



Note Sheet Reader

Final Project by Eyal Ronel

Let's make a computer see

- Already proved to be extremely difficult
- ...unless the domain is limited and restricted

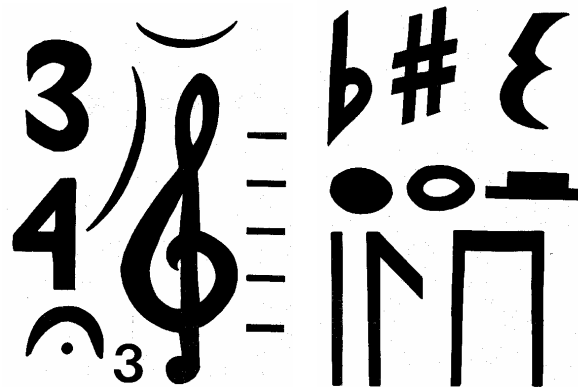
Black marks, white background

Feasible!

- Printed characters – widespread (OCR)
- How about music sheets? 🎵
 - **Voices** recorded as **music** and played back
 - **Music** converted to **MIDI** and played back
 - **MIDI** converted to **note sheets**...
 - *Does anyone convert note sheets to MIDI?*
 - I will! 😊

How do you recognize music?

- Notes are black circles positioned on black horizontal lines
- Note stems and bar lines are black vertical lines that cross black horizontal lines
- Specific symbols:
- One step at a time.



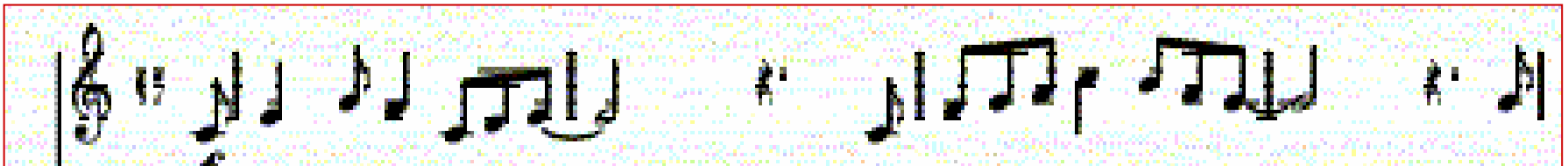
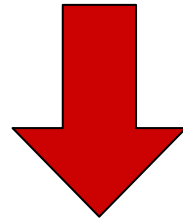
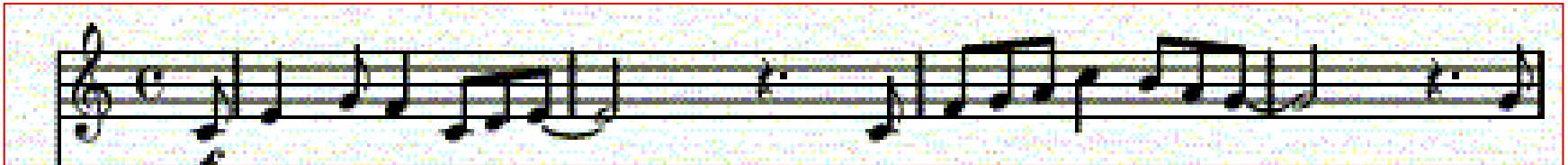
Task List

- Recognize staves
- Find the minimal *space* between staff lines
- Gather fives of lines conforming to said *space*
- Find bar lines
- Recognize round shapes roughly the height of *space*
- Distinguish filled circles from empty ones
- Detect stems protruding from circles
- Detect dots to the right of circles
- Detect other symbols: flat sign, sharp sign, rests, ...

Look for horizontal lines

- Assuming the page is straight.
- Look for lines that are at least 80% dark
- Count fives with minimal distance and denote them staves.
- Wipe 'em out!

