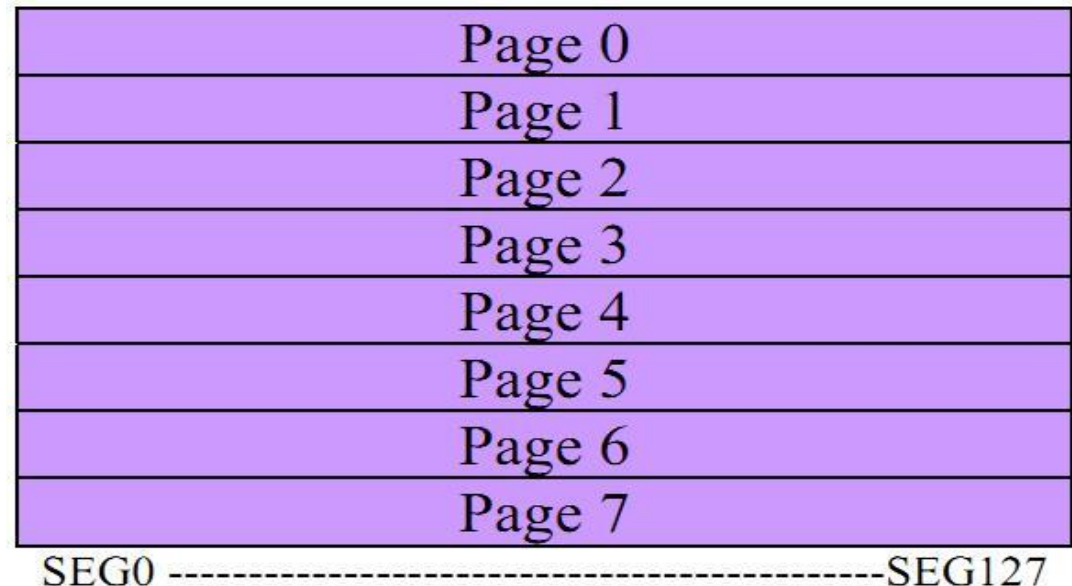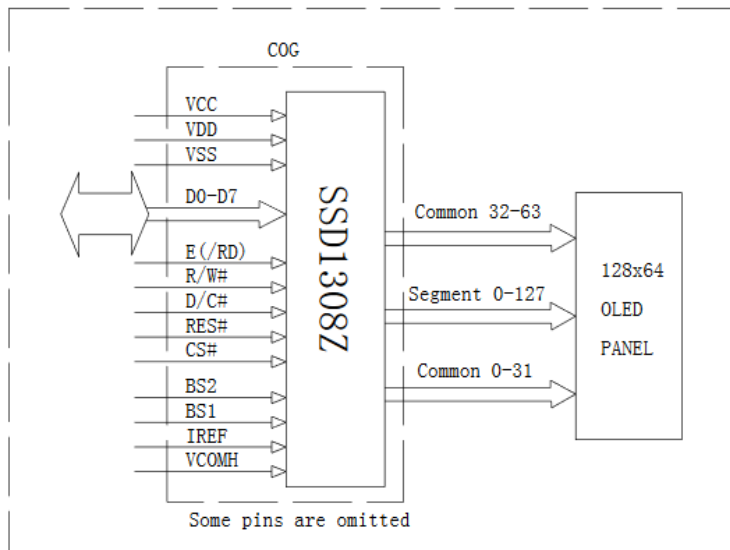
OLED & RAM (GDDRAM)

- OLED => 128x64 pixels. Supports SPI, I^{2}C and parallel mode (6800 and 8080).
- USB multifunction board hardwired for 8080, as seen in schematic.
- Size of GDDRAM 128x64 bits (1kB), one bit for each pixel.
- Divided into 8 pages, each holding 128 bytes.
- One byte holds a column of eight pixels within a page.

