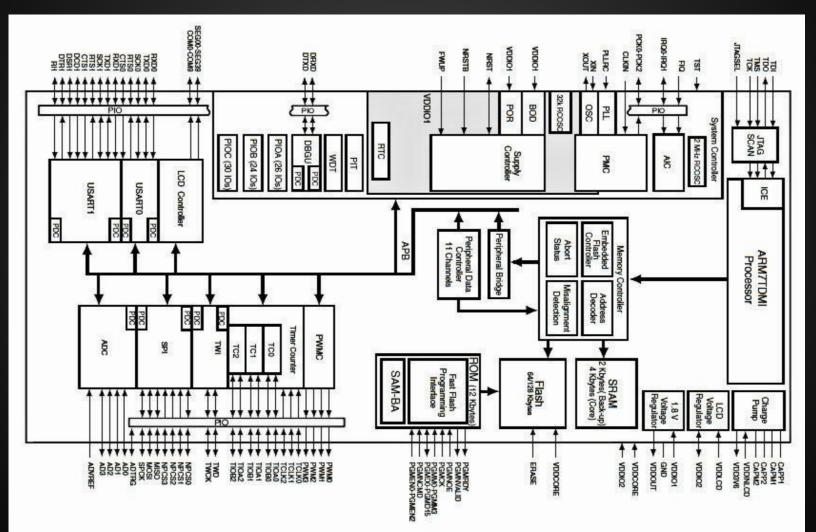
#### **Reprogramming the HP 20b**

Alex Kalicki Siddharth Ramakrishnan Xiahui(Forrest) Huang Andy Hadjigeorgiou

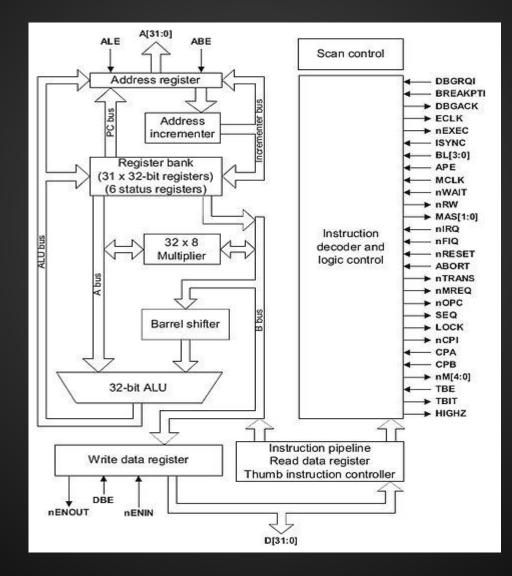
#### Introduction to the HP 20b



#### **Platform: Processor**

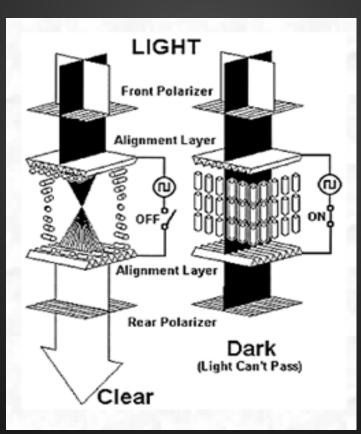


#### **Platform: Processor**

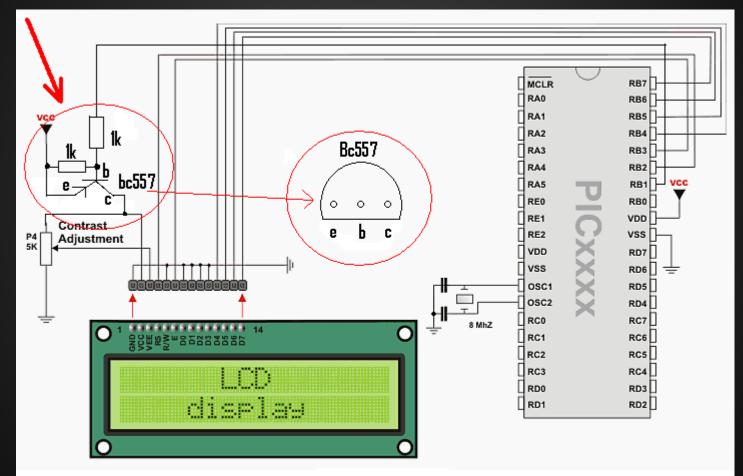


# Platform: LCD Display



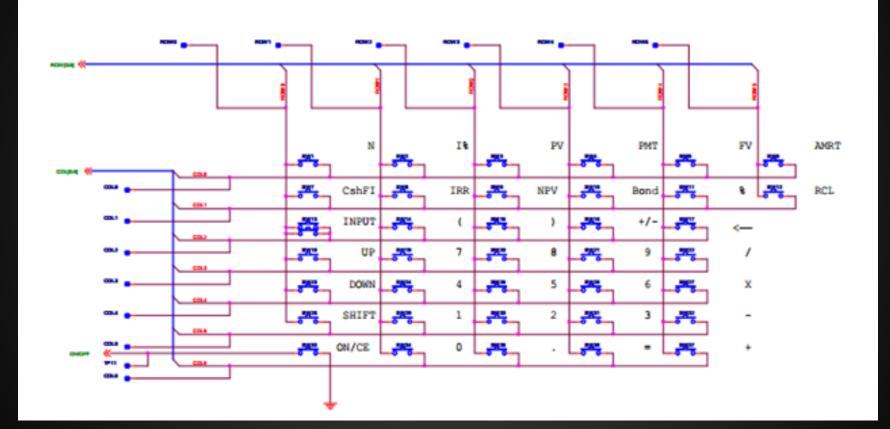


# **Platform: LCD Display**



Circuit diagram to reset the LCD during "LCD1602Init"

