# MIDI Visualizer

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# The Goal: MIDI Visualizer

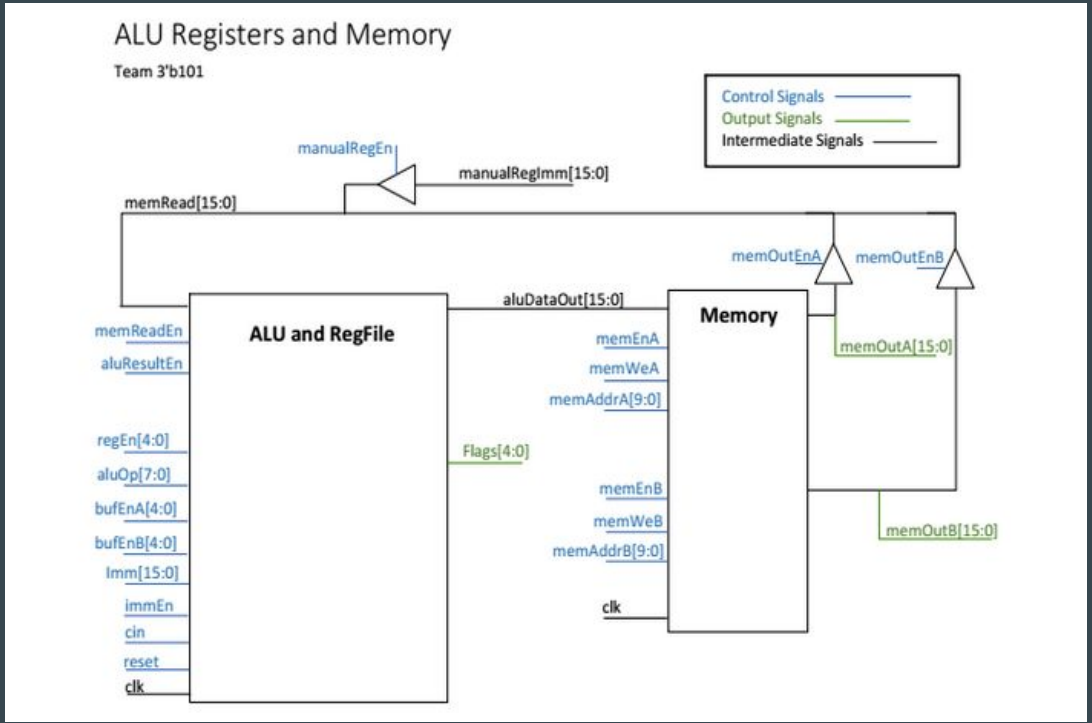
- Piano Keyboard Input
- MIDI Note Parser
- Glyph-Based Graphics by Note
- Possible Gamification

Topics:

- ALU / Registers / Memory
- Immediates
- Simple Operations
- Control Flow
- MIDI Input and VGA Output