How are we so far



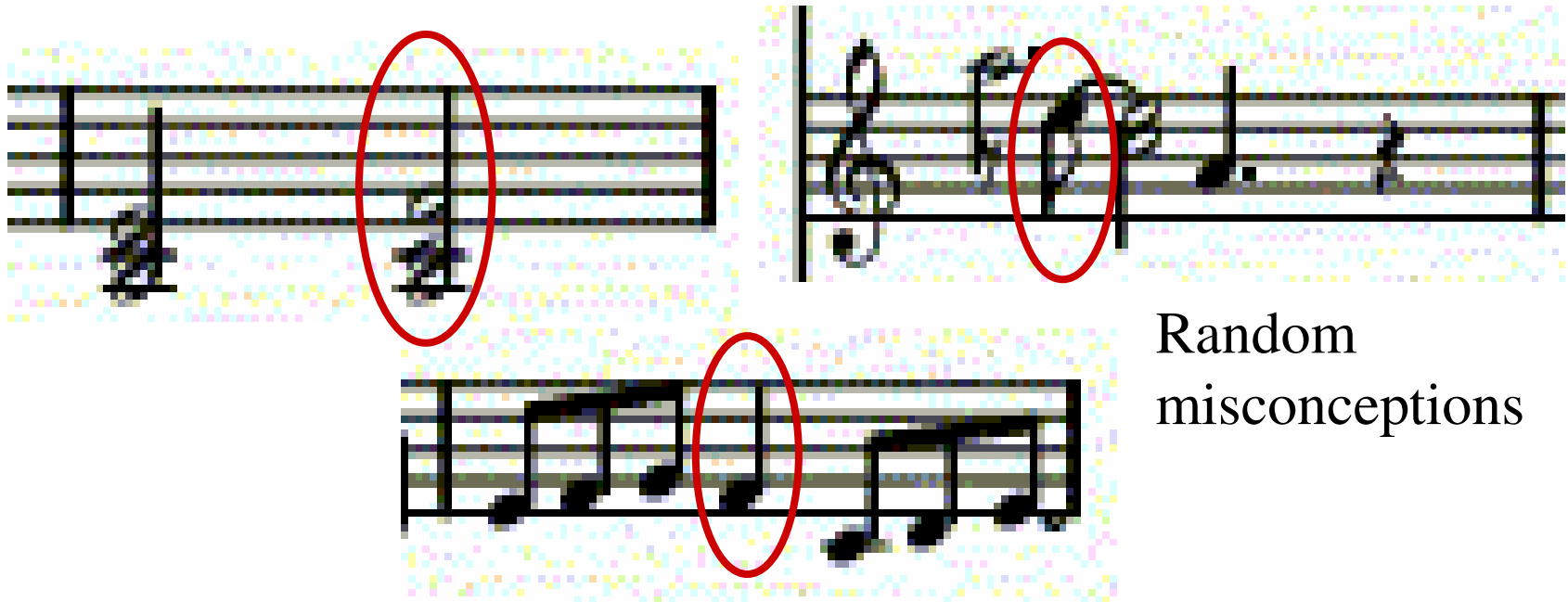
Not so bad.

What now? Vertical lines!

- Recognize staves
- Find the minimal space between staff lines
- Gather fives of lines conforming to said space
- **Find bar lines**
- Recognize round shapes roughly the height of *space*
- Distinguish filled circles from empty ones
- Detect stems protruding from circles
- Detect dots to the right of circles
- Detect other symbols: flat sign, sharp sign, rests, ...

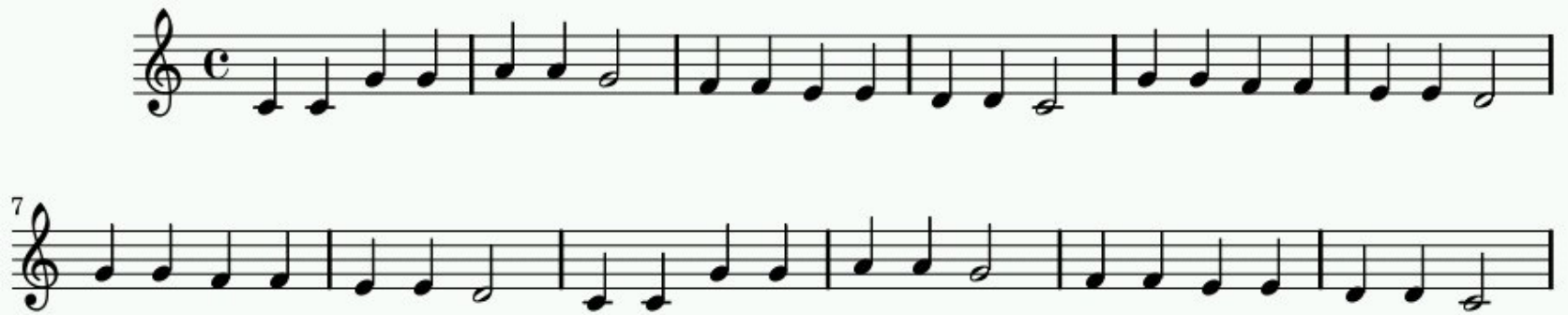
Same principle

- Just make sure you don't recognize note stems as bar lines by mistake!

