Your LED cube

ENGR 40M
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Electrically it’s an array, but physically...

How do we arrange these in a $4 \times 4 \times 4$ cube?
...it’s a cube?
...it’s a cube?

second from bottom

second from top
Decomposition

`loop()`

- The main Arduino loop

`display()`

- Does one pass through the LEDs (time-division multiplexing)
- which calls

`getLEDState()`

- Looks up the LED state associated with an anode/cathode pair
Mapping between 2-D and 3-D
Mapping between 2-D and 3-D

We want a function that maps

*from* anode/cathode pairs

\((a, c)\)

(e.g. “D6”)

*to* 3D coordinates

\((x, y, z)\)
Mapping between 2-D and 3-D

Anodes

Cathodes
Mapping between 2-D and 3-D

Operations we might consider using:

- * (multiplication)
- % (modulo division)
- / (integer division)
- & (bitwise and)
- | (bitwise or)
- ^ (bitwise xor)
What do bitwise operations do?

- Bitwise operations apply to each bit in the binary representation of a number individually.

Examples (in binary):

```
00110101 | 01100011 == 01110111
00110101 & 01100011 == 00100001
```

```
00110101
| 01100011
01110111
```

```
00110101
& 01100011
00100001
```
Mapping between 2-D and 3-D

We want a function that maps

* from anode/cathode pairs \((a, c)\) 
  (e.g. “D6”)

* to 3D coordinates \((x, y, z)\)
Mapping between 2-D and 3-D

Anodes

Cathodes
Making the mapping function easier

You can reorder the anodes/cathodes however you like. Would a different ordering make the relationship simpler?
Mapping between 2-D and 3-D
Mapping between 2-D and 3-D