# ALU / Registers / Memory

- 16 Register Processor
- Dual-Port BRAM Memory
- RISC 8-bit ALU OpCodes

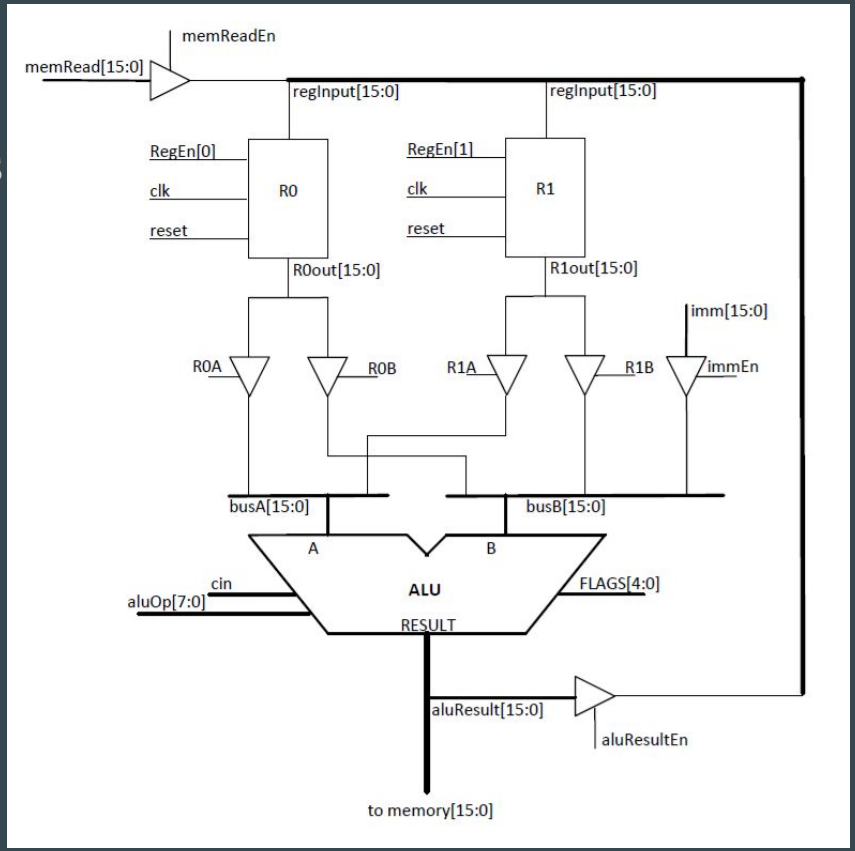


# Simple Operations

- Direct Load From Memory to Registers
- Immediates on ALU Input B
- ALU Result to Memory

ToDo:

- Control Flow
  - Flag Based Jumps and Branches
- Memory Partition
  - Program Memory Block
  - MIDI Buffer Block
  - Graphics Block
- MIDI and VGA Controllers



# MIDI to FPGA

- Standard MIDI Output on Keyboard
- USB Input on Nexys3
- Buffer Bit Patterns in Block RAM
- MIDI Clock Time Slow vs 100MHz

Multiple Instruments - Multiple Inputs

USB to MIDI Adapter

# MIDI Specs

- 31.25K bits/sec
- Period: 320 microseconds
- Asynchronous
- Bits:
  - 1 Start Bit
  - 8 Data Bits
  - 1 Stop Bit

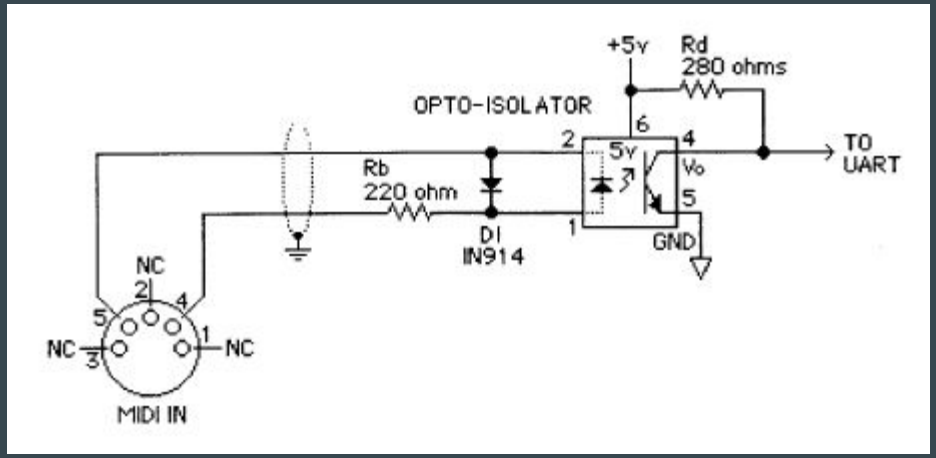



Image: MIDI 1.0 Detailed Specifications; midi.org

# MIDI Bit Patterns

Message Types:

- Channel Messages
- System Messages
  - Common: All Channels
  - Real-Time:  Synchronization
  - Exclusive: HW Dependant

Data Types:

- Status Bytes
  - Note-on, Note-off, etc.
- Data Bytes:
  - Note Number, Velocity