#### **Platform: Keyboard**



# Software

#### Architecture and Design

# Lab 1: Getting Started: Hello World

```
while (slot >= 0)
ł
    if (x > 0)
    Ł
        lcd_put_char7(x%10+ASCIIADD, slot);
        x /= 10;
    }
    else
        if (negative)
             lcd_put_char7('-', slot);
            negative = 0;
        }
        else
            lcd_put_char7(' ', slot);
    3
    slot--;
}
```

## Goal:

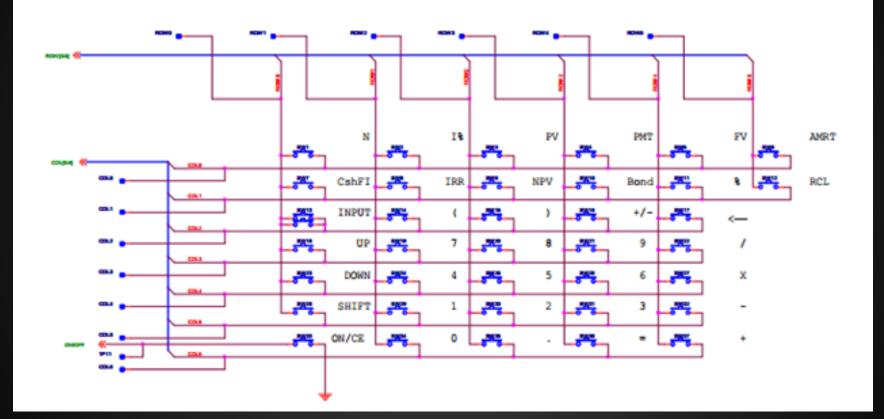
write a method that prints an integer argument on the calculator LCD

# Lab 2: Listening to the Keyboard

```
int keyboard_key ()
{
    int i:
    int i:
    for (j = 0; j < 7; j++)
        keyboard_column_low(j);
        for (i = 0 : i < 6 : i++)
            if (!keyboard_row_read(i))
                keyboard_column_high(j);
                return keyArray[j][i];
            3
        keyboard_column_high(j);
    }
    return -1;
```

#### Goal:

write a method that returns a code indicating which key is being pressed (if any)



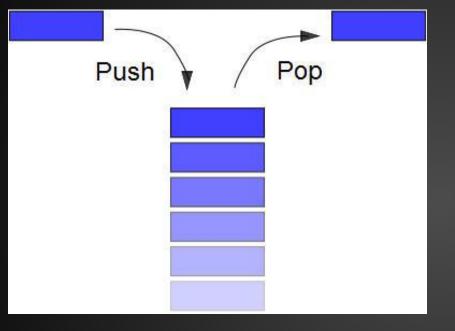
# Lab 3: Entering and Displaying Numbers

```
while (!operationPressed)
Ł
    int keyPressed = keyboard_key();
    if (kevPressed != -1)
        int tempKey = keyPressed;
        while (tempKey != -1)
            tempKey = keyboard_key();
        }
        if (keyPressed >= '0' && keyPressed <= '9')
            pressedKey = 1;
            if (slot_count < SLOTS)
                result->number = result->number*10 + (keyPressed - '0');
                if (result->number != 0)
                    slot_count++;
            }
        }
        else
            result->operation = (char)keyPressed;
            if (!pressedKey)
                result->number = INT_MAX;
            operationPressed = 1;
    }
    lcd_print_int(result->number);
    lcd_put_char7(result->operation, 0);
}
```

## Goal:

allow the user to input a number followed by an operation and display it on the LCD

# Lab 4: An RPN Calculator



#### Goal:

implement a stack and make the calculator behave like an RPN calculator

# **User Guide** How to use the final product



# User Guide

Reverse Polish Notation  $1 \rightarrow INPUT \rightarrow 3 \rightarrow INPUT \rightarrow +$ Is the same as  $1 \rightarrow + \rightarrow 3$  on a normal calculator

HP 20b	Business Co	nsultant		(IP)
P/4 203		=	I INPUT BEG RAD 30	' = 50 rpn
N		PAAT	EV	Amor
xP/YR	I/YR PV IConv Beg	P/YR	End	Depr
	IRR NP	Bond Date	% % calc	RCL
	BIRL	() Dates)	, o care	
INPU Memor	т (,	↓ () x	+/-	Rese
				Kese
INS	7 SIN	8 cos	9 TAN	÷ Math
				1- 10-101
•	4	5	6	×
DEL	4 LN	5 <i>e<sup>x</sup></i>	6 x <sup>2</sup>	× ~
DEL	4 LN		6 x <sup>2</sup> 3 y <sup>x</sup>	× √ - 1/x
DEL ON/CE OFF	1 RAND	2		√

# **User Guide**

Negative Sign2147483647

HP 20b	Business C	onsultani		4
P/ 203	YR 33		= BEG RAD	UT = 360 RPN
N xP/YR	I/YR P IConv Be	V PM	T FV R End	Amori
	IRR NI Stats Brk			
INPU Memor	T ( y Mo	de )	× +/- EEX	eset
INS	7 SIN	8 cos	9 TAN	÷ Math
DEL	4 LN	5 e <sup>x</sup>	6 x <sup>2</sup>	★
	1 RAND	2	3 y <sup>x</sup>	- 1/x
ON/CE OFF	0 nPr	• nCr	= ANS	+ RND

## Conclusions

- Simple calculator tasks are still somewhat difficult to program
- Project groups must communicate effectively in order to succeed