COG

VCC
VDD
VSS
D0–D7
E(/RD)
R/W#
D/C#
RES#
CS#
BS2
BS1
IREF
VCOMH

SSD1308Z

Common 32–63
Segment 0–127
Common 0–31

128x64
OLED
PANEL

Some pins are omitted

Page 0
Page 1
Page 2
Page 3
Page 4
Page 5
Page 6
Page 7

SEG0 -- SEG127
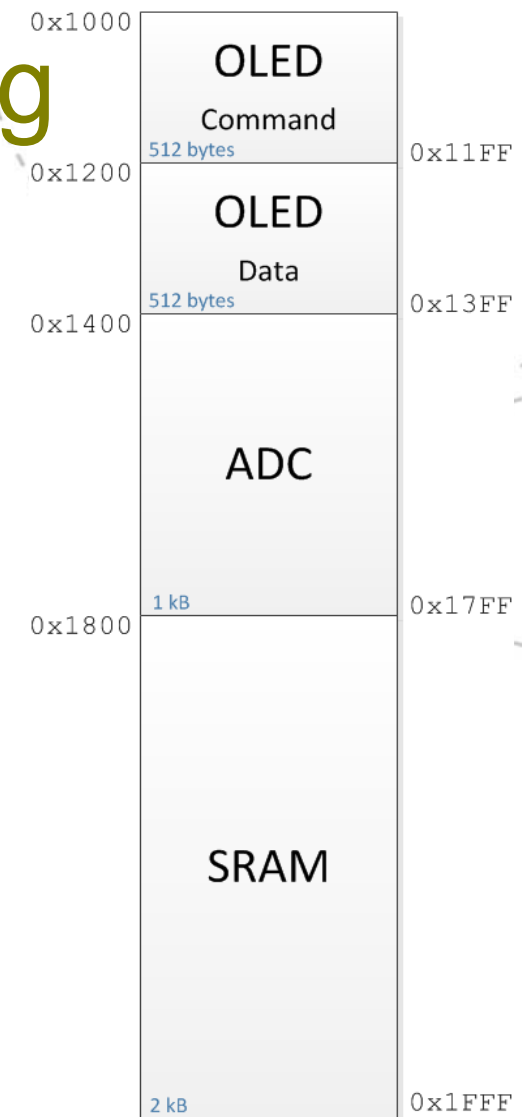
Interface & control signals

- Parallel interface, 8080 write only mode.

- D/!C: Data/Command (0 = command, 1 = data)

- !CS: Chip select (active low)

- Two operating modes:
  - Write command (set address pointer, turn on screen, etc)
  - Write data (output to screen)

- Addressing mode command(0b0010_00xx) =>decides page, horizontal or vertical data write mode(see SSD1308).

Suggested address partitioning

Unit	From – to (hex)	From – to (binary)			
OLED	0x1000	0000	0000	0000	0000
	0x13FF	0000	0011	1111	1111
	CS when:	0000	00XX	XXXX	XXXX

0x1000

OLED
Command
512 bytes

0x11FF

0x1200

OLED
Data
512 bytes

0x13FF

0x1400

ADC

1 kB

0x17FF

0x1800

SRAM

2 kB

0x1FFF

Suggested address partitioning

Unit	From – to (hex)	From – to (binary)			
OLED command	0x1000	0001	0000	0000	0000
	0x11FF	0001	0001	1111	1111
	Command when:	0001	**000**X	XXXX	XXXX

Unit	From – to (hex)	From – to (binary)			
OLED data	0x1200	0001	0010	0000	0000
	0x13FF	0001	0011	1111	1111
	Data when:	0001	**001**X	XXXX	XXXX

0x1000
OLED
Command
512 bytes   0x11FF
0x1200
OLED
Data
512 bytes   0x13FF
0x1400

