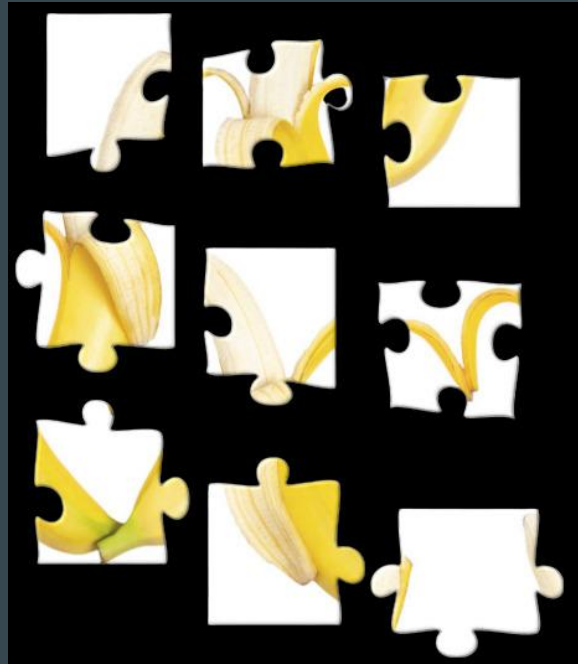# Jigsaw Solver

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Problem in Question

Coming up with the solution to a Jigsaw puzzle given only the pieces and a reference picture.

Attempted Solution

1. Take a photo of the reference photo using cozmo's camera

2. Take a photo of all the puzzle pieces using cozmo's camera

3. Isolate each piece by thresholding and filtering out irrelevant connected components

4. Cropping out each individual piece

5. Repeatedly ask GPT4-V to decide which piece should be placed down

Most Interesting Portion

- GPT4-V's ability to follow directions (much better than ChatGPT) and analyze images even with low resolution

```
chenjta@kttt:~/Lab$ python Lab36.py
=The puzzle piece shown is an edge piece, typically characterized by one straigh
t edge and the remaining sides featuring the usual interlocking tabs and blanks
found on jigsaw puzzle pieces. This piece has one tab on its top, a straight e
dge on the left side, a blank or indentation on the right side, and a combinati
on of a small indentation and a protruding part on the bottom side.

Within the puzzle piece, we can see part of an image of a banana. You can tell
it's a banana due to its distinctive yellow color and texture. The image captur
es a section of the banana's peel, as well as a bit of the banana's flesh on th
e upper right portion, where the peel appears to be pulled back or cut.
```
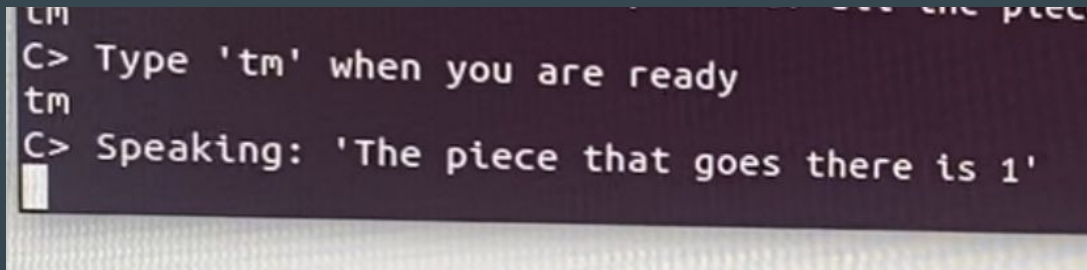
- Much of the work is off-loaded to GPT
  - Except for preprocessing the images used
  - Passing the answer to cozmo

What Worked

- Successfully cropped pieces

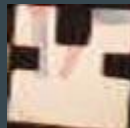- Prompt engineering to get answer in a usable format


```
tm
C> Type 'tm' when you are ready
tm
C> Speaking: 'The piece that goes there is 1'
```

- Correct (sometimes)

What Didn't

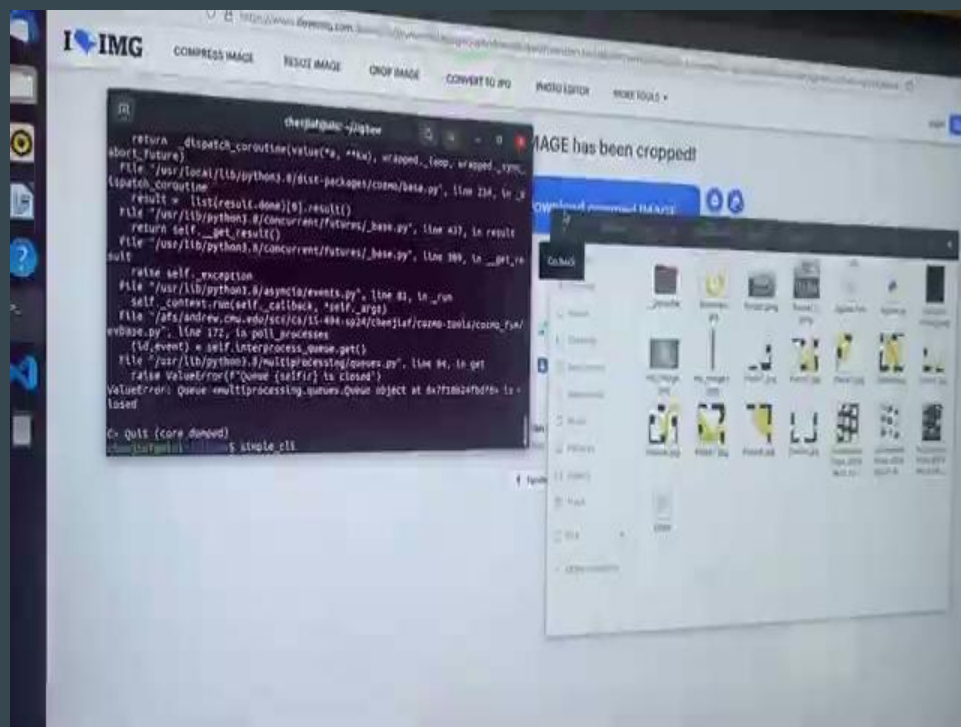- Hard time cropping diverse photo
- GPT4-V is paranoid

This triggered error


```
8, th _request
    raise self._make_status_error_from_response(err.response) from None
)openai.BadRequestError: Error code: 400 - {'error': {'message': 'Your input ima
ge may contain content that is not allowed by our safety system.', 'type': 'inv
alid_request_error', 'param': None, 'code': 'content_policy_violation'}}
```

- GPT4-V can't count
- Inconsistent answers
- Gets worse with more images

Demo

Future Work

- Jigsaw piece classification using CV
  - Reduces choices for GPT4-V
  - Higher accuracy
  - Faster
- Better prompting
  - Few shot learning
  - Jigsaw piece classification using GPT4-V?
- Different LLM
  - Gemini
  - LLaVA (Maybe)