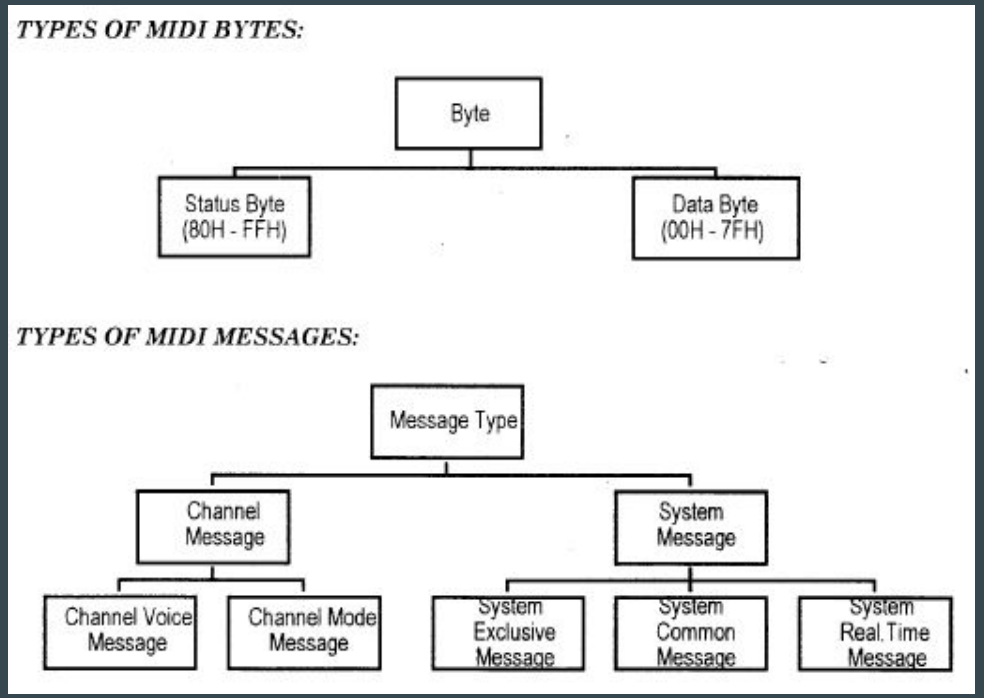



Image: MIDI 1.0 Detailed Specifications; midi.org

# MIDI Data

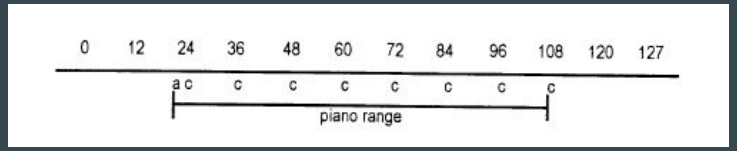
## Code Index Number (CIN)

- 0x2 - 0x5: System Common Messages
- 0x9: Note-on


Image: USB Device Class Definition for Audio Devices

## Example: 0x90 3C 7F

- 0x9: Note-On (0x8: Note-Off)
- 0x0: Channel 1
- 0x3C (8'd60)Middle C
- 0x7F (8'd127) Max Vel
- Followed by 0x90 3C 00, end of note

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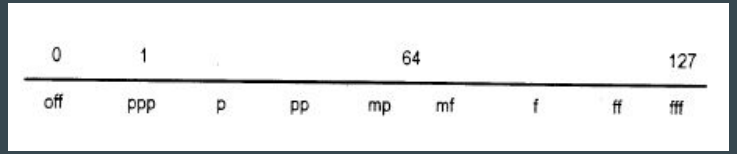
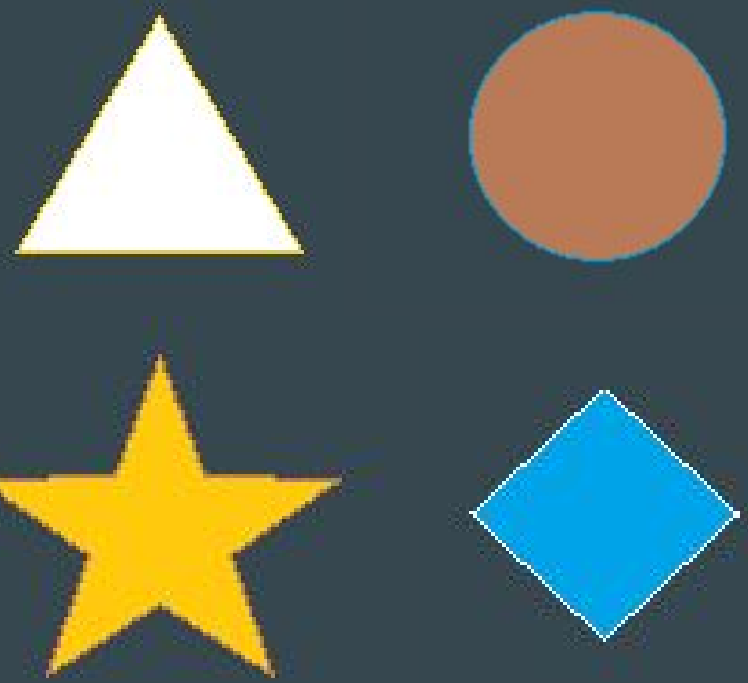



Image: MIDI 1.0 Detailed Specifications; midi.org

# Glyph Graphics

- Basic Shapes
- Array of Colors: Change Colors
- Public Domain Images
- Pattern Output
  - Note Played
  - Note Length
  - Velocity



# Future Decisions

-Glyph Based Graphics vs Bit-Mapped Graphics
    -PSRAM (Cellular) for Bit-Mapped Graphics
-Assembly Format: 2 Variable vs. 3 Variable
-Additional OpCodes

# Gamification

Need to Decide on More Complex Projects:

-“Guitar Hero” Game
-Multiplayer Pong
-Visualize Precomposed MIDI Files
-MIDI Looper: Output MIDI Back to Keyboard
-Multiple Instrument I/O Signal “Shuffling”
-Multi-Player Memory Games (Simon Says, Solve the Puzzle)
-Side-Scrolling Game
-Tug-of-War

# CONCLUSION

-MIDI Visualizer

- -Keyboard Note Input
- -MIDI Note Parser
- -Glyph Based Graphics