ADC

1 kB   0x17FF
0x1800

SRAM

2 kB   0x1FFF
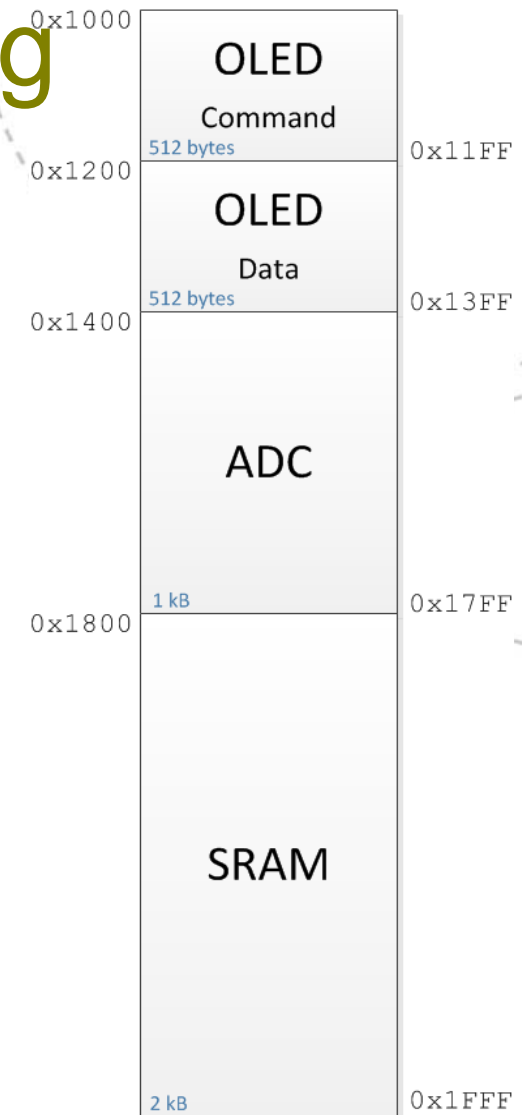
The Assignment

- Connect the display to the memory bus.

- Extend the logic in the GAL.

- Write code to
  - Initialize the OLED display.
  - Print out a character (character byte array on Blackboard).
  - Implement printf or your own string printing function for use with the OLED display.

- Make a menu for your system.

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Menu system – possible menu items

- Goal => selection and navigation is possible

- Ideas:
  - Start new game.
  - See/reset highscore.
  - Calibrate joystick.
  - Set difficulty
  - Debugging

- Can be a very simple or advanced (counted as extras).

- Take some time to design basic framework and then implement. Maybe extras are future additions…

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Tips

- Remember to connect a jumper to EXTSEL on the multifunction board (see schematic)

- OLED initiation code is in the datasheet "OLED LY190-128064" in section 9.4

- Read about storing static data in program memory (google AVR PROGMEM)

- The character set is quite big; it would be a good idea to remove unused characters to reduce program size