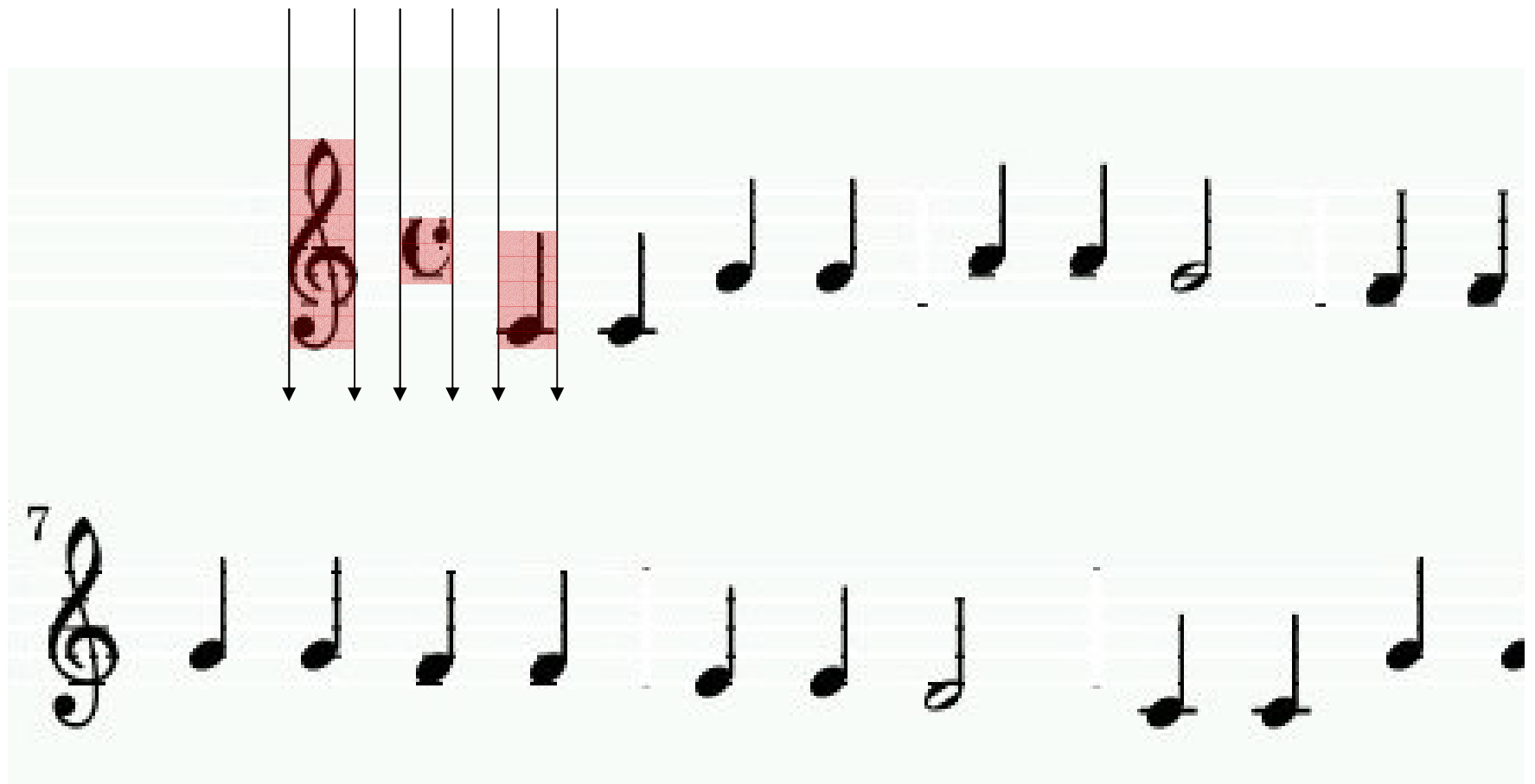


Random
misconceptions

Mom, look! No lines!