- https://www.sparkfun.com/datasheets/LCD/SSD1308.pdf

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Possible useful functions

- `OLED_init(); // PDF:"OLED LY190-128064" section 9.4`
- `OLED_reset();`
- `OLED_home();`
- `OLED_goto_line(line);`
- `OLED_clear_line(line);`
- `OLED_pos(row, column);`
- `OLED_print(char*);`
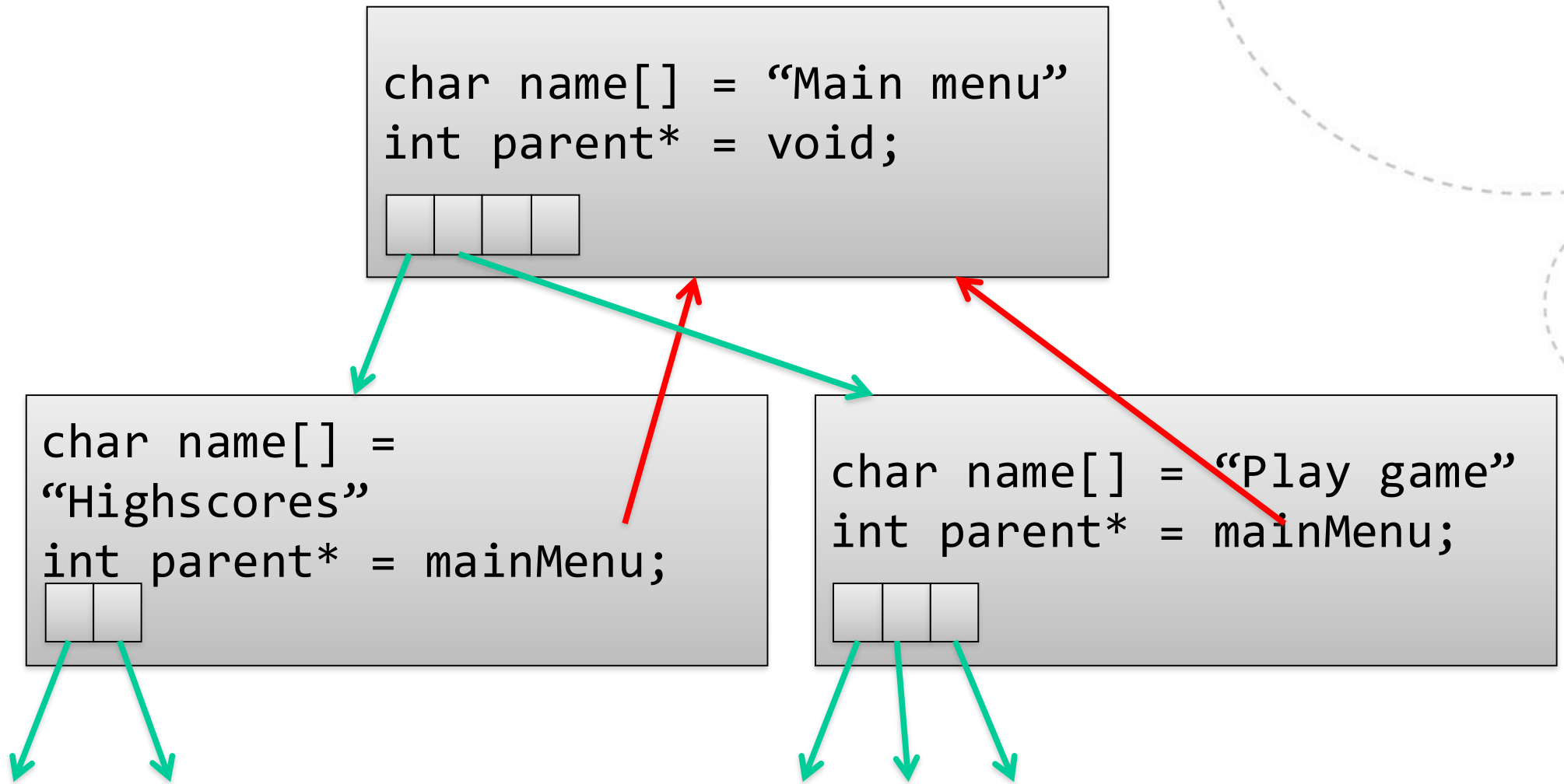- `OLED_set_brightness(lvl);`

Example

- Maybe you need an arrow?

```
void OLED_print_arrow(uint8_t row, uint8_t col)
{
  OLED_pos(row, col);
  OLED_write_data(0b00011000);
  OLED_write_data(0b00011000);
  OLED_write_data(0b01111110);
  OLED_write_data(0b00111100);
  OLED_write_data(0b00011000);
}
```

Menu suggestion – linked list


```
char name[] = "Main menu"
int parent* = void;
```

```
char name[] =
"Highscores"
int parent* = mainMenu;
```

```
char name[] = "Play game"
int parent* = mainMenu;
```

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Questions?

Auf wiedersehen

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