Recognize dark shapes

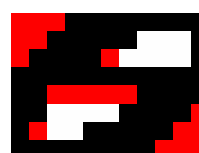
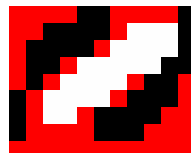


Reference Note Heads

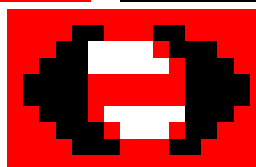
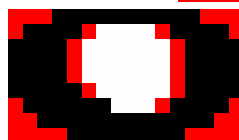
- Filled note head



- Empty note head

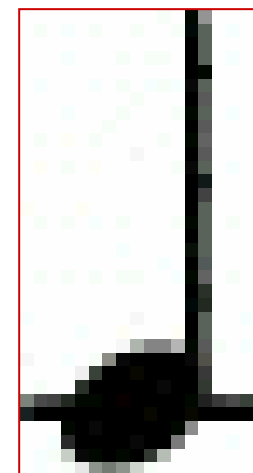


- Whole note



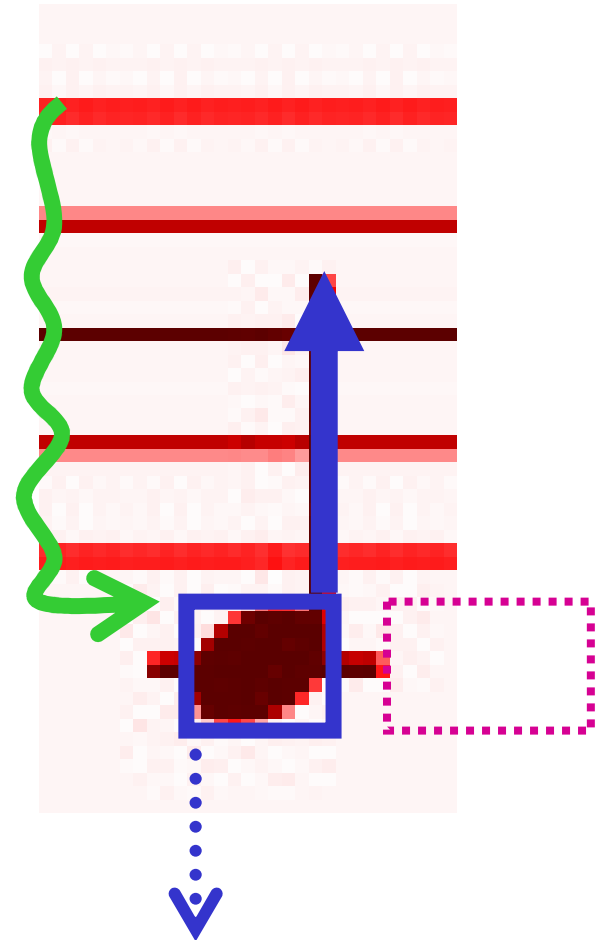
Red means
“ignore as
background”

Can you find any of these here? →



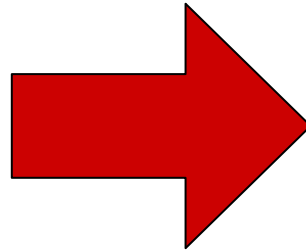
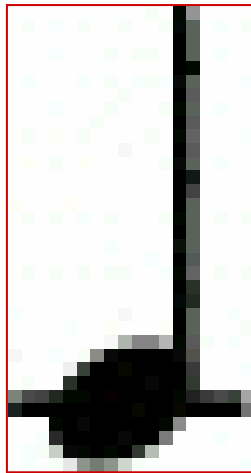
Handling notes

- Find its stem
- Find its position on the staff
- Search for dots



Announce its identity

- A quarter note C!



c' 4

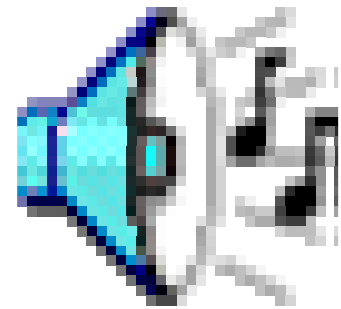
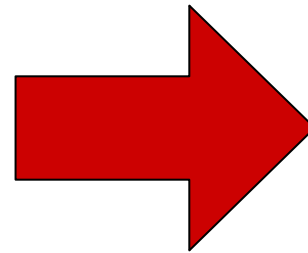
Lilypond does the rest

```
\version "2.10.0"

TheMusic = { \tempo 4=80
c'4
}

\score {
  \new Voice {\TheMusic}
  \midi {}
  \layout {}
}
```


Lilypond input



Problems yet to be solved

- Better note head recognition
- Correct detection of tails
- Handling sharps and flats, rests
- And this is only the beginning...





But hey,
it was a nice experience

Thank you for listening 🎵